Comparative Economic Analysis of Environmentally Friendly Agriculture and Conventional Agriculture in Soyang Watershed of South Korea

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Abstract: The purpose of this research is to test whether there are significant differences among farmers implementing conventional agriculture in comparison to environmentally friendly agriculture with respect to economic investments and gains, and in their effectiveness in providing ecosystem services. This study will evaluate the economics of environmentally friendly agriculture versus conventional farming in 4 counties located within Soyang Watershed. This study will evaluate factors which play a role in the adoption of environmental friendly farming such as economic risk and private economic gains. Also, the study will establish preferences of consumers with respect to agricultural products, whether they are influenced by quality, health and safety gains in the consumption of environmental friendly agricultural products. It is expected that the integrated results of multi-attribute preference methodologies make it possible to compare farmers and consumers' behavior.

Key words: benefit-cost, stated preference, willingness to pay, willingness to accept

1. Introduction

Human society derives benefits as goods and services from ecosystems. The changes to landscape systems that are associated with agriculture affect a wide range of ecosystem services, including food and products for human consumption and use, water quality and quantity, soil quality, air quality, carbon sequestration, pollination services, seed dispersal, pest mitigation, biodiversity, habitat change and habitat degradation, and resistance and resilience with respect to disturbances (Dale et al, 2007). The increasing recognition and clear definition of ecosystem services has affected policy decisions and human concerns about services such as soil erosion, land degradation and reduced biodiversity. The loss of services is now considered to be a major environmental threat influencing sustainability and productive capacity of agriculture. Extreme agricultural inputs (energy, fertilizers, pesticides) not only can reduce economic sustainability but also simultaneously result in severe negative impacts on environmental quality (National Research Council, 1993). Alternative agricultural methodologies that reduce erosion and conserve biodiversity have been referred to as 'environmentally friendly agriculture'. In recent years, environmentally friendly farming has become an important feature of agricultural policy and the academic research agenda (Battershill et al, 1997). It has led to changes in agricultural production methods all over the world.

South Korea is no exception. Actually, Korean agriculture, which entered a period of transition with the official inauguration of the World Trade Organization (WTO), had no choice but to adopt an open market policy. As a result, it became an imperative task to improve the industry structure of agriculture. Thus, the Korean central government implemented policy objectives and a basic plan according to the Environmental-Friendly Agriculture Promotion Act. In addition since 1999, a direct payment system was set up to compensate farm households practicing environmental friendly agriculture in order to offset their initial reductions in income and differences in production costs. This program can have a positive influence on ecosystem services and biodiversity (see Table 1). Attempts to solve environment problems and the pressure to open the agricultural products market have changed the direction of agriculture policy from conventional farming to environmentally friendly farming. Policy decisions to meet public concerns about sustainability have led to a concept of sustainable agriculture and ideas about how organic agriculture might gain suitable profits and supply needed ecosystem services. Such farming approaches are generally referred to as "environmentally friendly" farm management practices (Kimchang-Gil et al., 2004).

Table 1. Statistics related to the implementation of the 'Environmentally Friendly' direct payment program

	2004	2005	2006	2007	2008	2009	2010
Amount of payments (in millions of KRW)	3,977	7,703	14,055	17,525	26,282	40,868	37,608
Implementation area (ha)	12,354	20,780	34,896	45,434	72,444	98,849	93,305
Number of participating farm households	13,968	22,119	45,567	66,090	87,416	115,300	116,385
Average direct payment (1000s KRW/ha)	552	548	546	523	614	413	403

Source: Ministry for Food, Agriculture, Forestry and Fisheries (2011)

In addition to the use of large amounts of fertilizers, pesticides and water use in irrigation, intensive agriculture has adversely affected soil stability in Gangwon. Soil erosion and turbid runoff from sloping highland agricultural fields have reduced water quality in Soyang Lake watershed. As a possible means of combating so-called muddy water problem, both officials in Gangwon-do as well as the central government have paid increasing attention to environmentally friendly agriculture. Efforts of environmentally friendly agriculture have increased In the context water quality, the extent to which environmentally friendly agriculture can lead to improved landscape nutrient balances and soil stability are now important questions.

However, intensive agriculture with extremely high use of chemical fertilizers and pesticides still accounts for the major production component in Korean agriculture. Regardless of supports, the environmentally friendly agriculture was only ca. 11% of production at the end of 2009 (see Table 2). Therefore, we must understand better the determinants for adoption of environmentally friendly agriculture by farming households. This planned study will evaluate the economics of environmentally friendly agriculture versus conventional farming in Soyang Watershed. We will test if there are significant differences between the preferences of farmers implementing conventional agriculture in comparison to environmentally friendly agriculture with respect to economic performance and the resulting gains in particular types of ecosystem services.

The planned study will examine the following points:

1. We hypothesize that environmentally friendly farmers have greater input costs in production, even though their economic gains on a hectare basis may be the same as conventional farmers.

2. It is expected that assessment of economic risk and returns play a key role in the decisions of farmers who choose conventional versus environmentally friendly farming. Accordingly, we will examine whether established environmentally friendly farmers are more willing to accept a reduced short-term gain with the expectation of larger future gains.

3. Due to the fact that environmentally friendly farmers are more willing to use conservation practices than conventional farmers, we expect that they are more interested in improving the overall gain in ecosystem services rather than being focused solely on economic performance.

4. Environmentally friendly products are expected to have more valuable characteristics than conventional farming products in terms of nutritive value, taste and environmental appeal. We will evaluate whether consumers' decisions at the marketing level are influenced strongly by product quality.

5. It is expected that concerns for human health and safety has been increasing, and that it is a key factor that influences consumers' preference for environmentally friendly products. Accordingly, we will determine whether consumers buy environmentally friendly products as an investment in health and safety.

Table 2. Statistics related to the outputs from environmentally friendly agriculture

		2000	2005	2006	2007	2008	2009	Total %
Organic agriculture	Farm households	353	5,403	7,167	7,507	8,460	9,403	0.8
	Area (ha)	296	6,095	8,559	9,729	12,033	13,343	0.8
	Shipment (tons)	6,538	68,091	95,405	107,179	114,649	108,810	0.6
No-pesticide agriculture	Farm households	1,060	15,278	21,656	31,540	45,089	63,653	5.3
	Area (ha)	876	13,803	18,066	27,288	42,938	71,039	4.1
	Shipment (tons)	15,694	242,068	320,309	443,989	554,592	879,930	4.9
Low-pesticide agriculture	Farm households	1,035	32,797	50,812	92,413	119,004	125,835	10.5
	Area (ha)	867	29,909	48,371	85,865	119,136	117,306	6.8
	Shipment (tons)	13,174	487,588	712,380	1,234,706	1,519,070	1,369,034	7.6
Total	Farm households	2,448	53,478	79,635	131,460	172,553	198,891	16.6
	Area (ha)	2,039	49,807	74,995	122,882	174,107	201,688	11.6
	Shipment (tons)	35,406	797,747	1,128,093	1,785,874	2,188,311	2,357,774	13.1

Note:
1) Certification of organic agricultural products in conversion periods is included in organic products.
2) Total percentage is based on total farm households, total cultivation area, and total production. Production refers to foods, vegetables, fruits, oilseeds, ginseng and mushroom production.

Source: National Agricultural Products Quality Management Service (2010).

2. Methods and Research Strategy

Data will be collected in 2011 by means of 200 face-to-face interviews in South Korea. The sample area is Gangwon-do, specifically Yanggu, Inje, Hongcheon, Chuncheon counties, all located in Soyang Lake Watershed. The sample will involve 100 conventional farmers and 100 environmentally friendly farmers. This study will be conducted in two ways. The first one is a farm level evaluation of producers, and the survey will compare profitability and risks. Also, it will consider preference models in terms of ecosystem services, returns and costs ,relating attribute levels to preferences. The statistical methods will include conjoint analysis and contingent valuation. It will analyze data by using STATA. Conjoint analysis is a well-known technique and has been applied in marketing for over twenty years. This analysis encompasses a range of stated preference techniques. However, conjoint techniques have more recently been applied in geography, transportation, and economics (Ian J Bateman & Kenneth G. Willis, 2010). This approach is based on idea that any good can be described in terms of its attributes, or characteristics, and the levels that these take (Ian J. Bateman, 2002). This technique will be used to detect the attributes that are important in the construction of farmers' preferences on ecosystem services and include attribute levels including willingness-to-accept for farmers. Moreover, it will include income of farmers, subsidies from the central government and/or Gangwon-do and approach to ecosystem service such as erosion level and flood regulation through identifying the relevant attributes of the non-market good in question. Thus, we will compare yields, costs, returns, inputs and outputs of environmentally friendly farming and conventional farming. Also, we will evaluate how much money is paid for machinery, fertilizer and pesticides.

Each respondent will be asked to answer choice questions, which include benefit and cost of farmers who practice conventional farming and environmentally friendly farming. When the cost or price of the program is included as an attribute, marginal utility estimates can easily be converted into willingness-to-pay (WTP) estimates for changes in the attribute levels and by combining different attribute changes, welfare measures may be obtained. Given that compensating variation measures are obtained, results can be used directly within the

cost-benefit analysis framework. (David Hoyos, 2010). Substitutes are made explicit in the conjoint analysis format and this may encourage respondents to explore their preferences and tradeoffs in more detail (Stevens et.al., 2000). It will include several attributes in order to compare performance of ecosystem services and economics.

In addition, this study will include the consumers' aspects that consumers' willingness to pay (WTP) for environmentally friendly farming products, which reflect consumers' concerns in terms of its quality and safety and environmental friendliness, will be included by constructing survey to consumers who live in metropolitan area in Korea.

3. Conclusion

This study will evaluate factors which play a role in the adoption of environmental friendly farming such as economic risk and private economic gains. Also, the study will establish preferences of consumers with respect to agricultural products, whether they are influenced by quality, health and safety gains in the consumption of environmental friendly agricultural products. It is expected that the integrated results of multi-attribute preference methodologies make it possible to compare farmers and consumers' behavior.

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