# The Interactive Effect of Diversification and Farming Scale on Productivity of Family Farm:Taking Rice Cultivation as An Example

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**Abstract.** Based on the diversification and cultivation scale, the rice cropping data of rural fixed observation points in 2011 were selected and the effect of diversification degree on rice productivity was analyzed by the Tobit model. The empirical results of the model show that diversification of sample farm will lead to loss of rice production efficiency. With the increase of rice planting scale, the loss of rice production efficiency will need to be further increased by diversification. Thus, we should stick to the family farm of specialized production operation. The transfer of land, the price and quantity of leasing, respecting the law of the market; the raising of funds can be considered non-subsidized capital market financing to help, while maintaining a certain degree of diversification, to avoid idle assets, low resource efficiency loss.

## 1. Introduction

With the gradual development and deepening of agricultural modernization, as an emerging form of agricultural production and management, family farms are adapted to social and economic development. Due to the weak nature of agriculture and the special nature of the production process, making agriculture throughout the reproduction cycle is facing many risks. In addition, agriculture also has the risk of an economic market and social behavior shared by other industries. So agriculture is a case in high-risk industries [1]. To this end, family farms must diversify their operations to resist and mitigate the effects of natural and market risks on farmers' incomes, diversify farmers' income channels and increase farmers' incomes [2-3]. Then, the diversification of agricultural production in the form of family farms can be expected to result in a significant increase in income for farmers. Will diversification of family farms have an influence on current grain production? Can guarantee China's food security? These issues are available to question and study.

Family farm as the main body of new agricultural management, in recent years, for family farm research is very popular, the main research focused on the status qua, the significance of family farms and other production and management of the relationship between the main problems and perfect system [4-6]. For example, Huang Xinjian, etc. about Jiangxi rice cultivation, for example, should be transferred from the contract right to improve the financial subsidies to promote family farm progress [7]. Sci Guoqing and other family farms that China is an important form of agricultural micro-management, he achieved the land family business and commercial production of the organic integration. In the developed countries, he argues, there are basically three categories of workers in agriculture: those who occupy the means of production and who are only responsible for farming; and those who own the means of production and who are engaged in most of the work themselves

Producers; third is not the possession of means of production, employment of agricultural machinery operators, they have actually become industrial workers [8-9]. For its significance, Chi-hung, etc. (2013) that this is a global phenomenon. Family farms have an efficient efficiency advantage that is unmatched by other forms of business organization. Lin (2008) argues that family farms are the most appropriate system for agricultural growth in developing states. On the other hand, Wang Chunlai (2014) argues that the advantages of family farms lie in agricultural production, while the benefits of farmers' cooperatives and industrial and commercial enterprises lie in production services and market linkages. Three should seek advantages Complementarity and common development [10]. In terms of the plight of family farms, Shi Guoqing et al. (2014) argue that the plight of land transfer at this stage restricts the realization of moderate scale management of family farms in China [11-16]. Depending on Wang Jianhua et al. (2014), the construction of the sustainable development mechanism of family farms is a systematic and holistic project. It is made up of five complementary developmental stages: quasi-quasi- Into the recognition mechanism, support management mechanism, cooperation and incentive mechanism, social service mechanism, the mechanism of vocational peasant cultivation.

Most existing studies on family farms focus on the theoretical analysis of family farm progress. However, there is poorly research on the empirical analysis of the effectiveness of family farms. For instance, there are relatively few empirical studies on the relative efficiency of diversified family farms and diversified family farms, and whether the diversification has significant effects on the efficiency of production and management of family farms. Rice is the most important nation in China, more than 65% of the population of rice-based foods, its development is directly related to China's food security. Based on this, this paper chooses the family farm which is mainly engaged in rice planting as the research theme of this paper, trying to answer the question of the influence mechanism and the effect of diversification on its production efficiency.

## 2. Theoretical analysis and hypothesis

### 2.1. Behavioral decision theory
The basic view of behavior decision-making theory is that farmers as producers are not entirely rational, and their production and management behavior cannot be fully explained by rational decision-making theory.

For a long time, agriculture as a vulnerable industry has been put in a high input, low output of the embarrassing situation. Coupled with imported rice and other bulk imports of agricultural products continue to increase domestic grain prices continue to decline, leading to a sharp decline in domestic grain production income. On the other hand, a large number of farmers abandon the cultivation of the traditional rice and other traditional food crops, and change the vegetables into the second or third industry. On the other hand, a large number of farmers choose to ", Fruits and other high economic crops [17]. Farmers, as limited "rational decision makers", use "cost-benefit" comparisons in the agrarian production process to select good-benefit crops for planting. Compare to the traditional small-scale farmers, the agricultural income accounts for the proportion of the total family income of the newly-emerged agricultural management households, such as family farms. Therefore, the family farmers pay greater attention to the "cost-benefit" comparison in production and management decision-making.

In view of this, when the income of traditional grain crops such as rice is declining, the farmer is bound to look for other crops to grow crops, and even replace the existing rice cultivation, and thus showing the diversification of agricultural production situation The pursuit of higher agricultural production efficiency [18].

### 2.2. hypothesis
Therefore, this paper presents the first hypothesis:
    Hypothesis 1: (1) Diversification of family farms helps improve rice production efficiency.
    (2) The impact of family farm scale on diversification and agricultural performance

With the increase in scale of family farms, family farms can derive more economies of scale benefits from diversification and economies of scale in brand building. Therefore, opposed to small-scale rice farming family farms, large scale rice farming family farm diversification gains relatively significant. With the continuous expansion of agricultural production and management, family farms can gradually reduce the negative impact of labor transfer on pastoral production, reduce agricultural production costs by large scale mechanized production, and provide agricultural production efficiency. However, it should be pointed out that the scale of the economy there is "moderate" restrictions, not the scale of the operation the better. Once the business scale is too large, beyond the optimal scale, there may be management level lag, management ineffective and additional constraints. In addition, as family farms are still mainly family members as the main labor force, so too large scale will reduce the level of specialization of farmers. There will be diminishing returns to phenomenon. In view of this, this paper proposes:

Hypothesis 2: The scale of family farms has a positive effect on the relationship between diversification and agricultural performance.

## 3. Model Construction

### 3.1. The specific settings are as follows:

DIV denotes the independent variable, for example, the degree of diversification of the sample family farm. In order to improve the credibility of the model, the Herfindahl index (HI) is used to measure the degree of diversification of the sample farm. $X_i$, $Z_j$, $P_k$ and $W_m$ are control variables, including personal and family traits variables, labor force variables, external environment variables and land characteristics variables.

Although all of the rice production and management efficiency of the sample family farms is observable, their distribution ranges are limited to 0-1, and the explanatory variable TE is compressed to a certain interval. In this case, In the traditional least-squares regression model, the estimation results may be inconsistent in both the global sample and the sub-sample in which the discrete points are deleted.

Compared with the traditional least squares regression model, the Tobit model is applicable to the case where the part of the explanatory variable is positive and partly 0. Specifically, if the observed value is, the unobserved value is:

### 3.2. conditional expectation

The conditional expectation can be written as follows for a sample satisfying the condition:

Therefore, the traditional least-squares regression regression of the above samples, ignoring the non-linear terms have been included in the reality of the random disturbance, resulting in interpretation of the variable $X_i$ and random disturbance items are related, leading to the traditional least-squares regression The results are not consistent. In response to this situation, Tobin proposed the use of MLE to re-estimate the model, you can model the probability density function rewritten as:

Where, for the demonstrative function, if true then the function value is 1, if false then the function value is 0. Depending on the above formula, we can further write the likelihood function of the whole sample, and then estimate it by MLE to get the final estimation result.

Built on the model of analyzing the effect of diversification on rice production efficiency, this paper investigates the effects of diversified management on the diversification of rice production by analyzing the interaction between diversification and rice planting scale. And rice planting efficiency, the specific settings are as follows:

TE represents the dependent variable of the model, ie, the rice production efficiency of the sample family farm; the independent variable, which is the interaction item between the diversification degree of the sample family farm and the rice planting scale, in order to improve the credibility of the model, the degree of diversification $X_i$, $Z_j$, $P_k$, $W_m$ are control variables, including personal and family traits

variables, labor characteristics variables, external environment variables and land characteristics variables (EI) .

## 4. Empirical Analysis

### 4.1. Data sources
A total of 9667 valid family farm samples were screened. Among them, 4245 households in Northeast China (Heilongjiang Province, Liaoning Province and Jilin Province) were divided according to the principal producing areas of rice. The Yangtze River Basin (Hunan, Henan, Hubei, Jiangsu, Anhui, Zhejiang, Jiangxi, Yunnan Province, Sichuan Province, Chongqing City, Guizhou Province, Guangxi Zhuang Autonomous Region) a total of 5422 households. The distribution of the entire sample is relatively uniform, can better represent the main producing areas of China's actual production of rice.

### 4.2. the status of the sample family farm operations
Because the Standard Industrial Classification does not have detailed industry segmentation criteria for the agricultural sector and the limitations of rural fixed observation data design, this paper divides the scope of operation of rice-growing family farms into four categories (That is, N = 4): pure grain cultivation industry, including rice-based traditional food crop cultivation; livestock breeding industry, including pig, sheep, chicken, duck and other poultry farming; economic crop industry, including vegetables, Crop cultivation; other industries, including leisure tourism, farmhouse and other tertiary industry activities.

Based on the formula of the Herfindahl index (HI) and the entropy index (EI), we can obtain the index of diversification of the sample family farms. On the whole, at present, the diversification of the principal rice family farms in China is relatively low. Traditional rice cultivation is still the core content of family farms.

Built on the above analysis, the traditional BCC model and Bootstrap-DEA model were used to estimate the rice production efficiency of all sample farms. In this paper, after testing the Bootstrap-DEA model and the traditional DEA model, we find that there are significant differences in the efficiency values of the two models under the assumption of equality of variance and variance, and the Bootstrap-DEA. The model is consistent with the conclusion that small sample analysis is more advantageous (Kneip, 2003). Results of Bootstrap-DEA model are as follows:

Results of model estimation show that the technical efficiency of the sample farms is relatively low under Bootstrap-DEA model and traditional DEA model. The estimated technical efficiency of the modified Bootstrap-DEA model is only 0.1817, and the lowest mechanical efficiency Farm only 0.014, and the standard deviation of 0.1512, showing that the difference between the technical efficiency of the sample farm farms. In the aspect of scale efficiency, Bootstrap-DEA model is changed to estimate the sample family farm scale efficiency value of 0.5891, of which the scale efficiency is 0.9549 and the lowest is 0.3355. In addition, in the pure technical efficiency, the Bootstrap-DEA model modified to estimate the sample family farm efficiency is relatively low, in which the sample family farm pure technical efficiency of the minimum is only 0.0234, the standard deviation of 0.2882, the overall situation and family farms Of the technical efficiency of the same. It can be seen that the pure technical efficiency and scale efficiency of the rice production in the family farms still have much room for improvement at present, but the principal factor restricting the improvement of household agricultural efficiency lies in the pure technical efficiency.

### 4.3. model estimation results and analysis
In the sample farm, the rice production efficiency value is between 0 and 1, which are a limited variable. Therefore, the traditional least square regression is no longer utilized, so this paper carries out regression analysis through the Tobit model. The Probability of Probability of the model was greater than the confidence level of 1% confidence level, and the R-squared was 0.6211 And 0.5621, respectively. The results show that the model has a great fit with the model.

The effect of diversification on rice production efficiency shows that all the variables have passed the significance test. The empirical results show that both the Herfindahl index (HI) and the entropy index (EI) is negatively correlated with the rice production efficiency of household farms. With the diversification of family farms, Traditional rice production efficiency will be still decline. The reason may be that, on the one hand, although diversification can improve the ability of resisting risks to some degree, the overall management level and management ability of the family farms are relatively weak, leading to the shortage of rice farms On the other hand, due to the special nature of agricultural production assets, assets between the different production activities cannot be universal.

Built on the analysis of the effect of diversification level on the rice production efficiency, the effect of diversification scale on rice production efficiency was analyzed by constructing the interaction item between the degree of diversification and the rice planting scale. Depending on the results of the regression model, the probability values of the diversified degree represented by the Herfindahl index (HI) and the entropy index (EI) were all significant at the confidence level of 1% R-squared are 0.5781 and 0.5861 respectively. Despite the fact that the fitting degree of the model is slightly different from that of the previous model, the overall regression result is still relatively good and the reliability is high.

The regression results showed that the coefficients corresponding to the interaction between the degree of diversification and the rice planting scale were both significant at the 1% confidence level and negatively correlated with the rice production efficiency, indicating that with the increase of rice planting area and diversification The rice production efficiency will decrease gradually. It is worth noting that, compared with the previous section, the coefficient of diversification is considerably higher than that of paddy rice, ie, it has a greater impact on production efficiency. It can be seen that family farms in the degree of diversification is bound to part of the management of energy and production funds from the rice production in the withdrawal, and gradually shifted to other industries, leading to rice production materials and technology, resulting in the efficiency of diversification loss. With the increase of rice planting area, the diversification of the loss effect is increasing, has slightly offset the large scale cultivation of the scale effect.

## 5. Conclusions and Recommendations

Based on the improvement of the traditional data envelopment analysis, this paper calculates the rice planting efficiency of domestic firms by Bootstrap-DEA model. The results demonstrate that the efficiency of rice production is relatively low, and the pure technical efficiency is the main Constraints. In addition, it is found that the rice production efficiency is relatively low on the family farms with a higher degree of diversification, and the loss of rice production efficiency will be further increased with the increase of rice planting scale.

First, adhere to the family farm of specialized production operation. Land as the most important and basic factor of production of family farms, the transfer and lease prices and quantity, to respect the laws of the market, and should not be policy-based means to determine factor prices and the number of transactions, which can improve the productivity of family farms. The problem of capital can be considered for family farms to help non-subsidized capital market financing to the market way, so that the market "foot voting", so that family farms can achieve the effect of survival of the fittest, so as to improve the efficiency of family farms .

Second, to maintain a certain degree of diversification. According to the results of the present study, the diversification level of the main rice family farms in China is relatively low. The increase of diversification will bring loss of production and management efficiency to family farms. However, complete specialization also has the malpractice, will bring the asset specificity low resources idle and the waste, also can cause the efficiency loss. Some researchers believe that diversification cannot only bring diversification of operational risks to the family farms, improve the efficiency of resource allocation and other benefits, but also conducive to the realization of environmental protection, more suitable for China's special national conditions. In China, the successful examples of family farms in the initial stage include both specialized grain farms, specialized vegetable farms, specialized fruit

farms, specialized chicken farms and specialized fish farming farms; There is no shortage of diversified family farms engaged in both cultivation and cultivation. The practice shows that at this stage, diversification is suitable for China's national conditions, but also to maintain an appropriate degree, cannot be too scattered managers production and management of energy resulting in loss of efficiency.

## 6. References

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