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# Do attitudes toward ecosystem services determine agricultural land use practices? An analysis of farmers' decision-making in a South Korean watershed

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ABSTRACT

Land use practices directly influence the provision of ecosystem services from agrarian landscapes, and are thus key factors for the development of environmental policy programs. This study analyzes farmers' decision-making processes with respect to land use in a South Korean watershed, based on the theory of planned behavior. Decisions between cultivation of rice, annual or perennial crops, and between organic and conventional farming were compared among farmers as a function of their attitudes toward the following ecosystem services: biomass production, prevention of soil erosion, improvement of water quality, and conservation of plants and animals. Results show that decisions to plant perennial crops are most often accompanied by positive attitudes toward ecosystem services, whereas no differences were found between organic and conventional farming. In addition, latent class analysis reveals that positive attitudes toward ecosystem services are most likely held by farmers with high income, showing that financial means are key determinants of farmers' environmental attitudes.



## Introduction

Understanding and modeling farmer decision-making is of key importance to environmental policy makers as it lays the foundation for design and implementation of successful programs. Accordingly, analysis of decision-making receives considerable academic attention and is addressed by various scientific disciplines. One main approach evolving from traditional economic theory is based on the assumption that farmers' decisions are driven by their desire to achieve the greatest possible utility as defined in welfare economics. Although theoretically appropriate, several shortcomings arise when this idea is to be implemented in real life situations. Since utility is highly subjective and lacks consistent scalability, it does not lend itself for inter-individual comparisons. The usual economists' workaround is to approximate it by measuring profit via monetary returns, which offers the possibility of scaling and relating results from different actors.

As pointed out by Edwards-Jones (2007) decision analyses solely based on the assumption of rational profit-maximizing behavior yield useful results on large spatial scales where economic factors define the overall agricultural land use as a function of the given ecoregion (e.g. livestock farming versus crop farming). However, solely economic descriptors can lose most of their predictive power when it comes to analyzing decisions on small scales, since more and more non-financial factors start taking effect on land use preferences. Studies with input from sociology and psychology indicate that these preferences are influenced by a variety of motives, attitudes and values intrinsic to every individual decision-maker (Morris and Potter, 1995; Rogers, 2003; Willock et al., 1999). Variables that are most influential can be summarized under (a) farmer characteristics, (b) household characteristics, (c) farm structure, (d) social milieu, and (e) the characteristics of the policy under consideration (Edwards-Jones, 2007).

This joint consideration of motivational and structural/economic features has been termed 'behavioral approach' by Burton (2004) who argues that this approach is especially well suited for investigating farmers' responses to policy initiatives. Its distinctive advantages are the consideration of factors that reflect more than monetary motives and the use of standardized and repeatable methodologies which allow for comparisons between actors on different temporal and spatial scales (Beedell and Rehman, 2000). These qualities have led to an increasing implementation of behavioral studies for analyzing farmers' reactions to agricultural policies of the European Union. Since the late 1980s policy makers have been increasingly interested in diversifying rural land use and focus has shifted away from intensive commodity production toward a multifunctional design, which also takes into account the cultural and environmental heritage of agrarian landscapes. Corresponding studies are numerous and cover a wide range of topics such as general analyses dealing with farmers' conservation behavior (Beedell and Rehman, 1999, 2000; Carr and Tait, 1991; Lynne et al., 1995; Sutherland, 2010) or with environmentally-friendly farming (Battershill and

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Gilg, 1997; Willock et al., 1999), but also more specific works about for instance organic farming (Beharrell and Crockett, 1992; Fairweather, 1999; Locke, 2006; Midmore et al., 2001; Sutherland, 2011), management of field boundary vegetation (Morris et al., 2002), and riparian zone management (Fielding et al., 2005).

The idea of multifunctionality is closely associated with that of ecosystem services (ES), which was substantially conceptualized by the Millennium Ecosystem Assessment (MA) in 2005. Aiming at a paradigm shift in the appreciation of agricultural as well as of natural landscapes in general, the MA expanded the traditional view of the relationship between human well-being and ecosystems. In addition to the benefit of producing tangible goods, they placed emphasis on those merits of nature that bring about intangible services sustaining human life (MA, 2005). Although the vision of the MA to foster nature conservation by recognizing its full value holds more and more sway in the minds of individual and institutional decision makers, appropriate policy mechanisms for its successful incorporation into everyday decision-making are widely lacking. Daily et al. (2009) summarize three main areas that would aid this process: (a) understanding and discussion of peoples' motives and the evolvement of social norms in the context of natural ecosystems (Ehrlich and Kennedy, 2005; Pergams and Zaradic, 2008), (b) incorporation of traditional knowledge and practices into modern conservation approaches (Berkes and Folke, 2000), and (c) development of a broader vision for conservation and approaches that move from confrontation to participatory efforts seeking a wide range of benefits (Goldman et al., 2007; Manning et al., 2006; Pejchar et al., 2007; Theobald et al., 2005).

Following this vein, this study aims to investigate the motives and social norms involved in farmers' land use decision-making, with particular focus on the importance of ecosystem services in shaping these decisions. While market-based approaches for managing ES are relatively common (e.g. Ananda and Herath, 2003; Kant and Lee, 2004), actor-oriented analyses are far more scarce (Koellner et al., 2008; Sell et al., 2006, 2007). Dealing specifically with ES supply from agricultural landscapes, Antle and Valdivia (2006) addressed the topic from a financial perspective and created a production model based on the spatial distribution of opportunity costs for providing ES. Likewise following economic rationale Wossink and Swinton (2007) examined farmers' willingness to supply non-marketed ES in dependence on their jointness in production with other agricultural commodities. Vignola et al. (2010), in contrast, included more than monetary motives and modeled decisions about soil conservation measures based on farmers' beliefs and knowledge, risk perceptions, values, and a set of socio-economic characteristics. There are further studies that deal with topics along these lines, such as farmers' management of riparian zones and field boundary vegetation, even though the findings of these studies are not related to ecosystem services as a concept (Fielding et al., 2005; Morris et al., 2002).

Despite the well-proven applicability of behavioral studies for analyzing policy programs and the steadily growing recognition of ecosystem services as a powerful program for the future, these two approaches have hardly been combined. Existing literature that uses behavioral approaches rarely addresses ES as a driver for agricultural land use decision-making. The ones that do either follow different methodologies, seldom consider more than one service simultaneously, or deal with the topic on a conceptual basis. This study strives to fill this gap by putting several ecosystem services into the focus of a behavioral analysis about farmers' decision-making. It examines the role of four services, namely primary production, flood regulation, water purification and biodiversity with respect to their influence on farmers' decisions to plant rice, annual dryland crops, or perennial crops, respectively. The approach is implemented in a watershed dominated by agricultural land use in South Korea, where most policy measures to mitigate environmental degradation show little success. In this context, the attempt to elucidate determinants of farmers' decision-making is based on the following hypotheses: farmers with more positive attitudes[1] toward the aforementioned ecosystem services are more likely to decide (1) to plant perennial crops instead of rice or annual crops, and (2) to implement organic farming instead of conventional farming. Although studies from the same field of investigation underline the importance of these variables (see Fielding et al., 2005; Schwenk and Möser, 2009), these hypotheses were above all chosen in accordance with the characteristics of the study area, as will be described in detail hereafter.

## Study area and background

### *Environmental policy in South Korea*

Similar to the trends in the European Union, South Korea started attempts to gear its agricultural production toward multifunctionality as of the mid-1990s. Policy reforms were introduced that aimed at promoting environmentally friendly farming by means of certification schemes, promotion acts as well as various kinds of direct payment schemes. The largest part of the latter's total budget was spent on behalf of paddy rice production, which accounted for as much as 97% in 2005 (Im and Lee, 2007). This underlines the tremendous role that paddy rice cultivation has played in South Korea's agricultural production ever since. For hundreds of years it has been forming the backbone of economic, social and cultural life, with benefits going beyond what monetary scales alone can reflect (Groenfeldt, 2006). It therefore serves as good example why productive functions of agriculture in South Korea cannot be seen separate from various environmental and sociocultural functions. Modern-day mainstream agricultural practices, however, pursue economic returns as paramount objective, while most other functions are neglected. As a result, farming often comes along with severe environmental degradation. Most prominent damages in this context are water related, hence soil erosion, water quality and water supply are issues topping the list of budget allocations by the Korean Ministry of Environment. One approach to improve water management is the Four Major Rivers Project, which supports measures to ensure ample water supply, prevent floods, improve water quality and restore ecosystems (Moon, 2004). Among these four rivers is the Han River, which carries freshwater to Korea's capital Seoul and is the fourth longest of the country. In order to restore its water quality level, watersheds contributing most to the pollution of the Han River and its tributaries are a main target of water improvement initiatives.

### *Study area Haean watershed*

The present study was conducted in Haean, a 64 $km^2$ basin designated as pollution hot spot by the Korean government (longitude 128°5′–128°11′ East and latitude 38°13′–38°20′ North). This catchment in Yanggu County, Gangwon Province, contributes to the Soyang River, which feeds one of the two main tributaries of the Han River. The kettle-like topography of Haean Basin has a range in altitude from 500 to 1100 m a.s.l. and the area's appearance can best be described by its local name 'Punch Bowl'. Land use is dominated by agricultural production, which accounts for approximately 40% of the area. Another 55% are forests while the rest is mainly residential area (Korean Ministry of Environment, personal communication). Crop distribution roughly follows the

[1] The term attitudes refers to one component of the theory of planned behavior (Ajzen, 1991), which constitutes the theoretical framework for this study. A detailed description is given in the methodology chapter.