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Direct Payments for Environmental Services from Mountain Agriculture in Japan: Evaluating its Effectiveness and Drawing Lessons for Developing Countries

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Abstract*: This article evaluates the effectiveness of ex-post targeting of the direct payment program for mountain agriculture in Japan. A regression analysis explaining the entry into the program shows that the farm profitability and the production cost were significant positive and negative factor, respectively, in determining the uptake, while the efforts by local governments were a robust factor in facilitating the enrollment. These findings imply ineffective ex-post targeting and call for the differentiation of the premium, alternative incentives to promote forestation for the un-enrolled fields and additional funds targeted to those prefectures with the low uptake ratio. Lessons drawn from the Japanese experience for effective incentive measures in developing countries include the use of composite indicators in designating eligible areas to avoid the risk of insufficient targeting and the engagement of local governments to facilitate the entry through the reduction of transaction costs among participants.*

Keywords: *cost-effectiveness, direct payment, environmental services, mountain farming, targeting, transaction costs, Japan.*

1. Introduction

The direct payment program for farmers in hilly and mountainous areas was introduced in Japan in 2000 with the aim of preserving environmental services from agriculture through the prevention of further abandonment of farmland (Yamashita, 2001). This scheme is the first full-fledged incentive payment in Japan specifically designed to maintain and enhance non-economic functions exhibited by agriculture, in light of the enactment of the New Agricultural Basic Law in 1999 (MAFF 1999). The program was inaugurated with the initial duration of 5 years until 2004. Despite some resistance from the budgetary authority (Ministry of Finance, 2004), it has extended further 5 years until 2009 with minor amendments to the scheme (MAFF, 2005). It is now appropriate to take stock of the first phase of the program, given that a sufficient amount of data on implementation results is now available. The evaluation is expected not only to provide useful insights to improve the effectiveness of the scheme, but also to draw informative lessons for the rapidly expanding 'payments for environmental services' (PES) in developing countries[1].

The concept of policy evaluation needs to be understood unambiguously, given than 'evaluation' can be interpreted as several different meanings. Policy evaluation in programme level (programme evaluation) is defined as 'a systematic and analytical assessment addressing important aspects of a programme and its value, and seeking reliability and usability of findings', and 'the main objectives of evaluation are to improve decision-making, resource allocation and accountability' (OECD, 1999). Evaluation can occur at any time in a programme's life-cycle and, in this respect, a distinction should be made between *ex-ante* and *ex-post* evaluation. The former type of perspective analysis is often called 'policy analysis' or 'appraisal'. While policy analysis explores policy options and likely effects, *ex-post* evaluation examines actual effects and judges the value of policies (Jones, 2004). It is obvious from the aforementioned distinction that the focus of this paper is the latter type of *ex-post* evaluation.

[1] The overview of payments for forest environmental services in developing countries is provided by Landell-Mills and Porras, 2002 and Pagiola, Bishop and Landell-Mills, 2002.

A programme should be evaluated against its objectives, and one of the most frequently used criteria for representing its performance is termed 'effectiveness'[2]. Notwithstanding a large volume of literature, the assessment on the effectiveness of the Japanese program is highly divided. One group of literature (e.g. MAFF, 2004a, Odagiri, 2002a) highly values its outcome. The main rationale is the fact that the average uptake ratio to the program was fairly high (85 percent in 2004 on an area basis) and that no farmland abandonment occurred in any plots enrolled in the program in the fast five years (665 thousands ha in 2004). Other studies reject such a positive assessment (e.g. Suda, 2002). They attach high importance on the failure of targeting exemplified by the fact the uptake ratio was high in favourable areas with high farm income whereas it was low in unfavourable regions with aging and steep topography. The former implies over-compensation while the latter suggests the under-compensation that would lead to farmland abandonment. This confusion suggests the need of establishing a solid analytical framework that includes a precise definition of 'effectiveness' and a criterion for evaluating it.

The existing literature on the performance of the Japanese program exhibits additional weaknesses. One of them is the fact that a vast majority is descriptive nature based on the data from the MAFF on its implementation results, lacking unambiguous quantitative evaluation about the effectiveness of the program (e.g. Board of Audit, 2002; Kashiwagi, 2004; Moritomo, 2002; and Odagiri, 2002a). The other weakness is the fact that, even in the literature attempting quantitative evaluation of the program (e.g. Yokouchi, Ohe and Kurihara, 2003, and Yonezawa and Takeuchi, 2003), its coverage is restricted to specific regions within a prefecture, which makes it difficult to draw general policy conclusions. In fact, there is no attempt to date of quantitative evaluation of the program at national level, which is somewhat surprising in light of high interests attached to it in Japan and potential relevance to similar initiatives in other countries[3]. The objective of this article is to fill the gap by evaluating the effectiveness of the program quantitatively based on the nation-wide data on a prefectural basis.

[2] Another commonly used criterion for programme evaluation is 'economic efficiency', which requires the marginal value of the environmental outcome being at least equals to the marginal cost of generating it. Often these marginal values are not available and this criterion cannot be made operational (OECD, 2001a).

[3] Ohe (2004) provides a quantitative analysis of the program, but it does not aim to assess the effectiveness vis-à-vis its policy objective.

The article is structured as follows. The basic scheme of the program is summarized and the implementation results of its first phase from 2000 to 2004 are reviewed in the next section. Then, an analytical framework that includes a precise definition of 'effectiveness' and a criterion and methodology in evaluating it is presented in section 3. A conceptual model describing the behaviour of profit-maximizing eligible farmers for enrolling in the program is developed in section 4. Based on the analytical framework and the conceptual model, an empirical model and data to be employed by a regression analysis is presented in section 5, while regression results, discussion based on the results and policy recommendations from the analysis are given in section 6. Lessons drawn from the Japanese experiences for incentive payments in developing countries are examined in section 7, and the paper is closed with summary and conclusions.

2. Review of the program

Although there is no single definition of 'hilly and mountainous areas' in Japan, they are generally understood as the areas characterized by high forest cover, steep topography and the remoteness from major cities. Japan's agricultural statistics designates them based on land use (e.g. the share of forestry), and, base on this definition, they account for around 40 percent of total farmland, number of farm households and value of agricultural production, respectively (Yamashita, 2001, p. 11). The need of specific support measures for the faming in hilly and mountainous areas became evident in the late 1990s in the wake of sharp increase in the abandonment of farmland in those areas (Table 1). This caused public concern over the loss of such environmental services as flood mitigation and soil and landslide prevention that has been maintained through proper management of farmland, especially paddy fields[4]. Consequently, the introduction of direct payment program specifically targeted to the farmers in hilly and mountainous areas was determined in 1998 with the aim of preserving environmental services through the prevention of further abandonment of farmland (MAFF, 1998a and 1998b).

[4] National Research Institute of Agricultural Economics (1998) provides the monetary evaluation of environmental services exhibited by agriculture in hilly and mountainous areas by the Replacement Cost Method. The criticism to the method can be found in Pagiola, von Ritter and Bishop (2004).

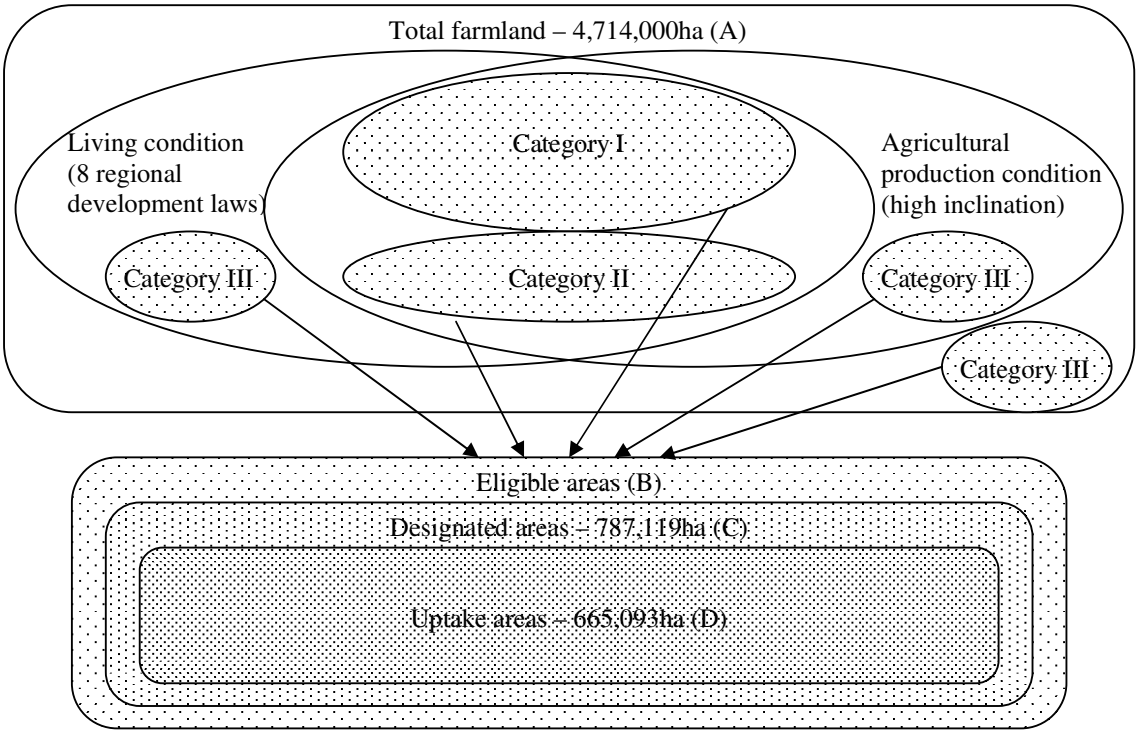
Table 1 Share of farmland abandonment ratio

	unit	1985	1990	1995	2000
flat areas	%	1.1	1.9	2.5	3.4
hilly and mountainous areas		2.8	4.8	5.2	7.0

Source: Yamashita, 2001, p. 32
Note: farmland abandonment ratio = abandoned farmland / (total farmland + abandoned farmland)

The basic scheme of the program can be distilled into three key parameters; criteria for designating eligible areas, the level and composition of premium and compliance requirements for the payment. The eligible areas are designated by both harsh living and agricultural production conditions in order to target the payment to those fields with high risk of abandonment. The specific criterion for harsh living conditions is an eligible municipality being designated by at least one of the 8 regional development laws which aims to promote economic development in disadvantaged regions. These regions include, among others, mountainous areas, highly depopulated areas, peninsulas and isolated islands. Eligible fields within eligible municipalities are then screened primarily based on their inclination. The process of screening eligible areas is presented in the upper panel of Figure 1.

Figure 1 Schema of screening process



Source: MAFF 2005a and 2005c
Note: Numbers in this schema are those in 2004.

Eligible areas are composed of three categories and criteria for their designation are different each other. The eligible fields in category I should exist within 8 regional development laws with high inclination. Specific criteria on inclination are more than 2.9 degrees for paddy field and 15 degrees for upland fields, meadow and pasture, respectively[5]. The eligible plots in category II are those within 8 regional development laws but with modest inclination. Specific criteria on inclination are more than 0.6 degrees for paddy field and 8 degrees for upland field, meadow and pasture, respectively. The category III is those areas with a similar likelihood of farmland abandonment as the previous two categories, but is designated by prefectural governments by their own criteria. As is presented in the lower panel of Figure1, three steps are followed in determining actual uptake area to the program: the central government first establishes the criteria for eligible areas (area B), local governments possessing the eligible areas then designate the areas where the payments are to be made (area C), and farmers within the designated areas finally decide whether they enrol in the scheme (area D).

The level of premium was determined based on opportunity costs for farmers in eligible areas to continue farming. Specifically, the premium was set so as to cover 80 percent of the difference in production costs of each crop (rice, upland crops, meadow and pasture) with flat areas. Table 2 presents specific rates of premium by inclination and land type. The premium is largely divided into two based on inclination, where farmland with high inclination receives more payment that that with low inclination, reflecting the higher production costs in the former farmland. A special category of premium for meadow is established irrespective of its inclination. The program is co-financed by the central government and local governments. Although the burden of local governments (prefectures and municipalities) is limited to half in total in the case of category I and II, their contribution is increased to two-thirds as far as category III is concerned with the purpose of preventing local governments from free-riding to the central government's budget by designating category III areas as much as they wish[6].

[5] Category I areas include 'special meadow areas' that cover the meadow in which the share of meadow to total farmland is 70 percent or more in a municipality.

[6] Another device to prevent free-riding was to establish the ceiling in terms of category III areas that municipalities are entitled to designate. Category III areas are limited to the sum of 5 percent of farmland within 8 regional development laws and 5 percent of farmland outside those laws in a given prefecture.

Table 2 Premium level by category and land type

land type	unit	Category I (high inclination)	Category II &III (low inclination)	special meadow area
paddy filed	yen/10a	21,000	8,000	-
upland field		11,500	3,500	-
meadow		10,500	3,000	1,500
pasture		1,000	300	-

Source: Yamashita, 2001, p. 193.

As for compliance requirements, recipients have to formulate a collective agreement with community members that stipulates conservation activities to be conducted for the duration of no less than five years. The conservation activities include proper cultivation or management of fields and the maintenance of such common property resources as irrigation canals, common ponds and community roads. Local governments (both prefectural and municipal) play key roles in propagating, implementing and enforcing the program and, in particular, municipal governments are supposed to conduct a number of such critical activities as designating eligible areas, approving community agreements, delivering premium and monitor the adherence to the agreements. The central government provides local governments with additional funds, apart from but proportional to the total payments to the recipients, for financing these complementary activities undertaken by local governments (MAFF, 2000).

Table 3 presents the overview of implementation results of the program. As of FY 2004, 93 percent (1,484) of eligible municipalities enrolled in this program and 85 percent (665 thousand ha) of total eligible farmland was covered by the agreements. The share of fields covered by the agreements accounted for 14 percent of total farmland. More than 33 thousand community agreements were established and participants to them amounted to 656 thousands. Total payment reached to 55 billion yen. Taking the voluntary nature of this program into consideration, the coverage of this scheme might be satisfactory in its entirety. However, the uptake ratio on an area basis varies depending on a district and land type, as is shown in Table 4. On a district basis, the uptake ratio was extremely high in Hokkaido with 96 percent, whereas it was low in Kantou, Kinki and Okinawa with the order of 60 percent. On the basis of land type, the uptake ratio was very high for meadow and pasture, both exceeding 90 percent, while it was low for upland fields with merely 64 percent.

Table 3 Overview of implementation results

	unit	2000	2001	2002	2003	2004
eligible municipalities	-	2,158	2,122	2,101	2,041	1,591
uptake municipalities	-	1,687	1,913	1,946	1,902	1,484
uptake ratio	%	78	90	93	93	93
eligible areas	1000 ha	798	782	784	783	787
uptake areas	1000 ha	541	632	655	662	665
uptake ratio	%	68	81	83	85	85
Total farmland	1000 ha	4,830	4,794	4,762	4,736	4,714
share of uptake areas	%	11	13	14	14	14
total number of community agreement	-	25,621	31,462	32,747	33,137	33,331
total participants to community agreement	1000	489	613	647	656	660
total amount of payment	1000 yen	41,937	51,417	53,830	54,584	54,905

Source: MAFF, 2001a, 2002a, 2003a, 2004b, 2005a and 2005c.

Note: The decrease in the number of municipalities is due to merger.

Table 4 Uptake ratio by district and land type (2004)

		eligible areas	uptake areas	uptake ratio
unit		1,000 ha	1,000 ha	percent
by district	Hokkaido	343	328	96
	Touhoku	83	66	80
	Kontou	38	26	69
	Hokuriku	33	27	84
	Toukai	13	11	83
	Kinki	41	26	63
	Chu-Shikoku	133	95	72
	Kyushu	98	81	83
	Okinawa	6	4	62
by land type	paddy field	344	279	81
	upland field	113	73	65
	meadow	313	297	95
	pasture	18	16	92

Source: MAFF, 2005a.

3. Analytical framework

In assessing the effectiveness of the payment program, several conceptual issues need to be clarified at the outset. These include (i) whether the analysis should focus on either *ex-ante* or *ex-post* targeting strategy, (ii) which criterion should be employed to assess the effectiveness, and (iii) what kind of methodology should be, and can be, applied from the viewpoint of analytical soundness and data availability. In addition to these conceptual challenges, the implication of farm-level transaction costs on the entry into the program also need to be taken into consideration in modelling the impact of the payment, given the scale of such costs in running incentive payments, as is demonstrated by Falconer, Dupraz and Whitby (2001). The task of this section is to establish an analytical framework for assessing the effectiveness of the program, and also examine the implication of farm-level transaction costs on the entry into the program and the devices to reduce such transaction costs. The close scrutiny of these issues paves the way for a conceptual model describing the behaviour of the recipients of the program in the section 4 and for an empirical analysis in the section 5.

Conceptual issues pertaining to *ex-post* evaluation

The effectiveness of the program can be assessed in light of the extent to which the scheme has delivered the payment to the predetermined target. The predetermined target in this case means those fields to be abandoned if the payment is not made. The issue of targeting is comprised of two distinct angles: *ex-ante* and *ex-post*. *Ex-ante* targeting relates primarily to the 'criteria' for designating eligible areas and the condition can be met if its key criterion (i.e. inclination of fields) serves as a good proxy for identifying those fields with high risk of abandonment and if the local governments designate eligible fields properly based on the determined criteria and procedure. *Ex-post* targeting is, on the other hand, a matter of the incentive structure and such a condition can be satisfied when the level and composition of the premium is tailored to compensate the opportunity cost of production for those fields to be abandoned without the payment. This paper exclusively focuses on the *ex-post* targeting, given that assessing alternative *ex-ante* targeting strategy is not feasible due to data limitation[7].

In assessing the success of *ex-post* targeting in the program, an appropriate criterion on effectiveness needs to be established, and this task can be clarified by a diagram describing the impact of the payment on the production of a commodity and the amount of farmland cultivated. In Figure 2, the upward vertical axis, downward vertical axis and horizontal axis denote the price of outputs (P), quantity of farmland (L) and quantity of outputs (Q), respectively. The upward sloping line in the upper panel and the downward sloping line in the lower panel represent aggregated marginal cost curve (i.e. supply curve) and yield curve, respectively. The area of cultivated land is obtained by dividing the total quantity produced given price level by yield. The yield line is assumed to be linier for simplicity. l_m, $l_m - l_1$ and $l_3 - l_1$ represent the endowment of total farmland (A), total eligible areas (B) and total designated areas (C), respectively[8], as is presented in the lower panel of Figure 1. The introduction of the flat area payment shifts the price line (p) of recipient producers upwards by d. As a result, the farmland $l_2 - l_1$, corresponding to the uptake areas (D) in Figure 1, is now cultivated, in addition to l_1 which has been cultivated under the current incentive level.

This simple diagram illustrates the interpretation of two different criteria in assessing the effectiveness of the incentive payment: environmental effectiveness and cost-effectiveness (Jones, 2004). 'Environmental effectiveness' refers to 'the extent to which the policy meets its intended environmental objective, including threshold levels, targets etc' (*ibid*). In the case of this program, the uptake ratio in an area basis as expressed D/C can be seen as an indicator for environmental effectiveness, since the higher uptake ratio, the most visible target in the program, implies that the premium level is sufficient to compensate opportunity cost and to prevent farmland abandonment. It is obvious from Figure 2, however, that meeting the criterion of environmental effectiveness does not guarantee the least cost way of attaining the stated policy objective. The flat area payment ignoring heterogeneous land quality generates over-compensation to low-cost producers, corresponding to the shaded upper triangle abc in Figure 2.

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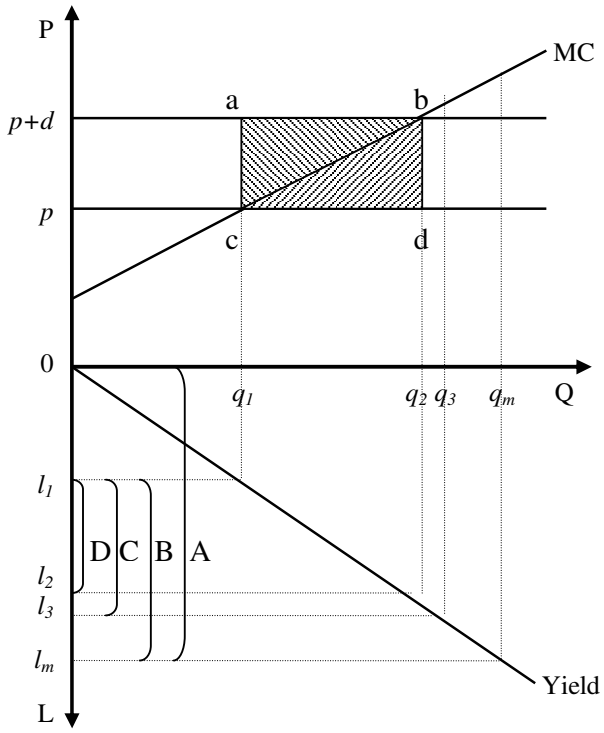
[7] Yang, Khanna, Farnsworth and Önal (2005) addresses the cost-effectiveness of *ex-ante* targeting strategy of the Conservation Reserve Enhancement Program in Illinois by using modelling approach.

[8] In this diagram, it is assumed that the local governments exclude plots with high opportunity cost, equivalent to $l_m - l_3$, from designation even if they are eligible. This is consistent with the actual tendency by local governments as indicate in MAFF, 2004c (p. 15).

Figure 2 Impact of flat area payment on land use



How can such an over-compensation be avoided? This is a question of 'cost-effectiveness', which denotes 'the extent to which the policy achieves its stated objectives at minimum cost, in terms of resource allocation, budgetary expenditure etc' (*ibid*). The condition for attaining cost-effectiveness, while meeting the environmental effectiveness, is to pay the premium equivalent to the total opportunity costs, corresponding to the shaded lower triangle bcd in Figure 2. In this case, over-compensation disappears completely and the premium is perfectly 'additional' in a sense that the payment actually changed the behaviour of enrolled farmers away from abandonment to continued cultivation (Cacho, Marshall and Milne, 2003). This illustration clearly shows that examining the environmental effectiveness based on the uptake ratio target is by no means sufficient and that close scrutiny of the degree of cost effectiveness is indispensable in assessing its performance[9].

[9] For ordinary agri-environmental payments in other OECD countries which aim to withdraw farmland from production (e.g. the Conservation Reserve Program of the US), 'slippage' is another factor in diminishing cost-effectiveness of incentive programs. 'Slippage' denotes the unintended side effect of the incentive payments that induce the conversion of non-cropland into crop production, offsetting their potential benefits (Wu, 2000). This is not an issue of the Japanese program, since its objective is, in contrast, to maintain the cultivation of farmland.

The next task is to determine an appropriate methodological approach in assessing the cost-effectiveness of *ex-post* targeting strategy of the program. Several options are examined based on the existing literature and the feasible methodology will be identified. The simplest way is, as is shown above, to estimate and compare the total payment (rectangle abcd) with the total opportunity cost of production (triangle bcd). The former (abcd) and latter (bcd) can be viewed, roughly speaking, as the cost and benefit, respectively[10]. Thus the ratio of the latter to the former implies the benefit-cost ratio of the program: higher the ratio, higher the cost-effectiveness would be. Such a straightforward approach is infeasible, however, due to the lack of date particularly on the aggregate opportunity costs. As the opportunity cost of production in each plot is a function of various factors, it cannot be directly observable and incurs insurmountable transaction costs for data collection.

Given the aforementioned obstacle, an alternative approach is to identify the factors determining the entry into the program through a regression analysis and to assess its cost-effectiveness based on the existence or non-existence of systematic biases in the enrolment. As for the Japan's direct payment program for example, Yokouchi, Ohe and Kurihara (2003) employs a probit model to examine the factors in determining the uptake in Abou District of Chiba Prefecture. The key conclusion from their analysis is that the uptake ratio is higher in those communities with, among others, high capital endowment, secured core farmers and high farm income, and is negatively correlated with the degree of farmland abandonment. A similar study can be found in Wynn, Crabtree and Potts (2001), in which factors affecting the entry to the Environmentally Sensitive Area Schemes in Scotland are identified by using a multinomial logit model, even though the study does not intend to assess the cost-effectiveness of the scheme.

This article employs a similar analytical approach as mentioned above, but the specific methodology is slightly different due to data limitations. The precondition of employing a qualitative dependant model is the availability of the data sets that include both entrants and non-entrant to the scheme. Since the information on non-entrants to the program is not readily available in all prefectures, the approach taken by Yokouchi, Ohe and Kurihara cannot be replicated when the scope of the analysis is expanded into nationwide. The methodology to be

[10] This is based on the assumption that the entry into the program automatically leads to the exhibition of environmental services through continued cultivation or conservation, as the designer of the program anticipated.

used is therefore to estimate a linear regression model based on the data in prefectural basis, with a dependent variable being continuous (i.e. uptake ratio to the program) rather than discrete (i.e. dichotomous choice of entry). Possible explanatory variables include farm revenue, level of payment, production cost and transaction costs for entry, and estimated coefficients of these explanatory variables provide indications as to whether the premium is delivered to the intended targets. For example, if the uptake is proved to be positively correlated with farm revenue in eligible areas, as suggested by Suda (2002), this implies that the payments benefit advantageous regions more and that the targeting strategy of the program is not cost-effective.

Implication of transaction costs on the entry into the program

Transaction costs can be defined as 'the costs of arranging a contract to exchange property rights *ex ante* and monitoring and enforcing the contract *ex post*, as opposed to production costs, which are the costs of executing a contract' (Matthews, 1986). Transaction costs could include all costs associated with any allocative decision regardless of whether the decision is made in a market or by a government (i.e. policies) (Challen, 2000). Transaction costs could therefore be divided into two categories: (i) non policy-related transaction costs, which are incurred by parties to voluntary transactions (e.g. market, club and voluntary provision), and (ii) policy-related transaction costs, which are associated with the implementation of policies. The former could prevent voluntary transactions from working efficiently while the latter could lead to inefficient policies (OECD, 2001b).

There is little doubt that this scheme is transaction cost intensive since, as presented in the previous section, recipients are obliged to form collective agreements among community members to receive the payment. This is a notable feature of this Japanese program, given that almost all incentive payments with environmental objective in the US and EU target individual farmers rather than collective groups. Such a transaction cost intensive scheme naturally should accompany a complementary measure to mitigate these transaction costs and facilitate the entry. In this regard, the active engagement of local governments is fundamental to facilitate the uptake and thus is expected to exhibit 'positive externalities' by reducing policy-related transaction costs at farm level, This 'cost saving effect' can in turn be influenced by; (i) the sense of urgency by local governments on the expansion of farmland abandonment, (ii) the scale of funds delivered from the central government to reduce policy-

related transaction costs and (iii) the degree of the economies of scale in policy-related transaction costs as the scale of payment increases within local governments (Aikawa, 2003).

4. Conceptual model

The aforementioned conceptual framework including the implication of transaction costs on the entry enables to establish a conceptual model to describe the behaviour of profit-maximizing farmers who are eligible for enrolling in the program. At the outset, a profit function of eligible farmers of the payment can be defined as:

$$\pi = PQ + TDP - wx - c - (TTC - TCS) \quad (1)$$

where π is profit, P is the price of a commodity, Q is the quantity of the commodity, TDP is total amount of premium, w is the price of a variable input, x is the quantity of the variable input and c is fixed cost. In addition to these standard elements of profit function, two types of transaction costs affecting the micro-level decision-making of recipients are explicitly included in this conceptual model: these are the total transaction costs (TTC) pertaining to negotiate, implement and enforce the community agreement[11] and the cost saving effects of these transaction costs (TCS) through promotional activities by local governments to facilitate the enrolment.

By assuming that premium is flat area payment and transaction costs are a linear function of area enrolled in the agreement, TDP, TTC and TCS can be rewritten as:

$$TDP = DP \times L = DP \times \frac{Q}{y} \quad (2)$$

$$TTC = TC \times L = TC \times \frac{Q}{y} \quad (3)$$

$$TCS = CS \times L = CS \times \frac{Q}{y} \quad (4)$$

where DP is premium per area, L is farmland enrolled in the contract, y is the yield of the commodity per area, TC is transaction costs per area and CS is saved transaction costs per area. By substituting equations (2), (3) and (4) for equations (1), the equation (1) can be rewritten as:

$$\pi = PQ + DP\frac{Q}{y} - wx - c - (TC\frac{Q}{y} - CS\frac{Q}{y}) \quad (5)$$

[11] Incorporation of transaction costs in the model is based on Peerlings and Polman, 2004.

The condition for farmers to maintain the production considering both direct payment and accompanying transaction costs can be obtained by taking derivative of the equation (5) with respect to Q and by setting the equation equals to zero.

$$\text{maximize } \pi \Rightarrow \frac{\partial \pi}{\partial Q} = \frac{\partial PQ}{\partial Q} + \frac{\partial DP \frac{Q}{y}}{\partial Q} - \frac{\partial wx}{\partial Q} - \frac{\partial c}{\partial Q} - \frac{\partial TC \frac{Q}{y}}{\partial Q} + \frac{\partial CS \frac{Q}{y}}{\partial Q} = 0 \quad (6)$$

Thus, the first-order condition for profit maximization can be defined as:

$$P + \frac{DP}{y} = \frac{\partial wx}{\partial Q} + \frac{TC - CS}{y} = MC + \frac{TC - CS}{y} \quad (7)$$

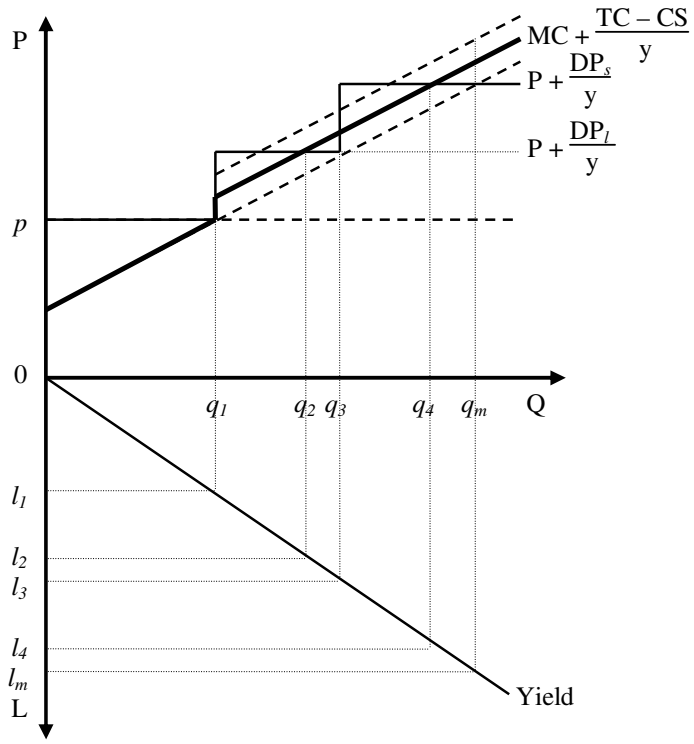
As the level of premium is differentiated based on the inclination of fields, the first order condition can be differentiated accordingly as follows:

$$\text{eligible areas with low inclination} \Rightarrow P + \frac{DP_l}{y} = MC + \frac{TC - CS}{y} \quad (8)$$

$$\text{eligible areas with high inclination} \Rightarrow P + \frac{DP_s}{y} = MC + \frac{TC - CS}{y} \quad (9)$$

where DP_l and DP_s denote the level of premium for eligible area with low and high inclination, respectively.

Figure 3 Impact of two-stage payment on land use



Following the previous diagram, the impact of the program is described in Figure 3. Owing to the introduction of two-stage payment rates, the price line shifts upwards by $\frac{DP_l}{y}$ and $\frac{DP_s}{y}$ in the eligible areas with low and high inclination, respectively. The marginal cost curve shifts upwards initially by $\frac{TC}{y}$ due to the existence of transaction costs, but the spill-over effects of saving these transaction cost act to restrain this movement by $\frac{CS}{y}$. Therefore, the areas equivalent to $l_2 - l_1$ and $l_4 - l_3$ are now being cultivated in the wake of the payment[12]. The aggregate uptake ratio can be new expressed as:

$$UR_l = \frac{l_2 - l_1}{l_3 - l_1} \times 100 \tag{10}$$

$$UR_s = \frac{l_4 - l_3}{l_m - l_3} \times 100 \tag{11}$$

where UR_l and UR_s denote the uptake ratio in low and high inclination fields, respectively.

[12] This conceptual model ignores the costs necessary for recovering abandoned farmland for simplicity.

5. Empirical model and data

Building on the analytical framework and particularly on the conceptual model describing profit maximization behaviour of recipient farmers developed in the previous section, the structural model on the entry into the program (UR) can be defined as:

$$UR = f(AR, DP, C, TC, CS) \tag{12}$$

where AR, DP, C, TC and CS are the factors of agricultural revenue, level of premium, production costs, transaction costs pertaining to the program and the saving of transaction costs due to spill-over effects through the efforts by local governments, respectively. Following the equation (7), the expected direction of the effects of these factors on the uptake to the program can be expressed as:

$$\frac{\partial UR}{\partial AR} > 0, \frac{\partial UR}{\partial DP} > 0, \frac{\partial UR}{\partial C} < 0, \frac{\partial UR}{\partial TC} < 0 \text{ and } \frac{\partial UR}{\partial CS} > 0 \tag{13}$$

This structural model can be transformed into the empirical model to be estimated as follows, in light of the practical limitations on data availability:

$$UR_{it} = \beta_0 + \beta_1 AR_{it-1} + \beta_2 DP_{it} + \beta_3 AG_{it} + \beta_4 TC_{it} + \beta_5 CS_{it} + \varepsilon_{it} \tag{14}$$

where UR_{it} is uptake ratio, AR_{it} is net agricultural revenue per capita[13], DP_{it} is the premium per capita, AG_{it} is production costs approximated by the aging of farmers, TC_{it} is transaction costs in farm level, CS_{it} is the saving of transaction costs in farm level by local governments' efforts, $\beta_0 \sim \beta_5$ are parameters to be estimated, and ε_{it} is independently and identically distributed error terms. Subscript i and t denote prefectures (i = 1, ..., N) and year (t = 1, ..., T), respectively. As is evident from expected direction of effects on the uptake ratio presented in (13), expected sign of these parameters are:

$$\beta_1 > 0, \beta_2 > 0, \beta_3 < 0, \beta_4 < 0 \text{ and } \beta_5 > 0 \tag{15}$$

The definition and source of data and means and standard deviations for variables are presented in Table 5 and Table 6, respectively. The rational and interpretation of the data on explanatory variables are the following. First of all, net agricultural revenue per capita (total net agricultural revenue divided by the number of core farm workers) is used as a variable representing farm revenue (AR). Secondly, as an explanatory variable for the attractiveness of the premium (DP), actual premium par capita (total premium divided by the number of

recipients) is employed. Thirdly, the degree of aging (i.e. the share of farms whose owner's age is 65 years old or more to total farms) is used as a proxy for production costs (AG). The rationale is the fact that the aging of farmers is one of the key factors determining production costs through (i) the increasing opportunity cost of self-labour due to the increase in pain from farming as farmers are getting on in years, and (ii) the high opportunity cost of self-labour for farm household successors who usually have stable non-farm employment opportunities (Suda, 2000)[14].

Table 5 Data description

variables		definition	unit	year	scope	data source
dependant variable	uptake ratio (UR)	ratio of uptake fields to total eligible farmland	%	2001-04	eligible area	MAFF 2005a, 2004b, 2003a, 2002a
explanatory variables	farm revenue (AR)	net agricultural revenue per capita	1000 yen	2000-03	whole prefecture	MAFF 2004d, 2003b, 2002b, 2001b
	premium (DP)	actual premium per capita in uptake area	1000 yen	2001-04	eligible area	MAFF 2005a, 2004b, 2003a, 2002a
	production cost (AG)	ratio of farms whose owners are 65 years old or more to total farms	%	2000	whole prefecture	MAFF 2004e
	transaction cost (TC)	number of participants in total uptake fields	person per ha	2001-04	eligible area	MAFF 2005a, 2004b, 2003a, 2002a
	cost saving (CS)	ratio of eligible municipalities to total municipalities	%	2001	whole prefecture	MAFF 2002a

[13] One year lag (AR_{it-1}) is used given that a farmer's decision on the uptake is considered to be influenced by farm revenue in a previous year.

[14] Another reason for using aging as a proxy for production costs is that, as opposed to revenue side, there is no aggregated single indicator to cover production costs of all crops.

Table 6 Mean values and standard deviations for modeling variables

variables		unit	year	mean	standard deviation
dependant variable	uptake ratio (UR)	%	2001	67.80	18.52
			2002	71.34	17.74
			2003	71.57	17.68
			2004	71.66	17.96
explanatory variables	farm revenue (AR)	1000 yen	2000	1385.83	415.95
			2001	1348.79	420.59
			2002	1403.32	460.98
			2003	1506.04	511.23
	premium (DP)	1000 yen	2001	75.08	52.42
			2002	74.10	51.64
			2003	74.13	51.30
			2004	73.70	51.83
	production cost (AG)	%	2000	40.05	7.69
	transaction cost (TC)	person per ha	2001	2.25	0.89
			2002	2.28	0.88
			2003	2.28	0.89
			2004	2.29	0.88
	cost saving (CS)	%	2001	65.37	26.25

Fourthly, as far as transaction costs borne by farmers participating in community agreements are concerned, the number of participants in total uptake fields is used as an explanatory variable (TC), given that transaction costs are likely to increase as the density of population grows. The final explanatory variable, representing the degree of transaction cost saving in farm level through the efforts by local governments (CS), is the ratio of the municipalities with eligible fields to total municipalities. The underlying rationales are that, as identified in section 3, those prefectures with high share of eligible municipalities (i.e. high proportion of disadvantaged areas) are likely to (i) have high sense of urgency to the expansion of farmland abandonment, (ii) receive large scale funds delivered from the central government to reduce policy-related transaction costs and (iii) benefit from the economies of scale in policy-related transaction costs as the scale of payment increases.

It should be noted that, as is shown in Table 5, the scope of data is not necessarily consistent across explanatory variables due to data limitations. For example, data on AR (net agricultural

revenue per capita) and AG (the share of farms whose owner's age is 65 years old or more to total farms) are available only in a prefectural basis, not in eligible areas within each prefecture. The impacts of such a geographical discrepancy may be relatively minor, however, for many prefectures except for those in metropolitan districts (e.g. Tokyo, Osaka etc), since the coverage of designated areas is fairly high and the discrepancy is considered to be small. Furthermore, data on DP (actual premium par capita in uptake areas) and TC (the number of actual participants in total uptake fields) should have ideally been 'potential premium per capita in eligible areas' and 'the number of eligible recipients to total eligible areas' in order to assess the attractiveness of the payment by taking non-entrants into consideration. In other words, *ex-ante*, rather than *ex-post*, indicators should have been employed. These deficiencies need to be taken into consideration in interpreting the estimation results.

6. Regression results, discussion and policy recommendations

The results of estimating the equation (14) are reported in Table 7. The ordinary least square method is used based on cross-sectional data with 47 observations (i.e. total number of prefecture in Japan). The regression analysis cannot be made for the year 2000 because the uptake ratio by prefectural basis is not made public (MAFF, 2001a). The sign of parameters is largely consistent with *a priori* expectations as presented in (15). Table 8 presents the relative magnitude of contribution of each explanatory variable to the average uptake ratio in a percentage term, based on the means and estimated coefficients reported in Table 6 and Table 7, respectively.

Table 7 Regression results

explanatory variables	year	equation (year of dependant variable)			
		2001	2002	2003	2004
constant		70.33*** (3.48)	59.04*** (2.79)	54.50*** (2.72)	45.09* (1.99)
farm revenue (AR)	2000	0.003 (0.43)			
	2001		0.01** (2.11)		
	2002			0.01* (1.97)	
	2003				0.01** (2.24)
premium (DP)	2001	0.03 (0.57)			
	2002		-0.06 (-0.99)		
	2003			-0.04 (-0.65)	
	2004				-0.06 (-0.98)
production cost (AG)	2000	-1.20***(-4.01)	-0.77** (-2.50)	-0.62* (-1.99)	-0.42 (-1.15)
transaction cost (TC)	2001	5.02* (1.72)			
	2002		-0.54(-0.19)		
	2003			-0.93(-0.32)	
	2004				-1.85(-0.62)
cost saving (CS)	2001	0.43*** (5.33)	0.44*** (5.41)	0.46*** (5.90)	0.46*** (5.90)
number of observations		47	47	47	47
F value		12.62	11.80	12.45	12.41
adjusted R square		0.56	0.54	0.55	0.55

Note: The numbers in parentheses are t-values. *, ** and *** show significance at 10, 5 and 1 percent, respectively.

Table 8 Percentage contribution of each variable to the uptake ratio

explanatory variables	year of dependant variable			
	2001	2002	2003	2004
constant	103.7	82.8	76.2	62.9
farm revenue (AR)	5.6	28.2	23.9	29.8
premium (DP)	3.5	-6.1	-3.9	-5.9
production cost (AG)	-70.9	-43.5	-34.8	-23.2
transaction cost (TC)	16.7	-1.7	-3.0	-5.9
cost saving (CS)	41.4	40.4	41.6	42.4
Total	100.0	100.0	100.0	100.0

The regression results can be distilled into the following four findings. First of all, it is found that the farm profitability (i.e. net agricultural revenue, AR) had been a significant positive

factor in raising the uptake to the program after 2002, with its contribution being between 20 and 30 percentage points to the average uptake ratio. This implies that the *ex-post* targeting strategy was not effective enough, attracting more profitable regions while failing to compensate the cost gap with less profitable regions. Secondly, the estimation results show that the level of premium (DP) and the transaction costs (as exemplified by the number of participants in total uptake fields, TC) had little impact on the enrolment to the program. These results do not necessarily mean, however, that the premium level was sufficient to compensate the cost gap and the transaction costs were not serious obstacle in formulating community agreements in light of the *ex-post* nature of these variables as cautioned in the previous section.

The third notable finding from the analysis is that the production cost approximated by aged farmer ratio (AG) was a statistically significant negative factor in hampering the entry. This implies that the level of premium was insufficient to attract those prefectures with high opportunity cost for continued cultivation and thus ex-post targeting was not cost-effective. It should be noted, however, that the negative impact of this aging factor on the enrolment had declined gradually from around 70 percentage points in 2001 to 30 percentage points in 2003, and the aging was no longer a statistically significant factor in impeding the entry as of 2004. This shows that those prefectures with relatively high degree of aging raised the uptake ratio than other prefectures and that the inverse relationship between aging and uptake ratio had weakened as the program penetrated into local governments and communities over time[15]. Finally, it is found that the cost saving efforts by local governments (CS) had consistently been a robust factor in facilitating the uptake by raising the uptake ratio by about 40 percentage points. This can be interpreted that the spill-over effects by local governments might have promoted the uptake presumably through reducing transaction costs at farm level.

In light of the objective of this article to evaluate the cost-effectiveness of *ex-post* targeting strategy, what policy recommendations can be drawn from the analysis to improve the effectiveness of the program? The first recommendation relates to the structure of incentive premium and the scope of eligible areas. The positive correlation of farm profitability and

[15] It is reported that some municipalities designated eligible areas only if community agreements became likely to be established, or excluded some parts from predetermined eligible areas when community agreements became unlikely to emerge (MAFF, 2004c). This shows that municipalities have inherent incentive to

negative association of aging with the entry into the program show that the ex-post targeting strategy can be improved by further differentiating the premium level so as to match heterogeneous land quality. It is not feasible, however, to preserve even extremely disadvantaged fields by substantially raising premium (Suda, 2002), since it was not the initial intent of the policy-makers, as exemplified by the simplified two-staged payment rates based on average production costs (Yamashita, 2001, p. 109). Given that the entry into the program served as a touchstone to differentiate those fields where farming can be continued from others where it can no longer be possible, a complementary measure should be introduced to provide alternative incentives to promote forestation for the fields that did not enrolled in the program to prevent the loss of environmental services that has been exhibited by agriculture.

The second policy recommendation is concerned with the roles of local governments. The statistically robust positive correlation between the efforts by local governments and the uptake ratio implies that the observed large discrepancy of the uptake ratio among prefectures can be resolved partly by more active engagements by those prefectures with low uptake ratio[16]. Although the central government has already delivered funds to prefectural and municipal governments to save policy-related transaction costs, there is a possibility that those prefectures having relatively small proportion of eligible areas failed to exploit cost saving originating from the economies of scale in policy-related transaction costs, because the funds are proportional to the scale of eligible areas within a prefecture. Thus, additional funds exclusively targeted to those prefectures with the low uptake ratio are expected to act as an effective measure to overcome high average policy-related transaction cost and to narrow the discrepancy of the uptake ratio.

7. Lessons for incentive payments in developing countries

The findings from the evaluation of Japan's direct payment program can provide several useful lessons for similar incentive payments with environmental objectives, which have been mushrooming both in developed and developing countries. In OECD countries, environmental considerations are increasingly integrated into the overall agricultural policy, and direct

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manipulate (i.e. reduce) eligible areas with an attempt to raise uptake ratio, given that the low ratio can be perceived as their negligence by residents, prefectural governments and the central government.

[16] This is especially relevant for the prefectures in metropolitan regions. The uptake ratio in Tokyo, Kanagawa and Osaka in 2004 was the lowest among all prefectures in Japan with merely 24, 38 and 20 percent,

payments to farmers to improve environmental outcome, often termed 'agri-environmental payments', play a prominent role for this purpose (OECD, 2003). In developing countries, even if the application of incentive payments is still thin as far as in agricultural sector is concerned; there is a mounting interests in, and actual initiatives of, 'payments for environmental (or ecosystem) services' (PES) targeting mainly forestry in Latin America (Pagiola, Arcenas and Platais, 2005). The purpose of this section is to draw lessons from the Japanese experience for designing and implementing eventual incentive measures for environmental services from agriculture in developing countries, given the scarceness of such literature.

Although a number of obstacles have been identified in initiating incentive measures for environmental services in developing countries, one of the most serious impediments is high transaction costs reflecting the insufficient institutional development in these countries (Sakuyama, 2005). In this regard, the following two lessons can be drawn from Japanese experience to save transaction costs in designing, implementing and enforcing effective incentive measures in developing countries. The first lesson relates to the transaction costs for incentive design. One of the biggest challenges in designing incentive payments for environmental purposes is to determine the appropriate level and structure of premium so as to change the behaviour of recipients (i.e. additionality) by compensating the opportunity costs incurred for more environmentally benign alternative actions. It is needless to say that tailored payments are superior in terms of better targeting and higher cost-effectiveness of the program. The difficulty is that the targeting, or precision, necessitates high transaction costs for collecting information on the opportunity costs (Vatn, 2002), and, in many cases, sufficient information for perfect precision can never be obtained, even whatever efforts are made, due to insurmountable transaction costs.

A most commonly used devise to solve this trade-off between precision and transaction costs in designing incentive payments is to find a proxy to represent the level of opportunity costs for alternative action. In the case of Japan, it was primarily the inclination of fields that were employed as an indicator for approximating the risk of farmland abandonment and the amount of premium, as is shown in section 2. It is also evident from the analysis in this paper that the

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respectively, and the corresponding share of eligible municipalities to total municipalities was 8, 19 and 7 percent, respectively (MAFF 2005a).

targeting strategy mainly on steepness was not effective enough, attracting more productive regions while deterring those areas with high level of aging, and thus leaves room for further improvement. Even though there cannot be 'one-size-fits-all' indicators in terms of an appropriate proxy for designating eligible areas and determining the level and structure of premium due to the site-specific nature of every environmental services, one lesson that can be learned from unsatisfactory Japanese experience is to employ composite indicators to avoid the risk of insufficient targeting by relying on a single proxy.

The second lesson from the Japanese experience is about the transaction costs for the implementation of incentives. One of the notable features of the Japanese program is that the payments are in principle made to a group of community members rather than individual farmers. Such type of payments seems to be quite rare in developed countries in Europe and North America, but is widely observed in the PES in developing countries, such as those in Mexico and Costa Rica (Pagiola, Arcenas and Platais, 2005). In addition to these two examples, payments to a group, rather than individual, are considered to be an effective mechanism for those developing countries with having dense farming population in rural areas or large share of such common pool resources as community roads, ponds and irrigation canals, as a mean to save policy-related transaction costs that would otherwise be necessary in the case of individual contracts. Contrary to the previous example, therefore, the Japanese case can provide a positive lesson for these developing countries in this regard.

Although ascertaining the amount of transaction costs saved through the exploitation of group contracts is not the aim of this paper, the merit of the group contracts is obvious, by merely reconfirming the number of participants to this scheme (660 thousands in 2004) as reported in Table 3. The lesson that can be drawn from the analysis is not necessarily about the amount of transaction cost saved through group contracts, therefore, but about the importance of the roles of local governments in promoting this new type of incentive payments to local farmers. The group contracts can be seen as a device to transfer the policy-related transaction costs incurred away from a provider (i.e. governments) of payments to a group of their recipients, and the key for its success depends on the smooth coordination among participants in negotiating conditions and implementing and enforcing the contracts by saving transaction costs necessary for these activities. The analysis of the Japanese case shows that the active

engagements of local governments can reduce these transaction costs among participants and thus support measures to them play a decisive role to facilitate the entry into the programs.

8. Summary and conclusions

This article aims to evaluate the effectiveness of *ex-post* targeting strategy of the direct payment program for the farmers in hilly and mountainous areas in Japan, with a view to providing insights to improve its performance as well as to drawing lessons for the payments for environmental services in developing countries. An analytical framework developed in this article provides the rationale for the analytical approach of this paper, which focuses on the issue of *ex-post* targeting strategy rather than *ex-ante*, employs cost-effectiveness as a 'criterion' for effectiveness, and estimates a linear regression model explaining the entry into the program as a feasible 'methodology' in evaluating its cost-effectiveness. Based on the analytical framework, a conceptual model describing the behaviour of profit-maximizing eligible farmers for enrolling in the program is developed to identify the factors determining the entry into the program, and the linear regression model on the uptake to the program was estimated based on cross-sectional data on a prefecture basis from 2001 to 2004.

It was found from the regression analysis that, although their impacts changed during the estimation period, the farm profitability and the production cost approximated by aging were significant positive and negative factor, respectively, in influencing the uptake to the program. It was also found that the efforts by local governments were consistently a robust factor in facilitating the uptake to the program by raising the uptake ratio. The former finding show that the ex-post targeting strategy of the program was not cost-effective, whereas the latter implies the spill-over effects by local governments promoted the uptake presumably through reducing transaction costs at farm level. Two main policy recommendations are identified to improve the effectiveness of the program. The first is to differentiate further the premium level so as to match heterogeneous land quality, while simultaneously to provide alternative incentives to promote forestation for the fields that did not enrolled in the program. The second policy recommendation is to introduce additional funds exclusively targeted to those prefectures with the low uptake ratio.

The following two lessons can be drawn from Japanese experience to design, implement and enforce effective incentive measures in developing countries while saving transaction costs,

given that one of the most serious impediments is high transaction costs reflecting the insufficient institutional development in these countries. The first lesson relates to the transaction costs for incentive design. Unsatisfactory Japanese experience on ex-post targeting strategy demonstrates the importance to employ composite indicators in designating eligible areas to avoid the risk of insufficient targeting by relying on a single proxy. The second lesson from the Japanese experience is about the transaction costs for the implementation of incentives. The analysis of the Japanese case shows that local governments can play a decisive role to facilitate the entry through their active engagements to reduce these transaction costs among participants.

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