Economic value of the beneficial function of organic paddy farming in Korea

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Abstract
In order to evaluate the beneficial functions for organic farming, we have divided beneficial functions as 9 sub-functions such as flooding control, fostering water resources, purifying the air, mitigating summer climate, purifying water quality, decreasing soil erosion, accumulating soil carbon, conserving biodiversity, and preventing accidents from pesticides. They were quantified by searching related reports and statistics, and surveying fields. Organic farming, especially organic paddy farming, showed that some functions like fostering water resources, accumulating soil carbon, conserving biodiversity, and preventing accidents from pesticides were higher than conventional paddy farming, while for the others were similar. The fostering water resources function was evaluated as 4,297 ton/ha.year an increase of about 3.6% compare with that of conventional farming. A New function for accumulating soil carbon at organic paddy fields has been assessed by 4.67 ton/ha in terms of long periods over 10 years. Considering the area of organic paddy farming in Korea and value of carbon price, it the monetary value is 22.4 to 84.1 billion won using the new method. It could be also evaluated that flooding control, fostering water resources, purifying the air, mitigating summer climate, purifying water quality, decreasing soil erosion, and preventing accidents from pesticides were value at 2,980, 123.4, 482.6, 87.5, 0.9, 55.6, and 284.1 billion won, respectively. Conserving biodiversity function would be a very big benefit of organic farming though it couldn't be evaluated as monetary value.

Key Words
Multifunctionality, beneficial function, organic paddy farming.

Introduction
Modern agriculture made it possible to grow more food per unit area by using of modified seeds and chemical input like pesticides and chemical fertilizers. Because agro-ecosystem has been threatened by over application of pesticides and fertilizers, the current challenges is to meet the food demands of a growing population by maintaining and enhancing the productivity of agricultural system without further damaging their beneficial functions, so called multifunctionality. Especially, organic paddy farming will be predicted to have higher values of beneficial function than conventional paddy farming. But most people do not know how much beneficial values has been embedded, even though they have recognized there is a beneficial side in paddy farming including organic farming. The role of environmental service for organic farming needs to be propagated to public citizens. Objectives of this study were to assess the beneficial functions of organic paddy farming on the basis of research reports, national statistics, and fields survey, and evaluate then as monetary values.

Materials and methods
Categories
There would be many beneficial functions according to researchers or other peoples because of differences on standpoints. According to previous reports(Seo *et al.* 2001), it could be categorized 6 sub functions for conventional paddy farming such as flooding control, fostering water resources, purifying the air, mitigating summer climate, purifying water quality, decreasing soil erosion. In addition to these sub functions, sub functions of organic paddy farming such as accumulating soil carbon, conserving biodiversity, and preventing accidents from pesticides also exist.

Assessment
The amount of each function was quantified against 9 categories. flooding control, fostering water resources, purifying the air, mitigating summer climate, purifying water quality, decreasing soil erosion were followed by previous research's method, which were established estimated models. Especially, the depth of water level at organic paddy fields was measured with near conventional paddy fields for estimating the function of fostering water resources. The function of accumulating soil carbon was analyzed by establishing a model using data from long-term rice cultivating fields and analyzing soil carbon in organic paddy fields. The

function of preventing accidents from pesticides uses stastical data about pesticide poisoning deaths. rates were evaluated using a first-order kinetic models.

Economic value
After assessment of on beneficial functions about organic paddy farming, we made an attempt to give each function a monetary value by means of a replacing method. The amount of carbon accumulated in soil in organic paddy fields should be replaced by the price in carbon exchange markets which is related to climate changes.

Results and discussion
As results of surveying the level of flooded water at organic snail paddy fields with near conventional paddy fields, it was showed water level at organic snail practice filed were deeper as almost two times than near conventional practice. Comparing soil organic matter for organic and conventional paddy fields, organic matter was higher than conventional, being 30.1 and 23.5 g/kg, respectively. On the basis of soil carbon in the view of long term practices, the function of accumulating soil carbon could be estimated as 4.69 ton/ha for organic paddy farming. Organic farming could prevent poisoning by pesticides accidents. The amount of each sub function was estimated by unit area as shown as Table 1 except for conserving biodiversity.

Table 1. The amount of beneficial function for organic paddy farming dividing as 8 categories.

Sub functions	Amount of sub function	Monetary value (billion won)	Comparing with conventional farming
flooding control	2.94 ton/ha.year	2,980	Same
fostering water resources	4.3 ton/ha.year	123.4	Increase 3.6%
purifying the air	CO_2: 21.9 ton/ha.year	76.2	Same
	O_2: 15.9 ton/ha.year	406.4	Same
mitigating summer climate	3,049 ton/ha in summer	87.5	Same
purifying water quality	20.7 N kg	0.9	Same
decreasing soil erosion	110.8	55.6	Same
accumulating soil carbon	4.69 C	22.4-84.1	New
preventing accidents from pesticides	984 person	284.1	Average in 2003-2005

Table 1 also shows their monetary values for sub functions for organic paddy farming while the function of preventing accidents from pesticides was for the whole of organic farming. But It the function of conserving biodiversity cannot be quantified even though there were many examples related during the research for example finding rare animals in organic paddy fields.

Conclusion
The beneficial function of organic paddy farming was investigated by analyzing reports, statistics and fields data. In the view of the environmental conservation function, most subfunctions were very similar to those for conventional farming except fostering water resources, which is increased by 3.6%. From the view of alleviating green house gases, a new beneficial function was revealed to make a role of accumulating soil carbon in long term a continuing practice. Generally organic farming does not use dangerous chemicals. It means that organic farming has the potential for preventing accidents from pesticides which bring about social problems.

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