Empirical Analysis of Agricultural Cultural Resources Value Evaluation under DEA Model

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Abstract: Agricultural culture is a productive activity about education and management. It aims at high efficiency and high quality, uses technology as its means, and takes nature as its carrier. Agricultural cultural resources are the product of the rapid development of modern economy. It promotes the development of the national economy and profoundly affects people's production and life. DEA model, also known as data envelope analysis method, is an algorithm that uses multiple data decision units for input and output training to obtain the final model. This article explains the concept and basic characteristics of agricultural culture. Through questionnaire surveys and expert interviews, we collected development data, screened human, material, and financial data, and calculated information on economic and social resources. On this basis, this paper establishes the evaluation index of agricultural culture based on DEA model. Then, through empirical analysis from a specific perspective, it can be concluded that increasing human, material and financial input can achieve economic and social benefits. Generally speaking, cultural investment can promote the development of the industry. The research results of this paper laid a theoretical foundation for the development of agricultural culture, and put forward a development model focusing on technology development, improving investment efficiency, and investing in material resources.

1 Introduction

At present, various regions are actively developing various forms of creative agriculture. Agriculture has changed from a single supply mode to an important means to improve the urban and rural environment and develop tourism and cultural industries [Jiang, Tang, Gu et al. (2020)]. It covers modern and rural areas and is representative of food, entertainment and other activities. New agricultural products represented by processing and waste utilization have strong vitality and have become a new bright spot in urban

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modern agriculture. In the development and utilization of agricultural projects, carefully sculpted conditional farming and characteristic farming have cultural connotation and ecological value, and provide a resting place for the citizens. At present, there are several major problems in the use and development of creative agriculture in my country. These problems have led to the development lag and uneven development in different regions [Luo, Qin, Xiang et al. (2020)].

1.1 The understanding of agricultural cultural resources is flawed

On the one hand, people have misunderstood agricultural culture itself, thinking that it represents backward culture [Fang, Wen, Xu et al. (2019)]. This concept is a social cognitive problem that limits the development of creative agriculture [Farahmand and Adrow (2015)]. On the other hand, the social understanding derived from the above has caused another misunderstanding that the culture deviates from capital [Fang, Ding, Zhang et al. (2019)]. In the process of creative development, the excessive pursuit of adapting to modern society rarely reflects its essence, and cultural resources have not been reflected or developed [Fang, Zhang, Ding et al. (2019)]. It is often seen that many farmhouses or ecological parks have abandoned the true natural scenery during the construction process and have become modern playgrounds or parks. In terms of composition, entertainment facilities are essential [Fang, Sheng and Wen (2018)]. Many parks gradually abandoned the original elements in the process of attracting tourists [Gueorguiev and Malesky (2012)].

1.2 Defects in the development of agricultural cultural resources

The transformation of traditional agriculture is still on the surface, and it has not yet been discussed in depth [Indera, Fukami and Ahmad (2015)]. Agricultural culture includes not only material culture, such as cultural relics, construction facilities, advanced sightseeing parks, natural scenery and tourist attractions. [Li, Zheng Heian et al. (2017)]. It should also include the spirit of the times, production customs, traditional crafts, literature and art [Nitzken, Beache and Ismail (2017)]. There are many forms and resources of agricultural culture, and creative thinking can be better integrated into architecture [Schwerter, Lietzmann and Schad (2017)]. The reality is often based on misunderstanding of positioning and purpose. When many developers carry out transformation, the transformation only stays on the surface, even exceeds the profit demand, and gradually becomes utilitarian and simple. For example, many farms are scrambling to carry out creative picking activities. Visitors can experience the fruit and vegetable picking and production process in the park. This is a utilitarian development of the planting process, and it also reflects the creative agriculture of practitioners [Pelagatti and Matteo (2007)].

1.3 Defects in the development of agricultural cultural resources

The transformation of traditional agriculture is still on the surface and has not yet been deeply involved in the material culture [Pan, Sun and Zheng (2017)]. For example, cultural relics, building facilities and advanced models, technology demonstration areas, ecological parks, tourist attractions, folk experiences [Portman, Michelle and Jin (2019)].

Leisure functions and natural scenery, original crafts and literature and art appear in more forms, you can use creative thinking to better set up [Ribeiro, Janssen and De (2017)]. These farms will even expand the planting area, so that the original developed farmland will not be directly converted into a large piece of land, and the fruit tree production base also deviates from the definition of "creative farmland" [Sun, Li and Lowe (2017)]. The sense of integration in production, ecology, life, cultural resources, etc. is lost as leisure [Schwerter, Lietzmann and Schad (2017)].

1.4 Defects of the combination of agricultural culture and modern civilization

In traditional Chinese consciousness, agricultural culture represents a relatively backward culture. In daily life, many people distinguish agricultural culture from modern culture represented by urban culture, which seems to have become synonymous with backward culture [Zeng, Dai, Li et al. (2019)]. Considering this situation, many people treat cereals as farming and harvesting. Agriculture is the least productive industry. People think it is alienating rural areas and farmers [Usman and Aliyu (2010)]. Creative agriculture reflects the relationship between agricultural culture and modern civilization, and meets the living and leisure needs of urban residents. The hustle and bustle of city streets makes people with great pressure of life very eager for the tranquility and comfort of the idyllic scenery, as well as self-sufficient leisure and entertainment. Therefore, while promoting leisure and personality traits, it does not lose affinity. However, due to the opposite of supply and the city, people may feel uncomfortable. When seeking a friendly transition between urban and rural areas, people will feel "home away from home". Even the "farm" has not disappeared, but a warm home should be the goal of building a creative park. However, many farms or farmhouses cannot fully meet people's actual needs. Agricultural culture is out of touch with modern civilization.

2 DEA model

2.1 DEA research process

Since 1957, Farrel [Farrel (2014)] first proposed the use of production boundaries to measure technical efficiency and price efficiency. Since then, the academic research on DEA has been continuously deepened, the field of vision has continued to expand, and the data envelope model has been constantly enriched and improved. The DEA model uses an envelope to replace the production function, and uses its own advantages in technology and scale to implement the methods and methods of evaluation research [Wang, Wei and Chen (2017)]. This method can introduce indicators that cannot be introduced in the traditional sense, and achieve relative effectiveness evaluation. Generally, it has an absolute advantage in dealing with the evaluation of indicators. It can ignore the index size and automatically obtain limited weights [Xin, Lv, Zheng et al. (2017)]. The application and promotion of DEA model has become an important evaluation index in the field of operations research and management, and it has also laid a theoretical foundation for practical application. The process of the DEA model is shown in Fig. 1.
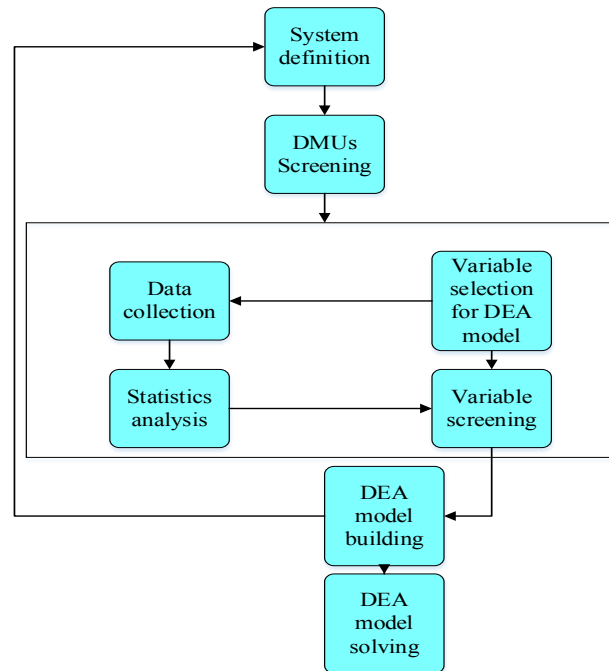
Figure 1: The process of DEA model

2.2 Overview of the DEA method

The Data Envelopment (DEA) method was first proposed in 1978 and can be used to compare multiple input and multiple output decision units of the same type (relative efficiency of decision units, DMU) [Yan, Bin and Zheng (2017)]. The basic idea is to treat each evaluation object as a decision-making unit (DMU). Through a comprehensive analysis of the input-output ratio of each DMU, the weight of each DMU input-output indicator is used as a variable to determine the effective production frontier [Zheng and Zheng (2017)]. According to the distance between each DMU and the effective production boundary, determine whether each DMU has reached the DEA efficiency. At the same time, the reason for the low efficiency of DEA evaluation objects was analyzed by projection method, and quantitative improvement goals were proposed. The basic DEA model is shown in Fig. 1. DEA is a CCR model and a BCC model [Zheng, Jeong and Huang (2017)].

(1) DEA-CCR model

In 1978, it was proposed to use the CCR model to measure multiple inputs and multiple outputs under fixed-scale returns. The efficiency measurement problem at the time of output can also be used to find the production boundary of the decision unit through the linear programming technique and calculate the relative efficiency value. The calculated efficiency value is called the comprehensive technical efficiency (Technical Efficiency).

The CCR mode indicates that the DMU is regarded as a valid unit only when the efficiency value is 1, otherwise it is invalid compared with other DMU rate units [Zhang, Jin, sun et al. (2018)].

(2) DEA-BCC model

In actual production, it is impossible to require every decision-making unit to be in a fixed wage state. Therefore, in 1984, someone proposed a BCC model with variable scale compensation to explore pure technical efficiency and pure problems of scale efficiency. This technology is also called variable scale compensation model-VRS model, in which the comprehensive technical efficiency is equal to the product of pure technical efficiency and scale efficiency [Liu, Yang, Lv et al. (2019)]. The DEA method has advantages in handling multiple inputs and multiple outputs, but the number of inputs and outputs it can process is not unlimited. For other input or output items, the new input-output ratio will reduce the discriminative ability of the DEA model. Therefore, according to the rule of thumb, when the number of decision-making units is greater than twice the number of input-output projects, the reliability and interpretability of the analysis results can be achieved [Li, Li, Zhang et al. (2019)]. The DEA mode is shown in Fig. 2.
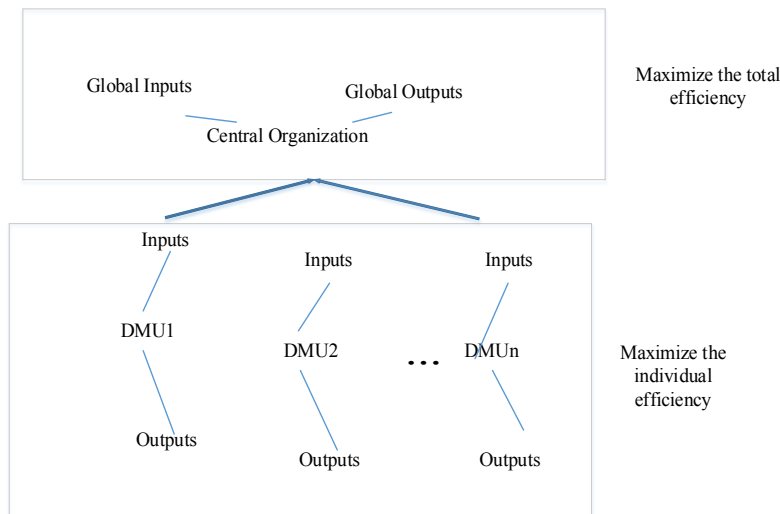
Figure 2: DEA model

2.3 Evaluation index of agricultural culture based on DEA principle

Leisure agriculture has the characteristics of rich connotation, sound system and high level. Scientific selection based on DEA evaluation indicators should follow the principles of independence, comprehensiveness, directionality and testability.

(1) Independence. In order to ensure the independence of the selected indicators, each indicator has its own different characteristics and expresses different aspects of the goal.

(2) Comprehensiveness. The establishment of the index can reflect the essence of the evaluation object as a basic feature, so it is necessary to reduce certain aspects of the evaluation object that can be specified.

(3) Direction. The selected indicators can reflect the overall future development trend and direction, and have important guiding significance for development.

(4) Testability. The data of each indicator needs to be easily collected to ensure the

measurability and authenticity of the evaluation results, and to minimize the influence of human factors.

2.4 DEA analysis mode selection

DEA has multiple models. Choosing the right scientific model is crucial. When choosing a model, it should be based on four criteria: analysis purpose, data type, characteristics of input-output analysis, and the existence of selection information. Tab. 1 lists the selection criteria of the DEA model.

Table 1: Selection criteria for DEA mode

	Selection criteria	Mode type	
Analysis purpose	Efficiency analysis	General DEA mode can be used to measure efficiency	Technical efficiency, scale efficiency, congestion efficiency, cost efficiency, revenue efficiency, profit efficiency, and configuration efficiency must replace the inputs in the general DEA model
	Performance analysis	Performance measure	
Data type	Cross-sectional data	General DEA mode	Window analysis: can amplify the number of DMUs, increase the discriminative power and discernment of efficiency analysis; Mann Quist index can measure the change of technical efficiency across time, technical change
	Vertical and horizontal data	Window analysis, the Man Quist index measures static efficiency	
Input-output item attribute	Controllable variable	General DEA mode	Uncontrollable variables refer to variables that are beyond the control of decision makers
			Non-arbitrary variables are limited, but can be partially adjusted
	Uncontrollable variable	Uncontrollable variable DEA mode	
	Non arbitrary variable	Non-arbitrary variable DEA mode	
Whether there is a priori information	YES	General DEA mode	Can find closer to the real efficiency value
	NO	Guaranteed area mode (AR method)	

2.4.1 Establishment of evaluation index system of leisure agriculture based on DEA model

Since leisure agriculture is still an emerging industry, the evaluation index system is still in development. Through the form of questionnaire surveys and interviews, and with the suggestions of relevant professionals, this article revised the design evaluation indicators

many times to determine the number of scientific and technological activities of enterprises. The amount of leisure investment and the social and economic benefits of the enterprise are used as evaluation indicators. Among them, the number of scientific and technological activities is the input indicator of the DEA model, the main choice is the number of employees engaged in scientific and technological activities. Leisure investment is also an input indicator of the DEA model. It is the economic support for development and requires huge investment. Finally, select the social and economic benefits involved in the sample as output indicators. The economic benefits here mainly refer to the intensity of annual operating income management. Social benefits reflect the annual number of local employees who promote farmers' employment. The two together reflect the development model of Henan Province.

2.4.2 Leisure agriculture DEA evaluation process

In the whole evaluation process, the first thing is to establish the corresponding decision-making unit, and also to determine the input and output of the decision-making unit.

The vector $i = (i_1, i_2, i_3)^T$ indicates the input of the decision-making unit in the production activity, where i_x denotes human, financial and material resources respectively; the vector $o = (o_1, o_2)^T$ represents the output of the decision-making unit, in which, O_x represents economic benefit and social benefit respectively; (i, o) represents the production and operation process. Since the following is an empirical demonstration of 12 representative demonstration points, there are 12 separate decision units DMU, $1 \leq j \leq 12$, the corresponding input and output vectors are:

$$I = (i_1, i_2, i_3)^T, O = (o_1, o_2)^T, j = 1, 2, \cdots, 12 \tag{1}$$

In which, O is the set of output factors, i is a univariate that makes up the input factors, I is a collection of input factors, and o is a single variable that makes up the output factor.

The level of interest of the influencing factors is expressed as:

$$M = \frac{\sum O}{\sum I} = \frac{\alpha O}{\beta I} \tag{2}$$

In the formula, α the weight coefficient, β is output, that is, $\alpha = (\alpha_1, \alpha_2, \cdots, \alpha_n)^T$, the input weight coefficient $\beta = (\beta_1, \beta_2, \cdots, \beta_n)^T$.

Transforming Eq. (2) and introducing other variables into the model, the model becomes:

$$M = \begin{cases} \min \theta \\ s.t. \sum_{j=1}^{n} \lambda_j i_j + s = \theta_{i0} \\ \sum_{j=1}^{n} \lambda_j i_j - X = o_0 \end{cases} \quad (3)$$

$$\lambda_j \geq 0, j = 1, 2, \cdots 12 \quad (4)$$

$$\theta \in E, s \geq 0, X \geq 0 \quad (5)$$

In which, j is a decision unit, θ is the overall technical efficiency of a single decision unit j, and the output input weight of the entire decision unit is represented by λ_j; where the input variable of the decision unit is represented by i_j; and the output variable is represented by o_j; The amount of loss in the entire production process is indicated by s; if there is excess or deficiency in the input, it is represented by X hand Y. Through the collected data, the above equation can be solved to obtain the optimal comprehensive technical efficiency θ. The economic significance of DEA can be further explained by the comprehensive technical efficiency and other corresponding indicators such as pure efficiency and scale.

The decision unit analysis method used in this article aims to find invalid units. The key to optimizing decision-making units is whether inputs and outputs are effective at the current investment level. When the decision-making unit is valid, the overall technical efficiency at this time is equal to 1, and all other reference indicators are 0. In other words, the entire production system has reached its optimal state without any overcapacity or underinvestment. When the comprehensive technical efficiency is equal to 1, but at least one of the remaining indicators is not 0, it means that the decision-making unit is effective, and the technology and scale cannot be effectively achieved. That is, there are problems such as insufficient resource utilization efficiency. If the efficiency of the integrated technology is not 1, it means that all efficiency in the entire production and production activities is not optimal, and economies of scale cannot be achieved.

3 Empirical analysis of the value of agricultural cultural resources based on DEA

An empirical analysis of the value of agricultural cultural resources based on DEA. In order to make the results of empirical analysis available for reference, the sample selected in this article is a representative demonstration site. The agricultural demonstration sites involved come from four regions in the east, west and north. At the same time, based on the nature and geographic attributes of the demonstration sites, global and representative research on the entire leisure system can reflect current developments. Through the questionnaire survey of the demonstration sites in 2015, SPSS software was used for data statistics. According to the output of the indicators, a resource assessment based on DEA was conducted from two aspects of economic and social benefits. Finally, the two are combined to obtain a comprehensive benefit assessment of the resource development model.

3.1 Specific analysis of the development model of agricultural resources DEA

This part uses the DEA method to calculate the results of the selected sample data as shown below. The results mainly consist of various indicators, as shown in Tab. 2.

Table 2: Analysis results of economic benefits and social benefits demonstration sites DEA

Agricultural demonstration sites	S1	S2	S3	X	Y
Quzhou Shuosuo Agricultural Ecological Park.	0	0	0	0	0
Tianqiaogou Village, Checun Town, Ji County	43	2200	2	567	662
Jiyuan City Health Jiayuan Leisure Tourism Park	0	0	0	0	0
Qingyun Agricultural Technology Co., Ltd.	0	0	0	0	0
Nanjie Village, Linying County	0	458	0	312	68
Baishawan Ecological Farm	0	0	0	0	0
Shaying Spring Modern Agriculture Park, Xicheng District, Luohe City	0	0	657	232	67
Changchun County Shengxue High-tech Agricultural Park	0	0	0	0	0
Mengli Water Town Ecological Farm	826	0	0	243	334
Gongyugou Village, Jiajinkou Town, Gongyi City	0	0	936	221	421
Henan Luohe Ecological Farm Co., Ltd.	0	0	0	0	0
Zhuomadian Laoleshan Leisure Agriculture Industrial Park	0	0	0	0	0

Scientific and technical personnel information, capital investment and material input are respectively used s_1, s_2, s_3. Economic and social benefits are represented by X and Y; comprehensive technical efficiency is represented by θ. The efficiency is expressed by Z; the scale efficiency is represented by Cale; the scale return is indicated by R_s.

The analysis found that at the zap demonstration site, the investment in science and technology, capital and material resources is not high, and the popularity is not high. Among them, Tianqiaogou Village is a demonstration point for realizing all investment in manpower, financial resources and material resources, and has achieved economic and social benefits with the greatest achievements. Nanle Village has achieved scientific and technological investment, capital investment and material investment in the ecological farm of Male Water Township, and has achieved certain results in social benefits. It can be seen that by investing manpower, material and financial resources, economic and social benefits can be improved and have a certain positive impact.

3.2 Comprehensive analysis of agricultural dea development model

Based on the specific analysis, the comprehensive analysis is mainly manifested as comprehensive efficiency, scale efficiency and scale returns. The comprehensive analysis results are shown in Tab. 3.

**Table 3:** Results of comprehensive analysis of DEA in demonstration sites

	Crste (θ)	Scale	R3
Shuoshuo Agriculture	0	0	—
Tianqiaogou Village	1	1	↑
Health Jiayuan	0	0	—
Qingyun Agriculture	0	0	—
Nanjie Village	0.985	0.90	↑
White Sand Bay	0	0	—
Satay spring	0.88	0.88	↑
Sheng Xue Gaoxin	0	0	—
Dream Water	0.78	0.98	↑
Jiajinkou Zhenyun	0.7	0.90	↑
Henan Weihe	0	0	—
Old Leshan	0.48	0.48	0.48

The names mentioned above are all abbreviated. The overall efficiency is expressed by θ; the scale efficiency is represented by Cale; the scale return is represented by R_s. It is known from Tab. 3 that Tianqiaogou Village has achieved the best results and can fully realize the benefits. The evaluation results of Nanjie Village, Jiajinkou Township and Laole Mountain are all greater than 0 and less than 1. It can be seen that the five demonstration points have not yet reached the optimal state, and the input of manpower, material resources and financial resources is still Room for improvement. The comprehensive demonstration sites that have obtained inputs have achieved comprehensive benefits, scale benefits and scale benefits. The greater the investment, the better the results achieved. Other demonstration sites without human, material and financial resources have not yet achieved corresponding economic and social effects.

3.3 Analysis of scale benefit based on DEA

Scale efficiency (SE) reflects the effectiveness of production scale. Refers to the distance between the production frontier measuring scale change and the production frontier of scale change return, reflecting whether the decision-making unit is at the optimal scale.

When the scale efficiency value SE is equal to 1, it indicates that the decision unit has scale efficiency; when SE<1, it indicates that the ratio is invalid. Scale inefficiency involves the increase or decrease in scale returns. The proportional efficiency values obtained from the DEA model are organized into Tab. 4. The statistical results are shown in Fig. 3.
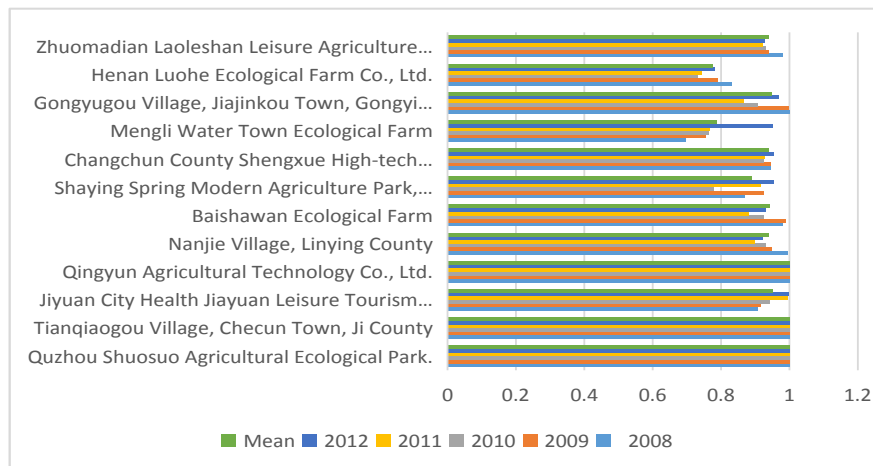
Figure 3: Statistical results of resources in 12 agricultural demonstration sites

Fig. 3 and Tab. 4 show that the overall size of the township economy is still relatively high, usually above 0.8. In addition to the cities and towns that are at the forefront of effective production, it also shows that scale efficiency is not a failure of these cities and towns. The returns to scale in these towns are increasing and decreasing. There are 4 cities and towns whose income from scale continues to increase. In other words, in the development process, growth output will be greater than investment growth. Therefore, these townships should adopt appropriate control scale to realize the development and utilization of cultural resources.

Table 4: Statistical results of resources in 12 agricultural demonstration sites

Period	2008	2009	2010	2011	2012	Mean
Quzhou Shuosuo Agricultural Ecological Park.	1	1	1	1	1	1
Tianqiaogou Village, Checun Town, Ji County	1	1	1	1	1	1
Jiyuan City Health Jiayuan Leisure Tourism Park	0.907	0.917	0.944	0.995	0.998	0.952
Qingyun Agricultural Technology Co., Ltd.	1	1	1	1	1	1
Nanjie Village, Linying County	0.995	0.948	0.93	0.898	0.922	0.939
Baishawan Ecological Farm	0.981	0.99	0.924	0.881	0.932	0.942
Xicheng District, Luohe City	0.869	0.926	0.778	0.916	0.954	0.889
Shengxue High-tech Agricultural Park	0.946	0.946	0.926	0.929	0.955	0.94
Mengli Water Town Ecological Farm	0.697	0.756	0.765	0.767	0.953	0.788
Jiajinkou Town, Gongyi City	1	0.999	0.907	0.868	0.97	0.949
Henan Luohe Ecological Farm Co., Ltd.	0.831	0.79	0.731	0.744	0.782	0.776
Laoleshan Leisure Agriculture Industrial Park	0.982	0.939	0.931	0.922	0.927	0.941

4 Conclusions

As a combination of traditional agriculture and emerging industries, agricultural culture plays a vital role in promoting rural development. Through the DEA analysis method, an empirical analysis of the selected samples found that at the re-agricultural demonstration site, the investment in science, technology, capital and material resources was generally not high. However, from the perspective of manpower, material and financial resources, economic and social benefits can be improved, and there is a direct relationship between them. It can be seen that in this process, in order to obtain economic and social benefits, investment in manpower, material and financial resources can be increased. This conclusion laid a theoretical foundation for the establishment of leisure agriculture development model. At the same time, it also laid the foundation for the development model of the progress and development of other related industries. The research in this article points out the future development direction, but its evaluation index still needs to be further subdivided. Affected by the unique attributes of the evaluation indicators, the selected demonstration points will convert the information resources required for the evaluation indicators from quantitative to qualitative, and certain errors will occur.

Conflicts of Interest: We declare that we have no conflicts of interest to report regarding the present study.

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