Application of DEA method in the evaluation of agriculture economic efficiency

Liu ke-fei

School of Economics and Trade, Henan University of Technology, Zhengzhou, China
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ABSTRACT

This article aims to build a set of exploratory and strong operability evaluation index system, the collection of 3 cities in zhengzhou to use construction land on the basis of economic efficiency index of related data, the selection of the zhengzhou region as the object of empirical study, using data envelopment analysis (DEA) method), and C squared R dual model, with the help of a DEAP Version 2.1 software, the construction land use of 3 cities in zhengzhou economic efficiency from the vertical and horizontal two dimensions are compared, and analysis and quantitatively reflect the Zhengzhou municipal construction land use level of economic efficiency, so as to provide reference for policymakers to promote urban land use transforming to intensive way is more extensive.
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INTRODUCTION

Land resources are the foundation of human survival and development and the carrier. To realize the sustainable use of land resources must improve the existing land use efficiency. At present, the construction of a conservation-minded society is an important national policy in China, land resources, as a kind of important resources and assets, need more intensive conservation. Urban construction land is the carrier of urban and regional economic development, economic development and urban construction land use is reasonable is an important basis, to a large extent depends on the efficiency of utilization of the urban construction land. Therefore, how to establish a set of complete index system to evaluate the overall economic efficiency of land utilization, and improve the use efficiency of construction land is an important research topic.

Developing recycle economy is the only way to realize agricultural sustainable development. As a basic link in the circulation system of the national economy, agricultural circular economy is to combine the concept of circular economy and agricultural production systems, infiltration in the process of agricultural production and the product life cycle theory of circular economy, with a view to agricultural productivity as well as reducing the amount of emissions and waste of resources, in order to achieve its economic and ecological benefit of "win-win" development. There are currently a large number of scholars to study the agricultural circular economy. Domestic research focuses on theoretical aspects, such as the connotation, principle and development of agricultural circular economy mode. Designing for quantitative analysis of agriculture circular economy is less, it mostly uses grey relational degree analysis and analytic hierarchy process and fuzzy comprehensive evaluation method to evaluate the overall development of regional agricultural recycling economy, and then the quantitative estimation of efficiency of agricultural recycling economy is rare. As agricultural production is a complex system involving multiple input, multiple output, only quantitative determination for the output efficiency of agricultural circular economy development can completely figure out whether developing agricultural circular economy to achieve the effective and rational use of resources, whether truly implement circular economy "3R" principle.

1 Research method
Zhengzhou province, is a big agricultural province of China, food production increases gradually, but extensive form of agriculture makes resource constraints evident, environmental pollution have further worsened. Its outstanding

performance is poor in water resources and land resources per capita in Zhengzhou province. According to statistics, Zhengzhou Province uses 0. 7% water of China to raise 5% of the country's population. The province's per capita possession of water resources is $307m^3$, just as 1/7 of the national average. Meanwhile, per capita arable land is less in Zhengzhou province. In late 2008, in Zhengzhou province, per capita arable land is only 0. 056 $3hm^2$, national per capita area of cultivated land is 0. $09hm^2$, it is lower than the national average level. Thus, resource shortage has become the primary problem of Zhengzhou agriculture development. Meanwhile, agricultural pollution in Zhengzhou province is also serious: on the one hand from the agricultural production process, with the increased use of fertilizer, pesticide and plastic film mulching,   it causes soil and water pollution, on the other hand it comes from agricultural environmental pollution caused by the improper discharge of waste. For example, improper use of chemical fertilizers can alter the soil structure, resulting in organic matter of nitrogen, phosphorus, potassium reducing and soil fertility decline, discharge of livestock manure and straw-burning cause environment pollution. Therefore, Zhengzhou province urgently needs to change the traditional, extensive mode of economic growth, developing circular agricultural economy, adjusting the agricultural structure, to achieve economic development and resource conservation, environmental protection, coordinated operation.

This paper uses data envelopment analysis method for calculating efficiency of agricultural circular economy development in Zhengzhou province. Data envelopment analysis (DEA) is a non-parametric method of the measurement of inputs and multiple indicator output relative efficiency. by input and output indicators of original samples data it can evaluate and   judge   validation of decision making unit (DMU), its aim is to reflect that the DMU can reach "with minimal investment, maximum benefit" decision results. The basic model of DEA is the C^2R model. C^2R is used for evaluation of decision making units at the same time as the "technical efficiency" and "scale efficiency" typical model. According to the result of calculation, when theta is 1, it calls the DMU as DEA efficient, when theta < 1, it calls DMU as non-DEA effective. "Projection" for non DEA efficient decision making units can also measure input redundancy and output value, and make improvement. Because agricultural production system involves many input and output indicators and some are overlapped, the dimensions of input and output indicators are also obvious difference. Therefore, the evaluation of the efficiency of the system of agricultural production must take into account a variety of input and output elements, and does not take into account the dimension difference of each index. Since DEA is the most effective method calculating he multiple input and output without considering dimensions, this paper uses DEA method to quantitatively measure the efficiency of the development of agricultural circular economy in Zhengzhou province, based on the result to obtain the adjustment in the invalid region.

2 The selection of indicators and data sources

Application of DEA analysis on agricultural eco-efficiency scientifically evaluated, depends in a large extent on the input and output parameters whether are reasonable to be chosen. Because resources efficiency and recycling is as the core of the agricultural circular economy, from saving agricultural resources, protecting the ecological environment and improving the economic benefit, at the same time of improving the efficiency of agricultural production, we should make decrement of the recycling of resources and environmental protection for the purpose.

Table 1 Evaluation index system of agricultural circular economy efficiency In Zhengzhou

Element layer	Index layer	
	3R index	Specific index
Input index	Resourse index	Total crop sown area X1/khm^2
		The agricultural workers X2
	Environment index	Agricultural fertilizer surueyed
Output index	Economic index	Grain output

Therefore, the evaluation index should be able to reflect the principle of circular economy and characteristics. Because the input and output variables involved in the production of agricultural circular economy are more, the DEA model has quantity requirements of input and output variables, namely the number of decision making units should be close to or more than 2 times of input variable and output variable, so the number of input and output variables should not be too much, try to reflect the characteristics of the agricultural circular economy and the typical variable. In terms of input variables, this article selects the main crop planting area to represent the agricultural inputs of land, agricultural professionals to represent the human capital investment, the two indicators reflect the situation of the resources in agricultural circular economy; Appropriate amount of fertilizer has a big impact on agricultural environmental, so choosing appropriate amount of agricultural fertilizer indicates environmental impact of agricultural circular economy. In terms of output variables, many scholars have adopted an ecological-economic output value, per capita annual net income of rural households and food production. Because

the animal husbandry fishery output and per capita annual net income of rural households, the two indexes are related to the price, and food production truly embodies results of agricultural production of a region, this paper only selects an output index of grain yield, as shown in Table 1.

From a purely technical and scale efficiency, DEA has 4 effective pure technical efficiency, and scale efficiencies are also effective, and no input redundancy and lack of output. Therefore, this may be considered agricultural circulation economy and output efficiency of the 4 cities is the best, agricultural circular economy maintains a good momentum of development. Agricultural resources and environmental elements should have appropriate percentage, agricultural technology level, management level and scale of operation should be on speaking terms agricultural circular economy development is in the optimal state. Pure technical efficiency and scale efficiency value of non DEA effective seven cities is different. Among them, pure technical efficiency is effective in the four cities of Chengde, Zhang Jiakou, Qin Huangdao and Langfang, but the scale efficiency is invalid. Invalid reason of comprehensive efficiency of these four cities mainly lies in the scale, the pure technical efficiency positive impact on the overall efficiency is offset by low scale efficiency. And from the perspective of the type of return to scale, the four cities are in a state of increasing return to scale, so the invalid agricultural circular economy of the four cities mainly because of the small size in agricultural resources. If we can expand agricultural inputs, the output will increase a larger proportion, agricultural economy of scale. But along with the increase of the investment it should be guided by the "3 r" principle, to ensure the sustainable development of agriculture. The pure technical efficiency and scale efficiency of three cities of Tangshan, Xingtai and Handan are less than 1, which indicates that the pure technical level and scale configuration of the three cities are not the best. All kinds of factors of production in agricultural are belong to the edge non efficiency collection, agricultural technology level and management level does not adapt its business scale, agricultural production and operation performance has not been fully played, agricultural circular economy of agricultural circular economy has low efficiency.

3 Proposal to escalation of Zhengzhou agricultural circular economy efficiency

According to the result of empirical analysis, the efficiency of agricultural circular economy in different cities in Zhengzhou province is obvious regional difference, so making agriculture circulation economy development policy should not impose uniformity in all cases, and should adjust measures to local conditions. In measuring the efficiency of agricultural circular economy in Zhengzhou province, despite five cities belong to the DEA effective, but it is relatively effective, and comparing with agricultural resources use efficiency of the other seven cities, it is higher, but not absolutely effective. Relative to the goal of agricultural circular economy development, a lot of problems still exist in these cities. In these regions, therefore, maintaining high efficiency of agricultural circular economy at the same time should also continue to increase the supply of agricultural innovation achievements and the continuous improvement of food production through the improvement of quality of the labor force and the investment of agricultural science and technology. In the cities that agricultural circular economy is invalid, the invalid of four cities is caused by the scale, and the four cities are increasing return to scale, that is to say, for the four cities increase of agricultural investment will significantly improve the level of agricultural output. Therefore, agricultural circular economy of the four cities should be given priority in order to improve the efficiency of the scale efficiency. Small and scattered farmers scale is currently one of the main bottlenecks of restricting agricultural scale efficiency. In the area of low scale efficiency it can land moderate scale management in order to improve the efficiency of scale: firstly, the establishment of effective circulation mechanism of land resource can form land scale operation mechanism of concentration. Second, through cultivating the core farmers and supporting policies, it can strengthen the implementation of the agricultural scale management main body, as the core of peasant household continually expand the scale of production and operation, forming a family farm. Third, developing agricultural specialized cooperative organization is also an inevitable choice for the current expand the scale of agricultural production. In the cities of agricultural circular economy invalid, there are three cities whose pure technical efficiency and scale efficiency are invalid. Therefore, improving the efficiency of agricultural circular economy of the three cities should consider two aspects: one is the adjustment and improvement of the pure technical efficiency, the other is adjustment and improvement of scale efficiency. The relaxation existed in the city of Zhengzhou province is as shown in Table 2.

Table 2 shows that agriculture fertilizer, crop acreage and agricultural practitioners of the Tangshan, Xingtai and Handan, these 3 variables are in excess, so these 3 cities inputs should be reduced accordingly. Among them, the greatest potential is to adjust the appropriate amount of fertilizer in agriculture, the second is the agriculture workers. The cause of this phenomenon is that in Zhengzhou province chemical fertilizer input intensity is too large. Large amounts of chemical fertilizer wastes make utilization of fertilizers less efficient, which has a negative impact on the agricultural economic efficiency and chemical fertilizer application leads to the pollution of the environment which is not conducive to development of agricultural circular economy. Therefore it should reduce the amount of fertilizer applied and increase fertilizer use efficiency. Too many agricultural workers are mainly due to a lot of surplus labor in rural areas, so government should optimize the industrial structure, develop labor-intensive industries and expand

township enterprises to promote the transfer of rural surplus labor.

Table 2 Acount of slack of invested loosely city in Zhengzhou

Cities	Agricultural fertilizer surueyed	Total crop sown area $\times 1/khm^2$	Agricultural workers
Tangshan	92 625.972	111.509	145 570.509
Xingtai	23 614.471	70.123	91 721.840
Handan	52 593.124	122.035	173 205.013

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