The impacts of regional differences on farmland consolidation in Japan: The case of Tohoku, Hokuriku and Kinki

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Abstract:

This paper conducted cross-sectional and panel census data analysis from year 2005 and 2010 in addition to factor share analysis to consider the regional differences that impact farmland consolidation in three areas of Japan, namely Tohoku, Hokuriku, and Kinki. First, the characteristics of each area indicated differential influences on the performance of the land consolidation policy. Second, organized farm management bodies such as village-based farming organization approved by the government also had positive impacts on farmland consolidation. The results of factor share analysis indicated three points. First, the effect of the number of Non-farmer with farmland ownerships had highest share in all areas. Second, the impacts of regionally differential characteristics on farmland consolidation had individual characteristic effects of municipality and time effect such as Kinki has high contribution rate of farm-work contract farming management body in panel data than cross-sectional data. Third, the factors that characterized the problem of each area showed higher effect on farmland consolidation. The government needs to consider regional differences when making decisions on farmland consolidation policies. .

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1. Introduction

The issue of farm land consolidation has been playing a critical role to enhance agricultural production in Japan. To solve this issue, the government carried out agricultural policies which induce farmland consolidation to principal farmers who is a

certified farmer and village-based farming organization so that agriculture sector can acquire household income equivalent to other sectors of the economy. According to Ministry of Agriculture, Forestry and Fisheries, certified farmer is the farmer who are authorized by the government for their motivation and ability to keep their farming and to reform management plan based on The Law of Enhancing Agricultural Management Foundation. And village-based farming organization was established by farmers in village for sharing their farm work, farming machines such as harvesters, rice planting machines. and marketing produce. The organization needs to satisfy requirements based on this Law. so that they can receive subsidy from the government. Government now call these two farming management bodies as principal farmers who are sponsored by government for the development of their management practices so that they can solve agricultural issues we are facing in Japan.

The government reformed agriculture subsidy policy in 2007 which make difference in subsidy between farmers and principal farmers. This reform attempt to encourage uncertified farmers exit from the agriculture sector and to smoothly consolidate farmland to principal farmers. By this process, the government plans to reach their final goal considering that only a few large-scale farmers or farming organizations are required to keep income of Japanese agriculture sector equivalent to other sectors. The government approves not only certified famers as a principal farmer but also village-based farming organizations whose primal purpose has been to maintain regional conservation for agriculture including farmland.

Imai (2003) and Kaji (1978) described a theory of farmland consolidation in Japan which is caused by a scale of economies based on the income differences from farm size between small-scale and large-scale farmers. Fujie (2016) analyzed the

efficiency of the village-based farming organization on farmland consolidation. Most of the previous literature on farmland consolidation in Japan basically assume competitive market conditions. On the contrary, Kusakari and Nakagawa (2010) are against those perfect competition and empirically analyzed farmland consolidation based on imperfect market competition.

Other literature on farmland consolidation debated about the effect of scale economies of large farmer by consolidating farmland. According to Fan and Chan-Kang (year) and Kuroda (1989), the optimum scale of farm size was suggested differently using total factor productive (TFP) which was ratio of total outputs and total inputs. In Fan and Chan-Kang (year) research, they suggested the characteristics of Asian farm scale structure, and the optimum scale of efficient productive scale farm was small farmer since they have high TFP among all farmers. However, since many country experienced green revolution, new technology such as machines, fertilize among others. are adopted by large farmers who have strong advantage of credit. Consequently, small farmers needed protection from government to supply high efficiency in production. On the other hand, Kuroda (year) suggested that from scale effect and technological change effect, the optimum scale which had high growth rate of TFP was large-scale farmer. Although technological change effect decreased in all class, those effects on large-scale farmers remained. However, small-scale farmer had greater average cost shifting upward-left than large-scale had. Hayami and Kawagoe (1989) estimated how mechanization affected economies of scale and polarization of farmers in Japan. The research indicated that there were two stages of employing mechanization in Japan and each stage had effect of economies of scale in all classes, but later stage had more and differential effect on l each class which induced disequilibrium on economies of scale.

And increased opportunity of off-farm work encouraged remaining farmers to expand their farmland and therefore farmland consolidation to large farmers was induced. However, this encouragement was only worked if farming wage rate was equal to or even higher than off-farming wage rate. Roberts and Key (2008) estimated relationship between agriculture payment and farmland consolidation from U.S. case. They revealed that there was great connection between agriculture payment and farmland consolidation by increasing farmland concentration rate of large-scale farmers using GAM regression method and suggested it was quite low concentration rate if there were no agriculture subsidy policy.

These previous researches use economic models to estimate the efficiency or the impacts of some factors on farmland consolidation. However, the factors of farmland consolidation are also influenced by regional farming condition. Ando and others (2012) analyzed regional data of the Census of Agriculture and pointed out the characteristics of each region and regional issues associated with their characteristics. Unfortunately, there are a few statistical researches considering the effect of regional farming condition on the process of farmland consolidation.

This paper, thus assuming there are regional characteristic differences on farming condition, aims to analyze the effect of regionally different characteristics on the farmland consolidation using cross-section and panel data of Tohoku, Hokuriku and Kinki.

This paper is organized as follows. Section 2 elaborates the farmland consolidation theories and the intervention factors of farmland consolidation which were discussed in the previous literature and then we explain regional conditions of selected areas and underlying assumptions. Section 3 indicates the empirical model for

analyzing the effect of each regional characteristic on the farmland consolidation and describe the data set. Section 4 explains results and the factor share of each variable. Section 5 summarizes the results and provides two policy recommendations and future agenda.

2. The theory of farmland consolidation under regional characteristics

2.1 Review of literature

The theory farmland consolidation system in Japan are heavily based on the reform of Agricultural Land Law in 1975 which allowed farmers to lease their farmland easier and safer than before. Important previous literature constituting farmland consolidation theory in Japan include the one by Kaji (1973) and Imamura (2003). In their research, farmland consolidation will follow the process below. First, famers of high income level increase their income by enhancing their farm productivity and surplus from the income increase provides the famers with incentives to expand their farmland. On the other hand, farmers of low income level have low opportunity cost of working on other sectors because of increased opportunity of another sectors' employment. Second, when a gap of each income level is enough to take an action, high income famers have enough surplus to pay farmland leasing cost which is equal to low farmers' income from farming and low-income farmers lease out their farmland to high income farmers and take opportunity of working out to other sectors. And then from these processes, farmland consolidation will proceed.

Equation (1) indicates the farmer's revenue maximization model including leasing out land and off-farm work designed by Deininger and Jin (2005) which make

similar explanation on farmland consolidation processes of Kaji and Imamura.

$$\max_{l^a,A} p\alpha f(l^a, A_i) + wl^0 + r(\bar{A} - A)$$

$$\text{s.t L} = l^a + l^0, \tag{1}$$

where *p*, *w*, *r* are farm output price, off-farming wage and farm rent on unit area, respectably. α is an attribute of an individual farmer which is interpreted as famer's ability of farm productivity. L, l^a, l^0 are total labor force, farming labor force, and off-farm labor force, respectably. $\bar{A}$, A are initial endowment area of farmland and area under cultivation, respectably. Therefore $\bar{A} - A > 0$ means lease out, and $\bar{A} - \text{A} < 0$ means leas in. First order differentiations for optimal solution of equation (1) are shown below.

$$p\alpha f_{l^a}(l^a, A_i) = w \tag{2}$$

$$p\alpha f_A(l^a, A_i) = r \tag{3}$$

In equation (2) when marginal revenue is equal to off-farm payment, the optimal level of labor force can be obtained. In equation (3), when marginal revenue from farmland is equal to farm rent on unit area, the optimal cultivation area can be obtained. Yet, total differential of the first order differentiations above by α and w are shown below.

$$\frac{\partial A}{\partial \alpha} = \frac{f_{Al^a} f_{l^a} - f_A f_{l^a l^a}}{\alpha(f_{AA} f_{l^a l^a} - f_{Al^a} f_{l^a A})} = \frac{f_{Al^a} f_{l^a} - f_A f_{l^a l^a}}{\alpha\{f_{AA} f_{l^a l^a} - (f_{Al^a})^2\}} > 0 \tag{4}$$

$$\frac{\partial A}{\partial w} = \frac{f_{Al^a}}{p\alpha\{(f_{Al^a})^2 - f_{AA} f_{l^a l^a}\}} < 0 \tag{5}$$

In equation (4), farm productivity of a famer induces the opportunity of cultivation land to expand. In equation (5), when off-farm payment increases the opportunity of off-farm

work and low-income farmers will decide to lease out by decreasing their cultivated land. These Deininger and Jin (2005) equations above are significantly essential for verifying the assumption of Kaji and Imamura's farmland consolidation theory. For this reason, these processes imply that the increase of farmland leasing associated with labor force movement from farming village which is induced by the difference of farm productivity among farmers and the transition of off-farm condition by high economic growth.

2.2 The constraining factors of farmland consolidation

Some previous researches using this explanation and theory expected there are enough farmland to consolidate quickly to highly productive farmers by leasing. However, actual farmland consolidation rate has been much slower than they expected (Kusakari 2011). As a reason for that, the theory is based on the assumption of competitive market and the real market has constraining factors that prevent contraction of farmland leasing. Some constraining factors are to be explained below.

First, there are characteristics of farmland itself. In the first place, farmland is immovable property and has an advantage of consolidation, which means it is much more efficient to consolidate them than to scatter them. Therefore, potential demands are constrained and efficient transaction through price mechanism are limited due to localization of the land market (Shogenji 1998).

Second, there is an issue concerned with legal claim and investment of farmland. In the leasing farmland consolidation case, it is essential to make confirmation of ownership and loan use right, but it is also essential to make balance between borrower's right and lender's right. Although leasing system of agricultural land law is reformed a lot, it is still unbalanced between their rights and yet, there remains an issue

of useful expenses by investment in land improvement when farmland leasing is withdrawn (Nakajima 2008).

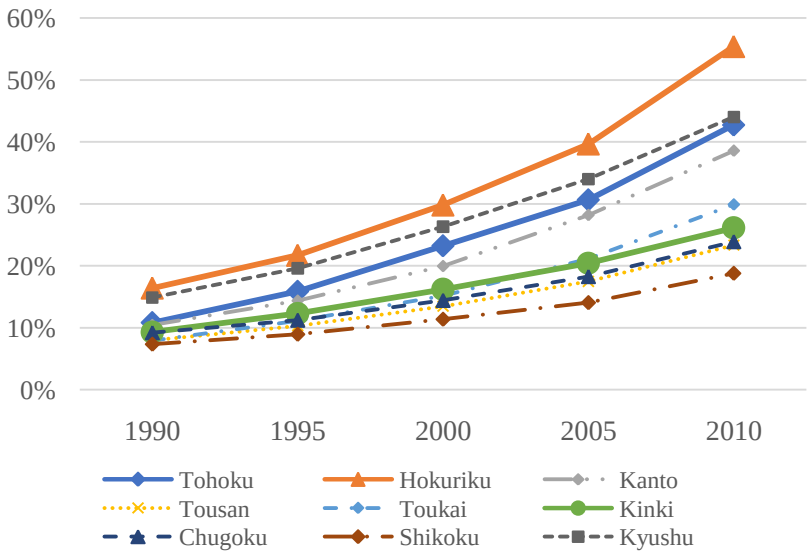
Third, there are transaction costs. Due to asymmetry of information between borrower and lender, farmland leasing costs become relatively higher. Those transaction costs include searching cost, costs for surveying farmland condition, contract arrangement cost, among others (Kusakari and Nakagawa 2011, Kusakari 1998, Takahashi 2010).

Forth, there is an issue of scattered small-size farmlands with many owners. For this issue, even if farmlands are consolidated, it is hard to cultivate farmland efficiently and therefor lender losses their incentive and benefit from expanding their farmland.

Fifth, there is an issue that farmland owner has an opportunity to divert their farmland to non-farm land. The agricultural law prohibits farmland diversion, though, this restriction often be distorted by regional selfishness. Once farmland is to be allowed diversion, farmers gain huge capital. For this reason, farmland owners, who are not a farmer and acquired the land through inheritance and small-scale farmers with side job, intend to keep their farmlands or to cultivate them instead of leasing out(Godo 1996, Hayami and Godo 2002) .

These factors mentioned above hinder the progress of farmland consolidation. However, the impact of influence and the correlation among these constraining factors differ among each region because of their characteristics and farming conditions and structures.

Figure1 shows farmland consolidation rate of each region in Japan. Form this figure it is obvious that progress of farmland consolidation rate is significantly different among each region.

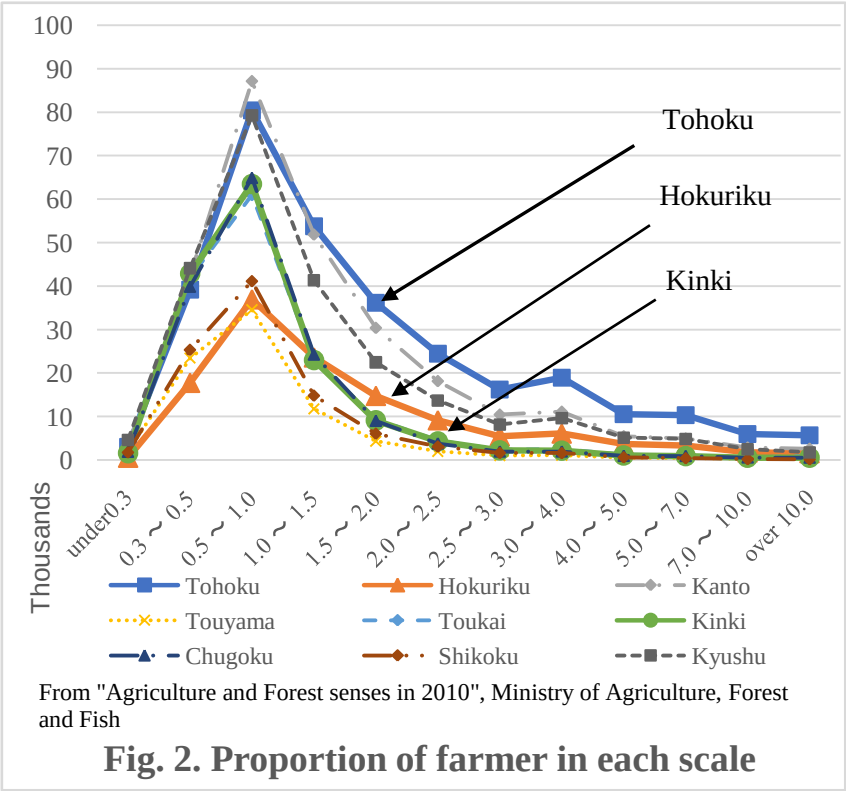


From "agricultural and forestry census accumulation statistics", Ministary of Agriculture, Forest and Fish

Fig. 1. Ratio of farmland consolidation

2.3 The characteristics of targeted region

Unlike the theory of farmland consolidation, the reason why the farmland consolidation rate has regional difference is because real farmland markets are under imperfect competition. We can understand this evidence from inequivalences between demand and supply. This is because economy of scale and cost reduction depends on operation efficiency and market efficiency depended on cultivation condition. While regions which have a large area of flat land accelerated farmland consolidation to larger farmers , regions where most of farmlands are located in hilly rural area have difficulty in consolidating farmland to large scale farmers. Figure 2 shows rate of farmers by farm size in each area. From this figure, we can recognize that large scale farmers with over 5ha mostly exist in Tohoku whose farmlands are practically plain field and on the contrary, only a few exist in Kinki whose farmlands are largely in hilly rural area.

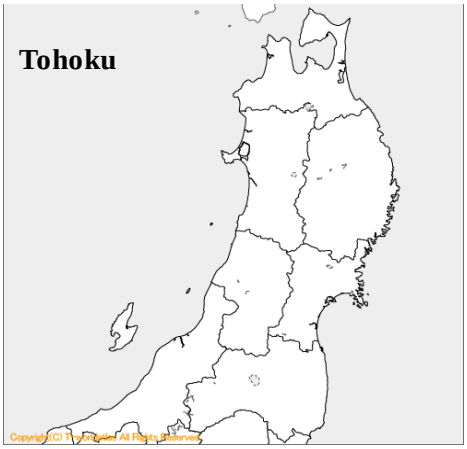


From "Agriculture and Forest senses in 2010", Ministry of Agriculture, Forest and Fish

Fig. 2. Proportion of farmer in each scale

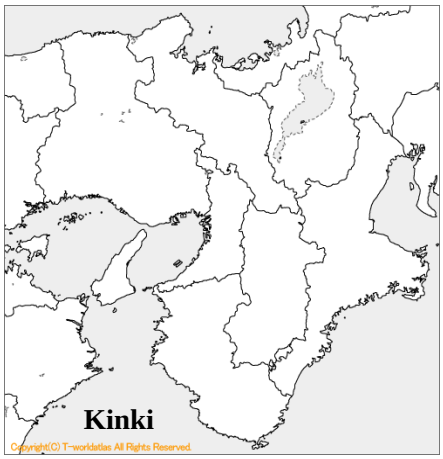
Because each region has their own different farm structure, it is necessary to verify the impact of regional difference on farmland consolidation rate, for considering a solution to farmland consolidation issue.

To analyze these impacts, this paper focuses on three regions which are Tohoku, Hokuriku and Kinki. The reason we chose these three regions are, firstly, farmer rates by size in these three regions are significantly different as shown in Figure 2. Secondly, farming condition between Tohoku and Kinki are quite different according to previous research. And finally, Hokuriku is geographically located between these two regions and has unique characteristics in farming structure. Figure3 shows maps of each targeted regions.



Prefecture of each region

Tohoku	Hokuriku	Kinki
Aomori	Nigata	Kyoto
Iwate	Toyama	Shiga
Akita	Ishikawa	Osaka
Yamagata	Fukui	Hyogo
Miyagi		Nara
Fukushima		Wakayama



from World map, http://www.sekaichizu.jp/

Fig. 3. Maps of each region

2.3.1 The characteristics of Tohoku

Tohoku owns major paddy area with high quality and high yield although the opportunity of off-farm work is hardly found, and farmer class polarization is stagnated. Hence, stagnation of mid-scale farmers ceases the progress of farmland consolidation to large scale farmers. As the opportunity for off-farm work is unstable, mid-scale farmer can't shift their income source to off-farm work and therefore they need to stick to their farmland and farming for gaining enough income to live. Thereby, farmland consolidation to large-scale farmers is blocked and leasing farmlands are not fully

arranged but only partly arranged. This stagnation problem is shown specially in farm-work contract farming, which gives mid-scale farmer advantage of their farming work force and which stagnate mid-scale farmer from leaving farming sector (Nakamura and Watabe 2012)

2.3.2 The characteristics of Hokuriku

Hokuriku, like Tohoku, has major paddy area with high quality and high yield. Unlike Tohoku, Hokuriku has plenty of opportunities of off-farm work. Consequently, leasing farmland consolidation to a few principal farmers is shaped up. However principal farmers are recently in short supply and as the result, the farmland market become borrower market. Another Hokuriku's major characteristic is that farming condition and structure are different among prefectures[1]. More than a half of certified farmers in Hokuriku are distributed in Nigata prefecture which is privileged with large plain field and others are distributed in other prefectures' plain field. On the other hand, village-based farming organizations are mostly located in Toyama and Fukui and few are in other prefectures. Ishikawa's principal farmer structure is based on certified farmers for leading part, and also based on village-based farming organizations for leading part in hilly rural area (Koshiba 2012, Onaka 2012, Kitagawa 2011, Tabayashi 2007)

2.3.3 The characteristics of Kinki

Almost all plain lands in Kinki are urbanized and therefore most of all farmland are distributed in hilly rural area. Yet farming condition around cities has unique condition such that farmers cultivate traditional and region-specific farm products. Most of

[1] Tohoku, Kinki and Hokuriku are larger administrative are and each prefecture includes Aomori, 6 prefectures as Akita, Miyagi, Yamagata, Fukushima and Iwate, 4 prefectures as Nigata, Toyama, Ishikawa and Fukui, 6 prefectures as Shiga, Kyoto, Osaka, Hyogo, Wakayama and Nara, respectively.

farmers are small-scale farmers with side job cultivating paddy field and a shortage of mid-scale farmers is a serious problem. Moreover, famers aging became serious problem to maintain farmer village. Consequently, Kinki is borrower market due to a shortage of borrower.

Village-based farming organization was initially organized for farming village which has a shortage of principal farmers. However, in case of Kinki where most farmlands are located in disadvantaged hilly rural side, it is hard for most of all farming village located in hilly rural area to organize village-based farming since there aren't enough farmlands or farmers to organize it. Therefore, village-based farming organizations in Kinki are mostly located in plain field. Instead of using village-based farming organization to consolidate farmland, due to poor land condition or small number of farmer villages, they tend to depend on farm-work contract farmer organizations to consolidate their farmland (Kawasaki 2012 and Hashizume 2010).

2.4 hypotheses

In the theory of farmland consolidation, the increase of farmland supply is basically induced by the following process. Income expectation of farming for farmer is decreased and meanwhile income expectation of off-farm working is increased. As a result, rent price of farmland is decreased, farmland supply is increased and then for a large-scale farmer their incentive of expanding farm land is motivated by decreasing rent price. Consequently, farmland demands are increased, and farmland consolidation is accelerated. However, this theory and process are based on the assumption of competitive market and this assumption doesn't fit real farmland market. In fact, the increase of farmland consolidation rate was much slower than the theory suggested. This was mainly because of influence of constraining factors on farmland consolidation

and many previous research clarify these influences. Even these influences are well recognized, , these influences among the factors of farmland consolidation is expected to differ among region due to regional characteristics.

To reveal this impact, this paper analyzes how the theoretical factors of farmland consolidation influence on leasing land area. The theoretical factors will be separated to demand side, supply side and other outside effects such as leasing mediation organization.

3. Empirical model and data set

3.1 Empirical model

In order to analyze the factor of farmland consolidation, Ito et al. (2016) adopted simultaneous decision model to determine how the factors of three sides as demand side, supply side, and other outside effect on leasing area rate and abandoned area rate using prefectural panel data. Referring to Ito et al. (2016), this paper adopts multiple regression model using cross-section and panel data to determine the effect of regional characteristic differences through the factor of three sides and leasing area rate. Due to a limited data availability, this paper uses two-time periods in 2005 and 2010.

3.1.1 Empirical model for panel data analysis

Equation (6) indicates empirical model for panel data analysis.

$$\mathrm{R_{it}} = \beta_0 + \beta_1 R_{it}^{LFP} + \beta_2 R_{it}^{company} + \beta_3 R_{it}^{NCNHFP} + \beta_4 R_{it}^{Tcomission} + \beta_5 R_{it}^{SmFP} + \beta_6 R_{it}^{NFLL} + \beta_7 R_{it}^{SubFH\,2} + \beta_8 R_{it}^{FHUC} + \beta_9 R_{it}^{padyfield} + \beta_{10} R_{it}^{woodpart} + \varepsilon, \quad (6)$$

where i and t are municipality and year in 2005 and 2010, respectively. R is farmland consolidation rate estimated from leasing out area in total cultivated area and total

abandoned area. R^{LFP} is large size farming management body rate which is over 5ha farming management body in total farming management body. R^{SmFP} is small-scale farming management body rate which is under 0.5ha farm management body in total farm management body. $R^{company}$ and R^{NCNHFP} are corporation farming organization body rate and incorporation farming organization body rate excluding individual famers, in total farming management body. $R^{Tcomission}$ and R^{FHUC} are total farm-work contract farming management body rate in total farming management body and rate of farmer employing farm-work contract in total farmers. R^{NFLL} is [2]non-farmer with farmland ownership rate in total farmers with non-famer who own farmland. $R^{SubFH\,2}$ is the rate of [3]category II famers with side job in total farmer. $R^{padyfield}$ is paddy field rate in total cultivated area. $R^{woodpart}$ is forest area rate in total hilly rural area. β_0 to β_{10} are parameters of coefficient and ε is an error term.

β_1 to β_4 is coefficient for verifying factor effect on demand sides. Farmland consolidation is mainly concentrated on large-scale farming management body. Corporate farming organization and non-corporate farming organization include village-based farming organizations which are designated to principal farmers in new policy. In Fujie (2014), village-based farming corporations accelerate farmland consolidation, indeed, but being corporate farming is not necessary for acceleration. Referring to this result, we separate village-based farming in corporate and non-corporate types. Farm-work contract farming usually means a transfer to full

[2] People who inherit farmland from father or grandfather who farm for his life. In addition, in the category of non-farmer in senses, farmer who has less than 0.5ha is counted. Therefore, this number is not substantial number of non-farmer.

[3] There are two categories of famer with side job in agriculture and forest senses. Category Ⅰ farmer with side job is categorized farmers who have more agriculture income than off-farm income. Category Ⅱ farmer with side job is defined as famers whose off-farm income are more than agriculture income.

managing contract farming. Consequently, contract farming will be demand side.

β_5 to β_8 is coefficient for verifying factor effect on supply sides. Small-scale faming management bodies and non-farmers with farmland ownership are main farmland supplier. Category II famers with side job have a potential to leave agricultural sector. In this reason, Category II famers with side job are considered as a potential farmland supplier. Famers employing farm-work contract farming adopt contract farming for main farm-work source and eventually give their farmland management to contract farmer.

3.1.2 Empirical model for cross-section analysis

Other significant variable which was not mentioned above and regarded as factors of farmland consolidation is certified farmers who are designated as a principal famer. Unfortunately, we could obtain only 2015-year version of these municipality -level data collected by local agriculture committee. Therefore, this paper adopts cross-section data analysis model as shown in equation (7).

$$\begin{aligned} \mathrm{R_i} = {} & \beta_0 + \beta_1 R_i^{LFP} + \beta_2 R_i^{company} + \beta_3 R_i^{NCNHFP} + \beta_4 R_i^{Tcomission} + \beta_5 R_i^{trusted} \\ & + \beta_6 R_i^{SmFP} + \beta_7 R_i^{NFLL} + \beta_8 R_i^{SubFH\,2} + \beta_9 R_i^{FHUC} \\ & + \beta_{10} R_i^{padyfield} + \beta_{11} R_i^{woodpart} + \beta_{12} HR + \varepsilon \end{aligned} \qquad (7)$$

Most of all predictor variable and explanatory variables are same as equation (6). $R_i^{trusted}$ is the variable for certified farmer rate in total famers. As we mentioned above, certified farmers are designated as a principal farmer and in this reason, its coefficient is demand side.

3.2 Data

In panel data, this paper adopts two empirical models, i.e., fix-effect model and

Tobit model. In cross-section model, this paper adopts OLS and Tobit model.

The data we used are municipality level data of 16 prefectures in Tohoku, Hokuriku and Kinki from Japanese Agriculture and Forest Census in 2005 and 2010. The reason we adopt only two periods is because the system of survey category was changed from 2005 census. New categories added in 2005 include village-based farming organizations. We use activity report data of municipalities agriculture committee as a source of certified farmer data. This data is published by national agriculture committee and activity report of each municipality agriculture committee in annual year. First published year was from 2012. The contents of the report are what municipality agriculture committee did in this year, farming structure figures in service area such as the number of farmers and cultivated area, the number of committee members and their budget, farmland consolidation rate and how advanced it in their service area, among others. The number of farming structure are mostly adopted from the latest Agriculture and Forest Census. the numbers in the report of 2015 was from agriculture and forest census of 2010.

Table 1 and Table 2 show descriptive statistics of each target region for both panel and cross-section data.

Table 1. Descriptive Statistics of Panel Data

Region		Tohoku			Hokuriku			Kinki		
Variable		Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
R	overall	N=388	0.2176	0.11775	N=140	0.35052	0.12593	N=344	0.16103	0.13894
	between	n=194		0.10136	n=70		0.10875	n=172		0.13454
	within	T=2		0.06015	T=2		0.06417	T=2		0.03546
R_LFP	overall	N=388	0.0729	0.09345	N=140	0.05566	0.03796	N=344	0.01030	0.02646
	between	n=194		0.09257	n=70		0.03477	n=172		0.02584
	within	T=2		0.01361	T=2		0.01551	T=2		0.00587
R_company	overall	N=388	0.0095	0.00825	N=140	0.01349	0.00965	N=344	0.00780	0.01574
	between	n=194		0.00771	n=70		0.00784	n=172		0.01211
	within	T=2		0.00296	T=2		0.00568	T=2		0.01007
R_NCNHFP	overall	N=388	0.0103	0.01380	N=140	0.01179	0.00990	N=344	0.00685	0.02107
	between	n=194		0.01271	n=70		0.00855	n=172		0.01570
	within	T=2		0.00541	T=2		0.00504	T=2		0.01408
R_TCFP	overall	N=388	0.0932	0.04515	N=140	0.10034	0.03033	N=344	0.04474	0.03582
	between	n=194		0.04243	n=70		0.02295	n=172		0.03346
	within	T=2		0.01557	T=2		0.01993	T=2		0.01290
R_SMFP	overall	N=388	0.1815	0.12082	N=140	0.1795	0.09276	N=344	0.40097	0.16535
	between	n=194		0.11814	n=70		0.09182	n=172		0.15605
	within	T=2		0.02597	T=2		0.01530	T=2		0.05534
R_subFH2	overall	N=388	0.6391	0.14071	N=140	0.7486	0.08591	N=344	0.64830	0.16717
	between	n=194		0.13683	n=70		0.08197	n=172		0.15865
	within	T=2		0.03355	T=2		0.02666	T=2		0.05337
R_NFHLL	overall	N=388	0.3001	0.12723	N=140	0.41106	0.12307	N=344	0.30289	0.11796
	between	n=194		0.12032	n=70		0.10866	n=172		0.11556
	within	T=2		0.04181	T=2		0.05852	T=2		0.02447
R_FHUC	overall	N=388	0.4727	0.20798	N=140	0.5615	0.18022	N=344	0.25343	0.20098
	between	n=194		0.18978	n=70		0.14346	n=172		0.19540
	within	T=2		0.08564	T=2		0.10975	T=2		0.04817
R_padyfield	overall	N=388	0.6751	0.24799	N=140	0.90321	0.11495	N=344	0.74903	0.25873
	between	n=194		0.24762	n=70		0.11496	n=172		0.25692
	within	T=2		0.01849	T=2		0.00965	T=2		0.03358
R_woodpart	overall	N=388	0.6105	0.22918	N=140	0.52752	0.25287	N=344	0.44265	0.30419
	between	n=194		0.22590	n=70		0.24740	n=172		0.30262
	within	T=2		0.04026	T=2		0.05639	T=2		0.03488

Table 2. Descriptive Statistics of Cross-Sectional Data

Region	Tohoku			Hokuriku			Kinki		
Variable	obs	mean	Std. Dev.	obs	mean	Std. Dev.	obs	mean	Std. Dev.
R	227	0.25204	0.12569	84	0.39741	0.11951	195	0.18355	0.15347
R_LFP	227	0.03136	0.06977	84	0.02718	0.01744	195	0.00418	0.00901
R_company	227	0.01061	0.00908	84	0.01704	0.01033	195	0.00887	0.01941
R_NCNHFP	227	0.01192	0.01577	84	0.01371	0.0111	195	0.00723	0.01361
R_TCFP	227	0.10467	0.04651	84	0.11604	0.02499	195	0.05542	0.03916
R_trusted	227	0.25131	0.13686	84	0.52508	1.21631	195	0.12076	0.1168
R_SMFP	227	0.03241	0.04116	84	0.01909	0.01749	195	0.04005	0.08088
R_NFHLL	227	0.33492	0.12637	84	0.45519	0.11458	195	0.3215	0.12143
R_subFH2	227	0.62685	0.12515	84	0.73660	0.0895	195	0.64236	0.1613
R_FHUC	227	0.33531	0.15354	84	0.36101	0.11714	195	0.15635	0.13511
HR	227	0.43172	0.49641	84	0.39286	0.49132	195	0.31282	0.46484
R_padyfield	227	0.68774	0.24281	84	0.90562	0.10885	195	0.74643	0.26412
R_woodpart	227	0.60836	0.23174	84	0.53394	0.2588	195	0.47426	0.30495

4. Results of factors affecting land consolidation

4.1 Results of panel data analysis

Table 3 shows the results of panel data analysis of each region. Fixed-effect model is indicated on the left and Tobit on the right. The variables not shown in the table is the variables which did not show significant results or had strong correlation with other

critical variables.

We'll check the results of demand side variables first. As for Hokuriku and Kinki regions, large-size farming organization rate has significantly positive effect. From their regional characteristics, Tohoku has a problem of mid-scale farmer stagnation, which suppresses farmland supply and consolidation to large-scale farmer and prevent mid-scale famers from shifting higher or lower size classes. On the contrary, Kinki and Hokuriku have ample farmland supply, however they have insufficient demanders such as principal farmers.

Corporate farming organization rate and non-corporate farming organization rate had different results among two models. For Tobit, all regions have significantly positive effects on these two variables, except for non-corporate farming organization rate in Kinki (this is because correlation of these two variables in Kinki were strongly positive). For fixed-effect while only Tohoku had significant results in corporate farming organization rate, only Kinki had significant result of non-corporate farming organization rate, and Hokuriku had no significant result. This difference comes from the different models for analysis as you can see, this panel data has two time-periods for the same municipality data. This means that two-period municipality data have same individual characteristics. As a result, fixed-effect dropped these characteristics, although Tobit didn't. However, according to descriptive statistics in Table x, Tobit contains more data information than fixed-effect. Therefore, it is safe to say that we should check both two models to analyze regionally differential effects on this panel data. Based on the differences in two models, corporate farming organization in Kinki are more willing to consolidate farmland however despite of their individual abilities, non-corporate farming organizations effect more on farmland consolidation.

In Tohoku, the first village-based farming organization was organized after government designated a principal farmer and the policy required village-based farming to become corporation farming in five years in order to receive subsidy. With this reason, both corporate and non-corporate farming organizations had positive effects on farmland consolidation, however, because of shortage of time for most of less motivated organizations to shift from non-corporate to corporate, only corporate farming organizations had positive effect in fixed-effect model. Hokuriku was probably influenced much more from municipality-level characteristics than other regions. The details of this hypothesis are shown in cross-section results. Farm-work contract farming organization rate are significantly positive in all regions and this result conforms with the theory.

Next, we'll check supply side results. Non-farmer with farmland ownership rate had significantly positive in all regions and this follows the theory's conjecture. In Tohoku small-scale farming management body is significantly positive in both models, however in Kinki significantly negative in Tobit. In Hokuriku Category II farmers with side jobs are significantly positive. This result contains a lot of information about regional characteristic effects on farmland consolidation. From characteristics in Tohoku, stagnation of mid-scale farmers constrains farmland supply, which means the increase in farmland supply induces mid-scale farmers to move to large-scale farmers, then the increase in number of large-scale famers induces large demand of farmland resulting in the increase in leasing price of land. And finally, other mid-scale famers can decide to lease out their farmland and shift to small-scale farmers. From this process, stagnation would be alleviated. In Kinki, on the other hand, the absence of principal farmers and large-scale farmers causes serious problem to most of rural farming villages

where most of farmers in Kinki are distributed. In other words, there are numerous small-scale farmers and abundant farmland left to become abandoned area, which implies that there are none or negative effect on farmland consolidation, if medium-scale farmers change their farm scale to small-scale class. In Hokuriku, most of their small-scale and medium-scale famers are the Category II farmers with side jobs because the opportunity of off-farm job is plenty. By this reason, this result is theoretically correct. Farmers employing farm-work contract farming rate in Kinki is significantly positive in Tobit and in Tohoku, significantly negative. As for Kinki, farmers employing farm-work contract farming might have induced farmland consolidation positively, however, its effect mostly depended on conditions of individual municipality. As for Tohoku, the regional characteristics suggest that contract farming does not induce farmland consolidation. And further farm-work contract farming induce opportunity for middle-scale farmer to stay agricultural sector and not to lease out their farmland. By this reason, when there are more farmers who use contract farming, there would be less advancement for farmland consolidation.

Table 3. Estimation of Panel data

	Tobit			Fixed-Effect		
	Tohoku	Hokuriku	Kinki	Tohoku	Hokuriku	Kinki
R_LFP		0.438**	1.737**		1.038***	2.510**
		(1.97)	(9.03)		(3.24)	(5.18)
R_company	2.256**	2.405***	0.453**			0.671**
	(3.70)	(3.13)	(2.33)			(2.78)
R_NCNHFP	2.683**	2.145***		1.061**		
	(6.88)	(3.59)		(1.98)		
R_TCFP	0.957**	0.347**	1.070**	0.374**	0.295*	0.918**
	(7.41)	(2.16)	(7.87)	(2.20)	(1.73)	(5.28)
R_SMFP	0.192**		-	0.623**		
	(3.50)		(-5.53)	(6.81)		
R_NFHLL		0.172**			0.156*	
		(2.39)			(1.70)	
R_subFH2	0.344**	0.521***	0.256**	0.806**	0.724***	0.193*
	(6.72)	(7.08)	(5.96)	(10.27)	(8.54)	(1.78)
R_FHUC	-		0.149**	-		
	(-2.98)		(5.42)	(-2.87)		
R_padyfield		0.329***	0.125**		0.506*	
		(5.34)	(5.88)		(1.97)	
R_woodpart	0.0508*			0.107**		
	(1.90)			(2.18)		
Constant	-0.055*	-	-	-	-0.609**	0.030
	(-1.86)	(-5.78)	(-2.14)	(-4.96)	(-2.52)	(1.06)
Observations	388	140	344	388	140	344
R-squared				0.80	0.91	0.44
Chi-squared	511.2	753.6	702.2			
Number of	194	70	172	194	70	172

Notes. Stars indicate *** p<0.01 ** p<0.05 *p<0.1. T-statistics are in ph parentheses

From the results of Tohoku and Kinki, the factors of farmland consolidation are strongly affected by regional differences in their regional characteristics. If there is no impact of regional differences on farmland consolidation factors, all these variables must be significantly positive. The result of small-scale farmers rate in Tohoku and Kinki and of farmers employing farm-work contract farming in Tohoku are obvious case to reveal regional characteristics that are affecting farmland consolidation factors. Therefore, the regional characteristics certainly effect factors of farmland consolidation.

4.2 Results of cross-section data analysis

Table 4 shows the results of cross-section analysis. The OLS is shown on the left

and Tobit on the right. Results from two methods are fairly same, which prove there are almost no differential effects from the method of analysis.

By comparing cross-section data results with panel data results, Tohoku had almost no difference, however only farmers employing farm-work contract farming rate was different. This difference probably came from the effect of time. When farmers contract farm-work to contract farmers or faming organizations, they lease out their farmland temporarily, and the contract term of leasing might be very short for example x years. Therefore, famers employing farm-work contracting farming rate has a positive effect on land consolidation in cross-section data analysis, but negative effect in panel data analysis. In Hokuriku large-scale farming management body rate is significant in panel data but insignificant in cross-section data, and corporate farming organization and non-corporate farming organization rates, on the contrary are insignificant in panel data but significant in cross-section data. This reason is probably same as the difference in results between Tobit and fixed-effect. Village-based farming organization had positive effect on farmland consolidation but it effects are mainly considered as characteristics of individual municipality. On the other hand, impacts of large-scale farmer rate have been produced annually. For this reason, cross-section data had insignificant effects on large-scale farmer and fixed-effect model of panel data had insignificant effect on corporate and non-corporate farming organizations. Kinki, unlike other regions, showed almost all variables significant in cross-section data, which didn't indicate that the results of cross-section data in Kinki followed theoretical conjecture since supply side variable has negative effect. To settle these difference between two results from panel and cross-section data sets, there are probably two possible explanations to interpret this. Firstly, the effect of each demand and supply side

variables is converged to some variable effect. This can be seen from the fact that Category II farmers with side jobs rate, who are almost equal to small-scale farmers in Kinki, has significant effect in cross-section data but not in panel data. Secondly, variables that were significant in cross-section data but insignificant in panel-data Tobit were affected by individual characteristics of municipality but more strongly by time effect. In other word, these variables have impacts on farmland consolidation but depend on individual characteristics of municipality. However, these variables turn to have no impact on land consolidation when the time passed.

Next, we check the results of certified farmer rate. In Tohoku and Kinki, certified famer rate was significantly positive. These results follow both the theory and political objection. However, In Tohoku, certified farmer rate showed 1% significance level in Tohoku, on the other hand 5% significance level in Kinki. This result implies that even though the stagnation of medium-scale farmer class exists in both areas, certified farmer consolidated farmland in Tohoku. In addition, certified farmers in Kinki effected farmland consolidation rate as well as large farmer, although the impact of certified farmer in both region can be compared. We will estimate this comparison later. In Hokuriku, on the contrary, certified farmer rate didn't have a significant effect of certified famer rate on farmland consolidation. Therefore, we can't argue true impact of certified farmer in Tohoku from this result. However, if we try to debate about what cause the result of certified farmer in Tohoku. This result might be affected by polarized distribution of certified farmers in Hokuriku. According to the regional characteristics of Hokuriku mentioned in section 2, certified farmers in Hokuriku are mainly distributed in Niigata Prefecture, which implies that the impact of certified farmers in Hokuriku are limited only in Niigata and for other prefectures farmlands are consolidated to

village-based farming organizations. However, large-scale farming management body rate in panel data analysis showed significantly positive and most large-scale farmers are registered as a certified farmer. Including this fact, although the impact of certified farmer rate didn't have significant effects in cross-section data analysis, it might have had significantly positive effect in panel data analysis. However, since we only had limited period data for certified farmer rate, we couldn't assess this impact in panel analysis.

From the results of cross-section data analysis, we reach two conclusions. Firstly, some factors are influenced not only by regional differences but also by local municipality level characteristics and time effect. Secondly, certified farmer had positive impacts on farmland consolidation in cross section analysis as other previous literature concluded (citation). However, we couldn't empirically test this second theory in longer time periods since Hokuriku didn't have significant effect and our data for certified farmer was limited.

The results from panel data and cross-section data indicated factors of farmland consolidation are affected by regional differences which were synchronized with their regional farming condition and political attempts of consolidating farmland to principal farmers, although its achievement for improving farmland consolidation was slightly different. To verify these impacts in detail, in the next section, we analyze the factor share of significant variables from cross-section and panel data analysis.

Table 4. Estimation of Cross-sectional data

	Tobit			OLS		
	Tohoku	Hokuriku	Kinki	Tohoku	Hokuriku	Kinki
R_LFP			8.343**			8.241**
			(14.18)			(13.92)
R_company		4.112**	1.108**		4.112**	1.075**
		(5.30)	(5.33)		(5.11)	(5.14)
R_NCNHFP	0.917**	2.850**	1.550**	0.911**	2.850**	1.599**
	(2.12)	(4.36)	(3.75)	(2.08)	(4.20)	(3.98)
R_TCFP	1.078**		0.426**	1.067**		0.402**
	(7.76)		(2.94)	(7.61)		(2.77)
R_trusted	0.227**		0.0955*	0.225**		0.0879*
	(4.79)		(2.46)	(4.70)		(2.25)
R_SMFP	0.911**		-	0.912**		-
	(5.85)		(-3.77)	(5.81)		(-3.87)
R_NFHLL			-			-
			(-3.26)			(-3.05)
R_subFH2	0.189**	0.375**	0.129**	0.193**	0.375**	0.145**
	(3.57)	(5.05)	(2.94)	(3.61)	(4.87)	(3.32)
R_FHUC		0.105*	0.277**		0.105*	0.281**
		(1.88)	(5.78)		(1.81)	(5.82)
HR	0.0216*		0.0211*	0.0212*		0.0201*
	(1.88)		(2.46)	(1.83)		(2.33)
R_padyfield		0.357**	0.124**		0.357**	0.116**
		(5.89)	(4.99)		(5.67)	(4.66)
R_woodpart	0.0438*		0.0336*	0.0444*		0.0320*
	(1.75)		(2.18)	(1.76)		(2.07)
Constant	0.0836*	0.0538*	0.0515*	-	-	-0.00815
	(21.11)	(12.96)	(19.19)	(-2.04)	(-4.07)	(-0.28)
Observations	226	84	193	226	84	193
R-squared				0.55	0.795	0.892
Chi-squared	182.1	133.1	416.6			

Notes. Stars indicate *** p<0.01 ** p<0.05 *p<0.1. T-statistics are in ph parentheses

4.3 Factor share of significant variables

Table 5 shows factor share of significant variables in Tobit model for panel data and cross section data. In this table, we only concentrate on the factor share of variables which didn't follow the results from the theory nor represent the characteristics of each regional condition.

To investigate Tohoku first, we focus on the factor share of small-scale farming management body as well as non-farmer with farming ownership for supply side, and discuss about the relation between farm-work contract farming management body and

farmer with employing farm-work contract farming in panel data. Total factor share of small-scale farming management body and non-farmer with farming ownership are over 50%. However, if you see factor share of small-scale farming organization, it had only 12 to 16%. This implies that farmland supplied by small-scale farming management couldn't fully satisfy farmland demand in Tohoku. In other word, it is not enough to solve stagnation problem of medium-scale farmers by shifting the farmers to small-scale class. Factor share of farm-work contract farming management body was 41%, however, on the contrary, factor share of farmer with employing farm-work contract farming was -16%. This means that farmers with employing farm-work contract farming reduced the impact of farm-work contract farming management body on farmland factor share by 30%.

In Hokuriku, we couldn't recognize prefecture level differences in factor share but could do differences due to time effect. This result is confirmed with the fact that the total factor share of supply side and demand side in both data are roughly equivalent. However, as we mentioned before, relation between factor share of large-scale farmers and certified farmers are ambiguous.

In Kinki, we focus attention on the factor share of farm-work contract farming management body as main supplier. Referring from information of regional condition and characteristics, most of all hilled rural farming villages are facing problem establishing village-based farming organization for some reasons such as few farmers who can organize, core members being too old to farm full-time, among others. To solve these difficulties, they depend on farm-work contract farming management body for farmland consolidation and their farming work instead of establishing village-based farming organization. For this reason, factor share of farm-work contract farming

management body must be higher than other factor shares of supply side. To check factor share of farm-work contract farming management body, it was 13% in cross-section data and 30% in panel data. On the contrary, factor share of large-scale farming management body was 19% in cross-section and 11% in panel data. Therefore, in each municipality level, increasing farm-work contract farming management body has less impact than increasing large-scale farming management body, but year by year, impact of farm-work contract farming management body became larger, although the impact of large-scale farming management body become smaller. Consequently, farm-work contract farming management body has great impact on farmland consolidation in Kinki.

Lastly, we compare factor share of certified farming in Tohoku with in Kinki. The factor share of certified farming was 23% in Tohoku and 6% in Kinki. This large difference implies their regional differences which indicate that the principal farmers in Tohoku is mainly certified farmer while in Kinki those are village-based farming organizations although they have difficulty in establishing them.

Table 5. Factor Share of Significant Variables for Farmland Consolidation

Variable	Tohoku		Hokuriku		Kinki	
	panel	Cross-section	Panel	Cross-section	Panel	Cross-section
R_LFP			7%		11%	19%
R_company	10%		9%	18%	2%	5%
R_NCNHFP	13%	4%	7%	10%		6%
R_TCFP	41%	45%	10%		30%	13%
R_trusted		23%				6%
R_SMFP	16%	12%			-46%	-5%
R_NFHLL			37%			-24%
R_subFH2	47%	47%	61%	70%	48%	45%
R_FHUC	-16%			10%	23%	24%
HR		4%				4%
Others	-11%	-34%	-31%	-7%	31%	8%
Total	100%	100%	100%	100%	100%	100%

From Table 5 and interpretation above, the variables representing each regional characteristic had a great impact on regional farmland consolidations in both positive and negative direction. However, it became more certain by verifying factor share of significant variables in two models that factors of farmland consolidation were affected by regional differences and the differences were almost same as differential regional characteristics of farming condition and problems.

5. Summary and conclusions

This paper analyzes the effect of regionally different characteristics on the farmland consolidation in Japan. Due to a shortage of principal farmers, government is carrying out agricultural policy measures to foster a group of principal farmers and to consolidate farmland towards them. To achieve this goal, government is trying to conduct homogeneous measures in entire Japan, without little attention to differential

regional farming condition and characteristics.

The results of our analysis from three targeted regions revealed the way regionally different characteristics such as farming condition and geographical condition affected land consolidation. Those are summarized in three points below. Firstly, under imperfect market competition, factors of farmland consolidation were affected by regional characteristics. Secondly, village-based farming organization which satisfied the requirement of the Law of Enhancing Agricultural Management Foundation had different impacts on farmland consolidation by regions. Tohoku had little impact or no impact of corporate farming organization but had significant impact of non-corporate farming organization on land consolidation. On the other hand, corporate farming organizations in Kinki had more impacts than non-corporate farming organizations. Thirdly, impact of agriculture policy on demand side yielded different degree of impact by region. For example, main farmers consolidating farmland in Tohoku were large-scale farmers and certified farmers. However main farmers consolidating farmland in Kinki were farm-work contract farming management bodies since geographical and farmer rate condition on many villages in Kinki were not favorable to establish village-based farming organizations.

From these conclusions, we provide two policy implications. Firstly, the requirements for authorizing principal farmer can be relaxed so that the requirements and condition can be modified at the municipality level. Since farming condition and characteristics in each region are different, principal farmers and their condition or availability in each region are different. Therefore, the requirement must have flexibility to adapt such conditions. Secondly, main famers who will engage in farmland consolidation should not be appointed. Like Kinki, farmer distribution is skewed to

small-scale farmers with side jobs. As long as the agriculture policy which aims to consolidate farmland to large farmers by encouraging small-scale farmers to leave from agriculture sector is conducted, almost no farmer will survive in the region of geographically disadvantaged regions and most of all farmland will become abandoned area, and farmland in Japan will diminish. Therefore, main farmers who is designated for farmland consolidation must be chosen based on the regional condition.

However, we might still have some unraveled factors that influence farming consolidation by each region. First, in this paper, we use only 2005 and 2010 Agriculture and Forest Census data, which did not have more detailed category of village-based farming organization. Secondly, the impact of non-farmer with farmland ownership rate contains part of the impact of village-based farming organization. To clear these two impacts, in the future study data should be based on village level rather than municipality level.

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