Study on the optimization model of rural spatial main function area distribution based on 5g Technology

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Abstract: In view of the problem that the traditional main function area allocation optimization model leads to the small rural profit, the optimization model of rural space main function allocation based on 5G technology is studied. First of all, the distribution index system of the main function area of the village is established, and the weight of each index system is determined. The quadrant method is used to determine the main function area, and the 5G technology is used to schedule the communication resources of the main function area. Combining with the established main function area allocation index system, the construction of the main function area allocation optimization model is completed. By comparing with the traditional allocation optimization model, it is proved that the functional area allocation optimization model based on 5G technology can improve the rural profit with better application prospect.

Keywords:5G Technology; Rural Space; Main Function Area Distribution; Optimization Model;

1 Introduction

The main function area is the area that can represent the core function of the region. Each region because of the different main functions, division of labor and cooperation, common prosperity, common development. The main function is determined by its own resources, environmental conditions, social and economic basis, and is also given by a higher level of region [1]. The main function is different, the region type will have the difference. The natural environment and resource conditions of various regions of China are quite different, so that all regions cannot develop in accordance with a unified development model. The main function area is an effective way to promote the coordinated development of the region and realize the rational distribution of population and economy, is the urgent need to realize sustainable development and improve the utilization ratio of resources, is the inevitable requirement to adhere to the people-oriented and realize the equalization of public services, and is an important measure to improve the level of regional regulation and enhance the effectiveness of regional macro-control [2]. Therefore, the spatial main function area can better promote the regional development. For the rural space, the rational allocation of the main functional areas

EAI MOBIMEDIA 2020, August 27-28, Harbin, People's Republic of China

DOI 10.4108/eai.27-8-2020.2294600

can better develop and protect the rural resources. The traditional main function area allocation optimization model, because the overall grasp of the village is not comprehensive in the distribution, the allocated area cannot maximize the advantages of rural space, there are some limitations [3].

The fifth generation of mobile communication technology is the latest generation of cellular mobile communication technology, and it is also an extension after 4G,3G and 2G systems. The performance goals of 5G are high data rate, reduced delay, energy saving, reduced cost, improved system capacity and large-scale device connectivity [4]. The first phase of the 5G specification in Release-15 is to adapt to early commercial deployment. Phase II of the release-16 will be completed in April 2020 and submitted to ITU as a candidate for IMT-2020 technology. The ITUIMT-2020 specification requires speeds up to 20 Gbit/s, enabling wide channel bandwidth and large capacity MIMO. Based on the above analysis, this paper will study the optimization model of the main function area of rural space based on 5G technology.

2 Constructing the Optimization Model of the Functional Area of Rural Space Based on 5G Technology

2.1 Establishing the Distribution Index System of the Rural Main Function Area

The distribution of main functional areas should mainly consider natural ecological conditions, carrying capacity of soil and water resources, location characteristics, environmental capacity, existing development density, economic structure characteristics, population agglomeration, participation in the international division of labor and other factors. As shown in the following table, this paper first establishes the distribution index system of the main function area of rural space.

Table 1 Distribution index system of main function area of rural space

Primary indexes	Secondly indexes	Instructions
Resource utilization	Land resources are available per person	Assess the amount or carrying capacity of available land resources in an area
	Available water resources	The amount of water available in an area in the future
		The amount or potential to support socio-economic development
		Force size
Environment	Environmental capacity	To assess the absorption capacity of an

		area
	Ecosystem vulnerability	The fragility of the ecological environment
	Ecological importance	Importance of ecosystem structure and function
	Risk of natural disasters	To assess the probability of natural disasters in a region and the extent of their destruction
Economy, population, transportation	Population concentration	Current population agglomeration
	Level of economic development	Assess the impact and impetus of regional economic development
	Traffic dominance	Assess the current accessibility of the area

After establishing the distribution index system of the main function area of the rural space shown in the above table, the weight of each index of the index system is determined.

2.2 Determine the weight of each index in the index system

For the environmental level indicators in Table 1, experts from relevant fields are invited to rate the ecological environment of the target main functional areas of rural space. Combined with the results of the following formula, the index weight of the first-level index environment in the distribution index system is obtained.

$$E = \frac{\sum_{i=1}^{n} R_i B_i}{\sum_{i=1}^{n} B_i} \quad (1)$$

In formula (1), E is the ecological carrying capacity of regional unit area. R_i A global equilibrium factor for regional productivity of the same land type; B_i Represents productive land area in the region. If the average score of the expert is divided into $\overline{x}$, then the index weight calculation formula of the first-level index environment in the main function area allocation index system is as follows.

$$W_E = \frac{E + \overline{x}}{2} \quad (2)$$

For the traffic index in the first class index, traffic accessibility to the response area can be used. The formula for calculating accessibility is as follows:

$$A_i = \frac{\sum_{j=1}^{n} T_{ij} M_j}{\sum_{j=1}^{n} M_j} \quad (3)$$

In formula (3), A_i For the accessibility of i roads in regional traffic networks, T_{ij} is the shortest distance from Road i to Road j, time is used in this paper to measure the length of the distance, and M_j is the attraction user of the j road using the gravitational size parameter [5].

The resource index in the distribution index system of the main function area of rural space can first compare the per capita available land resources with the per capita available water resources, and take the small value as the molecule in the calculation formula. Then, compare the risk of natural disasters and environmental capacity, take the large value as the denominator of the formula, that is:

$$W_r = \frac{\min\left(x_1, x_2\right)}{\max\left(x_3, x_4\right)} \quad (4)$$

In formula (4), x_1 Land resources available per capita, x_2 for available water resources, x_3 Risk of natural disasters, x_4 for environmental capacity. After calculating the weight of the primary index in the system, the weight of the secondary index in the distribution system is calculated [6]. According to the following formula, the weight of the first-level index in the distribution index system of the main function area of rural space can be calculated.

$$W_i = \frac{\sum_{i=0}^{n} S_i * \mu_i}{\sum_{i=0}^{n} S_i} \quad (5)$$

In formula (5), W_i is the weight of i first-level indicator, S_i The degree of importance set in accordance with the criteria for distribution of i first-level indicator, μ_i Relevant index for the allocation of i first-level indicator, n is the number of secondary indicators included in the first-order indicator. After determining the weight of the first-level index, the weight of the second-level index can be determined according to the following formula.

$$W_{ij} = W_i * \mu_{ij} \quad (6)$$

In formula (6), W_{ij} is the weight of the secondary indicator under the i -first-level indicator, μ_{ij} the allocation index for secondary indicators [7].

After determining the weight of each index in the distribution index system of the main function area of the rural space, the index weight in the distribution index system is used to locate the main function area of the rural space.

2.3 Location of main function area of rural space

According to the distribution index system of the main function area of rural space, the image limit method is adopted to determine the main function area and establish the number axis. The x-axis represents the economic development support (including the carrying capacity of resources and the carrying capacity of the environment), and the y-axis represents the natural ecological binding force (including the development density and the development constraint potential).

As shown in the following figure, in area I, the x value is high and the y value is low. There are two situations in Area II: The x value is high, the y value is moderate and the x value is moderate. There are also two cases in area III: low x value, moderate y value and moderate x value, and low y value. In Area IV, the x value is low and the y value is high [8].

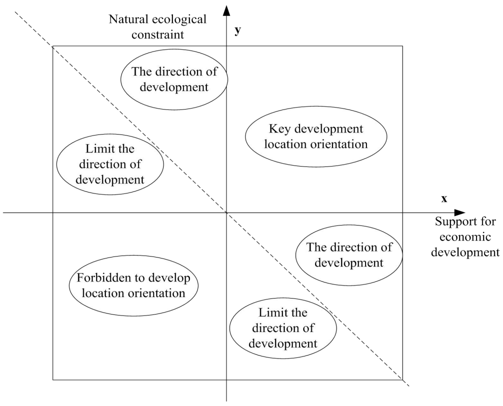

Fig.1 Subject function zoning of quadrant method

Among them, development zones are forbidden to be important ecological service functional areas and environmentally sensitive areas, including nature reserves and drinking water source protection areas.

Restricting the development zone as the ecological fragile zone and the environment sensitive zone around the development zone, its resources and environment carrying capacity is weak, the large-scale agglomeration economy and population conditions are not good enough, and it is related to the ecological security of the larger area. Including the experimental areas of nature reserves, important water conservation areas, serious areas of soil erosion, scenic spots and so on.

Optimal development area refers to the area with high density of land development and weakening of carrying capacity of resources and environment, which is the core of economy. The key development area refers to the areas with strong carrying capacity of resources and environment, great potential for development and good conditions for economic and population agglomeration.

The entropy value method is used to divide the main function area, assuming that there are m items to be evaluated, n items evaluation index, thus forming an evaluation of the original data matrix $X=\{x_{ij}\}_{m\times n}$, x_{ij} represents the value of the evaluation index of item j of the i sample. The information entropy is defined as follows:

$$H(x)=-\sum_{j=1}^{n}g(x_j)\ln(x_j) \quad (7)$$

By means of standardized data processing, the information entropy values e of the evaluation index and j of the information utility value are calculated as follows:

$$e_j = -K\sum_{i=1}^{n} y_{ij} \ln y_{ij} \quad (8)$$

In formula (8), K is constant [9]. when m samples are in a completely disordered distribution state, $y_{ij}=1$ and $K=\frac{1}{\ln m}$ at this time. After calculating the entropy value, combined with the weight of each index in the distribution index system, the location of the main function area in the rural space is located. After locating the main function area, in order to make better use of the resources of the main function area, use 5G technology to schedule the communication resources of the main function area.

2.4 Using 5G Technology to Schedule Main Function Area Communication Resources

When the main function area of rural space is allocated, the main function area resources are allocated according to the communication transmission in rural space. The following figure is a schematic diagram of using 5G technology to schedule the main function area resources.

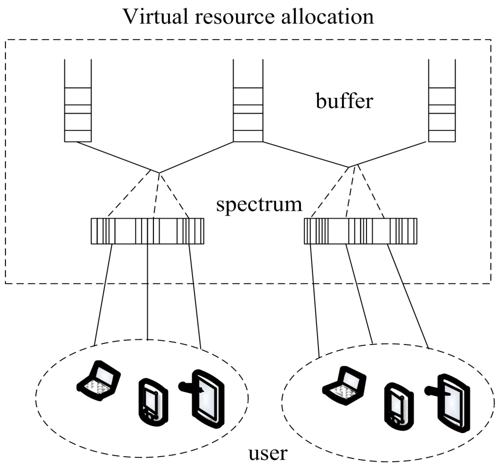

Fig. 2 Schematic diagram of the resources of the main function area of the scheduler

Set a total of t 5G communication users assigned to Q main function areas $c_1, c_2, \cdots, c_Q$, each main functional area is provided with a C-RAN system RRHs, several adjacent main functional areas are divided into a local area, a total of U regions, and each region is provided with a microcloud server. On this basis, we define $b_{k,j,i}$ and $p_{k,j,i}$ as the frequency band and transmit power corresponding to the service s_i required for user y_j in the main functional area k, the downlink rate R_i corresponding to this service.

$$\begin{cases} R_i = \sum_{y_i \in c_k} x_{k,j,i} b_{k,j,i} lb\left(1+\gamma_i\right) \\ \gamma_i = \dfrac{p_{k,j,i} G_{k,j}}{\sum P_d G_{d,j} + N_0 b_{k,j,i}} \end{cases} \quad (9)$$

In formula (9), $x_{k,j,i} = 1$ indicates that user y_j in the main function area k is using the service s_i; γ_i denotes the signal-to-noise ratio; $G_{k,j}$ is the transmission loss of user y_j in the main function area k; $G_{d,j}$ is the transmission loss of user y_j that interferes with the base station to the main function area k; $P_d G_{d,j}$ interference for other base stations; $N_0 b_{k,j,i}$ Gaussian white noise interference.

For the resource scheduling scheme of network C-RAN, assuming that the frequency band of a certain time point system distributed to the main functional area k is B_k, then the constraints are as follows:

$$\sum_{y_j \in Y} \sum_{s_i \in S} x_{k,j,i} b_{k,j,i} \le B_k \quad (10)$$

According to the above conditions, the communication resources in the main function area are scheduled [10]. In the main function area after positioning, combined with the optimal communication resource scheduling model and the allocation index system, the allocation of the main function area is optimized to complete the construction of the model.

2.5 Complete the construction of allocation optimization model

The optimal use of 5G technology to schedule the main function area communication resource is optimized. Get the assignment optimization model objective function shown below.

$$\min f(x)$$
$$s.t. \quad \begin{cases} Ax \geq b \\ l \leq x \leq h \end{cases} \quad (11)$$

In the above formula, A allocates the expense parameter for the main function area, b is the constraint vector, and l and h are the cost function constraints for the rural space main function area. There are more than one optimization parameters for the distribution of the main function area of the rural space satisfying the above objective function, the parameters of the optimization model are determined, and the model is cross verified.

Use the training data set and use the established allocation index system to assign weight to the data set. Multiple optimization model parameters are developed by training. These model parameters are used to calculate the cross validation error for the cross validation set separately, and the model parameters with the minimum cost function are selected. Final error checking of the model using actual data. If the error between the output and the actual value of the final model is within the expected error range, then the error of the model is determined to meet the requirements. If the error between the output of the model and the actual value is not within the expected error range, continue to train the model until the model output meets the requirements. At this point, the construction of the allocation optimization model of rural main function area based on 5G technology is completed.

3 Experiment

This paper constructs the rural main function area allocation optimization model based on 5g technology. this section will design contrast experiments to test the model performance constructed in this paper.

3.1 Experiment content

The experimental group is the traditional allocation optimization model based on improved PSO, and the experimental group is the rural main function area allocation optimization model based on 5G technology studied in this paper. The contrast index of the experiment is the rural profit growth ratio of the experimental area after two optimization models.

The experimental data are processed and analyzed on the computer platform configured in the following table.

Table 2 Parameters of Computer Virtual Simulation Platform

project	configuration	instructions
CPU	Intel(r) core	processing instructions, performing

	i7-8400 3.50GHz	operations
hard disk	200G	store data
memory	16G	temporarily store the calculated data
operating system	Windows 8.1	control program operation
graphics card	GTX1660 Super	auxiliary display run
data processing software	MATLAB 2012	experimental data processing

3.2 Experimental data

The experimental objects selected in this paper are A and B two rural spaces. The experimental group was rural A, and the contrast group was rural B. the specific parameters of the experimental object are shown in the table below.

Table 3 Experimental Object Parameters

project	A	B
Geological landforms	Mountains and plains	Plains and hills
Climate	Monsoon climate of medium latitudes	Monsoon climate of medium latitudes
The water resources	18 rivers and streams	16 rivers and streams
Soil resources	White pulp soil, sand ginger black soil	Meadow soil, paddy soil, mulch soil,
Vegetation resources	Shrub and broadleaf forests	Meadows, shrubs, cultural vegetation
Cultivated land area	1,605,230	1,724,010
Woodland area	75,369	52,147
The number of residents	35,000	42,700
Number of industries	8	11

Use the experimental data shown in the above table to complete the experimental verification process, record and analyze the experimental data, and draw the corresponding conclusions.

3.3 Experimental result

The experimental results are shown in the following figure, analyze the information in the diagram, and draw the experimental conclusion.

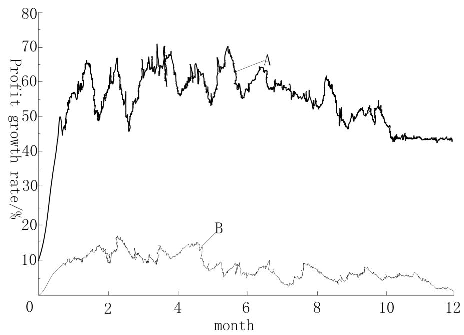

Fig.3 Experimental results

As can be seen from the above figure, the P/E growth ratio of village A using the experimental group model is much higher than that of village B using the contrast group model. Analyzing the trend of the curve, the profit growth ratio curve of rural A fluctuates in a certain range, and finally remains stable. The rural B-earnings ratio curve showed a downward trend as a whole, and then the downward trend slowed down, gradually approaching zero. indicating that the rural profitability of the applied experimental group model is better. To sum up, the allocation optimization model based on 5G technology can improve the rural profit and have a better application prospect.

4 Conclusion

The main function zoning involves all aspects of population, economy, society, resources and environment, which needs a lot of coordination and overall planning. This is a very challenging innovation work different from any previous zoning. The main function orientation is a tangible hand for the government to regulate and control the economic and social development under the market economy system. It is of great value and innovative significance for the implementation of the scientific development concept, the establishment and improvement of the socialist market economy system, the promotion of resource conservation and environmental friendliness, and the overall planning of the efficiency and fairness of urban and rural regional development.

This paper constructs the allocation optimization model of the rural main function area based on 5g technology. through the comparison experiment with the traditional distribution optimization model, it is proved that the village with the allocation optimization model constructed in this paper is more profitable and can promote the use of resources in the rural main function area.

5 Fund project

supported by the philosophy and Social Sciences Planning of Hainan Province, Project No.: HNSK(YB)18-52

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