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ECONOMICS OF CONVERSION TO ENVIRONMENTALLY FRIENDLY PRACTICES OF RICE PRODUCTION

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Key words: Environmentally friendly rice farming, organic production, conventional farming, whole farm planning, physical productivity, economic performance, farm-gate price premium

ABSTRACT

Environmentally friendly rice farming practices in Korea divide into three groups such as organic production with no synthetic pesticides of fertilizers applied, no-pesticide production not using pesticides, and low-pesticide production using low quantities of synthetic pesticides and with an appropriate nutrient management. This paper discusses some methodological aspects important for the comparative analysis of the economic performance of rice farming practices, and gives an overview of the financial performance of environmentally friendly farming practices at farm level using the survey data. The revenues of environmentally friendly and conventional rice farms are compared, and then main factors influencing profitability, especially yields, price premium and production costs are discussed. The result shows that conversion payment for promoting environmentally friendly rice farming practices need to compensate for cost increment and/or income reduction during the three to five years within switching periods depending on the realization of farm-gate premium prices.

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I. Introduction

There is a widespread perception that conventional farm management practices have severely harmed the environment and the natural base of agriculture. Conventional farm management practices rely on the use of chemical fertilizers and pesticides, which have been implicated in a variety of environmental problems. There has been increasing interest in developing alternative farm management practices that are less detrimental to the environment and to the natural resource base of agriculture. This kind of farming approaches generally referred to as "sustainable" or "environmentally friendly" farm management practices. The meaning of the term "sustainable" as applied to agriculture has been debated, but its broad interpretation covers practices that reduce damage to the natural resource base of agriculture and to the environment.

In reality, the acceptability of sustainable farm management practices depends largely on their ability to generate acceptable level of farm incomes. Farmers can be persuaded to switch to practices that are more profitable, and they can be persuaded to adopt practices that are more beneficial to the environment of those practices will not reduce their income too much; however, most will not accept large reduction incomes to grows crops in a more environmentally friendly fashion. However, there is mixed evidence as to whether farmers' incomes are comparable with sustainable and conventional farm management practices. Typically, sustainable farm management practices are neither more profitable nor higher yielding that the conventional systems they replace.

Increasing demand for food production in Korea has resulted in the application of more chemical fertilizers and the introduction of mechanization in agricultural management in the last few decades. It has been reported that, in some areas, intensive agricultural practices have caused environmental problems such as excess residual nitrogen in cultivated farmland. This problem should be taken into account in order to practice better management of agricultural-environmental conditions. Sustainable

farm management practices have attracted increasing attention because it is perceived to solve the problems that the modern agricultural system faces. In this note, Korean government has recognized and responded to potential benefits by encouraging farmers to adopt sustainable farming technologies, either directly through financial incentives or indirectly through support for research and marketing initiatives. *The Environmentally Friendly Agriculture Promotion Act* established in December 1997 has been played a major role for the growth of sustainable farming in Korea. More recently, the environmental-friendly direct payment and preferential government policy loans have been provided to environmentally friendly practicing farmers as economic incentives. As a consequence, the number of farms adopting organic farming practices has been increasing since middle of 1990s.

The need to develop environmentally friendly agriculture has led to significant research efforts aimed at analysing economic aspects of sustainable farming practices. Several studies directly compared returns on organic and conventional farms. Yoon, et al. (1999) analysed the economic performance of organic rice farming using the survey results of 25 farms. In addition, Jeon, et al. (2000) also investigated the management performance of environmentally friendly rice farming practices based on duck and/or snail farming methods. Those studies were more focused on the economic aspects of organic and specific rice farming practices. There is very limited information on comparing the overall economic performance of environmentally friendly rice farming practices such as organic and low input methods.

Based on empirical findings, this paper discusses some methodological aspects important for the comparative analysis of the economic performance of rice farm management practices, and gives an overview of the financial performance of environmentally friendly farm management practices at farm level using the survey data. On the basis of a review of current and previous studies, as well as farm accounting survey data, the revenues of environmentally friendly and comparable conventional rice farms are compared, and the main factors influencing profitability,

especially yields, price premium and production costs for the farm management practices is discussed.

II. Methodological Discussion

Farm management deals with the organization and operation of a farm with the objective of maximizing profits from the farm business on a continuing basis. The farmer needs to adjust his farm organization from year to year to keep abreast of changes in methods, price variability and resources available to him. Thus, farm management is complex, requiring intimacy with agricultural resources supporting the farm and must meet the specific needs of the farm households. This complex information is integrated and synthesized to increase profitability of the farming business, the ultimate aim being to raise the standard of living of the farm household.

With respect to intensity of chemical input use, there is a spectrum of farming system, with intensive conventional at one end and "pure" organic at the other hand, as shown in Figure 1. The economic literature on farm management system typically starts from a baseline called "conventional practice."[1] To this are compared alternative sustainable farming systems that typically use less fertilizer of less pesticide. The alternative systems may use lower amount of existing technology, or they may introduce new technology. Sustainable farm management practices are based on minimizing the use of synthetic chemical inputs such as fertilizers and pesticides and represent an environmentally friendly attempt to make the best use of natural resources. These practices

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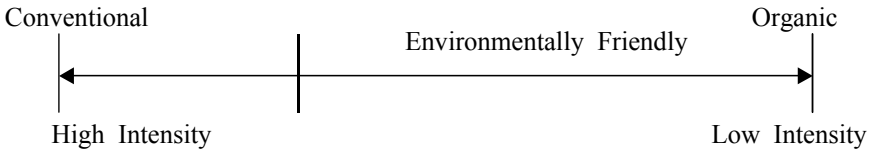
[1] In this paper, the term "organic agriculture (or faming)" is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives, but only natural materials such as organic matters, microbes and natural minerals are used. The term "conventional farming" will be used here to refer to a production system which employs a full range of agricultural chemicals.

FIGURE 1. Schematic spectrum of conventional and sustainable farming system



generate less stress to the environment than conventional agriculture, in terms of nutrient runoff, soil erosion, and biodiversity. There are several evidences suggesting that sustainable farming practices are more effective in reducing soil erosion than conventional farming practices and therefore in maintaining soil productivity.

As with any other farming system, sustainable farming must be adapted to the farmer's individual situation. A sustainable farming system is probably more dependent than conventional systems on the integration of the major management factors such as crop, soil and livestock management. Though sustainable farmers use far fewer purchased external inputs, they will need to manage their farms more intensively. Farmers must carefully consider crop rotations, soil fertility and soil management when planning a transition from conventional to sustainable farming. Based on the inputs used in crop production, Korea divides farms with sustainable farming into three groups such as organic practice with no synthetic pesticides or fertilizers applied, no-pesticide practice with appropriate nutrient management and low-pesticide with appropriate nutrients management.

In evaluating economic performance of sustainable farm management practices, agricultural economists are considered productivity and profitability as main criteria. The choice of analytical method largely depends on the performance criteria of interest. Enterprise budgets are the predominant method for comparing profitability, providing a focus for evaluating costs and returns of alternative farm management practices. Uncertainty about prices and yields in enterprise budgets can be accommodated partially using sensitivity analysis. Sensitivity analysis brackets a

baseline enterprise budget with more favourable and more unfavourable scenarios. It shows the stability of an outcome under a range of plausible assumption about risky, uncontrollable factors such as prices and yields.

In practice, the criteria for evaluating the economic performance of sustainable farm management practices depend on the objectives of the farmer and the time horizon of the analysis.[2] A minimum requirement would be that sustainable farming system is economically viable, that means the monetary return to the activity has to be high enough to cover all that expenses incurred. The concepts of farm management indicators that are oriented toward the achievement and monitoring of environmentally sustainable agriculture, include farm management capacity and farm management practices. Indicators of farm management capacity concern the investment in the capacity of the agricultural sector to build and transfer knowledge to improve on-farm management practices leading to a more environmentally sustainable agriculture. This covers a broad range of elements to encourage environmentally sound farm management practices and farming systems, in particular investment into research and farm education. Indicators of farm management practices that encompass overall trends of farming methods cover whole farm management, organic farming and various aspects of farm management such as nutrient management, pest management, soil and land management, and irrigation and water management. The phase "whole farm planning" from a sustainable agriculture perspective has gained national attention in recent years, and has come into widespread use. Other related terms are comprehensive farm planning, "holistic management and integrated farm management." The goal of whole-farm management planning is simply to find a way to tie all of the various parts of a plan (economic, environmental, and social)

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[2] For more detailed description about the criteria for measuring and evaluating the economic performance of sustainable arming, see Lampkin and Padel (1994), Hanson, Lichtenberg, and Peters (1997), and Offermann and Nieberg (2000).

together into an integrated whole. Farm management indicators have the potential to help policy makers take into account the linkages and trade-offs between different management practices and their impact on the environment, including: whole farm management involving the overall farming system; and farm management aimed at specific practices related to nutrients, pests, soils, and irrigation.[3]

III. Overview of Environmentally Friendly Rice Farming Practices

During the past three decades, agricultural policies in Korea were focused on intensive rice farming used chemicals and farmers became apathetic to environmental and natural ecosystem destruction and were least interested in sustainable farming. Starting the early part of 1990, the *National Agricultural Cooperative Federation* introduced organic rice farms as one of sustainable farming its training program implemented for members called as the *Farming Technology Support Team*. In 1994, the central government created a specific department responsible for promoting sustainable agriculture in the Ministry of Agriculture and Forestry (MAF), and in 1997 the Korean National Assembly passed the *Environment-Friendly Agriculture Promotion Act* (EAPA). In the late of 1998, the *Enforcement Ordinance and Regulation of the EAPA* was enacted to set an institutional basis for fostering sustainable agriculture in Korea. Based on the institutional framework, the MAF established both supporting and regulatory system to encourage farmers to participate and to promote environmentally friendly agriculture.[4] In connection with marketing environmentally friendly agricultural products, there is a need for

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[3] Farm management indicator in developing OECD agricultural environmental indicators is closely related to indicators on farm financial resources and agricultural sustainability (OECD, 2001, pp.83-110).

[4] For more detailed information on policy programs for developing environmentally friendly agriculture, see Kim, Oh, and Kim(2003, pp.17-30).

certification that could give guarantee to consumers. Subsequently, an institutional labelling system was established for four types of agricultural products, i.e., low-pesticide products with low level of chemical pesticides use (less than 50% of quantity used in conventional farming), no-pesticide products with no pesticides used, transitional organic products under conversion period less than three years and organic products. For efficient and reliable implementation, a government organization, the *National Agricultural Products Quality Management Service* (NAQS), is designated as a government certification body for sustainable agricultural products.[5]

In particular, the Korean government introduced a new scheme of *Direct Payment for Environmentally Friendly Rice Farming* in 1999 with a budget of 5.7 billion Won (USD 4.8 million). This payment was given to paddy-field farmers who carry out environmental conservation, including reduced use of chemical fertilizers and pesticides, and who submit farming records to the authorities. In 2004, direct payment for certified sustainable rice producing farmers receive 682,000 Won ha^{-1} (USD 578) under no-pesticide farming and 802,000 Won ha^{-1} (USD 680) under organic farming (including transitional organic farming).[6]

The number of farms under certified sustainable farming system has been increasing very rapidly since late 1990s. According to statistics of the *National Agricultural Products Management Service*, the number of farm households practicing environmental-friendly agriculture in 2002 is 23,302 accounting for 1.8% of total number of farm households. The number of

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[5] The NAQS is a subsidiary organization of the MAF, specialized in quality management for agricultural products including safety inspection and quality certification. This agency conducts to establish order in quality control and fair trade of farm products in the marketing stage including standardization of agricultural products, management for labelling of origin and GMO inspection and storage control of government grains.

[6] For more detailed exposition on the scheme of environmentally friendly direct payment, see Park, et al.(2004), pp.163-168.

organic producers is 2,749 households, or 11.8% of farm households practicing environmental-friendly agriculture (refer to Table 1).

In recently, new types of sustainable farming practices have been widely developed by farmers. Sustainable rice farming practices with use of duck, freshwater snail, rice bran, micro-organism, and clean farming practices for water land vegetables are widely adopted by farmers who are producing the

TABLE 1. Change of Certified Sustainable Farming Practices

Year	Organic[1)]		No-pesticide		Low-pesticide		Total	
	Farms	Area	Farms	Area	Farms	Area	Farms	Area
	(No)	(ha)	(No)	(ha)	(No)	(ha)	(No)	(ha)
1999	355	231	449	262	502	383	1,306	875
2000	353	296	1,060	876	1,035	867	2,448	2,039
2001	442	449	1,645	1,293	2,591	2,811	4,678	4,553
2002	1,505	1,601	4,084	3,727	6,303	5,911	11,892	11,240
2003	2,749	4,654	7,426	6,756	13,127	12,155	23,302	23,564

Note: 1) The data in the organic farming include those of the transitional organic farming.
Source: National Agricultural Products Quality Management Service (NAQS, 2003).

TABLE 2. Current Status of Sustainable Rice Farming Practices (2003)

Alternative Farming	Household	Area
	-------- Number -------	-------- ha -------
Organic Farming[1)]	1,547 (14.9)	1,546 (18.6)
No-Pesticide Farming	4,666 (44.8)	3,772 (45.3)
Low-Pesticide Farming	4,200 (40.3)	3,004 (36.1)
Total	10,413 (100.0)	8,322 (100.0)

Note: 1) The data in the organic farming include those of the transitional organic farming.
Source: National Agricultural Products Quality Management Service (NAQS, 2003).

differentiated agricultural products. The number of rice farm households practicing environmental-friendly agriculture in 2003 is 10,143 accounting for 1.5% of total number of rice farm households. The number of organic producers is 1,547 households, or 14.9% of farm households practicing environmental-friendly agriculture (refer to Table 2).

In reality, the important aspect of the profitability of sustainable rice farming is the opportunity to receive higher farm-gate prices for environmentally friendly agricultural products than for conventionally produced ones. Prices vary considerably between the different marketing channels. Like other countries, marketing sustainable farm products is essential to develop sustainable agriculture in Korea. It is especially true in an initial stage in developing sustainable farm management practices. At the beginning stage, direct marketing system in which both producer and consumer organizations are principal market agents, played important roles to connect organic products between producers and consumers. Currently, there are two different marketing channels in: 1) the direct marketing channel between producers' and consumers' organization; 2) the indirect marketing channel between producers and consumers through the wholesale and/or retail marketing center (Kim and Kim, 2003, pp.28-30).

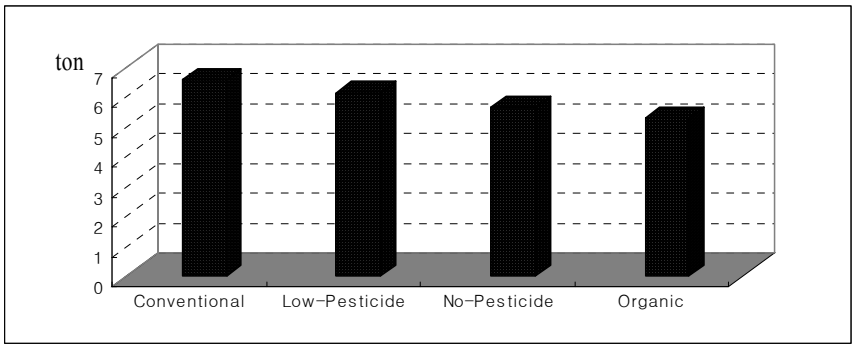
IV. Comparative Analysis of Physical Productivity and Economic Performance

1. Physical Productivity

Information about the productivity of sustainable farming systems comes from several sources such as research plots and case studies using actual farms surveys. A wide ranging, face-to-face survey was made of 71 rice farming households which consisted of 23 organic farms, 25 no-pesticide farms, 23 low-pesticide farms.[7] A series of in-depth interviews were conducted using a

[7] The surveyed sample may not have been a representative sample of

FIGURE 2. Comparison of Rice Yields



	Conventional	Low-Pesticide	No-Pesticide	Organic
	---------- ton/ha ----------			
Mean[1)]	6.540	6.110	5.634	5.257
	(100.0)	(93.4)	(86.1)	(80.4)
Standard Deviation	-	0.362	0.416	0.327

Note: 1) The figures in the parenthesis represent the indices based on the conventional farming
Source: Kim and Kim (2003).

questionnaire during the period of November 25 to December 5, 2003 (Kim and Kim, 2003). This actual farm survey addressed issues ranging from production cost and revenues of environmentally friendly agricultural products and structure to farm information sources, attitudes to sustainability, the values and views of farmers on a number of sustainable agricultural issues. The data set for conventional rice farming as a baseline was formulated from an official statistics by Korea National Statistical Office (2003).

Yield level is an important factor of the relative physical productivity performance in farming systems. As shown in Figure 2,

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environmentally friendly farms in Korea. The weakness of this study was not provide the statistical test due to small sample size. For more detailed information on the surveyed sample farms, farm households' characteristics and regional distribution, see Kim and Kim (2003), pp.22-26.

rice yields of sustainable farming practices in 2002 are 5.2t ha^{-1} in organic and 6.5t ha^{-1}, about 7 % to 20% below the conventional average.

Generally, lower yields are achieved in organic farming than in conventional agriculture. The lower yields are primarily due to the reduced use of yield-promoting inputs. Through the conscious avoidance of synthetic fertilizers and plant-protection chemicals, it is often not possible for the genetic potential of the crop to be fully exploited. In practice, part of yield variability may be attributable to differences in soil quality and climate, technology, and management ability.

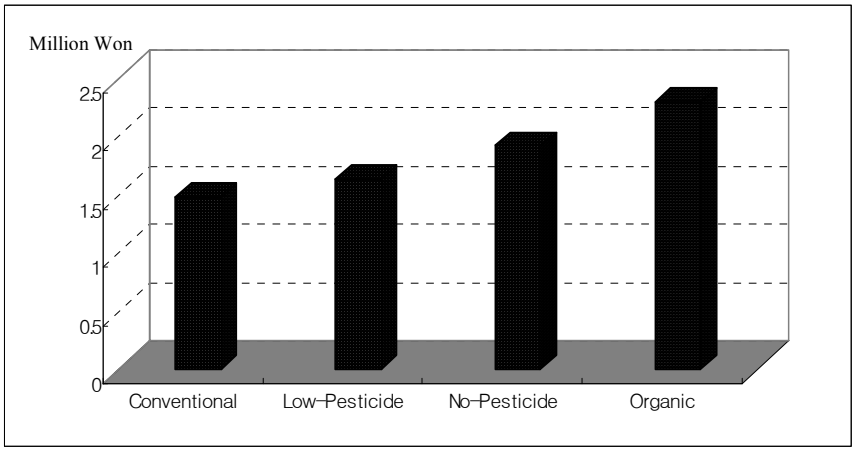
2. Enterprise Financial Performance

Korean farmers, in general, are not very market-oriented. The importance of marketing for sustainable farm products was recently recognized. Premium prices have an important influence on the financial performance of sustainable farming. The marketing of environmentally friendly farm products is conducted via a number of different channels. Alongside private traders and producer cooperatives, direct marketing to consumers plays an important role. Direct marketing in various forms (farm-gate sales, weekly market, local distribution rounds, etc.) is practised on many organic farms. Korean organic farms preferred direct selling and/or specialized organic outlets (such as wholesale food market) to supermarkets, but the situation is changing.

As in other countries, strong market demand for organic products has led to high premium prices for organic products. Certified organic products can achieve prices significantly above the price level for conventional products. The price premiums at the farm gate level, as shown in Figure 3, are 54.8% in organic, 29.6% in no-pesticide, 10.2% in low-pesticide, respectively.

A sharp reduction in production input use is characteristic of organic farms. Expenditures on these items are consequently also lower. In crop production, the expenditure on fertilizers and sprays is significantly lower. Depending on the enterprise, savings in variable costs of between 30% and 50% are possible. In

FIGURE 3. Comparison of Farm Gate Price



	Conventional	Low-Pesticide	No-Pesticide	Organic
	---------- Thousand Won/ton ----------			
Mean[1)]	1,481	1,633	1,920	2,292
	(100.0)	(110.2)	(129.6)	(154.8)
Standard Deviation	-	138.6	208.1	304.0

Note: 1) The figures in the parenthesis represent the indices based on the conventional farming.

interpreting these figures, it needs to be remembered that the parameters shown only include directly applicable fertiliser and plant-protection costs. In addition, the rejection of herbicides is often accompanied by increased labour use and hence higher labour costs.

The findings reported in Table 3 indicate that the organic farming practice uses about twice as much labour per hectare as the conventional counterparts. It was investigated to what extent cost savings due to the non-use of chemical fertilizer and pesticides compensate for lower yields and higher labour requirements in organic farming. On average, cost savings on fertilizer and chemicals cover about 40 percent of the losses or extra cost incurred by lower yields and higher labour requirements. Thus, considerable price premiums on organically produced farm

TABLE 3. Economic Performance Comparison of Rice Farm Management Practices

Cost/Revenue Items	Organic	No-Pesticide	Low-Pesticide	Conventional
	----------1,000Won / ha----------			
Gross Receipt (A)	12,050	10,814	9,976	9,686
Yield (ton/ha)	5.257	5.634	6.110	6.540
	(0.327)	(0.416)	(0.362)	-
Unit Price (1,000Won/ton)	2,292	1,920	1,633	1,481
	(304)	(208)	(139)	-
Production Cost (B)	9,225	8,368	7,475	5,296
	(1,240)	(1,619)	(1,099)	-
- Material Cost (C)	2,961	2,657	2,412	1,464
· Seed & Seedling	136	110	101	98
· Inorganic Fertilizer	-	108	152	192
· Organic Fertilizer	739	446	398	57
· Soil Conditioners	230	227	189	-
Pests, Insects, Weeding Prevention	267	223	159	225
· Env-friendly Material	587	576	458	-
· Fuels, Electricity and Maintenance	32	30	30	25
· Farm Implement and Facilities	904	871	868	804
· Others	67	65	58	64
- Management Cost (D)	6,813	6,266	5,875	4,326
	(1,142)	(673)	(643)	-
· Hired Labour	422	396	365	158
· Land Service	2,688	2,498	2,428	2,406
· Custom Works	487	469	427	51
· Capital Service	256	246	242	247
- Self-Service Labour	2,412	2,102	1,599	970
Value Added (A-C)	9,089	8,157	7,564	8,222
Revenue (A-D)	5,237	4,549	4,101	5,360
	(1,610)	(2,291)	(1,722)	-
Net Revenue (A-B)	2,825	2,447	2,501	4,390
Revenue Ratio (%)	43.5	42.1	41.1	55.3

Note: The figures in the parenthesis represent the standard deviation on the items under consideration.
Source: Kim and Kim (2003).

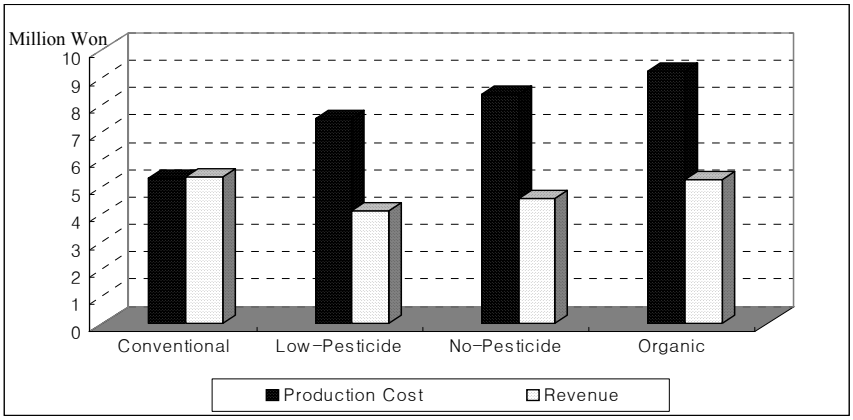
products are needed to obtain a remuneration of labour and capital at about same level as in conventional agriculture.

In most cases, farmers select which farming system to use, whether conventional or organic, by considering profitability in the short run. Until recently, conventional farming systems have usually appeared to be more profitable in the short term than organic farming system. This comes as no surprise, given that agricultural research and policy over the last three decades have promoted conventional agriculture. Even so, the long-term profitability of conventional farming seems questionable if the environmental and health costs are taken into account. Indirect costs such as off-site damage from soil erosion, pollution of surface water and groundwater, hazards to human and animal health from conventional farming practices are at present borne by society. If these external costs were factored into the costs of farm production, the overall profitability and benefits to society of organic farming systems would probably be much higher.

As mentioned above section, the yields in organic farming are generally lower than in conventional agriculture. These lower yields may, in part, be offset by higher prices and lower variable costs. These three factors influence the level of the gross margin. Depending on the crops, the net revenue results for the two management systems differ correspondingly. As shown in Table 1, production cost of organic rice faming is 9,225,000Won ha^{-1} (equivalent to USD 7,818 ha^{-1}) higher on the conventional farm, but the higher price premium less than offset the difference. The organic rice farming has a low-level of net revenue 2,825,000 Won ha^{-1} (equivalent to USD 2,394 ha^{-1}), compared to 4,390,000 Won ha^{-1} (equivalent to USD 3,720 ha^{-1}) for the conventional.

As shown in Figure 4, the comparison of production cost under stainable farm management practices is 74.2 percent in organic farming, 58.0 percent in no-pesticide farming, and 41.1 percent in low-pesticide farming higher than that of conventional farming. On the other hand, the comparison of revenue based on conventional farming realized is 76.5 percent in low-pesticide farming, 84.9 percent in mo-pesticide farming, and 97.7 percent in organic farming.

FIGURE 4. Comparison of Production Cost and Revenue in Alternative Farming Methods



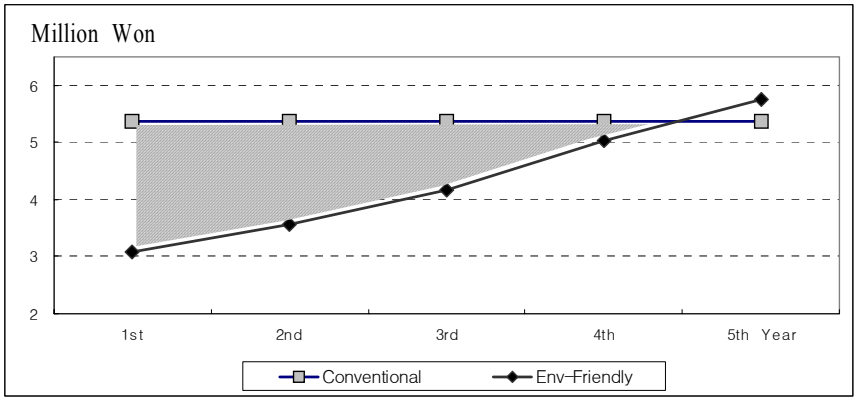
	Conventional	Low-Pesticide	No-Pesticide	Organic
	---------- 1,000 Won/ha ----------			
Production Cost	5,296	7,475	8,368	9,225
	(100.0)	(141.1)	(158.0)	(174.2)
Revenue	5,360	4,101	4,549	5,237
	(100.0)	(76.5)	(84.9)	(97.7)

Note: The figures in the parenthesis represent the indices based on the conventional farming

The stream of revenue over time has special characteristics in conversion period as shown in Figure 5.[8] The revenue differences between sustainable and conventional farming are gradually decreasing as to sustainable practicing careers. After 4th year in acquiring certified sustainable farm production, the revenue generated from sustainable farming practices would be higher than that of conventional farming. The analytical result

[8] The number of 71 surveyed farm households of over the time yearly consists of 15 farms in the 1st year, 12 farms in the 2nd year, 9 farms in the 3rd year, 6 farms in the 4th year, and 29 farms over the 5th years.

FIGURE 5. Revenue Differences between Conventional and Sustainable Farming over Time



	1st Year	2nd Year	3rd Year	4th Year	5th Year
	----------1,000 Won/ha----------				
Conventional (A)	5,360	5,360	5,360	5,360	5,360
Env-Friendly Mean(B)	3,094 (57.7)	3,559 (66.4)	4,164 (77.7)	5,038 (94.0)	5,749 (107.3)
Standard Deviation	1,203	938	875	789	628
(A) - (B)	-2,266	-1,801	-1,196	-322	389

Note: The figures in the parenthesis represent the indices based on the conventional farming revenue.

shows that the revenue of sustainable farm management practices after 5th year would be higher than amount of 389,000 Won ha^{-1} (equivalent to USD 330 ha^{-1}). The striped area in Figure 5 represents the stream of revenues difference between conventional and sustainable farming change over time.

At least for the time being, Korean agriculture under the limited agricultural resources cannot completely abandon conventional and intensive farming based on the use of agricultural chemicals. This does not, however, imply that the basic concepts of organic farming cannot be generally accepted, and an attempt made to combine sustainable and conventional farming practices in practical way. Perhaps the term, ‘organic

farming' and 'no-pesticide farming' in its rigid sense can be replaced with a more practical term. Regardless of the terminology, what will have to be sought in Korean agriculture in coming years is farming systems that are attractive to farmers economically, while satisfactorily meeting the consumers' demand for food safety and environmental quality. Sustainable farming would be a feasible and a desirable approach to this goal.

In reality, many farmers express their interests in sustainable farm management. However, farmers are reluctant to adopt sustainable farming practices because of many obstacles. They perceive that there are high risks involved, although they earn similar expected income to their conventional counterparts. However, in the long run, it may be considered as the most desirable approach, provided that the necessary technical and economical improvement can be made. Price premium of organic products is an important factor to induce farmers to participate in the organic agriculture. Premium prices can be achieved by means of selling to a special market outlet, or selling their products directly to the consumers.

The perceived risk involved in converting from conventional to sustainable farm management is a major constraint at present. More information as well as a change in the way of thinking is needed. Sustainable farm management requires a greater awareness and understanding of biological and ecological processes and interactions, and a long-term approach to making the system work without depending on chemical remedies. Although a farm may attain organic certification within three years, it may take longer for soil biological processes to fully develop. There are risks of lower yields, especially during the 3 or 4 year required conversion period before rice crop can be certified as organic. However, some established environmentally friendly practicing farmers have indicated in submissions that they achieve satisfactory production and consider these constraints are more perceived than real application. Management ability is likely to have the greatest effect on yields during transition. In this note, the analytical result shows that conversion payment for promoting sustainable

rice management practices need to compensate for cost increases and/or income reduction during the three to five years within switching periods depending on the realization of farm-gate premium prices.

V. Concluding Remarks

Farmers have shown rapidly increasing interest in sustainable farm management practices. In recently, many farmers who adopted sustainable farm management practices including organic and no-pesticide farm management practices were motivated by reasons relating to the health and safety of their families and consumers, and by idealistic convictions about soil and land stewardship. The relative economic performance of sustainable and conventional farming practices is sensitive to the ratio of input costs to the value of outputs. Both sustainable and conventional farmers are vulnerable to fluctuations in both input and output prices, but the effect of a given change will differ between the two farming systems.

Certified sustainable farming cropland in 2003 is rapidly increased more than eleven times in 2000, but is still modest because the low starting base. Only 1.3 percent of total cropland was managed under certified sustainable farming system in 2003. Strong market signals for originally produced agricultural goods, along with public and private support for organic farming systems, make it likely that organic production will remain a fast-growing segment of Korean agriculture. Currently, government's efforts to facilitate sustainable agriculture have focused primarily on developing national certification standards, but MAF has recently begun several policy-supporting programs on sustainable farming management technology as well as production and marketing areas.

Since the technologies relating to sustainable farming involve high risks in productivity, it is not easy for farmers to adopt sustainable farming practices. Therefore, a comprehensive long-term approach is required. In order to be an environmental

whole farm structure of national agricultural system, Korea should change the present agricultural support system to a system favourable to sustainable farming. This means that the mechanism of technology development and extension, market promotion and farm income support system should be changed.

The relative economic performance of environmentally friendly farming and conventional farming is sensitive to the input costs and output prices. The results of the accounts survey reviewed in this paper indicate that factors production receive about the lower remuneration in environmentally friendly farming than conventional counterpart. Substantial price premiums on outputs are essential for the economic viability of organic farming. Consumers' lack of willingness to pay significant price premiums on environmentally friendly produced rice due to some credible problem of accreditation scheme seems to be the most important obstacle to the expansion of sustainable farm management practices. Thus, conversion payment for promoting sustainable rice management practices need to compensate for cost increases and/or income reduction during the three to five years within switching periods depending on the realization of farm-gate premium prices.

Finally, in order to continuously and soundly promote sustainable farm management practices, additional public and private research is needed on many aspects of organic production and marketing in Korea. What are the primary incentives that motivate farmers to switch from conventional to sustainable farming systems? What would the economic impacts and social benefits be under widespread adoption of sustainable farming system? Additional research is also needed on how to improve sustainable farm management practices from agronomic and ecological perspectives, as well as from an economic perspective. The extent of the national research agenda on sustainable agriculture development, along with program and policy initiatives, will help shape the role that environmental whole farming systems play in Korean agriculture in the decades ahead.

Even within the limit of the data collected for this

empirical study, there may be errors. The samples drawn from purposive sampling method may not accurately represent the larger populations of farms from which they drawn as a result of the manner in which they were selected. Errors may arise from reliance on farmer's report of yields, field operations, purchased inputs, and other data used in the calculations. For further research on analysing economic performance of sustainable farm management practices, we need for developing methodology of dynamic green budgeting and for minimizing errors using the accurate farmers' bookkeeping. Recently, environmentally friendly farming is an attractive alternative for both farmers and policy makers. With the development and delivery of better information on economic performance, both will be able to make the best use of this alternative.

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