2014

ISSN : 0974 - 7435 Volume 10 Issue 18

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(18), 2014 [09983-09990]

Ta-pieh mountains region national fitness organization network construction and path selection study

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ABSTRACT

According to Ta-pieh Mountains region's geographical features, through central place model, it analyzes Ta-pieh Mountains region fitness organization website; applies honeycomb model to proceed with network coverage on websites, the purpose is to comprehensive and less repeatedly cover. Make evaluation on Ta-pieh Mountains region's national fitness organization network utilized honeycomb model. Score section after fuzzy comprehensive evaluation is in the interval of 90 to 100 scores, which shows evaluation result is excellent, and the model adaptability is higher.

KEYWORDS

Ta-pieh mountains; National fitness; Honeycomb model; Fuzzy evaluation.

INTRODUCTION

Ta-pieh Mountains (dà bié shān) region fitness organizations establishment is implemented on Chinese national fitness policies, the purpose is to improve national physique, but due to Ta-pieh Mountains region terrain is specific, and resident aggregation point is relative dispersed,it cannot be analyzed by referencing normal regions' completely cover model, so the paper firstly analyzes it according to central place model.

Honeycomb model belongs to cover model, it approximately fits coverage regions that have specific radiuses into round to complete cover and non-overlapping cover. Due to everything has lots of uncertainty, Ta-pieh Mountains fitness organization network's covering also has no exception, the paper establishes mathematical fuzzy comprehensive evaluation model to analyze its expression.

MODEL ESTABLISHMENTS

Central place theory

When applies central place theory into discussing urban sports facilities (in the following it calls sports central place for short) space layout, at first it will use central place model.

The paper makes following assumption

1) Central place model has discussed central place provided sports services, and it establishes in the center of Ta-pieh Mountains dense population;
2) Low level sports facilities groups features are they can reduce sports land, convenient and efficient, and is proper for small size user;
3) Relative high level sports stadiums quantities are fewer, and covers large areas; their available design range is wide.

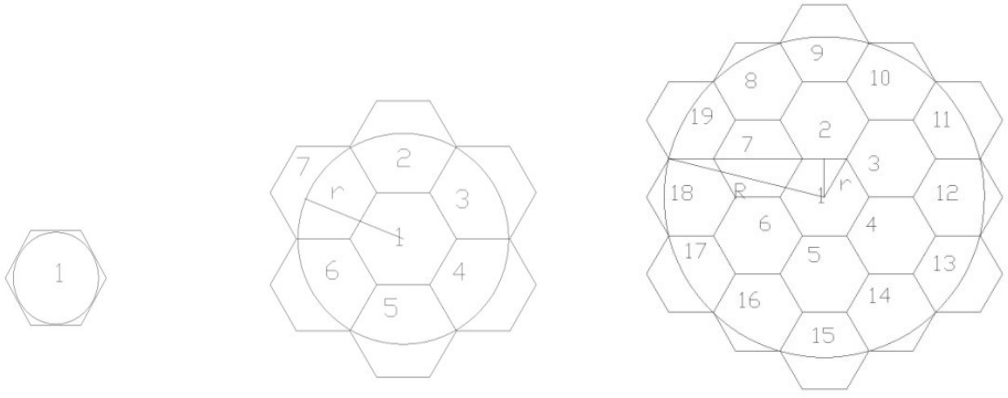
Honeycomb model

In view of numbers of people that need sports services, due to coverage area is a round. On the condition that radiation radius r is the same, calculate three shapes regions' neighboring region distances, regional area, crossover region width and crossover region area as TABLE 1 show.

TABLE 1 : Three kinds of graphs comparison

Regional shape	Regular triangle	Square	Regular Hexagon
Neighboring region distances	r	$\sqrt{2}r$	$\sqrt{3}r$
Regional area	$1.3r^2$	$2r^2$	$2.6r^2$
Crossover region width	r	$0.59r$	$0.27r$
Crossover region area	$1.2\pi r^2$	$0.73\pi r^2$	$0.35\pi r^2$

From TABLE 1, it is clear that regular hexagon shape is the nearest ideal round, it can effective meet cover region, which is most proper. So that takes regular hexagon center as honeycomb structure, extends outside, as following process shows:



From the paper, we can find diameter d and number N relationships:

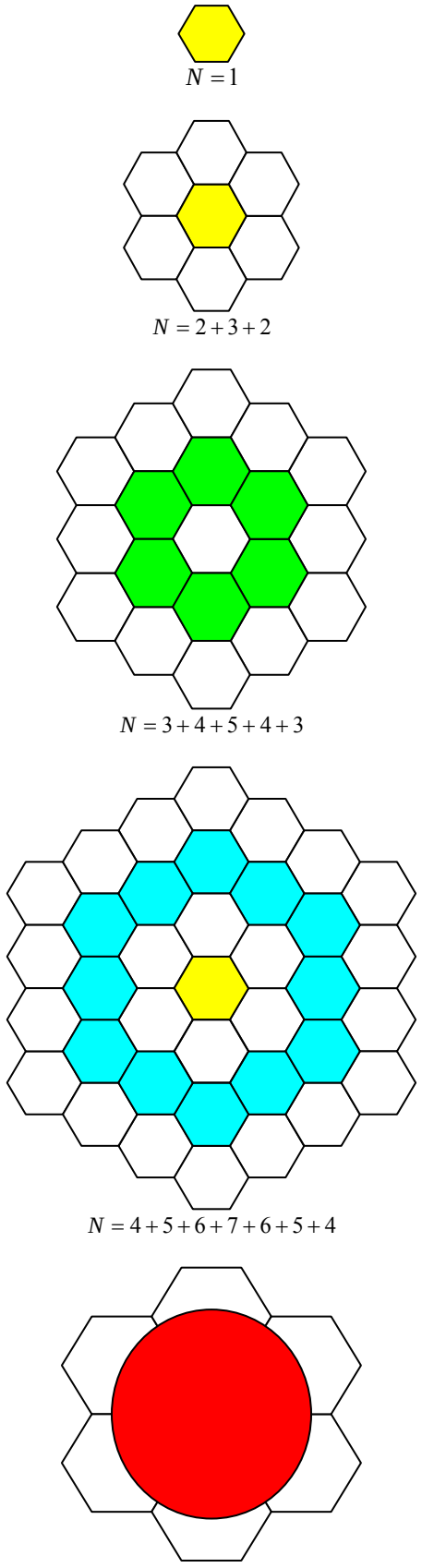


Figure 1 : Round region border

As Figure 1 show, round region border lies in the outermost layer hexagon center, it can get by rules that: $N = 12n^2 + 30n + 19$

Among them, N is overspread round region required numbers of hexagons. n is equal to: $n = \frac{D}{d}$

Among them, D is round region diameter, d is hexagon inscribed circle diameter.

The paper makes TABLE with these data as TABLE 2 shows.

TABLE 2 : Statistical table

Number of sports facilities or basic public service facilities N	Coverage radius r	Number of sports facilities or basic public service facilities N	Coverage radius r
1	45	1254	1.849
6	25	1317	1.798
17	11.19	1459	1.691
38	8	1657	1.667
59	7.154	1841	1.568
41	6.667	1941	1.528
127	5.298	2117	1.464
169	5	2279	1.438
218	4.193	2397	1.365
249	4	2685	1.324
362	3.52	2781	1.25
385	3.83	2973	1.29
458	2.97	3167	1.197
545	2.67	3365	1.176
619	2.556	3571	1.136
731	2.41	3786	1.121
817	2.283	4004	1.156
1000	2.222	4318	1.045
1021	2.049	4644	1.012
1143	2	4752	1

Fuzzy comprehensive evaluation model review

Utilize fuzzy comprehensive evaluation, and steps are as following:

(1)Establish factor set U.

(2)Establish judgment set V (evaluation set) : $R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$

Establish weight set, $A = (a_1, a_2, \cdots, a_n)$,it meets conditions:

$$\sum_{i=1}^{n} a_i = 1 \quad a_i \geq 0$$

$$\sum_{i=1}^{n} r_{ij} \quad j = 1, 2, 3, \cdots, m$$

$$B = A \cdot R$$

$$= (a_1, a_2, a_3, \cdots, a_n) \cdot \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$$

$$= (b_1, b_2, b_3, \cdots, b_n)$$

Establish factor set U ,$U=(U_1 \quad U_2 \quad U_3 \quad U_4)$. Among them, fitness facility U_1, sports personnel field awareness cultivation U_2, economic factor U_3 ,geographic orientation U_4 ,it gets TABLE 3.

TABLE 3 : Ta-pieh Mountains fitness facility construction evaluation indicator system

Fitness facility U_1	**Sports personnel field awareness cultivation** U_2	**Economic factor** U_3 **0.2**	**Geographic orientation** U_4 **0.15**
Facility introduction u_{11}	Maintenance personnel cultivation u_{21}	Resident income u_{31}	Resident aggregation degree u_{41}
Facility maintenance u_{12}	Construction personnel cultivation u_{22}	Consumption level u_{32}	Terrain cause u_{42}
Daily match facilities construction u_{13}	Policies introduction u_{23}	National economic input u_{33}	Weather conditions u_{43}
Daily facilities construction u_{14}	Coaches training expense u_{24}	Usage amount per capita u_{34}	
Equipment changing u_{15}			

The paper gets evaluation set.

$$U_1=\{u_{11},u_{12},u_{13},u_{14}\};U_2=\{u_{21},u_{22},u_{23},u_{24},u_{25}\}$$

$$U_3=\{u_{31},u_{32},u_{33}\};U_4=\{u_{41},u_{42},u_{43},u_{44}\}$$

By collecting data and analyzing, it gets four factors importance degree ranking statistics as TABLE 4 shows.

TABLE 4 : Four factors importance degree ranking statistics

Classification	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 4**
Field awareness U_1	23	7	4	0
Technology U_2	7	18	8	0
Psychological quality U_3	0	9	13	12
Physical quality U_4	3	0	9	21

But:

$$U_2=\{23,7,4,0\};U_2=\{7,18,8\ 0\}$$

$$U_3=\{0,9,13,12\};U_4=\{3,0,9,21\}$$

Obtained weighted vector from rank 1 to rank 2:

$$\beta=\{\beta_1,\beta_2,\beta_3,\beta_4\}=\{0.4,0.3,0.2,0.1\}$$

$$U_i^*=U_i\cdot\beta^T$$

$U_1^* = 12, U_2^* = 9.7, U_3^* = 6, U_4^* = 5$

The paper makes normalization processing: $U_1^* = 0.35, U_2^* = 0.3, U_3^* = 0.2, U_4^* = 0.15$

It gets: $\bar{A} = (0.35 \quad 0.3 \quad 0.2 \quad 0.15)$

TABLE 5 : Remarks membership

Evaluation way	Set scores interval			
	0-60	60-80	80-90	90-100
Excellent	0	0	0.05	0.95
Good	0	0.05	0.9	0.05
Medium	0.05	0.9	0.05	0
Bad	0.95	0.05	0	0

The paper through obtained evaluation on Ta-pieh Mountains fitness facilities each indicator (as TABLE 5), it gets TABLE 6.

TABLE 6 : Ta-pieh Mountains fitness facilities construction each indicator obtained evaluation value

Each layer indicator	Evaluation value	Each layer indicator	Evaluation value
Facility introduction u_{11}	Excellent	Resident income u_{31}	Excellent
Facility maintenance u_{12}	Excellent	Consumption level u_{32}	Good
Daily match facilities construction u_{13}	Medium	National economic input u_{33}	Good
Daily facilities construction u_{14}	Medium	Usage amount per capita u_{34}	Medium
Equipment changing u_{15}	Medium	Resident aggregation degree u_{41}	Good
School sports personnel cultivation U_2	Excellent	Terrain cause u_{42}	Excellent
Maintenance personnel cultivation u_{21}	Excellent	Weather conditions u_{43}	Medium
Construction personnel cultivation u_{22}	Excellent		
Policies introduction u_{23}	Good		

By above model, it gets single layer indicator weight factor fuzzy set is:

$U_1^* = \{U_{11}, U_{12}, U_{13}, U_{14}, U_{15}\} = \{0.25\ 0.25\ 0.2\ 0.15\ 0.15\}$

$U_2^* = \{U_{21}, U_{22}, U_{23}, U_{24}\} = \{0.54\ 0.1\ 0.24\ 0.14\}$

$U_1^* = \{U_{31}, U_{32}, U_{33}, U_{34}\} = \{0.4\ 0.3\ 0.1\ 0.2\}$

$U_1^* = \{U_{41}, U_{42}, U_{43}\} = \{0.3\ 0.4\ 0.3\}$

By TABLE 4, and combine with TABLE 3 remarks membership, the paper gets fitness facility U_1, sports personnel field awareness cultivation U_2, economic factor U_3, geographic orientation U_4 each aspect evaluation set.

Fitness facility $U_1=\begin{pmatrix}0 & 0 & 0.05 & 0.95\\ 0 & 0 & 0.05 & 0.95\\ 0 & 0.05 & 0.95 & 0.05\\ 0 & 0.05 & 0.95 & 0.05\\ 0 & 0.05 & 0.95 & 0.05\end{pmatrix}$

Sports personnel field awareness cultivation $U_2=\begin{pmatrix}0 & 0 & 0.05 & 0.95\\ 0 & 0 & 0.05 & 0.95\\ 0 & 0 & 0.05 & 0.95\\ 0 & 0.05 & 0.9 & 0.05\end{pmatrix}$

Economic factor $U_3=\begin{pmatrix}0 & 0 & 0.05 & 0.95\\ 0 & 0.05 & 0.9 & 0.05\\ 0 & 0.05 & 0.9 & 0.05\\ 0.05 & 0.9 & 0.05 & 0\end{pmatrix}$

Geographic orientation $U_4=\begin{pmatrix}0 & 0 & 0.05 & 0.95\\ 0 & 0.05 & 0.9 & 0.05\\ 0 & 0.05 & 0.9 & 0.05\end{pmatrix}$

$$B_i = A_i \cdot R_i$$

Make normalization processing with obtained B_i ,it gets second layer fuzzy evaluation matrix:

$$\bar{B}=\begin{pmatrix}B_1\\ B_2\\ B_3\\ B_4\end{pmatrix}=\begin{pmatrix}0.07 & 0.27 & 0.13 & 0.53\\ 0 & 0.1 & 0.4 & 0.5\\ 0.08 & 0.46 & 0.38 & 0.08\\ 0.14 & 0.2 & 0.3 & 0.36\end{pmatrix}$$

$$Z = U^* \cdot B = \begin{pmatrix}0.15 & 0.26 & 0.29 & 0.36\end{pmatrix}$$

Because $0.36 > 0.29 > 0.26 > 0.15$,Ta-pieh Mountains fitness facilities construction gets excellent results, its score frame after fuzzy comprehensive evaluation is in the interval of 90 to 100 scores.

CONCLUSION

Base on China's national fitness policy and Ta-pieh Mountains region terrain features, firstly analyze it according to central place model, secondly apply honeycomb model to proceed with network complete cover and non-overlapping cover on websites. Score section after fuzzy comprehensive evaluation is in the interval of 90 to 100 scores, which shows evaluation result is excellent, and the model adaptability is higher.

ACKNOWLEDGMENT

This article for Hubei province in 2015, humanities and social science research project support; Hubei province key project of humanities and social science research (13d122); Huanggang Normal University scientific research project (2013021303).

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