

Article

Uncovering the Deviation of Farmers' Green Manure Planting Willingness and Behavior

Jing Ren ¹, Fuduo Li ¹, Changbin Yin ^{1,*}  and Jiudong Zhang ²

¹ Institute of Agriculture Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, China

² Institute of Soil Fertilizer and Water-Saving Agriculture, Gansu Academy of Agricultural Sciences, Lanzhou 730000, China

* Correspondence: yinchangbin@caas.cn

Abstract: Planting green manure is an effective way to improve the agricultural environment and the quality of cultivated land in China. However, deviation from green manure planting willingness and behavior (DWB) becomes a serious obstacle to the promotion of green manure planting technology. For economic farmers, whether to plant green manure is a rational choice made after weighing up family endowments. In addition, ecological cognition plays a moderating role in the “willingness-behavior” transformation process of farmers’ green manure planting on the basis of family endowments. We selected four counties in which to conduct a questionnaire survey in Gansu and carried out interviews with 375 farmers. Based on the survey data, our study identified determinants that influence farmers’ DWB and examined the moderating effect of ecological cognition. In our paper, results show that the probability of farmers’ DWB is 41.87%. Farmers’ DWB is not only negatively affected by social network information and ecological compensation (eco-compensation) and positively influenced by the scale of cultivated land, but also restricted by human capital endowment characteristics such as age and education. In addition, ecological cognition played a significant moderating effect on farmers’ DWB. Farmers with high ecological cognition were more aware and capable of promoting green manure planting intentions into practice. Furthermore, different groups of farmers had different characteristics of DWB. The findings are useful and helpful in better understand the influencing factors of farmers’ DWB for policy makers and managers and can provide some effective support for policies designed to encourage farmers to adopt more sustainable green manure.

Keywords: green manure; family endowment; ecological cognition; planting willingness and behavior; deviation



Citation: Ren, J.; Li, F.; Yin, C.; Zhang, J. Uncovering the Deviation of Farmers’ Green Manure Planting Willingness and Behavior. *Sustainability* **2022**, *14*, 14315. <https://doi.org/10.3390/su142114315>

Received: 22 August 2022

Accepted: 11 October 2022

Published: 2 November 2022

Publisher’s Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Since the 1980s, with the rapid development of China’s chemical fertilizer industry, almost all the nutrients needed for crop growth are provided by chemical fertilizer, and chemical fertilizer seems to have become an indispensable production factor in agricultural production. However, the unreasonable long-term inputs of chemicals have caused prominent environmental problems, such as the decline of cultivated land quality, serious non-point source pollution, and low quality of agricultural products [1], which have seriously hindered the sustainable development of agriculture [2]. In response to the degradation and pollution of farmland, some scholars proposed that green manure is one of the most prevalent and effective measures to mitigate ecological environment problems [3–7]. However, although the central and local government extends green manure planting (GMP) technology vigorously, a low planting rate of about 9.5% has been observed [8]; the main reason for this mainly lies in the low enthusiasm and willingness of farmers to plant green manure.

Farmers are growers of green manure, and clarifying the characteristics of green manure planting willingness (GMPW) and behavior (GMPB) is the prerequisite and basis

for the promotion of green manure planting [7,9]. A previous study has shown that individual characteristics, family characteristics, and environmental factors are the essential factors that affect farmers' willingness and behavior [10]. When farmers seek to maximize their benefits, GMPB is affected by the price of production factors and the amount of resources they own; GMPB is a rational decision made by farmers after weighing planting costs and benefits under the constraints of established conditions [11]. It is confirmed that increasing and optimizing capital endowments significantly reduces the probability of deviation from farmers' willingness and behavior for green production [12]. An individual's perception of a certain item changes his subjective attitude or perception of the item, which in turn affects the final behavior [12]. Farmers are the main body adopting environmentally friendly technologies; their ecological cognition level can significantly promote agricultural green technology adoption and reduce the occurrence of deviations [13–15]. However, good ecological cognition does not always lead to pro-environmental behavioral decisions. The effect of ecological cognition needs to be explored in depth.

Willingness is the antecedent of behavior, and willingness determines behavior [16–18]. However, in reality, farmers have a higher willingness to plant green manure, but do not actually adopt the behavior, so the deviation arises [19]. For smallholder farmers, factors such as the farmer's education level, opportunities to receive technical training, and the level of awareness of green manure can significantly promote the consistency of GMPW and GMPB [20]. M.Becker et al. [21] concluded that, in most instances, reasons for non-adoption is related to the riskiness of green manure (performance variability), time-consuming and labor-intensive crop establishment, lost opportunity costs, the high price of land, and a low mineral fertilizer price, and planting willingness is difficult to translate into planting behavior. Mubarik [22] found that the short-term economic advantage of green manure must be improved by enhancing its use as food and feed, otherwise green manure planting is rejected by farmers.

Family endowment is the resources and abilities possessed by a family and its members [23,24]. Most farmers usually face certain resource endowment constraints when making decisions and may show a low level of willingness or no willingness. Due to insufficient endowments, whether to plant green manure in farmland is a rational choice made after weighing up family endowments [19]. The effects of economic capital, human capital, social capital, and natural capital on farmers' GMPW and GMPB have been studied [10]; however, most of these studies only selected some of the family endowment variables and did not incorporate the farmers' GMPW and GMPB into a unified framework of family endowments. Therefore, this research greatly lacked systematic and persuasive explanation for the deviation from farmers' high-willingness and low-willingness behavior surrounding green manure planting. At the same time, ecological cognition, as an internal factor, significantly affects the pro-environmental behavior of farmers [25], but the existing literature primarily discusses its direct effect, and there is a lack of empirical studies on the moderating effects of ecological cognition on the transformation of farmers' willingness behavior from the perspective of family endowment. Therefore, on the basis of family endowments, using the logistic binary regression model, this article hopes to reveal the reasons for the deviation of farmers' GMPW and GMPB by introducing ecological cognition as a moderating variable. The study aims to investigate which family endowment factor mainly affects the deviation from farmers' GMPW and GMPB, how ecological cognition moderates the deviation, and which type of farmers are more likely to induce deviations: large-scale farmers or small-scale farmers, farmers with low ecological cognition or farmers with high ecological awareness, etc. These findings provide convincing suggestions for policy makers to adjust existing policies surrounding green manure in the future, and further promote the green development of China's agriculture.

The remainder of this research is organized as follows: Section 2 discusses the theoretical hypothesis and framework. Section 3 introduces the materials and methodology, including the study area, survey design, data collection, econometric models, sample characteristics, and variable construction. Section 4 presents empirical results. Section 5

provides a discussion and the implications of the results. Section 6 outlines the conclusions. Abbreviations in this study are shown in Table 1.

Table 1. Abbreviations in this study.

Abbreviations	Explanation
GMPW	Green manure planting willingness
GMPB	Green manure planting behavior
DWB	Deviation from green manure planting willingness and behavior
RGMPW	Ratio of farmers' green manure planting willingness
RGMPB	Ratio of farmers' green manure planting behavior
RDWB	Ratio of farmers' deviation from GMPW and GMPB
Eco-compensation	Ecological compensation
GMP	Green manure planting
The high ecological cognition group	The H-ECC group
The low ecological cognition group	The L-ECC group

2. Theoretical Hypothesis and Framework

2.1. The Influence of Family Endowment

Family endowments have significant impacts on individual behaviors [26]. Planting green manure requires a certain input of manpower, materials, and financial resources. Based on previous studies [26–28], this article divides family endowments into four aspects: human capital endowment, natural capital endowment, social capital endowment, and economic capital endowment [29,30].

2.1.1. Human Capital Endowment

Human capital endowment refers to the knowledge and skill reserves acquired by family members through investment in education, training, and practical experience [31]. Farmers who are younger and more educated tend to adopt conservation tillage techniques [32,33]. The research results of Kaliba [34] showed that age, education level, and nature of work have a significant impact on farmers' adoption of green farmland protection technology. Therefore, the richer the human capital endowment of farmers, the more likely they are to adopt green manure. Based on the above research, this article proposes the following hypotheses:

H1-1. *The more educated farmers are, the less likely they are to deviate from their GMPW and GMPB.*

H1-2. *The older the farmers are, the less likely they are to deviate from their GMPW and GMPB.*

H1-3. *The higher the level of part-time jobs of farmers, the more likely they are to deviate from their GMPW and GMPB.*

2.1.2. Social Capital Endowment

Social capital mainly refers to the social network owned by social subjects. In rural areas, family social capital refers to the social network, the norms of reciprocity, and the resulting trust formed by the family or its members and other subjects in the village. Social capital as an asset can broaden people's contact with resources and other actors; people with fewer funds can also obtain resources by contacting important figures in social organizations, governments, and markets [35,36]. Broadening social network information channels of farmers and improving the level of mutual assistance in social network relationships can significantly promote the adoption and diffusion of agricultural technology [15,37]. Our study mainly selects whether to participate in agricultural professional cooperatives and the impact of social networks to measure social capital endowment. Therefore, we propose the following hypotheses:

H2-1. *Whether to participate in agricultural professional cooperatives negatively affects the deviation from farmers' GMPW and GMPB.*

H2-2. *The greater the impact of the social network on farmers, the less likely they are to deviate from their GMPW and GMPB.*

2.1.3. Natural Capital Endowment

Cultivated land is an important natural capital endowment in the process of agricultural production. Research by Li et al. [32] showed that the scale and quality of cultivated land have a positive impact on the adoption of conservation tillage technology by farmers. The larger the farmer's cultivated area is, the more willing the farmer is to learn and master new agricultural technologies [38]. The scale of cultivated land has a positive impact on farmers' agricultural technology adoption, which is conducive to transforming willingness to adopt a behavior [39–41]. Based on the above research, the following hypotheses can be proposed:

H3-1. *The larger the scale of farmers' cultivated land, the less likely they are to deviate from their GMPW and GMPB.*

H3-2. *The better the quality of farmers' cultivated land, the less likely they are to deviate from their GMPW and GMPB.*

2.1.4. Economic Capital Endowment

Economic capital is the prerequisite and basis for farmers' agricultural production inputs. Huang et al. [25] believed that the richer a peasant's economic capital endowment, the smaller the economic burden of adopting agro-ecological protection technology on the peasant, and the more capable and willing the peasant is to invest in this technology, especially eco-compensation, which can encourage farmers to adopt agricultural environmental protection technologies [42–44]. Based on the above research, we propose the following hypotheses:

H4-1. *The more the total annual household income of farmers, the less likely they are to deviate from their GMPW and GMPB.*

H4-2. *Eco-compensation negatively affects the deviation from farmers' GMPW and GMPB.*

2.2. The Moderating Effect of Ecological Cognition

Cognition is the basis of behavior. When the subject is faced with willingness and behavioral choices, they are usually limited by the individual's cognitive level, which determines whether and how the behavior changes. Individual behavior is usually the result of a combination of internal and external factors. As an external factor, family endowment cannot explain the difference in technology adoption behavior of farmers under the same endowment level. In this case, ecological cognition as an internal factor plays a key role in technology adoption behavior. Studies has shown that differences in farmers' ecological cognition are an important reason for the deviation from willingness to adopt green production technologies and behaviors [45,46]; therefore, farmers' ecological cognition plays a crucial role in technology adoption behavior.

As we know, family endowment is an important guarantee for the production and life of farmers [19]. Only when the current economic interests are basically guaranteed can farmers have extra energy to pay attention to green agricultural technology and the agricultural ecological environment and enhance their personal ecological cognition level, then producing green manure planting willingness and behavior. Therefore, ecological cognition exerts a regulatory effect on the transformation of farmers' GMPW and GMPB on the basis of family endowments, thereby inhibiting or inducing deviation phenomena. The moderating effect of ecological cognition is reflected in the following: if the level of ecological cognition is high, even if the family endowment is poor, it may produce GMPW

and GMPB; conversely, even if the family endowment is rich, farmers are not concerned about protecting the farmland environment. It is difficult to generate willingness to plant green manure or to transform willingness into behavior, which leads to the phenomenon of deviation. Based on the above point of view, the study proposes the following hypothesis:

H5. The higher the farmers' ecological cognition of green manure, the less likely they are to deviate from their GMPW and GMPB.

2.3. Framework of the Study

In reality, most farmers have a high willingness to plant green manure, but no actual behavior, which is the deviation from GMPW and GMPB. The number of farmers with deviation accounts for nearly 50% of the total number of surveyed farmers. Therefore, the focus of this study is on the factors influencing the deviation from GMPW and GMPB. We thus developed a conceptual framework based on the field research and hypothesis, suggesting farmers' deviation is affected by family endowment and ecological cognition. The theoretical research framework and the hypothesized relationships are shown in Figure 1.

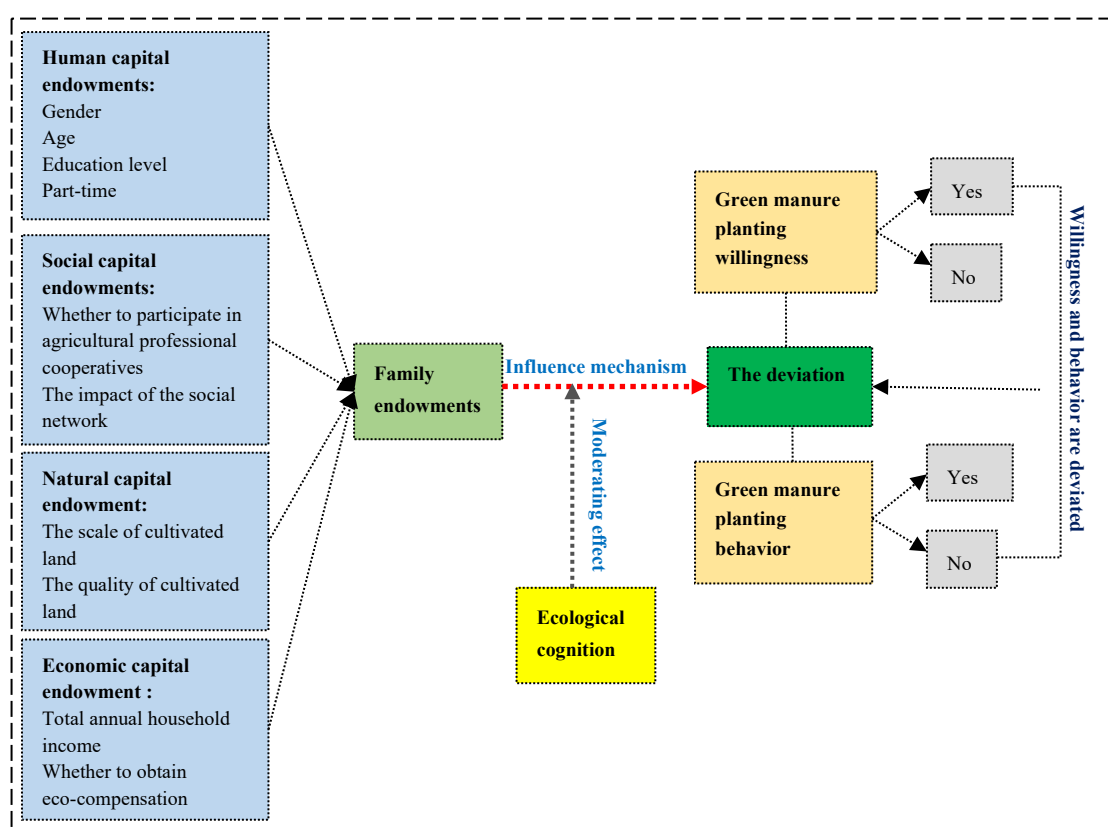


Figure 1. Basic theoretical analysis framework.

3. Survey Design and Research Models

3.1. Study Region

Gansu Province is located in northwestern China, the GMP area of which was 5.33×10^4 ha, distributed in two regions, i.e., the central Hexi Corridor region and the southern region, which accounts for 60% of the total GMP area in Gansu. The typical GMP pattern in the two regions is corn intercropping green manure.

Thus, the study area covers two counties in the middle and two counties in the south, i.e., Liangzhou District in Wuwei, Jingning County in Pingliang City, Shandan County in Zhangye, and Yongjing County in Linxia, the GMP area of which occupies 40% of the total GMP area in Gansu. According to the statistics of long-term positioning experiments at

the Wuwei Experimental Station in Gansu Province, green manure significantly improved soil moisture and organic matter, which increased the corn output to 15,000–16,500 kg/ha and economic efficiency to 19,500 CNY/ha. It is a high-efficiency production technology that integrates breeding land and high yield. According to our research, based on the good effect of green manure in improving arable land, more than 60% of farmers have begun to try to understand and consult the role of green manure. Hence, the good foundations of green manure in the four counties make them appropriate candidates for studying farmers' willingness and behavior surrounding green manure planting. The location of the study region is shown in Figure 2.

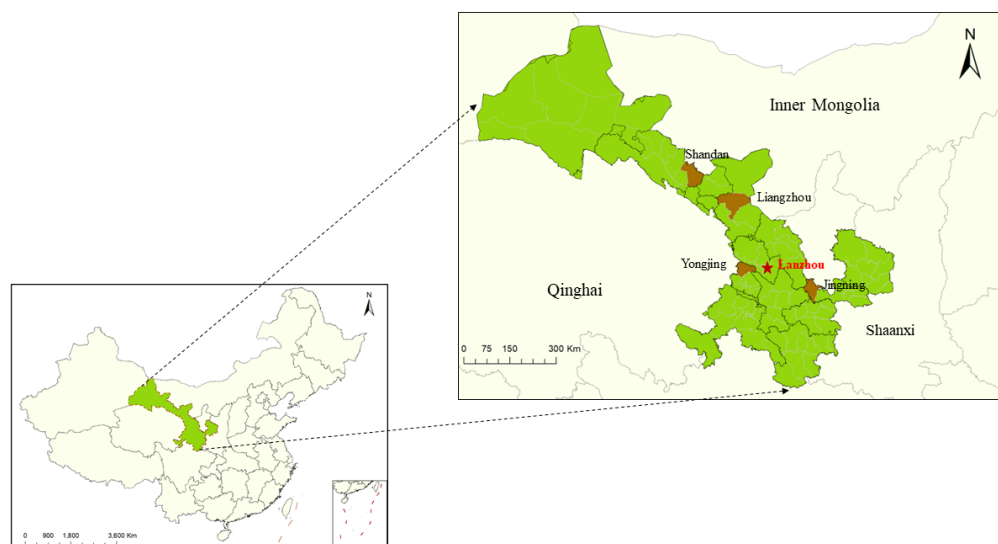


Figure 2. The geographic location of the study region.

3.2. Data Collection

The formula for determining the minimum sample size is as follows [47,48]:

$$x = Z_c^2 r(100 - r) \quad (1)$$

$$n = \frac{N}{((N - 1)E^2 + x)} \quad (2)$$

$$E = \text{Sqrt}[(N - n) / (n(N - n))] \quad (3)$$

where x represents the margin of error (5% is a common choice) Z_c is the critical value for the confidence level c (the value is taken 90% in this article), and r is the fraction of responses, often set to 50%, which provides the paper with the most reliable sample size [49]. N is the rural population size of the study area; n is the number of sample sizes; and E is SD (standard deviation). In 2018, the total rural population of our research area was 150.8 million (Gansu Statistical Yearbook, 2018), i.e., 74.99 million in Liangzhou, 16.39 million in Yongjing, 15.28 million in Shandan, and 44.14 million in Jingning, respectively. In total, the minimum sample size cannot be less than 271.

The survey was conducted from 6 April 2019 to 10 May 2019 via a face-to-face survey. Three townships were randomly selected from each county, and 36 villages in 12 townships were selected in total. The selection of sample farmers adopted a typical sampling method in order to ensure the comprehensiveness of the sample. A total of 375 questionnaires were distributed, and 332 valid questionnaires were obtained. The effective response rate of the questionnaires was 88.53% (Figure 3).

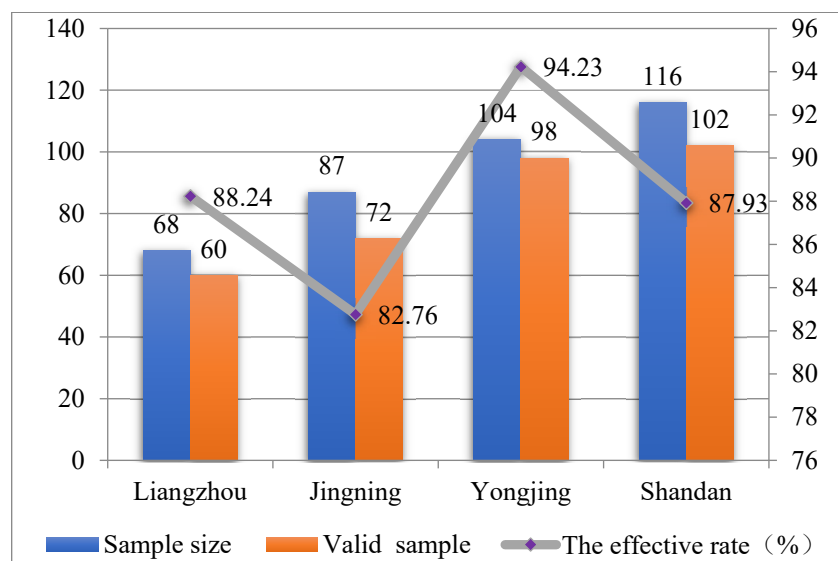


Figure 3. The sample size in the four counties of Gansu.

3.3. Variables and Research Model

3.3.1. Variable Construction

We selected DWB as the dependent variable. Human capital endowment variables include gender (*GEN*), age (*AGE*), education level (*EDU*), and part-time (*PAT*) work. Social capital endowment variables include whether to join an agricultural professional cooperative (*APC*) and the impact of a social network (*SOT*). The natural capital endowment variables include the scale of cultivated land (*CUS*) and the quality of cultivated land (*CUQ*). The economic capital endowment variables include total annual household income (*THI*) and received government eco-compensation (*ECOC*). Ecological cognition is a moderating variable, including the following variables: Planting green manure can improve the quality of agricultural products (*IAPQ*); Planting green manure can improve the quality of cultivated field (*ICUQ*); Planting green manure can save the amount of fertilizer used in production (*SFEA*). *SOT*, *CUQ*, *IAPQ*, *ICUQ*, and *SFEA* are assigned using a Likert 5-point scale. The area where the farmer is located (*LOCA*) is the control variable. See Table 2 for the description of each variable.

Table 2. Variable definition.

	Variable	Variable Definition and Unit	Min	Max	Average	Standard Deviation
Dependent variable	DWB	Whether there is a deviation from GMPW and GMPB? (0 = No, 1 = Yes)	0	1	0.420	0.494
	GEN	Gender (0 = Female, 1 = Male)	0	1	0.304	0.461
Family endowment	AGE	Age (year)	21	78	51.687	10.017
	EDU	Education (1 = Elementary school and below, 2 = Junior middle school, 3 = Senior middle school, 4 = College degree and above)	1	4	1.780	0.806
	PAT	Are you a part-time farmer ? (0 = No, 1 = Yes)	0	1	0.320	0.466
	APC	Have you joined an agricultural professional cooperative? (0 = No, 1 = Yes)	0	1	0.320	0.468

Table 2. Cont.

Variable	Variable Definition and Unit	Min	Max	Average	Standard Deviation
SOT	The extent to which farmers are affected by the social network (1 = no impact, 2 = little impact, 3 = uncertain impact, 4 = minor impact, 5 = huge impact)	1	5	3.600	1.113
CUS	Families' cultivated field scale (ha)	0.013	66.667	3.668	119.415
CUQ	What do you think of the quality of your farmland? (1 = very poor, 2 = relatively poor, 3 = average, 4 = relatively good, 5 = very good)	1	5	3.490	0.828
THI	Total annual household income ($\times 10^4$ CNY)	0.04	23.56	4.681	6.698
ECOC	Are you willing to accept eco-compensation to adopt green manure? (0 = No, 1 = Yes)	0	1	0.110	0.311
Ecological cognition	IAPQ What is the effect of green manure in improving the quality of agricultural products? (1 = cannot improve at all, 2 = improve less, 3 = average improvement, 4 = improve greatly, 5 = improve very much)	1	5	3.300	1.039
	ICUQ What is the effect of green manure in improving the quality of cultivated field? (1 = cannot improve at all, 2 = improve less, 3 = average improvement, 4 = improve greatly, 5 = improve very much)	1	5	3.940	0.922
	SFEA What is the effect of green manure in saving the amount of fertilizer used in agricultural production? (1 = cannot save at all, 2 = save less, 3 = general save, 4 = save more, 5 = save a lot)	1	5	3.230	1.167
Regional variable	LOCA ₁ 1 = Wuwei, 0 = others	0	1	0.180	0.385
	LOCA ₂ 1 = Jingning, 0 = others	0	1	0.220	0.413
	LOCA ₃ 1 = Yongjing, 0 = others	0	1	0.300	0.457
	LOCA ₄ 1 = Shandan, 0 = others	0	1	0.310	0.462

3.3.2. Research Model

The phenomenon that farmers have the willingness to plant green manure but do not actually plant it is defined as deviation. Obviously, this is a binary decision-making problem. If farmers are willing to plant green manure and do plant green manure, the GMPW and GMPB are consistent, which is defined as $y = 0$. If farmers are willing to plant green manure but do not plant green manure, the GMPW and GMPB are deviations, which is defined as $y = 1$. Since the dependent variable is a typical binary discrete variable, the logistic binary regression model was used to analyze the key factors influencing the “deviation”. The specific form of the model is as follows:

$$p_i = F(y_i) = \frac{\exp(a + \sum_{m=1}^m \beta_m x_{mi})}{1 + \exp(a + \sum_{m=1}^m \beta_m x_{mi})} \quad (4)$$

where y_i , the dependent variable, represents whether the willingness and the behavior (to plant green manure) of the i th farmer are contradictory; p_i , represents the probability that the willingness and behavior of the i th farmer are contradictory; (y_i) is the probability

distribution function; a is a constant term, which is the intercept of the independent variables; $\beta_1, \beta_2, \beta_3, \dots, \beta_m$ are the parameters of the m th independent variable to be estimated; and x_{mi} is the value of the m th independent variable, that is, the influencing factor that affects the “deviation” from the planting willingness and planting behavior of farmers, including key variables (family endowment variables), regulatory variables (ecological cognition variables), and control variables (district variables).

For Formula (2), the general form of the model is as follows:

$$y_i = \ln\left(\frac{p_i}{1 - p_i}\right) = a + \sum_{m=1}^m \beta_m x_{mi} \quad (5)$$

4. Results

4.1. Statistical Characteristics of the Surveyed Farmers

In order to prevent a strong correlation between the explanatory variables, a multicollinearity test is required. The variance inflation factor $VIF = 1.44 < 10$ displayed by stata15.0 indicates that the degree of collinearity of the model is within a reasonable range.

The sample farmers' characteristics are shown in Table 3. Most of the respondents were male, accounting for 69.58% of the total sample size. With respect to age and education, farmers aged 51–60 years old accounted for 40.66% of the total sample, while farmers above senior middle school accounted for only 19.58%, indicating approximately 80% of Chinese farmers have not received systematic higher education due to the limited educational conditions in the countryside. Farmers who are engaged in part-time work are at a lower ratio, and the average annual household incomes of the surveyed farmers were about 4.68×10^4 CNY, while the income from agriculture was only 1.87×10^4 CNY, which reflects the fact that non-agricultural income from part-time work has become the main income of rural households in China. In addition, nearly 68% of farmers' cultivated land is less than 1.33 ha, and 48% of farmers' cultivated land is in the middle or lower level. On the whole, the characteristics of the sample farmers are basically in line with the reality of China's rural area, and the sample is representative.

Table 3. Main statistical characteristics of sample farmers.

Index	Definition	Number	Ratio%
Gender	male	231	69.58
	female	101	30.42
Age(year)	≤30	10	3.01
	31–40	31	9.34
	41–50	96	28.92
	51–60	135	40.66
	>60	60	18.07
Education level	Elementary school and below	145	43.67
	Junior middle school	122	36.75
	Senior middle school	58	17.47
	College degree and above	7	2.11
Whether part-time	No	227	68.37
	Yes	105	31.63
Total annual household income ($\times 10^4$ CNY)	≤5	210	63.25
	(5–10]	86	25.90
	(10–20]	29	8.73
	>20	7	2.11
	>4	59	17.77
Cultivated land area (ha)	≤1.33	224	67.47
	(1.33–2.67]	36	10.84
	(2.67–4]	13	3.92
	>4	59	17.77

Note: “CNY” is the abbreviation of “Chinese yuan”.

4.2. The Statistical Description of Farmers' DWB

As can be seen in Table 4, 65.06% of farmers expressed a relatively high willingness to plant green manure in the study area, while only 23.19% of farmers had planted green manure, which reported 41.87% of farmers showed DWB. Figure 4 presented that farmers in Shandan have the highest ratio of farmers' deviation from GMPW and GMPB (RDWB), with a value of 50.98%. In Jingning and Yongjing, farmers' RDWB was 38.89% and 35.71%, respectively. Farmers' RDWB in Liangzhou was between Jingning and Shandan, as the value was 40%. Farmers' RDWB is directly affected by their ecological cognition of green manure. According to our survey, 69.58% of interviewed farmers agreed with the ecological effects of green manure. Farmers located in Shandan and Liangzhou have a lower level of ecological cognition, while those in Jingning and Yongjing have a higher level of ecological cognition. The reason may be that farmers who have lower eco-cognition do not have enough knowledge and ability to distinguish the ecological effects of green manure and believe that planting green manure does not produce obvious economic effects in the short term, which leads to obvious DWB.

Table 4. Statistical analysis of farmers' DWB.

Index	Question Item	Definition	Number	Ratio %
GMPW	Are you willing to plant green manure?	Yes	216	65.06
		No	116	34.94
GMPB	Do you want to plant green manure?	Yes	77	23.19
		No	255	76.81
DWB	Is there a deviation of willingness and behavior?	Yes	139	41.87
		No	193	58.13

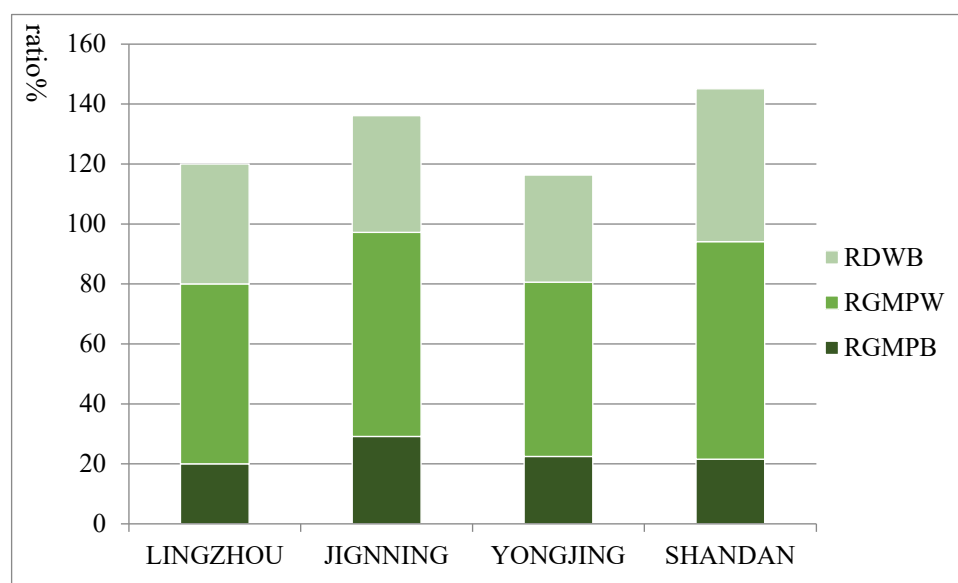


Figure 4. Regional characteristics of farmers' DWB.

4.3. The Determinants of DWB

A total of ten key variables and a regional dummy variable were considered in the DWB model, out of which five variables, i.e., $\log(\text{AGE})$, EDU , $\log(\text{CUS})$, SOT , and ECOC had a significant impact. Regression results and the average marginal effects of the explanatory variables on farmers' DWB are presented in Table 5.

Table 5. The regression results of farmers' DWB model.

Variables	Coefficients	Standard Deviation	Average Marginal Effects
SEX	0.049	0.295	0.0105
log(AGE)	−0.397 **	0.164	−0.0208
PAT	−0.313	0.271	−0.0672
EDU	−0.298 *	0.173	−0.0032
Log(CUS)	0.616 ***	0.108	0.1034
CUQ	−0.214	0.155	−0.0459
SOT	−0.688 ***	0.133	−0.1474
APC	−0.175	0.293	−0.0375
THI	0.004	0.018	0.0008
ECOC	−0.592 *	0.233	−0.127
WUWEI	−0.191	0.405	−0.041
JIGNNING	−0.593	0.413	−0.1272
YONGJING	−0.512	0.400	−0.1097
SHANDAN	0 (omitted)	—	0 (omitted)
constant	−2.28	−2.92	

Note: *, **, *** represent statistics significant at the 0.10, 0.05, and 0.01 levels, respectively. The model was calculated with Shandan as a reference.

$\log(AGE)$ has a negative and significant impact on farmers' DWB, which confirms H1-2. In China, from the 1950s to the early 1980s, the green manure planting area was relatively large, and the production of green manure was greatly increased; therefore, farmers born in the 50–80s understand better the role and value of green manure. In addition, compared with the younger generation, older farmers have accumulated long-term experience and are more familiar with green manure planting techniques and usage methods, so the older farmers are less likely to deviate. According to average marginal effects, if $\log(AGE)$ increases by 1% and other things are constant, it decreases the probability of DWB by 2.08%, which further confirms that age affects deviation. The estimated coefficient of *EDU* is found to be negatively statistically significant. This means that farmers who obtain a higher level of education are less likely to deviate. Hypothesis H1-1 was tested. The marginal effect shows that the probability of DWB of farmers with a higher level of education was 0.32% lower than farmers who have a lower level of education. The explanation for this is that the higher the education level of farmers, the more rational their behavioral decision making. This is because when the highly educated farmers adopt green manure, they not only consider the technical and economic feasibility of green manure planting, but also include the ecological value of green manure itself. At this time, these farmers showed a more positive attitude towards green manure adoption, and planting willingness could easily be transformed into actual behavior. Although *PAT* is not statistically significant, it negatively affects the DWB. This may be due to the fact that some part-time jobs, such as teachers and village cadres, can improve farmers' cultural quality intangibly and help farmers better understand the role and benefits of green manure. Furthermore, the farmers' GMPW and GMPB are consistent, and the occurrence of deviations is suppressed. Hypothesis H1-3 was tested. *SEX* has a positive but not statistically significant relationship with farmers' DWB. This result indicates that there is no significant difference in the influence of male and female farmers on the DWB. However, compared with female farmers, male farmers are more likely to produce deviations in GMPW and GMPB. The average marginal effect shows that, when the number of male farmers increased by 1%, the deviation probability of female farmers would reduce by 1.05%. This may be due to the fact that, compared with female farmers, male farmers who have undertaken the main productive labor for a long time have a better understanding of the actual situation of agricultural production and tend to be more rational when making behavioral decisions. When planting green manure, the factors they considered include not only the green manure planting technology itself, but also technical feasibility and other aspects. Even if male farmers have the willingness to adopt, they do not take action due to resource endowment constraints.

SOT shows a negative and significant effect on DWB, which indicates that the stronger the impact of village cadres, technicians, and the masses on farmers, the easier it is to convert

GMPW into interpersonal GMPB, and the less likely deviation from their willingness and behavior. When the impact of social networks on farmers increases by 1%, it increases the probability of farmers' DWB by 14.74%. The reason may be that, if there are relatives, friends, or neighbors planting green manure, the possible risks and loss of adopting green manure are verified in the production practices of these farmers. Based on this, other farmers can preliminarily judge the risk of planting green manure. Once other farmers feel that the risks are within their tolerance, plus the farmers' general herd mentality, they are more likely to adopt green manure, and the deviation from willingness and behavior does happen. *APC* has a negative but not significant impact on DWB, implying farmers participating in agricultural organizations can obtain relevant technical information and knowledge of green manure, which can be conducive to enhance GMPW and GMPB. The deviation is easy to inhibit. Hypotheses H2-1 and H2-2 were supported.

Log(CUS) is significant at the 1% significance level, and the regression coefficients were positive, which means that farmers with a large area of fields were more likely to produce DWB. When the field area increased by 1%, it increased the probability of farmers' DWB by 10.34%. This may be due to the fact that, despite the large area of cultivated land for farmers, land fragmentation is serious, and farmers own more plots, which increases the difficulty of farming and agricultural production costs for farmers. In order to reduce the cost of agricultural production as much as possible, especially for farmers with larger planting scales, even if these farmers have GMPW, it is difficult for actual GMPB to occur. H3-1 was not supported. *CUQ* has a negative impact on the DWB, which shows that the higher the cultivated land quality, the more farmers tend to further improve the quality of cultivated land by planting green manure, thereby promoting the conversion of GMPW and GMPB. H3-2 was supported.

ECOC has a negative impact on DWB at the significant levels of 10%. Eco-compensation can not only make up for the increased production costs of farmers; but also increase the enthusiasm of farmers' green manure planting. If *ECOC* increases by 1% and other things remain constant, it decreases the probability of DWB by 12.7%, which implies eco-compensation can suppress the phenomenon of deviation of farmers' GMPW and GMPB. Hypothesis H4-2 was supported. *THI* shows a positive but not significant effect on DWB. In other words, the higher the farmers total annual household income is, the more likely they are to show DWB. Based on our survey, non-agricultural income accounts for more than 60% of the total income of farmers' households. This means that the higher the household income, the greater the proportion of non-agricultural income from part-time activities, and the less these farmers pay attention to agricultural production. The marginal effect result shows that, when the income increased 1% and other things were constant, the farmers' DWB would increase by 0.08%, which indicates that the impact of household income on DWB was close to the threshold value of the increasing marginal effect. H4-1 was partly supported.

4.4. The Moderating Effect of Ecological Cognition on DWB

The moderating variable in this article is ecological cognition, which is a situational factor that affects farmers' DWB. Three items, including: Planting green manure can improve the quality of agricultural products (*IAPQ*); Planting green manure can improve the quality of cultivated field (*ICUQ*); and Planting green manure can save the amount of fertilizer (*SFEA*) (Refer to Table 4 for score definition), were used to define the ecological cognition. Due to the moderating variable being a categorical variable and the independent variable being a continuous variable, the moderating effect is done through "group regression" analysis [50]. Therefore, the specific method of examining the moderating effect of ecological cognition on farmers' DWB in this paper is as follows: following existing research [25,30], firstly we calculated the average value of the three items of ecological cognition, which is used as the grouping standard; farmers below the average value are regarded as the low ecological cognition group, and those higher than the average value are regarded as the high ecological cognition group. Secondly, using Stata15.0 to carry out the logistic

regression analysis, the moderating effect of ecological cognition was tested by examining the magnitude, direction, and significance changes of different variable coefficients in the two groups of high and low ecological cognition.

In the equation of the high ecological cognition group (H-ECC group), four variables (*Log(CUS)*, *CUQ*, *SOT*, and *ECOC*) show a statistically significant effect on farmers' DWB, but *CUQ* and *ECOC* have no significant effect on DWB in the equation of the low ecological cognition group (L-ECC group). This indicates that ecological cognition has an obvious moderating effect. The specific regression results are shown in Table 6.

Table 6. Regression analysis of the moderating effect of ecological cognition.

Variables	The Group of Low Ecological Cognition		The Group of High Ecological Cognition	
	Coef.	Std. Err.	Coef.	Std. Err.
SEX	0.333	0.439	0.211	0.445
log(AGE)	−0.278	0.995	−0.671	0.939
PAT	−0.335	0.433	−0.321	0.365
EDU	−0.062	0.304	−0.026	0.225
Log(CUS)	0.336 *	0.181	0.308 *	0.165
CUQ	−0.065	0.232	−0.444 **	0.213
SOT	−0.598 ***	0.189	−0.827 ***	0.230
APC	−0.471	0.491	−0.242	0.435
THI	0.015	0.030	0.012	0.024
ECOC	−0.558	0.601	−1.804 ***	0.629
WUWEI	0.361	0.572	−0.581	0.691
JIGNNING	−0.525	0.672	−1.051 *	0.615
YONGJING	0.182	0.661	−1.544 **	0.666
SHANDAN				
constant	−4.546	4.652	2.614	4.188

Note: *, **, *** represent statistics significant at the 0.10, 0.05, and 0.01 levels, respectively. The model was calculated with Shandan as a reference.

Log(CUS) generates a positive impact on farmers' DWB at a significance level of 10% in the equations of H-ECC and L-ECC groups, but the coefficient of *Log(CUS)* in the L-ECC group is bigger. This shows that, under the premise of the willingness to plant green manure, large-scale farmers with low ecological cognition are more likely to deviate from their GMPW and GMPB, and the probability of deviation is 1.09 times that of large-scale farmers with high ecological cognition. *CUQ* is found to negatively significantly influence farmers' DWB in the equation of the H-ECC group but failed the significance test in the L-ECC group. This may be because farmers with high ecological cognition have a better understanding of eco-environmental farmland policies, deepened their understanding of the harsh reality of the decline in the quality of cultivated land, and are more likely to take practical actions to respond to the calls of relevant agricultural departments under the guidance of policies. The willingness to improve the quality of cultivated land through GMP is stronger, so that their GMPW and GMPB can be strongly consistent. The significance test result of *ECOC* is the same as that of *CUQ*. Ecological compensation can make up the economic cost of planting green manure, to a certain extent, ensure that the income of farmers does not decrease, trigger farmers with high ecological cognition to pay attention to and think about green manure, then increase farmers' attention to green manure and ecological environmental protection, and mobilize farmers' enthusiasm of GMP, so that the possibility of deviation is greatly reduced. In summary, ecological cognition has a moderating effect in the process of farmland quality and ecological compensation affecting farmers' DWB. The variable of *SOT* has a negative impact on farmers' DWB in the equations of both the H-ECC and the L-ECC group, at a significance level of 1%, while the absolute value of the *SOT* coefficient of the H-ECC group is higher than that of the L-ECC group. Compared with farmers with low ecological cognition, farmers with high ecological cognition have a stronger ability to obtain social network information and resources, which can effectively promote the occurrence of farmers' GMPB. Other variables, *SEX*, *log AGE*, *PAT*, *EDU*, *APC*, and *THI* affect farmers' DWB in the H-ECC and L-ECC groups, but have no significant moderating effect on DWB in both groups. In summary, hypothesis H5 was partly supported.

4.5. Multi-Group Heterogeneity Analysis

The above analysis of all sample farmers showed that only *SOT* and *CUS* have a significant impact at the 1% level. Firstly, regarding *SOT*, farmers who have obtained abundant resources and information from social interactions show higher GMPBs and lower DWBs; secondly, regarding *CUS*, due to the fragmentation of cultivated land, the increase in the scale of cultivated land may restrict the adoption of green manure planting technology. Therefore, in order to distinguish the differences of DWB of farmers with different degrees of social network influence and farmland scale, a cross-group regression equation model is used to analyze the differences.

4.5.1. The Impact of Social Networks on Farmers

In response to this item, this article classifies the farmers who answered “no impact”, “smaller impact”, and “average impactment” as the low-affected group, and classifies those who answered “larger impact” and “full impact” as the high-affected group. In this survey, 92 low-affected farmers accounting for 27.71% of sample farmers, and 240 high-affected farmers accounting for 72.29% of sample farmers.

The results of Table 7 show that *EDU* and *Log(CUS)* have a significant impact on DWB at the 5% level in the low-affected group, and the coefficient of the two variables is positive, implying that for farmers who are less affected by social network information, because of their limited access to information, they are in a state of incomplete understanding of green manure [51,52]; even if they have a higher level of education and a large scale of cultivated land, the DWB of these farmers is also very obvious. The DWB of the high-affected group is susceptible to being negatively significantly impacted by *CUQ* and *SFEA*. This means that the higher the quality of cultivated land, the stronger the awareness that green manure can save chemical fertilizers, and the less likely it is for farmers with rich social network information to deviate from their GMPW and GMPB. This may be due to these farmers being able to obtain information about green manure, such as green manure’s contribution to the improvement of cultivated land quality and green manure’s replacement of chemical fertilizers through social interaction, to modify the expected benefits of green manure and make rational decisions. In a word, the influencing factors of DWB are obviously different in the two groups of low-affected and high-affected.

Table 7. Multi-group heterogeneity regression analysis.

Variables	The Affected Farmers by Social Network		The Scale of Cultivated Land	
	Low-Affected Farmers	High-Affected Farmers	Small-Scale Farmers	Large-Scale Farmers
Family endowment				
SEX	0.895 (0.893)	−0.038 (0.347)	0.117 (0.377)	−0.902 (0.700)
log(AGE)	−2.423 (1.769)	0.539 (0.740)	0.655 (0.813)	−0.929 (1.375)
PAT	0.389 (0.774)	0.346 (0.307)	0.250 (0.364)	0.135 (0.480)
EDU	1.283 ** (0.602)	−0.127 (0.195)	0.049 (0.228)	−0.408 (0.346)
APC	−2.112 (1.406)	−0.220 (0.344)	−0.261 (0.406)	−0.200 (0.536)
SOT	—	—	−0.699 *** (0.180)	−0.755 *** (0.286)
LOG(CUS)	0.880 ** (0.410)	−0.085 (0.130)	—	—
CUQ	0.211 (0.449)	−0.320 * (0.171)	−0.455 ** (0.191)	0.180 (0.305)
THI	−0.091 (0.084)	0.006 (0.019)	0.113 * (0.059)	−0.008 (0.023)
ECOC	−1.119 (1.350)	−0.564 (0.448)	0.081 (0.0.550)	−1.613 * (0.925)
Ecological cognition				
IAPQ	0.150 (0.384)	−0.002 (0.154)	0.071 (0.176)	0.007 (0.256)
ICUQ	−0.470 (0.413)	−0.262 (0.167)	−0.247 (0.200)	−0.258 (0.280)
SFEA	−0.169 (0.368)	−0.384 *** (0.129)	0.496 *** (0.173)	0.160 (0.195)
WUWEI	3.061 ** (1.454)	−0.757 (0.487)	0.028 (0.611)	0.147 (0.683)
JINGNING	3.473 ** (1.636)	−0.984 ** (0.481)	−0.204 (0.611)	−2.580 ** (1.170)
YONGJING	3.160 * (1.874)	−0.687 (0.505)	−0.142 (0.583)	−1.051 (0.741)
SHANDAN		0(omitted)		
Constant	0.464 (8.069)	−0.033 (3.248)	−5.462 (3.710)	2.408 (5.742)

Note: *, **, *** represent statistics significant at the 0.10, 0.05, and 0.01 levels, respectively. The value in parentheses “()” indicates the standard deviation. The model was calculated with Shandan as a reference.

4.5.2. The Scale of Cultivated Land

The farmland area of the four research regions in this study is quite different, so the average area of total cultivated land of the four research regions is used as the basis for dividing the relative scale. In this survey sample, there are 212 small-scale farmers, accounting for 63.86% of sample farmers, and 120 large-scale farmers, accounting for 36.14% of sample farmers.

The results show (Table 7) that *SFEA* has a positively significant impact on the DWB of small-scale farmers, meaning small-scale farmers lack the knowledge that green manure can replace chemical fertilizer. The coefficient of *SFEA* in the large-scale group is also positive, indicating that for large-scale farmers, in order to ensure the yield of crops, even if green manure is planted, the amount of chemical fertilizer applied to the cultivated land may not be reduced. Obviously, large-scale farmers and small-scale farmers both have low green manure planting enthusiasm, GMPW is difficult to be transformed into GMPB, and the DWB easily occurs. *SOT* is a negative and significant factor affecting DWB of small-scale and larger-scale farmers. It may be because social networks expanded the channels of farmers' information sources, adoption rate of green manure by farmers was increased, and greatly enhanced the possibility of transforming GMPW into GMPB. Compared with small-scale farmers, *ECOC* has a negatively significant effect on large-scale farmers' DWB. The possible reason is as follows: although large-scale farmers are willing to plant green manure, green manure planting requires a certain cost, which weakens farmers' enthusiasm. Eco-compensation can reduce the burden on farmers and make them more motivated to plant green manure. *THI* shows a significant and positive effect on the DWB of small-scale farmers, but it is a negative effect on the DWB of large-scale farmers. For small-scale farmers, based on the field survey, the current proportion of agricultural income in the total annual household income of a small-scale household is less than 29%, which leads to the test results in Table 7: the higher the income, the more obvious the DWB of small-scale farmers. For large-scale farmers, especially those new business entities, such as family farms and agricultural enterprises, their family income is mostly operating income of business entities, and they may understand that green manure can make agricultural products top-quality and high-yield and increase benefits. Therefore, when income increases, large-scale farmers are willing to increase investment in green manure and expand the area of GMP. Obviously, deviation does not happen. The estimated coefficient of *CUQ* is found to be negatively significant in the small-scale group. This means the better the quality of arable land, the less likely it is to deviate. This shows that some small-scale farmers are willing to improve the quality of cultivated land by planting green manure. Considering the above, there are different influencing factors of DWB for the groups of farmers.

5. Discussions and Implications

In this study, we analyzed the main reasons for the DWB from the perspective of family endowment and examined the moderating effect of ecological cognition.

Our research found that the farmers who are more affected by social network information are less likely to have a DWB, and in actual production, their planting willingness is more easily transformed into actual behavior. This is consistent with the results of existing studies that social network information can improve the adoption efficiency of agricultural technology [12].

China's rural areas have a complex social environment, and the social network of farmers has a very prominent impact on their production and life. Due to the limitation of their eco-cognition, farmers tend to trust the subjective evaluation of green manure by other farmers in the network, on the one hand, and on the other hand, they follow and imitate the production decisions of other farmers in the social network, especially large growers and expert farmers, which enhances farmers' GMPW and GMPB, and reduces the probability of DWB. Therefore, in view of the fact that social network information can inhibit farmers' DWB, farmers should first actively expand their social network information channels, strengthen technical exchanges and knowledge sharing with relatives and friends, other growers, agricultural technicians, and other related personnel, correct their own

cognitive biases on GMP, and reduce the risk of GMP. Secondly, the government should pay attention to the construction of farmers' social networks, guide the development of informal organizations based on relatives in rural areas, construct a green manure planting information exchange platform for farmers, reduce the cost of GMP, and promote the transformation of willingness to behavior [53].

In addition to the social network, raising the standard of eco-compensation is an effective measure to encourage farmers to adopt GMP and to reduce their DWB. GMP has a slower impact on the yield and quality of agricultural products, so farmers lack the enthusiasm to invest in green manure. Therefore, farmers who have received eco-compensation have a significant increase in their enthusiasm for planting green manure after the cost is made up. He et al. [54] and Omotilewa et al. [55] also confirmed that eco-compensation can encourage people to participate in agricultural environmental protection measures. Therefore, the government should establish a precise compensation mechanism to make up for the increased production cost of GMP and increase the relative benefits of farmers, so as to enhance the enthusiasm of farmers to adopt GMP and promote the transformation of GMPW to GMPB. It is recommended to determine a differentiated green manure eco-compensation method based on the characteristics of heterogeneous farmers. For small-scale farmers, the government should provide green manure seeds and a full set of agricultural machinery services; for large-scale farmers, the integrated cash compensation method or the green manure terminal product subsidy method should be adopted, and these subsidy methods can improve farmers' satisfaction with eco-compensation policies.

The fact that farmers' DWB is influenced by their individual characteristics, such as age and education, etc., cannot be ignored. We confirmed that the older the farmers, the lower the probability of DWB, which is caused by specific historical factors in China. However, in rural China, according to our questionnaire survey data, the proportion of farmers over 60 years old with senior high school and above is 10.8%, and more than 85% of the elderly have a "superficial recognition of green manure", which means that, for the rural elderly population, it is not only difficult to master modern green manure planting technology, but also difficult to understand the true meaning of green manure for the country's green agricultural development. In addition, currently, population aging is an emerging issue in rural China [56]. When these elderly agricultural producers cannot engage in agricultural work, even if they raise their awareness of green manure, the area of green manure promotion will not expand, but decrease, and the probability of DWB may be greatly increased. Therefore, from the perspective of the effects of rural population aging and farmers' education level, it is very likely that the probability of farmers' DWB will gradually increase in the future.

Moreover, according to our results, farmers' probability of DWB decreases due to their ecological cognition of green manure. This conclusion is consistent with the conclusion reached by [57], who found that the higher the cognitive level of farmers, the less likely the willingness to apply organic fertilizer to deviate from their behavior. Therefore, in order to improve farmers' ecological cognition, the knowledge publicity and technical training of green manure production must be strengthened. Local agricultural technology-related departments should strengthen the promotion of green manure production knowledge and technical training, increase the frequency and depth of technical training, and innovate the content and methods of technology promotion. Through targeted measures, such as distributing technical manuals, regular training, on-site production guidance, TV programs, and establishing demonstration sites, farmers can have a deep understanding of the benefits of green manure in improving the quality and efficiency of agricultural production, and have a higher level of cognition of the environmental welfare of green manure. When farmers' ecological cognition is improved, they consciously convert GMPW into GMPB.

6. Conclusions

This study analyzed the influence of family endowment on farmers' deviation from green manure planting willingness and behavior and the moderating effect of ecological

cognition based on the survey data of 332 farmers collected in Gansu province, China. Results show that 65.06% of farmers are willing to plant green manure, while only 23.19% of farmers actually plant green manure; the probability of farmers' deviation is 41.87%. Farmers' deviation is not only negatively affected by social network information and ecological compensation and positively influenced by the scale of cultivated land, but also restricted by human capital endowment characteristics such as age and education. In addition, ecological cognition played a significant moderating effect on farmers' deviation. Farmers with high ecological cognition were more aware and capable of promoting green manure planting intentions into practice. We also found that different groups of farmers had different characteristics of deviation.

However, there is a limitation in this study. The research data in this article come from farmers in Wuwei, Pingliang, Linxia, and Zhangye in Gansu Province. Due to differences in farmland types, farming systems, crop varieties, and related policies and measures, farmers' willingness and behavior in planting green manure are different in different regions. The specific influencing factors and mechanisms of action need to be further studied, which is the limitation of this article. Thus, more surveys should be done to strengthen the reliability and applicability of the findings in further research.

Author Contributions: J.R.: Conceptualization, methodology, software, validation, formal analysis, investigation; F.L.: Resources, data curation, writing—original draft preparation; C.Y.: Writing—review and editing, visualization, supervision; J.Z.: Writing—original draft preparation. All authors have read and agreed to the published version of the manuscript.

Funding: This study was funded by the Fundamental Research Funds for Central Non-profit Scientific Institution (No.1610132022011) and the earmarked fund for Modern Agro-industry Technology Research System-Green manure (CARS-22).

Institutional Review Board Statement: Ethical review and approval were waived for this study due to: The survey is completely anonymous and our results will only be used for academic re-search. Please do not have any concerns regarding your answers, just answer truthfully.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: We would like to thank the Institution of Soil, Fertilizer and Water-saving Agriculture, Gansu Academy of Agricultural Sciences, for its strong support in the data survey. And we should thank the editor and the anonymous reviewers for their helpful comments and suggestions.

Conflicts of Interest: The authors declare no conflict of interest

References

1. Marie, R.; Marie, D.; Laurent, T. Organic fertilizers, green manures and mixtures of the two revealed their potential as substitutes for inorganic fertilizers used in pineapple cropping. *Sci. Hortic.* **2019**, *257*, 108691.
2. Fan, Z.-L.; Chai, Q.; Cao, W.D.; Yu, A.Z.; Zhao, C.; Xie, J.H.; Yin, W.; Hu, F.L. Ecosystem service function of green manure and its application in dryland agriculture of China. *Chin. J. Appl. Ecol.* **2020**, *31*, 1389–1402.
3. Raheem, A.; Zhang, J.; Huang, J.; Jiang, Y.; Siddik, M.A.; Deng, A.; Gao, J.; Zhang, W. Greenhouse gas emissions from a rice-rice-green manure cropping system in South China. *Geoderma* **2019**, *353*, 331–339. [\[CrossRef\]](#)
4. Badaruddin, M.; Meyer, D.W. Green-manure legume effects on soil nitrogen, grain yield, and nitrogen nutrition of wheat. *Crop Sci.* **1990**, *30*, 819–825. [\[CrossRef\]](#)
5. Brennan, E.B.; Smith, R.F. Winter Cover Crop Growth and Weed Suppression on the Central Coast of California. *Weed Tech.* **2005**, *19*, 1017–1024. [\[CrossRef\]](#)
6. Zhao, R.; Geng, Y.; Liu, Y.Y.; Tao, X.Q.; Xue, B. Consumers' perception, purchase intention, and willingness to pay for carbon-labeled products: A case study of Chengdu in China. *J. Clean. Prod.* **2018**, *171*, 1664–1671. [\[CrossRef\]](#)
7. Jiao, B. Brief introduction of the role of green manure in agricultural production in China. *Soil Fertil.* **1980**, *5*, 16–18.
8. Cao, W.D.; Bao, X.G.; Xu, C.X.; Nie, J.; Gao, Y.J.; Geng, M.J. Reviews and prospects on science and technology of green manure in China. *J. Plant Nutr. Fertil.* **2017**, *23*, 1450–1461.
9. Jiang, W.J.; Yan, T.W. Study on the consistency of farmers' straw returning willingness and behavior under the dual drive of ability and opportunity—A case study of Hubei Province. *J. Huazhong Agric. Univ.* **2020**, *47–55*, 163–164.

10. Li, M.; Wang, J.; Zhao, P.; Chen, K.; Wu, L. Factors affecting the willingness of agricultural green production from the perspective of farmers' perceptions. *Sci. Total Environ.* **2020**, *738*, 140289. [\[CrossRef\]](#)
11. Ren, J.; Yin, C.B.; Duan, Z.L. Discussion on the ecological compensation standard of green manure planting based on the willingness of fruit farmers to pay. *Chin. J. Eco-Agric.* **2020**, *28*, 448–457.
12. Wang, X.L.; Zhou, J. Information ability, cognition and behavior change of vegetable farmers using pesticides: An empirical test based on data of vegetable farmers in shandong province. *J. Agrotech. Econ.* **2016**, *5*, 22–31.
13. Li, F.; Ren, J.; Wimmer, S.; Yin, C.; Li, Z.; Xu, C. Incentive mechanism for promoting farmers to plant green manure in China. *J. Clean. Prod.* **2020**, *267*, 122197. [\[CrossRef\]](#)
14. Xue, Y.; Guo, J.; Li, C.; Xu, X.; Sun, Z.; Xu, Z.; Feng, L.; Zhang, L. Influencing factors of farmers' cognition on agricultural mulch film pollution in rural China. *Sci. Total Environ.* **2021**, *787*, 147702. [\[CrossRef\]](#)
15. Despotovic, J.; Rodic, V.; Caracciolo, F. Farmers' environmental awareness: Construct development, measurement, and use. *J. Clean. Prod.* **2021**, *295*, 126378. [\[CrossRef\]](#)
16. Lee, C. Modifying an American Consumer Behavior Model for Consumers in Confucian Culture: The Case of Fishbein Behavioral Intentions Model. *J. Int. Consum. Mark.* **1991**, *3*, 27–50. [\[CrossRef\]](#)
17. Schwepker, C.H.; Cornwell, T.B. An Examination of Ecologically Concerned Consumers and their Intention to Purchase Ecologically Packaged Products. *J. Public Policy Mark.* **1991**, *10*, 77–101. [\[CrossRef\]](#)
18. Rhodes, R.E.; de Bruijn, G.-J. How big is the physical activity intention-behaviour gap? A meta-analysis using the action control framework. *Br. J. Health Psychol.* **2013**, *18*, 296–309. [\[CrossRef\]](#)
19. Zhi, J.-G.; Yan, T.-W.; Yang, G. The paradox between farmers' willingness and their behaviors of straw-return-to-field practice from the perspective of family endowment and the analysis of the moderating effects of farmers' ecological cognition. *Res. Agric. Mod.* **2020**, *41*, 999–1010.
20. Ntakirutimana, L.; Li, F.; Huang, X.; Wang, S.; Yin, C. Green Manure Planting Incentive Measures of Local Authorities and Farmers' Perceptions of the Utilization of Rotation Fallow for Sustainable Agriculture in Guangxi, China. *Sustainability* **2019**, *11*, 2723. [\[CrossRef\]](#)
21. Becker, M.; Ladha, J.K.; Ali, M. Green manure technology: Potential, usage, and limitations. A case study for lowland rice. *Plant Soil* **1995**, *174*, 181–194. [\[CrossRef\]](#)
22. Mubarik, A. Evaluation of green manure technology in tropical lowland rice systems. *Field Crops Res.* **1999**, *61*, 61–78.
23. Huffman, W.E.; Orazem, P.F. *Agriculture and Human Capital in Economic Growth: Farmers, Schooling and Nutrition*; Elsevier Science: Amsterdam, The Netherlands, 2004.
24. Bourdieu, P. The Forms of Capital. In *Handbook of Theory and Research for the Sociology of Education*; Richardson, J., Ed.; Greenwood Press: Westport, CT, USA, 1986.
25. Huang, X.H.; Lu, Q.; Wang, L.L. Capital endowment, ecological cognition and farmers' adoption behavior of soil and water conservation technology—Based on the moderating effect of ecological compensation policy. *J. Agrotech. Econ.* **2020**, *1*, 33–44.
26. Shi, Z.L.; Yang, Y.Y. Family Endowment, Family Decision-making and the Return of Rural Migrant Labor. *Sociol. Res.* **2012**, *3*, 157–181.
27. Démurger, S.; Xu, H. Return migrants: The rise of new entrepreneurs in rural China. *World Dev.* **2011**, *39*, 1847–1861. [\[CrossRef\]](#)
28. Giulietti, C.; Ning, G.; Zimmerman, K. Self-employment of rural-to-urban migrants in China. *Int. J. Manpow.* **2012**, *33*, 96–117. [\[CrossRef\]](#)
29. Wachenheim, C.; Fan, L.; Zheng, S. Adoption of unmanned aerial vehicles for pesticide application: Role of social network, resource endowment, and perceptions. *Technol. Soc.* **2020**, *64*, 101470. [\[CrossRef\]](#)
30. Zhang, Y.; Qi, Z.H.; Meng, X.H.; Zhang, D.M.; Wu, L.Y. Study on the influence of family endowments on the environmental behavior of massive pig farmers under the situation of ecological compensation policy: Based on the survey of 248 massive pig farmers in Hubei Province. *Issues Agric. Econ.* **2015**, *6*, 82–91.
31. Yang, Y.Y.; Shi, Z.L. Family Endowment and Return Migration in Rural China. *Popul. Res.* **2012**, *36*, 3–17.
32. Li, W.; Xue, C.X.; Yao, S.B.; Zhu, R.X. The Adoption Behavior of Households' Conservation Tillage Technology: An Empirical Analysis based on Data Collected from 476 households on the Loess Plateau. *Chin. Rural. Econ.* **2017**, *1*, 44–57.
33. Feder, G. Farm size, risk aversion and the adoption of new technology under uncertainty. *Oxf. Econ. Pap.* **1980**, *32*, 263–283. [\[CrossRef\]](#)
34. Kaliba, A.R.M.; Featherstone, A.M.; Norman, D.W. A stall-feeding management for improved cattle in semiarid central Tanzania: Factors influencing adoption. *Agric. Econ.* **1997**, *17*, 133–146.
35. Bebbington, A. Capitals and Capabilities: A Framework for Analyzing Peasant Viability, Rural Livelihoods and Poverty. *World Dev.* **1999**, *27*, 2021–2044. [\[CrossRef\]](#)
36. Gao, Y.; Liu, B.; Yu, L.; Yang, H.; Yin, S. Social capital, land tenure and the adoption of green control techniques by family farms: Evidence from Shandong and Henan Provinces of China. *Land Use Policy* **2019**, *89*, 104250. [\[CrossRef\]](#)
37. Paswan, A.; Sinha, A.; Basu, D. Diffusion of Agricultural Technologies through Social Network Analysis in Selected Villages of Bihar, India. *J. Glob. Commun.* **2018**, *11*, 24–32. [\[CrossRef\]](#)
38. Mao, H.; Zhou, L.; Ifft, J.; Ying, R.Y. Risk preferences, production contracts and technology adoption by broiler farmers in China. *China Econ. Rev.* **2019**, *54*, 147–159. [\[CrossRef\]](#)
39. Feder, G.; O'Mara, G.T. On information and innovation diffusion: A Bayesian approach. *Am. J. Agric. Econ.* **1982**, *64*, 145–147. [\[CrossRef\]](#)

40. Miranowski, J.; Shortle, J. *Effects of Risk Perceptions and Other Characteristics of Farmers and Farm Operations on the Adoption of Conservation Tillage Practices*; Iowa State University, Department of Economics: Ames, IA, USA, 1986.
41. Sidibé, A. Farm-level adoption of soil and water conservation techniques in northern Burkina Faso. *Agric. Water Manag.* **2005**, *71*, 211–224. [[CrossRef](#)]
42. Sumita, C.; Ushio, S.; Ashraful, I.; Idriss, B. Importance of policy for energy system transformation: Diffusion of PV technology in Japan and Germany. *Energy Policy* **2014**, *68*, 285–293.
43. Dinar, A.; Yaron, D. Adoption and abandonment of irrigation technologies. *Agric. Econ.* **1992**, *6*, 315–332. [[CrossRef](#)]
44. Greiner, R.; Gregg, D. Farmers' intrinsic motivations, barriers to the adoption of conservation practices and effectiveness of policy instruments: Empirical evidence from northern Australia. *Land Use Policy* **2011**, *28*, 257–265. [[CrossRef](#)]
45. Kotchen, M.J.; Reiling, S.D. Environmental attitudes, motivations, and contingent valuation of nonuse values: A case study involving endangered species. *Ecol. Econ.* **2000**, *32*, 93–107. [[CrossRef](#)]
46. Yu, W.; Luo, X.; Li, R.; Xue, L.; Huang, L. The paradox between farmer willingness and their adoption of green technology from the perspective of green cognition. *Resour. Sci.* **2017**, *39*, 1573–1583.
47. Gonick, L.; Smith, W.; Smith, W. *The Cartoon Guide to Statistics*; HarperPerennial: New York, NY, USA, 1993; p. 141e142.
48. Pituch, K.A.; Stevens, J.P.; Whittaker, T.A. *Intermediate Statistics: A Modern Approach*; Routledge: London, UK, 2013.
49. Hemming, K.; Girling, A.J.; Sitch, A.J.; Marsh, J.; Lilford, R.J. Sample size calculations for cluster randomised controlled trials with a fixed number of clusters. *BMC Med. Res. Methodol.* **2011**, *11*, 102. [[CrossRef](#)] [[PubMed](#)]
50. Wen, Z.L.; Zhou, J.T.; Zhang, L. A Comparison and Application of Moderating Effect and Mediating Effect. *Acta Psychol. News* **2005**, *37*, 268–274.
51. Besley, T.; Case, A. Does Electoral Accountability Affect Economic Policy Choices? Evidence from Gubernatorial Term Limits. *Q. J. Econ.* **1995**, *100*, 769–799. [[CrossRef](#)]
52. Foster, A.D.; Rosenzweig, M.R. Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture. *J. Political Econ.* **1995**, *103*, 1176–1209. [[CrossRef](#)]
53. Wang, G.; Lu, Q.; Capareda, S.C. Social network and extension service in farmers' agricultural technology adoption efficiency. *PLoS ONE* **2020**, *15*, 78–96. [[CrossRef](#)]
54. He, K.; Zhang, J.; Zeng, Y.; Zhang, L. Households' willingness to accept compensation for agricultural waste recycling: Taking biogas production from livestock manure waste in Hubei, P.R. China as an example. *J. Clean. Prod.* **2016**, *131*, 410–420. [[CrossRef](#)]
55. Omotilewa, O.J.; Ricker-Gilbert, J.; Ainembabazi, J.H. Subsidies for Agricultural Technology Adoption: Evidence from a Randomized Experiment with Improved Grain Storage Bags in Uganda. *Am. J. Agric. Econ.* **2019**, *101*, 753–772. [[CrossRef](#)]
56. Williams, J.S.; Norstrom, F.; Ng, N. disability and ageing in China and India decomposing the effects of gender and residence. Result from the WHO study on global ageing and adult health (SAGE). *BMC Geriatr.* **2017**, *17*, 197.
57. Guo, Q.H.; Li, S.P.; Li, H. Adoption behaviors of farmers' chemical fertilizer reduction measures based on the perspective of social norms. *J. Arid. Land Resour. Environ.* **2018**, *32*, 50–55.