



Rural households' willingness to participate in the Grain for Green program again: A case study of Zhungeer, China



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ABSTRACT

The Grain for Green program (GGP) is one of the most ambitious forestry projects in China. The GGP uses a public payment scheme to propel the participation of rural households in order to make the program acceptable and sustainable. The modification of the GGP for its long-term effectiveness has raised interest from researchers. However, few researchers have realized the role that rural households play in adjusting the GGP. By building an econometric model, we found that the decision making of rural households is optimal when the sum of the marginal benefit from residual farmland and the marginal benefit from agricultural labor time equals the sum of the subsidies for retired farmland, benefits from the increased forest/grassland and the opportunity cost rate of the rural household engaged in agricultural labor divided by agricultural labor efficiency. The results derived by a Logit regression method indicate that the economic benefit and non-monetary values stimulate households' willingness to participate, and households' attitudes have significant effects on their willingness. Our attempt to comprehensively explore the influencing factors concerning households' attitudes, the environment benefits and benefits from the GGP proves to be promising as a reference for future studies and for decision making regarding GGP.

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1. Introduction

The Grain for Green program (GGP), which is also known as the Sloping Land Conversion Program, is one of the most ambitious "payment for environmental services" (PES) programs in China (Bennett, 2008). The GGP was proposed in 1999 and formally initiated in 2002. By the end of 2009, the Chinese government had achieved its ambition to increase the forest by approximately 27.67 million hm², while around 9.27 million hm² came from farmland and the rest from wasteland, with an investment of approximately 233.2 billion Yuan (35.88 billion US dollars).

To be acceptable and sustainable, the GGP uses a public payment scheme to engage rural households as the core agents of the project's implementation (Xu et al., 2004). Incentive payments or payments for environmental services (PES) were conducted in similar programs (Angelsen, 2010). In America, the Conservation Reserve Program (CRP) promoted contracts with landowners and paid them rental fees annually in exchange for their agreement not to plant the land (Secchi and Babcock, 2007). Natura 2000 created an incentive-based conservation tool to propel landholders' participation (Delacote et al., 2000). Finland launched a new policy program (METSO) to enhance the

conservation of forest biodiversity, which was also based on economic incentives (Horne, 2006). Different programs all showed the necessity to motivate and incentivize landowners to participate in voluntary conservation programs (Lindhjem and Mitani, 2012).

However, economic incentives are not the sole factor affecting a household's willingness. Without economic development in rural areas or rural residents' migration to urban areas, incentives will remain unchanged, limiting the long-term effectiveness of the GGP (Mullan et al., 2011). Kilgore et al. (2008) found that marketing efforts to raise program awareness, increasing annual stewardship payments, and eliminating land covenants are likely to be effective strategies for increasing program participation. Delacote et al. (2000) identified three categories of determinants on the basis of the literature on the decision to participate in conservation programs: landowner characteristics, land characteristics, and variables concerning conservation programs. Bergseng and Vatn (2009) realized that landowners with conservationist attitudes towards the environment tend to positively participate in conservation programs.

The adjustment of the GGP to ensure its long-term effectiveness has recently attracted researchers' interests. Ma and Fan (2005) argued that the GGP should emphasize regulating the farmland structure and optimizing the model of returning farmland to forests in Minqin County. He (2012) suggested the necessity to promote local industrial development following the GGP. Chen et al. (2007) investigated the follow-up

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industry policy, the establishment of the science and technology strut mechanism, the consummation of forest ownership and the construction of positive surveillance mechanisms. Kang and Xia (2008) suggested that the increase of investments in the GGP and the regulation of project management can ensure the sustainable development of the project. Nevertheless, the existing literature shows that few researchers have explored the role that rural households play in adjusting the GGP.

Our research aims at identifying the factors affecting households' willingness to participate in a new term of the GGP. Having officially ended the GGP in 2010, the Chinese government does not have new plans to convert more cropland to forest/grassland.¹ Given this fact, we suppose that the national government will perform a new term of the GGP and investigate rural households' willingness to again participate in the program. Rural households' willingness and responses can be considered as the feedback to the GGP policy after the first term of participation. The strong participating willingness from respondents may influence the government's policymaking. This effect may lead to a new term of the GGP in some regions. The bottom-up approach of policy decision making was already proven to be successful in China's reform history by the "Household Contract Responsibility system." As is well known, this land reform was initiated by a secret signing of land contracts by several households in Fengyang County of Anhui Province.

With the purpose of investigating the influential factors, we performed both theoretical and empirical analyses. For the empirical analysis, Zhungeer, which is a county in Inner Mongolia in the north-west of China, was taken as the study area. The remainder of this paper is organized as follows: In Section 2, we develop a general theoretical model of optimal land-use change for rural households. In Section 3, the empirical analysis is presented in a sequence of data description from the rural households' survey, methods, results and discussion. Finally, this paper concludes with a summary of the results, the implications and topics for future research.

2. Theoretical hypotheses about rural households' willingness to participate in the GGP again

2.1. Rural households' product model

The utility function is often used in economics to describe consumers' reasonable preferences about consumption under different circumstances (Wu, 2001). Maximizing the utility function of rural households is an appropriate way to speculate about their willingness because the utility function includes not only economic benefits but also non-monetary values (Delacote et al., 2000). Our survey showed that farmers usually farmed in an extensive way with small amounts of fertilizer, pesticide and machinery inputs in Zhungeer. Therefore, we assume that the primary agricultural production inputs are labor and land. Suppose a rural household is endowed with labor time $\bar{T}_A$ and cultivated land area $\bar{L}_A$ after the first GGP period. The rural household can determine whether to participate in the GGP again and how to assign its land and labor. For example, rural households can engage in agricultural or non-agricultural production. Suppose a rural household assigns its labor time T_{AN} to agricultural production and the other $(\bar{T}_A - T_{AN})$ to off-farm employment. The wage rate from off-farm employment is w and the rural household has to pay a cost rate w_0 for off-farm employment. Then, the net income from off-farm employment is $(w - w_0)(\bar{T}_A - T_{AN})$. Suppose that the price of agricultural production is p , climate variability is $\tau(1 \geq \tau \geq 0)$ and $(1 - \tau)$ is the impact of climate variability on rural households' agricultural production (the more the climate fluctuates, the less the rural households' agricultural

production is). The rural household allocates all cultivated land and part of its labor time to agricultural production. Suppose that agricultural production is a second-order continuous and differentiable strictly quasiconcave $f(\cdot)$ (Luo and Bao, 2010) and U_0 is a rural household's income ($U_0' \geq 0$, $U_0'' \leq 0$). The model of a rural household's income is as follows:

$$U_0 = (1 - \tau)p f(\bar{L}_A, T_{AN}) + (w - w_0)(\bar{T}_A - T_{AN}) \quad (1)$$

2.2. Model of the willingness to participate

Suppose that a rural household has the willingness to retire cultivated land area L_x , $L_x > 0$ if the respondent wants to participate in the GGP again, and $L_x = 0$ otherwise. According to the definitions in the former section, labor time input per unit area of farmland is $T_{AN}/\bar{L}_A$, and $\bar{L}_A/T_{AN}$ can be understood as agricultural labor efficiency. Then, the rural household can save labor time $(L_x \times T_{AN}/\bar{L}_A)$ by retiring farmland area L_x . Suppose that the fiscal support to the rural household from the central government is λ Yuan per unit area of retired land, the rural household obtains a subsidy λL_x . The benefit from the retired land is γ (primarily including harvested pine nuts and forage grasses as well as spiritual enjoyment from the improved natural environment). Assume a rural household's total benefit to be U_1 consisting of farming income, income from off-farm employment, the total subsidy from the government and the total benefit from the retired land. A rural household's decision model is therefore:

$$\max U_1 = (1 - \tau)p f[(\bar{L}_A - L_x), (T_{AN} - L_x \times T_{AN}/\bar{L}_A)] + (w - w_0) \times [(L_x \times T_{AN}/\bar{L}_A) + (\bar{T}_A - T_{AN})] + (\lambda + \gamma)L_x \quad (2)$$

The rural households' optimal cultivated land retirement can be represented by the following first-order condition:

$$\begin{aligned} \frac{dU_1}{dL_x} = & -(1 - \tau)p \left\{ \frac{\partial f[(\bar{L}_A - L_x), (T_{AN} - L_x \times T_{AN}/\bar{L}_A)]}{\partial (\bar{L}_A - L_x)} \right. \\ & \left. + \frac{T_{AN}}{\bar{L}_A} \frac{\partial f[(\bar{L}_A - L_x), (T_{AN} - L_x \times T_{AN}/\bar{L}_A)]}{\partial (T_{AN} - L_x \times T_{AN}/\bar{L}_A)} \right\} \\ & + (w - w_0) \frac{T_{AN}}{\bar{L}_A} + (\lambda + \gamma) = 0 \end{aligned} \quad (3)$$

The first-order condition can be rearranged as:

$$\begin{aligned} (1 - \tau)p \left\{ \frac{\partial f[(\bar{L}_A - L_x), (T_{AN} - L_x \times T_{AN}/\bar{L}_A)]}{\partial (\bar{L}_A - L_x)} + \frac{T_{AN}}{\bar{L}_A} \frac{\partial f[(\bar{L}_A - L_x), (T_{AN} - L_x \times T_{AN}/\bar{L}_A)]}{\partial (T_{AN} - L_x \times T_{AN}/\bar{L}_A)} \right\} \\ = (w - w_0) \frac{T_{AN}}{\bar{L}_A} + (\lambda + \gamma) \end{aligned} \quad (4)$$

The decision making of a rural household is optimal when the sum of the marginal benefit from residual farmland and the marginal benefit from agricultural labor time equals the sum of the subsidies for retired farmland, benefits from the increased forest/grassland and the opportunity cost rate of the rural household engaged in agricultural labor divided by agricultural labor efficiency. In Eq. (4), two factors, τ and p , can be regarded as "push" factors. The reduction of rural households' agricultural production caused by these two factors pushes landowners to again participate in the GGP. Another three factors, $(w - w_0)$, λ and γ , constitute households' benefit sources besides farming. They can be considered as "pull" factors by attracting rural households to participate in the GGP again. The impact of $\bar{L}_A/T_{AN}$ cannot be ascertained by Eq. (4). Based on the above assumptions and derivations, the following inference can be achieved.

¹ The Communist Party of China (CPC) Central Committee's "decision on major issues concerning comprehensively deepening reforms" was released on November 15, 2013, which proposed to stabilize and enlarge the scale of the Grain for Green program. <http://www.chinanews.com/gn/2013/11-15/5509757.shtml> (accessed on 3.27.2014)

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