Cost and Benefit for Launching Integrated Farming System of Arable and Livestock by Rice Whole Crop Silage
Economical Evaluation of Impacts on
Feed Self-Sufficiency, Livestock Waste Recycling, and Paddy Conservation

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Introduction Whole rice plants can be fed to cattle as whole crop silage (RWCS). In Japan, RWCS production has been expanded as a result of government subsidies. Why the government encourages RWCS production? The first reason is the decline in the domestic feed self-sufficiency rate and the corresponding increase in imported feeds, which has contributed to a decline in the domestic food self-sufficiency rate. Also, the decrease in feed cropping fields where livestock waste is recycled has led to environmental damage due to inappropriate disposal of livestock waste. The second reason for the subsidies is the increase in abandoned paddy acreage. That has meant a decline in non-market services supplied by the paddy agriculture, which include maintaining a rural landscape, promoting biodiversity, and land conservation, and so on.

By an "integrate farming system of arable and livestock" we mean cropping RWCS, feeding cattle on RWCS, and recycling cattle waste compost to RWCS cropping paddies. Launching the integrated farming system can help to improve the feed and food self-sufficiency rate, mitigate environmental damages and conserve rice paddy acreage. Given this, the government intervention through the use of subsidies appropriate? To examine this question, we conducted a cost-benefit analysis for launching an integrated farming system in eastern part of Tottori prefecture, Japan.

Materials and methods The cost identified was from the increased net production cost of the livestock products that resulted from the launching of the integrated farming system. The cost per cattle head (Δsc) can be defined as $\Delta sc = (c_w + c_r)w - P_w w$; where "$w$" :number of RWCS rolls fed per head (roll/head; 280kg/roll), "c_w": unit production, transport, and processing cost of RWCS (yen/roll), "c_r": unit cattle compost recycling cost (yen/roll), and "P_w": purchaser price of RWCS. "$c_r w$" means recycling cost for the amount of cattle waste which can be recycled into the feed rice planted acreage for one roll of RWCS. $P_w w$ means substitution cost of RWCS with imported hay which has same TDN value as RWCS.

Fig.1 A roll of RWCS (280kg/roll)

The benefit was identified as increased consumer willingness to pay for the livestock products. A choice experiment was used to evaluate how much consumers are willing to pay for the livestock products associated with the attributes of "domestic feed self-sufficiency ratio," "waste recycling ratio," and "abandoned paddies restoring ratio." We call the willingness to pay as premium price. The benefit per cattle head (Δsb) can be defined as $\Delta sb = \{\alpha_{FS} \cdot \Delta FS \cdot w + \alpha_{NR} \Delta NR \cdot w + \alpha_{RA} \Delta RA \cdot w\}q^0$; where $\alpha_{FS}, \alpha_{NR}, \alpha_{RA}$: premium price for the cattle product obtained from 1% increase of "domestic feed self-sufficiency ratio," "waste recycling ratio," "abandoned paddies restoring ratio" (yen/kg or liter); $\Delta FS, \Delta NR, \Delta RA$: increase of "feed self-sufficiency ratio," "waste recycling ratio," "abandoned paddies restoring ratio" that resulted from feeding one roll of RWCS substituting from imported hay per head (%); q^0: cattle product per head (kg or liter /head).

Results Premium prices for livestock products are shown in Table 1. For example, if feed self-sufficiency ratio is increased 1%, willingness to pay for beef is increased 16.6 yen/kg. The cost and benefit per cattle head can be expressed as a linear function of feeding amount of RWCS per head "w" as shown in Table 2

Table 1 Premium price for livestock products

Attributes		Beef yen / kg	Milk yen / liter
Feed self-sufficiency ratio	α_{FS}	16.6	1.03
Waste recycling ratio	α_{NR}	6.7	0.43
Abandoned paddies restoring ratio	α_{RA}	7.6	0.51

Table 2 Cost and benefit for launching the integrated farming system per head

Cost and Benefit		Beef 1000yen/head	Milk 1000yen/head·year
Cost	Δsc	11.7 w	13.9 w
Benefit	Δsb	6.8 w	6.8 w
Benefit / Cost		1.7	2.0

w : Number of RWCS roll fed per head per year.

Conclusions The benefit/cost ratio was computed as 1.7 for beef or 2.0 for milk. We therefore conclude that the government intervention provides net benefit to society.

References Fujimoto, T and I. Tunekawa(2007) Cost and Benefit for Launching Integrated Farming System of Arable and Livestock by Rice Whole Crop Silage: Economical Evaluation of Impacts on Feed Self-Sufficiency, Livestock Waste Recycling and Paddy Conservation, *Japanese Journal of Farm Management*, 45(1), 1-11.