УДК 37.371

REASEARCH ON FACTORS AFFECTING THE INTEGRATION OF COUNTY COMPULSORY EDUCATION RESOURCES BASED ON SPATIAL PERSPECTIVE – TAKING THE EMPIRICAL ANALYSIS OF JUNIOR HIGH SCHOOL S COUNTY AS AN EXAMPLE

Li Xu,
Professor of Shanxi University, Taiyuan, P.R. of China
Wang Qiang
Lecturer of Taiyuan Normal University, Taiyuan, P.R. of China

ИССЛЕДОВАНИЕ ФАКТОРОВ ВЛИЯНИЯ НА ИНТЕГРАЦИЮ РЕГИОНАЛЬНЫХ ОБРАЗОВАТЕЛЬНЫХ РЕСУРСОВ В ПРОСТРАНСТВЕННОЙ ПЕРСПЕКТИВЕ – ЭМПИРИЧЕСКИЙ АНАЛИЗ НА БАЗЕ ДЕЯТЕЛЬНОСТИ ОКРУЖНЫХ СРЕДНИХ ОБЩЕОБРАЗОВАТЕЛЬНЫХ ШКОЛ

Li Xu,
профессор Университета Шаньси, Тайюань, Республика Китай
Wang Qiang,
рреподаватель Тайюаньского педагогического университета, Тайюань, Республика Китай

Abstract. Under the current conditions of compulsory education resources, resource integration is an important issue facing the balanced development of compulsory education in China. Re-adjusting or arranging the county school layout in economically backward areas can promote the balanced development of rural education. This article takes S County of S Province as a case research area, taking the accessibility of space as an important factor into the index system of resource integration in junior high schools, the purpose is to evaluate the school's layout adjustment for the junior high school education resources in S County. Research suggests: Adjustment of junior high school layout in agricultural county, the number of students and teachers are the first considerations, second factor is the impact of school hardware facilities. Meanwhile, the influence of traffic factors exceeds the influence of economic factors. Junior high schools need to be added in economic centers and planned economic development areas. The surrounding areas of economic centers that are greatly affected by economic centers often need to remove and merge schools. The remote areas which are affected by the economic center tend to maintain the status quo. The removing and merging of schools in urban towns is affected by both the local towns and the urban areas. Therefore, comprehensive consideration is needed.

Аннотация. Интеграция базовых образовательных ресурсов является важным аспектом сбалансированного развития системы общего среднего образования в Китае. Региональная организация и регулирование ресурсов экономически отсталых районов может способствовать развитию сельских

школ, расположенных в экономически малоразвитых районах. В статье отражено региональное исследование с учетом доступности пространства в качестве важного фактора индексирования интеграционных ресурсов, цель которого заключалась в том, чтобы определить необходимые меры по корректированию структуры учебных ресурсов в исследуемом регионе. Исследование показывают, что корректирование планирования средней школы в сельском районе должно осуществляться, во-первых, в учетом количества учащихся и учителей, а во-вторых, с учетом имеющихся средств. Влияние фактора доступности месторасположения школы превышает влияние экономических факторов. Необходимо использовать возможности средних школ в экономических центрах и районах планируемого экономического развития. Часто возникает необходимость слияния школ близлежащих районов. Отдаленные районы, на которые влияет экономический центр, как правило, сохраняют статускво. Необходим всесторонний анализ вопросов, связанных с данными процессами.

Keywords: Integration of compulsory resources; Analytic hierarchy process; Spatial accessibility.

Ключевые слова: интеграция общеобразовательных ресурсов, аналитический иерархический процесс, доступность месторасположения.

The unbalanced allocation of compulsory education resources between urban and rural areas in counties is one of the main factors that restrict the balanced development of compulsory education in China. Along with the urbanization process, a large number of rural population swarmed into cities and towns, and the social and economic development affected the unbalanced allocation of basic education resources through the change of school-age population. Due to unbalanced allocation of educational resources, there exists the phenomena of low resource utilization rate and waste of resources in county compulsory education, such as teacher redundancy and waste, resource surplus and resource shortage, urban large-scale schools and rural micro schools (teaching points)widely exist, and the loss of rural education resources and the concentration of high-quality education resources in county towns. The Outline of the National Medium-and Long-Term Education Reform and Development Plan (2010-2020)*(hereinafter referred to as the Outline)*,proposesto "establish and improve the guarantee mechanism for the balanced development of compulsory education, and allocate all resources in a balanced way", "take the lead in achieving the balanced development between urban and rural areas within counties (districts), and gradually promote it on a larger scale". In 2016, The State Council adopted "*several Opinions on Promoting the Integrated Reform and Development of Urban and Rural Compulsory Education*. "Which requires that " the layout of compulsory education schools in urban and rural areas should be rationally planned, take practical and effective measures to narrow the gap between urban and rural areas, realize the overall allocation of urban and rural education resources, and promote the integrated development of urban and rural compulsory education in the

county." Thus it can be seen that, it is an urgent demand of current national conditions and policies to integrate and optimize the allocation of urban and rural compulsory education resources in county area, so as to narrow the gap between urban and rural education development in county area. It has an important practical value to scientifically promote the balanced development of compulsory education.

The integration of compulsory education resources in the county refers to the adjustment, reorganization and optimization of existing compulsory education resources by the county-level government according to local conditions on the basis of existing education resources, including teacher construction, school conditions and education funds, so as to achieve the approximate balance among towns, urban and rural areas and inter-school areas in the county, and improve the utilization efficiency of educational resources. Because of the integrity and indivisibility of educational resources investment, schools should invest resources regardless of the size. In economically backward agricultural counties, the poor conditions for running schools in rural areas and the large number of ultra-small-scale "Sparrow Schools", the excessively scattered school layout and the large number of ultra-small-scale schools have caused problems such as low efficiency in the use of educational resources, high cost of balanced resource investment in counties and difficult allocation of teachers, which have become bottlenecks restricting the balanced development of education. The researcher pointed out that by readjusting the school layout in economically backward areas and concentrating the limited educational resources in each place, the efficiency of resource use can be improved. But this does not mean blindly removing schools, in fact, removing schools does not necessarily save educational resources, but also undermine educational equity. Therefore, in order to achieve the balanced allocation of compulsory education resources, it is necessary to comprehensively consider the changes in the economic and social development of the county, the level of urbanization, the number of school-age population and other aspects, and adjust the layout of schools.

School layout adjustment is a complex project. The research data shows that since 2001 when the State Council issued *TheDecision on The Reform and Development of Basic Education* in May, which requiredall provinces, cities and regions to "adjust the layout of rural compulsory education schools as appropriate, plan and adjust the layout of schools reasonably" to2012, when *The General Office of the State Council Issued the Opinions on Regulating the Layout Adjustment of Rural Compulsory Education Schools*, in more than a decade, the number of rural junior high schools in China decreased from 37,520 in 2001 to 19,408 in 2012, and 48.27 percent less in 2018 than in 2001. In more than ten years, due to the excessive adjustment, the scale of schools has become too large, which has caused the dilution of the pursuit of economies of scale, the transfer of the cost of running schools, the quality of education service is reduced, and the rate of grade repeat and dropout rate increases. Therefore, in order to integrate compulsory education resources in the county, it is necessary to combine the law of educational development,multi-disciplinary integration toexplore the generation mechanism of

spatial layout of educational resources, and explore the principle and method of primary and secondary school layout adjustment.In other words, in order to achieve the balanced development of compulsory education, it is necessary to explore the principle of compulsory education resource integration combined with spatial analysis method.

From the perspective of the existing literature of spatial analysis,geographic information system (GIS) technology is introduced to evaluate the fairness of primary and secondary school layout adjustment, Huff model, nearest distance model, opportunity accumulation model, gravity model and the improved gravity model and other targeted accessibility calculation methods and spatial modelswere used to further explore the spatial site selection and principles of educational resource allocation. However, to explore the optimal location layout to better allocate resources, we should not only consider accessibility, but also establish a comprehensive index system.

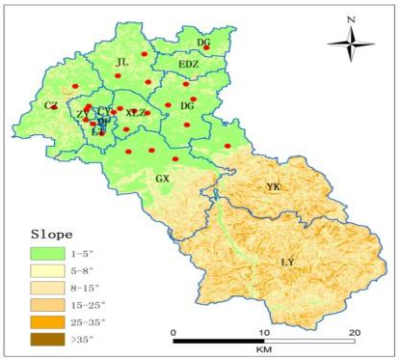
Since 2003, our country began to study the index system of education fairness, the research on county area compulsory education balance paid more attention to the construction of the monitoring index system for the balanced development of compulsory education and the evaluation index system for the balanced quality of compulsory education, only a few researchers paid attention to the importance of the school spatial layout index for the allocation of educational resources. Therefore, as there are more related factors involved in the selection of specific indicators for the study of educational resource integration, the interpretation of resource allocation indicators should be more cautious, and the existing indicators of educational equity should be improved. This paper aims to further integrate the spatial accessibility index into the index system of compulsory education resource integration from a multidisciplinary perspective,complete the adjustment planning of rural county junior high schools' layout, taking S County of S Province as an example, enrich the principle research of county compulsory education resources integration, and provide the basis for the next step of county compulsory education schools' layout adjustment and resources integration.

RESEARCH DESIGN

1. Education Overview of S County, S Province in the case area.

The terrain of S County in S province is high in the southeast and low in the northwest, gradually tilting from the southeast to the northwest, with mountains, hills and plains accounting for 46.6%, 12.4% and 41% of the land area respectively.The population is concentrated in the central and northern regions with flat terrain, and the population density is low in the mountains and hills (see Figure 1 and figure 2 for details).The county has jurisdiction over 6 towns, 2 townships and 1 district, with a total of 23 junior high schools, including 3 urban and county junior high schools, 7 township junior high schools and 13 village-level junior high schools.LYTown has no junior high school because of its sparse population. The economic and social development of S County also profoundly affects the future layout of junior high schools:(1) A provincial-level economic development zone has been established in the central area of DG Town in the

northeast of S County, and there is no junior high school in the economic development zone.(2) Under the influence of the establishment of economic development zone, DG Town is divided into three parts, namely, the north partof DG Town, the economic development zone and the south partof DG Town. There is only one high school in the north of DG Town, while there are four schools in the south ofDG Town. (As shown in Figure 1)



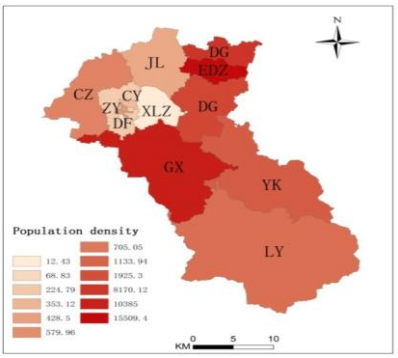


Figure 1. Distribution map of junior high schools in S Count

Figure 2. Population density map of S County

2．Data sources

Data sources of this study are as follows:(1) The vector map of the administrative divisions of towns in S county comes from the Bureau of Surveying and Mapping of S Province;(2) Educational statistics of S County were obtained from S County Education Bureau;(3) The specific location vector maps of rural residential areas and junior high schools in S County were interpreted from remote sensing images;(4) Remote sensing image data are from the geospatial Data Cloud website of Chinese Academy of Sciences (http://www.gscloud.cn/).

3.Index selection

This study drew on 8 indicators from*TheInterim Measures for Supervising and Evaluating the Balanced Development of Compulsory Education at County level*, issued by the Ministry of Education. And this study also usedthe index system constructed by famous domestic scholars Yang Dongping, Zhou Jinyan, Wang Shanmai, Zhu Jiacun, Lu Xiaoxu, Yu Fayou, Dong Shihua,Fan Xianzuo, Li Ling, Song Naiqing, Zhai Bo, Zhu Yali, Zhao Dan,etc for reference, through AHP method, establishing an expert group, through grading and feedback from group members, according to the score, indexes with high scores and concentrated opinions were retained and indexes with low scores and scattered opinions were eliminated.Finally, 1 first-level indexes, 4 second-level indexes and 15 third-level indexes were obtained. (As shown in Table 1)

Table 1 – Index system of educational resources integration

Target layer	First-level indexes	Second-level indexes
A Integration of educational resources	B School hardware factors	B1 Per student building area
		B2 Per student land
		B3 Number of library books per student

		B4 Computer ownership of 100 people
	C Teacher and student factors	C1 Teacher quality
		C2 Student-teacher ratios
	D Economic factors	D1 Education funding
		D2 Distance from high schoolto township
	E Accessibility factors	E1 Average distance from village to school

1. Research methods

(1) Literature method.1) This study referred to *The Basic Standards for Running Compulsory Education Schools in S Province (*for Trial Implementation*) Jin Education Base [2013]documentNo. 33*to determine the reasonable number of junior high schools that meet the basic education stage in S County. This is due to the reallocation of resources in junior high schools, the degree of population concentration should be considered first, and the reasonable number and layout of schools can be determined by the degree of population concentration. 2) This study referred to*The Construction Standards of Rural Ordinary Primary and Secondary Schools* issued by the former Ministry of Construction in 2008 and *The Acceptance Standards of Standardized Construction of Compulsory Education in S Province* in 2013 to determine the optimal standards of teaching hardware and software for the resource integration index system of junior high schools in S County. (As shown inTable 2).

Table 2 – Index system of resource integration

	First-level indexes	Second-level indexes	Standard
Integration of educational resources	School hardware factors	Per student building area	5 square meters
		Per student land	16 square meters
		Number of library books per student	30books
		Computer ownership of 100 people	7 tables
	Teacher and student factors	Teacher quality	100%
		Student-teacher ratios	13:01
	Economic factors	funding	-
		Distance from high school to township	0
	Accessibility factors	Average distance from the village to school	0

(2) Delphi method. Delphi, also known as expert scoring, is a back-to-back method in which experts are asked for their opinion on a particular task. In this study, with the help of Delphi method, we consultedthe staff of S County Education Bureau, teachers of S County schooland local resident' opinions on each indicator of participating factorsscreened out the more important indicators according to the local actual situation, and supplemented the indicators they thought were more important. In the questionnaire, team members scored 1, 2, 3, 4 and 5 points respectively in the column of(3) Accessibility analysis method.Accessibility analysis, as a quantitative method to measurethe time spent by students on their way to school, plays an important role in"importance" of each indicator according to five grades of "unimportant, relatively unimportant, general, relatively important and important" to jointly determine the weight of the indicator. (As shown in Table 3).

$$A_j = \frac{\sum_{j=1}^{i} T_{ij}}{i}$$

Type:

j is the number of junior high schools in township districts

i is the number of residential areas within the jurisdiction of the township

T_{ij} is the shortest distance from the residential area i in the townshipto the junior high school j

A_j is the average distance between a residential area and j schools

(4) Data standardization processing method.

Table 3 – Index weight of resource integration

	First-level indexes	**Weight**	**second-level indexes**	**Weight**
Integration of educational resources	School hardware factors	0.280	Per student building area	0.3
			Per student land	0.25
			Number of library books per student	0.25
			Computer ownership of 100 people	0.2
	Teacher and student factors	0.285	Teacher quality	0.5
			Student-teacher ratios	0.5
	Economic factors	0.215	Education funding	0.45
			Distance from high schoolto township	0.55
	Accessibility factors	0.220	Average distance from the village to school	1

Data standardization processing is to process dimensional data into dimensionless data between 0 and 1, so that they can be compared. In this paper, index data are divided into three categories, namely, appropriateness factor, positive factor and reverse factor (as shown in Table 4). Different formulas are used for conversion and quantification of different data. The conversion formulasare as follows:

1)The participating factors are positive factors, and the standardization is as follows:

$$x_i' = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}$$

2) The participating factors are reverse factors, and the standardization is as follows:

$$x_i' = \frac{x_{\min} - x_i}{x_{\max} - x_{\min}}$$

The participating factors are moderate factors, and the standardization is as follows:

When $x_i \geq a$, $x_i' = \frac{x_{\max} - x_i}{x_{\max} - a}$

When $x_i < a$ $x_i' = \frac{x_i - x_{\min}}{a - x_{\min}}$

Type,

x_i' is the standardized score of i indicator

Table 4 – Index system of resource integration

	First-level indexes	**Second-level indexes**	**Factor type**
Integration of educational resources	School hardware factors	Per student building area	Moderate factors
		Per student land	Moderate factors
		Number of library books per student	Moderate factors
		Computer ownership of 100 people	Moderate factors
	Teacher and student factors	Teacher quality	Positive factor
		Student-teacher ratios	Positive factor
	Economic factors	funding	Positive factor
		Distance from high schoolto township	Reverse factor
	Accessibility factors	Average distance from the village to school	Reverse factor

x_i is i indicator

$x_{\max}$ is the maximum value of participating indicators

$x_{\min}$ is the minimum value of participating indicators

a is the moderate value of a factor index

(5)

Comprehensive weighted calculation method

According to the index system established by analysis, the school hardware factors, teachers and students, and economic factors are weighted and summed to obtain the comprehensive score of S County resource integration, through weighted sum,the calculation method is as follows:

$$Z_i = \sum_{i=1}^{m} w_i y_i \quad (i = 1, 2, 3, ?, m)$$

Type,

i Is the number of indicators in the indicator system

w_i is the weight of i indicator

y_i is the score of i indicator

Z_i is the comprehensive score of i indicator

RESEARCH RESULTS AND ANALYSIS

1. Quantitative analysis of junior high schools

In 2013, S Province promulgated the document *the Basic Standards for Running Compulsory Education Schools in S Province (for Trial Implementation) Jin Education Base [2013] Document No. 33* (hereinafter referred to as *document*). The document stipulates that: the layout adjustmentof rural junior high school is set by the township as a unit, in principle, the township with a population of 1.5-20 million can set 1junior high school, more than 30,000 people in the township (town) can set 2junior high schools, junior high schools in the township (town) with the population of less than 15,000 people should be set upby the county (city, district). According to this provision, S County high schools need to be adjusted, and the specific number of adjustments are shown in Table 5.

As seen in Table 5, the number of junior high schools in LY Town, YK Town and CZ Town in S County is relatively appropriate and there is no need to adjust the number.The number of junior high schools in urban areas is insufficient. According to the trend of population mobility, at least one junior high school should be added. S county set up provincial economy development zone in DG town central area. Up to now, there is no junior high school in economic development zone, so we need to add a junior high school in economic development zone. Due to the establishment of the economic development zone, DG Town is divided into two parts. It is necessary to keep a junior high school in the north of DG Town. There are 4 junior high schools in the south of DG Town. According to the document requirements, 2 high schools need to be removed and merged. A junior high school in ZY town needs to be closed and consolidated; GX town needs to remove and merge a high school; JL Town needs to close and

consolidate a junior high school; XLZ Town needs to close and merge 2 junior high schools (As shown in Table 5).

Note: The scale of urban land is expanding, and the specific value of area cannot be given.

2. Analysis of measurement results of educational resource allocation level

According to the data collected from the educational statistics yearbook of S County, Per student building area,Per student land,number of library books per student and computer ownership of 100 people was obtained. For different data, standardized formulas are used for standardization, and weighted formulas are used for calculation, and the data in Table 6 are obtained. As can be seen from Table 6, in terms of school hardware factors, DWQ high school and DLZhigh schoolin the south of DG town scored low. JL high school in JL Township scored poorly. NShigh school in XLZ Town scored low. FZhigh school in ZY Town scored poorly. LC high school in GX Town scored poorly. After standardizing the collected data of teachers' qualified education rate and student-teacher ratio, the weighted calculation is carried out to obtain the score values of teacher and student factors.As can be seen from Table 7, in the factors of teachers and students, the scores of DWQ high school and QJB high school in the south of DG Town are relatively low. GL high school in JL Town scored poorly. NS high school in XLZ Town scored low. FZ high school in ZY Town scored poorly. GX high school in GX Town scored poorly. After standardizing the data such as average cost per student and the distance data from junior high schools to villages and towns obtained through interpretation of remote sensing image data by formula, the score value of economic factors was obtained through formula weighting calculation.See Table 7 for details. As can be seen from the table, in term of economic factors, the scores of DWQhigh school and DLZhigh school in DG Town.

Table 5 – The number of junior high schools

	Area（km^2）	Population（people）	Number of theoretical junior high school	Number of Actual junior high school	Measures
city proper	-	58458	3-4	3	Add
ZY town	27.33	23769	1-2	3	Remove and Merge
The north of DG Town	26.21	48456	1	1	Maintain
The south of DG Town			2	4	Remove and Merge
Economic development zone			1	0	Add

GX town	137.29	34463	2	3	Remove and Merge
JL Town	59.24	26688	1-2	3	Remove and Merge
CZ Town	74.02	35995	2	2	Maintain
LYTown	275.41	3496	0	0	Maintain
XLZ Town	28.49	21599	1	3	Remove and Merge
YKTown	132.44	10905	1	1	Maintain

3.Accessibility factors

Spatial accessibility is considered to be one of the important indicators to evaluate whether the allocation of public facilities and services is reasonable. Accessibility can be understood as the degree of accessibility to facilities and obtain services by means of vehicles and roads. In this paper, based on the traffic routes of S County, the traffic network database is established in ArcGIS, and with the help of OD cost matrix in network analysis, the accessibility formula is used to calculate, and the average distance between each school under the jurisdiction of each township and all residential areas is obtained.As shown in Figure 3-7.

The data in Figure 3- Figure 7 is the average distance between schools and residential areas, which are standardized with the formula and the score is shown in Table 8.As can be seen from Table 8, FZ high school is the township high school in ZY Town, which has the longest average distance from the residential areas under its jurisdiction, followed by The Fifth high school. The average distance between the LC high school and XH high school in GX Town and the residential areas within the jurisdiction is almost the same. QC high school was the farthest distance from the residential area in XLZ Town. GL high school in JL Town has the longest average distance from the residential areas under its jurisdiction. QJB high school in the south of DG Town has the longest average distance

Table 6 – The scores of school hardware factors in S county

Area	Junior high school	Category					
			Per student building area	Per student land	Number of books per student	Computer ownership of 100 people	School hardware factors
The south of	DG junior high school	Town school	0.155	0.232	0	0.201	0.164

DG Town	DWQ high school	Village school	0.158	0	0.25	0.039	0.125
	QJB high school	Village school	0	0.25	0.185	0.155	0.165
	DLZhigh school	Village school	0.3	0.03	0.152	0	0.135
JL Town	JLhigh school	Town school	0	0.199	0	0.199	0.111
	GL high school	Village school	0.288	0	0.25	0	0.151
	ZD high school	Village school	0.3	0.25	0.024	0.152	0.203
XLZ Town	XLZhigh school	Town school	0.3	0.25	0.193	0.201	0.264
	NS high school	Village school	0	0	0	0	0
	QC high school	Village school	0	0.154	0.25	0.095	0.14
ZY town	FZhigh school	Town school	0	0	0	0.17	0.047
	The Fifth high school	Village school	0.259	0.25	0.213	0.203	0.259
	BGFhigh school	Village school	0.3	0.014	0.25	0	0.158
GX Town	GXhigh school	Town school	0	0	0.194	0.185	0.106
	LC high school	Village school	0.185	0.019	0	0	0.057
	XH high school	Village school	0.3	0.25	0.25	0.206	0.282

The data in Figure 3- Figure 7 is the average distance between schools and residential areas, which are standardized with the formula and the score is shown in Table 8.As can be seen from Table 8, FZ high school is the township high school in ZY Town, which has the longest average distance from the residential areas under its jurisdiction, followed by The Fifth high school. The average distance between the LC high school and XH high school in GX Town and the

residential areas within the jurisdiction is almost the same. QC high school was the farthest distance from the residential area in XLZ Town. GL high school in JL Town has the longest average distance from the residential areas under its jurisdiction. QJB high school in the south of DG Town has the longest average distance The data in Figure 3- Figure 7 is the average distance between schools and residential areas, which are standardized with the formula and the score is shown in Table 8.As can be seen from Table 8, FZ high school is the township high school in ZY Town, which has the longest average distance from the residential areas under its jurisdiction, followed by The Fifth high school. The average distance between the LC high school and XH high school in GX Town and the residential areas within the jurisdiction is almost the same. QC high school was the farthest distance from the residential area in XLZ Town. GL high school in JL Town has the longest average distance from the residential areas under its jurisdiction. QJB high school in the south of DG Town has the longest average distance planning school layout in areas with complicated terrain and inconvenient transportation. The principle is to use OD cost matrix to find and measure the least cost path from multiple starting points to multiple destinations in the network. In this study, based on the existing traffic network, junior high schools and residential areas in the same township, withresidential areas as the starting point, junior high school as the destination, assuming that any one of the students from the residential areas will go to the nearest school to study, and set up OD costmatrix, to analyze the average distance between residents in each township and each junior high school. The average distance is taken as a factor to measure spatial accessibility to participate in the integration index system and participate in the resource integration evaluation of junior high schools. The formula for calculating the average distance is as follows.

Table 7 –The scores of teachers and students, economic factors in S county

Area	Junior high school	Category						
			The teacher school record success rate	Student-teacher ratio	Teacher and student factors	Education funding	Distance from high schoolto township	Economic factors
DG Town	DGhigh school	Town school	0.154	0.521	0.192	0.45	0.55	0.215
	DWQhigh school	Village school	0	0	0	0.036	0	0.008
	QJB high school	Village school	0.019	0.521	0.154	0.091	0.356	0.096

	DLZhigh school	Village school	0.5	0.104	0.172	0	0.207	0.045
JL Town	JL high school	Town school	0.042	0.3	0.097	0.45	0.55	0.215
	GL high school	Village school	0	0	0	0	0.145	0.031
	ZDhigh school	Village school	0.5	0.45	0.271	0.043	0	0.009
XLZ Town	XLZ high school	Town school	0.5	0.25	0.214	0.45	0.55	0.215
	NS high school	Village school	0.345	0	0.098	0	0.356	0.077
	QChigh school	Village school	0	0.5	0.143	0.047	0	0.01
ZY Town	FZ high school	Town school	0	0	0	0.03	0.449	0.103
	The Fifthhigh school	Village school	0.219	0.5	0.205	0.45	0	0.097
	BGFhigh school	Village school	0.5	0.375	0.249	0	0.55	0.118
GX Town	GXhigh school	Town school	0.179	0.2	0.108	0.45	0.55	0.215
	LC high school	Village school	0.5	0	0.143	0	0	0
	XH high school	Village school	0	0.5	0.143	0.359	0.033	0.084

The data in Figure 3- Figure 7 is the average distance between schools and residential areas, which are standardized with the formula and the score is shown in Table 8.As can be seen from Table 8, FZ high school is the township high school in ZY Town, which has the longest average distance from the residential areas under its jurisdiction, followed by The Fifth high school. The average distance between the LC high school and XH high school in GX Town and the residential areas within the jurisdiction is almost the same. QC high school was the farthest distance from the residential area in XLZ Town. GL high school in JL Town has the longest average distance from the residential areas under its jurisdiction. QJB high school in the south of DG Town has the longest average distance The data in Figure 3- Figure 7 is the average distance between schools and residential areas, which are standardized with the formula and the score is shown

in Table 8.As can be seen from Table 8, FZ high school is the township high school in ZY Town, which has the longest average distance from the residential areas under its jurisdiction, followed by The Fifth high school. The average distance between the LC high school and XH high school in GX Town and the residential areas within the jurisdiction is almost the same. QC high school was the farthest distance from the residential area in XLZ Town. GL high school in JL Town has the longest average distance from the residential areas under its jurisdiction. QJB high school in the south of DG Town has the longest average distance from the residential area, followed by DWQ high school. Taking each township area as the network analysis unit, the average distance between junior high schools and residential areas in each township area is standardized. According to the average distance score analysis, BGF high school in ZY Town, GX high school in GX town, XLZ high school in XLZ Town, JL high school in JL Town, DG high school in the south of DG Town, scored the highest and had the best accessibility.

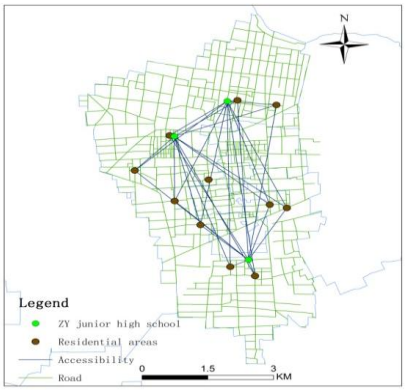


Figure3.OD cost matrixdiagram ofZY Town

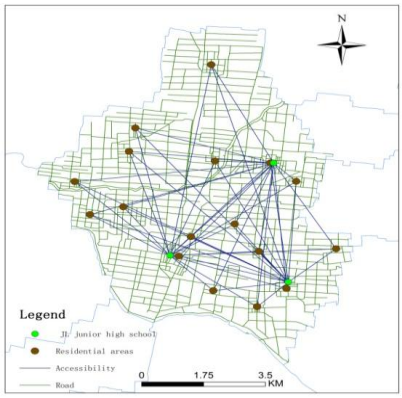


Figure4. OD cost matrix diagram ofJL Town

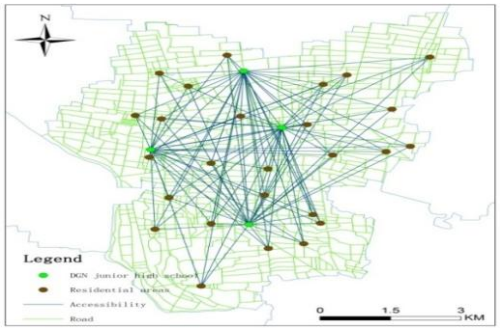


Figure5. OD cost matrix diagram of the south of DG Town

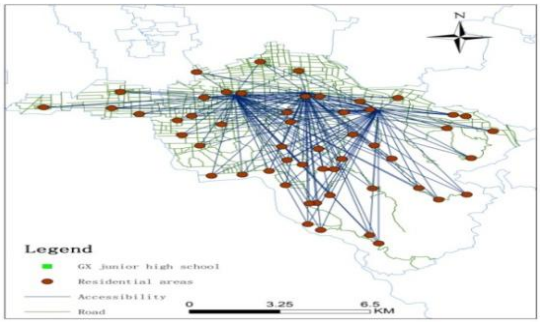


Figure6. OD cost matrix diagram ofGX Tow

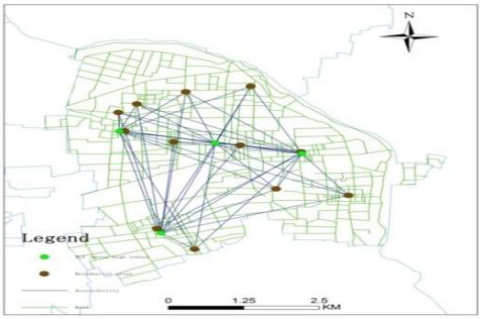


Figure7. OD cost matrix diagramof XLZ Town.

Table 8 – Accessibility of junior high schools

Location	School	Category	Average distance (meter)	Accessibility score	Location	School	Category	Average distance (meter)	Accessibility score
ZY Town	FZ high school	Town school	3611.12	0.001	JL Town	JL high school	Townschool	3972.26	0.220
	BDF high school	Village school	3127.56	0.220		GL high school	Villageschool	5170.58	0.001
	The Fifth high school	Village school	3425.94	0.084		ZD high school	Villageschool	4292.44	0.161
GX Town	GX high school	Townschool	6673.15	0.220	The south of DG Town	DG high school	Villageschool	3724.81	0.220
	LC high school	Village school	7233.86	0.001		DWQ high school	Villageschool	4511.10	0.049
	XH high school	Village school	7230.42	0.001		QJB high school	Villageschool	4736.82	0.001
XLZ Town	XLZ high school	Townschool	2400.30	0.220		DLZ high school	Villageschool	4248.36	0.106
	NS high school	Village school	2850.81	0.140					
	QC high school	Village school	3635.78	0.001					

4. Resource integration index system

According to the established index system, the school hardware factors, teachers and studentsfactors, economic factors and spatial accessibility factors are weighted and summed by the formula to obtain the comprehensive score table of S County resource integration, as shown in Table 9 below.

Table 9 – Comprehensive score of junior high school

Area	Junior high school	Category	Total	Area	Junior high school	Category	Total
ZY Town	FZ high school	Town school	0.527	JL Town	JL high school	Town school	1.429
	The Fifth high school	Village school	0.998		GL high school	Village school	0.296

	BGF high school	Village school	1.177		ZD high school	Village school	0.678
GX Town	GX high school	Town school	1.434	The south of DG Town	DG high school	Town school	1.577
	LC high school	Village school	0.200		DWQ high school	Village school	0.210
	XH high school	Village school	0.818		QJB high school	Village school	0.766
XLZ Town	XLZ high school	Town school	1.698		BLZ high school	Village school	0.621
	NS high school	Village school	0.594				
	QC high school	Village school	0.329				

As can be seen from Table 9, FZhigh school in ZY Town has the lowest score and needs to be removed. LChigh school in GX Town received the lowest score and needs to be removed.GL high school in JLTown received the lowest score and needs to be removed.QC high school, NShigh school, has a low score and needs to be closed down. DWQ high school and DLZhigh schoolin the south of DG own scored low, so the two schools need to be removed.

The areas where schools need to be added are S county economic development zone and urban area. Due to the economic agglomeration effect, S county Economic Development Zone will have a large population inflow in the future, so according to *the document* requirements, in the administrative center of this area needs to layout a junior high school, the space position has been determined.

For the urban area of S County, the spatial layout of additional schools is complicated: on the one hand, due to historical reasons, the layout of existing urban high schools is not very reasonable, which does not cover the urban area as much as possible; On the other hand, the urban area is gradually expanding to ZY town, and more and more residential areas are included in the urban area, so the new high school service area covers these residential areas as much as possible. Therefore, the OD cost matrix of accessibility analysis is used to analyze the average distance between the residential area of ZY Town (including urban residential area) and the five junior high schools in ZY Town (including urban area), and the average distance between the residential area and the five junior high schools is used to analyze the approximate spatial location of newly added schools (see Table 10 for specific information).

Table 10 – OD cost distance analysis of ZY Town

Residential area of ZY Town	Average distance	Residential area of ZYTown	Average distance
DNJ Village	2571.59	FZZhuang	3921.73
XBJ Village	2070.45	CQDG village	2760.94
DFL Community	2382.70	G Village	3121.30
XJBL Community	2351.96	XSVillage	3567.93
NGF Village	2981.56	CQXG village	2216.24
BGF Village	2775.77	CQNG village	2815.60
FZ Village	3750.01	SHVillage	3190.47

As can be seen from Table 10, the FZ Village, the FZ Zhuang, the G village, the XS Village and the SH Village are far away from the five junior high schools. FZ Village and FZZhuang are located in the northeast of the urban area, while G Village, XS Village, and SH Villageare located in the southeast of the urban area. See Figure 8 for specific locations. In the northeast and southeast of the city, it is not convenient to go to school compared with other residential areas, so it is more reasonable to set up a high school in the northeast or southeast of the city.

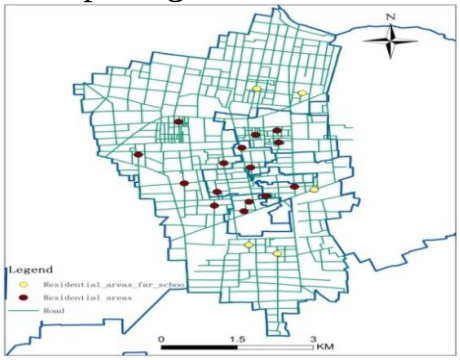


Figure 8. Location of residential area far away from school.

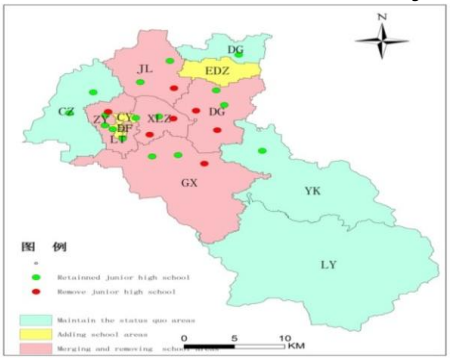


Figure 9. Adjustment map of school layout.

It can be seen from the above that the economic centers and future economic development areas in the county are the areas that need to add schools.The southern part of the county with complex terrain, the areas to the east and west remain as they are. The area between the two needs to remove and merge junior high schools, as shown in Figure 9. The specific layout adjustment is as follows:

(1)Build another junior high school in the northeast or southeast of s county; Build a junior high school in the administrative center of the development zone.

(2)LY Town, YK Town, CZ Town and the north of DG Town, shall maintain the status quo and not make adjustments.

(3)The south of DG Town in S County will remove and merge two village-level junior high schools, namely DWQ high school and DLZ high school.

ZYTown will remove and merge one township high school namedFZhigh school. GX Town will remove and merge one village level high school named LC high school. JL Townwill remove and merge a village-level junior high school,GL high school. XLZ Town will remove and merge two village level junior high school, namely QC high school and NS high school.

CONCLUSION AND DISCUSSION

By establishing a comprehensive index system for the integration of compulsory education resources based on spatial analysis, as well as accessibility and comprehensive weighting analysis, this paper obtains the following conclusions:

1.The number of students and teachers are the first factor considered in the layout adjustment of junior high schools in agricultural counties, followed by the influence of school hardware and facilities factors, and the influence of transportation factors outweighs the influence of economic factors.

2. From the perspective of space, the adjustment of the layout of junior high schools in agricultural counties is obviously influenced by the economy. The economic centers and planned economic development areas need to add junior high schools; the areas around the economic center which are greatly affected by the economic center often need to remove and merge the schools; remote areas less affected by the economic center tend to maintain the status quo.

3. The removing and merging schools in the towns which located in the urban areas are not necessarily retained just because they are township junior middle schools. Both the township and the urban area affect the removing and merging of the junior high schools, so the choice of the removing and merging schools is more complicated and needs to be taken into overall consideration.

In previous studies, including the county compulsory education fair study, compulsory education resource balanced allocation study, study of index design from the theoretical perspective of the compulsory education quality balance and so on, though they covered most of the contents of educational resources integration, there was still a problem of lack of essential connection between indicators and the actual situation. Space is not only a kind of resource itself, but also bears the human, material and financial resources of compulsory education. The integration of compulsory education resources must ensure that the distribution of educational resources and opportunities in space is reasonable, that is, to ensure the fairness of accessibility. This paper considers that school accessibility is an important spatial factor affecting the balance of education in county, and puts school accessibility into the index system of educational resource integration. This is an improvement on the previous index system of educational resource allocation. In addition, this article put forward the school space adjustment scheme by establishing OD cost and taking the average distance as a factor to measure spatial accessibility, using standardized formula on other indexes of different dimensional data standardization based on the weighted formula calculation results, grading and sorting. To a certain extent, this study promoted the scientificity of the compulsory education resource integration.

To explore a more scientific and rational school layout adjustment plan, it is necessary to establish a resource integration index system involving economic ,school-age population, education, human resources quality and hardware facilities according to the local actual situation, and further incorporate the spatial accessibility index into the resource integration system, complete the adjustment plan of rural junior high school layout based on spatial analysis, so as to optimize the allocation of educational resources in the county. As far as the conclusion of this study is concerned, due to the differences in geographical characteristics and population distribution, the same results may not be obtained in other regions. More case studies are needed to explore the principles of compulsory education resource integration, so as to provide a more scientific decision-making basis for school layout optimization and compulsory education resource integration in different regions.

Literature

1. Tian Baohong. Study on the influence of school-age population change on the development of basic education / Tian Baohong // Chongqing:Southwest university, 2008.
2. An Yongjun. Flow of students, reorganization of educational resources and imbalance between urban and rural compulsory education based on the case study of N County, Gansu Province / An Yongjun // Journal of Beijing University of Technology (Social Science Edition). – Beijing. – 2021, 21(05). – P. 39-47.
3. Several opinions of The State Council on promoting the integrated reform and development of compulsory education in urban and rural areas at county level[EB/OL]//http://www.gov.cn/zhengce/content/201607/11/content_5090298.htm.
4. Li Yanxi. Research on integration mechanism of higher education resources in less developed provinces./ Li Yanxi // Wuhan University of Technology – Wuhan, 2010.
5. Liu Hongyan, Chen Wen. A review on the distribution of basic education resources in China / Liu Hongyan, Chen Wen // Science-Geographical Science. – 2017. – № 5. – P. 57-568.
6. Ren Ruohan. Research on spatial distribution and accessibility of basic education resources in poverty-stricken areas/ Ren Ruohan. – Chengdu: Chengdu University of Technology, 2014.
7. Liu Xiao. Research on the layout optimization of primary school planning based on accessibility / Liu Xiao. – Wuhan: Wuhan university, 2017.
8. Zhang Qianlin. Research on spatial gap and spatial model of Basic education in China/ Zhang Qianlin. – Dalian: Northeast University of Finance and Economics, 2016.
9. Xiong Xiaoyan, Xu Yaobin / Xiong Xiaoyan, Xu Yaobin // Measuring the balance of Compulsory education development in China. – 2015. – № 22. – P. 5-58.