Science of the Total Environment 550 (2016) 382–390

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Analysis of the ecological conservation behavior of farmers in payment for ecosystem service programs in eco-environmentally fragile areas using social psychology models

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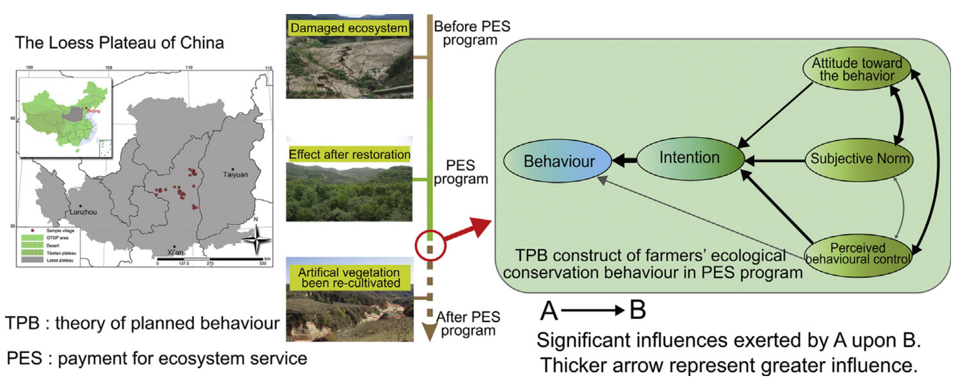
HIGHLIGHTS

- TPB can be used to analyze farmers' ecological conservation behavior in PES programs.
- The ecological conservation behavior of farmers was significantly affected by intention.
- Attitude, subjective norms, and perceived behavioral control influence intention.
- Comprehensive measures should be taken to facilitate farmers' conservation intentions.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 17 October 2015
Received in revised form 23 January 2016
Accepted 23 January 2016
Available online xxxx

Editor: D. Barcelo

Keywords:
Theory of planned behavior
Farmers' behavior
Ecological conservation
Environmental restoration
Structural equation model

ABSTRACT

Studies on the ecological conservation behavior of farmers usually focus on individual and socio-economic characteristics without consideration of the underlying psychological constructs, such as farmers' intention and perceptions. This study uses the theory of planned behavior (TPB), a typical social psychology construct, to analyze the factors affecting the intention and behavior of farmers for conserving the ecological achievements from payment for ecosystem service (PES) programs in eco-environmentally fragile areas. Questionnaires based on TPB were administered to 1004 farmers from the Grain to Green Program area in the Loess Plateau, China, with the resulting dataset used to identify the underlying factors determining farmers' intention and behavior based on the structural equation model. The results show that the farmers' intention and behavior toward conserving ecological achievements were explained well by TPB. The farmers'behavior was significantly positively affected by their intention toward conserving ecological achievements, and their intention was significantly influenced by their attitude (positive or negative value of performance), the subjective norm (social pressure in engaging behavior), and perceived behavioral control (perceptions of their ability). The farmers' degree of support for PES programs and their recognition of environmental effects were the factors that most

Abbreviations: AB, attitude toward a behavior; B, behavior; CFA, confirmatory factor analysis; CFI, comparative fit index; EFA, exploratory factor analysis; EEF, eco-environment fragile; GFI, goodness of fit index; GOF, Goodness-of-Fit; GTGP, Grain to Green Program; IN, intention; NFI, normed fit index; PBC, perceived behavioral control; PES, payment for ecosystem service; PGFI, parsimonious goodness of fit index; PNFI, parsimonious normal-fit index; RMSEA, root mean square error of approximation; SN, subjective norms; SEM, structural equation modeling; TPB, theory of planned behavior; χ2/df, chi-squared fit statistic.

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http://dx.doi.org/10.1016/j.scitotenv.2016.01.152

influenced the farmers' attitude. Pressure from neighbors was the most potent driver of the subjective norm. Meanwhile, perceptions of their ability to perform the behavior were the most potent factors affecting intention and it was mostly driven by the farmers' feelings toward environmental improvement and perceived ability (time and labor) to participate in ecological conservation. The drivers of attitude, subjective norm, and perceived behavioral control can be used by policy makers to direct farmers' intention and behavior toward conserving ecological achievements in fragile eco-environmentally areas through PES programs. Thus, this strategy can improve the sustainability of ecological and environmental restoration programs.

1. Introduction

Since the start of the 20th century, human activities have affected the earth with an unprecedented intensity because of population growth and resource consumption, causing severe damage to natural ecosystems (DeFries et al., 2004; Foley et al., 2005). The implementation of payment for ecosystem service (PES) programs was considered as a direct conservation approach to repair damaged natural ecosystems and environments, especially in eco-environmentally fragile (EEF) areas (Jack et al., 2008; Wunder and Wertz-Kanounnikoff, 2009). PES is defined as "a transparent system for the additional provision of environmental services through conditional payments to voluntary providers" (Tacconi, 2012). In other words, PES pays individuals or communities to undertake actions that increase the levels of desired ecosystem services. To date, PES programs have been proven to create considerable ecological achievements, including the promotion of regional ecosystem services, increases in biodiversity, and improvement in rural living conditions (Ingram et al., 2014; Liu et al., 2008). However, unlike the outright purchase of land or permanent easements, many PES programs are short-term. The uncertain land use succeeding the programs may render the conservation benefits only temporary. Previous studies have shown that restored vegetation lands are under the risk of being reconverted to cultivated land or other land-use types after the termination of the PES programs; hence, conservation achievements(e.g., the restored biodiversity and reclaimed soil) cannot be sustained without subsequent subsidies (Cao, 2008; Roberts and Lubowski, 2007). Therefore, subsequent programs are highly relevant to the sustainability of conservation achievements from PES programs. Although farmers are the program implementers and stakeholders, an understanding of farmers' motivations regarding ecological protection and land use could help policy makers design extended policies and conservation practices to enhance the sustainability of the conservation achievements (Page and Bellotti, 2015).

Similar to other ecological restoration programs worldwide, the Grain to Green Program (GTGP) in China aimed to restore damaged natural vegetation, prevent soil and water erosion in EEF areas, and support rural economic development (Xu et al., 2004). This program is a highly ambitious PES system globally (Xu et al., 2004). Since the establishment of GTGP in 1999, the Chinese government has provided direct subsidies for a maximum of eight years to farmers in compensation for their economic loss from translating slope croplands to vegetation, as well as to encourage them to reduce environmentally harmful activities. To sustain the benefits obtained, the government decided to extend the subsidies for another eight years upon termination of the first phase. Recently in 2014, another round of the program was launched to convert another 2.8 million ha of barren cropland to vegetation (State Forestry Administration of China, 2012). Total investment in the program has already reached $40.83 billion, and 22.54 million households were involved by the end of 2012, increasing the artificial vegetation areas by 26.75 million ha. GTGP has produced tremendous achievements both at ecological and socio-economic scopes, such as the increase in vegetation coverage ratio, reduction in water loss and soil erosion, and promotion of regional development (Liu et al., 2008; Peng et al., 2007). Among all of these achievements, vegetation recovery was the most intuitive and led to the advancement of ecological functions under canopies, such as an increase in biodiversity, soil quality improvement and, carbon sequestration (Fu et al., 2000; Jin et al., 2014; Zhao et al., 2013). Particularly, vegetation recovery in EEF areas such as the Loess Plateau, which covers 62.4×10^4 km^2 and has the most vulnerable ecological environment in the world (the average erosion rate has reached 150 Mg/ha per year) (Fu et al., 2000), has considerably contributed to maintaining ecological stability.

However, evidence shows that the vegetation restored by GTGP is under the threat of being reclaimed to cultivated land. Based on a 1768-household investigation in northern China, Cao et al. (2009) found that 37.2% of the farmers involved in GTGP intended to re-cultivate the reforested land. Similarly, another work in southwest China showed that more than 20% of the afforestation land in GTGP was highly likely to be re-cultivated (Chen et al., 2009). Why do such large numbers of farmers plan to abandon the ecological achievements, and what motivation and attitudes lay behind their behavior? Relevant studies are highly important for policy makers in designing subsequent policies for strengthening the sustainability of GTGP. Beedell and Rehman (2000) noted that such research should identify both socio-economic variables that affect the farmers' land-use plan and the farmers' intention to protect conservation achievements. Many studies have focused on the effects of policy and farmers' socio-economic characteristics on their decision-making and behavior using decision-making models with classic adoption variables. In particular, Cao et al. (2009) found that the sex, education, age, location, and net annual income of farmers are closely related with their land-use plan and attitude toward the program. Bo et al. (2014) reported a logistic regression model demonstrating that the age of the household respondents, number of family members, crop land area, and the degree of satisfaction toward the compensation were the most significant factors affecting farmers' willingness to preserve the achievements of GTGP in western China. Other studies have also found that the subsidy, duration of the program, labor in the family, economic income, and distance from the house to land should be considered (Wang et al., 2010; Yang and Xu, 2014).

Although previous studies have shown valuable information, limitations exist. First, large inconsistencies between the factors initially selected and those proven to have significant effects were found among different studies. Second, most of these studies were based on the assumption that the farmers'behaviors were positively correlated with their intentions (Chen et al., 2009). However, this assumption has not been verified in the EEF area. On the contrary, a meta-analysis by Knowler and Bradshaw (2007) showed that socio-economic characteristics usually exert a negligible effect on farmers' adoption decisions. Prokopy et al. (2008) also emphasized this conclusion. Therefore, a deeper understanding of the farmer's intention and its relation with behavior to conserve the ecological achievements in EEF areas is urgently needed.

Socio-psychological methods are widely used to identify farmers' intention to adopt improved technology (Borges et al., 2014), conservation behavior (Wauters and Mathijs, 2012), a land-use plan (Poppenborg and Koellner, 2013), climate-change adaptation (Truelove et al., 2015), and water conservation (Yazdanpanah et al., 2014). Among all of these approaches, the theory of planned behavior (TPB) is the one most commonly used for analyzing farmers' intention and behavior. TPB was developed by Ajzen (1991) as an extension of the theory of the reasoned action model (Fishbein and Ajzen, 1975). The basic