The Choice of Participation Forms in Community-Based Group Farming and Efficiency in Team Production

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Abstract

Past studies suggest that family farming is more productive than farming groups, but empirical studies are not enough to conclude which is more efficient. This paper tries to econometrically analyze the efficiency difference between farming groups and family farming, using original plot yield data from a district in Japan. We accomplish this by, first, analyzing the empirical determinants behind the farmers' choice of participation forms in farming groups based on communities. Second, we verify the presence of free-riding at community-based farming groups which adopts an income-pooling system. Results of the regression analysis showed that for the choice of participation forms in farming groups the most important factor is family labor force. Estimating yield differences between farming group plots and family farming plots shows that farming groups is less efficient due to the incentive problem. Since the core problem of community-based farming groups seems to be the trade-off between efficiency and equity, even if farming groups yield level decreases, the adoption of commission paid according to each plot's yield is not necessarily desirable. Therefore, a profit distribution mechanism in community-based farming groups should be designed, taking equity issues also into consideration.

Keywords: Agricultural Collectives; Tenancy Contract; Moral Hazard

JEL classifications: D23; D86; Q15

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1. Introduction

Recently, the environment surrounding Japanese agriculture has become extremely difficult. Under the WTO framework, Japan faces immediate open agricultural markets. Therefore, further cost reduction is essential. Japanese agricultural policy has also drastically shifted. In the process of dismantling price support policy, the government policy target has been limited to 'approved farmers', i.e. 'individual entity[1]' and 'organizational entity[2]', which must satisfy certain requirements regarding farm size (the Japanese Farm Management Stability Policy). Whether applying strong selective measures, such as in the case of 'approved farmers', is correct or not is beyond the scope of this paper. What will be focused on is that according to selective measurement, not only 'individual entities' but also 'organizational entities', especially community-based farming groups, have been certified by the Japanese government as 'approved farmers'.

Even if community-based farming groups are certified by the government in this way, one of their purposes should be 'to preserve farmland in the hamlet' (Ando, 2007). Consequently, it is doubtful that community-based farming groups necessarily develops as an 'efficient and stable' managerial entity, as is desired by the government (Ando, 2007, Kaneko, 2008). However, as part of 'approved farmers', community-based farming groups must pursue efficiency while developing their advantages at the same time as overcoming their drawbacks.

Compared to individual farmers, the strength of community-based farming groups lies in production cost advantages. Their predominant advantage in production arise from avoiding the excessive machinery investment that is common to individual farmers, as well as the effective use of heavy machinery by means of the consolidation of fragmented farm plots[3] (Katsura, 2006). On the other hand, community-based farming groups also have weaknesses, mainly the inefficiency of team production (Holmstrom, 1982). With many farmers collectively working in production teams, there exists a possibility of farmers' free riding. In this regard, incentive of community-based farming groups is an important issue.

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1 "Individual entity is a farm operated by an individuals or a household (Teruoka, 2008, p. 362)".

2 "Organizational entity is a farm collectively operated by several individuals or households, or a entity engaged in agricultural work (which could be an agricultural producer's cooperative, a limited company, or an agricultural production organization, so long as the entity was coherent and independent) (Teruoka, 2008, p. 362)".

3 In many cases of Japanese individual farmers, land plots are fragmented in the process of the expansion of farming scale, creating difficulties in economies of scale.

For each farm plot, farmers' participatory forms in community-based farming groups are classified into farmland lease contracts and custom work contracts[4]. An important point regarding these participation forms is the existence of border maintenance[5] and water management labor. The first problem concerns who is to take charge of those works. In the case of farmland lease contracts, the community-based group farmers should carry the responsibility of border maintenance and water management. While in the case of custom work contracts, individual farmers should bear the responsibility. Another related important point is the relationship between the management of water and fertilizer, and the yield and quality of rice. Depending on the farmer's management of water and fertilizer, rice yield and quality may become unstable. Therefore, farmers' choice of participation forms in community-based farming groups, as well as water management incentives affect yield and quality of rice, which in turn influences the efficiency of community-based farming groups.

Based on these points, the purpose of this paper is as follows. First, to discuss the empirical determinants behind the choice of participation forms in community-based farming groups i.e. farmland lease contract, custom work contract, and owner-cultivation. In order to create sustainable development of community-based farming groups, it is necessary to ensure the availability of labor forces for border maintenance and water management. In that sense, border maintenance and water management responsibility should be of special concern, as they factor that influences participation forms in community-based farming groups.

The second purpose is to verify the presence of free-riding at community-based farming groups. In the case of community-based farming groups which adopts an income-pooling system, no matter how high the output of a particular farmer, the yield is collected into the total community and distributed evenly to each farmer according to his land area. As a result, farmers delegate effort level of water management which affect yield and quality of rice. Using original yield data at the farm plot level, we compare econometrically the yield levels between community-based farming groups and owner-cultivation approaches.

Past studies have dealt with the efficiency of farming groups, in comparison to family farming, by using econometric models (Sabates-Wheeler, 2002), while others have analyzed qualitatively the advantages and disadvantages of farming groups (Deininger, 1995, Putterman,

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[4] Allen and Lueck (2005) points out as follows. "In agriculture, the term "custom" refers to the practice of contracting for equipment and an operator (often the owner) at the same time."

[5] In Japanese agriculture, border refers to the area between adjacent paddy fields, which require weeding and pest control.

1989). Ishida and Kiminami (1987), Allen and Lueck (1998) discuss the empirical determinants on the choice of farm organization using the model of the transaction cost economics. While theory suggests that family farming is more productive, this paper tries to test empirically the difference in efficiency of farming groups and family farming, taking equity issues also into consideration.

2. Description of the Study Area

The study focus for this paper is the ‘Yanagihara Farming Group’ located in Iiyama City. From now we will refer them as YFG. Iiyama City is located at the northernmost tip of Nagano Prefecture covering an area of 202.32km^2. The agricultural region of Iiyama City is comprised of steep mountainous areas. YFG was established in 2002 to conserve farmland in the hamlet, and to prevent farmland from abandonment.

A summary of YFG is shown in Table 1. As space is limited, we will concentrate only on characteristics related to this study[6].

[Insert Table 1 about here]

The first characteristic of YFG is that it is composed of 7 hamlets. While most Japanese farming groups are comprised of one hamlet, the number of farmers who participate in YFG is much greater. YFG covers 7 hamlets, i.e. Kamisinden, Sasagawa, Minamijo, Yotsuya, Fujinoki, Yamaguchi, and Ogasawara, among the total 11 hamlets in the district of Yanagihara. In 2007, 224 farmers participated in YFG[7].

Since YFG covers a large area, it succeeds in cost reduction by using economies of scale[8]. As a result, YFG guarantees income of nearly 3 million yen to full-time operators for the employment period between April and November.

The second characteristic is the income-pooling system used for calculating revenue. Details are described in the next section. For the case of YFG, the paddy harvest yield is collected from farmland lease contract plots and custom work contract plots. The total profit is then pooled and distributed in proportion to land area. While this system has the advantage of equality of profit, i.e. by calculating the revenue pool equitably, its disadvantage is that it may

6 For more detail about it, see Nakajima (2007).
7 The only qualification for admission into the YFG is to possess land in the district of Yanagihara.
8 Recently, a trend of merger or combination between small farming groups, e.g. comprised of one hamlet, has been explored throughout Japan in order to further reduce cost (Ando, 2007).

induce farmers to moral hazards. This appears particularly true in the case of YFG. As stated before, its large number of farmers makes monitoring difficult and can cause opportunistic behaviors.

3. The Choice of Participation Forms in Community-Based Farming Groups

3.1. The participation forms in YFG

The participation forms in YFG are classified into three categories: (a) farmland lease contract, (b) custom work contract, (c) owner-cultivation (See Table 2 and Figure 1). For the case of farmland lease contract plots and custom work contract plots, management rights and ownership of harvest yield belong to farming group.

In 2007, 37 farmers were under farmland lease contracts, while 134 farmers belonged to custom work contracts, and owner-cultivation farmers were represented by 59 farmers (with a total area of 26.9 ha). The combined land of farmland lease contract plots and custom work contract plots accounted for 66.9 ha (farmland lease contract plots with 14.7 ha, and custom work contract plots with 52.2 ha)[9].

[Insert Table 2 about here]

[Insert Figure 1 about here]

For the case of farmland lease contract, landlords receive a fixed rent of 15,000 yen per 10are[10,11], while farming group undertakes all the farm work. On the other hand, in the case of custom work contract, farming group carries out all machinery operation, i.e. plowing, transplanting, and harvesting, while farmers have the contractual obligation for border maintenance and water management. The annual profit allotment under custom work contract fluctuates between 50,000 yen to 60,000 yen per 10are, generating greater profits for farmers under this contract type.

On the other hand, owner-cultivation farmers do not offer their farmland to farming group, mostly because they possess their own machinery and labor to farm by themselves [12]. The sole

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[9] Year by year farmland lease contract plots have risen from 7.1ha in 2002 to 9.5ha in 2003, 11.1ha in 2004, 11.8ha in 2005, and 13.5ha in 2006. Meanwhile, custom work contract plots are almost constant from 56.8ha in 2002 to 52.5ha in 2003, 52.7ha in 2004, 52.1ha in 2005, and 52.4ha in 2006.

[10] 10are equals 0.1ha.

[11] The standard fixed rent in the district of Yanagihara is set at 13,000 yen per 10are by the local government.

[12] If owner-cultivation farmers do not possess their own machinery, they might offer partial custom

purpose for their joining farming group is for reserving the option of contracting with the group in the future.

3.2. Determinants of participation forms choice in community-based farming groups

(a) Data description

The data for this study was collected in a survey using a questionnaire form, conducted for all farmers in YFG on June 2007. The final response rate was 85.9% (213 farmers out of 248 farmers). The response rate for each hamlet was similar. Farmers belonging to farmland lease contracts were 28 households, custom work contract were 121 households, owner-cultivation were 44 households. Farmers belonging to both farmland lease contract and custom work contract were 3 households, to farmland lease contract and owner-cultivation was 1 household, and belonging to custom work contract and owner-cultivation were 6 households. 10 participants did not have any participation form with YFG.

The data used to estimate the parameters in the econometric analysis were obtained from 138 complete questionnaires (17 farmland lease households, 93 custom work households, and owner-cultivation with 28 households) with 355 plots (69 plots for farmland lease, 248 for custom work, and 38 for owner-cultivation).

(b) Hypotheses

We tested two hypotheses that were likely to determine the choice of participation forms.

For YFG, rent and profit distribution appear the same regardless of plot condition. Accordingly, if a farmer possesses a plot in poor condition, they would prefer to offer their land to the farming group. Such opportunistic behavior in these circumstances is tested as follows.

Hypothesis 1: *The poorer the plot quality is, the less likely the landowner will prefer owner-cultivation to farmland lease contract or custom work contract.*

According to Tashiro (1988), since border maintenance and water management is labor

work to the farming group.

intensive, retaining sufficient labor is important. Therefore a household with a large number of family generations, or a large amount of labor, would tend to favor a custom work contract. This leads us to the next hypothesis.

Hypothesis 2: *The greater the number of family members a household has, the more likely will the landowner prefer custom work over farmland lease contract.*

(c) Regression model and definition of variables

In estimating the participation choice, it is assumed that this is a two stage choice problem as in Figure 2. In the first stage, farmers choose whether or not to offer farmland over to YFG. If they do not offer their farmland, that means they choose owner-cultivation. In the second stage, farmers choose whether or not to be responsible for border maintenance and water management. If they do not accept responsibility, they choose farmland lease contract instead. The two stage choice problem is estimated by applying a Nested Logit Model.

[Insert Figure 2 about here]

A Nested Logit Model was used to generate Full Information Maximum Likelihood (FIML) estimates. The dependent variables for participation forms in community-based farming group are: farmland lease contract, custom work contract, and owner-cultivation. The description of independent variables is presented in Table 3.

[Insert Table 3 about here]

For the first stage choice, farmers that whether or not to offer their farmland to YFG, we have included the following independent variables: number of household members, generation dummy variable, elder household head dummy variable, rate of outside agriculture workers, farm successor dummy variable, machinery (tractor, rice transplanter, combine harvester) dummy variable, Sasagawa hamlet dummy variable, slope, and plot area. The positive parameters imply that the value of the independent variables will increase with a higher probability of choice in favor of owner-cultivation.

The reason for including the machinery dummy variable, i.e. tractor, rice transplanter, combine harvester, is because the farmers who possess machinery tend to engage in agriculture individually. Therefore, the estimated coefficient for the machinery dummy variable is expected to be positive.

To take into account the special characteristics of the Sasagawa hamlet, a Sasagawa hamlet dummy variable is included. Sasagawa hamlet is, within the district of Yanagihara, the farthest away from the center of Iiyama City. According to interviews, farmers from Sasagawa hamlet were inclined toward individual farming practices since previous times. Therefore, we expect the coefficient for the Sasagawa hamlet dummy variable to be positive.

The slope and plot area variables represent the plot condition, therefore they are used to test Hypothesis 1. If farmers behave opportunistically, the coefficient for slope will be negative and the coefficient for plot area will be positive.

For the second stage choice between farmland lease contract and custom work contract, we include the following independent variables: number of household members, generation dummy variable, elder household head dummy variable, owned land, rate of outside agriculture workers, farm successor dummy variable, slope, and plot area. Positive parameters imply that the value of the independent variables will increase and the probability of choosing the custom work contract.

The number of household members and generation dummy variable are used to test Hypothesis 2. Therefore, the expected sign condition for the number of household members and three generations dummy variable are positive, while the expected coefficient for the single generation dummy variable is negative.

The household labor force depends not only on the number of its members but also on the age of the household head. The older the household head, the harder it is to undertake border maintenance and water management, so they are inclined to choose farmland lease contract. Consequently a negative coefficient is expected for the elder household head dummy variable.

On the other hand, if a farm successor is present (regardless of living at the same household or living apart), the head of the household will be inclined towards choosing a custom work contract because there may be a possibility for the successor to continue with the farm work. As a result, a positive coefficient is expected for the farm successor dummy variable.

We have no prediction for the owned land area coefficient because of the land size configuration irregularities associated with the border maintenance and water management costs. If the border maintenance and water management cost decreases according to owned land area, then the expected coefficient for owned land will be negative. Inversely, the expected coefficient for owned land will be positive if the border maintenance and water management cost increases according to owned land area.

(d) Regression results

The results of the regression analyses are presented in Table 4.

[Insert Table 4 about here]

The interpretation of the parameters for the first stage choice is as follows. The independent variables relating to household labor force, i.e. number of household members, generation dummy variable, elder household head dummy variable, rate of outside agriculture workers, and farm successor dummy variable, are not statistically significant.

On the other hand, the coefficients relating to agricultural machinery, i.e. tractor and rice transplanters, are positive at the 5% significance level. This implies that farmers who possess tractors and rice transplanters tend to choose owner-cultivation.

The coefficient for Sasagawa hamlet dummy was positive at the 1% significance level as expected. This implies that the farmers of Sasagawa hamlet tend to choose owner-cultivation.

For the plot condition variables, slope was positive at the 10% significance level, while plot area was not statistically significant. Contrary to Hypothesis 1, this result indicates that farmers who possess plots in steep areas are inclined to choose owner-cultivation instead of farmland lease or custom work contracts. This implies that farmers' opportunistic behavior is not prevalent. According to personal interviews, the reason for this seems to be that the farmers who possess plots in steep areas are aware of their difficult farming conditions, and opt for not offering their lands to the YFG in order not to add the burden to them.

Next, the interpretation of the parameters for the second stage choice is as follows. For the independent variables relating to household generation, the number of household member coefficient is positive at the 5% significance level, the three generation dummy variable is positive at the 10% level, while the single generation dummy variable is not statistically significant. This result implies that, as the number of household member increases, e.g. three generation households, they will be inclined to choose custom work contracts. This result supports Hypothesis 2.

The coefficient of the elder household head dummy variable is negative at the 5% significance level for Estimation 1, and 10% for Estimation 2. This implies that the labor force is influenced not only by the household generation structure but also by the age of the household head. Therefore, as the household head gets older, the farmland lease contract is preferred.

On the other hand, the independent variable relating to farm successors is not statistically significant for all estimations. As seen in Table 3, there is a significant difference between farmland lease contracts and custom work contracts according to whether there is or not a farm successor. However, in the estimation controlled by the number of household members, the household generation structure, and the age of the household head, there is no significant relationship between the choice of participation form and the availability of a farm successor.

The coefficient of the owned land area is positive at the 10% significance level for Estimation 1, 1% for Estimation 2, and 5% for Estimation 3. Because of the positive coefficient, as the owned land increases, farmers are inclined to choose custom work contracts. The result of this estimation suggests that the border maintenance and water management cost decreases as the owned land increases. The farmers participating in YFG have an average owned land of 44.3are with a standard deviation of 26.4are. The small size of owned land in this range can lead to an assumption of well consolidated land holdings. Therefore the border maintenance and water management cost is assumed to decrease. Because of the low value of the owned land coefficient, the choice of participation forms has a negligible influence in owned land.

4. The Inefficiency of Team Production in Community-Based Farming Groups

4.1. Relationship between rice paddy yield and participation forms in community-based farming groups

The advantage of income-pooling system relies on its equal distribution of profits. For the case of Yanagihara, which is comprised of steep mountainous areas, each plot has diverse qualities, in terms of slope and plot area, creating differences in border maintenance and water management costs as well as yields of rice. If a profit distribution system were enforced with commission paid according to each plot's yield, the plots in poorer condition would be abandoned by the farmers. To prevent this occurrence, YFG adopted the income-pooling system.

On the other hand, the income-pooling system has the disadvantage of an incentive problem relating to border maintenance and water management. Based on the income-pooling system, no matter how high the output of a particular farmer, the yield in the total farming group community is collected together and distributed proportionally according to land area.

Consequently, community-based farming groups provide poor incentives for border maintenance and water management, which brings about the possibility of lower yield and crop quality[13].

A simple economic model which represents the previous problem is shown as follows (Holmstrom, 1982). The farmer i owns total farmland area A_i. The estimated cost per hectare of border maintenance and water management effort level is represented by e_i, while the rice paddy yield is represented by the function $f(e_i)$. The farmers' profit Π_i is then as follows,

$$\Pi_i = A_i\{f(e_i) - e_i\}$$

Then, the owner cultivation's optimal effort level is $f'(e_i^*) = 1$, which satisfies e_i^*. But in the case of income-pooling system, farmers' profit is,

$$\Pi_i = A_i\left\{\frac{\sum_j A_j f(e_j)}{\sum_j A_j} - e_i\right\}$$

In this case, the optimal effort level for border maintenance and water management is e_i^{**} which satisfies

$$\frac{A_i}{\sum_j A_j} f'(e_i^{**}) = 1$$

with e_i^{**} less than e_i^*.

The main points are as follows. First, based on income-pooling system, farmer's incentive relating to border maintenance and water management is weakened. Second, the incentive is decreasing in the ratio of farmer's owned land per farming groups' farmland, in other words, as farming groups land size increases, the border maintenance and water management incentive decreases.

As mentioned before, for the plots under custom work contracts, the landowners should bear the water management jobs, while for farmland lease contract plots, YFG should accept the water management responsibility. In reality, even though YFG accepts the duty for water management, they entrust the job to the farmers who cultivate adjacent to the farmland lease contract plots. These entrusted farmers, regardless of plot condition, equally receive a fixed fee

[13] In the case of machinery work, the operators' unobservable effort level has little influence in rice paddy yield. On the other hand, in the case of border maintenance and water management e.g. time and quantity of use, has great influence in rice paddy yield (Katsura, 2006).

of 6,000 yen. Therefore the following hypothesis can be formulated.

Hypothesis 3: *Rice yield levels for each participation form increases in the order of farmland lease contract plots first, custom work contract plots second, and owner-cultivation plots last.*

4.2. Regression analysis

Since the border maintenance and water management effort level is unobservable, the yield of rice is used as the resulting outcome of effort in the regression analysis[14]. A regression model is tested for rice yield differences between farmland lease contracts, custom work contracts, and owner-cultivation plots.

(a) Data description

For the regression model the two main variables needed are yield and plot data. The rice yield data for this study is provided by the country grain elevator in the Japan Agriculture (JA)[15] 'Kita-Shinshu Miyuki'. The plot data was obtained from YFG which is a registered plot area. According to this registered plot area, YFG calculates their profit distribution, thus the precise measurement of this data is vital for this study. The process of data cleansing was followed to ensure certifiable results. The registered plot area data from the YFG is corroborated with the plot data from the country grain elevator. If there was a difference of 1are or more between the data sets, that data was dropped. All yield data bellow 300kg per 10are and over 600kg per 10are were also deleted from the sample[16]. As a result around 400 records per year were used for the econometric regression from 2003 to 2007, with 1,770 plot data. Figure 3 shows the accumulated distribution of rice yields from 2003 to 2007.

[Insert Figure 3 about here]

(b) Regression model and definition of variables

By regressing yield levels per participation form, the yield level differences caused by the income-pooling system can be observed.

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14 Shaban (1987) tested "Marshallian productive inefficiency" of sharecropping by using differences in input and output intensities.

15 JA stands for Japanese Agriculture Cooperative.

16 According to interviews with the YFG, yields over 600kg per 10are were unfeasible, and yields below 300kg per 10are were considered too small.

Our empirical specification is the following:

$$Yield_{ij} = \beta_0 + \beta_1 Contract_{ij} + \beta_2 DirectSeeding_{ij} + \beta_3 PlotCondition_{ij} + \beta_4 Year_j + \varepsilon_{ij}$$

The dependent variable $Yield_{ij}$ is the rice yield per 10are in farmers' plot i at year j, j contains the years from 2003 to 2007. The independent variables include the contract dummy variable, i.e. custom work contract dummy and owner-cultivation dummy, direct seeding dummy, and plot condition variable, which encompasses the slope and plot area, and year dummy variable.

An important point remains to be considered regarding the participation form that farmers choose. That is, if plots in poor condition tend to be entrusted to YFG, a decline of yield caused by the income-pooling system and the state of the plot cannot be properly distinguished. However, according to estimation results in Section 3, there is no clear tendency that plots in poorer condition are entrusted to farming group, and therefore farmers' opportunistic behavior is not supported.

(c) Regression results

The results of the regression analyses are presented in Table 5.

[Insert Table 5 about here]

Most of the coefficients have the expected sign and are statistically significant. 2004 was a lean year and yield levels were lower than the average yield. Furthermore the steeper the plot's slope, the lower the yield level. As the plot area increases, yield per 10are tends to increase by 4kg to 5kg. Also as expected, yield levels in direct seeding plots declined by 20kg per 10are compared to rice transplanting plots. By controlling the direct seeding and plot condition, the yield level for owner-cultivation plots was higher by 10kg to 15kg per 10are than custom work contract plots. This result supports Hypothesis 3, by showing the occurrence of farmers' moral hazards under the income-pooling system. Yield levels in farmland lease contract plots were lower by around 6kg per 10are than in custom work contract plots. However, this is lower than the yield difference between owner-cultivation plots and custom work contract plots. This suggests that as the number of farming group members increase, custom work contracts and farmland lease contract members' incentive levels narrow.

Estimating the yield difference between farming group plots and owner cultivation plots, a decline of yield may generate a loss of 4,500 to 6,000 yen per 10are which add up to 3 million to 4.5 million yen for the whole farming group. Some may perceive this amount to be rather trivial, but in order to continue the sustainable development of farming groups this loss is indeed significant and should be taken into consideration. The only ways to increase profit levels in farming groups are cost reductions by economies of scale and increases in output. Since the field of activity of community-based farming groups is limited to the village, farming scale, expansion is not feasible. This limits any possible advances by economies of scale. Therefore it is important to consider any and all possible increases of output levels that may lead to a more efficient farming group outcome.

5. Concluding Remark

In this paper, the forms of community-based farming group participation, i.e. farmland lease contracts, custom work contracts, and owner-cultivation, for the case of YFG were examined. As a result of the regression analysis, the choice between farmland lease contracts and custom work contracts was found to be influenced by the family labor force. On the other hand, even with a higher economic advantage, that is, higher profit distributions for custom work contract over farmland lease contract on average, as the household labor force declines, farmers are forced to choose farmland lease contracts.

Using original yield data from farm plots, we compare econometrically the yield levels between community-based farming group and owner-cultivation. Estimating the yield difference between farming group plots and owner cultivation plots shows a decline in yields due to the incentive problem.

Even if community-based farming groups yield levels decrease, for the sake of equity, the adoption of a commission system paid according to each plot’s yield is not necessarily desirable. As mentioned above, in a community-based farming group situation which requires equality among members, a profit distribution mechanism should be designed under the restriction of equity. The core problem of community-based farming groups is the trade-off between equity and efficiency. To conclude the discussion of the best profit distribution mechanism, this study has explored the different restrictions which are faced by group farmers, as well as the wide range of possible selections available.

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Table 1
The summary of YFG (2007)

Date of establishment	February in 2002
Form	Corporation (December in 2007)
Field of activities	7 hamlets
Number of participation farmers	224 farmers
Organization	Director: 6 persons, Manager: 2 persons
Number of operators	Full-time opetrator: 2 persons
	Part-time operator: 8 persons
Income and Wage	Full-time operator: 3 million yen
	Part-time operator: 2 thousand yen per hour
Machinery	Tractor: 8 units
	Rice transplanter: 3 units
	Combine harvester: 5 units
Farm size	Paddy field: 66.9ha
	(Farmland lease: 14.7ha, Custom work: 52.2ha)
Partial custom work[a, b]	Raising seeding: 2,055 pieces
	Plowing: 12.6ha
	Harvesting: 9.6ha
Direct payment system for mountainous areas[c]	Target area: 35.3ha
Acreage control	Direct seeding[d], Asparagus

Source: Interview at YFG.

[a] YFG does not practice partial custom work for rice transplantting.

[b] If owner-cultivation farmers do not possess their own machinery, they might offer partial custom work to the group farming.

[c] 'Direct payment system for mountainous areas' is a national organization established in 2000 to maintain agriculture production in mountainous areas and secure multifunctionality by providing direct subsidies.

[d] In case of direct seeding, paddy yield is lower than rice transplanting. Therefore it is recorginzed as a way of acreage control.

Table 2

Participation forms in YFG (2007)

Participation forms	Number of farmers	Farmland area	Economic share per 10are[a]	Resposability for border maintenance and water management labor
Income-pooling				
Farmland lease	37 farmers	14.7ha	Rent 15,000 yen	Farming group
Custom work	134 farmers	52.2ha	Profit distribution 50,000-60,000 yen	Landowner
Owner-cultivation	59 farmers	26.9ha	—	Landowner

Source: Interview at YFG.

[a] 10are equals 0.1ha.

Table 3

Description of variables and Test Mean Difference for each participation form

First Stage Choice Independent Variables	Farmland lease and Custom work	Owner-Cultivation	Test Mean Difference[a,b]	
Number of household member	3.95	3.82		E
Single generation Dummy	0.17	0.21		E
Three generations Dummy	0.39	0.43		E
Elder head household Dummy[c]	0.35	0.29		E
Outside agriculture workers (%)[d]	0.36	0.46		E
Farm successor Dummy[e]	0.46	0.50		E
Tractor Dummy	***0.23***	***0.46***	**	N
Rice transplanter Dummy	***0.01***	***0.14***	*	N
Combine harvester Dummy	0.05	0.14		N
Sasagawa hamlet Dummy	***0.12***	***0.50***	***	N
Slope[f]	37.7	52.2		N
Plot area (are)	17.1	16.5		E
Second Stage Choice Independent Variables	**Farmland lease**	**Custom work**	**Test Mean Difference[a,b]**	
Number of household member	***2.71***	***4.17***	***	N
Single generation Dummy	0.35	0.14		N
Three generations Dummy	***0.06***	***0.45***	***	N
Elder head household Dummy[c]	***0.59***	***0.31***	**	E
Owned land (are)	***32.4***	***46.5***	**	E
Outside agriculture workers (%)[d]	0.33	0.36		E
Farm successor Dummy[e]	***0.18***	***0.52***	***	E
Slope[f]	***29.7***	***39.9***	**	E
Plot area (are)	***15.6***	***17.5***	*	E

Source: Authors' Calculations

[a] The result of Test Mean Difference, *significant at 10% level; **significant at 5% level; ***significant at 1% level.

[b] The result of Test Variance Difference, 'E' significant at 5% level; 'N' is not significant at 5% level.

[c] 1 if head household is over 70 years old, 0 if otherwise.

[d] Ratio of member working outside the agriculture sector per household

[e] Being a successor is irrelevant to living location (same household or living apart)

[f] Slope is relative value calculated by GIS (Geographical Information System).

Table 4

Result of the regression analysis explaining the choice of participation forms (Nested Logit Model)

	Each households		Each plots
	Estimation 1	Estimation 2	Estimation 3
First Stage Choice	Dependent variable: Owner-Cultivation		
Number of household member	0.93 (0.98)	—	0.48 (0.55)
Single generation Dummy	—	1.23 (1.25)	—
Three generations Dummy	—	3.34 (2.71)	—
Elder head household Dummy	-2.89 (1.51)*	-2.25 (1.11)	0.56 (1.45)
Outside agriculture workers	-0.63 (2.01)	-0.57 (1.63)	1.53 (1.39)
Farm successor Dummy	2.18 (2.01)	2.43 (1.80)	-1.04 (3.69)
Tractor Dummy	1.65 (0.68)**	1.52 (0.67)**	1.24 (0.50)**
Rice transplanter Dummy	2.96 (1.29)**	3.21 (1.33)**	1.77 (0.79)**
Combine harvester Dummy	0.44 (1.12)	0.72 (1.08)	0.14 (0.92)
Sasagawa hamlet Dummy	2.91 (0.66)***	2.86 (0.66)***	2.89 (0.46)***
Slope	—	—	0.04 ($6.53*10^{-4}$)*
Plot area	—	—	$4.81*10^{-5}$ (0.02)
Second Stage Choice	Dependent variable: Custom work contract		
Number of household member	0.44 (0.98)**	—	0.18 (0.09)**
Single generation Dummy	—	0.51 (0.62)	—
Three generations Dummy	—	1.98 (1.08)*	—
Elder head household Dummy	-1.17 (0.54)**	-1.04 (0.63)*	-0.17 (0.31)
Outside agriculture workers	-0.99 (0.85)	-0.28 (0.87)	-0.18 (0.29)
Farm successor Dummy	0.95 (0.76)	1.36 (0.78)	-0.09 (0.81)
Owned land	0.02 (0.01)*	0.03 (0.01)***	$3.46*10^{-5}$ ($1.75*10^{-5}$)**
Slope	—	—	$6.59*10^{-3}$ ($3.96*10^{-3}$)*
Plot area	—	—	$1.44*10^{-5}$ ($1.38*10^{-4}$)
Inclusive Value Parameter			
Farmland lease and Custom work	2.76 (1.43)*	2.08 (0.74)***	5.38 (1.48)***
Owner-Cultivation	1.00	1.00	1.00
Likelihood Ratio Test of Homoscedasticity	χ^2 (1) 3.63*	χ^2 (1) 3.82*	χ^2 (1) 16.41***
Sample size	138	138	355

Source: Authors' Calculations

Standard errors in parentheses.

*significant at 10% level; **significant at 5% level; ***significant at 1% level.

In Likelihood Ratio Test Statistics, degree of freedom in parenthesis.

Table 5

Result of the regression analysis explaining the yield levels for each participation form (Pooled OLS)

Independent variables	Estimation 1	Estimation 2	Estimation 3
Constant	477.2 (4.44)***	465.8 (4.64)***	472.3 (4.85)***
Custom work contract Dummy	6.68 (3.09)**	4.64 (3.10)	6.13 (3.09)**
Owner-cultvation Dummy	20.3 (4.64)***	13.8 (4.75)**	17.6 (4.75)***
The year 2004 Dummy	-20.4 (3.78)***	-20.0 (3.81)***	-20.1 (3.78)***
The year 2005 Dummy	36.4 (3.71)***	36.9 (3.73)***	36.6 (3.71)***
The year 2006 Dummy	10.8 (3.71)***	11.4 (3.73)***	11.0 (3.70)***
The year 2007 Dummy	13.4 (3.72)***	13.9 (3.75)***	13.6 (3.72)***
Direct seeding Dummy	-19.3 (2.59)***	-20.2 (2.76)***	-22.3 (2.85)***
Slope	-0.12 (0.03)***	—	-0.12 (0.03)***
Plot area	—	0.49 (0.15)***	0.39 (0.15)***
Sample size	1,765	1,770	1,765
R^2	0.183	0.176	0.186
adjusted R^2	0.180	0.172	0.182

Source: Authors' Calculations

Standard errors in parentheses.

*significant at 10% level; **significant at 5% level; ***significant at 1% level.

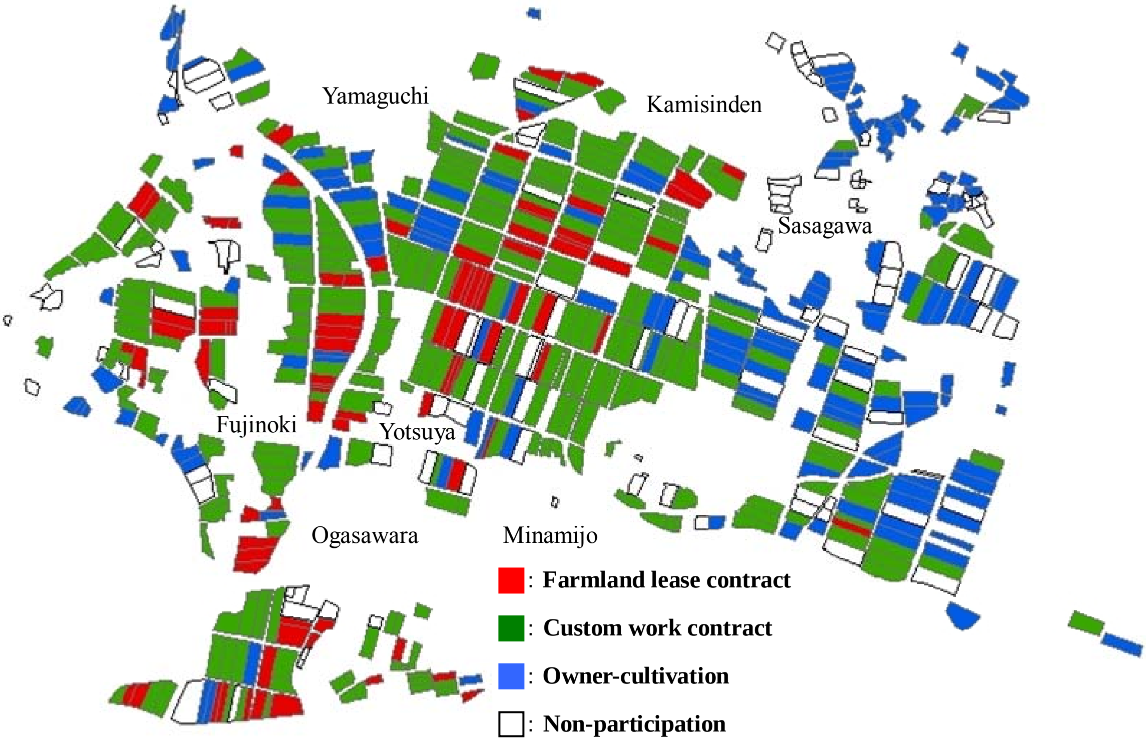

Figure 1　Participation forms in YFG（2007）

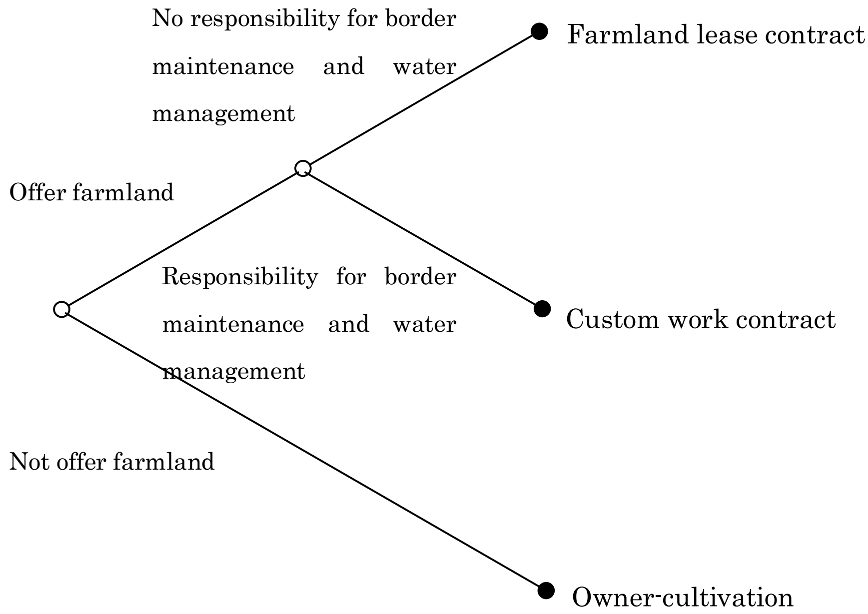

Figure 2　The choice of participation forms in YFG

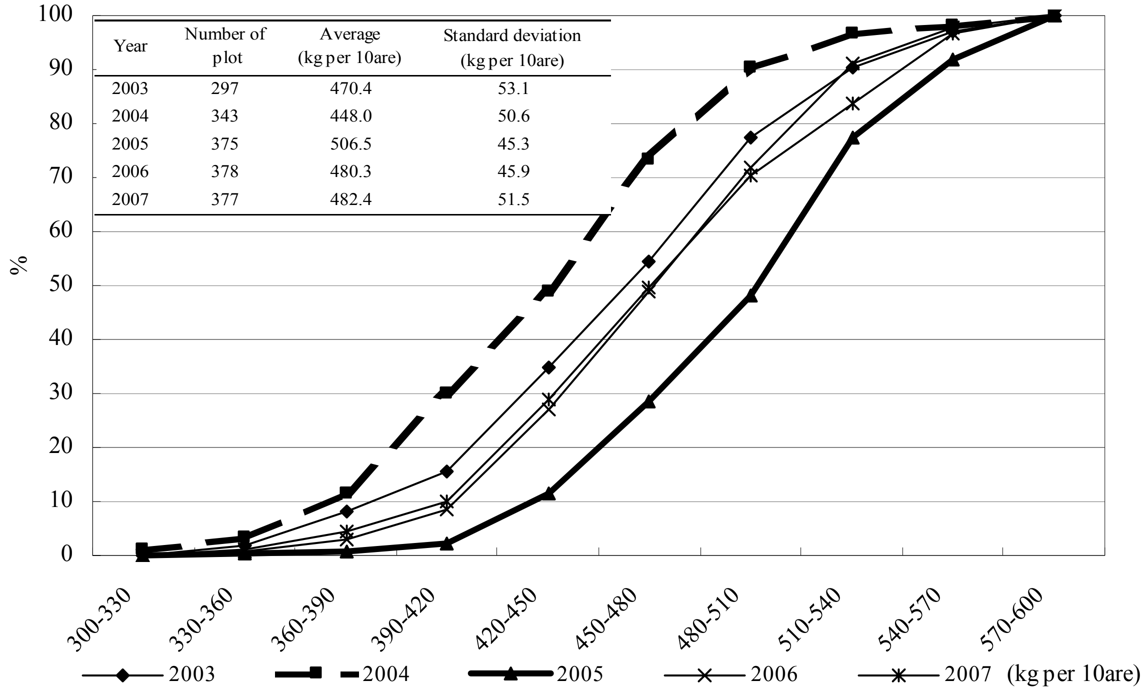

Figure 3 The accumulated distribution of rice yield

Source: The rice yield data is provided by the country grain elevator in Japanese Agricultural Coperative 'Kita-Shinshu Miyuki'. The plot data is obtained from YFG which is registered plot area.