Village-Scale Public Cultural Service Supply Efficiency and its Influencing Factors Based on DEA and Tobit Model

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Keywords	Abstract
Public cultural services; Supply of efficiency; Influencing factors; Rural revitalization; DEA	Rural revitalization cannot be separated from rural culture. The study of the supply efficiency of public cultural services from the perspective of the village area is helpful to help the rural revitalization with cultural precision. Taking Heilongjiang Province as the research area, collect relevant data of 14 natural villages from 2017 to 2021, explain the efficiency of public cultural service according to the concept of Pareto optimal, and using the DEA model to analyze the supply efficiency of culture, economy, society and education by various elements, and finally, to analyze the efficiency of village public cultural service. The research shows that the overall efficiency of rural public cultural service supply in Heilongjiang Province from 2017 to 2021 is low; the spatial dimension varies greatly and the time dimension fluctuates obviously; meanwhile, multiple elements can improve the efficiency of public cultural service supply. Three suggestions are provided based on the results.

1. Introduction

In recent years, an important law on the Protection of Public Cultural Services, the Law of the People's Republic of China, has been promulgated and implemented in the field of public culture, providing a legal basis for the construction of the urban and rural public cultural service system. In 2019, the Publicity Department of the CPC Central Committee and the Ministry of Culture and Tourism and 17 other government departments jointly issued the Work Plan for Promoting the Revitalization of Rural Culture, making specific arrangements for the implementation of the rural revitalization strategy in the field of publicity and culture. Since 2021, culture and tourism joint relevant departments issued by the opinions on promoting the development of public cultural services quality "public service planning" difference "the national basic public service standards, compiled issued by the" difference "culture and tourism development planning", the "difference" public cultural service system planning, will "promote the construction of urban and rural public cultural service system integration" as an important target task to plan, in deepening the standardization construction, cultural prosperity power

rural revitalization, improve the coordinated development mechanism of the development of urban and rural public cultural services to make specific deployment (Jiang & Wu, 2022; Tong et al., 2022).

Rural revitalization cannot be separated from the revitalization of rural culture, and the construction of rural public cultural services is also a hot issue discussed by scholars. In recent years, many scholars from different angles have studied public cultural services: Li and Wang (2010) analyzed from the perspective of supply socialization, the supply socialization is divided into government leading, social subject dominant and double subject cooperation three modes, and build the government, enterprises and the third department multicenter governance subject interactive cooperation mode. Yang and Guo (2020) analyzed from the perspective of demand, and through the method of questionnaire and household interview, investigated that the current rural public cultural services have inefficient operation, lack of content, and disconnection with the needs of farmers (Chen, 2022; Geng, 2022). Chen (2017) analyzed from the perspective of supply-side reform, and found that the current rural public cultural services have some problems of supply-side structural failure, such as homogenization of supply content and fragmentation, and tried to adjust with the mode of "autonomy + other governance (Shang & Chen, 2022; Song & Yu, 2016) ". Song and Yu (2016) analyzed from the perspective of experience introduction, referred to the practices of foreign rural public cultural service and advanced innovative ideas, and sorted out the operation mechanism of rural public cultural service in China (Luo, 2022; Sun, 2011). From the perspective of inhibitory factors, Sun (2011) found that there are institutional obstacles in rural public cultural services, which restrict the expression of farmers' cultural needs, so a multi-dimensional co-governance management system should be constructed to solve the problems (Wang, 2022; Liu & Xiong, 2020; Tian et al.,2017). It can be seen that the research results on rural public cultural services cover a wide range, but there are few studies based on the village scale. In this paper, the starting point is to study the efficiency of public cultural services supply and its influence mechanism, so as to help improve the rural public service system and expand the achievements of rural revitalization.

This paper takes Heilongjiang Province as the research area. The operating system and operating environment of rural public cultural services are taken as the research object. On the basis of previous studies, this paper constructs the evaluation of public cultural service system in Heilongjiang Province from the perspective of village. In this paper, 14 rural areas in Heilongjiang Province are selected as research samples, and the system internal coupling analysis is carried out. On the basis of the analysis results, the paper analyzes the shortcomings and defects of rural public cultural services, and constructs reasonable solutions. In terms of research method selection, this paper uses DEA and Tobit models to measure rural public cultural services. First, DEA model (Data Envelopment Analysis) is used to evaluate the relative efficiency of DMUs through multi-dimensional vectors. Then, by comparing the distance between the input and output vectors of DMU (Decision-making Unit) and those of other DMU, the relative efficiency score of each DMU can be calculated (Wang & Wu, 2011). Secondly, the Tobit model is used to estimate the linear relationship between the potential variables after dimensionality reduction to infer the unobserved value, so as to analyze the efficiency of rural public cultural service at the village scale at the present stage (Zhou & Li, 2012).

2. Calculation and Analysis of the Efficiency of Public Cultural Service Supply

2.1. Study scope and data source

In this paper, Heilongjiang Province is taken as the research area, and 14 natural villages around the six cities of Harbin, Qiqihar, Suihua, Mudanjiang, Jiamisi and Heihe are selected as the research focus based on the location distance from the core city and the degree of regional economic development.

In order to ensure that each object in the population has a known, non-zero probability of being selected as the research object, and then ensure the representability of the sample, this paper adopts the equal probability random sampling method to randomly select all villages around the six cities.

The final results are as follows: 4 villages in Harbin City (V1-V4), 3 villages in Qiqihar city (V5-V7), 3 villages in Suihua City (V8-V10), 2 villages in Mudanjiang City (V11-V12), 1 village in Jiamisi City (V13) and 1 village in Heihe city (V14).

Data sources: Heilongjiang Provincial Yearbook (2018-2022), six city yearbooks (2018-2022), and sample village records (2018-2022).According to the research design and the collected data, the missing data in the village records were supplemented by interviewing the village secretary of 14 villages. Finally, 2000 valid data of 14 villages from 2017 to 2021 were collected.

2.2. Selection of the supply efficiency of public cultural services at the village area scale

At the same time, based on the Pareto optimal condition, the supply efficiency of rural public cultural services should be measured, and its production efficiency and exchange efficiency should be considered (Liu & Guo, 2020). In terms of production, it mainly considers the cultural environment in the village and the degree of emphasis on cultural services, so it chooses two indicators: the number of cultural activities and the proportion of cultural expenditure in the village in the financial expenditure. In terms of exchange, considering the construction of various forms of service platforms such as "digital countryside" and "Internet + culture" to give public cultural services more feasible ways, the utilization rate of digital public service platforms and the per capita public land area are selected, and the Internet is also the main supply way for public cultural services due to the epidemic. Finally, from the two aspects of the overall cultural atmosphere construction and the change of villagers' onsciousness, the proportion of civilized families and the proportion of family cultural consumption expenditure are selected as output considerations. From the perspective of economic theory, this paper summarizes the above indicators into two aspects of input and output, and constructs an indicator of the supply efficiency of rural public cultural services (Table 1).

Table 1 *Efficiency index of rural public cultural services supply*

Level 1 Indicators	Secondary Indicators	Index Interpretation
Investment index	Number of cultural activities	The statistics include the number of comprehensive cultural activities such as drama performance, film broadcasting, legal education and health education
	Land area for public welfare per capita	The per capita area of cultural service center, library, cultural station and public welfare square in the village
	Digital public service platform usage rate	The frequency of use of multiple Internet digital public service platforms such as mobile phones and computers
	Cultural expenditure in the village accounts for the proportion of fiscal expenditure	The proportion of cultural service expenditure in the annual village expenditure item
Output indicators	The proportion of civilized families	All levels of good in-laws, good children, new villagers, good neighbors and other comprehensive civilized families account for the proportion of the whole village
	The proportion of family culture consumption expenditure	The proportion of cultural and tourism consumption in the total expenditure of each family

2.3. Efficiency model construction

In this paper, DEA-BCC model is adopted that DMU is in the case of variable scale compensation, which is used to measure pure technology and scale efficiency (Zhou & Li, 2012).

DEA-BCC model mainly measures the pure technical efficiency, that is, the ratio of technical efficiency to scale efficiency. Compared with the DEA-CCR model, the DEA-BCC model takes into account the variable returns to scale (VRS) situation, that is, when some decision units are not operating at the optimal scale, The measurement of Technology efficiency (TE) is influenced by Scale efficiency (SE).

The taper assumption of producing possible sets is sometimes unrealistic or unreasonable, and therefore the term assumption is removed. When the production possible set T only meets convexity (inclusion conditions), invalidation and minimization, the BCC model with variable scale returns is met. $\sum \lambda j = 1$

$$
\left.
\begin{aligned}
\min \quad & \left[\theta - \varepsilon \left(e^{\mathrm{T}} s^- + e^{\mathrm{T}} s^+ \right) \right] \\
\text{s.t.} \quad & \sum X_j \lambda_j + s^- = \theta X_0 \\
& \sum Y_j \lambda_j - s^+ = Y_0 \\
& \sum \lambda_j = 1 \\
& \lambda_j \geq 0, \quad s^+ \geq 0, \quad s^- \geq 0 \; ; j = 1, 2, \ldots, \; n
\end{aligned}
\right\}
\tag{2.1}
$$

This model simply evaluates the technical effectiveness of the DMU. Its dual form is follows:

$$
\left.
\begin{aligned}
\max \quad & \left(\mu^{\mathrm{T}} Y_0 - u_0 \right) \\
\text{s.t.} \quad & mu^{\mathrm{T}} Y_j - \omega^{\mathrm{T}} X_j - \mu_0 \leq 0 \\
& \omega^{\mathrm{T}} X_0 = 1 \\
& \omega \geq \varepsilon, \quad \mu \geq \varepsilon, \quad \mu_0, \quad \text{isfree}
\end{aligned}
\right\}
\tag{2.2}
$$

u_0 Where is the indication of scale gain. If it is the optimal value of the above formula, then: u_0^*

$u_0^* < 0$ (1). Increasing income from scale;

$u_0^* = 0$ (2), the scale income remains unchanged;

$u_0^* > 0$ (3) Gdiminishing returns on scale.

2.4. Results of the efficiency measurement of rural public cultural services

The data was imported into DEAP 2.1 software and calculated by BCC model. The specific results are shown in Table 2. It can be seen that the overall efficiency of public cultural services in rural areas of Heilongjiang Province is low. From the overall point of view, only 3 villages of 14 natural villages (V6, V10 and V121) all reached 1 in 2017, in the effective state of DEA, belonging to Qiqihar City, Suihua City and Jiamusi City respectively, and the comprehensive efficiency of the other 11 villages was lower than 1 in 2017-2021.

From the perspective of space, the spatial distribution of efficiency varies greatly. The average efficiency of public cultural service supply in 14 villages is 0.7631, the highest value is 1, the lowest value is 0.2366, and the difference value is 0.7634. The overall efficiency of the four natural villages in Harbin city is ok, but only the V4 efficiency value is relatively low, but it is also more than 66%, and the efficiency value is 0.6616. Qiqihar city, Suihua City and Jiamusi City belong to the polarization area. Among the statistical natural villages, the efficiency value is 1. Meanwhile, there are also villages with low efficiency value, namely V7 (0.5668) and V8 (0.6810). This shows that there are some problems in regional coordination among the three cities, and there is an imbalance in the supply of public cultural services between regions. V13 village of Mudanjiang City is the area with the lowest efficiency value of public cultural service supply, which is only 0.2366, but its technology supply efficiency is relatively high, and there are certain production efficiency problems. The efficiency of public service supply in the villages selected by other cities is more than 90%, and the gap between regions is small.

From the perspective of time, from 2017 to 2021, V1, V2 and V3 in the four villages in Harbin were stable on the whole, but they were all in the downward trend of efficiency value. V4 had certain fluctuations. The efficiency value rose to 1 in 2020, and then dropped to 0.451, pulling down the average value of the whole region. After in-depth analysis, it is found that both the technical efficiency and the scale efficiency of V4 fluctuate, and the change range of the technical efficiency is higher than the scale efficiency, which further affects the comprehensive efficiency value. In other cities, except for the highest efficiency value of V6, V10 and V12, the change of the efficiency value in the other 5 years was relatively stable, and there was no strong amplitude change.

Table 2 *Supply efficiency of public cultural services in 14 villages in Heilongjiang Province*

Area	Village	Productiveness	2017	2018	2019	2020	2021	Average value
Harbin City	V1	vrste	1.000	1.000	1.000	1.000	1.000	1
		scale	0.827	1.000	1.000	1.000	0.811	0.9276
		crste	0.827	1.000	1.000	1.000	0.811	0.9276
		E f	Drs	-	-	-	Drs	
	V2	vrste	1.000	1.000	1.000	1.000	0.900	0.9800
		scale	1.000	1.000	1.000	1.000	0.498	0.8996
		crste	1.000	1.000	1.000	1.000	0.448	0.8896
		E f	-	-	-	-	Drs	
	V3	vrste	1.000	1.000	0.927	1.000	1.000	0.9854
		scale	1.000	0.858	0.937	0.880	0.789	0.8928
		crste	1.000	0.858	0.869	0.880	0.789	0.8792
		E f	-	Drs	Drs	Drs	Drs	
	V4	vrste	0.942	0.703	0.588	1.000	0.687	0.7840
		scale	0.882	0.865	0.772	1.000	0.604	0.8246
		crste	0.831	0.608	0.454	1.000	0.415	0.6616
		E f	Drs	Drs	Drs	-	Drs	
Qiqihar City	V5	vrste	0.967	1.000	0.953	0.989	0.937	0.9692
		scale	0.929	1.000	0.976	0.940	0.919	0.9528
		crste	0.899	1.000	0.930	0.930	0.861	0.9240
		E f	Drs	-	Drs	Drs	Drs	
	V6	vrste	1.000	1.000	1.000	1.000	1.000	1
		scale	1.000	1.000	1.000	1.000	1.000	1
		crste	1.000	1.000	1.000	1.000	1.000	1
		E f	-	-	-	-	-	
	V7	vrste	1.000	1.000	0.965	0.973	0.907	0.9690
		scale	0.683	0.659	0.570	0.524	0.477	0.5826
		crste	0.683	0.659	0.550	0.510	0.432	0.5668
		E f	Drs	Drs	Drs	Drs	Drs	
Suihua City	V8	vrste	0.722	0.864	0.866	1.000	0.816	0.8536
		scale	0.889	0.876	0.833	0.861	0.520	0.7958
		crste	0.642	0.757	0.721	0.861	0.424	0.6810
		E f	Drs	Drs	Irs	Drs	Drs	
	V9	vrste	1.000	1.000	1.000	1.000	1.000	1
		scale	0.872	1.000	1.000	1.000	1.000	0.9744
		crste	0.872	1.000	1.000	1.000	1.000	0.9744
		E f	Drs	-	-	-	-	

		vrste	1.000	1.000	1.000	1.000	1.000	1
	V10	scale	1.000	1.000	1.000	1.000	1.000	1
		crste	1.000	1.000	1.000	1.000	1.000	1
		E f	-	-	-	-	-	
Jiamusi City	V11	vrste	0.858	1.000	1.000	0.993	1.000	0.9702
		scale	0.967	1.000	1.000	0.902	1.000	0.9738
		crste	0.829	1.000	1.000	0.896	1.000	0.9450
		E f	Drs	-	-	Drs	-	
	V12	vrste	1.000	1.000	1.000	1.000	1.000	1
		scale	1.000	1.000	1.000	1.000	1.000	1
		crste	1.000	1.000	1.000	1.000	1.000	1
		E f	-	-	-	-	-	
Mudanjiang City	V13	vrste	1.000	1.000	1.000	1.000	1.000	1
		scale	0.235	0.246	0.222	0.234	0.246	0.2366
		crste	0.235	0.246	0.222	0.234	0.246	0.2366
		E f	Drs	Drs	Drs	Drs	Drs	
Heihe city	V14	vrste	1.000	1.000	1.000	1.000	0.866	0.9732
		scale	1.000	1.000	1.000	1.000	0.996	0.9992
		crste	1.000	1.000	1.000	1.000	0.863	0.9726
		E f	-	-	-	-	Drs	

Note: vrste is technical efficiency; scale is scale efficiency; crste stands for technical efficiency; Ef is return to scale; Drs is decreasing returns to scale; Irs is increasing returns to scale; -No change in returns to scale.

3. Selection and Analysis of the Factors Influencing the Efficiency of Public Cultural Service Supply

3.1. Selection of influencing factors

Based on the study of many scholars, this paper believes that the village domain scale of rural public cultural services supply is not a single designated for the provision of public goods, because the boundary between the rural public products is relatively fuzzy and high correlation, such as economic foundation, social security, education supply has strong influence effect on cultural supply. In general, the rural regional economy is better, high social security level, education popularity is wider, so the farmers' cultural demand is higher, otherwise will reduce cultural demand and seek other growth, so in the analysis of rural public cultural service supply efficiency influence factors need to consider the village domain boundaries of economic level, social security degree, education popularity and other complex environment. Therefore, from the perspective of village area, after comprehensively analyzing the interaction of culture, economy, society, education and other factors, the influencing factors of the supply efficiency of rural public cultural services were selected from the perspective of village area, as shown in Table 3.

The relevant indicators of economic level are selected as the proportion of migrant workers (X3), per capita GDP (X8), agricultural output value ratio (X10) and regional economic development degree (X11). The relevant indicators of education popularization were selected as population base (X1), high grade and popularization rate (X4), years of education for cultural service providers (X5), number of farmers' amateur cultural organizations (X6), and utilization rate of comprehensive cultural places (X7). Social security degree is selected by aging population ratio (X2), Engel coefficient (X9), and basic medical and old-age security penetration rate (X12). (The meanings of the 12 indicators are shown in Table 3)

Table 3 *Related indicators of influencing factors*

Variable	Index	Indicator Meaning
explanatory variable	Population base (X1)	Number of permanent residents
	Aging population ratio (X2)	The ratio of the elderly to the permanent resident population
	Proportion of migrant workers (X3)	The ratio of migrant workers in the permanent resident population
	Higher education penetration rate (X4)	The proportion of people receiving higher education among the permanent resident population
	Years of education for cultural service providers (X5)	The average number of years of education among public cultural service workers
	Number of peasant amateur cultural organizations (X6)	The number of farmers' amateur cultural organizations that can provide public cultural services
	Utilization rate of comprehensive cultural sites (X7)	Use efficiency of public cultural service places
	GDP per capita (X8)	Per-capita disposable income of each village
	The Engel Coefficient (X9)	The Engel coefficient for each village
	Agricultural output value ratio (X10)	The proportion of agricultural output value in each village in the total GDP
	Regional economic evelopment (X11)	The economic development degree of the location of each village belongs to (extremely poor, poor, general, more developed, developed)
	The rate of basic medical care and pension security (X12)	Villages can participate in the basic pension and the new rural cooperative medical personnel proportion
explained variable	Efficiency of rural public cultural services (Y)	The DEA-BCC calculates the efficiency value of public cultural services in each village

3.2. Factor analysis results

Therefore, the selected indexes have strong collinearity, and the data were compared with KMO and Bartlett test by SPSS software, and the results are shown in Table 4. The results of KMO test showed that the value of KMO was 0.729. Meanwhile, the results of Bartlett spherical test showed that the significance P value was 0.000[***], significant at the level, rejected the null hypothesis, correlation among variables, and the factor analysis was valid. Factor analysis was used to extract the common factor of the selected index. In the variance interpretation table (Table 5), the contribution rate of variable interpretation reached 64.911%. The common factor vector F, namely, the specific score of the original variable on the public factor, can be estimated by the regression method. Finally, the component matrix table is calculated, and the score of each component can be calculated according to the formula (3) of the factor score coefficient of each component.

$$\widehat{F}_j = \widehat{A}^T S^{-1} \chi_j \tag{3.1}$$

Table 4 *KMO and Bartlett*

KMO and Bartlett		
KMO		0.729
Bartlett	Approximate	994.298
	df	66
	P	0.000[***]

Note: [***], [**] and [*] represent the significance levels of 1%, 5% and 10%, respectively

Table 5 *The variance interpretation table*

	Total variance interpretation					
	Rate of variance interpretation before rotation			Rate of variance interpretation after rotation		
Ingredient	Characteristic Root	Variance Interpretation Rate (%)	Cumulative Variance Interpretation Rate (%)	Characteristic Root	Variance Interpretation Rate (%)	Cumulative Variance Interpretation Rate (%)
1	3.092	25.77	25.77	296.671	24.723	24.723
2	1.369	11.411	37.181	134.956	11.246	35.969
3	1.281	10.671	47.852	130.653	10.888	46.857
4	1.058	8.821	56.672	117.79	9.816	56.672
5	0.989	8.238	64.911			
6	0.93	7.749	72.66			
7	0.75	6.247	78.907			
8	0.638	5.321	84.228			
9	0.63	5.247	89.475			
10	0.57	4.752	94.227			
11	0.411	3.426	97.653			
12	0.282	2.347	100			

Table 6 *The component matrix table*

| name | Component Matrix Table | | | |
| | Ingredient | | | |
	F 1	F 2	F 3	F 4
X1	-0.012	0.034	0.117	0.824
X2	-0.195	0.133	-0.028	0.194
X3	0.036	-0.014	0.632	0.124
X4	-0.034	0.002	0.123	-0.262
X5	0.197	0.057	0.052	0.247
X6	0.244	-0.125	-0.043	0.153
X7	0.083	-0.143	-0.084	0.313
X8	0.244	0.014	0.049	0.109
X9	0.001	-0.012	0.593	-0.197
X10	0.149	0.557	-0.021	0.062
X11	0.269	0.113	0.01	0.089
X12	-0.101	0.582	-0.027	-0.077

As can be seen from Table 6, The variable with a larger load in F1 is GDP per capita (X8, 0.244) and regional economic development degree (X11, 0.269), Therefore, F1 can be summarized as the village economic level; The variable with a large load in F2 is the agricultural output value ratio (X10, 0.557) and the penetration rate of basic medical care and old-age security (X12, 0.582), Therefore, F2 can be summarized as the village security level; The variable with a larger load in F3 is the proportion of migrant workers (X3, 0.632) and the Engel coefficient (X9, 0.593), Therefore, F3 can be summarized as the village living standard; The variable with a large load in F4 is the population base (X1, 0.824) and the utilization rate of comprehensive cultural sites (X7, 0.313), Therefore, F4 can be summarized as the village population level.

4. Tobit Regression Model Construction and Outcome Analysis

4.1. Tobit regression model construction

Based on the DEA-BCC analysis of the supply efficiency results of village-scale public cultural services, the Tobit regression model is the most appropriate one. The Tobit regression model is a dependent-variable-restricted model (Song & Xu, 2016). Assuming that only the merge point (left restricted value) is 0, the formula is:

$$Y = \max\left(L, \ y_i^*\right) = \begin{cases} y_i^*, \ y_i^* > L \\ L, y_i^* \leq L \end{cases} \tag{4.1}$$

The likelihood function is then constructed according to the distribution characteristics of the error values as follows, and the coefficient is obtained according to the likelihood function:

$$L = \prod\nolimits_{y_i = 0} \Pr\left(\varepsilon < -\chi_i\beta\right) * \prod\nolimits_{y_s > 0} f\left(y_i < -\chi_i\beta\right) \tag{4.2}$$

4.2. Calculation results and analysis

The regression analysis was performed using Stata17 software, and the calculation results are shown in Table 7. It can be seen that, first of all, the village economic level (F1) has a significant positive impact on the supply efficiency of public cultural services in all the 14 villages. From the perspective of correlation coefficient, the regression coefficient of the village economic level is between 0.044 and 0.076, which indicates that it has an impact on the supply efficiency of public cultural services in the 14 villages, but the influence is not high. The main reason is that the main body of the supply of public cultural services is still the government, and the production of public cultural products does not adopt the supply mode of multiple subjects, but is still a single mode led by the government. Therefore, the level of economic development and the financial input of public cultural services have little impact, but the economic level of the village has a certain impact on the public cultural needs of the villagers. Then, optimizing the production mode of public cultural products and enhancing the coordinated development of multiple subjects are the fundamental to improve the supply efficiency of public cultural services.

Secondly, the village guarantee level (F2) has a significant positive impact on the supply efficiency of public cultural services in V1, V3 and V6) except for a few villages in other 11 villages. From the perspective of correlation coefficient, the regression coefficient of the village guarantee level is between 0.086 and 0.133, which indicates that it has a certain influence on the supply efficiency of public cultural services in the 11 villages and has a strong influence. It can be seen from the results that creating a stable agricultural operation environment, good medical care and old-age security policies promotes the supply efficiency of public cultural services to a certain extent. On the contrary, with a better public cultural atmosphere, can also promote the village production, life stable and harmonious.

Third, the living standard of villages (F3) is significantly and positively correlated to the supply efficiency of public cultural services in 8 villages (V2, V3, V5, V6, V7, V9, V13, and V14). From the perspective of the coefficient relationship, the regression coefficient of the living standard in the village is between 0.48 and 1.05, which indicates that it has a strong influence on the supply efficiency of public cultural services in the 8 villages. The connotation of F3 public factor can be developed, and the main load factor is the ratio of migrant workers and Engel coefficient. Migrant workers are younger and have received certain education and training and can quickly adapt to various ways of public cultural services, which greatly guarantees the efficiency of the supply, which mainly explains the higher the quality of life of farmers. The higher the Engel coefficient, the higher the living standard in rural areas, the higher the demand for culture, and the higher the utilization rate of public cultural services at the present stage.

Fourth, the village population level (F4) has a significant positive impact on the supply efficiency of public cultural services in all the 14 villages. From the perspective of correlation coefficient, the regression coefficient of the population level in the village is between 0.368 and 0.565, indicating that it has a strong influence on the supply efficiency of public cultural services in the 14 villages. The two factors with the highest load in F4 are population and the utilization rate of population and comprehensive cultural places, both of which are related to the population base in the village. The basis of public cultural services is the villagers in the village, and the supply level and service efficiency need to match the number of population. Therefore, the number of permanent resident population is the core factor affecting the supply efficiency of

public cultural services in villages. To coordinate and balance the relationship between supply and population is an effective way to improve the supply efficiency of public cultural services in villages.

Table 7 *Results of the Tobit regression analysis*

Variable	Harbin				Qiqihar		
	V1	V2	V3	V4	V5	V6	V7
y	2.488 (0.014^{**})	2.456 (0.000^{***})	1.863 (0.055^{*})	3.598 (0.000^{***})	2.681 (0.000^{***})	2.277 (0.048^{**})	2.584 (0.000^{***})
F1	0.066 (0.009^{***})	0.051 (0.000^{***})	0.043 (0.039^{**})	0.072 (0.000^{***})	0.049 (0.000^{***})	0.052 (0.025^{**})	0.049 (0.000^{***})
F2	0.075 (0.233)	0.114 (0.003^{***})	0.044 (0.438)	0.101 (0.009^{***})	0.091 (0.011^{**})	0.071 (0.287)	0.116 (0.000^{***})
F3	-0.1 (0.802)	0.537 (0.036^{**})	1.05 (0.009^{***})	0.17 (0.518)	0.758 (0.002^{***})	0.864 (0.059^{*})	0.48 (0.000^{***})
F4	0.477 (0.000^{***})	0.368 (0.000^{***})	0.446 (0.000^{***})	0.565 (0.000^{***})	0.524 (0.000^{***})	0.385 (0.007^{***})	0.48 (0.000^{***})
Variable	Suihua			Jiamusi		Mudanjiang	Heihe
	V8	V9	V10	V11	V12	V13	V14
y	3.58 (0.000^{***})	2.52 (0.000^{***})	3.875 (0.000^{***})	3.007 (0.000^{***})	3.008 (0.000^{***})	2.291 (0.000^{***})	2.596 (0.000^{***})
F1	0.065 (0.000^{***})	0.044 (0.000^{***})	0.076 (0.001^{***})	0.065 (0.000^{***})	0.054 (0.000^{***})	0.052 (0.000^{***})	0.051 (0.000^{***})
F2	0.131 (0.000^{***})	0.123 (0.000^{***})	0.125 (0.034^{**})	0.115 (0.000^{***})	0.133 (0.000^{***})	0.088 (0.000^{***})	0.086 (0.005^{***})
F3	0.113 (0.62)	0.508 (0.002^{***})	0.179 (0.679)	0.01 (0.966)	0.235 (0.238)	0.521 (0.002^{***})	0.768 (0.000^{***})
F4	0.528 (0.000^{***})	0.514 (0.000^{***})	0.508 (0.000^{***})	0.477 (0.000^{***})	0.5 (0.000^{***})	0.448 (0.000^{***})	0.477 (0.000^{***})

Note: Parentheses represent the P-value; ***, ** and * represent the significance levels of 1%, 5% and 10%, respectively

5. Conclusions and Recommendations

5.1. Conclusion

Based on the 2017-2021 data collected from 14 natural villages in Heilongjiang Province, this paper constructs a suitable econometric model to study and analyze the supply efficiency of public cultural services in villages in Heilongjiang Province. The main results are as follows:

First, the overall supply efficiency of rural public cultural services in Heilongjiang Province from 2017 to 2021 is low. At the same time, the gap between the actual scale of village public cultural service supply and the optimal production scale fluctuates constantly, which affects the

comprehensive technical efficiency. The scale efficiency of most villages showed a decreasing trend in the past five years, indicating that the key reason restricting the supply efficiency of public cultural services was the decreasing scale efficiency. Second, the spatial dimension of rural public cultural service supply efficiency is different and the temporal dimension fluctuates obviously. From the perspective of urban distribution, it can be found that the overall situation of the four villages in Harbin is relatively balanced with a high average value, and the sub-provincial cities still have certain location advantages in terms of infrastructure construction. Qiqihar City, Suihua City and Jiamusi City belong to the state of polarization, with the highest value, but the efficiency value of other villages is very low, because these three cities have coordination problems in public cultural supply between regions, and there are great differences between supply and production in the same region. Other cities performed moderately, with smaller regional disparities. From the perspective of time, from 2017 to 2021, V1, V2 and V3 of the four villages in Harbin are stable on the whole, but they are all in a downward trend of efficiency value, while V4 has certain fluctuations. After the efficiency value rises to 1 in 2020, it drops to 0.451 in a cliff shape, dragging down the average value of the whole region, which should indicate that there is no problem with the supply mechanism. It is only the production coordination problem in a given year that causes the efficiency value to fall. In other cities, the 5-year change range is small and stable, indicating that the service improvement in the supply of public cultural services in the village area is not large in the past 5 years, and the effect is average, but there is great room for improvement. Third, multi-elements have an obvious effect on improving the efficiency of public cultural service supply. Factors such as economy, security and life have significant positive effects on the supply efficiency of village public cultural services. The population base and the living standard of villagers belong to the core factors affecting the supply efficiency of public cultural services in villages. Therefore, the improvement of regional economy can form a good labor supply, and then increase the number of regional population and increase the audience group of public cultural services in the village. Stability guarantee is conducive to the improvement of regional stability, increase the security of regional residents, and enhance the demand of regional residents for public culture; The improvement of living standards is directly to enhance the public cultural needs. Therefore, these three core elements are the key to improve the level of village public services.

The research of this paper has certain limitations, which are mainly reflected in the following aspects: due to the lack of an overall rural data collection platform in Heilongjiang Province, the research can only be conducted by sampling survey, so the sample research can only represent part of the situation in the sampling area, and cannot truly restore the overall status quo of rural public cultural services. At the same time, it is impossible to carry out a comprehensive investigation, and the time cost and labor cost are huge. Where feasible, it is suggested that relevant investigation departments should establish monitoring points for rural public cultural services and share data to facilitate the investigation of rural public cultural services by scholars in the later period.

5.2. Suggestions

First, promote diversified participation services. The supply subject of public cultural services in villages is too single, and the main supplier is the government, and the village collective organization supplements the supply. By introducing social resources or adopting the government purchase mode, we can increase the supply subject and form a multi-subject supply

mode, which can effectively increase the output effect of public cultural services. At the same time, the supply to a certain extent, the existence of single content, lack of elasticity of supply and other problems. Increasing investment in the construction of smart platforms and carrying out digital public cultural services in various channels and ways are also effective ways to improve the supply efficiency of public cultural services.

Second, to stabilize the living environment of the village. Public cultural service is a silent work, and its external expression is often gathered together with the representation of farmers' life. That is to say, when farmers live and work in peace and contentment, their cultural undertakings are also thriving, and vice versa, the two complement each other. Therefore, stabilizing the life of regional residents, creating a good agricultural operation environment and improving the daily life of villagers are the basic elements of the implementation of public cultural services. At the same time, it is also the basis for stabilizing the number of villagers and implementing precise supply.

Third, improve regional supply differences. The survey found that there are certain regional differences in the supply of public cultural services between villages, and there are also certain differences in the cognition of public cultural services in each village. This shows that there are differences in the production factors in the supply of public cultural services between regions on the urban scale. Improving the supply coordination mechanism is helpful to balance the production of cultural services between regions, and is the main factor to improve the supply efficiency of public cultural services in villages.

Acknowledgements

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