

# Market Competitiveness and the Sustainability of the Cultivation of Kaga Vegetables

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## Abstract

Traditional vegetables in Japan serve not only as an important food source but also as the basis of local customs and cultural landscapes. There are few case studies on the problems faced by traditional vegetables cultivation, such as the lack of successors in the production areas. Therefore, this study evaluates the relationship between the characteristics of growers and the market competitiveness and sustainability of Kaga traditional vegetables. We analyzed the results of a questionnaire distributed to farm households who cultivate Kaga vegetables in Kanazawa City, Ishikawa Prefecture along with the cultivation and sales data collected from public organization. The recent trends of each of the 15 Kaga vegetables were calculated from the cultivation and sales data, and the statistical relationship between the numerical value and questionnaire survey data was derived. The total effective sample size was 278. Market competitiveness was statistically related to the age of the farmers and the dependence of the household on agricultural income. There was no relationship between the sustainability of cultivation and characteristics of the individual farmers.

Keywords: Kaga vegetables / market competitiveness / sustainability / cultivation area

## 1. Introduction

Ethnic foods are dishes made with traditional agricultural products local to a specific geographical region. Ethnic foods are consumed around the world and have a long history associated with local cultures and traditions of the regions where they originate (Kwon, 2016). Although there is no unified definition for traditional agricultural products the foods which have been grown and consumed in harmony with the weather and climate in the region using traditional farming methods and over a long period are considered native. Ethnic foods made with local species are cooked as staple foods and side dishes and they are the basis of various regional cultures (Karizakia, 2016; Tamang and Thapa, 2014; Ma, 2015). Recently local species and ethnic foods have been recognized by people inside and outside of the region as a geographical indicator and have become the basis of agribusiness in these regions (Bérard & Marchenay, 2006; Gugerell et al., 2017; Fernández-Ferrín et al., 2019; Teuber, 2011; Haimid et al., 2012).

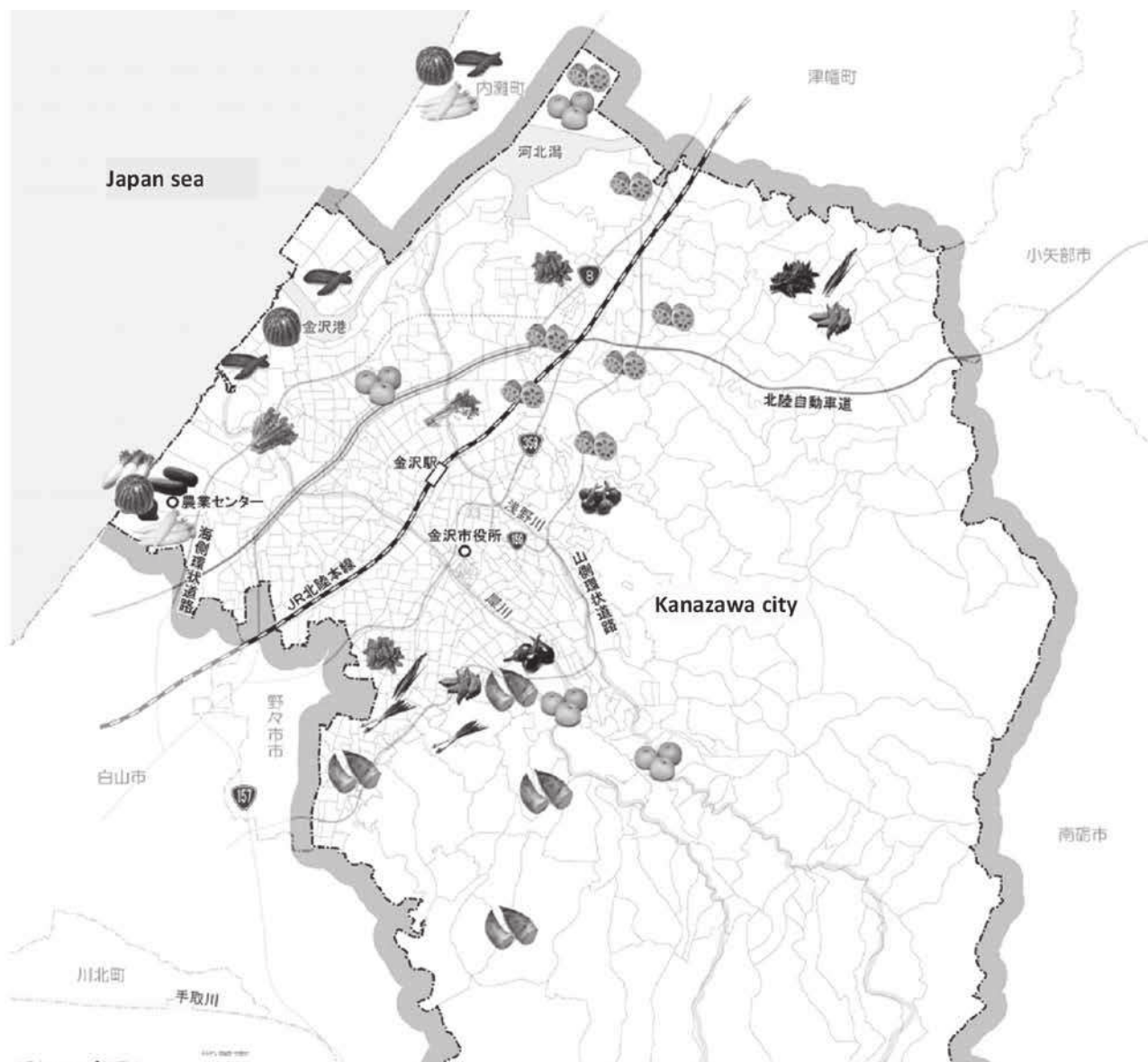
In various parts of Japan, traditional vegetables

(hereinafter referred to as "TV" for short). are important agriculture products and ethnic foods. Traditional vegetables are not only a food that has been familiar to people in and out of the region for many years but are also connected with the socio-cultural and ecological landscape of the region (Uchiyama et al., 2017). However, as Japan's agricultural methods have been modernized since the 1960s many traditional vegetables are unsuitable for efficient agricultural production and distribution, leading to a steady decline in cultivation. There are very few new young farmers producing traditional vegetables; this is directly connected with their decline. The modern varieties of some traditional vegetables that are resistant to disease are mass-produced in fixed quality and fixed form and have thus become mainstream (Abe, 2015). As a result, the decrease in income of TV farmers and the problem of knowledge management on cultivation gradually became apparent, and the number of successors decreased.

This study focuses on "Kaga Yasai" or Kaga vegetables, which are a group of fifteen traditional vegetables cultivated only in Kanazawa, Ishikawa prefecture and a few suburban areas (Fig. 1). Kaga Yasai is a label for

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15 items of K-TV

No	Picture	name	Main season
1		Satsuma imo	August ~ June
2		Kaga renkon	August ~ May
3		Takenoko	April ~ May
4		Kaga futo kyuri	April ~ November
5		Kinji so	June ~ November
6		Kaga tsurumame	June ~ October
7		Heta murasaki nasu	June ~ October
8		Gensuke daikon	October ~ February
9		Seri	November ~ April
10		Utsugi akagawa amaguri kabocha	June ~ September

No	Picture	name	Main season
11		Futatsuka karashina	November ~ March
12		Kaga ippon hutonegi	November ~ January
13		Kuwai	November ~ December
14		Aka zuiki	July ~ September
15		Kanazawa shungiku	October ~ April

Items of Other Brand

No	Image	名称	産地	出荷時期
1		だいこん	金沢市安原地区、兼五地区	9月下旬～11月中旬
2		すいか	金沢市安原地区、兼五地区	6月中旬～7月下旬
3		なし	金沢市崎浦地区、鞍月地区、河北湯	8月上旬～10月下旬



Figure 1 Study map of Kaga vegetables cultivation areas in Kanazawa City, Japan.  
Source: Kanazawa city and Nihonkai Consultant Co., Ltd. (2014)

Table 1 Common name and local name of the fifteen certified Kaga vegetables

Item No.	Local name	General name of the species	Scientific name	Certified year
1	Satsuma imo	Sweet potato	<i>Ipomoea batatas</i>	1997
2	Kaga renkon	Lotus root	<i>Nelumbo nucifera</i>	1997
3	Takenoko	Bamboo shoot	<i>Phyllostachys pubescens</i>	1997
4	Kaga futo kyuri	Cucumbers	<i>Cucumis sativus</i>	1997
5	Kinji so	Kinji so	<i>Gynura bicolor</i>	1997
6	Kaga tsurumame	Beans	<i>Glycine soja</i>	1998
7	Heta murasaki nasu	Eggplant	<i>Solanum melongena</i>	1997
8	Gensuke daikon	Radish	<i>Raphanus sativus</i> var. <i>Longipinnatus</i>	1997
9	Seri	Seri	<i>Oenanthe javanica</i>	1997
10	Utsugi akagawa amaguri kabocha	Pumpkin	<i>Cucurbita</i>	1997
11	Futatsuka karashina	Mustard greens	<i>Brassica juncea</i>	1998
12	Kaga ippon hutonegi	Long onion	<i>Allium fistulosum</i>	1997
13	Kuwai	Kuwai	<i>Sagittaria trifolia</i> 'Caerulea'	2002
14	Aka zuiki	Zuiki	<i>Colocasia esculenta</i>	2002
15	Kanazawa shungiku	Crown daisy	<i>Glebionis coronaria</i>	2003

Source: Kanazawa City (2018)

“indigenous vegetables cultivated before 1945 and still grown mainly in Kanazawa City.” Fifteen Kaga vegetables have been certified (Table 1). Kaga vegetables were traditionally only cultivated in rural areas, but they have recently gained value as a regional brand (Burgess, 2014; Kishimoto & Saito, 2011). The Kaga brand value increases the willingness of consumers to pay more for the product (Roselli et al., 2018; Sugita & Kiminami, 2012). Kaga is now recognized as a source of tourism for the region of Kanazawa (Ting et al., 2014; Ting et al., 2019). It is reported that the regional branding of traditional vegetables provides benefits such as increasing the sense of community between area residents (Cañada & Vázquez, 2005) and promoting revitalization of the region (Yasuda, 2011).

This study examines how Kaga vegetables excel in market competition with non-branded products. It is clear that the behavior and ideas of individual producers constitute the market competitiveness of items. However, at least with regard to Kaga vegetables, no studies have analyzed the opinions and actual conditions of individual producers. We hypothesize that the important factors that determine the market competitiveness of item sales and the sustainability of item production have not been quantitatively identified. Based on this hypothesis, this study aims to explore the factors related to the sustainability of Kaga vegetables using data collected from individual producers to overcome the problems of the traditional vegetable cultivation system. A factorial

analysis of Kaga vegetables, one of the leading traditional vegetable brands in Japan, can provide valuable insights into the succession of traditional vegetables in Japan and other countries with similar regionality. This study is unique as it considers the comprehensive opinions of many farmers as the basis data for the analysis, which have not been considered in previous studies on Kaga vegetables.

Although Kaga vegetables are a successful brand, the fundamental problem of achieving continuous cultivation has not yet been solved. For example, regarding 15 items of Kaga vegetables, the number of cultivation farms decreased for 10 items, the cultivation area decreased for 10 items, and the shipment amount decreased for 6 items, compared with the actual results in 2016 based on the brand recognition year (Kanazawa City, 2018). In other words, even within the scope of the Kaga vegetable brand, the market competitiveness differs depending on the item. This paper focuses on the factors of market competitiveness and sustainability of cultivation of each item. The competitiveness of a particular item in the agricultural market depends on many factors beyond the responsibility of farmers, such as changes in business conditions, international relations, consumer preferences, and climate change.

## 2. Methods

### 2.1 Overall analytical framework and key concepts

Data was collected on the annual sales (shipment quantity × unit price) from total number of farms where

reliable statistical data was recorded (“ND” in Table 3 mentioned later). The annual sales and the total number of farmers can be interpreted as market competitiveness and sustainability of item production, respectively. The determinants of sustainability for each vegetable were statistically analyzed based on the results of a comprehensive questionnaire for farmers supervised by the authors and carried out by administrative agencies.

## 2.2 Data collection

Most Kaga vegetable farmers do not ship or sell them under their own names. Cultivation groups for each item are organized, and each farmer contributes to the groups. Shipment and sales are carried out under the name of the group, or the brand, of each vegetable. Data was collected through a questionnaire distributed to all farmers participating in the cultivation of all Kaga vegetables.

Data on the number of farms, cultivation area, shipping volume, and unit price for each item was collected. A questionnaire distributed in October 2012, and collected in November of the same year was used to collect information from individual farmers. The questionnaire was distributed and collected by the representatives of the cultivation groups of each item, as requested by the administration of Kanazawa who were in charge of the survey. Out of the 480 questionnaires distributed, 312 were collected. The analysis excluded incomplete questionnaires, for a final sample size of 278. The survey consisted of 27 questions, six of which were used for the analysis (Table 2). The number of questionnaires distributed per item, the

number of responses collected, and the final number of samples included in the analysis are presented in Table 3. In addition, other statistical data compiled independently by the city administration and not open to the public were also used in the study, and their summaries are shown in Table 5.

## 2.3 Statistical analysis

We analyzed the statistical relationship between data from 2003 to 2013 of the annual sales and the total number of farmers, and the intention and characteristics of individual farmers involved in Kaga vegetable production collected from the 2012 questionnaire. We used linear regression to quantify the annual sales and the total number of farmhouses within the observation period, that is, the tendency of the time change. The sales amount is easily affected by factors such as climate, the total number of farmers, and short-term entry and retirement of farmers. These short-term fluctuations can result in inaccurate calculations of the overall trend of change. For the annual sales data, the value of each observation year was treated as a moving average for five years including the preceding and following 2 years in the equation. The total number of farmers was also calculated for seven years using the same formula.

$$\begin{aligned} \text{Annual sales}(t) = & \\ & (\text{Annual sales}(t-2) + \text{Annual sales}(t-1) + \text{Annual sales}(t) \\ & + \text{Annual sales}(t+1) + \text{Annual sales}(t+2))/5 \\ & \text{where, } t \text{ equals observed year}(t-2 \geq 2003, t+2 \leq 2013). \end{aligned}$$

Table 2 Survey questions considered in the analysis of Kaga vegetable production.

No.	Sentence of the question	Question item (Summary)	Choice options
1	(Fill in directly)	Cultivating item of Kaga vegetables	Equivalent of 1 ~ 15 in Table 1
2	Please write your age.	Age	1. <49 years 2. 50~59 years 3. 60~69 years 4. >70 years
3	Which of the following is the ratio of agricultural income as a percentage of household income?	Agricultural income as a percentage of household income	1. All, 2. More than half, 3. Less than half,
4	How will you change the area of Kaga vegetables you are growing now?	Intention to expand farming area on Kaga vegetables	1.Expansion, 2. Maintenance of the status quo 3.Reduction or abandonment completely 4. TBD
5	How many more years can you continue farming?	Prospect of remaining period as farmer	1. >10 years 2. Approximately 5~10 years 3. Approximately 3~5 years 4. <3 years 5. TBD
6	What do you think about new membership for non-current members of the cultivation group?	Cognition for new farmers wishing to join production groups	1.Welcome 2.Not especially opposed 3.Not welcome

Table 3 Number of distributed questionnaires, number of total collected responses, and number of samples included in the analysis of Kaga vegetable production for each item.

Item No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ND	62	61	204	12	31	10	7	18	3	9	17	14	12	10	10
NT	33	28	134	11	18	9	6	11	3	9	7	14	9	6	10
NF	30	26	116	10	18	9	6	11	3	9	6	14	6	5	9
NT*100/ND	53.2	45.9	65.7	91.7	58.1	90.0	85.7	61.1	100	100	41.2	100	75.0	60.0	100
NF*100/ND	48.4	42.6	56.9	83.3	58.1	90.0	85.7	61.1	100	100	35.3	100	50.0	50.0	90.0

ND: Number of distributed questionnaires; NT: number of total collected responses; NF: final number of samples included in the analysis.

The unit of NT\*100/ND and NF\*100/ND= %.

In order to exclude the effect of the difference in unit price of each item and the scale of the total number of farmers for the regression coefficient, all values of annual sales and total number of farmers for each item were standardized by the average value of the data for seven years.

### 3. Results and discussion

#### 3.1 Summary of collected data

The summary statistics of the questionnaire results are presented in Table 4. In the survey, some basic information such as sex and the number of agricultural workers in the household were left blank. To keep the sample size up these factors were excluded from the analysis instead of excluding the whole survey response. Total farmland area and percentage of total agricultural income from Kaga vegetable sales were also excluded from the analysis because these factors depend on unit price and crop characteristics of each item.

#### 3.2 Results

Sustainability of each Kaga vegetable is represented by the annual sales and the number of farm data compiled by the Kanazawa City Agriculture Department. Data from 2003 to 2013 are presented in Table 5. The regression coefficients of the linear regression for the seven years of sales and production data for each Kaga vegetable are presented in Table 6.

The relationship between each regression coefficient in Table 6 and the information obtained in Table 2 was examined using regression analysis. Due to the large differences in the number and recovery rates of data collected for each Kaga vegetable (Table 3) the analytical framework of this study is constructed as follows. First one or two choice options that clearly reflect the implications of the individual questions are extracted after considering the intention of each question, and the percentages are calculated for each item. The percentages

of answer of extracted options within all options and the regression coefficients in Table 6 are plotted on the vertical and horizontal axes and analyzed by a single regression model to interpret the results (Fig. 2). Table 7 presents the choice options in Table 4 that were used for the analysis the intent of the analysis and the numerical values for the 15 Kaga vegetables.

#### 3.3 Discussion

For each item, Figure 2 is a scatter plot that plots the percentage of each index calculated in Table 7 against two regression coefficients (annual sales and total number of farmers). Symbols A-J were assigned to identify 10 scatter plots. In general, the threshold of the coefficient of determination for evaluating the presence or absence of correlation is examined according to the accuracy of the data and the purpose of the research. Although the coefficient of determination in Figure 2 is generally low, it is not appropriate to exclude some outliers from the data of all 15 items for the purposes of the study. According to the explanation in the previous research (Cohen, 1988) that provides generous criteria for the coefficient of determination, the coefficient of determination of 0.02 is the lower limit of significance of the analytical result.

Based on the above criteria, A and B are weakly correlated. C and F also have a coefficient of determination of about 0.02, but the correlation is so minimal that they are excluded from consideration here. All other analyses showed no correlation. The results of the left half of Figure 2 revealed that the annual sales tended to decrease as the farmers aged. In other words, it was judged that the sustainability of the items in which the number of young farmers was maintained was high because the technique of Kaga vegetable cultivation was inherited by young farmers. Considering that the correlation was not confirmed in the analysis of D, it cannot be concluded that the aging of farmers is directly related to the collapse of cultivation organization. Nevertheless, it is important to



Table 4 Summary statistics of survey responses on Kaga vegetable production.

No.	Question item	Choice options (Dummy variable)	ID	Times	Average
1	Age	1. <49 years	1-1	38	0.14
		2. 50~59 years	1-2	64	0.23
		3. 60~69 years	1-3	84	0.30
		4. >70 year	1-4	92	0.33
2	Agricultural income as a percentage of household income	1. All	2-1	75	0.27
		2. More than half	2-2	38	0.14
		3. Less than half	2-3	165	0.59
3	Intention to expand farming area on K-TVs	1. Expansion	3-1	39	0.14
		2. Maintenance of the status quo	3-2	147	0.53
		3. Reduction or abandonment completely	3-3	54	0.20
		4. TBD	3-4	38	0.14
4	Prospect of remaining period as farmer	1. >10 years	4-1	74	0.27
		2. Approximately 5~10 years	4-2	49	0.18
		3. Approximately 3~5 years	4-3	86	0.31
		4. <3 years	4-4	49	0.18
		5. TBD	4-5	20	0.07
5	Cognition for new farmers wishing to join production groups	1. Welcome	5-1	74	0.27
		2. Not especially opposed	5-2	165	0.59
		3. Not welcome	5-3	39	0.14

Table 5 Annual sales and number of farms for each item of Kaga vegetables.

Item No.		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	AS	535791	524308	527221	543468	589605	572539	560043	585259	608625	546790	571801
	TNF	76	76	76	76	79	65	60	61	60	61	57
2	AS	375849	359667	376449	378789	408421	385614	354729	263696	375856	354311	435198
	TNF	83	83	83	83	81	66	66	60	58	63	64
3	AS	104110	188571	134750	139728	137070	183218	195751	247622	128924	181852	127374
	TNF	245	245	245	245	245	245	214	214	210	209	195
4	AS	96039	100036	181557	127367	121850	116681	108171	95260	106011	98179	91907
	TNF	13	13	13	13	13	13	13	12	12	12	12
5	AS	46563	32271	35187	31046	36556	29400	37750	24033	26015	31750	31628
	TNF	30	30	35	36	42	29	35	33	35	39	42
6	AS	20356	27666	30511	23475	21984	10012	11760	4471	3635	4224	3298
	TNF	24	24	24	24	24	12	12	10	10	10	11
7	AS	14524	17137	11889	6930	4830	5415	6858	8050	6678	6266	7971
	TNF	8	11	11	7	8	3	8	8	8	7	7
8	AS	11746	232976	147556	12022	10100	11136	11136	24827	21756	19869	29725
	TNF	6	16	16	16	16	23	22	18	18	18	17
9	AS	8511	8511	8400	8400	11485	9912	8761	5492	4792	4792	3211
	TNF	5	5	5	5	5	5	4	4	3	3	3
10	AS	6976	9474	8104	11532	10545	10167	9749	9206	8611	8041	7284
	TNF	7	16	16	16	13	12	11	10	9	9	9
11	AS	320	344	330	300	203	108	172	113	163	163	131
	TNF	2	3	4	4	4	4	3	1	1	1	1
12	AS	1009	2061	2459	2410	1755	1463	2146	1524	1979	1979	1934
	TNF	4	10	10	10	10	7	14	11	13	13	13
13	AS	452	375	416	1016	1063	1089	853	1163	860	765	1076
	TNF	6	6	6	6	6	6	7	7	8	10	10
14	AS	1086	1050	1100	1800	1661	1764	2354	2177	2226	1223	1497
	TNF	9	9	10	9	9	9	11	6	5	8	7
15	AS	209	1438	1650	1200	1984	1051	1500	1557	1964	1064	2636
	TNF	1	3	3	3	3	2	2	10	11	11	7

AS: Annual sales (unit: Thousand yen); TNF: Total number of farms.

Table 6 Regression coefficient list of time series data of each Kaga vegetable.

Item no.	Local name	AS	r <sup>2</sup>	TNF	r <sup>2</sup>
1	Satsuma imo	0.01	0.78	- 0.04	0.99
2	Kaga renkon	- 0.01	0.75	- 0.05	0.98
3	Takenoko	0.04	0.75	- 0.03	0.96
4	Kaga futo kyuri	- 0.05	0.84	- 0.01	0.91
5	Kinji so	- 0.03	0.84	0.006	0.24
6	Kaga tsurumame	- 0.24	0.98	- 0.14	0.98
7	Heta murasaki nasu	- 0.07	0.60	- 0.03	0.47
8	Gensuke daikon	0.07	0.62	0.04	0.60
9	Seri	- 0.08	0.79	- 0.06	0.94
10	Utsugi akagawa amaguri kabocha	- 0.02	0.31	- 0.07	0.89
11	Futatsuka karashina	- 0.12	0.90	- 0.15	0.82
12	Kaga ippon hutonegi	- 0.01	0.34	0.06	0.97
13	Kuwai	0.05	0.56	0.06	0.87
14	Aka zuiki	0.06	0.71	- 0.04	0.82
15	Kanazawa shungiku	0.03	0.58	0.20	0.91

AS: Annual sales (unit: Thousand yen); TNF: Total number of farms

Table 7 Choice options extracted from the questionnaire (Table 4) in this analysis and intentions to the extraction.

Extracted ID	Implication of the extraction	Percentage of extracted ID choice options selected (By Item)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1-3&1-4	Progress of aging of farmers	0.33	0.42	0.73	0.1	0.89	0.89	0.67	0.36	1	0.33	1	0.71	0.67	0.8	0.78
2-3	Become not main source of income	0.33	0.23	0.87	0	0.5	0.78	0.5	0	0.67	0.11	0.83	0.64	0.33	0.6	0.78
3-2&3-3	Non-expansionist orientation	0.17	0.08	0.49	0.1	0.28	0.33	0.33	0.09	0.33	0	0.17	0.43	0.5	0.6	0.22
4-3&4-4	Retirement risk in near future	0.2	0.23	0.57	0	0.61	0.78	0.67	0.27	0	0.44	1	0.57	1	0.8	0.44
5-1	Welcome of new entrants	0.27	0.5	0.11	0	0.39	0.44	0.17	0	0	0.22	0.67	0.64	1	0.8	0.33

pass down the techniques to more young farmers.

The results of the right half of Figure 2 revealed that annual sales tended to decrease when the proportion of income from Kaga vegetables production was low. This indicates that the household could not be maintained only by agricultural income and depended on the income from other industries. It cannot be concluded that the collapse of the cultivation organization is imminent if the income from other industries is stable, but it implies that the profitability gap between items of Kaga vegetables is widening.

These results were consistent with the broad recognition of the agricultural administration departments and agricultural cooperatives in the study area at the time of the survey. The novelty of this study result was that this recognition was statistically supported for the first time

from the answers of individual farmers to the questionnaire survey.

#### 4. Conclusion

In this study, the market competitiveness and the sustainability of the cultivation of Kaga vegetables in Kanazawa, Ishikawa Prefecture, were evaluated based on the characteristics and intentions of individual farmers. In terms of market competitiveness differences among 15 items of Kaga vegetables were explained by the aging tendency of farmers and the dependence on agricultural income. Factors affecting the differences in the sustainability of the cultivation of 15 items of Kaga vegetables were not identified from the study.

The reevaluation of the market competitiveness and sustainability of each Kaga vegetable based on the latest

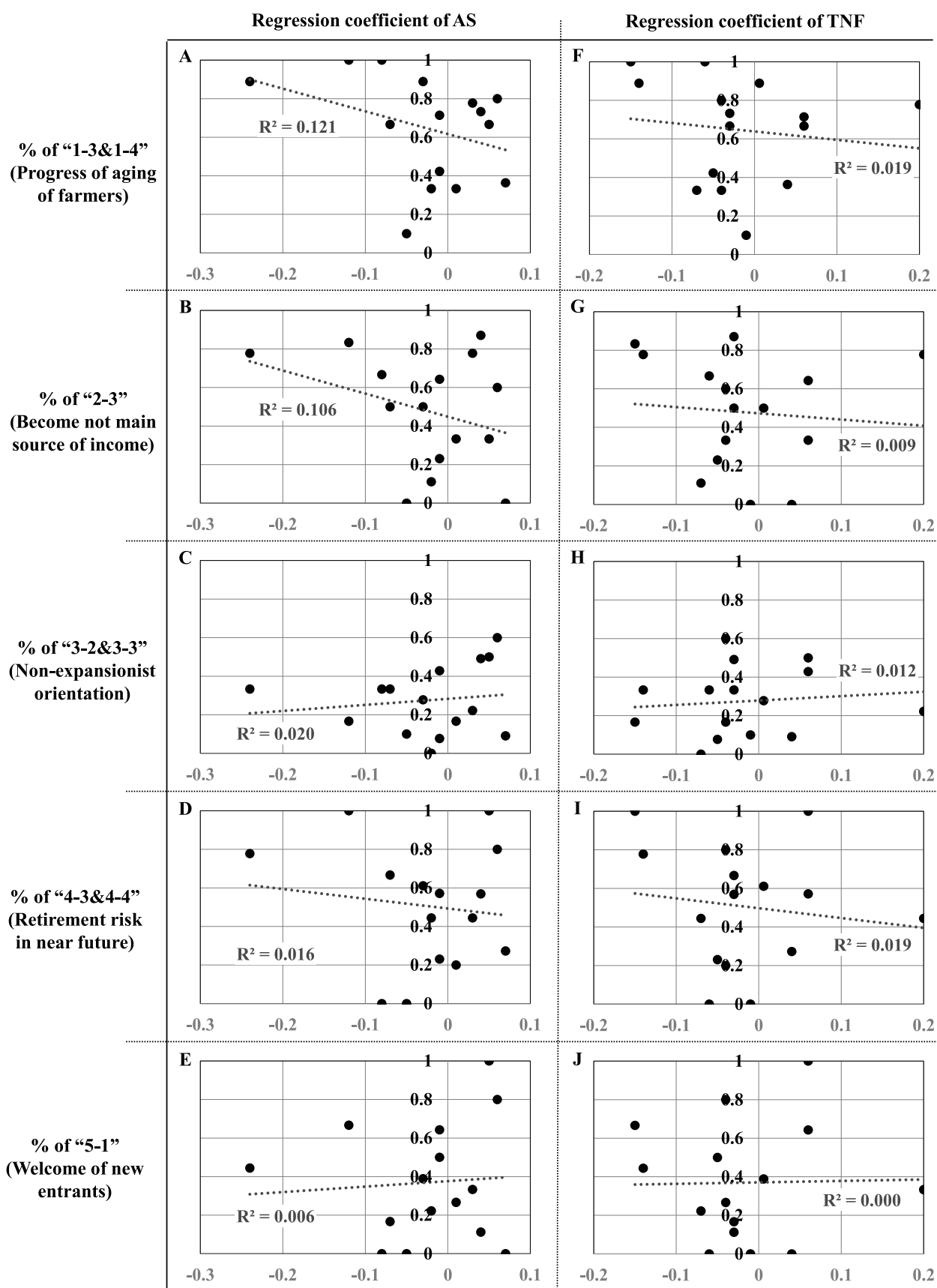


Figure 2 Scatter plots of each index calculated in Table 7 against two regression coefficients  
(Annual sales and Total number of farmers)  
AS: Annual sales (unit: Thousand yen); TNF: Total number of farms



spatial distribution of farmland is required. The severe situation for farmers and organizations cultivating Kaga vegetables cooperatives managing the distribution and sales of agricultural products and the government supporting them. The inheritance of traditional vegetables as a part of Japanese culture has become a common problem in many domestic cultivation regions. There is value in collecting the latest information on marketing and cultivation methods and to continue the pass down the value of traditional vegetables to the next generation.

The following limitations of the study should be considered. The effects of important factors such as sex and number of agricultural workers on each farm which were excluded from the analysis could not be examined. Furthermore, spatial information on whether there is room to acquire new farmland was also excluded from the analysis of this study, but the existence of available land is an important constraint on the acceptance of would-be farmers. In particular, the dependence on agricultural income, i.e., the stability of income from non-agricultural jobs, is assumed to be an important factor for continuing agricultural production.

Several years have passed since the investigation of this paper and the present state of Kaga vegetable production is unknown. There are newspaper reports that new successors have started farming in some items (Hokkoku Shinbun Digital, 2021), so it is essential to update the information.

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## 加賀野菜栽培の市場競争力の持続性

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### 要 旨

日本に数ある伝統野菜は、重要な食料としてだけでなく、地域の風習や文化的景観の基盤としても機能している。今日に至る研究系譜を散見すると、産地の後継者不足など、伝統野菜栽培が抱える問題についてより多くの研究蓄積が求められている。そこで本研究では、生産者の特性に基づいて、石川県金沢市を主産地とする伝統野菜の市場競争力や持続性との関係性を評価するため、加賀野菜を栽培している農家対象のアンケートの結果と、公的機関から収集した栽培・販売データを分析した。そして、栽培・販売データから 15 種類の加賀野菜それぞれの近年の動向を算出し、その数値とアンケート調査データとの統計的関係を導き出した。有効サンプル数は 278 であった。市場競争力は、農家の年齢や世帯の農業収入への依存度と統計的に関係していた。産地の持続性と個々の農家の特徴との間には統計的な関係がみられなかった。

キーワード：加賀野菜／市場競争力／持続性／産地