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Research Article

A Case Study on the Appropriate Scale of Vegetable Operation in Hebei Province

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Abstract: This study investigates the situation and efficiency of large scale model in vegetable operation with interview and DEA method. The study site is Hebei province with the second large vegetables output in China. The samples were collected among the farmers in northern, southern and central Hebei Province. The result of the survey indicate the farmer family are more suitable than agricultural companies to take part in the larger scale planting of vegetables. Moreover, the appropriate planting area for family farm to plant vegetable is 5-6 mu.

Keywords: Industrial organization, vegetable production, vegetable production efficiency

INTRODUCTION

As one of the industries of spurring agricultural economic growth, the vegetable industry occupies an important position in agricultural production in China. Hebei Province, with a rich vegetable output, has been rapidly growing since 1978 in its vegetable productivity. In 2012, the whole vegetable planting area of Hebei was 1.203 million hectares and the output was 12.03 million tons, ranking respectively seventh and second of the country. Since 2001, the vegetable output value has excelled that of crops and the vegetable industry has become an important industry to promote rural economic development and drive the increase of farmers' income. Forty percent of Hebei's labor force works in the agriculture, forestry and animal husbandry sectors, with the majority of production from these industries going to Beijing and Tianjin Hebei's main agricultural products are cereal crops including wheat, maize, millet and sorghum. Cash crops like cotton, peanut, soya bean and sesame are also produced.

In 2014, the ministry of agriculture of Chinese promulgated the (guidance on the promotion of the development of family farms), which proposed "The family farm as a new leader, which will engage in the large-scale, intensive and commercialized agriculture production". How much scale is appropriate for the family farm? To answer this question, the study base on the scale-economics theory, adopt the data envelope analysis method to analyze and efficiency of different family farm's scale.

LITERATURE REVIEW

Studies on field-scale analysis date back to the 50s and they have shown an increase in scope as well as number within the course of the years. This growth has been accompanied by an increasing sophistication of the research tools available to investigate the subject in depth and revealing new relationships.

Sen (1962) is the earliest scholar observed the "stylized fact" of the inverse relationship between farm size and yields his phenomenon from an analysis of Indian farm management data. A comprehensive account of this relationship studies are provided by Berry and Cline (1979) who found that land productivity on small farms is systematically higher than on large ones and the total factor productivities are at least comparable. However, Binswanger *et al*. (1993) have indicated that most of the empirical work on the farm size productivity relationship has been awed by methodological shortcomings and has failed to deal adequately with the complexity of issues. And then the study of Townsend *et al*. (1998) confirmed this view. The results suggested that co-operative membership can overcome the economies of scale associated with processing and marketing. The inverse relationship between farm size and both land productivity and total factor productivity is weak. Helfand and Levine (2004) found the relationship is non-linear, with efficiency first falling and then rising with size. Type of land tenure, access to institutions and markets and modern inputs are found to be important determinants of the differences in efficiency across farms. Wu (2011) found a inverted U-shaped relationship by taking example of rice in China.

It is obvious there is a big difference in the conclusion on this issue from the above literatures. The reasons maybe are the diversity and the magnitude of the crops and the unique industrial organization of each country. But measuring the efficiency of the crop planting scale should be regarded as a basic starting step.

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Table 1: Summary of input and output indicators

The input indicators	Name of the variable	The output indicator	Name of the variable
Vegetable planting area (mu)	X_1	Family incomes (Yuan)	Y
Land rents (Yuan)	X_2		
The investment on fixed assets (Yuan)	X_3		
The labor wages (Yuan)	X_4		
Fertilizer and other material input (Yuan)	X_5		

mu is a unit of area; 1 mu = 0.0667 ha

The situation of large-scale planting of vegetables in Hebei province: The farmer family is more suitable to be engaged in vegetable production. In Hebei province, there are two industry organizations in vegetables planting, one is farmer family and another is agricultural company. The farmer families always have only two members in vegetables operation and other family members are engage in non-agricultural occupation. They use their own lands and hire workers for a short period of time. The most agricultural companies turn to agriculture in recent years from original commerce. They have to rent many lands and hire workers throughout the years. With the development of economic, the worker's salary and rent of land increase rapidly in China that making high costs for the companies. Moreover, when some unexpected things happen such as bad weather, the farmers can manage their own vegetables for 24 h, but the farmer workers can't do that. At last the companies need to build road and office buildings which will reduce the utilization of lands. Due to above reasons the survey find that the most agricultural companies are defective in operating vegetables. So the study only research the efficiency of the farmer family.

MATERIALS AND METHODS

Analytical framework: Data Envelopment Analysis (DEA) is a developed efficiency evaluation method based on "relative efficiency". Farrell (1957) first raised the concept of deterministic non-parametric frontier which provides a basis theory for DEA. According to different objectives, DEA is divided into two models which are CCR (Charnes *et al*., 1978) model and BCC (Banker *et al*., 1984) model. Since then, the CCR and BCC models were widely used in empirical research.

The efficiency of Decision Making Unit (DMU) which is calculated by CCR is shown in the equation:

$$h_j^* = \max \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1$$

$$0 < \varepsilon \le u_r, y_i; i = 1,\ldots,m; r = 1,\ldots,s; j = 1,\ldots,n \quad (1)$$

where,
j = The number of DMU
h_j = The efficiency of DMU
x_{ij} = The inputs
y_{rj} = The outputs
u_r and v_i = The weights attached to each DMU

The BCC model is shown in the equation:

$$OE = TE \times SE \quad (2)$$

where,
OE = The total efficiency
TE = The pure technical efficiency
SE = The scale efficiency

Study site and the indicators system: Hebei province is located in northeastern China, surrounding Beijing. Hebei province has long history of vegetables planting, now there are 57 national key vegetable counties in it. This survey selected 5 key counties, Xushui, Yongqing, Raoyang, Qingxian and Yongnian which are located in northern, central and southern of Hebei. Because of the different kinds of vegetables have the different planting patterns and costs, tomato is selected as the object of survey. One hundred and fifty sample farmers were collected by interview and questionnaire, which use facilities such as arch shed and greenhouse in tomato planting, but have different size. The input and output indicators are listed in Table 1.

Vegetable planting area (X_1): This is the actual cultivated area in the greenhouse or arch shed, including the famers own and the leasing lands.

Land rents (X_2): They are the paid for the leased land.

Fixed asset investment (X_3): This indicator include the investments for arch shed, greenhouse and machinery what are needed in vegetable planting.

The labor wages (X_4): The labor include the household labor and employees.

Fertilizer and other material inputs ((X_5): They are costs of the use of vegetable production in the chemical fertilizer, organic fertilizer, seeds and pesticides, through the reasonable investment of these material elements, we can improve the quality of land, increase the fixed land area yield.

Family incomes (Y): It refers to monetary economic interests of farmers planting year, which is a comprehensive indicators.

RESULTS AND DISCUSSION

Respondent profile: Farmers were chosen by typical sampling method and finally 135 questionnaires were

Table 2: The basic situation of the sample farmer

Project	Group	Proportion (%)	Project	Group	Proportion (%)	Project	Group (mu)	Proportion (%)
Gender	Male	68.97	Age	20-29	2.33	Planting scale	1-2	13.98
	Female	31.03		30-39	15.12		3-4	18.28
Family income	Under ￥50000	32.27		40-49	51.16		5-6	20.43
	￥60000-100000	48.73		50-59	20.93		7-8	13.98
	￥110000-200000	10.49		Over 60	10.47		9-10	11.83
	Above￥200000	8.51	Education level	Elementary school	18.52		11-15	6.45
Vegetables planting experience	5 years	19.15		Junior school	55.56		16-20	3.23
	6-10 years	36.17		High school	19.75		21-30	8.60
	Over 10 years	44.68		University	6.17		Over 30	3.23

Table 3: DEA calculation results

Farmers planting scale (mu)	OE	TE	SE
1-2	0.953	0.987	0.965
3-4	0.825	0.952	0.867
5-6	0.850	0.805	0.936
7-8	0.632	0.778	0.814
9-10	0.605	0.689	0.807
11-15	0.378	0.510	0.760
16-20	0.577	0.780	0.783
21-30	0.514	0.790	0.668
Over 30	0.476	0.695	0.685

valid. The basic situation of the sample farmer are listed in Table 2.

The majority of the respondents (68.97%) were male and most older than 40 years (84.88%). In terms of the education level, there was a concentration at the junior school level (56.9%), while university graduates constituted 6.17% of the sample and 18.52% had completed only elementary school level education. .In 2013, Chinese families disposal incomes were 51569 Yuan (RMB) per year. A large part (67.73%) of the sample families' income were more than 50,000 Yuan. Most of the respondents (80.85%) have the experience of planting vegetable over 5 years. The vegetable planting size were grouped accordingly and the area between 1-2 mu is 13.98%, 5-6 mu is 20.43%, the production scale above 10 mu only account for 21.53%. This shows that the production scale in Hebei province are mainly single family, scattered planting. In the survey, seen from the input, different scale farmers input number of family members of vegetable production is basically the same, mostly are 2 people full-time engaged in vegetable production, the bigger the production is, farmers achieve scaled production through leasing more land, more investment in greenhouse, more workers.

The efficiencies of different scales: The study will use each vegetable production and farmers as a decision making unit in this study, using MAXDEA6.2 software, will respectively calculate each vegetable farmers comprehensive efficiency, technical efficiency and scale efficiency, with the input oriented research methods for DEA analysis, Then according to the farmers' grouping production scale, measure relative efficiency for each group. The concrete results as shown in Table 3.

CONCLUSION

Five to six mu is the proper scale: From the results of comprehensive efficiency and scale efficiency, it is can be conducted that the better vegetable planting scale is 1-2 and 5-6 Mu. Three to four mu group comprehensive efficiency and scale efficiency is between both of them and is in the increasing stage. When the scale of production is more than 6 mu, the scale efficiency will begin to decline. The reason is that the 1-2 of the farmers is mainly through the intensive and meticulous farming, get the maximum output with minimum input. Another group, planting scale in the 5-6 mu, are mainly based on their own land, through a small rent land, expand the scale of planting vegetables. And with economic benefit maximization as the goal, through rational allocation of various fixed assets, labor and other production data, to improve production efficiency.

Technology efficiency is lower than scale efficiency: This phenomenon reflect that the enlarge of vegetable production scale is through extensive material resources, the investment labor resources scale and the supporting role of science, but the technology do not much work. In recent years, a large number of new varieties, new cultivation technique are promoted in Hebei province, but the production technology of vegetable mechanization has no apparent breakthrough. As seen from Table 3, with the expansion of production scale, the decline rate of technology efficiency is faster than scale efficiency rate of descent.

The whole efficiency of vegetable production in Hebei province is low: From the technical efficiency, we can see that the technical efficiency of 1-2 mu group is the highest, which is 0.987. The comprehensive efficiency, technical efficiency and scale efficiency in each group has not reached the "1" efficiency. The rest of the technical efficiency of each division are descending.

In recent years, the development of vegetable industry develops fast, vegetable planting scale, yield are in the forefront of the country. But from the micro subject of production, vegetable production scale level is not high in Hebei province, the production efficiency is low. During the investigation, we find the reason

restricting the efficiency of vegetable production are: lacking of practical vegetable mechanization production equipment, labor shortage, continued rise of labor costs, centralization, industrial organization. In the future, farmers should appropriately expand the planting scale, in order to gain the maximum economic benefit. The government should cultivate the family whose main body, make clear of vegetables moderate scale management, play its demonstration and guidance role.

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