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On the Relationship between Multifunctionality and Hamlet Activities as a Rural Institution

Yasuo Ohe*

The relationship between multifunctionality and the roles of rural communities has not been discussed fully although the connection between the two is an essential issue in the rural policy arena. Pursuing this issue, this paper considers that multifunctional hamlet activities are generated as institutional joint products within the hamlet. Also evaluated is the connection between multifunctional activities and institutional hamlet conditions under the Japanese direct payment program for less favored areas. Results of conceptual considerations and empirical evaluations reveal that specific multifunctional hamlet activities depend on hamlet conditions; those on the least favorable level tend to perform land preservation activities while those under the most favorable conditions tend to undertake recreational activity. Hamlets participating in forming landscape fall in the middle. Thus, firstly, institutional jointness is not constant but variable depending on hamlet conditions. Consequently, programs to enhance multifunctionality should respect hamlet conditions that represent different levels of institutional jointness of multifunctional activity rather than treat multifunctionality as a single concept. Secondly, for diversification, it would be effective to organize hamlet activities based on an open and wider human network rather than the traditional closed one in rural communities.

Key words : multifunctionality, rural community, institution, jointness, diversification, human resources, direct payment.

1. Introduction

Multifunctionality has tended to be discussed as a single concept although it actually includes multifunctional activities, and the conditions under which each is promoted are considered to differ.[1] For instance, rural tourism is an activity that internalizes the externality of multifunctionality while another activity may not.[2] Therefore, to ensure the effectiveness of policy measures to promote multifunctionality, each feature of a multifunctional activity should be evaluated.

Little attention has been given to the multifunctionality provided by collective action, such as hamlet activities. Yet such multifunctional activities are crucial in promoting multifunctionality from the perspective of both Japanese and East Asian rural policies[3] that have been emphasizing community-based agricultural and rural development. In studying this issue, an institutional approach is effective because hamlet activity has been based on the institutional process and such an approach will help to clarify the institutional jointness of multifunctionality.[4]

As such an example of this jointness, a direct payment program for less favored areas was started in 2000 in Japan and has been used to promote multifunctionality in those areas.[5] This program mandates that the rural community agree to maintain farmland and hamlet activities that promote multifunctionality in the rural community. This is because for centuries the role of the rural community has been essential in farming and in life as an institutional foundation in this country. We feel that this program is an example that implicitly assumes institutional jointness wherein hamlet activity generates multifunctionality.

However, we do not have an effective institutional framework that can be applied to ru-

*Chiba University

ral community issues because the institutional approach has focused on farm organizations and policy aspects rather than on the rural community.[6] We need an institutional framework applicable not only to hamlet activities based solely on the traditional closed human network in the rural community but also to those based on an open human intercommunity network. The latter perspective will become more important in the rural policy arena and for identification of new roles for rural communities.

In consideration of this background, this paper focuses on multifunctional activities under the direct payment program (hereafter, this program) and aims to clarify how each multifunctional activity is connected with levels of hamlet conditions from a conceptual and empirical point of view. In addressing these aims, firstly, we briefly outline the program. Then we explore a conceptual model to deal with institutional aspects of hamlet activity and, based on the conceptual model, we estimate empirical multifunctional activity determinant models to clarify the features of multifunctional activities and factors that determine those features. Finally, we discuss prospects for future policy direction in promoting multifunctionality.

2. Data

Data at the hamlet level are not disclosed on a nationwide basis. Therefore, this paper uses data disclosed by the administrative body of this program, the Rural Development Bureau, Ministry of Agriculture and Forestry and Fisheries of Japan (MAFFJ), which is "The Result of the Direct Payment Program in the Hilly and Mountainous Areas 2001," and which were aggregated at the prefectural level in the 2001 fiscal year. Data for the 2002 version are also available, but do not contain details of hamlet conditions necessary for empirical evaluation. Therefore, we used the 2001 data that cover all 47 prefectures. Included from this source are data on multifunctional hamlet activities.

3. Outline of Direct Payment Program and Multifunctionality

The program requires one of two kinds of agreements from participants. One is a hamlet agreement entered into by hamlets and the other is an individual agreement signed by designated farmers. These farmers are progressive model farmers designated by the prefectural government as policy targets. As of year 2001 hamlet agreements comprised 98.1% (32,067) of all agreements and individual agreements accounted for only 1.9 % (605) of agreements. This is because the program places importance on hamlet functions. Therefore, this paper also focuses on hamlet agreements.

This program has two aims: to preserve farmland and to promote multifunctionality in the hilly and mountainous less competitive areas based on hamlet activities that have been the foundation of farming and rural life for centuries. For this reason, hamlets that want to receive a direct payment are required to sign a hamlet agreement defining what activities they will perform for preservation of farmland and enhancement of multifunctionality as a unit of the local community.

As of 2001, this program was implemented in the 1,900 towns and cities that had hamlet agreements; 613,304 farmers participated and there were 627,736 ha of beneficiary land. The total payment was 51 billion 132 million yen. On average, each hamlet agreement had 19.5 participants and 20 ha of designated farmland. Payment received was 1,630,000 yen per hamlet and 83,000 yen per capita as shown in Table 1.

The acreage that agreements, including individual agreements, cover comprises 80.8% of the targeted farmland. Covered are 77.0% of rice paddy, 59.4% of upland, 93.1% of cultivated grassland, and 75.6% of meadow. One reason for the lower coverage in upland is that the program mainly aims at the paddy, rice being the main crop in this country in terms of land use and production, and the grassland in hilly and mountainous areas.

In examining the hamlet agreement in detail, it is evident that the first aim concerns minimum acreage for farmland preservation. A hamlet agreement must satisfy one of two conditions: coverage of more than one hectare of single or unit farmland or coverage of more than one hectare of total area of separated farmlands that have been farmed consistently as one unit.

The latter condition for separated farmlands is related to how consistent farming is

Table 1. Outline of direct payment program (as of 2001)

1) Outline of hamlet agreement and payment

Items	Participants (persons)	Covered acreage (ha)	Amount of payment (thousand Yen)	Payment per head (thousand Yen)
Total	613, 304	627, 736	51, 132, 000	—
Average per hamlet agreement	19. 5	20	1, 630	83

2) Farming consistency condition for hamlet agreement

Composition of farming consistency conditions	% of hamlet agreement	Necessary cost-bearing capability for activity
Maintenance of irrigation and farm road lines	73. 8%	Low
Exchange of farming operation and joint farming operation	23. 7%	Middle
Farming groups or farming corporate bodies	4. 0%	High

3) Types of multifunctional activity undertaken in the hamlet agreement

Types of multifunctional activity	% of hamlet agreement	Necessary cost-bearing capability for activity
Land preservation	58. 6%	Low
Landscape forming	38. 3%	Middle
Recreational	3. 2%	High

Source: The Result of Direct Payment Program in the Hilly and Mountainous Areas 2001, Rural Development Bureau, MAFFJ, 2002.
Note: The sum of composition of farming consistency conditions does not equal to 100% because there were cases in which multiple conditions applied.

conducted as a single unit and thus needs collective action for preserving these farmlands, that is, "the condition of farming consistency." This is "red-tape" terminology, so it needs a little explanation. Simply put, this condition indicates the degree of farming cooperation[7)] in the hamlet. Farming cooperation has been traditionally practiced among hamlet members to provide mutual help such as exchange of labor during busy seasons and, in more recent times, contract-based cooperation in use of machinery. This program is based on these communal practices in this country. Under these circumstances, consistent or cooperative farming operations are considered to be crucial for preservation of farmland in the hamlet because they indicate how the level of hamlet conditions influences signing of a hamlet agreement for multifunctional activity. Strictly speaking, the status of farming cooperation is a result or outcome of hamlet conditions rather than a reflection of hamlet conditions. However, we consider that the status of farming cooperation will affect multifunctional activity because multifunctionality is a joint production of farming activity in the hamlet; thus, we should take into account the institutional connection between farming and multifunctional activities in the hamlet.

Hamlet agreements that applied to consistent farming operations made up 60. 3% of all agreements. The following three types of hamlet behaviors are conducted in consistent farming operations in order of prevalence: 1) maintenance of irrigation lines and farm roads by hamlet members accounts for 73.8% of the total, 2) exchange of farming operation services and joint farming operations are conducted in the hamlet, mutually benefiting hamlet members and accounting for 23.7% of the total, and 3) performance of farming activities by the same farming groups or farming corporate bodies (4%) (Table 1). The necessary cost level of these activities rises with the decreased prevalence of the three activities, with the lowest level of cost required for the maintenance of waterways and farm roads and the highest for group or corporate farming (Table 1).

Concerning the second aim, which is to promote multifunctional activities, in reality numerous activities are widely interpreted as "multifunctional hamlet activities," even though they do not always correspond directly to the generally accepted concept of multifunctionality. Thus, we classified these activities into the following three major multifunctional activities: preservation of land (land-preservation function), which includes clearing away undergrowth of woods surrounding farmland; the formation of landscape (landscape-formation function), which includes cultivating crops and plant materials that preserve the beauty of the countryside; and recreation (recreational function), examples of which are leasing for one year a terrace paddy or renting farm plots for those who seek an agricultural experience as recreation and also providing farmhouse accommodations for tourists.

Among the hamlet agreements, preservation of land is the most common practice (58.6%), followed by formation of landscape (38.3%). Recreation accounts for only 3.2% of activity (Table 1). These differences in share suggest that there are different cost levels necessary for each multifunctional hamlet activity. The lowest cost is related to preserving land and the highest cost is related to recreation, with forming landscape in the middle. Therefore, it can be concluded that different multifunctional activities are undertaken depending on the cost-bearing capability of the hamlets; the higher the cost for multifunctional activity, the fewer hamlets conduct that activity.

We have characterized multifunctional hamlet activities into two types depending on the orientation of internalization of externality: the non-internalizing type and the internalizing type.

The former, the non-internalizing type, is a hamlet activity that is based on traditional hamlet actions such as maintenance of the farm road and irrigation system and preserving farmland. These activities are conventionally institutionalized as collective work, called "village work" (Kawano [7]), to maintain the community's farm production base. These are considered as land preserving activity, which may not internalize external effects.

The latter, the internalizing type, is a hamlet activity that is undertaken as a new activity such as rural tourism that has not been conventionally institutionalized although this activity could occur on the basis of conventional hamlet activity. Especially, recreational activity such as rural tourism will be in this category. Rural tourism is an activity that enables farmers to internalize the externality that has not been rewarded and then create a new income source.

The landscape-forming function will be intermediate between the two types of activities, that is, involving non-internalizing and internalizing activities because this function is considered to be comprised of two features.

4. Conceptual Model

We have endeavored to clarify what and how hamlet conditions influence institutional cost structure and jointness. Figure 1 summarizes the view presented in this paper, wherein we assume that hamlet conditions determine multifunctional activities through the institutional cost structure in the hamlet. This whole process represents the institutional jointness that generates multifunctional hamlet activities. In this model, hamlet conditions are comprised of two main factors, human resources and consensus-making, with other conditions of agricultural production playing a role. These conditions determine institutional costs and the optimal multifunctional activities undertaken as a hamlet function. Empirically we consider two models: model 1, which estimates the institutional cost structure, and model 2, which estimates how hamlet conditions create actual differ-

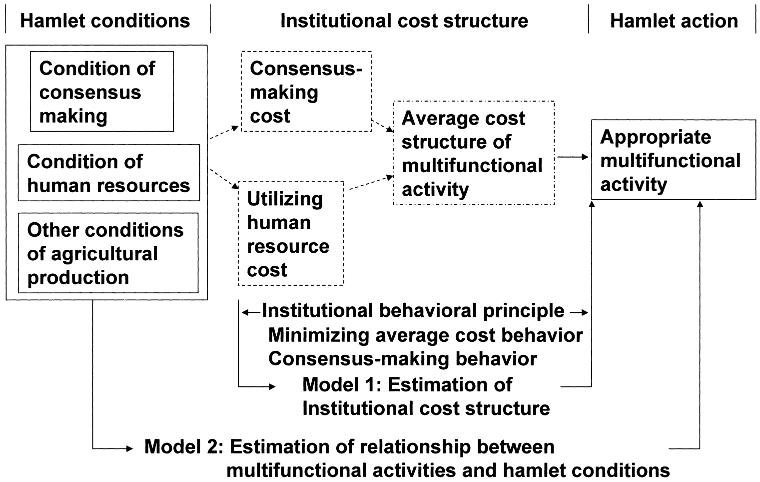

Figure 1. Process of institutional jointness (hamlet function) of multifunctional activity

Note : Data of real lines are observable while those of dotted lines are not and those of semi-dotted line are partially observable.

ences in the undertaken multifunctional activities.

We present a conceptual model that enables us to explore the institutional factors and relationships[8)] between hamlet multifunctional activity and hamlet size for a hamlet agreement under this program. This model of the institutional process will be applicable not only to hamlet agreements, but also to multifunctional activities in hamlets in general.

First, we assume that farmers in the hamlet act on the principle of minimizing the average cost of the multifunctional hamlet activity rather than on the principle of minimizing marginal cost. This is because hamlet activities have been traditionally maintained by non-profit behavior as collective action for mutual help in the local community. Second, we assume that decision making about hamlet activity is determined by a consensus among hamlet members, which also has been the traditional decision-making method. This program allows farmers to take cost-minimizing action in the range of a municipality that generally consists of multiple hamlets. Therefore, multifunctional activity would be undertaken not only on a single-hamlet basis, but also on a multiple-hamlet basis.

With the above two assumptions, supposing other conditions are constant and based on the reality of the hilly and mountainous areas, we assume two institutional factors that determine the cost of multifunctional hamlet activities: human resources and con sensus-making among hamlet members.[9)] Thus, we consider two cost factors: the cost of utilizing human resources and the cost of consensus-making. The vertical sum of the two cost curves becomes the total average cost (AC). Therefore, equation (1) is assumed concerning multifunctional hamlet activity i.

$$AC_i(x) = HC_i(x) + NC_i(x) \qquad (1)$$

Where, $AC_i(x)$ = average cost curve of multifunctional hamlet activity i in the hamlet agreement

$HC_i(x)$ = average cost for utilizing human resources for multifunctional hamlet activity i

$NC_i(x)$ = average cost for consensus-making for multifunctional hamlet activity i

x = size of hamlet agreement

Farmers in the hamlet are supposed to minimize the average cost AC consisting of the two factors and then the optimal size of the hamlet agreement is determined for each activity. This is depicted in Figure 2 showing measurement of the cost level vertically and size of participants in the hamlet agreement horizontally. These two factors have opposite relationships with the size of the hamlet agreement for reasons that we will explain below.

First, the average cost of utilizing human

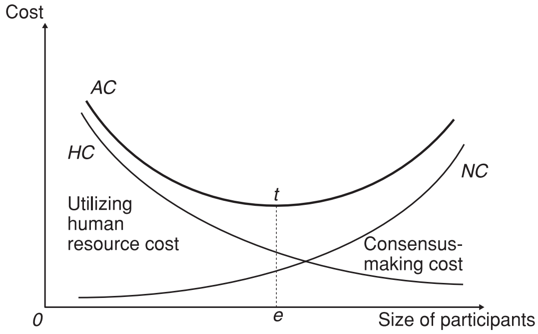

Figure 2. Institutional cost curves for multifunctional hamlet activity

resources has a negative relationship with the size of the hamlet agreement, which is illustrated by the curve *HC*. Utilizing human resources is crucial to conducting hamlet activity but is difficult, especially in hilly and mountainous areas.[10] In the case of little availability of human resources, the cost of utilizing human resources is prohibitive. Therefore, the more you expand the size of the hamlet agreement, the greater the possibility of finding appropriate human resources will be, and then these participants can share the cost of the multifunctional activity. In other words, per capita average cost of utilizing human resources is supposed to be non-positively correlated, that is, negative or no correlation, with the number of participants, which means that we can expect a rightward-declining curve.

Second, the average consensus-making cost has a positive relationship with size, which is illustrated as curve *NC*. The larger the number of participants, the greater is the increase in transaction cost for reaching consensus. This is because an increase in people involved shifts the pattern of consensus-making from that among acquaintances to that among those not acquainted. Consequently, the average cost for reaching a consensus is non-negatively correlated, that is, positive or no correlation, with the size of hamlet agreements, which means that we can expect a rightward-increasing curve.

Third, the vertical sum of the two cost curves results in the total average cost curve (*AC*). Thus the total average cost of multifunctional activity i for the optimal size hamlet agreement is determined and *AC* reaches the minimum at point e in Figure 2. As already mentioned, the optimal size hamlet agreement would consist of a single hamlet or multiple hamlets, depending on the institutional cost factors.

This is the basic conceptual framework of the relationship between multifunctionality and hamlet behaviour, which shows how the total average cost is determined.

For simplification it is assumed that direct payment causes a downward shift of the *AC* curve in the long run. This study is conducted for *AC* evaluation under the initial conditions. In other words, this study does not evaluate the effects of the direct payment, but evaluates the initial hamlet conditions for multifunctional activities.

Thus the optimal size of each multifunctional activity is determined although the optimal point differs from one area to another depending on the cost structure attributed to local conditions of the institutional factors. Consequently, cost curves are obtained for each multifunctional activity. The above conceptual model is a general framework; therefore, we need a more concrete model applicable for empirical study.

5. Analytical Model

Here we explore how to apply the above conceptual model to an empirical study by considering the possible institutional cost structure. In fact, we can not observe actual *AC* curves, but only aggregated envelope curves at the national level. Thus, we focus on the VC_i curve that envelops the AC_i curves of each area at the national level concerning multifunctional activity i. Naturally, *VC* curves have more flexibility regarding the size of participants than *AC* curves. With these decision-making processes, hamlets determine optimal multifunctional activity based on their cost-bearing capabilities. If the same characteristics as shown in Figure 2 are correctly reflected in the *VC* curves, the information presented in Table 2 can show how the combination of shapes of the *VC* envelope cost curves influences the two institutional factors. There are four different cases of cost structure to be considered.

The first case (Case 1) involves those hamlets that have a high level of hamlet function under favorable conditions. Thus, in Case 1

Table 2. Institutional factors of hamlet agreement and shape of cost curves

Status of hamlet agreement	Types	Ulitizing human resource cost A	Consensus-making cost B	Total average cost for hamlet agreement C(=A+B)
Yes	Case 1	Low	Low	Diminishing and then increasing
Yes	Case 2	Low	High	Portion diminishing < Portion increasing
Yes	Case 3	High	Low	Portion diminishing > Portion increasing
No	Case 4	High	High	Diminishing and then increasing

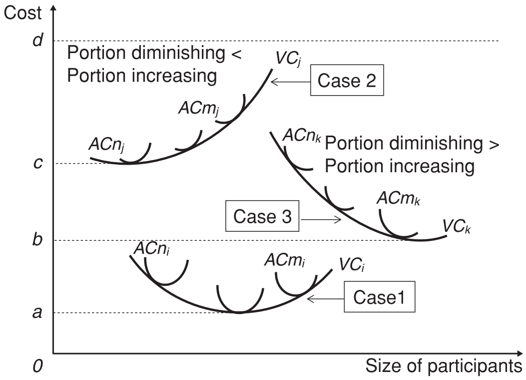

Figure 3. Envelope cost curve for multi-functional activities

as depicted in Figure 3, those hamlets can conduct multifunctional activity sufficiently at a low institutional cost in terms of utilizing both human resources and consensus making. In this sense, those hamlets have higher cost-bearing capability for conducting multifunctional activity than ordinary hamlets and therefore the institutional jointness is supposedly more stable than in the other cases. For instance, in Figure 3 those hamlets that can conduct this multifunctional activity at the cost *oa* have cost-bearing capacity *ad* if *od* is the maximum cost level for implementing multifunctional activity. Nevertheless, this case hardly represents the majority of actual situations in hilly and mountainous areas because this case is too favorable for ordinary hamlets in these areas.

On the opposite extreme from Case 1, those rural areas with hamlet conditions at a low level inevitably have high costs both for consensus-making and utilizing human resources (Case 4). In this case, the level of hamlet function is too low to start a hamlet agreement, meaning that the cost-bearing capability is too low. In other words, institutional costs are still too high to bear for those hamlets. We do not expect institutional jointness in this case. This case is not illustrated because this case falls above *od* in Figure 3.

There exist intermediate cases in which hamlet function can be maintained at a level between those extreme cases described above. Those intermediate cases are not uncommon, and, in fact, in such hamlets one cost is usually higher than the other. For example, in one case (Case 2) the cost of utilizing human resources is low while consensus-making costs are high. In the other case (Case 3), there is a high cost for utilizing human resources and a low consensus-making cost.

In Case 2, the shape of the *VC* curve indicates that the cost-increasing portion is greater than the cost-decreasing portion, so the right upward portion becomes larger. Conversely, in Case 3, the cost-decreasing portion is greater than the cost-increasing portion, so the right downward portion becomes larger.

These different shapes provide not only information on institutional cost structure, but also on different prospects for multifunctional hamlet activities. In Case 2, it could be more effective to undertake hamlet activities within the traditional community range because it is rational for hamlets in Case 2 to save consensus-making cost. Conversely, in Case 3, it could be more appropriate to undertake hamlet activities in the inter-community range, which suggests that it will be rational to utilize the extended human network beyond a single hamlet boundary.

What we deal with here are Case 1, Case 2, and Case 3 as depicted in Figure 3, because

Case 4 is not considered to be feasible for a hamlet agreement due to the lowest hamlet conditions. How these three cases are connected with multifunctional activities is the empirical question.

6. Structural and Estimation Models

We focus on the three multifunctional activities: land-preserving activity, landscape-forming activity, and recreational activity. In fact, data for the cost function *VC* in the conceptual model above are not available, so that it is not possible to estimate the cost function directly. What is observable is the portion of undertaken multifunctional activity in the hamlet agreement at the prefectural level, called variable *Y*. Therefore, under the conceptual framework of cost minimizing behavior we use variable *NY* (=1− variable *Y*) as a proxy variable for the cost for each multifunctional activity.[11] We expect that the larger the variable *NY* is, the higher the cost for this multifunctional activity is. Put differently, we can assume a proportional relationship between the cost level of multifunctional activity and the variable *NY*. This is why we use the variable *NY* for the estimation. If the parameter is negative, the variable works favorably for the multifunctional activity and if the parameter is positive, the variable works unfavorably.

1) Model 1: Institutional cost structure

The next question is into which case each multifunctional activity actually falls. To clarify this point, we consider a *VC* curve determinant model concerning multifunctional activity *k* as below.

$$VC_k = f(x_k) \qquad (2)$$

Where, VC_k=envelope cost for multifunctional activity *k*

x_k = size of participants for multifunctional activity *k*

Regarding explanatory variables, first we use participant size per hamlet agreement as the explanatory variable of the size of the hamlet agreement. There are two reasons for this. 1) The participant size is not available for a specific multifunctional activity per se, but for each hamlet agreement that contains multifunctional activities. 2) We can assume that the participant size in a hamlet agreement roughly equals the size of each multifunctional activity because hamlet behavior is originally a unit of activity in this program.

Furthermore, to consider the difference in farm size in Hokkaido, a northern island, from other parts of Japan, we use a regional dummy variable: Hokkaido=1, other prefectures=0. The estimation model is a quadratic function. The estimation method is *OLS*. Strictly speaking, this estimated curve is different from the envelope cost curve. This is because *OLS* estimated curves will be inward curves rather than actual envelope curves, which means that the estimated cost level would be overestimated. However, the shape of the envelope curve will be clarified by this estimation. Bearing this in mind, we should be careful in the interpretation of the parameters.

$$NY_i^k = \alpha_0^k + \alpha_1^k (x_i^k)^2 + \alpha_2^k x_i^k + \alpha_3^k HD_i^k + \varepsilon_i^k \qquad (3)$$

Where, NY_i^k=1−(portion of undertaken multifunctional activity *k* in prefecture *i*)

x_i^k=participant size of multifunctional activity *k* in prefecture *i*

HD_i^k=regional dummy variable (Hokkaido =1, others=0)

ε_i^k=stochastic error

α_j^k=parameter to be estimated, α_o^k=constant

2) Model 2: factors determining multifunctional activities

Here, we evaluate what and how the factors of hamlet conditions listed in Figure 1 are connected with multifunctional activities. First is how the difference in human resources works, second is how the degree of consensus-making works, and third is how differences in agricultural production work.

$$VC = f(\boldsymbol{hc},\ \boldsymbol{nc},\ \boldsymbol{ag}) \qquad (4)$$

Where, $\boldsymbol{hc}$=vector of human resources factors

$\boldsymbol{nc}$=vector of consensus-making factors

$\boldsymbol{ag}$=vector of agricultural production factors

The dependent variable is the same as above. Because of limited availability of data, the explanatory variables are as follows:

In the data for the first variable of human resources, we take the portion of the elderly because the problems related to an aging population are much more serious in the mountainous and hilly areas. However, such data are not available at every agreement level. As an alternative, in this direct payment program, the local government is able to designate farmland with a ratio of elderly of 40% and a high land abandonment ratio at its own discretion.[12] Thus, we used the above criteria as the proportion of elderly since the data are available on the prefectural level. Generally, progression of aging results in depopulation, making it more difficult to secure human resources. This could be a major obstacle for starting a new multifunctional activity. Nevertheless, it could be a factor in promoting non-internalizing hamlet activity. Therefore, we do not give any sign condition beforehand.

For the second variable of consensus making, we take "the condition of farming consistency," or the condition of farming cooperation, which is a necessary condition for a hamlet agreement as mentioned. We consider two cases in accordance with the level of farming cooperation. We use a dummy variable either for the ordinary level or the high level in estimation. The ordinary level of cooperation is the case whereby one of the three farming consistency conditions mentioned above was met (yes=1, no=0). The highest level is the case wherein group farming or corporate farming is practiced (yes=1, no=0). Generally speaking, the higher the level of farming cooperation, the less could be the consensus-making cost for multifunctional activities. However, whether this is correct for every multifunctional activity is not a predetermined fact, but an empirical question to be examined. Therefore, we do not give a sign condition.

In the third vector of agricultural production, firstly we consider how the difference in farming productivity among areas affects a diversified activity such as rural tourism. To deal with this point, we use two opposing hypotheses. With the first hypothesis, it can be assumed that the larger the negative productivity gap, the greater the eagerness to promote farm diversification, such as rural tourism or the internalizing type of multifunctional activity, to gain additional income, i. e. the productivity gap hypothesis. Thus, this point aims at evaluating the possibility of farm activities taking advantage of multifunctionality in farming in less competitive areas. The second hypothesis, contrary to the first, assumes that areas with high productivity could be easily converted to diversified activity by taking advantage of the favorable farming conditions, i. e. the reverse productivity gap hypothesis. In short, if the first productivity gap hypothesis is true, the less competitive the area is, the greater the eagerness to undertake multifunctional activity of the internalizing type. On the other hand, the more competitive the area, the more diversified will be the activity to support the reverse productivity gap hypothesis.

Thus, if the productivity gap hypothesis is accepted, diversified activity will contribute to reducing the geographical productivity gap. Otherwise, if the reverse productivity gap will be adopted, the gap will widen. Therefore, findings on the issue of a productivity gap can disclose how productivity is connected with diversification behavior. Results of the estimation below will reveal which hypothesis can be accepted.

The productivity gap variable was obtained from the gross agricultural product per hectare as surveyed by MAFFJ. The data are calculated in the formula: the national average minus the prefectural data in 2000.[13] If the parameter is negative, the productivity gap hypothesis is accepted. This is because the lower the productivity, the more seriously needed are other income sources, which reduces the cost for this type of hamlet activity. In contrast, if the parameter is positive, the higher the productivity, the more activity is undertaken, which is the case of the reverse productivity gap hypothesis.

Secondly, as another variable of agricultural production, we consider the difference in land use reflecting essential factors of farming. We consider variables of land use focusing on rice paddy and livestock farming, which are major land uses in the program. For paddy we classify paddy as less steep (yes=1, no=0) and steep (yes=1, no=0) because all areas concerned are disadvantaged areas in terms of geographical and farming conditions. For livestock farming, we take steep grassland (yes=1, no=0). One of these dummy variables is used for estimation. Here again none of the sign conditions are predetermined.

The estimation model is below.

$$NY_i^k = \beta_0^k + \beta_1^k hc_i^k + \beta_2^k nc_i^k + \beta_3^k ag_{1i}^k + \beta_4^k ag_{2i}^k + \varphi_i^k \quad (5)$$

Where, hc_i^k=elderly ratio of multifunctional activity k in prefecture i

nc_i^k=farming constituency dummy variable (either farming consistency in general or group farming)

ag_{1i}^k=productivity gap variable

ag_{2i}^k=land use dummy variable (either less steep paddy or steep paddy or steep grass land)

φ_i^k=stochastic error

β_j^k=parameter to be estimated, β_0^k=constant

We do not use the regional dummy used in model 1 because it correlates with other explanatory variables. Estimation was conducted by *OLS* to compare the three multifunctional activities and to obtain indicators of multicollinearity.

7. Estimation Results

1) Model 1

The estimation result is shown in Table 3. Heteroscedasticity was not found by the White test. However, we cannot say that we had satisfactory results. The *VIF* and *CN* indicators were so high that multicollinearity was serious.[14] This is because of a strong correlation between the quadratic and linear terms of size variables. Therefore the parameters are not stable and are hard to interpret in detail. Still, we can obtain information for shapes of the cost curves.

This strong correlation between quadratic and linear terms means that the cost curve is a monotonously increasing or decreasing function for size. In other words, either the right downward portion or the right upward portion of the curve is quite large. This suggests that one of the two institutional factors works much more strongly than the other, which does not occur in Case 1 whereby the two factors work evenly. This is one of the main reasons for the serious multicollinearity. Thus we estimated models using only one size variable in quadratic or linear terms. For this reason, we only interpret the signs of the parameters.

The results of these cases of single-size variables are also shown in Table 3. Adjusted R^2 is the highest for recreational activity, followed by land-preserving activity and is lowest for landscape-forming activity. This is because land-preserving activity and landscape- forming activity are activities commonly undertaken across the nation, which makes the characteristic less apparent. The regional dummy is positive in the land-preserving function (5%).

Next, let us look into size parameters.

Table 3. Size of participants and multifunctional activities (Model 1)

Model type	Quadratic and linear			Quadratic			Linear		
Multifunctional activities	Land preserving	Landscape forming	Recreational	Land preserving	Landscape forming	Recreational	Land preserving	Landscape forming	Recreational
Constant	0.2056+	0.8093***	0.9490***	0.3525***	0.6827***	0.9896**	0.1958***	0.8415***	1.0393***
	(1.58)	(6.19)	(45.09)	(13.14)	(25.33)	(221.08)	(3.66)	(15.58)	(97.14)
(No. of participants)^2	0.0000	0.0000	−0.0001***	0.0001***	−0.0001***	−0.0001***	—	—	—
	(0.08)	(−0.27)	(−4.72)	(4.34)	(−4.60)	(−9.98)	—	—	—
No. of participants	0.0103	−0.0089	0.0028*	—	—	—	0.0110***	−0.0112***	−0.0037***
	(1.16)	(−0.99)	(1.97)	—	—	—	(4.56)	(−4.60)	(−7.69)
Regional dummy	0.3428**	0.0646	−0.0312	0.3989**	0.0162	−0.0157	0.3394**	0.0759	0.0006
	(2.15)	(0.40)	(−1.21)	(2.62)	(0.11)	(−0.62)	(2.23)	(0.50)	(0.02)
ajsR^2	0.3748	0.2815	0.7066	0.3700	0.2819	0.6874	0.3889	0.2967	0.5647
VIF		13.8748			1.0156			1.0435	
CN		19.0863			1.9994			4.8960	
White test	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*

Source: Same as Table 1.

Note: The t ratios are given in parentheses. Significance levels are shown by the results of the t test, such that***= 1%, **=5%, *=10%, +=20% (as reference), *ns*=not significant.

What is obvious is that linear and quadratic terms have the same sign and the sign is different from one multifunctional activity to another. The sign of land-preserving activity is positive, while the signs of landscape-forming and recreational activity are negative.[15] The interesting point here is that the sign reverses between the former and the latter two. What makes sense here is that in the first quadrant both variables have positive values. In that quadrant the land-preserving activity is monotonously increasing, which means that the right upward portion of the cost curve is large, while the landscape-forming activity and the recreational activity are monotonously decreasing, which means that the right downward portion is large.

In summary, we can characterize the relation between the *VC* cost curve and multifunctional activities in Table 4. First, land-preserving multifunctional activity, as a non-internalizing activity, has the positive parameter of size. This result suggests that the right upward portion of the *VC* curve is large, corresponding to Case 2. Concerning cost factors, we can surmise that the decreasing effect of costs of utilizing human resources is smaller than the increasing effect of consensus-making cost. This is because this type of hamlet activity is not a new activity, so that the cost of utilizing human resources would be low. However, on the other hand, the cost of consensus-making would increase as size grows. In this case it is rational to take the behavior of saving the consensus-making cost. Thus, it is safe to say that this characterizes non-internalizing hamlet behavior well. Put differently, a relatively small size based on the conventional hamlet would be rational. In short, this is a result of rational hamlet behavior and this multifunctional activity is undertaken in accordance with such a behavioral principle.

On the other hand, landscape-forming activity and recreational activity, classified as internalizing or internalizing-related hamlet activities, have negative parameters of size. This case is considered to be that in which the right downward portion of the *VC* curve is large, corresponding to Case 3. This indicates that the decreasing effect of utilizing human resources is greater than the increasing effect of consensus-making cost. Therefore, it is rational to consider cost-saving behavior in utilizing human resources. This means that a group of several hamlets or a wider hamlet network will be effective for these types of activity.

To summarize, the results of model 1 estimation suggest that there is an apparent difference derived from the cost structure between internalizing hamlet activity and non-internalizing activity. For non-internalizing hamlet activity, factors of consensus-making exert influence on the cost structure, so behavior in saving this cost is taken. Conversely, for the internalizing-related hamlet activity the cost of utilizing human resources is influential and this cost-saving behavior is performed. The implication of these results is that we should take into account the different characteristics of institutional cost structure and therefore different jointness of multifunctional activity. We explore factors related to these differences below.

2) Model 2

Results of estimation are shown in Tables 5-1, -2, -3. The *F* test for goodness of fit was significant in all estimations in Tables 5-1 and -2 but not in some of Table 5-3 because there were differences of adjusted R^2 just like those in model 1. Multicollinearity was

Table 4. Hamlet size and cost structure of multifunctional activities

Multifunctional activities	Size parameter	Area on the cost curve	Types of cost behavior
Land preserving	Plus	Area of right upward: Case 2	Consensus-making cost saving
Landscape forming	Minus	Area of right downward: Case 3	Utilizing human resource cost saving
Recreational	Minus	Area of right downward: Case 3	Utilizing human resource cost saving

not a serious problem in any estimation due to $VIF<10$ and heteroscedasticity was not observed. Let us examine estimation results.

First, land-preserving activity has the lowest adjusted R^2 among the three activities (Table 5-1). This is because this activity is too common to be distinguished from one region to another as mentioned earlier. The parameters affirm this fact. Regarding the parameters, neither the elderly portion nor the productivity gap was significant. The opposite is farming consistency; farming consistency in general is a negative parameter while group farming has a positive value with significance (1% level of significance for each).

These results mean that the level of farming cooperation up to a certain point works positively for land-preserving activity but works negatively for land-preserving activity above such a point. Therefore, land-preserving activity does not need a high level of farming cooperation, although this cooperation must reach a certain level.

The parameters of land use condition reaffirm that this hamlet behavior is commonly practiced because they were negative in paddy: less steep and steep paddy (5%). The parameter of steep grassland is slightly nega-

Table 5-1. Result of multifunctional activity determinant function 1 (Model 2)

Multifunctional activity	Land preserving					
Constant	0.7179***	0.7275***	0.6655***	0.4392***	0.4418***	0.4018***
	(8.26)	(7.83)	(7.98)	(10.37)	(7.99)	(12.85)
Portion of elderly	0.8893	0.5279	1.1957	1.9337	1.7125	2.0929
	(0.55)	(0.32)	(0.71)	(1.23)	(1.06)	(1.30)
Productivity gap	0.0028	0.0030	0.0029	0.0034	0.0034	0.0033
	(0.90)	(0.94)	(0.90)	(1.11)	(1.07)	(1.03)
Farming consistency	−0.3852***	−0.3716***	−0.3797***	—	—	—
	(−3.10)	(−2.97)	(−2.96)	—	—	—
Group farming	—	—	—	0.5366***	0.5279***	0.5548***
	—	—	—	(3.21)	(3.07)	(3.26)
Ratio of less steep paddy	−0.2814**	—	—	−0.1912+	—	—
	(−2.18)	—	—	(−1.49)	—	—
Ratio of steep paddy	—	−0.1867*	—	—	−0.1056	—
	—	(−1.91)	—	—	(−1.06)	—
Ratio of steep grassland	—	—	−0.0840+	—	—	−0.0441
	—	—	(−1.39)	—	—	(−0.74)
$ajsR^2$	0.2061	0.1870	0.1552	0.2161	0.1966	0.1857
VIF	1.0773	1.0720	1.0914	1.0357	1.0985	1.0845
CN	7.6653	7.9994	6.9829	3.3019	4.4087	2.1568
White test	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Goodness of fit	***	**	**	***	**	**

Source: Same as Table 1.
Note: The *t* ratios are given in parentheses. Significance levels are shown by the results of the *t* test, such that ***=1%, **=5%, *=10%, +=20% (as reference), *ns*=not significant.

tive, but not so apparent. To summarize, it is safe to say that this activity is undertaken in hamlets where paddy is common, which is a typical rural land use in this country.

Second, the results of landscape-forming activity demonstrate a unique feature in the portion of elderly with minus values (Table 5-2). The reason is that the activity of taking care of landscape plants, such as planting flowers, requires relatively lighter labor for participation of the elderly than an ordinary farming operation. This type of activity requires a relatively high level of farming cooperation unlike land-preserving activity. Farming consistency was a positive parameter (1%) whereas group farming was negative (1%). This is probably because this activity needs coherent collective action, especially for the elderly. The productivity gap is not significant, meaning no connection with this type of activity. Regarding land use, livestock farming and landscape-forming activity are not friendly; for example, steep grassland was positive. This is probably due to natural constraints on diversified land use. In short, the areas that have a relatively high level of farming cooperation and high portion of elderly prefer landscape-forming activity.

Table 5-2. Result of multifunctional activity determinant function 2 (Model 2)

Multifunctional activity	Landscape forming					
Constant	0.4278*** (5.22)	0.3753*** (4.39)	0.3758*** (5.21)	0.6913*** (19.02)	0.6623*** (13.95)	0.6427*** (24.80)
Ratio of the elderly	−2.6040* (−1.71)	−2.3672+ (−1.55)	−2.8802* (−1.99)	−3.5552** (−2.63)	−3.5417** (−2.56)	−3.7746*** (−2.82)
Productivity gap	−0.0011 (−0.39)	−0.0017 (−0.59)	−0.0026 (−0.91)	−0.0015 (−0.57)	−0.0019 (−0.71)	−0.0029 (−1.09)
Farming consistency	0.3473*** (2.97)	0.3558*** (3.09)	0.3796*** (3.42)	— —	— —	— —
Group farming	— —	— —	— —	−0.6454*** (−4.50)	−0.6275*** (−4.25)	−0.6070*** (−4.31)
Ratio of less steep paddy	−0.0183 (−0.15)	— —	— —	−0.1146 (−1.04)	— —	— —
Ratio of steep paddy	— —	0.0922 (1.02)	— —	— —	−0.0003 (−0.00)	— —
Ratio of steep grassland	— —	— —	0.1177** (2.25)	— —	— —	0.0761+ (1.55)
ajsR^2	0.2011	0.2201	0.2868	0.3478	0.3310	0.3673
VIF	1.0773	1.0720	1.0914	1.0357	1.0985	1.0845
CN	7.6653	7.9994	6.9829	3.3019	4.4087	2.1568
White test	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Goodness of fit	***	***	***	***	***	***

Source: Same as Table 1.
Note: The *t* ratios are given in parentheses. Significance levels are shown by the results of the *t* test, such that ***=1%, **=5%, *=10%, +=20% (as reference), *ns*=not significant.

Table 5-3. Result of multifunctional activity determinant function 3 (Model 2)

Multifunctional activity	Recreational					
Constant	0. 9086***	0. 9287***	0. 9229***	0. 9653***	0. 9910***	0. 9743***
	(41. 66)	(38. 30)	(43. 80)	(146. 06)	(116. 51)	(195. 12)
Portion of elderly	0. 1686	0. 1468	0. 1032	−0. 0120	−0. 0904	−0. 0335
	(0. 42)	(0. 34)	(0. 24)	(−0. 05)	(−0. 36)	(−0. 13)
Productivity gap	−0. 0010	−0. 0008	−0. 0010	−0. 0009*	−0. 0006	−0. 0009*
	(−1. 30)	(−0. 98)	(−1. 21)	(−1. 98)	(−1. 27)	(−1. 71)
Farming consistency	0. 0635**	0. 0569*	0. 0611*	—	—	—
	(2. 04)	(1. 74)	(1. 88)	—	—	—
Group farming	—	—	—	−0. 2320***	−0. 2499***	−0. 2369***
	—	—	—	(−8. 89)	(−9. 45)	(−8. 72)
Ratio of less steep paddy	0. 0688**	—	—	0. 0406**	—	—
	(2. 12)	—	—	(2. 02)	—	—
Ratio of steep paddy	—	0. 0015	—	—	−0. 0316**	—
	—	(0. 06)	—	—	(−2. 07)	—
Ratio of steep grassland	—	—	0. 0166	—	—	0. 0053
	—	—	(1. 09)	—	—	(0. 57)
ajsR^2	0. 1080	0. 0124	0. 0393	0. 6598	0. 6612	0. 6294
VIF	1. 0773	1. 0720	1. 0914	1. 0357	1. 0985	1. 0845
CN	7. 6653	7. 9994	6. 9829	3. 3019	4. 4087	2. 1568
White test	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Goodness of fit	*	*ns*	*ns*	***	***	***

Source: Same as Table 1.
Note: The *t* ratios are given in parentheses. Significance levels are shown by the results of the *t* test, such that ***=1%, **=5%, *=10%, $^+$=20% (as reference), *ns*=not significant.

Finally, recreational activity has no connection with the portion of the elderly since its parameter has no statistical difference at zero (Table 5-3). However, this type of activity needs a high level of hamlet function, as does landscape-forming activity, since farming consistency is positive (1%) while group farming is negative. An interesting point here is that the productivity gap hypothesis is barely accepted due its negative parameter, with 10% significance. This means that the productivity gap is accepted somewhat, so that low productivity areas will be eager to diversify their activity through rural tourism. However, it should be noted that the degree of farming cooperation exerts a stronger influence than the productivity gap.

Thus the results of the model 2 estimation revealed that choices of multifunctional activity would differ from one level of hamlet conditions to another. This also means that institutional jointness varies with hamlet conditions. We give further consideration to the implication of these results.

8. Discussion

Table 6 summarizes the characteristics of the three multifunctional activities based on the estimation results. Land-preserving activity is a commonly undertaken hamlet activity because the cost-bearing capability of performing this hamlet activity is rather low, which means that extra cost reduction efforts are not required for these hamlets. Thus, this is an example of widely applied institutional jointness. From the perspective of cost structure, because of familiarity with this activity, the consensus-making cost is low and will mildly increase when the size of participants grows. Cost of utilizing human resources will not decrease with size since there is neither the possibility nor the necessity for new human resources in starting this activity. For this reason there is neither orientation for internalizing the external effect into farm activity nor an increase in the size of the hamlet agreement.

Landscape-forming activity tends to be undertaken by hamlets in accordance with an aging population and with a relatively high level of hamlet function, characteristics that are not similar to land-preserving activity in this aspect. Because of the use of elderly human resources, consensus-making cost is low and will not rise with size while the cost of utilizing human resources is not too high and will decrease with size because of the advantage taken of the human network among the elderly. In this sense, it is empirically confirmed that this activity has intermediate features between land-preserving and recreational activities. So does the jointness.

Recreational activity needs the same high level of hamlet function as needed for group farming. This means that there is potential to tackle a new activity based on this high level of hamlet function. In other words, the cost-bearing capability for this activity is so high that only those hamlets that can perform at a low cost can conduct this activity. Thus this type of institutional jointness is the most stable although it is not widely observed. From the cost perspective, this means that consensus-making cost is sufficiently low because of highly motivated participants and no prospect for increasing this cost with size, suggesting a nearly constant size. On the other hand, there is some prospect of utilizing human resources, which means that a decreasing effect of the cost of utilizing human resources would be expected with size.[16] This is because often the main participants in this activity are middle-aged farming women who are proactive in extending the human network among themselves.

Thus, the differences in these activities are derived from the conditions of the hamlet and explain rural reality with no inconsistency.

9. Conclusions

Multifunctional activities differ from one rural area to another and these are often generated as a part of hamlet activities in Japan. Therefore, this paper evaluated multifunctional activities as rural hamlet activities by incorporating an institutional conceptual model under the direct payment program in Japan and conceptually and empirically explored institutional factors working for these activities. The following are the main conclusions, although we should be careful in generalizing the results to a great extent due to constraints on data and estimation results.

First, it was revealed that multifunctional activities differ in cost structure and subsequently institutional jointness varies. Thus, multifunctionality should be promoted taking into account these differences of institutional jointness derived from local conditions.

Second, a community-based approach especially based on an open and extended human

Table 6. Internalization of multifunctionality and necessary level of hamlet function

Types of multifunctional activities	Possibility of internalizing externality	Necessary level for utilizing human resources	Necessary level for hamlet function
Land preserving	Low	Low	Low
Landscape forming	Middle	Middle	Middle
Recreational	High	High	High

network rather than on the traditional closed one in rural communities will be effective for developing rural and farm diversification such as rural tourism.

Further, we observed a tendency that rural tourism activity was undertaken in areas with lower productivity. This means that diversification will reduce the productivity gap between areas. Therefore, we should emphasize diversification, taking advantage of multifunctionality, especially in the less competitive areas. In this sense, farm policy should be implemented complementarily together with rural policy.

1) For relation between multifunctionality and agriculture, see OECD [12] from the policy perspective, Van Huylenbroeck and Durand [18] from the European perspective and Ohe [13] from the Japanese perspective.
2) As an example of internalization of externality caused by multifunctionality, see Ohe [14], which explored conceptual and empirical evaluation of rural tourism. For land-preserving activity, or countryside stewardship, see Van Huylenbroeck and Whitby [17], OECD [11].
3) According to Platteau and Hayami [16], there are two types of rural communities: the village community where inhabitants live in the same place and the tribal community where inhabitants have a nomadic way of life. The rural community referred to here is the village community typically observed in East Asia.
4) For institutional jointness, see Hagedorn [5]. Little has been studied on institutional joint ness conceptually and empirically. We understand that institutional jointness represents a relationship in which institutional factors are involved in generating multifunctionality in the process of farming unlike technical jointness, which is determined by technical aspects of farming. Institutional factors are those such as policy institutions, management institutions and community institutions. We focus on rural community institutions here.
5) Yamashita [21], as a designer of this direct payment program, and National Chamber of Agriculture [10] explained the purpose and details, while Hayami and Godo [4] is critical of this program. The five-year first stage of this program ended in 2004 and the revised five-year second stage started in 2005.
6) For a neo-institutional economics approach to agricultural institutions, see Van Huylenbroeck, Verbeke and Lauwers [19]. For a more theoretical excursion of transaction cost economics, see Williamson [20]. However, the rural community has not been studied in this literature. We also take a neo-institutional approach here.
7) For an overview of group faming in Japan see Ito [6]. Ohe [13] clarified the role-sharing relationship between group faming in the hamlet and individual farm diversification activity.
8) We incorporate the idea of the public choice theory, one of the fields of neo-institutional economics, into the conceptual framework. See Buchanan and Tullock [1], Muller [9], and Olson [15] for the public choice theory.
9) If the first derivative of the consensus-making cost or cost of utilizing human resource is zero, then shape-wise the average cost curve would be linearly right upward or right downward. In this case marginal and average costs become identical.
10) To utilize the appropriate human resources, there will be search cost for appropriate human resources. However, this cost will be negligible because the search action will be undertaken within the range of the hamlet or in the neighboring inter-hamlet areas.
11) Even if we use the variable Y instead of NY, the statistical results do not change except for the constant and reversed signs of the parameters.
12) The portion of acreage covered by this criterion is 19.1% of all the designated areas on average.
13) We used a variable of income per hectare instead of the variable of land productivity for the estimation. The goodness of fit was worse than in the latter case although we obtained similar parameters with the latter case.
14) Multicollinearity is serious when VIF is over ten or CN is over 15 according to Chaterjee, Hadi and Price [2], while Greene [3] says over 20 of CN is the case. Kmenta [8] says that when CN is over 30 multicollinearity is harmful.
15) The negative parameter of the quadratic size variable means that the implicit assumption of the second order condition for cost minimization is not satisfied. Strictly speaking, in this case we should only examine the result of the linear size variable case, where marginal and average costs are identical. This is a constraint of this analysis that should be taken into consideration when we interpret the estimation results although in both cases results were similar, showing a negative sign for the size parameters.
16) We calculated the average size of participants in the hamlet agreement for the three multifunctional activities: land preserving was

19.5 persons, landscape forming was 20.6, and recreational was 21.0. There were no statistically significant differences among the three; hence, we could not confirm the economy of scale in terms of the size of each cost factor. This is probably because we had to use not the size of each multifunctional activity, but the average sizes of the hamlet agreement at the prefectural level due to data constraints, which would make the variance of the data smaller.

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