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Empirical Studies of the Factors Influencing Farmers' Enthusiasm for Growing Grain

Xin MA¹, Zhihong TIAN^{1*}, Qianwen GONG²

1. College of Economics and Management, China Agricultural University, Beijing 100083, China; 2. School of Humanities & Social Sciences, Beijing Forestry University, Beijing 100083, China

Abstract To ensure the future food self-sufficiency in China, it is necessary to mobilize producers' enthusiasm for growing grain. Theoretically, it is mainly influenced by economic interests, land scale, farmers' characteristics and agricultural support policy. Through field research of farmers, we use model to explore these influencing factors. The results show that the dwindling arable land making grain cultivation fail to form economies of scale is a key factor restricting farmers' enthusiasm for growing grain; farmers' age and the share of agricultural labor in the family are important factors restricting their grain growing; agricultural support policy can stimulate the enthusiasm for growing grain to a certain extent. Therefore, there is a need to promote the concentration of land and improve various agricultural support policies, in order to improve the economic benefits of growing grain and encourage qualified young workers to engage in grain production activities.

Key words Farmers, Grain cultivation, Enthusiasm

1 Introduction

For years, China's grain market has been in a tight balance. In the context of limited arable land resources, agriculture labor transfer and low grain cultivation benefits, the food supply and demand conflicts are likely to further deepen. Thus the future China's grain self-sufficiency is a problem that the government and the society are very concerned about. Previous studies have shown that the factors influencing grain production capacity include resource constraints, food production technology, government's agricultural support policy, and farmers' economic behavior choices. As far as we are concerned, when other conditions remain unchanged, the most important factor influencing China's food self-sufficiency in the future is the willingness of farmers to grow grain. In fact, the willingness of farmers to grow grain has a decisive impact on food production by influencing producers' effective labor and physical capital input as well as the actual acreage and allocation of resources (Fig. 1). Therefore, to ensure the future China's food self-sufficiency, it is necessary to focus on stimulating producers' enthusiasm for growing grain. Existing studies have shown that education level, gender, age and householder's farming experience are highly correlated with farmers' willingness to grow grain; farmers' demographic characteristics and householders' ability also affect farmers' willingness to grow grain^[1-2]. Some scholars believe that farmers' production behavior is mainly driven by economic interests, and enhancing the economic efficiency is the main motivation for farmers to engage in food production activities^[3-4]. In addition, some studies show that large scale operation

is of importance to mobilizing farmers' enthusiasm for growing grain^[5-6]. For the effect of food subsidies on farmers' enthusiasm for growing grain, there is heated debate. Some scholars believe that the food subsidy policy has played a role in promoting farmers' enthusiasm for growing grain, and improving the policy effects of food production^[7-8]. However, there are some scholars maintaining that the food subsidies can improve farmers' net income of grain cultivation to a certain extent, but due to low current subsidy levels, it is difficult to mobilize farmers' enthusiasm for growing grain^[9-10]. In this paper, based on the results of previous studies, we perform the theoretical analysis of the factors influencing farmers' willingness to grow grain, use the survey results on farmers in Hebei Province to make the empirical analysis of these factors and explore the constraints on current farmers' grain cultivation behavior, and finally put forth some targeted policy recommendations.

2 Theoretical analysis of farmers' grain growing behavior

2.1 Economic interests are the fundamental factor influencing farmers' willingness to grow grain Food price increase will improve farmers' enthusiasm for growing grain, and if the input costs are higher, the farmers' willingness to grow grain will be lower. On the one hand, grain competes with other crops for land factor, and the comparative benefits are bound to affect farmers' choice. From the cash earnings of major agricultural products (Fig. 2), the cash earnings of food crops (wheat, corn and rice) were only 68.9 yuan/50kg in 2013, significantly lower than the cash earnings of cotton (581.9 yuan/50kg) and soybean (136.4 yuan/50kg). It indicates that compared with other crops, the comparative benefits of growing grain are relatively low. On the other hand, food crops also compete with other industries for labor factor. Over the past 20 years, rural residents were more and more

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* Corresponding author. E-mail: cautzh@cau.edu.cn

dependent on non-agricultural industries to increase income, and the rising opportunity cost of growing grain will inevitably reduce the number of grain farmers. The share of farmers' wage income in net income ceaselessly increased (43.6% in 2012) while the

share of agricultural operating income in net income (26.6% in 2012) declined (Fig. 3). It can be expected that the farmers will be reluctant to continue to grow grain if the profits of growing grain are still not significantly improved.

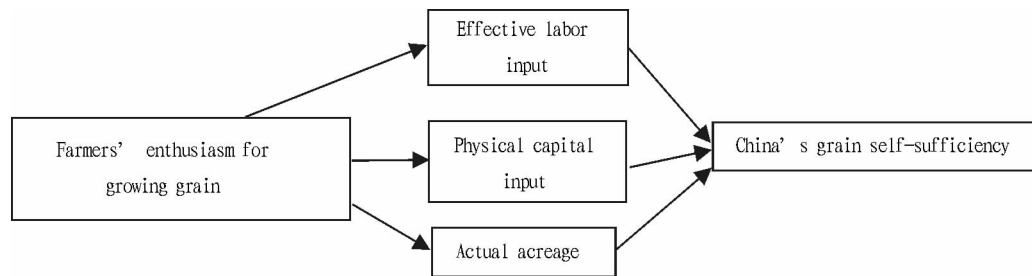


Fig.1 The path of influence of farmers' enthusiasm for growing grain on China's grain self-sufficiency

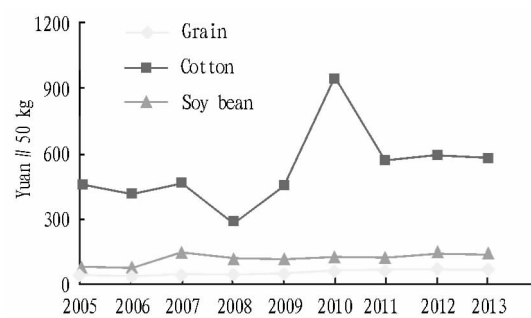
2.2 Land scale is also an important factor affecting farmers' behavior of growing grain

Due to agricultural resource constraints, China's agriculture is mainly based on small-scale family farms. China's per capita arable land area is 0.08 ha, less than 40% of the world average (World Bank, 2011). More importantly, there are also significant differences in the land resource endowments between different areas. Even in Heilongjiang Province with the most abundant arable land resources, the per capita cultivated land area of rural households is only 0.86 ha (Fig. 4). The per capita cultivated land area in 13 major grain-producing provinces is only 0.25 hectares. Due to the small area of arable land for rural households, it fails to form scale operation and low yield reduces the benefits of growing grain, thereby significantly restricting farmers' enthusiasm for growing grain. This reality is still difficult to improve in the short term.

2.3 Farmers' family characteristics have a tremendous impact on the behavior of growing grain In China, whether the farmers are willing to grow grain is to a large extent closely related to age, gender and education level. With a large number of rural labor forces transferring to non-agricultural industries and emerging industries, there is a trend of aging, feminine or ill-educated labor still engaged in agricultural activities in rural areas^[11]. According to the second national agricultural census data, the age of agricultural labor is significantly older than that of migrant labor, and the average length of education enjoyed is 7.14 years for agricultural labor and 8.68 years for migrant labor. In fact, the willingness of rural youth to engage in agricultural activities declines, and the high-quality and high-skilled labor lacks the enthusiasm for growing grain.

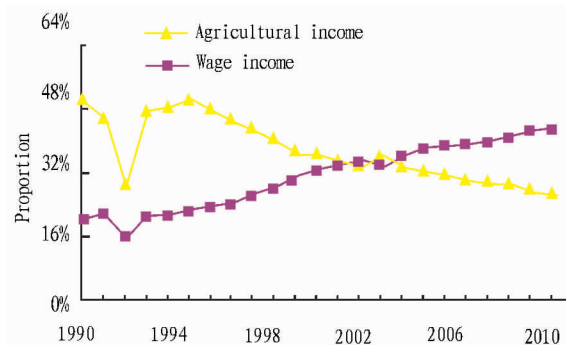
2.4 Government's agricultural support policies will stimulate the farmers' behavior of growing grain From a historical perspective, when the government introduced a strong policy, farmers' enthusiasm for growing grain would be significantly improved. The implementation of household contract responsibility system in 1982 and the agricultural tax relief since 2004, has brought the grain output growth rate of over 10%. Especially the implementation of four major agricultural subsidies since the 2006 has greatly stimulated the farmers' enthusiasm for growing grain.

However, the policy stimulus each time is temporary, and over time, the impact on farmers' willingness to grow grain will gradually weaken.



Data source: National Agricultural Costs and Returns Compilation.

Fig.2 The cash earnings of major agricultural products



Data source: China Statistical Yearbook.

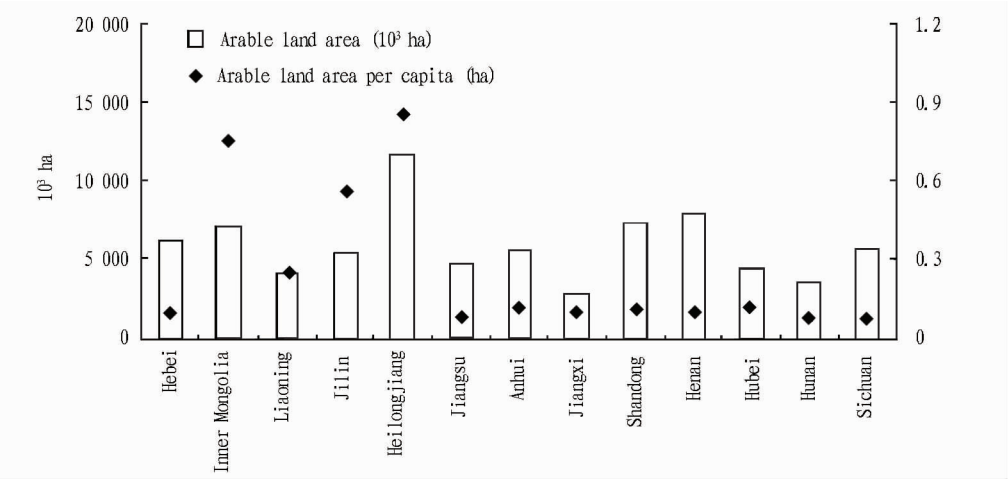
Fig.3 The share of agricultural income and wage income in farmers' per capita net income

3 Empirical analysis of the factors influencing farmers' enthusiasm for growing grain

3.1 Data sources The data in this paper are from the research and survey of our research team in Hebei Province. The main content of the questionnaire has four parts. (i) The basic characteristics of farmers, including householders' age, education level, household population and number of labor. (ii) Production and operation features, including arable land area, various levels

of production inputs, major crop structure and yield, sales, product price and income. (iii) The use of agricultural machinery, including whether farmers have farm machinery, whether it is easy to hire farm machinery. (iv) Farmers' awareness on food subsidy policies, including the understanding of policy and assessment of policy. The research uses multi-stage stratified sampling method. According to the two stages of county and village, each stage is di-

vided into three levels (high, middle and low) for sampling, so we choose three villages in Wuyi County, Cheng'an County and Zhaoxian County in Hebei Province, respectively. The random sampling method is used for farmer sampling. Ultimately, we get 263 valid samples, and the sample farmers in the counties are evenly distributed (Table 1).



Data source: China Statistical Yearbook 2012.
Fig. 4 The arable land resources in China's major grain-producing provinces

Table 1 Characteristics of the sample distribution

Regions	Number of villages surveyed	Number of valid samples	Share in the total samples //%
Zhaoxian County	3	86	32.7
Cheng'an County	3	84	31.9
Wuyi County	3	93	35.4
Total	9	263	100

Data source: Questionnaires.

3.2 Model setting and variable selection In this paper, we use binary logistic model to analyze the relevant data of research results in order to study what factors related to farmers' enthusiasm for growing grain. Logit model is a logical probability distribution function, and its basic form is as follows:

$$P_i = F(Z_i) = F(\alpha + \beta X_i + \mu) = \frac{1}{1 + e^{-Z_i}} = \frac{1}{1 + e^{-(\alpha + \beta X_i)}} \quad (1)$$

where $Z_i = \alpha + \beta X_i + \mu$.

The estimate of formula (1) is as follows:

$$\ln \frac{P_i}{1 - P_i} = Z_i = \alpha + \beta X_i + \mu \quad (2)$$

where P_i is the probability of occurrence of the dependent variable; Z_i is the variable to be explained.

Whether the farmers are willing to grow more grain reflects farmers' enthusiasm for growing grain, so it can be regarded as the variable to be explained. This variable is a categorical variable. Farmers are willing to expand grain cultivation area ("yes"), and the variable takes the value "1"; farmers reduce the grain cultivation area or make it remain unchanged ("no"), and the variable takes the value "0". Characteristics of explanatory variables and description can be shown in Table 2. Farmers' family characteris-

tics include householders' age, years of education for householders, share of agricultural labor to total household population, and share of agricultural income in total income. If the householders are older, the proportion of agricultural labor is higher and the proportion of agricultural income is higher, it will have a positive effect on farmers' enthusiasm for growing grain. If the householders' education level is higher, they may be more reluctant to engage in growing grain, and the expected effect is negative. Theoretically, in economic factors, grain price is the key factor determining farmers' enthusiasm for growing grain. The higher the input costs, the lower the enthusiasm for growing grain. Wage income, as the opportunity cost, is also one of the economic factors affecting the behavior of farmers to grow grain. The higher the wage income, the lower the enthusiasm for growing grain. The area of arable land operated by family reflect the farmers' resource endowments and agricultural production scale. The larger the scale of production, the higher the income, the greater the enthusiasm. Farmers believe that the more the subsidies for growing grain, the greater the enthusiasm for growing grain. Whether farmers have farm machinery and whether it is easy to hire farm machinery may also affect the enthusiasm for growing grain. The agricultural

mechanization is an alternative for labor, and it can reduce the grain. burden of growing grain, thereby stimulating behavior of growing

Table 2 Variable selection and sample statistics

Variables	Variable description	Priori judgment	Mean	Standard deviation
Whether the farmers are willing to expand grain cultivation	1 = yes, 0 = no		0.65	0.48
Household characteristics				
Householders' age	Unit : years	Positive	51.31	10.40
The actual number of years of education for householders		Negative	7.72	3.14
The proportion of agricultural labor	Unit : %	Positive	0.74	0.29
The proportion of farm income	Unit : %	Positive	49.30	30.16
Economic factors				
Grain prices	Unit : yuan	Positive	0.96	0.06
Physical capital inputs	The costs of fertilizer, seeds, irrigation and pesticides per mu of arable land, unit : yuan/mu	Negative	264.29	198.04
Wage income	Unit : yuan per day	Negative	55.44	22.31
Land scale				
The total cultivated land area of family	Unit : mu	Positive	10.87	9.29
Policy factors				
Awareness of impact of subsidies on the behavior of growing grain	Value assignment from low to high, 1 – 5	Positive	1.65	1.11
Others				
Whether it is easy to hire farm machinery	Value assignment from low to high, 1 – 5	Positive	4.46	0.88

Data source: The survey questionnaire.

4 Model estimates and results

The Logit model is used for estimation based on the above analysis. From the model estimate results (Table 3), it is found that the model fitting effect is good, and the model passes the test.

Householders' age, the share of agricultural labor in the family, arable land area of family and subsidies have the most significant effect on farmers' enthusiasm for growing grain.

Table 3 Model estimation results

Variables	Coefficient	Standard deviation	P value
Household characteristics			
Householders' age	−0.0355 * * *	0.0117	0.0024
The actual number of years of education for householders	−0.0258	0.0414	0.5332
The proportion of agricultural labor	1.0634 * *	0.4682	0.0231
The proportion of farm income	−0.0056	0.0049	0.2530
Economic factors			
Grain prices	0.1423	0.1555	0.3600
Physical capital inputs	0.0010	0.0009	0.2619
Wage income	0.0000	0.0065	0.9961
Land scale			
The total cultivated land area of family	0.0383 * *	0.0188	0.0421
Policy factors			
Awareness of impact of subsidies on the behavior of growing grain	0.3792 * * *	0.1382	0.0061
Others			
Whether it is easy to hire farm machinery	0.1621	0.1240	0.1911

Note: *, **, *** represent 10%, 5%, 1% significance level, respectively.

4.1 Household characteristics At the 5% significance level, the family farm labor is positively correlated with the farmers' enthusiasm for growing grain. The more the agricultural labor forces in the family, the higher the enthusiasm for expanding grain

cultivation. At the 1% significance level, householders' age is negatively correlated with farmers' enthusiasm for growing grain, indicating that as farmers get older, farmers' enthusiasm for growing grain is increasingly weak. In the field research, it is found

that age limit is the fundamental reason for the vast majority of farmers' unwillingness to expand grain cultivation. The household characteristics are bound to become important constraints on farmers' enthusiasm for growing grain in China in the future. The number of years of education in the model as well as the proportion of agricultural income has no significant impact on farmers' enthusiasm for growing grain.

4.2 Economic factors Surprisingly, the model results show that the grain prices have no significant impact on farmers' enthusiasm for growing grain, which is inconsistent with the theory. In this regard, we believe that the land scale restrictions make it difficult for grain farmers to form economies of scale. The family production scale of sample farmers is very small, and the average grain sale price is only 0.96 yuan/kg (Table 2). The limited production is not enough to mobilize farmers' enthusiasm for growing grain. The impact of physical input cost variables is not significant. It is found that fertilizers, pesticides and seeds are necessary inputs for farmers, and farmers rarely reduce the amount of them due to rising agricultural material prices. Wage income also has a small effect on farmers' enthusiasm for growing grain. In the survey, it is found that few farmers completely abandon growing grain due to high wage income. Of course, this is likely to be caused by geographical reasons. In economically developed coastal provinces such as Jiangsu, Zhejiang and Guangdong, the labor costs are high, and farmers are likely to completely abandon growing grain due to the high wage income.

4.3 Land scale The arable land area of family has a significant impact on farmers' enthusiasm for growing grain, and it plays a positive role in promoting farmers' enthusiasm at the 5% level. In the actual situation, the average arable land area of rural households in Hebei Province is small, and it is only 10.87 mu for the sample in this article (Table 2), which greatly restricts farmers' enthusiasm for growing grain. If this problem can be solved, farmers' enthusiasm will be greatly improved. This also explains the reason why the impact of grain prices on prices on farmers' enthusiasm for growing grain is unobvious in the model estimates.

4.4 Policy At 1% significance level, subsidy policy can stimulate farmers' enthusiasm for growing grain. This indicates that if there are more agricultural support policies, farmers are more willing to expand the scale of grain cultivation. Despite limited amount of subsidies, farmers generally think "better than nothing", indicating that farmers have positive evaluation of subsidies, and the subsidies can really stimulate their enthusiasm for growing grain to a certain extent.

4.5 Other factors Whether it is easy to hire farm machinery has no significant impact. Due to the high degree of agricultural mechanization, local residents are very easy to hire agricultural machinery, and it is no longer a limiting factor. In addition, some farmers' willingness to grow grain is not affected by the above factors. We tentatively call this force driving farmers to grow grain "inertia". For example, due to geographical reasons, a piece of land is suitable for growing grain; due to historical traditions, cus-

toms or family habits, some farmers always choose to grow grain; some old people and women hold believe that it is easiest to grow grain, and they have a lot of spare time to do other things, so they are more willing to grow grain. If there is such inertia, then there may be a lower limit for China's grain output. So it is necessary to further distinguish "inertia" and "enthusiasm" for growing grain in future studies.

5 Conclusions and policy recommendations

(i) By influencing the producers' allocation of input factors and resource, the farmers' willingness to grow grain and farmers' enthusiasm for growing grain play a decisive role in food production. Therefore, to ensure the future China's food self-sufficiency, it is necessary to stimulate producers' enthusiasm for growing grain. Farmers' enthusiasm for growing grain is mainly affected by economic interests, land scale, farmers' characteristics and agricultural support policy. (ii) Farmers' family characteristics have an increasing impact on China's grain production. The empirical results show that the older the farmers, the less the enthusiasm for growing grain; low levels of education will also limit the adoption of new technology and new methods of cultivation; the less the family farm labor, the less the enthusiasm for growing grain. These will affect farmers' effective labor input, thus affecting the future food production in China. In the long run, the most fundamental solution is to increase the comparative benefits of grain cultivation, and improve the social security system in rural areas in order to attract more highly qualified young people to enter the primary industry for grain production and management. (iii) In theory the economic interest of growing grain is a fundamental factor determining whether the farmers grow grain actively, but in the actual situation of China's rural areas, due to the constraints of family land scale, the impact of economic interests and especially food prices has not been fully reflected. The reason is that the small arable land area of rural households and limited food production make the food prices difficult to stimulate farmers to actively grow grain, which greatly limits the enthusiasm for growing grain. The key to solving this problem is land reform, agricultural land concentration and large-scale grain cultivation. It is necessary to accelerate the land transfer and achieve large-scale grain operation, thereby enhancing the economic interests of growing grain. (vi) The domestic agricultural subsidy policies have a positive impact on farmers' enthusiasm for growing grain, but there is a need to note the timeliness of policy. It is necessary to establish a stable long-term food subsidy mechanism and policy system in order to enhance farmers' enthusiasm for growing grain. In addition, the government should continue to regulate the food subsidy policy, and increase the effective subsidies in accordance with actual production or sales of food to stimulate the enthusiasm for growing grain.

4 Recommendations

4.1 Strengthening the scientific input to grain production and improving the commercial and industrial transformation mechanism of agricultural technology innovation achievements

(i) It is necessary to continue to play the dominant role of finance in agricultural research funding, and establish effective oversight and accountability mechanism for research input and indicator evaluation system for grain research. Government should give policy support for the private capital to enter the field of grain research. (ii) It is necessary to improve the transformation and trading platform of the agricultural scientific and technological achievements, and cross the "last mile" of agricultural science and technology extension. There is a need to change the existing supply mode of agricultural scientific and technological achievements, and establish objective, fair and scientific evaluation mechanism for agricultural science and technological achievements. At the same time, it is necessary to strengthen the building of agricultural technology extension demonstration station, to constantly promote agricultural technology extension departments and enterprises to bring new agricultural technologies to the rural areas.

4.2 Encouraging and supporting the operation of major grain growers to boost large-scale, intensive and specialized grain production

Governments at all levels should actively support and guide the major grain growers. It can learn from the experience of non-recourse loans for grain production in the United States to allow the major grain growers use grain as collateral for the loan application^[12]. Meanwhile, the agricultural departments should strengthen the communication with the major grain growers, and take various ways to provide effective technical services for them such as technical training and forum of experts. It is necessary to focus on diverse development patterns of major grain growers to gradually improve the degree of organization and industrialization, and continuously improve the market ability to resist risks.

4.3 Playing the guiding function of finance in agricultural infrastructure investment and exploring diversified investment modes

It is necessary to continue to increase financial investment in agricultural infrastructure, and actively explore gov-

ernment-led diversified investment and financing system. There is a need to give full play to the guiding and demonstrating effect of government funding to create a favorable institutional environment for the subsequent private investment; take a variety of ways and preferential policies to attract enormous social capital to be invested in agriculture-related infrastructure building; continue to strengthen water conservancy construction and improve the ability to withstand natural disasters.

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