The Economic Effect of Nature Farming by EM

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Abstract: *Along with the increasing concern among farmers and the general public about the adverse effect of conventional farming, questions have been increasingly raised in recent years about the long-term sustainability of the current agricultural system that relies on agricultural chemicals such as fertilizers and pesticides. Effective Micro-organisms (EM), as a potentially valuable technology that pursues more ecologically oriented agriculture than conventional farming, recently has garnered considerable attention from agricultural sectors in Korea. This paper is concerned primarily with the conditions and practices of sustainable agriculture and the economic impact of EM organic farming in Korea. Crops considered are rice, cucumber, tomato, lettuce, melon, red pepper and pear. The results of the analysis indicate the following: among all crops considered. (1) Rice and tomato produced higher crop yields with EM than conventional farming; (2) rice, tomato and red pepper required higher production costs with EM than the conventional farming; and (3) among seven crops, five resulted in much higher incomes with EM compared with conventional farming.*

Introduction

The improvement of living standards from higher national income accelerate increasing demand for highly qualified and safe agricultural products. Also recently most agricultural research are concerned about low input sustainable agriculture such as non- chemical farming. However, most of them are mainly focussing on the technical aspects of agricultural production and the direction of sustainable agriculture policy. A few research papers addressing farm management strategies and economic analysis on the environmentally friendly agriculture, especially EM nature farming have been published in Korea.

Since the RIO Declaration on Environment and Development in 1992, with the internationally increasing concerns about the environment, agricultural sectors also emphasize the importance of sustainable agricultural systems, In Korea, due to the intensive mono-culture of cash grains and the extensive and often excessive use of agricultural chemicals, both fertilizers and pesticides, societal concerns are increasing about the environmental pollution and food safety. In 1997, the National Assembly legislated for the promotion of sustainable agriculture and the institutional frame for agriculture. From 1999 the direct payment system was introduced to induce the farmers to adopt the sustainable agricultural system. With these changes in agricultural sectors, low input farmers and farm size have been gradually increasing. Therefore, prompt efforts are thus needed to improve the profitability, and management efficiency of sustainable agriculture.

In this study, economic effects of some products from EM nature farming as one concept of sustainable agriculture, and one of the low input farming systems, which was carried out practically by farmers themselves, or by custom operations cooperation were evaluated.

Methodology Data were collected from secondary data and field survey for major crops; rice, cucumber, tomato, lettuce, melon, red pepper and pear. Economic analysis was based on input-output method by comparing conventional farming with EM nature farming.

Results **Input Use and Problems of Conventional Farming**

Total input of chemical fertilizers in 1960 was 138kg/ha. In 1995, it was 434 kg/ha. T his input level is 40 percent higher than that of the recommended application level of 310kg/ha. For rice farming, the input level of phosphate and potash was similar to the recommended level but nitrogen use was 45 percent higher than the recommended a pplication level (Table 1).

Table 1. The Practical Application Fertilizer and Standard Input

Item	Input of Chemical Fertilizer (kg/0.1ha)			
	Total	Nitrogen	Phosphate	Potash
Applied Amount (‘95)	30.7	16.0	7.0	7.7
Recommended Amount	26.0	11.0	7.0	8.0
Excess(%)	18.1	45.5	0	3.8

Source: Ministry of Agriculture & Forestry(MAF), agricultural production statistics, each year

On the other hand consumption of agricultural chemicals based on market sales increased from 16,000 tonnes in 1980 to 26,000 tonnes in 1995, by about 50 percent. Since 1990 every year it is nearly stationary at more or less 25,000 tonnes. The consumption of chemicals for rice reduced by about 25 percent compared with the consumption in 1980, but the consumption of chemicals for horticulture increased by 19 percent compared in 1980. Due to the shortage of labour in rural areas, the consumption of herbicides increased by 72 percent compared with 1980 (Table 2). The consumption of chemicals in Korea is 12.8kg/ha. It is similar to Japan and Belgium, based on intensive farming but it is much higher than that of United States and Germany by extensive farming (Table 3).

Table 2. Transact Quantity of Chemicals by Year (ton)

Item	1980	1986	1990	1993	1995
Total	16,132	18,247	25,082	25,999	25,834
	(100%)	(113)	(155)	(161)	(160)
For Rice	6,430	8,609	8,429	6,000	4,867
	(100)	(133)	(131)	(93)	(75)
For Hort.	5,425	5,938	8,641	11,785	11,934
	(100)	(109)	(160)	(217)	(219)
Herbicide	3,374)	3,994	5,509	5,270	5,817
	(100)	(118)	(163)	(156)	(172)
Others	903	1,246	2,463	2,944	3,216

Source: The Association of Chemical Industry

Table 3. The Consumption of Chemicals by Major Countries

Korea ('91)	Japan (90)	Belgium (93)	USA (93)	Germany (93)
12.8	19.3	12.1	1.3	2.5
(100%)	(152)	(95)	(10)	(20)

Source: RDA, "Sustainable Agriculture Extension Method (1997)

Quality Certification and Practical Aspects for Sustainable Agriculture

The number of farms participating in quality certification program decreased slightly compared to the previous year as of August, 1998, but the number of crops certified exceeded by about 16 percent By cultivation condition the number of farms participating in quality certification for non-chemicals and organic farming increased and the number of farms in quality certification with low input farming have decreased (Table 4). And transaction quantity and in quality certification show increasing trends every year (Table 5).

Table 4. The Admission of Quality Certification by Farming Type

Farming Type	No. of items		No. of Admission		No. of farms		Field Area (ha)	
	'97	'98	'97	98	97	98	97	98
General Culture	54	52	1,117	1,083	52,407	50,725	49,412	
Natural Farming	18	20	53	53	395	229	286	
Non-chemicals	32	49	197	312	376	405	184	
Organic Farming	31	48	236	407	229	290	192	
Total	135	170	1,603	1,855	53,407	51,709	50,074	
	(81)	(117)	(486)	(772)	(1,000)	(994)	(662)	

Source: The status of quality certification for agricultural products, National Agricultural Products Inspect Office (NAPIO), 1997-98.

Table 5. The Admission of Quality Certification by Farming Type

Year	Number of Items	Transaction (ton)	Contrast to Previous yr.
1997	85	104,526	135(%)
1996	76	118,810	160
1995	71	74,331	253
1994	59	29,390	245
1993	40	11,983	316
1992	21	3,791	

Source: NAPIO, Status of admission of quality certification, 1997

The number of farms participating in sustainable agriculture has been increasing. As of August in 1998, the numbers of farms were 13,056, and farm area was 10,718 hectares in Korea. In contrast with those of 1997, the number and area increased by 43 and 46.5 percent, respectively (Table 6).

Table 6. Number of Farms and Farm Size (ha) by Sustainable Agriculture (Aug. 1998)

Items	Total		Organic Farming.		Non-chemical Farming		Nature Farming	
	No. of Farm	Area	No. of Farm	Area	No. of Farm	Area	No. of Farm	Area
Total	13,056 (100)	10,718 (100)	1,237 (9.5)	902 (8.4)	1,806 (13.8)	1,192 (11.1)	10,013 (76.7)	8,624 (80.5)
Rice	2,983	3,377	360	322	684	595	1,939	2,460
Vegetable	6,745	3,885	504	385	685	343	5,286	3,157
Fruits	2,454	2,606	109	102	128	91	2,217	2,413
Ind.crop	584	281	219	42	236	78	129	161
Others	560	569	45	51	73	85	442	433

Source: NAPIO, 1998

Comparison of Major Results between Conventional and EM Nature Farming

Crop yields of nature farming by EM appeared that rice was 111 per cent cucumber 71, tomato 113, lettuce 98, melon 96, red pepper 89 and pear 91 percent of the crop yields of conventional farming, respectively. Rice and tomato produced higher crop yields with EM. Higa and Lee (1993) argued that the cultivation conditions fitted with EM would improve soil structure and increase crop yields. The management costs of EM farming were 123 percent for tomato, 161 percent for melon and 152 percent for red pepper of the conventional farming. The labour inputs of EM farming were 115 percent for rice, 112 for cucumber, 117 for tomato, 116 for lettuce, 107 for melon, 112 for red pepper and 53 for pear of the conventional farming. The labour inputs of all crops surveyed for EM farms increased ranging from 7 to 17 percent, except for pear (Table7).

Table 7. Comparison of Major Results between Conventional (CF) and EM Farming

Classification		Yield (kg/0.1 ha)	Management. Cost (won/0.1ha)	Labour Input (hr./0.1ha)
Rice	CF	518(100)	228,147(100)	31.1(100)
	EM	575(111)	216,000(95)	35,9(115)
Cucumber	CF	17,599(100)	8,884,975(100)	1,040(100)
	EM	12,535(71)	6,835,000(77)	1,166(112)
Tomato	CF	6,941(100)	2,852,367(100)	660,6(100)
	EM	7,866(113)	3,499,000(123)	774(117)
Lettuce	CF	3,669(100)	1,429,483(100)	435(100)
	EM	3,600(98)	1,498,000(95)	505(116)
Melon	CF	3,380(100)	2,467,000(100)	284.3(100)
	EM	3,258(96)	3,981,000(161)	303(107)
Red pepper	CF	234(100)	396,000(100)	218(100)
	EM	208{89}	602,000(152)	245(112)
Pear	CF	2,471(100)	1,256,944(100)	314.6(100)
	EM	2,250(91)	1,142,422(91)	167.4(53)

Note: CF means Conventional Farming

Comparison of Profitability between Conventional Farming and EM Nature Farming

Per 0.1hectare production costs of EM showed that rice was 111 percent of conventional cultivation, cucumber 81, tomato 118, lettuce 107, melon 157, red pepper 121, and pear 67 percent. On income it appeared that rice was 113 percent of the conventional farming, cucumber 109, tomato 171, lettuce 123, melon 79, red pepper 97, and pear 159 percent (Table 8).

Table 8. Comparison of Profitability between the Conventional (CF) and EM Farming

(unit: kg/0.1ha, Won/kg, Won/0.1ha)

Item		Yield	Price	Gross Income	Managt. Cost	Production Cost	Income	Net Profit
Rice	CF	518	1,791	927,879	228,147	458,240	699,732	469,639
	EM	575	1,745	1,003,616	216,000	509,000	787,616	494,616
	%	111	97	108	95	111	113	105
Cucumber	CF	17,599	988	17,387,812	8,884,975	13,395,683	8,502,837	3,992,129
	EM	12,535	1,285	16,107,000	6,835,000	10,946,000	9,272,000	5,161,000
	%	71	130	93	77	81	109	129
Tomato	CF	6,941	911	6,323,251	2,852,367	5,100,818	3,470,884	1,222,433
	EM	7,866	1,240	9,753,795	3,499,000	6,022,000	5,923,000	3,400,000
	%	113	136	158	123	118	171	278
Lettuce	CF	3,699	974	3,573,606	1,429,483	2,807,132	2,144,123	766,474
	EM	3,600	1,150	4,140,000	1,498,000	2,995,000	2,642,000	1,145,000
	%	98	118	116	105	107	123	149
Melon	CF	3,380	1,960	6,625,000	2,467,000	3,259,000	4,158,000	3,366,000
	EM	3,258	2,228	7,259,000	3,981,000	5,126,000	3,278,000	2,133,000
	%	96	114	109	161	157	79	63
Red Pepper	CF	234	10,000	2,340,000	396,000	1,195,000	1,944,000	1,145,000
	EM	208	12,038	2,504,000	602,000	1,442,000	1,902,000	1,062,000
	%	89	120	89	152	121	97	93
Pear	CF	2,471	1,605	3,965,955	1,256,944	2,455,588	2,709,011	1,510,367
	EM	2,250	2,416	5,437,500	1,142,422	1,648,503	4,295,078	3,788,997
	%	91	151	137	91	67	159	251

Note: CF(=Conventional farm), EM(=EM farm)

Discussion

Not so many farms participated in EM nature farming in Korea. The nature farming is one of low input farming, terminology of similar concept of sustainable agriculture (Kim, 1995; Sim, 1998), because they have different purposes but the same activities with low input chemicals. Seven crops were surveyed were 7 crops,i.e. rice, cucumber, tomato, lettuce, melon, red pepper and pear. The above survey results in Table 8 show the differences in profitability between conventional and EM nature farming.

The consumption level of agricultural chemicals in Korea (18 percent higher than the recommended application level), based on intensive farming is very high ranging from 5 to 10 times the United States and Germany by extensive farming (Table 3).

The number of farms participating in quality certification decreased than in previous year as of August, 1998, but the number of quality certification exceeded by about 16 percent. By cultivation condition the number of farms participating in quality certification for non-chemicals and organic farming have been increasing. The number of farms participating in sustainable agriculture has been increasing. In contrast with those of 1997 they increased by 43 and 46.5 percent, respectively (Table 6).

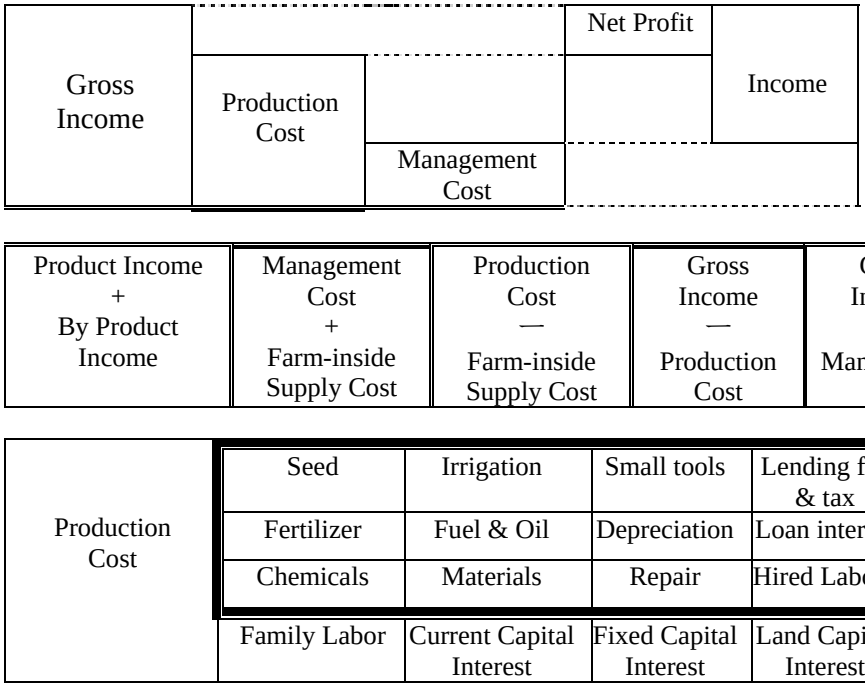

Figure 1. Diagram of Production Cost Structure
Source: MAF, Agricultural Officials Training Textbook, 1995

The yields of rice and tomato based on 0.1hectare produced higher crop yields with EM than those of the conventional farming. Management costs includes seed, fertilizer, chemicals, fuel and oil, irrigation fee, material, small tools, depreciation, repair, farm tax, custom farming fee and hired labor (Figure 1). The management costs for tomato, melon, and red pepper were much higher than those of the conventional farming. Other crops resulted in lower management costs compared with the conventional farming ranging from 77 to 95 percent of conventional farming. The labor inputs of all crops with EM ranged from 7 to 17 percent of the conventional farming except for pear. The main factors influencing the higher labor inputs with EM were fertilizer application, production of EM, weed control, harvest and grading.

Prices were the ones received by farmers. Prices of EM agricultural products were higher than that of the conventional farming. It seems that the consumers' preferences of EM agricultural products were high. Gross income was calculated by price time production quantity. The higher quality of the agricultural products with EM has enough potential to increase gross income of farmers (Higa and Lee, 1993).

Production costs consist of farm management cost, family labour cost, and interest of capital (current, fixed, land) (Figure 1). Income was calculated by subtracting management costs from gross income. Net income is equal to the gross income minus production cost. Except cucumber and pear the other crops needed higher production costs with EM than the conventional farming by 107 to 157 percent.

Conclusions

- The steps of the progress of nature farming with EM should be set up at the same time with the terminology of sustainable agriculture, low input farming, and organic farming (could be the same purpose with nature farming). There are too many concepts to carry out nature farming efficiently.

- There is a shortage of economic studies for nature farming with EM, except the technical aspect of agricultural production, and the direction of sustainable agricultural policy. The importance of sustainable agriculture needs strong policy, through more education, and public relations.

- The higher quality of the agricultural products with EM need time for fixing. The results of the analysis are as following: (1) rice and tomato produced higher crop yields with EM than conventional farming; (2) rice, tomato and red pepper required higher production costs with EM than the conventional farming; and (3) of the seven crops, five crops resulted in much higher net returns with EM compared with the conventional farming.

- The nature farming by EM in Korea is a new technique. Up to now, agricultural sectors pursued higher productivity with higher input to secure self-sufficiency of agricultural products(especially for rice). But it appeared that the high yield and price of the nature farming products by EM, as shown in the agricultural effect, made the economic effect increase (Higa and Park 1995). In the future the increase of living standards will increase the demand of agricultural products by EM.

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