| **RESEARCH ARTICLE**

The Construction of Agricultural Production Trusteeship Service Quality Evaluation Index System based on Farmers' Perception

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| **ABSTRACT**

At present, the problem of poor land utilization, reduced land production, and land desolation frequently happens in China's rural areas. As a new form of agricultural socialization service, agricultural production trusteeship can help farmers increase production and income, ensure food safety, and promote the organic connection between small farmers and modern agriculture. However, China's agricultural production trusteeship is still at a preliminary stage, and there are still certain shortcomings in terms of service quality and other aspects. To improve the service quality of agricultural production trusteeship, this paper constructs an evaluation system based on farmers' perceptions, combining Ridit analysis and multiplication scale method, with farmers' perceived service quality as the target, and six first-level indicators of plowing service, planting service, prevention service, harvesting service, selling service and complaint and risk handling, and puts forward relevant policy and suggestions for the high-quality development of agricultural production trusteeship.

| **KEYWORDS**

Agricultural production trusteeship, Service quality evaluation, Ridit analysis, multiplication scale method

1. Introduction

In recent years, the rural labour force has gradually moved to the cities, making the traditional agricultural production method unsustainable, which relies on a large amount of labour input, resulting in reduced production and harvests, and even abandoning the land. In order to solve the problem of farmers' low motivation to transfer their land and the problem of "who will grow the land and how to grow the land"(姜长云, 2016), agricultural production trusteeship has come into being. According to statistics, by the end of 2020, the number of socialized agricultural service organizations nationwide has exceeded 900,000, and the service area of agricultural production trusteeship has exceeded 107 million hm² (1.6 billion mu), among which the service area of grain crops has exceeded 60 million hm² (900 million mu), driving more than 70 million smallholder farmers, making agricultural production trusteeship an important form of realization to link smallholder farmers, indicating that China is now vigorously promoting and developing agricultural production trusteeship service.

However, some scholars have pointed out that there are still problems such as the capacity of service providers is not strong, the service area is not wide, the policy support is not strong enough, and the management of the industry needs to be strengthened(韩俊, 2020), which indicates that the development of agricultural production trusteeship services in China is still at a preliminary stage, and there are still some shortcomings in the service quality of service providers and the supervision of the industry. It is worth noting that the quality of services has an impact on farmers' motivation to participate in agricultural production trusteeship and that farmers are increasingly demanding the quality of agricultural production trusteeship services in order to adapt to grain market fluctuations and maximize their benefits(江帆 et al., 2022). Therefore, there is an urgent need to address the issue of how

to improve the quality of agricultural production trusteeship services provided by service providers so as to facilitate their rapid diffusion and high-quality development. The construction of a service quality evaluation index system helps to optimize the various aspects of the service and also facilitates service providers to follow up and continuously adjust and improve the overall service according to the real needs of farmers(徐开娟 et al., 2015), thus improving the quality of agricultural production trusteeship services. Lei Xin et al. (2020) also pointed out that a set of objectives, comprehensive, scientific and reasonable evaluation index system for agricultural production trusteeship services can be constructed to improve the quality of agricultural production trusteeship services(雷鑫 et al., 2020). Therefore, scientific evaluation of service quality is the key to service quality management by service providers and overall quality improvement of agricultural production trusteeship services. In addition, agricultural production trusteeship services are provided to farmers, and its service targets are mainly smallholders, so service providers should give priority to farmers' satisfaction.

In view of this, this paper constructs an index system for evaluating the quality of agricultural production trusteeship services from the perspective of farmers, taking farmers' perceived service quality as the target layer and setting six first-level indicators based on the specific aspects of agricultural production trusteeship services in practice: plowing service, planting service, prevention service, harvesting service, selling service and complaint and risk handling, and according to the five-point Likert scale questionnaire, a set of indicators based on farmers' perceptions of the quality of production trusteeship services is constructed by quantifying their subjective attitudes based on a five-point Likert scale questionnaire, combining Ridit analysis and multiplication scale method to assign weights.

2. Literature Review

After its implementation in China in 2017, agricultural production trusteeship has attracted extensive attention from domestic scholars as an emerging thing. Unlike land transfer, agricultural production trusteeship refers to an agricultural operation method in which all or part of the operational aspects of agricultural production, such as plowing, planting, prevention, harvesting and selling, are entrusted to agricultural production trusteeship service providers for completion, which is a kind of service scale operation. At present, scholars' research mainly focuses on the meaning, model and problems of agricultural production trusteeship by using case studies, or analyzing the risk allocation, sharing and benefit distribution mechanism of agricultural production trusteeship at the present stage. For example, Wen Riyu et al. (2019) analyzed the specific content, promotion pathways and development implications of the "enrichment-type, package" whole industry chain service model for maize under agricultural production trusteeship in Shanxi Province(温日宇 et al., 2019); Zhang Ruijuan and Huan Meili (2020) analyzed the characteristics, problems and improvement suggestions of three trusteeship models introduced in Lanxi County, Heilongjiang Province(张瑞娟 & 宦梅丽, 2020); Chang Wei and Wang Lixia (2018) examined the contractual nature of agricultural production trusteeship models, analyzed the exogenous and endogenous risks involved, and explored the risk formation mechanisms of different models and their allocation methods(常伟 & 王丽霞, 2018); Wang Yubin and Li Qian (2019) analyzed and summarised the existing benefit distribution models of agricultural production trusteeship(王玉斌 & 李乾, 2019).

Only some scholars have focused on the problems with the quality of agricultural production trusteeship services. Tian Zengqiang (2020) suggested that agricultural production trusteeship suffered from irregular service standards, a lack of corresponding understanding of service standards, prices, quality, and contracts among service providers, a high degree of service arbitrariness and lax gate-keeping of service quality(田增强, 2020). Shanxi Province released the "Norms for agricultural production trusteeship Services" in 2019, which set specific standards for service organization, content and methods. However, there is a need to further integrate practical needs and develop targeted standards for different segments of services. In summary, there is little literature on the evaluation of the quality of trusteeship services and the development of a set of indicators for evaluating the quality of production trusteeship services in line with reality. In view of this, this paper quantifies the subjective attitudes of small farmers from the recipients of trusteeship services, divides different index layers according to specific service links, and constructs an agricultural production trusteeship service quality evaluation index system based on scientific empowerment to provide a scientific basis for regulating the service quality of service organizations and the supervision of relevant departments.

3. Methodology
3.1 Model and indicators
3.1.1 Evaluation models:
Service quality evaluation models have been developed since the 1980s. Parasuraman, A et al. (1988) proposed a service quality gap model and the SERVQUAL model(Parasuraman et al., 1988). Cronin and Tayor (1992) proposed a service performance model, the SERVPERF model. The SERVPERF model measures service quality directly from perceived service performance instead of measuring customers' expectations of the service, which is easier and more efficient to operate and more suitable for measuring farmers. The SERVPERF model is therefore proposed to measure the importance of different indicators of the quality of agricultural production trust services by farmers in this paper.

3.1.2 Selection of indicators:

The key to the construction of the evaluation index system lies in the selection of evaluation indicators, which should firstly follow certain principles of comprehensiveness, scientificity, independence and operability. In this paper, specific indicators are developed based on the specific service aspects of agricultural production trusteeship services, the specific operation process in the services and the Model Text of Agricultural Production Trusteeship Service Contract (with the Guidelines on the Standards of Agricultural Production Trusteeship Services) formulated and released by the Ministry of Agriculture and Rural Affairs, in which the Model Text includes service contents, service standards, service duration, etc.; the Guidelines provide specific indicators on trusteeship in terms of tillage preparation, tillage, seed treatment, planting, crop harvesting, drying and storage, etc.

In addition, Lu Yangxiao et al. (2021) pointed out that the service aspects of agricultural production trusteeship include pre-production, production and post-production stages, of which the mid-production stage, which is the main part of agricultural production trusteeship, includes productive services such as field plant protection and farm machinery operation. In the post-production stage, the core of the service is the escrow for sale(卢洋啸 & 孔祥智, 2021). Therefore, this paper provides a summary of the specific service links by setting six primary indicators for plowing services, planting services, prevention services, harvesting services, selling services, and complaint and risk handling, reflecting the scientific and reasonable selection of indicators; and according to the model contract text, combining the five dimensions of service quality evaluation (tangibility, reliability, responsiveness, authenticity and empathy) to design six primary 28 secondary indicators under the indicators, and the specific indicator system is shown in Table 1.

Table 1: Farmers' perceived service quality evaluation indicators

Target	First-level indicators (criterion levels)	Second-level indicators
Farmers' perceived service quality	Plowing service (plowing and tilling) A1	Plowing and tilling staff are well groomed and uniformly dressed (A11)
		Use the plowing and tilling machinery on the contract (A12)
		Adopt a plowing pattern suitable for production reality, such as deep tillage and deep plowing (A13)
		Effective plowing and tilling to meet the standards promised on the contract (A14)
		Plowing and tilling staff are friendly and patient (A15)
		Complete ploughing and tilling on time (A16)
	planting service (sowing and fertilizing) A2	Sowing and fertilizing staff are well groomed and uniformly dressed (A21)
		Use the type of seed and treatment processes (A22)
		Use the type of fertilizer and fertilization methods on the contract (A23)
		Effective sowing and fertilization result to meet the standards promised on the contract (A24)
		Sowing and fertilizing staff are friendly and patient (A25)
		Complete Sowing and fertilizing on time (A26)
	prevention service (pest and weed control) A3	Pest control staff are well groomed and uniformly dressed (A31)
		Use the drug application program, equipment and facilities layout on the contract (A32)
		Equipped with professional technicians and plant protection team (A33)
		Effective prevention and treatment results to meet the standards promised on the contract (A34)
		prevention and treatment staff are friendly and patient (A35)
		Complete pest and weed control operations on time (A36)
	Harvesting service (grain harvesting) A4	Grain harvesting staff are well groomed and uniformly dressed (A41)

		Use the harvesting machines and methods on the contract (A42)
		The quality and output of harvested produce are up to standard (A43)
		Provide high quality storage and drying service (A44)
		Grain harvesters are friendly and patient (A45)
		Complete the harvesting operations on time (A46)
	Selling service (deep processing and sales of agricultural products) A5	Sell out the grain within the agreed sales time (A51)
		Sell at no less than the agreed agricultural price (A52)
		The total profits, in the end, meet your expectations (A53)
		extend the industry chain, deep processing of products, fine packaging to obtain high added value (A54)
	Complaint and risk handling A6	There are fast, convenient and efficient channels for farmers to file complaints (A61)
		Take steps to respond to your feedback in time(A62)
		Take emergency measures in time and actively communicate and negotiate with you to deal with losses when unexpected events such as natural disasters occur (A63)

3.1.3 Evaluation Methods:

According to the number of items included in trusteeship, agricultural production trusteeship can be divided into different forms, including full trusteeship, link trusteeship, order-based trusteeship, etc(杜洪燕 et al., 2021). Among them, the full trusteeship refers to the service organization charging certain trusteeship fees to provide farmers with the whole process of production and operation, such as plowing, sowing, prevention, harvesting and selling. (韩青 et al., 2021) The link trusteeship is the service that farmers receive parts of the services from the service provider according to their needs. In this paper, both link trusteeship and full trusteeship are considered in the construction of evaluation indices, so specific service links are chosen as the first-level indicators, which can evaluate the service quality of both link trusteeship and full trusteeship. The evaluation is based on the Likert five-level scale, which is divided into five levels: very dissatisfied, relatively dissatisfied, average, relatively satisfied, and very satisfied, with scores of 5, 4, 3, 2, and 1. The total scores were calculated as follows:

Link trusteeship was calculated according to the weight of the second-level indicators under the first-level indicators:
M=$\sum F_{ij} \times X_{ij}$（i = 1,2,3,4,5,6; j = 1,2,3,4）
Where M denotes the score of each link, F_{ij} denotes the satisfaction score of each indicator, and X_{ij} denotes the weight of the second-level indicator under the first-level indicator.
Full trusteeship is calculated based on the weight of the second-level indicators under the target layer:
N=$\sum F_{ij} \times Y_{ij}$（i = 1,2,3,4,5,6; j = 1,2,3,4）

Where N denotes the total score of all service links, F_{ij} denotes the satisfaction score of each indicator, and Y_{ij} denotes the weight of secondary indicators under the target layer.

3.2 data collection and analysis

The questionnaire is divided into three major sections. The first part is the basic information about farmers. The second part is the farmers' rating of agricultural production trust service quality evaluation indicators, using a five-point Likert scale as the measurement tool, divided into "very unimportant=1, relatively unimportant=2, average=3, relatively important=4, very important=5 " five levels of importance, and farmers scored different indicators based on their subjective perceptions of importance. The third part is an open-ended question that asks farmers about their suggestions for improving the quality of agricultural production trust services and the indicators that need to be added.

The study mainly focused on Xianyang City and Weinan City in Shaanxi Province, where a total of 140 questionnaires were distributed, and 123 questionnaires were collected, of which 104 were valid, with an efficiency rate of 84.55%.

Table 2: Descriptive statistics

Variables	Classification	Numbers	Percentage
Gender	Male	62	59.6%
	Female	42	40.4%
Age	18-40	24	23.1%
	41-65	48	46.1%
	Over 66	32	30.8%
Education	Elementary school and below	34	32.7%
	Junior High School	48	46.2%^
	High School (Secondary School)	18	17.3%
	University (college) and above	4	3.8%
	None	6	5.8%
Land area	1-10 acres	94	90.4%
	More than 10 acres	4	3.8%
Reception of agricultural production trust services	Yes	26	25%
	No	78	75%

According to Table 2, it can be seen that the ratio of males to females is close to 1:1. The age of the sample is concentrated between 41-65 years old and 66 years old or above, accounting for 46.1% and 30.8% of the total sample, respectively. And the education level is mostly elementary school and below(32.7%) and junior high school(46.2%). The area of land owned by those surveyed is mostly 10 acres and below, while only 3.8% is above 10 acres. 25% of farmers said they had received similar services of agricultural production trusteeship.

3.2.1 Reliability analysis:
Firstly, the reliability analysis of the subscales was conducted using Cronbach's alpha coefficient to measure the stability and reliability of the questionnaire. The results of the analysis showed that the Cronbach alpha coefficient would increase after deleting A11, A15, A21, A25, A31, and A35, leading to the result that the final Cronbach alpha coefficient of each dimension was greater than 0.7 and the deletion of any question would not significantly increase the alpha coefficient of each subscale, so there was good consistency within the subscales. For the reliability analysis of the overall scale, the results of the reliability analysis of the total scale after deleting 23 indicators of A11, A15, A21, A25, A31, and A35 showed that the Cronbach alpha coefficient of the total scale was 0.912, and deleting any question did not increase the alpha coefficient of the total scale significantly, which indicated that the internal consistency of the total scale was very good and the questionnaire had reliability and stability. The Cronbach alpha coefficients of each dimension and the total table Cronbach alpha coefficients are shown in Table 3.

Table 3: Cronbach α coefficients of the questionnaire for the farmers' perceived service quality evaluation

First-level indicators	A1	A2	A3	A4	A5	A6	α of the summary scale
Cronbach α	0.770	0.779	0.706	0.761	0.727	0.848	0.912

3.2.2 Validity analysis:
The KMO and Bartlett's sphericity tests were conducted on the remaining 23 question items. The KMO coefficient was 0. 721 > 0. 7, and Bartlett's sphericity test result of P=0.000 was significant, so this questionnaire can be considered to have good structural validity. Finally, after screening, the index system was determined as the results in Table 1 after deleting A11, A15, A21, A25, A31, and A35.

3.3 Calculation of indicator weights
3.3.1 Ridit analysis:
Ridit analysis is a method of non-parametric tests for the comparison of information grouped by rank. This questionnaire belongs to a five-level scale, which is data grouped by rank, so it can be tested non-parametrically using Ridit analysis. The product scale method is a method of assigning weights firstly proposed by He Jinping(何金平 et al., 2001), and Wu Jinzhong(2015) derived the library characteristic service quality evaluation index system by combining Ridit analysis with the product scale method, which is scientific and accurate(吴金仲, 2015). Therefore, this paper quantifies farmers' subjective evaluation of the importance of different indicators through the combination of Ridit analysis and the product scaling method to achieve scientific empowerment.

At first, the total cumulative frequency of each rank under the six dimensions of all questionnaire data was used as the six standard groups, and the R value under each rank of the standard group was calculated (recorded as R_{ij}). Then, the average value of Ridit of each group relative to its standard group was calculated based on R_{ij} and the cumulative frequency of each rank of several secondary indicators attached to the six dimensions. Based on the six first-level indicators divided into six criterion groups, the Ridit values of each criterion group were calculated. The results are shown in Table 4.

Table 4: Ridit values of the six standard groups

Group	Score (1)	Frequency m (2)	m/2 (3)	Accumulate m and move to the next line (4)	(3) + (4) (5)	$R_{ij} = (5)/n$ (6)
Group1	1	8	4		4	0.0096
	2	26	13	8	21	0.0505
	3	146	73	34	107	0.2572
	4	114	57	180	237	0.5697
	5	122	61	294	355	0.8534
	Total	416				
Group2	1	2	1		1	0.0024
	2	22	11	2	13	0.0313
	3	88	44	24	68	0.1635
	4	126	63	112	175	0.4207
	5	178	89	238	327	0.7861
	Total	416				
Group3	1	8	4		4	0.0096
	2	8	4	8	12	0.0288
	3	108	54	16	70	0.1683
	4	142	71	124	195	0.4688
	5	150	75	266	341	0.8197
	Total	416				
Group4	1	2	1		1	0.0024
	2	6	3	2	5	0.0120
	3	120	60	8	68	0.1635
	4	136	68	128	196	0.4712
	5	152	76	264	340	0.8173
	Total	416				
Group5	1	0	0		0	0.0000
	2	18	9	0	9	0.0216
	3	82	41	18	59	0.1418
	4	144	72	100	172	0.4135
	5	172	86	244	330	0.7933
	Total	416				
Group6	1	0	0		0	0.0000
	2	6	3	0	3	0.0072
	3	38	19	6	25	0.0601
	4	104	52	44	96	0.2308
	5	164	82	148	230	0.5529
	Total	416				

In the second step, statistical tests were performed. Firstly, Kruskal-Wallis H-test was used for multiple comparisons between groups, and if there was no statistically significant difference (P>0.05) in the results of multiple comparisons, then there was no

difference in the importance of each index between groups, and a value of "1" was assigned to all of them. The results of the Kruskal-Wallis H test among the six groups are shown in Table 5.

Table 5: Results of Kruskal-Wallis H test among the six groups

Group	P Values	Results
Group1	0.011	Significant difference
Group2	0.486	No significant difference
Group3	0.239	No significant difference
Group4	0.0021	Significant difference
Group5	0.003	Significant difference
Group6	0.941	No significant difference

As can be seen from Table 6, there is no difference between the group2, group3 and group6; the importance degree of each indicator is assigned as 1; Because of the differences in the importance of each index among group1, group4 and group5, the indicator with the lowest mean value of Ridit (A_{11}, A_{41}, A_{51}) in each group is needed as the comparison group, and the weights are assigned according to the p-values obtained after the two-by-two comparison between the indicators, combined with the assignment rules of the multiplication scale method as shown in Table 6. The final weights can be obtained by comparing two-by-two and according to Table 6, and the results are shown in Table 7.

Table 6: Weights of different p-values from two-by-two comparison test

P-values	Weights
P>0.05	1
0.01≤P<0.05	1.354
0.001≤P<0.01	1.354×1.354
P<0.001	1.354×1.354×1.354

Table 7: Mean values of Ridit from each group and their weights

Indicators	Mean values of Ridit	X_{ij}
A11	0.400	1
A12	0.537	1
A13	0.569	1.354
A14	0.493	1
A21	0.489	1
A22	0.544	1
A23	0.504	1
A24	0.463	1
A31	0.494	1
A32	0.457	1
A33	0.563	1
A34	0.486	1
A41	0.406	1
A42	0.570	1.354
A43	0.508	1
A44	0.516	1
A51	0.404	1
A52	0.527	1
A53	0.596	1.354×1.354
A54	0.474	1
A61	0.337	1
A62	0.347	1
A63	0.441	1

3.3.2 The calculation of indicators weights at each level:

(1) The weights of the first-level indicators

Since most farmers responded that each service is important and they are more willing to choose full trusteeship during the research, the weights of the first-level indicators can be calculated proportionally to the number of secondary indicators included, and the weights vector is A_i = (0.174, 0.174, 0.174, 0.174, 0.174, 0.174, 0.130).

(2) The weights of second-level indicators under first-level indicators

The weights of secondary indicators were determined by combining Ridit analysis with the product scalar method, and the weights of secondary indicators of agricultural production trust service quality were obtained from the above analysis, and the results are shown in Table 8.

Table 8: Weights of second-level indicators under first-level indicators

First-level indicators	Second-level indicators	Weights
A1	A11	0.230
	A12	0.230
	A13	0.310
	A14	0.230
A2	A21	0.25
	A22	0.25
	A23	0.25
	A24	0.25
A3	A31	0.25
	A32	0.25
	A33	0.25
	A34	0.25
A4	A41	0.230
	A42	0.310
	A43	0.230
	A44	0.230
A5	A51	0.207
	A52	0.207
	A53	0.379
	A54	0.207
A6	A61	0.333
	A62	0.333
	A63	0.333

(3) The weights of second-level indicators under the target layer

The weights of the second-level indicators under the target layer are calculated by combining the weights vector of the first-level indicators with the second-level indicators ($Y_{ij}=A_i \times X_{ij}$) to form the combined weights and normalizing them, and the total weights vector is Y_{ij} = (0.0400,0.0400,0.0539,0.0400,0.0435,0.0435,0.0435,0.0435,0.0435,0.0435,0.0435,0.0435,0.0400,0.0539, 0.0400,0.0400,0.0360,0.0360,.00659,0.0360,0.0433,0.0433,0.0433)

4. Results and Discussion

The construction of a service quality evaluation index system has a profound effect on regulating the quality of agricultural production trusteeship services and strengthening industry supervision. In this paper, through literature analysis and combined with practice, we designed the evaluation indexes of agricultural production trusteeships services quality based on the specific service aspects of agricultural production trusteeship, with farmers' perception as the target layer, and plowing service, planting service, prevention service, harvesting service, selling service and complaint and risk handling as the first-level indicators, using a five-point Likert scale to design the questionnaire to quantify farmers' subjective evaluation. The reliability and validity analysis was conducted on the collected data, with the final 25 secondary indicators selected. Then we determined the weights vector by the Ridit analysis combined with the multiplication scale method. Finally, the evaluation index system of agricultural production trusteeship service quality based on farmers' perceptions was constructed. The weighting results show that the second-level indicator A_{53} (The total profits, in the end, meet your expectations) has the largest weight of 0.0659, which indicates that farmers attach the most importance to the service benefits of service providers and the total profit obtained in the end is the key factor

affecting the service quality score. Therefore, service subjects should pay attention to the yield after carrying out production trust services and increase the final food production by actively adopting advanced planting techniques and production materials to ensure that farmers increase their production and income.

5. Conclusion

According to the analysis results of the questionnaire and the evaluation index system of farmers' perceived service quality, the following suggestions are made to the agricultural production trust service organizations:

(1) In the process of investigation, most farmers do not value tangible indicators such as " staff are well groomed and uniformly dressed ". Therefore, service providers are supposed to reduce the importance of tangibles and focus their attention on service effects, technical equipment, staff training and other aspects in improving the quality of services instead of putting the cart before the horse and excessively pursuing external forms of norms. (2) an Adequate number of technical personnel can ensure the quality of services to a certain extent. The number of personnel must meet the requirements of the service and technically must meet the needs of the position to guarantee the quality of trusteeship services up to standard. In recent years, there have been problems with the quantity and professionalism of agricultural production personnel, which leads to substandard quality of production and reduces farmers' confidence in agricultural production trusteeship. Therefore, the government and agricultural production trusteeship service providers should increase technical training for farmers, transform the surplus rural labor force, solve the problem of "farmer shortage", and drive the development of the agricultural production hosting market with talents while solving part of the employment problem. (3) Constructing a reasonable and perfect quality evaluation system for agricultural production trusteeship service is the premise of service quality evaluation, and developing a reasonable quality evaluation system should be accompanied by setting up a special evaluation team to regularly evaluate agricultural production trusteeship subjects and make the evaluation report public, so as to promote healthy competition among agricultural production trusteeship service subjects, supervise each other to improve service quality, and also help promote farmers' Acceptance of agricultural production trusteeship services. At the same time, service providers should provide farmers with effective feedback methods, such as establishing fast, convenient and efficient complaint channels for farmers and taking measures to solve problems in a timely manner after receiving feedback information.

Conflicts of Interest: The authors declare no conflict of interest.

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