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【Original Paper】

The Impact of Wine Grape Producing Farmers on Farmland Resource The Case of Chikuma River Wine Valley in Nagano

Masaki ODA*

Agro-Medical & Food Environment Laboratory, Louis Pasteur Center for Medical Research
103-5 Tanaka Monzen-Cho, Sakyo-ku, Kyoto 606-8225, Japan

Summary

Agriculture in Japan is facing a shortage of human resources. Therefore, to preserve farmland resources, it is critical that farming villages secure new farmers. Though there is a shortage of human resources, an increasing number of new farmers, with dreams of opening their own wineries, have migrated to Nagano. This study conducted a factor analysis to assess the effect of these pioneer wineries on abandoned farmland, using village card data from 2005, 2010, and 2015 and gives predicts the effect of increasing number of new farmers. The findings of the study are as follows. First, the ratio of abandoned farmland, in the regions to which the pioneer wineries migrated, decreased. Second, an increase in the number of vegetable fields in those regions negatively impacted farmland preservation. Third, farmers cultivating grapes in open fields reduced the proportion of abandoned farmland. Fourth, as the number of grape production farmers increased, the amount of abandoned farmland decreased if new farmers start farming through the Chikuma River Valley, although there might be a negative impact on abandoned farmland in regions where pioneer wineries have migrated.

Keywords: Farmland preservation, Factor analysis, Leading farmer, Project of Shinshu Wine Valley, Wine grape producer

1. Introduction

Currently, the Japanese agricultural sector is in a critical condition. Since the rapid economic growth in 1950, the outflow of the labor force to urban areas has resulted in the shortage of the labor force in rural regions. This has induced various problems in the local agricultural sector. To solve these problems, the government introduced and trained leading farmers by implementing new laws, such as the *Act on Promotion of Improvement of Agricultural Management Foundation* in 1993 and the *Basic Law on Food, Agriculture, and Rural Areas* in 1999. In 2007, the government designed a new system called the *Measures of Farming Management Stability with Cross-Product*, through which community-based farming organizations, as leading farmers, were established throughout Japan. These policies contributed to inducing leading farmers in rural regions, especially by establishing community-based farming organizations that revitalized social communities by connecting farmer community to other villages (Ando 2015, Takahashi 2013, Takahashi, Umemoto 2007).

* Corresponding author (email: masaki.oda@louis-pasteur.or.jp)
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Although some farmers and organizations were certified as leading farmers, it was still vital to induce new farmers into the labor force in rural regions. In response, the government implemented various policies to support new farmers. This support helped new farmers economically, through subsidies to secure income during the training period and funds for investing in farming machines. With this support, new farmers can utilize their training period effectively and become economically independent when they become a farmer. However, it is essential to preserve agricultural resources to ensure the attractiveness of agriculture for securing a certain number of new farmers.

To attract new farmers, it is necessary to make the agricultural sector seem attractive. The wine industry in Nagano Prefecture attracts new farmers who dream of opening their own winery. Since Nagano has an ideal condition for the cultivation of wine grapes, there has been a trend of migration of new farmers to this area for the cultivation of wine grapes and the opening of small-scale wineries. Although these new farmers come from various backgrounds, they are all attracted to the wine industry, become new farmers, and exponentially restore abandoned farmland. Under these circumstances, the Nagano local government designed the Shinshu Wine Valley project in 2013. By implementing the project, the local government in Nagano established four valley regions as special wine districts and provided support for the development of the wine industry.

To ensure the sustainability of local agriculture, it is critical to reveal the impact of the increased number of new farmers in Nagano on farmland resources, and to assess their potential to become leading farmers in local agriculture. Unfortunately, few studies have analyzed the relationship between farmland resources and wine grape farmers. Fukuzaki et al. (2021) revealed that small-scale wineries restored abandoned farmland when they migrated to Tomi city, Nagano prefecture, to cultivate wine grapes. Yuruka and Shimizu (2017) revealed that wine grape cultivation played a vital role in maintaining the number of cultivated farmlands in Nagano. These two studies suggested that wine grape cultivation and wineries have led to the restoration of abandoned farmland and prevented the decline in cultivated farmland. However, these studies did not statistically analyze the impact of an increased number of new farmers cultivating wine grapes on farmland resources. Although local governments have enforced the restoration and consolidation of farmland to create vineyards, the effect of these actions is not equivalent to the effect of an increased number of new farmers cultivating wine grapes.

To assess the possibility of new farmers cultivating wine grapes becoming leading farmers in local agriculture by highlighting the impact of an increased number of new farmers, this study analyzed the effect of new farmers, cultivating wine grapes in the Chikuma River wine valley, on abandoned farmland and to predict t the effect of increasing number of new farmers, using factor analysis on data from the Agriculture and Forest Census of 2005, 2010, and 2015.

The Chikuma River wine valley was selected as the focus of this study for two reasons. First, the Chikuma River wine valley is the most advanced wine producing district in Nagano, Japan. Second, this area has many small-scale winery owners who have begun farming and opening their wineries. New farmers in this region have adequate support from the official and private sectors.

The remainder of this paper is organized as follows. “The background of wine production in Nagano” section reveals the status of the agricultural sector in Nagano, the historical background of the Chikuma River wine valley, the contribution of new farmers cultivating wine grapes, and the support provided by the local government and private sectors for abandoned farmlands. The “Methods and data” section, explains the regression equations of the factor analysis and the verification analysis of the effects of other preservation policies and data were used. The “Results and discussion” section examines the results of the factor analysis and discusses the effect of increasing number of wine grape producers using the prospection results of the factor analysis. The “Conclusion” section summarizes this paper and assesses whether new farmers cultivating wine grapes have the potential to become leading farmers in local agriculture in the next generation.

2. The background of wine production in Nagano

1) Agriculture in Nagano and the wine industry

Nagano prefecture is located in the middle of Honshu Island surrounded by mountains with an elevation of 2000 m. While the Japan Alps run across the middle area, there are six valleys located near rivers such as the Chikuma River. Because of these geographical conditions, 80% of the farming districts are in hilly mountainous areas. Apples and grapes are traditionally cultivated as local specialties and the volume of these products is particularly high in Japan.

Figure 1 shows the number of farmers at each cultivation scale in 2020. The figure shows that the number of farmers in Nagano was higher than the average for 45 prefectures. However, because most farmers in Nagano are small-scale farmers (under 1 ha), there is a shortage of mid- and large-scale farmers: because of this shortage, there are only a few farmers who can potentially become leading farmers.

Figure 2 shows the distribution ratios of farmers and non-farming residents in farming villages. From the table, it can be seen that this ratio has declined over the years. Only 12% of the residents in the village are continuing farming in 2020, although the ratio of farmers was 45% in 1980. Since most farmers cultivate less than 1 ha of farmland, it is reasonable to assume that the preservation activities of agricultural resources are mostly undertaken by small-scale farmers. However, the sustainability of agricultural resources in Nagano is a serious issue because of the decline in the ratio of farmers in the farming villages.

These conditions of the agricultural structure in Nagano may lead to an absence of farmers who can consolidate farmland in rural areas. Figure 3 shows the transition in the ratio of abandoned farmlands. The figure shows that the ratio of abandoned farmland in Nagano is higher than the average ratio for 45 prefectures every year. In 2020, the ratio of abandoned farmland in Nagano was approximately 30%, which was 10% higher than the average.

To prevent farmland abandonment, Nagano must secure leaders by inducing or training farmers to become leading farmers. To solve this problem, organizations, rather than individuals, play a central role in connecting farmers in various villages. However, previous research suggests that it is difficult to ensure the sustainability of organizations

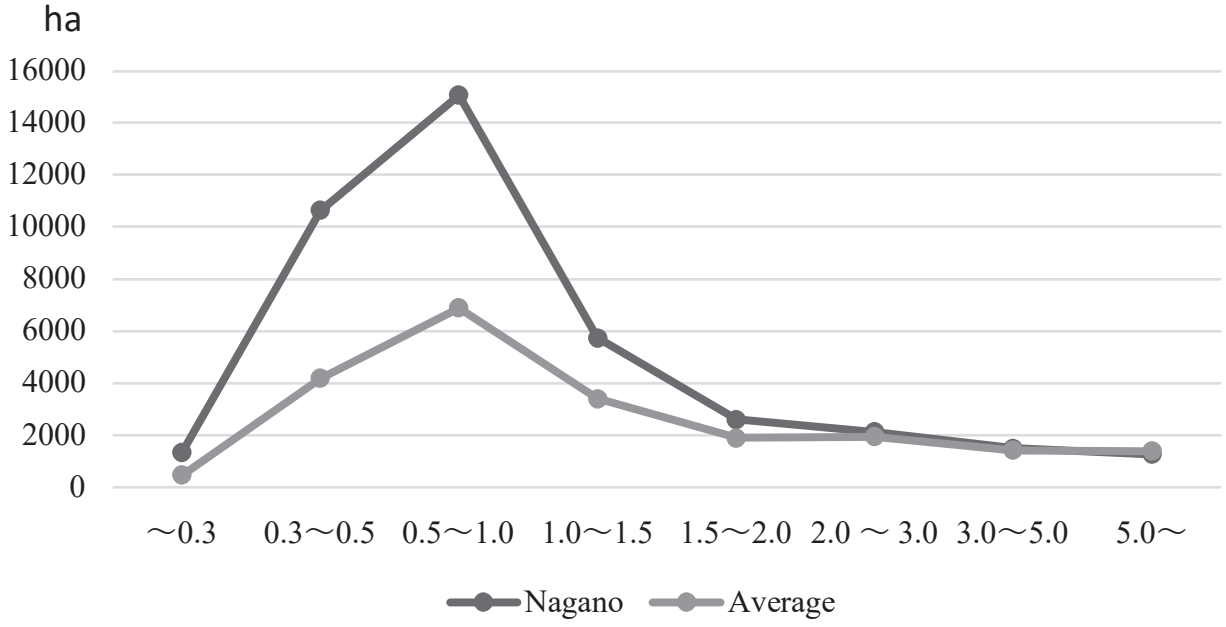

Fig. 1 Number of farmers by Farmland scale in 2020

From "Agriculture and Forest census in Japan", Ministry of Agriculture, Forest and Fish

Note: Average indicates the average for 45 prefectures excluding Hokaido

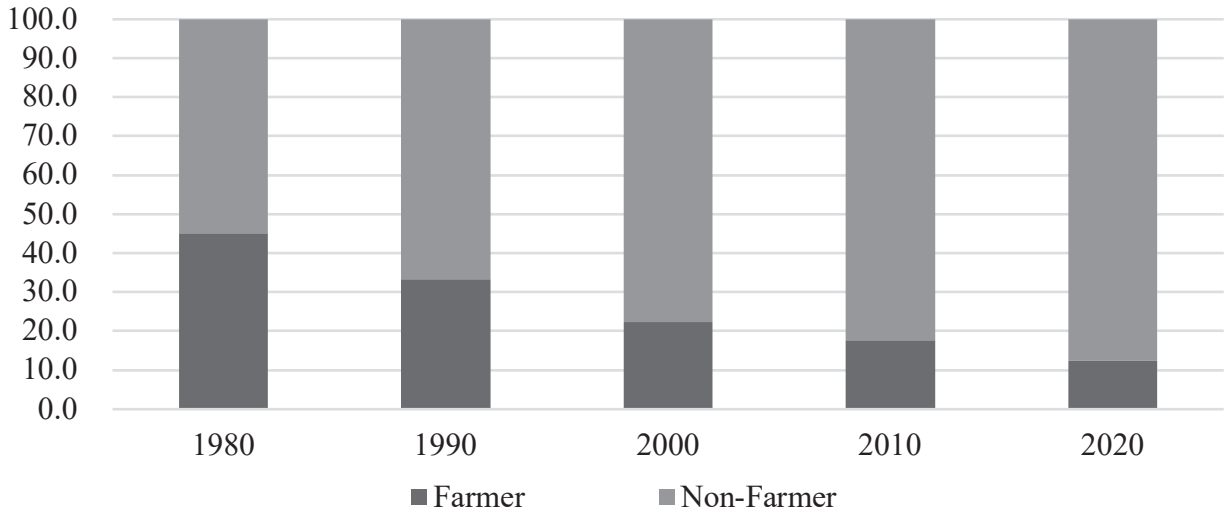

Fig. 2 Distribution of farmers and non-farmers in a farming village
From "Agriculture and Forest census in Japan", Ministry of Agriculture, Forest and Fish

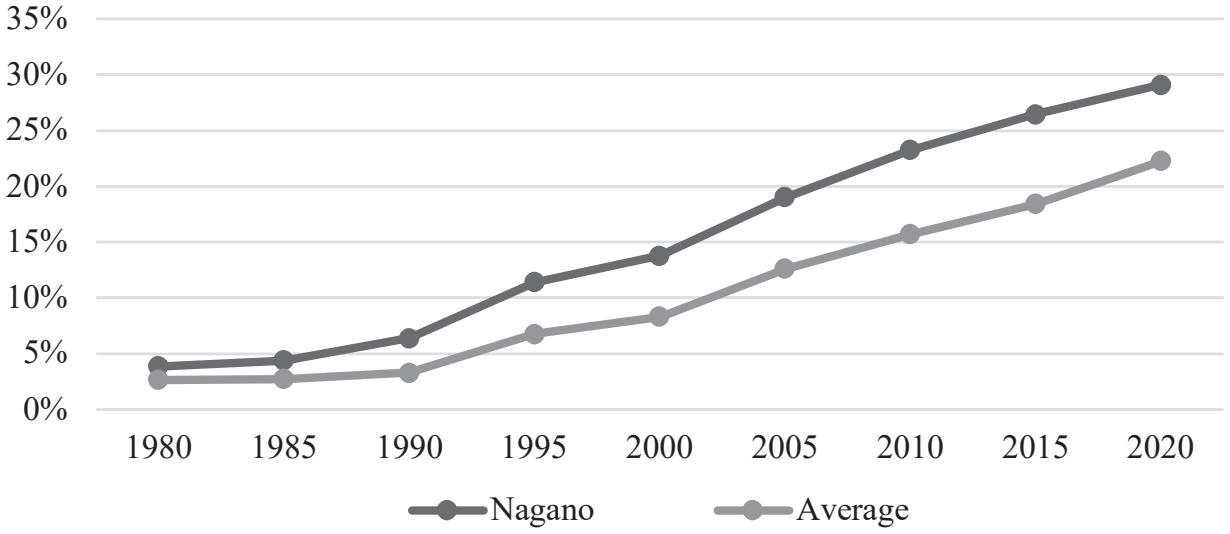

Fig. 3 The Rate of Change in Abandoned Farmland
From "Agriculture and Forest census in Japan", Ministry of Agriculture, Forest and Fish
Note: Average indicates the average for 45 prefectures excluding Hokaido

unless members of the organization reach a consensus to change the system of equity revenue distribution (Miyatake 2007, Kubo et al. 2016, Nakamura et al. 2016). Therefore, even in farming villages where organizations play the role of leading farmers, inducing new farmers to the village is becoming a pressing need.

Fortunately, there is an increasing number of new farmers migrating to Nagano who dream of opening their own wineries. Owing to the low annual rainfall throughout Japan, long daylight hours, temperature differences between daytime and nighttime, and farmland with good drainage, Nagano is one of the most suitable areas for the cultivation of wine grapes in Japan, and it also has some wineries that use the wine grapes cultivated in Nagano for brewing. Early on, wineries in Nagano were primarily owned by brewing companies. However, an increasing

number of new farmers who dream of opening their own winery have migrated to Tomi city in Nagano prefecture, and they have started cultivating wine grapes to open their own winery. In this situation, the wine industry has developed with a multiplier effect from the effects of an increased amount of wine grapes, an increased number of wineries, and an increased number of contracts to small-scale wineries for brewing wine (Kameyama 20182017).

Influenced by the wine industry in recent years, the local government introduced the Nagano Design Project of the Shinshu wine valley. This project was expected "to contribute to the establishment of Nagano wine brand and the development of the wine industry and, ultimately, to the development of Nagano itself by showing measures of cultivation, brewing, selling and consumption," to help create wine production districts. As part of this project, four valleys have been approved as special wine districts[1], namely the Kikyogahara wine valley, Japan Alps wine valley, Tenryu River wine valley, and Chikuma River wine valley. Furthermore, according to the project information, the local government provides various types of support, such as buying nursery stock of wine grapes, training for wine grape cultivation and management of wineries, and consolidation of and mediation services for the farmland.

In the Chikuma River wine valley, many new farmers migrated and opened small-scale wineries because the special wine zone of the valley includes a larger range of farming districts than other valleys. However, the pioneering winery owners decided to migrate, started to cultivate wine grapes, and opened wineries around Tomi. Even before the valley, Tomi city was approved as a special wine district. Therefore, the support systems for new farmers provided by the local government and private sector in this area, are more advanced and extensive than those in other areas because of the knowledge and experience of the pioneer wineries. Thus, it is reasonable to use the Chikuma River wine valley as the study area to assess the effects of wine grape producers. Figure 4 shows the map of the municipality of the Chikuma River wine valley. Table 1 shows the timeline of the migration and the opening year of the wineries in the Chikuma River wine valley.

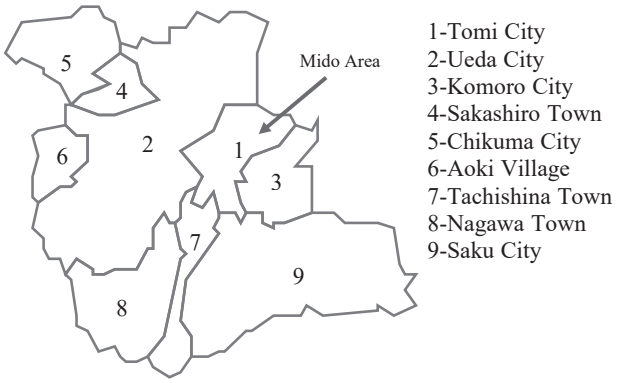

Fig. 4 Map of the municipalities in Chikuma River wine valley

Table 1 Historical Background of Chikuma River Wine Valley

Nname of wineries	Year	
	Start farming	Open winery
Manns wines Komuro winery		1973
St.Cousair		1988
Takara wine project start		1998
Villa dest gardenfarm and winery	2001	2003
Gio Hills	2002	2018
Kusunoki winery	2004	2011
Hasumi Farm & Winery	2005	2009
Shinshu Takayama winery	2006	2015
Cantina Riezo	2007	2015
Rue de Vin	2008	2010
funky Chateau	2008	2011
bonjour farm	2008	2021
Domaine Nakajima	2009	2014
Nagomi Vineyards	2010	2018
Vino della Gatta SAKAKI	2011	2018
Atelier du vin	2011	2018
496winery	2012	2019
Anne winery	2014	2018
Arc-En-Vigne		2015
Les vins vivants	2015	2019
Terre de ciel	2015	2020
Viniqrobe	2016	2019
Stardust Vineyard	2016	
Dinaube Nagatani		2017
Mother Vines Nagano wine		2018
Tatenapple winery		2018
Chateau mercian Mariko vineyard		2019
Tuiji labo	2020	

2) Relation between wine grape production and abandoned farmland

Cultivation of wine grapes requires a certain amount of farmland. Thus, when a new farmer migrates and attempts to cultivate wine grapes, it is critical to ensure the usabil-

ity of certain amounts of farmland in the migrated area. To fulfill this condition, the local government and the private sector in the Chikuma River wine valley provide support for the consolidation and mediation of unused farmland. New farmers restored these farmlands to cultivate wine grapes. Furthermore, in Tomi city, farmlands restored and cultivated by pioneer winery owners include farmlands that Takara Brewing Company tried to purchase and restore for vineyards[2]. Because pioneer winery owners restored over 20 ha of abandoned farmland as vineyards, the effect of their migration impacted the preservation of farmland resources in Tomi city. Therefore, it is reasonable to assume that an increased number of new farmers cultivating wine grapes will reduce the amount of abandoned farmland.

As part of the development of the wine industry and regional revitalization in the Chikuma River wine valley, the local government, and new farmers conducted a project for the restoration and consolidation of large-scale farmland in the Mido zone from 2015. By providing high quality landscape for vineyards, this project was designed not only to provide a cultivation area for new wine-grape farmers and existing wineries, but also to attract tourists by conducting various events, such as wine tourism, to revitalize regional communities and industries.

Thus, farmland cultivated by new farmers was mostly restored from abandoned and idle farmland. Therefore, an increase in the number of new farmers will accelerate the restoration of abandoned farmland. Thus, it is possible that the preservation of farmland resources will be enhanced if the number of new farmers cultivating wine grapes increases. Furthermore, encouraging a number of new farmers to open their own winery would contribute to maintaining the existing cultivated farmlands by supplying new sales channels for the wine grapes being produced.

3. Methods and data

By creating the wine products district designed by the project of Shinshu wine valley, numbers of wine grape producers and the scale of farmlands cultivating wine grapes increased. New farmers cultivating wine grapes may enhance the preservation of farmland resources by restoring abandoned farmlands. Therefore, to determine the sustainability of local agriculture, it is critical to assess the effects of new farmers cultivating wine grapes on abandoned farmland.

To assess this effect, this study analyzes the effects of the migration of pioneer wineries and farmers cultivating wine grapes on abandoned farmland in the Chikuma River wine valley, Nagano prefecture, using panel data analysis.

In the analysis, village card data from the “Agriculture and Forest Census” and three time periods of panel data from 2005, 2010, and 2015 were used. There were three reasons for choosing these periods. First, sample collection methods in the census are changed in 2005. Data on farming organizations have been collected, and aggregated items have been expanded, since 2005. Second, the effects of the migration of pioneer wineries can be observed after 2005. Since small-scale winery owners migrated to the Chikuma River wine valley area after 2002, it is reasonable to use the “Agriculture and Forest Census” data from 2005 as the first period. Third, since the pioneer wineries opened around 2015, the conditions for wine grape cultivation and winery management for pioneer wineries became stable around 2015.

Changes in farming village situations, such as an increased number of farmers, have time lags that do not instantly influence agricultural resources. Thus, this study included period differences as time lags between the independent and dependent variables.

Equation (1) presents the empirical model for factor analysis.

$$Y_i^t = \alpha + \beta_1 D_i^{t-1} + \beta_2 W_i^{t-1} + \Sigma\beta_3 DW_i^{t-1} + \Sigma\beta_4 X_i^{t-1} + \varepsilon \quad (1)$$

where i and t are villages and years (2005, 2010, and 2015), respectively. Y is farmland resources, represented by the ratio of abandoned farmland to the change in the ratio of abandoned farmland. D is a dummy variable for the target region that indicates the estimated migration area of the pioneering wineries. W is the wine grape producers, represented by the ratio of farmers cultivating open field grapes. DW is the transaction cross-term of the target region and is the ratio of farmers cultivating grapes

in open fields and vegetable fields. X is the controlling variable[3], and includes the ratios of small-scale farmers, non-farming farmland owners, type 2 sub-farmers, large-scale farmers, contracted farmers, corporate production farming organizations, certified farmers, farmers with successors, corporations, farming managers under 60, leased farmland, paddy fields, and vegetable fields. β_1 to β_4 are parameters of coefficients, is a constant and α is the error term.

To assess the preservation effects of pioneer wineries and farms cultivating wine grapes, it is critical to consider the effects of other preservation policies[4], as participation in other preservation policies will enhance preservation activities. However, owing to data limitations, it is difficult to determine whether a village is participating in the other policies. Therefore, to test the participation rate of other preservation policies, this study adopted the effect of pioneer wineries and wine grape producers on the preservation activity of farmland and the topic of environmental preservation discussed in farmers' meetings as representative variables. While analyzing these effects, it is important to remember that there might be time lags in the causal relationships. Therefore, this study adopted a model that included time lag and a model without time lag.

Equations (2) and (3) show the testing models with and without a time lag, respectively.

$$P_i^t = \alpha + \beta_1 D_i^{t-1} + \beta_2 W_i^{t-1} + \Sigma\beta_3 DW_i^{t-1} + \Sigma\beta_4 X_i^{t-1} + \varepsilon \quad (2)$$

$$P_i^t = \alpha + \beta_1 D_i^t + \beta_2 W_i^t + \Sigma\beta_3 DW_i^t + \Sigma\beta_4 X_i^t + \varepsilon \quad (3)$$

P is participation in the preservation policy of agricultural resources represented by the dummy variable of preservation activity of farmland and the topic of environmental preservation discussed in the farmers' meetings. D,W and X are the same as in the empirical model used for factor analysis.

The creation method and descriptive statistics for each variable are shown in Table 2 and Table 3.

Table 2 Variable Creation Methods

Variable name	Variable creation methods
Ratio of abandoned farmland	Total abandoned farmland / Total farmland [6]
Ratio of change on abandoned farmland	(Total abandoned farmland-Total abandoned farmland (previous priod)) /Total farmland
Preservation activity of farmland	If there are activity of farmladn preservation, 1. Otherwise, 0
Farmers meeting: Topic of enviromental preservation	If farmers discuss about the topic, 1. Otherwise, 0
Ratio of small scale farmers [1]	Namber of small scale farmer (under 1ha) / Total cultivating farmers
Ratio of non-farming farmland owner	Total non-farming farm owner / Total farm owners [7]
Ratio of type2 Subfarmers [2]	Number of Type2 sub farmers / Total farmers [8]
Ratio of large scale farmers [3]	Number of large scale farmers(over 5ha) / Total cultivating farmers
Ratio of contracted farmers	Total contracted farmers / Total farmers
Ratio of corporate production Farming Organizations	Total corporate production farming organization / Total farming management bodies [9]
Ratio of certified farmers [4]	Number of certified farmers / Total farming management bodies
Ratio of farmers with succecor	Number of farmers with succecor / Total farming management bodies
Ratio of corporation	Number of corporation / Total farmers
Ratio of farming manegers under age of 60	Number of farming manegers under age of 60 / Total farmer
Ratio of leased in farmland	Amount of farmland leased in / Total cultivated farmland
Ratio of paddy field	Amount of paddy field / Total cultivated farmland
Ratio of crop field [5]	Amount of Crop field / Total cultivated farmland
Target region	If pioneer new farmers migrated in a farming region, 1. Otherwise, 0
Ratio of farmers cultivation grape at open field	Number of farmers cultivating grape at open field / Total farming management bodies

1) cultivating farmers with under 1ha farmland are included in small scale farmers.
2) farmers who earn income from other work mainly are categolized as type2 subfarmer.
3) cultivating farmers with over 5ha farmland are included in large scale farmers.
4) farmers certified as leading farmer by government are named as certified farmer.
5) number of crop field include number of cultivating farmland excluding numbers of paddy field and orchan filed.
6) Total farmland is carculated from following formuler. total cultivated farmland- (amount of leased in + amount of leased out) +total abandoned farmland.
7) Total farmland owner is curculated from following formuler. total farmers + total non-farming farmland owner
8) Total farmers include total sale farmer and self cultivating farmer.
9) total farming management bodies include total farming organizations.

Table 3 Descriptic Statistics

Variable name	Variable abbreviation	All observations in target periods	number of observations	Period	Mean	Min	Max
Ratio of abandoned farmland	Ya	10332	3444	3	9.00	0	81.1
Ratio of change on abandoned farmland	Yc	9979	3444	3	-0.01	-2.56	0.79
Preservation activity of farmland	Yp	6888	3444	2	0.47	0	1
Farmers meeting: Topic of enviromental preservation	Ym	6888	3444	2	0.91	0	1
Ratio of small scale farmers	Rs	10332	3444	3	69.72	0	100
Ratio of non-farming farmland owner	Rn	10332	3444	3	47.09	0	100
Ratio of type2 Subfarmers	Rt	10332	3444	3	13.28	0	92.6
Ratio of large scale farmers	Rl	10332	3444	3	1.64	0	100
Ratio of contracted farmers	Rc	10332	3444	3	5.97	0	100
Ratio of corporate production Farming Organizations	Rcp	10332	3444	3	3.90	0	100
Ratio of certified farmers	Rcf	10332	3444	3	6.04	0	100
Ratio of farmers with succecor	Rfs	10332	3444	3	52.56	0	100
Ratio of corporation	Rc	10332	3444	3	1.17	0	66.67
Ratio of farming manegers under age of 60	Ru60	10332	3444	3	24.26	0	100
Ratio of leased in farmland	Rin	10332	3444	3	19.05	0	95
Ratio of paddy field	Rpf	10332	3444	3	51.76	0	100
Ratio of crop field	Rcf	10332	3444	3	24.54	0	100
Target region	Target	10332	3444	3	0.00	0	1
Ratio of farmers cultivation grape at open field	Rgo	10332	3444	3	4.14	0	100

4. Results and discussion

1) Results of the panel data analysis

Before conducting factor analysis, we conducted a Hausman test to verify the effect of endogeneity in the panel data. The null hypothesis could not be dismissed, indicating endogeneity in the panel data. Therefore, this study adopted a fixed-effects model for the test analysis of the participation of other preservation policies and the factor analysis.

Before assessing the results of the factor analysis, we first verified the effects of pioneering farmers and wine grape producers on other preservation policies. Table 4 shows the results of the farmland preservation action and farmers' tendencies toward environmental preservation. From left to right, the table shows farmland preservation actions with and without a time lag, and the topic of environmental preservation discussed in farmers' meetings with and without a time lag. From the table, both the target region and the ratio of farmers producing open-field grapes have non-significant effects on farmland-preserving activities in the model without a time lag. In the model with a time lag, both the target region and the ratio of farmers cultivating open-field grapes had negative effect of -0.07 and -0.0001, respectively, on farmland preserving activity. Furthermore, regarding the topic of environmental preservation discussed in the farmers' meetings, there were no significant effects on either the target region or wine grape producers in either model. These two results suggest that an increase in the number of new farmers cultivating wine grapes and the migration of pioneer wineries has negatively influenced the preservation action of farmers. Thus, participation in other preservation policies was not influenced by these two factors.

Table 5 shows the results of factor analysis using a fixed effect model. From left to right, the table shows the ratio of abandoned farmland, and change in the ratio of abandoned farmland in the models with and without cross terms. As a first, this paper will verify the results of the controlling variables and use the coefficient of determination to verify the model fit. In the table, R-squared is around 0.05 in all models, which indicates that ratio of abandoned farmland to the change in abandoned farmland is not thoroughly explained by the factor variables. The reason is that there are unobservable factors playing critical roles in the causal relationship of abandoned farmland. This paper used the village cards from the "Agriculture and Forest Census," whose data are collected by surveys. This means that certain data, such as the abilities of each farmer or existing leader, could not be observed. Therefore, it is speculated that the models without these factors could only explain

Table 4 Result of Tests for Other Preservation Policy

Variables	Yp	Yp_{t+1}	Ym	Ym_{t+1}
Rs	0.000	0.000	0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Rn	0.002***	-0.001**	0.005***	-0.001***
	(0.001)	(0.000)	(0.000)	(0.000)
Rt		0.001**		0.003***
		(0.000)		(0.001)
Rl	-0.001	-0.002	-0.001	0.003
	(0.002)	(0.002)	(0.001)	(0.002)
Rc	0.001	0.001	0.000	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)
Rcp	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Rcf	-0.001	0.001	0.001	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)
Rfs	-0.001***	0.001**	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Rc	0.000	-0.003	-0.001	-0.003
	(0.001)	(0.002)	(0.001)	(0.002)
Ru60	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Rin	-0.001	0.001	0.001	-0.001**
	(0.001)	(0.001)	(0.001)	(0.001)
Rpf	0.002***	-0.001***	0.000	0.001
	(0.001)	(0.001)	(0.000)	(0.000)
Rcf	0.001**	-0.001*	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Year (2010)		0.153***		0.322***
		(0.030)		(0.032)
year (2015)	0.055***		0.107***	
	(0.007)		(0.008)	
Target	-0.305	-0.079***	0.138	0.363
	(0.214)	(0.020)	(0.215)	(0.245)
Rgo	-0.000	-0.001***	-0.001	-0.000
	(0.001)	(0.000)	(0.001)	(0.000)
Constant	0.226***	0.432***	0.360***	0.791***
	(0.045)	(0.015)	(0.037)	(0.020)
Observations	6,888	6,888	6,888	6,888
R-squared	0.068	0.060	0.189	0.157
groups	3444	3444	3444	3444
R2	0.0675	0.0598	0.189	0.157
F-statistics	13.33	12.77	50.67	35.48

Robust standard errors in parentheses.
Stars indicate *** p<0.01, ** p<0.05, * p<0.1

Table 5 Result of Factor Analysis

Variables	Yp	Yp_{t+1}	Ym	Ym_{t+1}
Rs	-0.040***	-0.039***	-0.001***	-0.001***
	(0.012)	(0.012)	(0.000)	(0.000)
Rn	-0.020***	-0.020***	0.000**	0.000**
	(0.006)	(0.006)	(0.000)	(0.000)
Rt	0.099***	0.099***	0.001***	0.001***
	(0.014)	(0.014)	(0.000)	(0.000)
Rl	0.011	0.011	0.001	0.001
	(0.052)	(0.052)	(0.001)	(0.001)
Rc	-0.010	-0.011	-0.000	-0.000
	(0.019)	(0.019)	(0.000)	(0.000)
Rcp	-0.004	-0.004	-0.000	-0.000
	(0.005)	(0.005)	(0.000)	(0.000)
Rcf	-0.051***	-0.051***	-0.000	-0.000
	(0.012)	(0.012)	(0.000)	(0.000)
Rfs	0.003	0.003	0.000	0.000
	(0.008)	(0.008)	(0.000)	(0.000)
Rc	0.006	0.006	0.000	0.000
	(0.068)	(0.068)	(0.002)	(0.002)
Ru60	-0.017	-0.017	-0.001**	-0.001**
	(0.011)	(0.011)	(0.000)	(0.000)
Rin	-0.025	-0.025	-0.000	-0.000
	(0.018)	(0.018)	(0.000)	(0.000)
Rpf	-0.024*	-0.024*	-0.001*	-0.001*
	(0.015)	(0.015)	(0.000)	(0.000)
Rcf	-0.008	-0.009	-0.001*	-0.001*
	(0.020)	(0.020)	(0.000)	(0.000)
year(2015)	6.797***	6.801***	0.008	0.008
	(0.793)	(0.794)	(0.013)	(0.013)
Target	-3.105*	-19.487**	-0.059**	-0.130
	(1.807)	(7.820)	(0.030)	(0.202)
Rgo	-0.015**	-0.015**	-0.000	-0.000
	(0.006)	(0.006)	(0.000)	(0.000)
Target X Rgo		0.009		0.001
		(0.090)		(0.003)
Target X Rcf		0.531**		0.002
		(0.243)		(0.006)
Constant	9.838***	9.836***	0.086***	0.086***
	(0.631)	(0.631)	(0.013)	(0.013)
R-squared	0.051	0.051	0.047	0.047
Observations	6888	6888	6888	6888
groups	3444	3444	3444	3444
R2	0.0507	0.0511	0.0469	0.0470
F-statistics	6.898	6.358	7.829	6.940

Robust standard errors in parentheses.
Stars indicate *** p<0.01, ** p<0.05, * p<0.1

part of the causal effect of abandoned farmlands.

For the controlling variables, verification was first conducted from the results of the effect of farmland supply. Regarding the ratio of abandoned farmland and change in abandoned farmland, the ratio of small-scale farmers had negative effects of -0.04 and -0.001, respectively. The ratio of non-farming farmland owners had a negative effect of 0.02, although it had a positive effect on the change in abandoned farmland. On the other hand, the ratio of type 2 subfarmers had a positive effect of 0.09 and 0.001 on both the ratio of abandoned farmland and the change in abandoned farmland. This means that an increase in the number of subfarmers might deteriorate farmland resources, although an increase in the number of small-scale farmers and non-farming farmland owners would reduce the number of abandoned farmlands. Next, the effect of the farmland demand was verified. As a result of the variables representing the farmland demand effect, the ratio of certified farmers had a significant negative effect of -0.051. Since agricultural structures in Nagano face a shortage of mid- and large-scale farmers, it is difficult to ensure leading farmers in every village. Thus, an increased number of certified farmers only significantly influenced the causality of abandoned farmland. The proportion of farming managers below the age of 60 had a negative effect of -0.001. Therefore, an increase in the youth labor force will reduce farmland abandonment. Finally, verifying cultivated farmland conditions, the ratio of paddy fields had a negative impact of -0.024 on the ratio of abandoned farmland, and both the ratios of paddy and vegetable fields had negative impacts of -0.001 on changes in abandoned farmland. Therefore, maintaining a sufficient amount of cultivated farmland is vital.

This study verified the effects of pioneering farmers and farmers producing wine grapes. For the ratio of abandoned farmland, both the target region and the ratio of farmers cultivating open-field grapes had negative effect of -3.10 and -0.01, respectively. However, in the cross-term, the ratio of farmers cultivating open-field grapes in the target region was not significant. Therefore, the impact of the cross effect of new farmers cultivating wine grapes in the target region could not be determined from the analysis. While the cross effect of open-field grape farmers is not clearly defined, the cross term of the ratio of vegetable fields in the target region had a positive significance of 0.58. This result indicates that an increased number of vegetable fields in regions where pioneer wineries have migrated will lead to the deterioration of farmland. This suggests that the support for new farmers provided by both local governments in Tomi City and the Ueda Farms company might have caused an increased number of abandoned farmlands. In Tomi city, local governments and Ueda Farm company provided new farmers with training and mediation support to become vegetable farmers. This indicates that the increased number of vegetable farmers that were induced by the local government and Ueda Farms may have caused the deterioration of farmland.

For the ratio of change in abandoned farmland, the target region has a negative effect of -0.05, which means that the number of abandoned farmlands reduced by -0.05 from the previous period when pioneer winery owners first migrated to the area. However, the proportion of farmers cultivating open-field grapes was not statistically significant. The cross-terms were also statistically insignificant. Therefore, the effect of an increased number of farmers cultivating open-field grapes and the cross-term effects of the target region on farmland abandonment from the previous year have not been clearly determined, although the migration of pioneer wineries had a reducing effect on farmland abandonment.

2) Discussion

Factor analysis revealed that the effects of the migration of pioneer wineries and an increased number of farmers cultivating open-field grapes will reduce the number of abandoned farmlands. Therefore, an increased number of new farmers cultivating wine grapes and small-scale wineries have the potential to enhance the preservation of farmland resources. However, the cross-effects of these two factors remain ambiguous. Furthermore, the effect of the increased number of new farmers, which induced various forms of support from the local government and private sector after the Chikuma River wine valley was approved as a special wine district in 2015, could not be

assessed from the target periods of the factor analysis. Therefore, to assess the potential of new farmers cultivating wine grapes to become leading farmers in local agriculture, it is essential to prospect the increasing effect of the number of new farmers cultivating wine grapes in the target area on changes in abandoned farmland.

Figure 5 shows the prospect value of the ratio of change in abandoned farmland estimated by the increase in the ratio of farmers cultivating open-field grapes in the target region[5]. The figure shows that the preservation effect decreases when the ratio of farmers cultivating open-field grapes increases. When the ratio of farmers was over 15%, the ratio of the change in abandoned farmland became positive. This means that an increased number of new farmers will hinder the preservation of farmland resources if they account for more than 15% of all farmers in the target region. Therefore, an increase in the number of new farmers will induce farmland abandonment if there are pioneer wineries in their migration area. This result may have been caused by a conflict in the usage of abandoned farmland between pioneer wineries and new farmers. Since abandoned farmland in the target region, which is the area where pioneer winery owners migrated, is restored and consolidated by them, the amount of abandoned farmland for new farmers might be restricted. Therefore, there could be some conflicts between new and existing farmers cultivating wine grapes when they decide to migrate and try to consolidate an ample size of farmland for the cultivation of wine grapes.

However, as shown in Figure 5, the effect of the increased number of new farmers cultivating wine grapes is only predicted for the target region. Since 2015, eight more municipalities were approved as special wine districts in the Chikuma River wine valley[6], indicating that the potential areas for the migration of new farmers expanded after 2015. Therefore, it is reasonable to expand the range of the prospect from the target region to throughout the Chikuma River wine valley.

Figure 6 shows the prospect value of the ratio of change in abandoned farmland, estimated by the increased ratio of farmers cultivating open-field grapes in the Chikuma River wine valley[7]. An increase in the number of farmers cultivating open-field grapes tended to reduce the number of abandoned farmlands in the Chikuma River wine valley. Thus, inducing new farmers to cultivate wine grapes in the Chikuma River wine valley will preserve farmland resources. This result contrasts with the result of the target region in figure 5. This difference was related to the amount of farmland used. The increased number of new farmers in the target region may have induced farmland abandonment because of conflicts in the usage of abandoned farmland. However, the Chikuma River wine valley includes nine municipalities, with a considerable size of abandoned farmlands. Therefore, by expanding the potential locations for the migration of new farmers, there is sufficient farmland to induce new farmers, and the

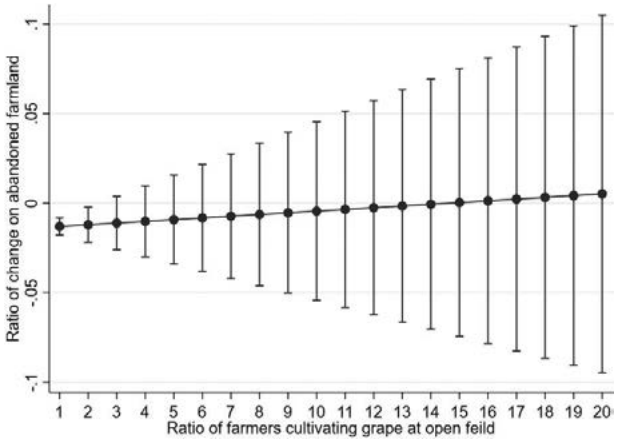

Fig. 5 Prediction for the Effect of Increasing Number of Grape Farmers on Target Region

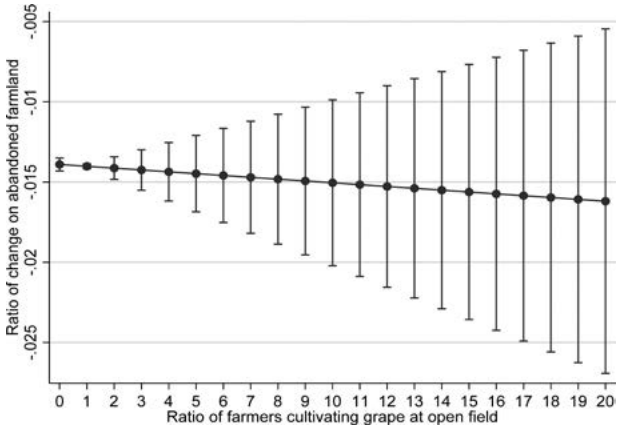

Fig. 6 Prediction for the Effect of Increasing Number of Grape farmers on Chikuma River wine valley

effect of wine grape producers on farmland resources is increasingly enhanced when the number of new farmers cultivating wine grapes increases.

From these prospections, it can be assumed that the increasing number of wine grape producers after 2015 enhanced the preservation of farmland resources. However, to reap the benefit, the condition of expanding potential locations where new farmers can migrate needs to be secured. If new farmers who dream of opening their own winery decide to migrate to the same region or a small area of the Chikuma River wine valley, the preservation of farmland resources will be hindered, and the occurrence of abandoned farmlands might increase. Therefore, it is critical to provide new farmers with the same conditions for wine grape cultivation throughout the Chikuma River wine valley.

The range of the 95% interval of the prospected value is expanded as the ratio of farmers cultivating open field grapes increases, and the values are not statistically significant. Therefore, these prospects may not fit the actual situation of the increased number of wine grape producers.

5. Conclusion

This study reveals the impact of creating a wine-producing district and the Shinshu wine valley project by analyzing the effect of the migration of pioneer wineries and new farmers cultivating wine grapes to assess the potential of these farmers to become leading farmers in local agriculture.

The results yielded four findings. First, the regions to which the pioneer wineries migrated experienced a decline in the number of abandoned farmlands. An increasing number of small-scale winery owners, as pioneer wineries, have migrated to and started farming in the Chikuma River wine valley since 2000. Although these winery owners consolidated and restored abandoned farmland, the results from the factor analysis statistically reveal that the migration reduced the number of abandoned farmlands. Second, in the regions where pioneer wineries migrated, support for the consolidation and mediation of abandoned farmland to vegetable farmers provided by the local government and private sector before 2018 might have hindered the preservation of farmland resources. Before 2018, the local government and Ueda Farms company provided new farmers with training to become vegetable farmers and allotted farmland to them. However, the results show that the increased number of vegetable fields increased the number of abandoned farmlands. Therefore, support provided by local governments and Ueda Farm corporation before 2018 might have indirectly increased the abandoned farmland. Third, the number of farmers cultivating open field grapes decreased the ratio of abandoned farmland throughout Nagano prefecture. This result coincides with the fact that maintaining the cultivation area of wine grapes restrains the occurrence of abandoned farmlands and the decline in the number of cultivated farmlands, as suggested by Yuruka and Shimizu (2017). Therefore, an increased number of new farmers cultivating wine grapes has restraining effects on the occurrence of abandoned farmland and maintained the number of cultivated farmland. Fourth, there is a need to reap the benefits of preservation by increasing the number of new farmers cultivating wine grapes in the Chikuma River wine valley in abandoned farmlands. From the prediction results, the effects of an increased number of farmers cultivating open-field grapes varied depending on two different ranges. In regions to which pioneer winery owners migrated, the inhibitory effect of abandoned farmland decreased as the number of farmers increased. By expanding the migration area throughout the Chikuma River wine valley, a number of abandoned farmlands will be restored, as the number of new farmers cultivating wine grapes increases. Therefore, an increase in the number of new farmers cultivating wine grapes will preserve farmland resources if the available locations for the migration of new farmers expands throughout the Chikuma River wine valley.

The results show that the migration of pioneer winery owners and wine grape producers reduces the proportion of abandoned farmland. However, the cross effects of migration between pioneer winery owners and wine grape producers remain unclear. Therefore, it has not been statistically determined whether an increase in the

number of new farmers cultivating wine grapes in special wine districts preserves farmland resources. Although the cross-effect is still unclear, it is highly probable that the increase in the number of wine grape producers would reduce the number of abandoned farmlands if new farmers migrated to all Chikuma River wine valleys. Therefore, the new farmers cultivating wine grapes could become leading farmers in local agriculture if they could obtain or mediate consolidated farmland of ample size without conflict with the forerunners who cultivated wine grapes before them.

This study has the following limitations. First, because of the limitations of the target periods, the results of the factor analysis did not fully reveal the effect of new farmers cultivating wine grapes in the Chikuma River wine valley on farmland resources. Since the Chikuma River wine valley was approved as a special wine district in 2015, and the support provided by the local government and private sectors was implemented after 2015, the target periods of the factor analysis could not include these effects in the results. Second, owing to data limitations, the effects of raw consumption by grape producers and wine grape producers could not be separated in the factor analysis. Data used for the factor analysis for both raw consumption grape producers and wine grape producers were collected from the same category. Therefore, the pure effect of an increased number of farmers cultivating wine grapes on abandoned farmlands has not yet been determined. These issues will be addressed in future studies.

[1] System of "special wine district" designed from the system of special zones for stricter reform in 2002 is a region where wine brewing regulations are loosened. In the approved region, regulations for liquor licenses are loosened from 6000l to 2000l as the necessary brewing quantity for each year. Therefore, because of the loosened regulations, small-scale wineries can obtain liquor licenses more easily than in other regions.

[2] During this time, winery owners made a contract regarding the usage rights of farmland with farmland owners. Although some owners wanted to make the wine owner purchase the land, these contracts contain usage rights only, a learning from the negotiation failures of the Takara brewing company.

[3] Controlling factors are elaborated form factors which are largely concerned with the changes in abandoned farmland (Hiraji 2016, Kawashima and Kono 2016, and Oda 2021).

[4] Implemented policies of agriculture resource preservation, such as direct payment for areas with natural constraints, agri-environment and climate measures, are paid directly by the plan for or action of agriculture resource preservation.

[5] Prospect values are estimated by increase effect of ratio of farmers cultivating open field grapes on the ratio of change of abandoned farmland in the target region using averaged values of other independent variables.

[6] The eight municipalities (Ueda city, Komoro city, Sakashiro town, Chikuma City, Aoki village, Tachishina town, Nagawa town and Saku city) are approved as special wine districts after 2015. Location of these municipalities is shown in figure 4.

[7] Estimation of this prospect value uses factor analysis using cross term of the ratio of farmers cultivating open field grapes in all Chikuma Eiver wine valley areas, in which the dummy variable of migration of pioneer winery is excluded.

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ワイン原料用ブドウ生産者が持つ農地保全効果についての考察
―長野県千曲川ワインバレーを対象に―

小田　昌希

公益財団法人ルイ・パストゥール医学研究センター　医農食情報環境連携研究室
〒606-8225　京都市左京区田中門前町103-5

我が国の農業資源の保全主体となる認定農業者や組織経営体は後継者の不在が大きな問題となっており，新規就農者の育成が急務となっている．長野県では個人経営の小規模ワイナリーの開業が進み，ワイナリー開業を目指す新規就農者の入植が増加している．ワイン産地の形成を目的に信州ワインバレー構想が策定されたことで，行政による支援が充実し，ますますワイナリー開業を目指す新規就農者が増加している．こうした原料用ブドウ生産をおこなう新規就農者は耕作放棄地等の農地再生を加速度的に進めていることから，地域農業の新たな担い手となりうる可能性がある．そこで本稿は原料用ブドウ生産者がもつ農地保全効果を，長野県における先駆的ワイナリーの入植地域を対象に彼らの入植による耕作放棄地への影響について要因分析とその結果を用いた予測値の計測によって明らかにする．分析の結果，以下の4点が明らかになった．第一に，先駆的ワイナリーの入植地域では他の地域に比べて耕作放棄地率が減少していた．第二に，先駆的ワイナリーの入植地域では畑作面積の増加が耕作放棄地の増加に繋がる可能性がある．第三に，露地ブドウ生産者の増加は耕作放棄地の抑制効果がある．第四に，原料用ブドウ生産をおこなう新規就農者の増加が耕作放棄地に対して抑制効果を発揮するには，十分な農地が利用可能な入植先を提供することが必要である．