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Adoption behavior of green control techniques by family farms in China: Evidence from 676 family farms in Huang-huai-hai Plain

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ABSTRACT

Technique adoption behavior by family farms comprises three stages with progressive relation, including information collection, adoption willingness, and adoption intensity. To explore the influence factors of the adoption of green control techniques (GCTs) by family farms, this study focused on sample selection problems, namely, understanding (or not) and willingness (or not), using bivariate probit and regression linear models based on a field survey data from 676 family farms in Huang-huai-hai Plain. Estimation results showed that: 1) the frequency of neighbor communication, the strengths of the extension of agricultural technique sector and media publicity, education, and degree of risk preference of farmers had significant positive influences on information collection individually; however, the gender of farmers had a significant negative influence. 2) The perceived ease of use and usefulness about the technique, the number of laborers, the strength of the extension of agricultural technique sector, education, and degree of risk preference of farmers had significant positive influences on adoption willingness. 3) Finally, the perceived ease of use and usefulness about the technique, fund status, the strengths of media publicity and the extension of agricultural technique sector, and education of farmers had significant positive influences on adoption intensity; whereas the frequency of neighbor communion, gender, and degree of risk preference of farmers had significant negative influences on adoption intensity. Thus, to develop the GCTs successfully, the Chinese government should improve the effects of technique training, ameliorate financing environment, focus on publicity and guidance, establish and improve the system of education and training for family farmers, and strengthen the team concerning the extended construction of grassroots technique.

1. Introduction

Chinese agricultural production and consumption plays a major role in the world. The quality and safety of agricultural products are not only related to the health of consumers and social stability, but also affects the competitiveness of Chinese agricultural products in international markets. The quality and safety of agricultural products in China are due to the excessive dependence on chemical pesticides (Wang and Gu, 2013). Agricultural producers increase the amount and frequency of chemical pesticides without authorization, which leads to the widespread problem of pesticide residues (Wang et al., 2015). Recently, the Chinese government has been vigorously promoting green control techniques (GCTs) to control pests and chemical pesticides. GCT, which is a technical concept, is a localization of the concept of integrated pest management (IPM) in China. GCT is based on the plant protection policies of "prevention first, comprehensive prevention and control, and green plant protection" for the reduction of the amount of chemical pesticides. The goals of GCT include ensuring production, product quality, and ecological environment security in agriculture. GCT has the characteristics of ecological regulation, biological and physical control, scientific use of chemical pesticides, and priority use of energy-saving resources and environment friendly techniques. In general, GCT in China is still in the pilot demonstration;

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its implementation and application still face several difficulties (Zhao and Cai, 2012).

The demand of farmers, as micro-level decision subjects of agriculture production and management, is the key to a successful GCT extension. Under the influence of market economy and agricultural modernization, Chinese farmers are classified as traditional peasants who have multiple jobs and decentralized features, and as family farms characterized by specialization, integration, systematization, and socialization. Both of these classifications coexist for a long period of time. At present, China has more than 870 thousand family farms; cultivated land areas achieve 176 million mu (1 mu = 0.067 ha), accounting for 13.4% of total cultivated land areas in China (Ministry of Agriculture of the People's Republic of China, Division of Management and System 2015).

Whether in elements of production (such as land, capital, and labor) or the operator's labor and product attributes, family farms are closer to agricultural enterprises. Compared with traditional peasant households, family farms adopt the business strategy of facing the consumers, market, and future, emphasize large-scale and enterprise management, and attach importance to agricultural product certifications and brand marketing concepts. Family farms can respond to market demand. They rely on local natural resource conditions, and adopt new techniques and equipment to produce high value-added agricultural products. Therefore, the actual needs of traditional peasant households and family farms should be considered in developing targeted support policies and promoting GCT effectively.

Furthermore, necessary arable land scale is the prerequisite of practical GCT application. Traditional peasant households not only lack conditions but also a motivational force for the progress of techniques (He, 2016). Conversely, family farms meet the demand of cultivated land scale to apply GCTs, and they have practical needs for technological progress to decrease cost and increase profit (Zhu et al., 2014). Previous Chinese studies, such as those of Cai (2013), Chu and Li (2014), and Liu et al. (2015), have used traditional peasant households as research subjects. However, the use of family farms as a research object has not been reported in literature. This study attempts to bridge this gap by using the influence factors of GCT adoption behavior of family farms as the key research content.

Subjective GCT evaluations by family farms are important to their adoption willingness, which rely on GCT information collection. Saha et al. (1994) indicated that every adoption decision is based on information collection. Similarly, Ortiz (2006) specified that information collection is the prerequisite of IPM adoption by farmers. Only family farms that fully understand GCTs can make correct subjective evaluation and produce adoption willingness. Then, these family farms who adopted GCTs can be evaluated for their adoption intensity. Thus, the technique adoption behavior of family farms consists of three stages: information collection, adoption willingness, and adoption intensity, which have progressive relation.

If only regressive family farms who understand GCTs are considered as subjects for adoption willingness, then this condition signifies non-random sampling, and its data screening will lead to bias problem in the sample selection. Similarly, directly estimating GCT adoption intensity of family farms using OLS method will cause sample selection bias. However, this problem has not attracted enough attention from scholars. Most of the existing studies have considered the GCT (IPM) adoption behaviors of peasant households (family farms) as adoption willingness or adoption intensity, and analyzed those two problems, respectively. For example, Shojaei et al. (2013), Chu and Li (2014), Murage et al. (2015), and Liu et al. (2015) studied the factors that influence the willingness of peasant households (family farms) to adopt GCT (IPM). Cai (2013), Korir et al. (2015), Allahyari et al. (2016), and Jayasooriya and Aheeyar (2016) discussed the factors that affect the adoption intensity of GCT (IPM) of peasant households (family farms). Chu (2015) and Borkhani et al. (2013) divided the adoption behavior of peasant households (family farms) of GCT (IPM) into adoption willingness and adoption intensity in their research; however, the authors ignored the stage of information collection.

In addition, two methods were used by previous studies to measure the intensity of adopting GCTs (IPM) by peasant households (family farms). The first method is utilizing the proportion of the area of peasant households (family farms) that adopt GCTs (IPM) compared with the full area as a standard measure (Chu, 2015). Evidently, this method does not conform with real situations. Once peasant households (family farms) adopt GCTs (IPM), such as insecticidal light traps for pests, the technique will be applied to all arable lands. The second method is utilizing the number of sub-GCTs (IPM) that peasant households (family farms) have adopted as a measurement index (Cai, 2013; Korir et al., 2015; Allahyari et al., 2016). However, peasant households (family farms) always determine their adoption number according to crop and pest species, and control foundation. For example, if peasant household (family farm) A adopts three sub-GCTs, and peasant household (family farm) B adopts five, then they will both achieve goals, such as controlling pests effectively, improving production quality, and ensuring the safety of ecological environment. In this situation, using the second method to measure the adoption intensity of peasant households (family farms) is unreasonable. In fact, the occurrence of excessive use of chemical pesticides can be avoided if family farms adopt IPM (Sharma and Peshin, 2016). In other words, a higher adoption intensity of GCTs (IPM) by family farms means less usage of chemical pesticides per mu. Thus, this paper evaluates the GCT adoption intensity by family farms by compared with the prior to adoption, reduction rate of chemical pesticides per mu.

Based on the above analysis, this study utilized the 676 family farms in Huang-huai-hai Plain as sample data, and applied the bivariate probit and regression linear models to establish a three-stage model for GCT adoption behaviors of family farmers to explore the influence factors on GCT adoption by family farms. This study also focused on the following sample selection problems of understanding and willingness. The conclusion and policy implications of this study have important reference value in improving the policy system for GCT promotion in China, especially in endorsing “zero-growth action of pesticide usage.”

The contributions of this paper are as follows. First, existing domestic studies have mainly used the traditional peasant households as their research objects; however, this study utilized family farms as its sample, thereby enriching the GCT adoption behavior research in farmer differentiation context in China. Second, compared with previous research, this study presents a more reasonable method in measuring the adoption intensity of GCTs (IPM) by peasant households (family farms). Third, existing studies on GCT (IPM) adoption behavior have ignored the stage of information collection, in which the adoption intensity of family farms is observed before they actually become willing to utilize GCTs; thus, these previous studies have sample selection biases. Conversely, the current study achieves more rigorous empirical results compared with previous research because it regards the three stages of adoption behavior of GCTs by family farms, which include information collection, adoption willingness, and adoption intensity.

2. Research hypotheses

Farmer behavior theory, theory of planned behavior, and