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Study on Intrinsic Factors Affecting Production Technology of Low Carbon Agriculture and Forestry Plants

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Abstract. The management of low-carbon agriculture and forestry plant farms is an important path to promote the development of agricultural industry. This study used binary logistic regression method to construct a logistic regression model of low-carbon agriculture and forestry plant production status. The various conditions of low-carbon agroforestry production were analysed. The various internal factors affecting the evaluation of the production status of low-carbon agroforestry plants and the farm production as well as production status were discussed and comprehensively evaluated. Six main influencing factors were summarized and analysed, which were seedling quality, seed market supervision, fruit and vegetable standardization, fruit and vegetable market supervision, fruit and vegetable market infrastructure, post-harvest treatment of fruits and vegetables, and the promotion of low carbon farmland and plant production.

1. Introduction

The development of modern agriculture requires that the current agricultural production relations must be improved to meet the needs of productivity changes and market economy. It is imperative to do research on the scale of agricultural land management and the realization of commercialization. China has promoted the process of agricultural modernization through "endogenous" growth factors such as natural capital, capital, technology, and talents, and successively introduced relevant policies and regulations to gradually support the scale, intensification, and commercial production of agriculture. The formation and development of low-carbon farms are closely related to the corresponding institutional environment, supporting policies, and social service systems. With the improvement of the agricultural system and the deepening of reforms, as a micro-economic organization of modern agriculture, low-carbon farms will surely become an indispensable business form and also an important carrier of China's modern agricultural industry.

Most of the overseas researchers focused on analysis of the factors affecting the scale of low-carbon farms. These factors can be divided into two categories: internal and external. Snider and Langemeier[1] believed that agricultural financial performance had a positive impact on farm size. Farms with higher financial performance and scale expansion were more competitive in the market; while farms with lower financial performance would shrink in size; Kimhi[2] suggested that the process of expanding the scale of the farm itself was irregular, but when scientific and technological factors were introduced, the advanced level of science and technology would become a crucial determinant of expanding the scale of the farm, but at a lower level. Carbon farms had different degrees of impact on their scale expansion during different growth periods; Eastwood et al.[3] suggested that farm soil grades were inversely proportional to farm size. The lower the land grade was, the more farm scale would be; Viaggi et al.[4] suggested that land resources were the most critical production factors in low-carbon farm development, while land transfer systems redistributed agricultural production factors. The land reform policy was a key factor affecting the size of the farm.

Chinese researchers focused more on the formation and growth of low-carbon farms, technical efficiency, and institutional environment for low-carbon farm research. He and Xiong[5] believed that the formation and development of low-carbon farms was to inherit and improve the agricultural household operating system, and to build a multi-faceted modern agricultural social service system to ensure the sustainable and healthy development of low-carbon farms in China. Accelerating the reform of the agricultural industrial system, the authorities increased the intensity of support, and promoted the integration of environmental and institutional arrangements for low-carbon farm development. It was also believed that the development of family farming needed to effectively consider local labor situation, original ecological conditions, cultivation, and breeding tradition, while ensuring food production and agricultural product safety, and clarifying the orientation of moderate scale, intensive production and commercial operation[6].

In summary, the empirical exploration and research on the production status of household farms and their interference factors are still not sufficient. This article used binary logistic regression method to establish a logistic regression model to analyse the influence degree of low carbon agroforestry production status, so that the impact of each influencing factor on the production status of the farm can be easier to understand. The results of this study would make corresponding improvements and appropriate adjustments to the farm.

2. Measurement models and data sources

The evaluation of the production status of low-carbon agriculture and forestry plant production technology is affected by multiple factors. This study summarized the influencing factors into the seedling quality and species on the market, seed and seedling market supervision, fruit and vegetable standardization, fruit and vegetable market supervision, fruit and vegetable market infrastructure, pesticide management for fruit and vegetable cultivation, post-harvest treatment of fruits and vegetables, processing capacity of fruits and vegetables, average planting scale, etc.

（1）Measurement model

This study verified the above research hypotheses from two levels: The first level was the factors affecting the production status of low-carbon agroforestry plants, and the second level was how these factors affected the production status of low-carbon agroforestry plants. Based on the above research ideas, two measurement models were used in this study: the binary selection model was adopted in the first level, and the binary selection model and counting model were the most commonly used micro-metering models in the second level. In order to ensure the robustness of the model, in the binary selection model regression, this study used both the robust standard error for Logit estimation and Probit estimation. While in the counting model, this study used the robust criteria for Poisson regression and negative binomial regression, and used zero-expansion Poisson regression and zero-expansion negative binomial regression, so that the appropriate regression method could be selected while verifying the estimation results.

（2）the source of data

This article was based on the research data of the innovation team, the research report of the relevant departments of the province, and the sample data of the “National Crop Cost and Income Data Summary” compiled by the National Development and Reform Commission Value Division. The situation of planting vegetables and fruits in Shandong province was selected as the object of investigation. According to the qualitative and quantitative analysis of the administrative divisions of prefecture-level cities, the data in the sample structure were obviously and incompletely excluded. The retained data included data from vegetable test stations in 16 cities other than Jining and fruit test stations in 13 cities except Texas, Laiwu, Rizhao and Dongying.

3. Empirical analysis

In this study, the binary logistic regression method was used to test the production status of low-carbon agroforestry plants and its influencing factors. The simplicity of this paper was that it could effectively avoid all kinds of difficult and complicated assumptions necessary in the linear discriminating process, and eliminate relevant Premise assumptions for independent variables. The Logistic regression model is a probability-oriented model. Logistic regression is a series of independent variables to estimate the probability of the dependent variable. In the application, there is often a case where the response change is a discrete change. In the logistic regression model, the dependent variable Y generally has two values. 0 and 1 are indicated.

Based on the research hypothesis, “production status evaluation” was considered as the dependent variable y, and “influencing factor of production status evaluation” was set as the automatic change quantity. The detailed variable definition and assignment are shown in Table 1. In this study, the evaluation of the market economy was divided into two categories: “good” and “poor”. The dependent variable of the model was the standard dichotomous variable. Therefore, the binary logistic regression was used to construct the evaluation model of low-carbon farm market operation. The probability of “good” market evaluation effect (y = 1) was set to P, and the probability of “poor” market evaluation effect (y = 0) was (1-P). Then, the ratio (ie, the ratio of the probability of good probability to the difference) was $\Omega=P/(1-P)$, and Ω was positively related to P. Since Ω had a value range of 0-+∞, $\ln\Omega=\ln\{P/(1-P)\}$.

Table 1. Description of model variables

variable	Variable code	Variable definition and assignment	average value	variance
Dependent variable				
Market management evaluation	Y	Good = "1", difference = "0"		
Independent variable				
Seedling quality on the market	X1	High = "1", medium = "2", low = "3"	1.5	0.25
Seed market supervision	X2	In place = "1", less than = "2", absence = "3"	1.75	0.6875
Degree of standardization of fruits and vegetables	X3	High = "1", medium = "2", low = "3"	1.975	0.3086
Fruit and vegetable market supervision	X4	In place = "1", less than = "2", absence = "3"	1.25	0.1875
Fruit and vegetable market infrastructure	X5	Perfect = "1", imperfect = "2", very imperfect = "3"	1.5625	0.3711
Fruit and vegetable planting pesticide management	X6	Valid = "1", more effective = "2", confusion = "3"	1.9375	0.4336
Postharvest treatment of fruits and vegetables	X7	Timely and effective = "1", more timely and effective = "2", insufficient = "3", serious shortage = "4"	1.875	0.4844
Fruit and vegetable processing capacity	X8	Strong = "1", stronger = "2", insufficient = "3", severely insufficient = "4"	2.6875	0.3398

Average planting size per household (unit: mu/household)	X9	actual data	3.9646	1.1937
The proportion of growers in each orchard with an area below 5 mu	X10	actual data	87.4208	97.537
The proportion of farmer households with an area of 5-15 mu per orchard	X11	actual data	8.3923	54.6099
The proportion of each household orchard with an area of more than 15 mu accounts for the proportion of growers	X12	actual data	4.1869	10.5468

Note: The average planting scale per household (unit: mu/household), the proportion of each household orchard with an area of 10 mu or less, 10-15 mu, and 15 mu or more accounted for the proportion of growers (unit: %)

In Logistic regression analysis, lnΩ was usually called Logit P, ie Logit P=In{P/(I-P)}. After Logit transformation, the model of the dependent variable and the dependent variable was constructed by using the model of ordinary linear regression, namely the logistic regression model:

$$\text{LogitP}=\beta_0+\beta_1\chi_1+\cdots+\beta_i\chi_i \qquad (1)$$

Where χ_i represents the influencing factors of production status evaluation; β_i is the regression coefficient of influencing factors; β_0 is a constant term; i=12.

Therefore:

$$\ln\Omega=\text{LogitP}=\beta_0+\beta_1\chi_1+\cdots+\beta_i\chi_i \qquad (2)$$

then:

$$\Omega=\exp(\beta_0+\beta_1\chi_1+\cdots+\beta_i\chi_i) \qquad (3)$$

When other independent variables were constant and only one unit changed, Ω*=exp($\beta_0+\beta_1\chi_1+\cdots+\beta_i\chi_i$), then Ω*/Ω=exp(β_1). Generally, when other independent variables were not changed, χ_i each increment of one unit would result in the ratio of exp(β_i) increased by Ω, that was, the probability P of the evaluation of the production condition increased, and the increase factor was positively correlated with exp(β_i); and when the regression coefficient became negative, the ratio of Ω decreased, and P decreased.

The data of each city test station was aggregated and processed, and the proportion of the variables assigned to the factors affecting the evaluation of the production status of vegetables and fruits could be obtained, as shown in Table 2.

Table 2. The proportion of variable assignments influencing factors of production status evaluation

variable	Variety	Variable assignment 1	2	3	4
Seedling quality on	vegetables	50%	50%		
the market	fruit		92.3%	7.69%	
Seed market	vegetables	50%	25%	25%	
supervision	fruit		69.23%	30.77	
Degree of	vegetables	12.55%	68.75%	18.75%	
standardization of	fruit	15.38%	61.54%	23.08%	

fruits and vegetables					
Fruit and vegetable market supervision	vegetables	75%	25%		
	fruit	30.77%	46.15%	23.08%	
Fruit and vegetable market infrastructure	vegetables	50%	43.75%	6.25%	
	fruit	23.08%	61.53%	15.38%	
Fruit and vegetable planting pesticide management	vegetables	25%	56.25%	18.75%	
	fruit	23.08%	61.53%	15.38%	
Postharvest treatment of fruits and vegetables	vegetables	31.25%	50%	18.75%	
	fruit		53.85%	46.15%	
Fruit and vegetable processing capacity	vegetables		37.5%	56.25%	6.25%
	fruit		30.77%	53.85%	15.38%

In this study, SPSS18.0 statistical software was used to make the relevant data unified treatment, then Logistic regression was used to solve it, the step forward regression method was used to select the variables, the obvious inspection was applied and stepped into the Logistic stepwise regression model, the model prediction was correct. The rate was 97.5 %. The overall effect of the mode operation and model parameters were listed in Table 3.

According to the verification results of the model population, the -2Loglikelihood value was 20.218, which was small, indicating that the model had a relatively high level of significance. At the same time, the Cox & Snell R Square value was 0.432, greater than 0.300, and the Nagelkerke R Square value was 0.753, greater than 0.500. It showed that the model had a good goodness of fit. According to the regression results of the model, the explanatory variables listed in the model had positive effects, which were the same as the previous assumptions, and the degree of influence of each explanatory variable on the model had the following order: the seedling quality in the market (4.363)> the degree of standardization of fruits and vegetables (3.565) > Postharvest treatment of fruits and vegetables (3.011)> Regulation of fruit and vegetable market (2.546)> Seed market regulation (2.375)> Fruit and vegetable market infrastructure (2.272).

Table 3. Model estimation results

Independent variable	Variable code	Regression coefficients	WALD value	Significant
Seedling quality on the market	X1	4.363	4.697	0.025
Seed market supervision	X2	2.375	6.268	0.024
Degree of standardization of fruits and vegetables	X3	3.565	4.207	0.036
Fruit and vegetable market supervision	X4	2.546	3.639	0.045
Fruit and vegetable market infrastructure	X5	2.272	3.154	0.035
Postharvest treatment of fruits and vegetables	X7	3.011	5.323	0.021
-2Loglikelihood				20.218
Cox & Snell R Square				0.432
Nagelkerke R Square				0.753

4. Conclusion

According to the results of model verification, it can be concluded from the evaluation of production status that the influencing factors of endogenous factors affecting the production of low-carbon agroforestry plants were as follows:

（1）The quality of seedlings on the market. Under the 10% significance level, “seed quality” had a significant positive effect on the evaluation of low carbon agriculture and forestry plant production status.

（2）Seed and seedling market supervision. The regression results showed that under the 10% significance level, the "seed market surveillance" variable was significantly positively correlated with the production status evaluation.

（3）The degree of standardization of fruits and vegetables. As shown in Table 1, the average degree of standardization of fruits and vegetables was 1.975, and the variance was 0.3398. Under the 5% significance level, the degree of standardization of fruits and vegetables had a significant positive effect on production status.

（4）Fruit and vegetable market supervision. As shown in Table 1, the fruit and vegetable market supervision average was 1.25, the variance was 0.1875. Under the 5% significant standard, the fruit and vegetable market supervision had a significant positive impact on the production situation.

（5）Fruit and vegetable market infrastructure. The regression results showed that under the 10% significance level, the "fruit and vegetable market infrastructure" variable was significantly positively correlated with the production status evaluation.

（6）Post-harvest treatment of fruits and vegetables. The regression results showed that under the 10% significance level, the timely treatment of fruits and vegetables had a significant positive impact on the production status.

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