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Study on the Influence of Agricultural Scale Management Mode on Production Efficiency Based on Meta-Analysis

Yawen Liang, Yue Wang, Yao Sun and Junhu Ruan *

College of Economics & Management, Northwest A&F University, Yangling 712100, China; liangyawen@nwafu.edu.cn (Y.L.); way@nwafu.edu.cn (Y.W.); sunyao@nwafu.edu.cn (Y.S.)
* Correspondence: rjh@nwsuaf.edu.cn

Abstract: Agricultural scale management is an important means of improving agricultural production efficiency. To answer the controversy over whether different agricultural scale management models can improve production efficiency, this paper obtained 117,627 samples from 68 domestic and foreign literature and used meta-analysis to study the effects of land-scale operation (LSO) and service-scale operation (SSO) on agricultural production efficiency (APE). The moderators that affect the relationship between LSO, SSO, and APE are also examined. The research results show that (1) both LSO and SSO positively impact production efficiency, but LSO has a stronger impact. (2) The relationship between LSO and APE is positively regulated by the agricultural production and operation environment, characteristics of the agricultural location, degree of farmers' participation, and types of APE, and negatively regulated by the research situation. (3) The relationship between SSO and APE is negatively regulated by APE types and data types. Therefore, the government should promote agricultural dual-scale operation according to the local conditions through the complementary advantages of LSO and SSO, so as to fully release the promotion potential of APE.

Keywords: agricultural-scale operation; land-scale operation; service-scale operation; agricultural production efficiency; meta-analysis

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1. Introduction

The core of agricultural economic growth lies in improving agricultural production efficiency (APE), and the key to solving the problem lies in realizing agricultural-scale operation. Agricultural scale management mainly includes land-scale operation (LSO) and service-scale operation (SSO); the former is mainly realized by land transfer, and the latter is mainly realized by agricultural socialization service. APE refers to the ratio relationship between the input of various production factors and the output of agricultural products in the process of agricultural production. Under the existing rural land system framework, China's basic conditions with a small amount of cultivated land cannot be changed in a short period, and the LSO promoted by land transfer has become an important way to improve APE [1]. In the late 1980s, the state issued relevant policies on land transfer, and governments at all levels began to issue a series of agricultural land policies one after another to encourage the orderly transfer of the contracted operation right of farmland and develop moderate agriculture-scale operation. However, due to the large number of small-scale farmers in China, it is impossible to solve the problem of the tense relationship between humans and land, which leads to the fact that the operation pattern of land decentralization has not changed basically [2,3]. During "The Twelfth Five-Year Plan" period, the national land transfer area increased by an average of 24.0% per year. After entering "The Thirteenth Five-Year Plan", the land transfer area increased by an average of only 4.4% per year from 2016 to 2018. In recent years, the growth rate of land transfer areas has obviously slowed down [4]. About 2/3 of the cultivated land in China is still operated by the original contracted farmers[1]. In this way, farmers can actively participate

in agricultural-scale operations and benefit from it. In the relevant policy documents, the state proposes to encourage various forms of moderate-scale operation and has repeatedly emphasized the development of agricultural socialization services. It can be seen that policymakers pay more and more attention to agricultural socialized services. By the end of 2020, there were 900,000 agricultural socialized service organizations in China, and the agricultural production custody service area exceeded 10.7 million ha. This means that the specific path to improve APE through agricultural-scale operation will not be unique.

However, the effect of agricultural-scale operation is not necessarily positive. A large number of empirical studies show that land transfer has a significant positive effect on improving APE [5–7]. Land transfer rearranges land property rights among subjects with different behavioral abilities and decision-making preferences [8]. Farmers participate in the division of labor activities according to their own endowment and comparative advantages to produce the division of labor efficiency and promote the overall optimal allocation of resources [9]. For example, the farmers in Sweden want to evaluate the lessee's ability to manage their own farmland according to the cleanliness of the existing farmland before transferring the land, and provide help to the lessee after transferring the land to make agricultural production more efficient [10]. However, if the cost of land transfer increases or the scale of land transfer expands indefinitely due to the asymmetry of market information, there may also be invalid land transfer, resulting in an uneconomical scale [11]. At the same time, because land transfer in China is mainly based on short-term contract arrangements at present [12], the difference in property right duration and stability between the own plots and the transferred plots directly affects farmers' production and investment behavior [10,13]. If farmers are not willing to invest in short-term operations, it will have a negative impact on agricultural production. With the weakening of the role of land-scale operation in agricultural production, SSO has found the "intersection" between farmers and scale economy under the current institutional framework [2,14]. Compared with LSO, SSO is less restricted by strong constraints such as human–land relationships and farmland systems [15,16]. It has the potential to quickly improve APE [17]. In the process of agricultural production, if farmers only engage in relatively efficient production links and outsource relatively inefficient production links by purchasing services, the structural effect will improve the average efficiency of the whole agricultural production process [18,19]. However, some scholars have put forward different opinions. For example, according to the theory of scale economy, if all kinds of elements invested in agricultural production and operation cannot reach the optimal combination, farmers can neither achieve scale operation nor improve the average productivity of production links through the outsourcing of the production links [20]. At the same time, there are still some problems in the current agricultural socialized service, such as the diversified demand is difficult to meet, the public welfare service system is not perfect, the connection mechanism between service subjects is not perfect, and the growth of business service subjects is slow, which will seriously affect the APE [21,22]. Therefore, the validity of LSO promoted by land transfer still needs further proof, and the relationship between LSO, SSO, and APE needs to be explored at the same time to make clear the concrete realization path of agricultural modernization in China.

Based on this, the paper uses meta-analysis to focus on agricultural-scale operations. By retrieving published journal articles, the observation period can be expanded, and a larger sample size can be obtained. By integrating and analyzing the existing empirical research literature on the relationship between LSO, SSO, and APE, 117,627 data from 68 articles are finally included in the research database. The innovation of this paper lies in that by deeply exploring the relationship between different agricultural scale management modes and APE, it can be determined whether LSO promoted by land circulation and SSO promoted by social services are conducive to the improvement of APE. This can solve the current differences in the path of agricultural scale management. On the basis of answering these questions, this study makes theoretical contributions through a moderator analysis, which is helpful to better understand the underlying economies of scale theory. It can explain the relationship between

agricultural-scale operations and APE more scientifically and reasonably. The structure of this paper is as follows: The second part introduces the theoretical analysis and conceptual model. The third part introduces the data sources and research methods. The fourth part discusses the results. The fifth part summarizes the conclusions of this paper, puts forward proposals, and discusses the scope for future research.

2. Theoretical Analysis and Research Hypothesis

Regarding the relationship between agricultural scale management and APE, the theory of LSO advocates changing the decentralized operation pattern of small-scale farmers in China through the transfer of farmland. The theory of SSO advocates that through the division of labor in the production process and the subdivision of farmers' operation rights, on the one hand, farmers are involved in the socialized division of labor [23]; on the other hand, large-scale outsourcing service supply is formed. However, the two views are not contradictory. Promoting LSO through land transfer is considered the only way to transform traditional agriculture into modern agriculture to improve the input level and intensive degree per unit area. Land transfer improves the phenomenon of decentralization and fragmentation caused by household contracts and realizes large-scale and intensive farming to a certain extent [24]. It is helpful for agricultural machinery to carry out large-scale operations [25] and improve production efficiency. Although the LSO has reached the "deep water area" of reform at present, it has been widely accepted by farmers [26]. At the same time, the agricultural socialized service provides important support for promoting the operation of agriculture scale and improving the comprehensive agricultural production capacity in China [27]. It also has a great thrust on the transformation of traditional agricultural production methods and operation models. Although the agricultural socialized service system is not yet mature, it is undeniable that it helps small-scale farmers to integrate into the modern agricultural production and operation system. It helps to overcome the problem that traditional small-scale farmers have low endowments and cannot match the modern market economy. Based on this, this study puts forward a hypothesis:

H1a. *Agricultural-scale operations can play a positive role in improving APE.*

H1b. *LSO and SSO can play a positive role in improving APE.*

However, the research in different situations leads to different conclusions; that is, the research results are influenced by moderator variables. Arthur Jr et al. [28] defined the moderating variable as any variable contained in the analysis that can explain or help explain more differences. Through a detailed review of the existing literature, this paper summarizes the moderator variables that may affect the relationship between LSO, SSO, and APE, which can be roughly divided into five aspects: the agricultural production and operation environment, characteristics of the agricultural location, degree of farmers' participation, types of APE, and research situation.

Agricultural production and operation environment: In 2017, after the 19th Session of the National Congress of the Communist Party of China, China began to develop an agricultural socialized service system for small-scale farmers. This shows that China should not only adhere to the direction of LSO but also recognize the present situation, which is that small-scale farming is the basic form of agriculture [29]. It is necessary to strengthen the socialized service for small-scale farmers and handle the relationship between moderate-scale operations and the development of small-scale farmers correctly. It can be seen that different agricultural production and operation environments are formed under different policy guidance. Because of the differences in the data acquisition time of different articles, this paper takes 2017 as the time node to represent different agricultural production and operation environments. Based on this, this study puts forward a hypothesis:

H2a. *The agricultural production and operation environment can moderate the relationship between LSO and APE; that is, before 2017, this relationship is stronger.*

H2b. *The agricultural production and operation environment can moderate the relationship between SSO and APE; that is, after 2017, this relationship is stronger.*

The characteristics of the agricultural location: Agricultural production activities are strictly restricted by time and space conditions [30]. A scholar pointed out that if land is allowed to transfer freely, the average productivity of agriculture in most underdeveloped countries will be doubled, and if the indirect effects (such as human capital accumulation) are considered, the impact of land transfer on agricultural productivity will be more considerable. It can be seen that LSO has different effects in the areas with different levels of economic and agricultural development [31]. Under the current agricultural production environment in China, making full use of the advantages of SSO can significantly improve the efficiency of production, especially in areas with large cultivated land per household and less agricultural labor [32]. Due to the huge geographical differences among the provinces in China, the land and SSO cannot be generalized [33]. For example, China has thirteen major grain-producing areas, and the provinces in the major grain-producing areas have superior natural conditions, which is very conducive to the development of agricultural production activities. Therefore, the characteristics of the agricultural location can affect the research results. Based on this, this study puts forward a hypothesis:

H3a. *The characteristics of the agricultural location can moderate the relationship between LSO and APE; that is, this relationship is stronger in major grain-producing areas.*

H3b. *The characteristics of the agricultural location can moderate the relationship between SSO and APE; that is, this relationship is stronger in major grain-producing areas.*

The degree of farmers' participation: Because of the heterogeneity of farmers' participation in LSO or SSO, the different forms of variables in the model can also affect the research results [34]. Represented by the form of independent variables in the sample literature model, the variable in the form of 0–1 only distinguishes whether to participate in land transfer or social services. Such variables may not be enough to describe the actual situation in detail, which leads to the overestimation of the empirical results, while continuous variables can measure the participation level more accurately. Therefore, the degree of farmers' participation can affect the research results. Because different forms of variables are used in the measurement of farmers' participation in the various literature, this study puts forward a hypothesis:

H4a. *The degree of farmers' participation can moderate the relationship between LSO and APE; that is, when 0–1 is taken as the independent variable, LSO has a positively significant impact on APE.*

H4b. *The degree of farmers' participation can moderate the relationship between SSO and APE; that is, when 0–1 is taken as the independent variable, SSO has a positively significant impact on APE.*

The types of APE: It is impossible to separate the two dimensions of "yield" and "income" for discussion when studying the land or SSO [35]. The former is the main concern of the government, while the latter is the demand for micro-operation subjects. As market subjects and rational economic men, farmers' behavior is driven by the motivation of profit maximization [36]. It is difficult to keep consistent with the government's public welfare goal of ensuring agricultural product supply when making land transfer choices. In contrast, in the construction of an agricultural socialized service system, more emphasis is placed on systematic and supporting services, and it is easier to focus on public welfare services, especially government-led public welfare services [37]. It can be seen that LSO and SSO can have different effects on the "production efficiency" and "output value" of farmers and the "yield" of the government. Because the indexes with different connotations are used in the measurement of APE in the various literature, this study puts forward a hypothesis accordingly:

H5a. *The types of APE can moderate the relationship between LSO and APE; that is, when the type is "efficiency or output value", LSO has a positively significant impact on APE.*

H5b. *The types of APE can moderate the relationship between SSO and APE; that is, when the type is "yield", SSO has a positively significant impact on APE.*

Research situation: The data for studying LSO or SSO are mainly divided into micro data and macro data. Different data types can affect the empirical results, leading to completely different conclusions on the same issue [38]. Micro data are more targeted, but the survey results are influenced by the subjective cognition of the respondents, which affects the objectivity and repeatability of the empirical analysis results. At the same time, there are cases in which the respondents do not cooperate, resulting in a biased estimation of data projections. Comparatively speaking, macro data are more objective and complete, and the measurement results of variables are repeatable and more convincing [39]. Therefore, the research situation can affect the research results. Based on this, this study puts forward a hypothesis:

H6a. *The research situation can moderate the relationship between LSO and APE; that is, this relationship is stronger under the macro situation.*

H6b. *The research situation can moderate the relationship between SSO and APE; that is, this relationship is stronger under the macro situation.*

To sum up, due to the complexity of agricultural-scale operations, the existing research on the influence of LSO and SSO on APE by theoretical analysis or econometric methods has not reached a consistent conclusion. Therefore, this paper adopts the method of meta-analysis to analyze the findings of multiple independent empirical studies comprehensively and quantitatively in the existing literature, clarify the moderator variables, and answer the dispute about whether different agricultural-scale operation modes can improve APE. The conceptual model of this study is shown in Figure 1.

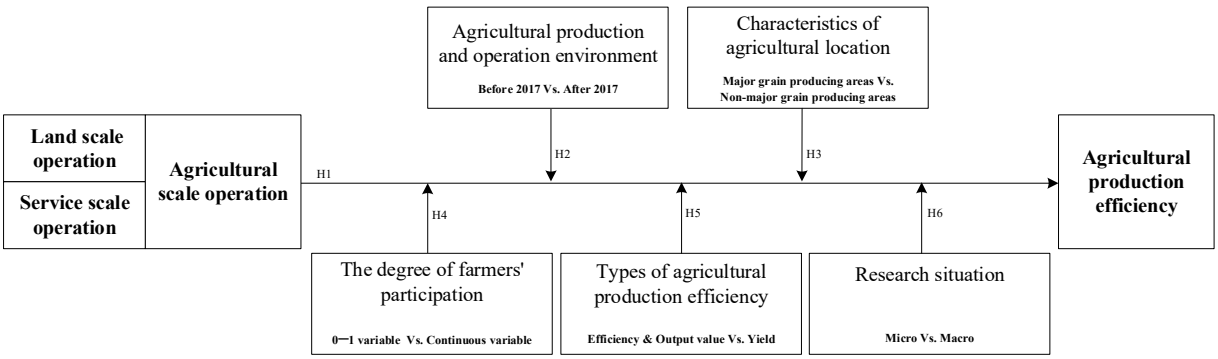


Figure 1. Conceptual model.

3. Materials and Methods

3.1. Data Source and Document Coding

1. Source of data: In this study, published journal articles were included in the research database through keyword and topic retrieval. Among them, Chinese journals were mainly obtained from CNKI, WANFANG DATA, and VIP journal resource integration service platforms, and the retrieval standard was CSSCI (including its expansion board). English journals were mainly obtained from Web of Science, Elsevier, and SpringerLink. The search terms included LSO, land transfer, agricultural efficiency, and their combinations on the one hand, and SSO, socialized service, agriculture services, productive service, service outsourcing, agricultural machinery service, agricultural trusteeship, agricultural efficiency,

and their combinations on the other. The deadline for retrieval was 31 December 2022. A preliminary literature search obtained 1831 records, and 1759 irrelevant documents were deleted. Then, by reading the titles and abstracts, 20 duplicate documents were eliminated, and the remaining 52 documents were supplemented. Moreover, 33 documents related to this study were supplemented until no new documents appeared. After the above steps, 85 articles were closely related to this study. After intensive reading of the articles based on the following criteria, it was finally determined that the sample size of this study was 68: Firstly, the research area is China, and the literature in non-China areas is excluded. Secondly, the article must include empirical analysis, and the results of the empirical analysis must report relevant coefficients or relevant data indicators that can be converted into the required effect values for research. Thirdly, the research problem must be the relationship between LSO, SSO, and APE. The empirical results must clarify the variables of LSO, SSO, and APE and delete the literature with vague results. Finally, for the research published in different journals by the same or different authors using the same sample group, select the literature with comprehensive information (Figure 2).

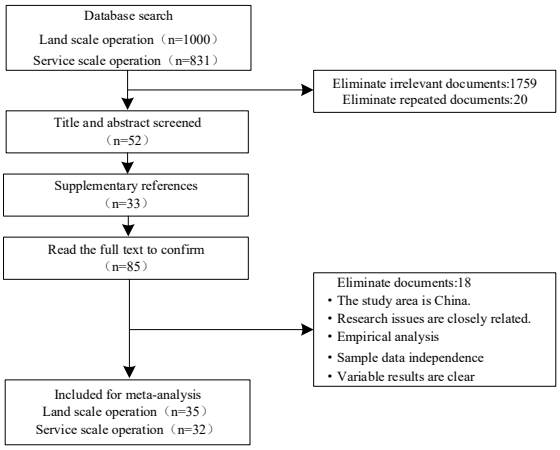


Figure 2. Literature screening process.

2. Document coding: This study tries to show the characteristics of different independent studies in detail, including the first author's name, publication time, journal name, sample size, model, variable effect value, and so on. The data required for the effect value include correlation coefficient, regression coefficient, sample freedom, and *t* value among the variables in empirical analysis. According to the principle of "one sample and one effect value", the effect value of a document is calculated and coded. If a document contains multiple independent and non-repetitive samples at the same time, the effect value of each sample is calculated and coded separately. In order to ensure the accuracy of the data, two authors carry out the above work at the same time. If the coding of the two authors is inconsistent, they should compare and discuss according to the original documents.

This study obtained 35 independent effect values about LSO and APE, and the sample size reached 90,267. Thirty-three independent effect values on SSO and APE were obtained, and the sample size reached 27,360. In this paper, the total sample size related to the variables is 117,627, as shown in Appendix A.

3.2. Calculation of Effect Value

This paper uses the correlation coefficient (r) as the effect value to express the relationship between LSO, SSO, and APE. However, some literature only reports the standard error or t value of the research, but not the correlation coefficient. Therefore, to calculate and convert the existing data indicators, the formula is as follows:

$$r = \sqrt{\frac{t^2}{t^2 + df}} \quad (1)$$

$$df = n - 1 - x \quad (2)$$

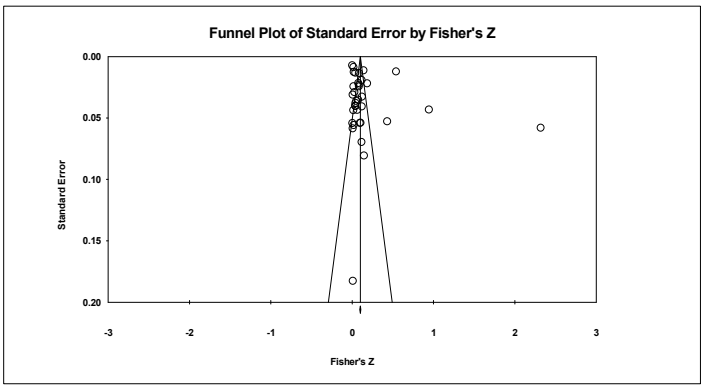
df is the degree of freedom, *n* is the number of samples, and *x* is the number of variables.

Finally, Fisher's Z is transformed to get the final effect value, and the formula is as follows:

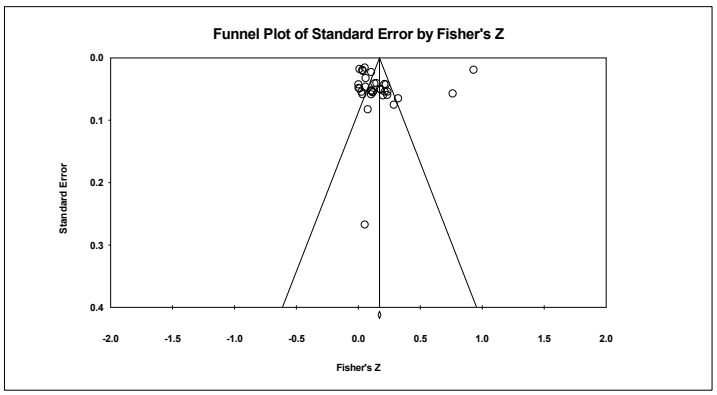
$$F_z = 0.5 \ln \left[\frac{1+r}{1-r} \right] \quad (3)$$

3.3. Publication Bias Test

Generally speaking, articles with significant empirical results are easier to publish, which can lead to publication bias. If there is a serious publication bias, the reliability of the meta-analysis will also be affected. The common test method of publication bias is a funnel plot. If the research samples are roughly symmetrically distributed at the top of the funnel, it means that the possibility of publication bias is small, and vice versa. As shown in Figure 3a,b, the sample documents of LSO and SSO are mainly concentrated on the top and distributed roughly symmetrically, indicating that the possibility of publication bias is not serious. However, this method is subjective and belongs to a qualitative conclusion, and it cannot explain the degree of bias. Therefore, this paper also uses Egger's method to test it [40], and according to the *p*-value, we can judge whether there is publication bias and how biased it is. The results are shown in Table 1. The values of the two kinds of literature are obviously greater than 0.05 (p = 0.191, p = 0.872). The results are insignificant, which once again proves that there is no publication bias in the study.



(**a**)



(**b**)

Figure 3. Funnel plot.

Table 1. Egger's regression.

Research Topic	Number of Documents	Sample Size	Intercept	SE	95%CI Upper Limit	95%CI Lower Limit	*t*	*p*
LSO	35	90,267	3.819	2.858	9.634	−1.996	1.337	0.191
SSO	33	27,360	−0.470	2.893	5.431	−6.371	0.162	0.872

3.4. Heterogeneity Test

Higgins and Thompson [41] point out that the heterogeneity test is carried out by the Q test and I^2 test. The Q test can find out whether there is heterogeneity among the different studies. If $p < 0.05$ in the Q test, it means there is heterogeneity. I^2 can be seen as the size of heterogeneity. It is generally believed that $I^2 > 50\%$ indicates that heterogeneity is large. Q and I^2 are also the basis for meta-analysis to adopt a fixed effect model or random effect model, with high heterogeneity adopting the random effect model and low heterogeneity adopting the fixed effect model. The Q of the sample literature on LSO is 3635.361, and I^2 is 99.1%. The Q of the SSO sample literature is 2027.199, and I^2 is 98.4%. There is strong heterogeneity in both types of sample documents, so a random effect model should be adopted.

$$Q = \sum_{i=1}^{n} w_i (Y_i - M)^2 \tag{4}$$

$$I^2 = \left(\frac{Q - df}{Q} \right) \times 100\% \tag{5}$$

Q is the overall heterogeneity, df is the degree of freedom, I^2 is the variance explained by heterogeneity, M is the comprehensive effect value, Y is the i-th study, and w_i is the weight of the i-th study.

3.5. Meta-Regression

Because of the differences in the research background, research area, research object, and data source of independent research, the relationship between different agricultural-scale operation modes and APE can be affected by moderator variables. In this paper, meta-regression is used, the effect value is taken as the explained variable, and the moderator variable is taken as the explanatory variable to verify the sources of heterogeneity among the different studies:

$$Y = \beta_0 x_i + \beta_1 + \varepsilon \tag{6}$$

Y is the effect value and the coefficient to be estimated, x_i is the moderator variable, β_0 is the coefficient, β_1 is the intercept term, and ε is the error term.

4. Results and Discussion

4.1. Overall Effect

The comprehensive effect value can reflect the correlation between the variables, and the meta-analysis results using the random effect model are shown in Table 2. The effect value of the research on LSO and APE is 0.174. The effect value of the research on SSO and APE is 0.162. The effect value of the research on agricultural-scale operation and APE is 0.168. This shows that there is a positive correlation between LSO, SSO, and APE; that is, agricultural-scale operation contributes to the improvement of APE, and the impact of LSO is stronger. H1a and H1b are established. LSO concentrates land resources and replaces land reasonably, which can avoid small-scale diseconomy caused by scattered plots [42]. It has played an important role in improving APE for a long time. However, the new agricultural socialized service system is still in the process of continuous improvement, and the specialized division of labor is not very detailed. The division of labor makes it difficult to carry out labor supervision, leading to higher transaction costs. At the same time, due to the diversification of the farmers' economic characteristics, the development

of agricultural socialized services is more difficult, and its role in agricultural production is not fully highlighted. However, this does not mean that the effect of agricultural SSO will always be lower than that of LSO in the future. If the problems of the existing socialized service system can be gradually solved in the future, SSO will have a stronger effect on improving APE. Therefore, improving APE is inseparable from the cross-integration of the two.

Table 2. Meta-analysis results.

Research Topic	Sample Size	N	B	Lower Limit	Upper Limit	*Z*	*p*
LSO	90,267	35	0.174	0.104	0.243	4.823	0.000 ***
SSO	27,360	33	0.162	0.065	0.255	3.261	0.001 ***
Agricultural-scale operation	117,627	68	0.168	0.114	0.222	6.001	0.000 ***

Note: *** indicates that the variable is significant at the 1% significance level.

4.2. Meta-Regression Analysis

As seen from Table 3, from the perspective of the agricultural production and operation environment, the coefficient of this variable is positive in the regression results of the sample documents of LSO, and it is significant at a 10% level ($\beta_0 = -0.195$, $p = 0.054$). H2a is established. However, it is insignificant in the regression results of the sample documents of SSO. H2b is not verified. From a practical point of view, it shows that the positive relationship between LSO and APE is stronger in the early research. This may be related to the increase in the transfer cost of land contractual operation rights [43] and the slowdown in the growth rate of land transfer areas in recent years. However, after 2017, the agricultural socialized service continued to develop [44], and the SSO was favored, which made this kind of sample literature data more distributed, resulting in the variable not playing a moderating role.

Table 3. Meta-regression results.

Moderator Variable	Research Topic	N	B	SE	*Z*	*p*
Agricultural production and operation environment (1 = after 2017, 0 = before 2017)	LSO	35	−0.195	0.121	−1.61	0.054 *
	SSO	33	0.058	0.126	0.46	0.322
The characteristics of the agricultural location (1 = includes major grain-producing areas, 0 = non-major grain producing areas)	LSO	35	0.141	0.087	1.62	0.053 *
	SSO	33	−0.111	0.121	−0.91	0.181
The degree of farmers' participation (1 = 0–1 variable, 0 = continuous variable)	LSO	35	0.130	0.083	1.57	0.058 *
	SSO	33	0.139	0.128	1.09	0.137
The types of APE (1 = efficiency or output value, 0 = yield)	LSO	35	0.264	0.109	2.42	0.008 ***
	SSO	33	−0.186	0.118	−1.58	−0.057 *
Research situation (1 = micro situation, 0 = macro situation)	LSO	35	−0.488	0.194	−2.52	0.006 ***
	SSO	33	−0.240	0.149	1.61	0.054 *

Note: *** indicates the variable is significant at the 1% significance level and * indicates the variable is significant at the 10% significance level.

From the characteristics of the agricultural location, in the regression results of the sample literature of LSO, it has a significant positive moderator effect ($\beta_0 = 0.114$, $p = 0.053$). H3a is established. It indicates that the effect of LSO is easily influenced by the agricultural location. The main grain-producing provinces have excellent climate, soil, and precipitation conditions [45]. Moreover, the scale of cultivated land per household is large, and the degree of land concentration is high, making the correlation between LSO and APE in the major grain-producing areas stronger than in the non-major grain-producing areas. The moderate effect of this variable is insignificant in the regression results of the SSO sample literature. H3b is not verified. The reason is that the form of service scale can avoid the constraints of human–land relationships or farmland systems to a certain extent. With the emergence of intelligent agricultural machinery, more agricultural machinery with precise positioning, terrain analysis, path planning, and other functions are put into agricultural productive

services [46–50], which break the limitation of regional natural conditions and make the SSO develop more widely.

From the perspective of farmers' participation, the literature meta-regression of the LSO samples results show that farmers' participation is significantly positive at the 10% level (β_0 = 0.130, p = 0.058). H4a is established. On the contrary, it is insignificant in the regression results of the SSO sample literature. H4b is not verified. It shows that the degree of farmers' participation affects the relationship between LSO and farmers' production efficiency. If the research is based solely on whether they participate in land transfer, it will produce results higher than the actual impact level. Comparatively speaking, SSO is more flexible, and social services can be divided into many different service links [51,52]. Therefore, if the variable in the form of 0–1 is used to measure whether farmers buy services in different links, respectively, the degree of their participation is also measured in detail. This can explain why the moderator variable is insignificant.

The types of APE are an important factor affecting the regression results of the model. The meta-regression results of the two types of samples show that the types of APE are significantly positive at the 1% level and significantly negative at the 10% level (β_0 = 0.264, p = 0.008; β_0 = −0.186, p = 0.057). H5a and H5b are established. It shows that the correlation between LSO and APE is stronger when "efficiency or output value" is the dependent variable, and the correlation between SSO and APE is stronger when "yield" is the dependent variable. Because the motivation of profit maximization drives farmers' behavior, the goal of land transfer is not to ensure food supply but to improve production efficiency or income. In contrast, the government dominates agricultural socialization services, and the services provided are of a public welfare nature. This makes farmers' agricultural production goals consistent with government goals, and "yield" is more easily concerned.

The research situation's meta-regression results of the two kinds of samples show that the moderator variable is significant at 1% and 10% levels, respectively (β_0 = −0.488, p = 0.006; β_0 = −0.240, p = 0.054). H6a and H6b are established. They show that the correlation between LSO, SSO, and APE is stronger under the macro situation.

4.3. Subgroup Regression

According to the results of meta-regression, the significant moderator variables are grouped to find more accurate heterogeneity information, and the results are shown in Tables 4 and 5.

Table 4. Subgroup analysis results of research samples on LSO and APE.

Moderator Variable		N	B	Lower Limit	Upper Limit	Z	p	
Agricultural production and operation environment	After 2017	5	0.076	0.049	0.103	5.505	0.000	0.000 ***
	Before 2017	30	0.192	0.114	0.268	4.768	0.000	
The characteristics of the agricultural location	Major grain-producing areas	16	0.200	0.056	0.336	2.701	0.007	0.000 ***
	Non-major grain-producing areas	19	0.154	0.068	0.239	3.469	0.001	
The degree of farmers' participation	0–1 variable	18	0.219	0.098	0.334	3.505	0.000	0.000 ***
	Continuous variable	17	0.127	0.063	0.190	3.889	0.000	
The types of APE	Efficiency or output value	29	0.208	0.122	0.290	4.704	0.000	0.226
	Yield	6	0.004	−0.009	0.016	0.555	0.579	
Research situation	Micro	33	0.154	0.086	0.222	4.383	0.000	0.000 ***
	Macro	2	0.457	−0.400	0.888	1.054	0.292	

Note: *** indicates the variable is significant at the 1% significance level.

1. LSO: From the agricultural production and operation environment, the effect value of document data collection time before 2017 is higher than that after 2017, and the heterogeneity is significant. From the characteristics of the agricultural location, the effect value of the major grain-producing areas is higher than that of the non-major grain-producing

areas, and the heterogeneity is significant. From the degree of farmers' participation, the effect of the variable in the form of 0–1 is higher than that of the continuous variable, and the heterogeneity is significant. From the different types of APE, "efficiency or output value" has a significant impact, while "yield" has no significant impact, and heterogeneity is significant. From the research situation, the effect value of using the macro situation is higher than that of the micro situation, and the heterogeneity is significant.

2. SSO: From the types of APE, "efficiency or output value" has a significant impact, while "yield" has no significant impact, and the heterogeneity is significant. From the research situation, the effect value of using the macro situation is higher than that of the micro situation, and the heterogeneity is significant.

Table 5. Subgroup analysis results of research samples on SSO and APE.

Moderator Variable		N	B	Lower Limit	Upper Limit	Z	p	
The types of APE	Efficiency or output value	28	0.140	0.096	0.184	6.140	0.000	0.000 ***
	Yield	5	0.259	−0.190	0.619	1.135	0.256	
Research situation	Micro	16	0.158	−0.019	0.325	1.750	0.080	0.000 ***
	Macro	17	0.164	0.093	0.233	4.510	0.000	

Note: *** indicates the variable is significant at the 1% significance level.

4.4. Sensitivity Analysis

In order to test the robustness of the estimation results of the previous model, the sensitivity analysis is carried out by using the leave-one-out method [53]. The effects of individual studies are eliminated one by one, and the remaining 34 and 32 studies are synthesized, respectively, and get the corresponding effect value. By integrating the remaining effect value, the difference between the variation interval of the effect values and the results of the overall effect analysis is observed. The results show that the literature range of the LSO sample is 0.114–0.180, and the literature range of the SSO sample is 0.134–0.167, which is not much different from the corresponding overall effect analysis results, so it can be considered that the analysis results obtained above are robust.

5. Conclusions and Suggestions

5.1. Conclusions

Different from the existing literature, which uses theoretical analysis or econometric model to analyze the influence of agricultural production and operation mode on APE, this paper adopts meta-analysis to integrate the empirical analysis results in the existing research and obtains reliable results that different agricultural-scale operation modes affect APE. The results show that (1) agricultural-scale operations have positive effects on APE, among which the effect value of LSO is higher than that of SSO. (2) The relationship between LSO and APE is positively regulated by the agricultural production and operation environment, characteristics of the agricultural location, degree of farmers' participation, and types of APE, and negatively regulated by the research situation. The relationship between SSO and APE is negatively regulated by the types of APE and research situation. Still, the moderator effects of the agricultural production and operation environment, characteristics of the agricultural location, and the degree of farmers' participation are insignificant. (3) Significant moderator variables are heterogeneous in all the research samples.

5.2. Suggestions

According to the research conclusion of the meta-analysis, the following policy suggestions are put forward: First, agricultural-scale operation is the main way to transform agricultural operations and realize agricultural modernization in China. It is necessary not only to pay attention to the important role of socialized service in the connection between small-scale farmers and modern agriculture but also to recognize the critical position of land transfer in agricultural-scale operations and guide farmers to transfer land effectively.

Second, China's agricultural-scale operation must promote "double-scale" according to local conditions. Because agricultural location conditions and farmland systems more easily restrict LSO, the development of intelligent agricultural service makes SSO effectively make up for the shortcomings of LSO. Therefore, only when they cooperate with each other can the potential of improving agricultural production efficiency be fully released. Third, the government should grasp the actual situation of agricultural production, and not only formulate inclusive policies to promote agricultural-scale operation but also encourage and support the realistic choice of producers and improve the enthusiasm of producers to explore new operation paths. Encourage agricultural producers through policy subsidies and support so that they have the same goal as the government, which is to improve agricultural production efficiency and ensure the supply of agricultural products such as grain. Fourthly, the promotion policy of agricultural-scale operation should consider both the macro development of the region and the endowment of the micro producer. Formulate different policies to avoid the mismatch of factors in agricultural production so as to effectively improve the production situation of agricultural micro subjects through the optimal allocation of production factors and then promote the improvement of agricultural production efficiency.

5.3. Research Limitations and Future Work

This study proves the effectiveness of LSO and SSO, and clarifies the dual-scale management path to improve agricultural production efficiency. It can provide a theoretical reference for the development of agricultural scale management in China. However, there are other factors that affect the APE, and we have not been able to include them all in this study, such as agricultural structure. In view of the important role of land scale management in improving agricultural production efficiency, we should pay attention to how to promote land transfer through the adjustment of agricultural structure in the future and explore the moderator effect of economic development and non-agricultural employment in the process of land transfer.

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Appendix A

Table A1. Research Sample Codes.

	First Author	Publication Time	Journal	Sample Size	Model	*r*	SE	Fisher's *Z*	References
LSO	Wang	2022	*China Rural Survey*	1912	NA	0.082	0.023	0.082	[53]
	Yang	2022	*Journal of Agrotechnical Economics*	5555	Logistic regression	0.084	0.013	0.085	[54]
	Dong	2022	*Resources Science*	534	Technical inefficiency model	0.062	0.043	0.062	[55]

Table A1. *Cont.*

First Author	Publication Time	Journal	Sample Size	Model	*r*	SE	Fisher's *Z*	References
Yuan	2022	*Chinese Journal of Agricultural Resources and Regional Planning*	611	Tobit	0.118	0.040	0.119	[56]
Zhang	2021	*Journal of Agrotechnical Economics*	1701	OLS	0.082	0.024	0.083	[57]
Li	2021	*Journal of Agrotechnical Economics*	344	Technical inefficiency model	0.003	0.054	0.003	[58]
Zhu	2021	*Rural Economy*	705	OLS	0.041	0.038	0.041	[59]
Shi	2020	*China Land Science*	540	Tobit	0.737	0.020	0.945	[60]
Luan	2020	*China Land Science*	620	OLS	0.041	0.040	0.041	[61]
Han	2020	*Journal of Northwest A&F University (Social Science Edition)*	2745	Tobit	0.116	0.019	0.116	[62]
Yang	2020	*Issues in Agricultural Economy*	1044	Fixed effects model	0.007	0.031	0.007	[63]
Chen	2020	*The Journal of World Economy*	8000	Fixed effects model	0.140	0.011	0.141	[64]
Chen	2020	*Journal of Hebei University of Economics and Business*	33	OLS	0.008	0.183	0.008	[65]
Yan	2019	*China Agricultural Economic Review*	6477	Influencing factor model of technical efficiency	0.021	0.012	0.021	[66]
Ji	2019	*China Rural Survey*	945	Influencing factor model of technical efficiency	0.120	0.032	0.120	[67]
Wei	2019	*Rural Economy*	530	OLS	0.014	0.044	0.014	[68]
Zeng	2018	*Journal of Agrotechnical Economics*	346	Tobit	0.094	0.054	0.094	[69]
Cai	2018	*Resources Science*	363	PSM	0.406	0.044	0.431	[70]
Yan	2018	*Resource Development & Market*	13676	Technical inefficiency model	0.017	0.009	0.017	[71]
Qiu	2017	*China Rural Survey*	1703	NA	0.016	0.024	0.016	[72]
Liu	2017	*Economic Geography*	5778	Average treatment effect	0.039	0.013	0.039	[73]
Zhang	2017	*Resources Science*	632	C-D	0.038	0.040	0.038	[74]
Chen	2017	*Journal of Agrotechnical Economics*	20,000	OLS	0.000	0.007	0.000	[75]
Qian	2016	*China Rural Survey*	6785	OLS	0.493	0.009	0.540	[76]
Xu	2016	*Journal of Agrotechnical Economics*	157	Efficiency loss function	0.144	0.079	0.145	[77]

Table A1. *Cont.*

	First Author	Publication Time	Journal	Sample Size	Model	*r*	SE	Fisher's *Z*	References
	Liu	2016	*Journal of Huazhong Agricultural University (Social Sciences Edition)*	347	Efficiency loss function	0.104	0.053	0.104	[78]
	Qi	2015	*Resources Science*	817	Tobit	0.074	0.035	0.074	[79]
	Mao	2015	*Economic Research Journal*	2115	PSM	0.182	0.021	0.184	[80]
	Chen	2015	*Journal of Arid Land Resources and Environment*	296	C-D	0.007	0.058	0.007	[81]
	Li	2015	*Journal of Agro-Forestry Economics and Management*	301	SFA	0.981	0.002	2.318	[82]
	Huang	2014	*China Rural Survey*	325	Influencing factor model of technical efficiency	0.018	0.056	0.018	[83]
	Fan	2014	*China Population, Resources and Environment*	1196	OLS	0.029	0.029	0.029	[84]
	Liu	2013	*China Rural Survey*	210	Technical inefficiency model	0.115	0.069	0.116	[85]
	Zhu	2011	*Journal of Agrotechnical Economics*	769	C-D	0.050	0.036	0.050	[86]
	Li	2009	*China Economic Quarterly*	2155	Fixed effects model	0.076	0.021	0.076	[87]
SSO	Cai	2022	*Journal of Arid Land Resources and Environment*	956	OLS	0.059	0.032	0.059	[88]
	Xu	2022	*Rural Economy*	286	Tobit	0.229	0.056	0.233	[89]
	Bi	2022	*Resources Science*	344	Tobit	0.231	0.051	0.236	[90]
	Huan	2022	*Journal of Agro-Forestry Economics and Management*	570	GLS	0.208	0.040	0.211	[91]
	Gu	2022	*Chinese Journal of Agricultural Resources and Regional Planning*	551	IV–2SLS	0.219	0.041	0.222	[92]
	Jiang	2022	*World Agriculture*	310	OLS	0.642	0.034	0.761	[93]
	Li	2021	*Journal of Agrotechnical Economics*	385	Tobit	0.181	0.049	0.183	[94]
	Zhang	2021	*Journal of Agrotechnical Economics*	558	IV–2SLS	0.001	0.042	0.001	[95]
	Zhang	2021	*Journal of Agrotechnical Economics*	338	Panel model	0.116	0.054	0.117	[96]
	Qiu	2021	*Journal of Agrotechnical Economics*	3179	OLS	0.009	0.018	0.009	[97]
	Qiu	2021	*Rural Economy*	2750	logit	0.731	0.009	0.930	[98]

Table A1. *Cont.*

First Author	Publication Time	Journal	Sample Size	Model	*r*	SE	Fisher's *Z*	References
Chu	2021	*Statistics & Decision*	434	Fixed effects model	0.001	0.048	0.001	[99]
Huan	2021	*Journal of Huazhong Agricultural University (Social Sciences Edition)*	2299	GLS	0.036	0.021	0.036	[100]
Tian	2021	*Commercial Research*	468	Tobit	0.057	0.046	0.057	[101]
Xu	2021	*Chinese Journal of Agricultural Resources and Regional Planning*	298	Technical inefficiency model	0.033	0.058	0.033	[102]
Wu	2021	*Contemporary Economic Management*	2666	OLS	0.032	0.019	0.032	[103]
Han	2020	*Journal of Agrotechnical Economics*	618	Fixed effects model	0145	0.039	0.146	[104]
Li	2020	*Journal of Agrotechnical Economics*	4080	SDM	0.052	0.016	0.052	[105]
Lu	2020	*Journal of Zhongnan University of Economics and Law*	328	Technical inefficiency model	0.116	0.055	0.116	[106]
Zhang	2020	*Journal of Huazhong Agricultural University (Social Sciences Edition)*	403	OLS	0.174	0.048	0.176	[107]
Yang	2019	*Journal of Agrotechnical Economics*	368	Technical efficiency model	0.102	0.052	0.103	[108]
Yu	2019	*Journal of Huazhong Agricultural University (Social Sciences Edition)*	345	SDM	0.210	0.052	0.213	[109]
Liu	2019	*Chinese Journal of Agricultural Resources and Regional Planning*	180	Fixed effects model	0.278	0.069	0.286	[110]
Hu	2018	*China Rural Survey*	240	Tobit	0.310	0.059	0.321	[111]
Hao	2018	*Study and Practice*	420	GLS	0.009	0.049	0.009	[112]
Liu	2018	*Chinese Journal of Agricultural Resources and Regional Planning*	17	Tobit	0.052	0.267	0.052	[113]
Yang	2017	*Journal of Huazhong Agricultural University (Social Sciences Edition)*	1926	Technical efficiency model	0.104	0.023	0.104	[114]
Qin	2017	*Modern Economic Research*	341	Panel threshold regression model	0.025	0.054	0.025	[115]
Sun	2016	*China Rural Survey*	295	Technical efficiency model	0.103	0.058	0.013	[116]
Zhang	2015	*Issues in Agricultural Economy*	358	NA	0.108	0.052	0.109	[117]

Table A1. *Cont.*

	First Author	Publication Time	Journal	Sample Size	Model	*r*	SE	Fisher's *Z*	References
	Wei	2015	*Economic Survey*	279	OLS	0.196	0.058	0.199	[118]
	Chen	2012	*China Rural Survey*	150	C-D	0.076	0.082	0.076	[119]
	Hao	2011	*Finance & Trade Economics*	600	OLS	0.129	0.040	0.130	[120]

Note

[1] https://www.gov.cn/xinwen/2021-02/08/content_5585799.htm (accessed on 10 February 2023).

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