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Research Article

Empirical Research on the Influences from Seed Subsidies and Labor Mobility on Food Yield in China

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Abstract: The paper puts forward countermeasures and suggestions on safeguarding national food security in terms of expediting promotion of subsidy variety, boosting land transfer, as well as speeding up new-type urbanization and others. Through investigating wheat production status to 581 peasant households in the north of Anhui Province, this study conducted empirical analysis to the influences from subsidy variety and labor mobility by means of expanding C-D production function. The result showed that the subsidies for growing superior grain cultivators have prominent yield-increasing effect to wheat yield; the labor mobility has no obvious impact to wheat yield and chemical fertilizer, pesticide, capital have obvious significance to wheat yield. Meanwhile economies of scale exist in wheat production.

Keywords: C-D production function, food security, subsidies for growing superior grain cultivators

INTRODUCTION

Grain is the most basic means of livelihood and it is also the important strategic substance that relates national security. Therefore it is crucial for our country, which is large in population, to safeguard national food security. Our country pays high attention to food security all the time (Jun-Wei, 2014). Many incentive policies on raising grain output have been enacted and the tremendous achievement, which is the grain yield continues to grow for eleven years, has been achieved. However along with the rapid expansion of industrialization and urbanization, the food security still faces severe challenge (Guo-Xin and Yin-Kang, 2012). Under the background of the agricultural acreage declines unceasingly, enhancing per unit area yield of grain becomes the inevitable choice to safeguard national food security. How to boost per unit area yield of grain is a great concern to our Chinese government.

Many scholars carried out research on the factors influence grain yield. By using the expanding production function, Kong *et al*. (2004) established wheat production model for peasant households in northern area, studied the influences from input factors and other influencing factors to wheat production and considered the effective approaches to boost grain yield are protecting cultivated land, improving irrigation condition, facilitating transfer of rural labor, utilizing labor force and chemical fertilizer reasonably. But they did not pay enough attention to the influence from technical input (Fan and QiHua, 2014). By using cross-section data in 2005 to rice farmer households in 22 counties of Jiangsu Province, Jingfei conducted research on the function to rice production from input factor, variety cognition, decision of agricultural production, personal characteristic and other influence factors and he considered the cognition to rice varieties by peasant household played positive significance in rice production (Xiang-Zhi, 2004). Many scholars carried out empirical analysis on the influence to grain yield from chemical fertilizer, intensification on cultivated land, natural disaster, grain direct subsidy and farmland transfer (Fei, 2008). The subsidies for growing superior grain cultivators are the significant measure to expedite popularizing agricultural techniques and boost grain yield. Our government focuses on the yield-increasing effect all the time, but there is only little research literature on the yield-increasing effect from this subsidy policy from the perspective of peasant household. Under the circumstance of the rapid urbanization in our country, according to the survey data from wheat planting peasant households in north of Anhui Province, this study conducted empirical analysis to the influences from subsidy variety and labor mobility by means of expanding C-D production function. The research result is significant to optimize subsidies for growing superior grain cultivators, as well as safeguard national food security.

MATERIALS AND METHODS

Data sources and sample conditions:

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Data sources: Anhui Province is the famous and major grain producing area in China and it is also the major province for wheat production. Its wheat production mainly concentrates in Huaibei district. Therefore this study selected Yongqiao District, Xiao County, Suixi County and Lieshan District in Huaibei as the survey sites, which are four large counties (districts) on producing wheat. Among which Xiao County is the demonstration county for science and technology households nationwide. The investigation this time took advantage of the good opportunity that the college students went home for holiday and conducted survey towards the production status of wheat farmer households through random sampling. This survey sent 650 questionnaires in total and collected 581 valid questionnaires, the effective rate reached to 89.38%.

Sample conditions: Seeing from the sample peasant households, male heads of households occupy 90.39% of the total amount, which illustrates the stable status to men during production decision. Seeing from the ages, the heads of households are generally in high ages with the average of 51.99, people below 40 years old only hold 12.1%, people above 50 years old hold 52.85% and some people are beyond 75 years old. The educational levels to heads of households are low generally, among which people below the level of elementary school hold 19.93%, people who are in the level of junior middle school hold 62.2%, people who have been to senior high school and technical secondary school hold 17.61%. The land scales to peasant households are small, the land per household to sample households is 0.053 ha and each piece of land only has 0.0067 ha. There are 74.7% families have labor force to work in other places, which explains labor mobility is the general circumstance in the rural areas at present. The conditions of sample peasant households and relative research are comparatively unanimous, which accounts for certain representativeness and reliability in this survey.

Among the samples, there are 60.76% peasant households adopt the wheat variety recommended by government, 4.06% peasant households adopt new varieties which appear on the market lately, 33.2% peasant households adopt old varieties and 1.97% peasant households cannot recall the name of wheat variety or say the name. There are 30% sample peasant households adopt technology of formula fertilizer, only 22.89% peasant households adopt fine and semi-fine quality sowing seeds, which illustrate the rate of adoption by subsidies for growing superior grain cultivators and matching technology is not ideal enough (Yang and Zhao, 2013).

RESULTS AND DISCUSSION

Empirical analysis on the influence to grain yield by subsidy policy for growing superior grain cultivators:

Model select: Analyzing the mutual relation between the input and the maximum output during material production by means of function method is referred to as production function analysis. This method not only could determine the principal factors which impact output, but also could calculate the rate of contribution to output by each input factor. The usual production functions, which analyze input-output, are Cobb-Douglas production function, transcendental production function, transcendental logarithmic production function and Speer production function. After comprehensive analysis towards the characteristic to each production function, this study selected the most common one: Cobb-Douglas production function to analyze the influence factors of wheat production by peasant households. Cobb-Douglas production function is the most common production function that calculates input-output. After discussing the relation between input and output, the US mathematician C.W. Cobb and the economist Paul H. Douglas created it according to the historical data from 1899 to 1922 in US. C-D's production function plays crucial role in econometrics and mathematical economics. Its fundamental form is:

$$Y = AL^{\alpha}K^{\beta}\mu \ (A > 0, 0 < \alpha < 1, 0 < \beta < 1, \mu \le 1) \qquad (1)$$

In this formula,

Y = The gross output
A = The technical level
L = The input labor force amount
K = The invested capital
α = The elastic coefficient output from labor force
β = The elastic coefficient of capital input
μ = Influence of random jamming, $\mu \le 1$

Seeing from the model, science, technology, labor and capital input are decisive elements to value of industrial output.

During the practice of economic research, the factors impacted output are relatively complex. Not only they are influenced by input factors, but also will be impacted by other factors. For instance, besides the cultivated land, seed, chemical fertilizer, pesticide, machinery, capital and other input factors, the wheat yield is restricted by variety, fertilization and other production technologies. Therefore, this study conducted empirical analysis to the factors impacted wheat yield by adopting expanding C-D production function. Taking the logarithm from various input factors in production function not only could reduce heteroscedasticity effectively, but also possesses economic significance to research value. That is to say, the change of one percentage point in production factor input results in percentage of output variation. So this study selected logarithmic form of expanding C-D production function to analyze the influence factors to wheat yield and the concrete form is:

In this formula, Y is the output per hectare to wheat, X_1, X_2, X_3, X_4, X_5, X_6, X_7 indicates chemical fertilizer, labor force, pesticide, irrigation, capital, wheat area and other factor input respectively, α_i is the parameter waited for estimation, D_1, D_2, D_3, D_4 are dummy variables and they indicate whether the peasant household adopts subsidy variety, testing soil for formulated fertilization, jointing fertilizer technology and the condition of labor mobility respectively.

Variable declaration: Whether the subsidy variety and labor mobility have obvious significance to wheat yield per unit are the research emphases in this study. The author chose hectare yield (kilogram) as the dependent variable (Y). Considering the availability and distinguishable nature to data, this study took the following technical elements and factor input as the independent variables to analyze:

- Chemical fertilizer (X_1), is the foremost input factor during wheat production, especially the purified amount of nitrogen, phosphorus, potassium and other major elements in it are crucial to wheat production. However it is difficult to investigate and calculate the purified amount in chemical fertilizer from the perspective of peasant household, in order to facilitate calculation and ensure relative accuracy to the measure, this study adopted the fund amount input per hectare to calculate the input of chemical fertilizer element
- Labor (X_2), the input labor is the amount to wheat per hectare during the whole productive process
- Drug application (X_3), due to it is difficult to calculate the drug variety and dose, this study took the drug application per hectare as the index, for the peasant household which has not conducted pest control, the drug application is 0
- Irrigation (X_4), indicates by irrigation expense per hectare
- Seed input (X_5), indicates by seeding quantity per hectare
- Other capital investment, other capital investment except input factors, the capital expenditure like transpiration, soil preparation, harvest and purchasing some socialized services
- Wheat planting scale (X_6), indicates by the total area the peasant household planted
- Variety technology (D_1), in order to conduct analysis to the influence of wheat yield from the subsidy variety recommended by government, set this variable to dummy variable, for the peasant household who adopts subsidy variety, set 1 as the value, for the peasant household who adopts non-subsidy variety, set 0 as the value
- Formula technology of soil measuring (D_2), this variable is dummy variable, for the peasant household who adopts formula fertilizer, set 1, for the peasant household who does not adopt formula fertilizer, set 0
- Whether apply jointing fertilizer (D_3), the peasant household who adopts it, set 1, who does not adopt it, set 0; ld whether there is member work outside in the family, set 1 for the family who have member work outside, set 0 for the family who have not (Table 1).

Regression result and possible explanation: This study adopted least square method and applied the statistical software eviews7.0 to fit regression function, the regression results to the model are shown in Table 2.

Seeing from the computational results in the model, the equation F inspection passes inspection under the circumstance of 1% significance level, which explains the equation is outstanding. The equation adjusts R^2 to 0.33, which explains high goodness of fit to the equation. The variable selection could explain dependent variable preferably and the model is set relatively reasonable as a whole (Shu-Dong, 2010).

Table 1: Explanation of variable name definition and direction of dependent variable estimated effect

Variable name	Unit	Variable meaning	Direction
Dependent variable			
LnY	Kilo	Hectare yield (kilo) logarithm	
Input factor			
	Yuan	Chemical fertilizer input logarithm	+
LnX_1	个	Labor force input logarithm	+/-
LnX_2	Yuan	Pesticide input logarithm	+
LnX_3	Yuan	Irrigation input logarithm	+
LnX_4	Kilo	Seed input	+/-
LnX_5	Yuan	Other capital input logarithm	+
LnX_6	Hectare	Scale of wheat planting	+
LnX_7			
Influence factor			
D_1	0.1	Peasant household adopted subsidy, Yes = 1, No = 0	+
D_2	0.1	Whether test soil for formulated fertilization, yes = 1, no = 0	+
D_3	0.1	Whether apply jointing fertilizer, yes = 1, no = 0	+
D_4	0.1	Whether have member work outside, yes = 1, no = 0	+/-

Table 2: Regression result to the model

Variable	Coefficient	S.E.	t-Statistic	Prob.
C	6.196***	0.126	45.55	0.000
LnX_1	0.025**	0.001	2.550	0.011
LnX_2	0.021	0.017	1.239	0.216
LnX_3	0.087***	0.012	6.901	0.000
LnX_4	0.013***	0.004	2.930	0.004
LnX_5	0.037	0.024	1.542	0.123
LnX_6	0.050**	0.020	2.466	0.014
LnX_7	0.085***	0.013	6.685	0.000
D_1	0.074***	0.013	5.520	0.000
D_2	-0.000	0.017	-0.048	0.961
D_3	0.125***	0.015	8.489	0.000
D_4	0.018	0.016	1.144	0.253
R^2	0.346	Adjusted R^2	0.33	
F-statistic	27.37	Significance level	0.00	
DW	1.81			

*, ** and *** indicates the statistical significance level when the variation coefficient reaches to 10%, 5% and 1% respectively; S.E.: Standard error

Seeing from the input factor, four variables chemical fertilizer, pesticide, capital investment and scale of cultivated land pass inspection under the significance levels of 5, 1, 10 and 1% respectively. Seeing from the elastic coefficient, the influences to output are listed from large to small in proper order: pesticide, area, capital and chemical fertilizer. The concrete analyses are as below:

- The input of chemical fertilizer is still the key factor impacted wheat yield, which is consistent with the hypothesis. When the capital input increases 1%, the wheat yield per unit will increase 0.025%.
- The input coefficient of labor force is positive, however it has not passed through significance testing, which is consistent with the hypothesis. The substitutability of the labor force during wheat production is relatively obvious. The reduction of labor sum may not result in reduction in production, which is consistent with the fact that a large number of peasants work outside but the grain yield is ever-increasing in recent years.
- The pesticide input has prominent and positive impact to yield, which is consistent with the hypothesis and explains the importance of reinforcing prevention of insect pests, weeds.
- The elastic coefficient of irrigation input is positive, which explains the positive impact of irrigation. The reason may be caused from different plough soils and irrigation conditions, certain differences are resulted from irrigation input and effect. So reinforcing construction of water conservancy works play vital role in saving irrigation cost and enhance grain yield.
- The elastic coefficient of seeding rate is negative and not passing through the inspection, which verifies enhancing seeding rate blindly during wheat production not only increases planting cost, but also may generate negative effects to the yield.
- The capital input has prominent and positive impact to yield, which is consistent with anticipation.
- The elastic coefficient of wheat cultivated area is positive and passes through the inspection under the level of 1% significance level, which explains the wheat production exists certain scale effect (Zhuang, 2013).

Seeing from the elements of technological choice:

- The adoption of subsidy variety has positive impact to wheat product and passes through inspection under 1% significance level. This result is very ideal and comparatively consistent with the macroscopic statistical data. This also explains expediting promotion of subsidy variety is a crucial link for enhancing wheat yield.
- Coefficient of testing soil for formulated fertilization is positive, but not passes through significance testing. The possible reason is major difference still exists in soil nutrition content in a county (district) and the pertinence of formula fertilizer is not enough.
- Whether dressing and jointing fertilizer has relatively prominent effect to yield, its coefficient passed through inspection under 1% significance level, which explains increasing jointing fertilizer scientifically means a lot to wheat yield.
- In a family whether there is labor force work outside has not passed through significance testing, which explains with the large scale utilization of mechanization, the quantity of labor force is not the dominant factor which impacts grain yield.

CONCLUSION

Through the empirical analysis towards the influence to wheat yield from subsidy variety and labor mobility, this study resulted that: compared with other old and new varieties, the wheat subsidy varieties which are recommended from various regions and screened from specialists are obvious in yield-increasing effect; further expediting promotion of subsidy variety, enhancing the fraction of coverage feasibly are effective means to increase wheat yield at present; perfecting the recommendation system of subsidy variety unceasingly means a lot to boost food production capacity in our country. In the meantime, on account of agricultural machinery is in large-scale use, the labor force is not the principal factor that impacts grain yield. Speeding up the progress of urbanization is vital to increase income for peasant and safeguard national food security.

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