Chinese urban and rural mass sports participation ability fuzzy comprehensive evaluation

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ABSTRACT
China is a country of the greatest population, for masses sports participation status, carry out measurement on Chinese national fitness activities, on the basis of integration of urban and rural, establish fuzzy comprehensive evaluation model, it gets comprehensive evaluation value: facility $U_1$ is 38%, staff cultivation $U_2$ is 25%, sports organization cultivation $U_3$ is 22%, high class stadium construction $U_4$ is 15%, therefore, Chinese sports construction mainly surrounds sports facilities construction and sports staff as well as organization cultivation, so that can effective improve mass sports participation degree.

KEYWORDS
Fuzzy comprehensive evaluation; National fitness; Sports facility and stadium; Health level; Sports participation; Sports industry.

INTRODUCTION
Chinese economic development ratio is not so balanced, and economy is an important link in social development and even is basis, village and town residents don’t quite understand real physical education and national fitness significances, awareness of national fitness is to be improved, and support to village and town sports is still not big enough. By comparing, urban high class stadium has good forces. Based on economic development is not very balanced, and economy is the important link in social development, even is basis, village and town residents don’t quite understand real physical education and national fitness significances, awareness of national fitness is to be improved, and support to village and town sports is still not big enough, by comparing, urban high class stadium has positive effects.

For Chinese sports service industry, urban and rural economic imbalanced development is up to sports service industry distribution important factors. The paper based on analytic hierarchy process model, it carries out sports service industry development strategy research on village and town regions. Due to economic development ratio is not very balanced, and economy is the important link in social development, even is basis; village and town residents don’t quite understand real physical education and national fitness significances, awareness of national fitness is to be improved, and support to village and town sports is still not big enough, by comparing, urban high class stadium has positive effects.

By TABLE 1, it is clear about Chinese different working environment staff fitness ways and fitness purposes.
Table 1: Different social classes’ participated in sports construction status

<table>
<thead>
<tr>
<th>Horizontal indicator</th>
<th>Enhance quality</th>
<th>Entertainment</th>
<th>Social communication</th>
<th>Improve sports level</th>
<th>Emotion adjustment</th>
<th>Beauty building, body building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nation and social administrative staff</td>
<td>51.4</td>
<td>16.4</td>
<td>7.7</td>
<td>4.9</td>
<td>5.5</td>
<td>14.2</td>
</tr>
<tr>
<td>Managerial staff</td>
<td>26.0</td>
<td>23.3</td>
<td>25.0</td>
<td>5.5</td>
<td>4.4</td>
<td>25.9</td>
</tr>
<tr>
<td>Private entrepreneur</td>
<td>32.4</td>
<td>19.0</td>
<td>22.9</td>
<td>5.7</td>
<td>12.4</td>
<td>7.6</td>
</tr>
<tr>
<td>Professionals</td>
<td>48.0</td>
<td>7.5</td>
<td>4.9</td>
<td>7.5</td>
<td>14.6</td>
<td>17.6</td>
</tr>
<tr>
<td>Clerks</td>
<td>37.7</td>
<td>21.2</td>
<td>9.2</td>
<td>3.5</td>
<td>8.5</td>
<td>19.9</td>
</tr>
<tr>
<td>Individual business</td>
<td>56.9</td>
<td>15.8</td>
<td>6.5</td>
<td>4.1</td>
<td>10.3</td>
<td>6.4</td>
</tr>
<tr>
<td>Commercial service personnel</td>
<td>38.3</td>
<td>14.9</td>
<td>11.3</td>
<td>4.9</td>
<td>9.7</td>
<td>21.0</td>
</tr>
<tr>
<td>Workers</td>
<td>35.4</td>
<td>13.6</td>
<td>14.6</td>
<td>3.0</td>
<td>4.8</td>
<td>18.6</td>
</tr>
<tr>
<td>Agricultural laborers</td>
<td>33.2</td>
<td>20.2</td>
<td>11.8</td>
<td>2.3</td>
<td>20.9</td>
<td>11.6</td>
</tr>
<tr>
<td>Laid-off workers</td>
<td>32.2</td>
<td>11.2</td>
<td>22.4</td>
<td>5.6</td>
<td>15.4</td>
<td>13.3</td>
</tr>
</tbody>
</table>

Take Beijing as an example, sports construction development on the basis of national fitness features is as following Figure 1-2 show.

MODEL ESTABLISHMENTS

Fuzzy comprehensive evaluation model

Utilize fuzzy comprehensive evaluation, steps are as following:
(1) Establish factor set $U$ :

\[ U = \left( U_1, U_2, \ldots, U_k \right) \]

(2) Establish judgment set $V$ (evaluation set);

(3) Establish evaluation matrix fuzzy mapping from $U$ to $V$, obtained fuzzy relations are as following matrix shows:

\[ R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \]

(4) Establish weight set, $A = (a_1, a_2, \ldots, a_n)$, it meets
conditions:
\[ \sum_{i=1}^{n} a_i = 1 \quad a_i \geq 0 \]

(5) Fuzzy relation \( R \) every line will reflect the line influence factors to object judgment degree, meanwhile, \( R \) every column will reflect the column influence factors to object judgment degree.

\[ \sum_{i=1}^{n} r_{ij} = 1, 2, 3, \ldots, m \]

\[ B = A \cdot R \]

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

\[ = (b_1, b_2, b_3, \ldots, b_n) \]

In \( V \), fuzzy combination is evaluation set \( B \). Based on above described facts, actual change model is as Figure 3.

As Figure 3 show, it gets fuzzy comprehensive evaluation change model, and can establish corresponding every factor grade evaluation transformation function, evaluation factors \( u_1, u_2, u_3, u_4, u_5 \) membership functions can be expressed as following:

\[ u_{v1}(u_i) = \begin{cases} 
0.5(1 + \frac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\
0.5(1 - \frac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\
0, & u_i < k_2 
\end{cases} \]

\[ u_{v2}(u_i) = \begin{cases} 
0.5(1 - \frac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\
0.5(1 + \frac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\
0.5(1 - \frac{u_i - k_3}{k_2 - k_3}), & k_3 \leq u_i < k_2 \\
0.5(1 - \frac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 
\end{cases} \]

\[ u_{v3}(u_i) = \begin{cases} 
0, & u_i \geq k_2 \\
0.5(1 - \frac{k_1 - u_i}{k_2 - k_3}), & k_2 \leq u_i < k_2 \\
0.5(1 + \frac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 
\end{cases} \]

Combine with fuzzy comprehensive evaluation model to evaluate Chinese urban and rural mass sports participation ability.

Establish factor set \( U \), among
them \( U = (U_1, U_2, U_3, U_4) \). Among them, facility is \( U_1 \), staff cultivation is \( U_2 \), sports organization cultivation is \( U_3 \), high class stadium construction is \( U_4 \), it gets TABLE 2.

By TABLE 2 listed factors, it gets evaluation set:

\[
\begin{align*}
U_1 &= \{u_{11}, u_{12}, u_{13}, u_{14}\} \\
U_2 &= \{u_{21}, u_{22}, u_{23}, u_{24}, u_{25}\} \\
U_3 &= \{u_{31}, u_{32}, u_{33}\} \\
U_4 &= \{u_{41}, u_{42}, u_{43}, u_{44}\}
\end{align*}
\]

By collecting data and analyzing, it gets four kinds of factors importance ranking statistics, as TABLE 3 show.

By TABLE 3 sorting, it gets facility \( U_1 \), staff cultivation \( U_2 \), sports organization cultivation \( U_3 \), high class stadium construction \( U_4 \) four aspects’ rank matrix:

\[
\begin{align*}
U_1 &= \{23, 7, 4, 0\} \\
U_2 &= \{7, 18, 8, 0\} \\
U_3 &= \{0, 9, 13, 12\}
\end{align*}
\]

TABLE 2 : Sports undertaking s to mass impact evaluation indicator system

<table>
<thead>
<tr>
<th>Facility ( U_1 )</th>
<th>Staff cultivation ( U_2 )</th>
<th>Sports organization cultivation ( U_3 )</th>
<th>High class stadium construction ( U_4 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of facility ( u_{11} )</td>
<td>Coaches’ cultivation ( u_{21} )</td>
<td>Competition ( u_{31} )</td>
<td>Introduction of stadium ( u_{41} )</td>
</tr>
<tr>
<td>Facility maintaining ( u_{12} )</td>
<td>Faculty cultivation ( u_{22} )</td>
<td>Activity ( u_{32} )</td>
<td>High class stadium development ( u_{42} )</td>
</tr>
<tr>
<td>Competition facilities construction ( u_{13} )</td>
<td>Introduction of foreign teachers ( u_{23} )</td>
<td>Lecture ( u_{33} )</td>
<td>High class stadium targeted group ( u_{43} )</td>
</tr>
<tr>
<td>Daily facilities construction ( u_{14} )</td>
<td>Cultivation expense ( u_{24} )</td>
<td>Outbound visiting ( u_{34} )</td>
<td></td>
</tr>
<tr>
<td>Equipment maintaining and changing ( u_{15} )</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Obtained weighted vector from rank 1 to rank 2:

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

\[
U_i^* = U_i \cdot \beta^T
\]

\[
U_1^* = 12, \quad U_2^* = 9.7, \quad U_3^* = 6, \quad U_4^* = 5
\]

The paper takes normalization processing:

\[
\begin{align*}
\beta^* &= \{0.35, 0.3, 0.2, 0.15\}
\end{align*}
\]

The paper gets remark membership by government propelling to sports, as TABLE 4 shows.

TABLE 5 is describing residents to the city sports construction satisfaction degree, according to the result to make evaluation, the paper obtained evaluation according to Chinese sports each kind of indicators, and it gets TABLE 6.

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

\[
\begin{align*}
U_1^* &= \{U_{11}, U_{12}, U_{13}, U_{14}\} = \{0.25, 0.25, 0.2, 0.15\} \\
U_2^* &= \{U_{21}, U_{22}, U_{23}, U_{24}\} = \{0.54, 0.1, 0.24, 0.14\} \\
U_3^* &= \{U_{31}, U_{32}, U_{33}, U_{34}\} = \{0.4, 0.3, 0.1, 0.2\}
\end{align*}
\]

The paper gets remark membership by government propelling to sports, as TABLE 4 shows.

The paper gets remark membership by government propelling to sports, as TABLE 4 shows.
TABLE 3: Four kinds of factors importance degree ranking statistics

<table>
<thead>
<tr>
<th>Classification</th>
<th>Rank 1</th>
<th>Rank 2</th>
<th>Rank 3</th>
<th>Rank 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility $U_1$</td>
<td>23</td>
<td>7</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Staff cultivation $U_2$</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Sports organization cultivation $U_3$</td>
<td>0</td>
<td>9</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>High class stadium construction $U_4$</td>
<td>3</td>
<td>21</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

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

By TABLE 5, and combine with TABLE 3 remarks membership, the paper gets facility $U_1$, staff cultivation $U_2$, sports organization cultivation $U_3$, high class stadium construction $U_4$, each aspect evaluation set:

$$U_1 = \begin{bmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0.05 & 0.95 & 0.05 & 0.05 \\ 0.05 & 0.95 & 0.05 & 0.05 \end{bmatrix}$$

TABLE 4: Remarks membership

<table>
<thead>
<tr>
<th>Evaluation way</th>
<th>Set scores interval</th>
<th>0-60</th>
<th>60-80</th>
<th>80-90</th>
<th>90-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very good</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0.05</td>
<td>0.95</td>
</tr>
<tr>
<td>Good</td>
<td></td>
<td>0</td>
<td>0.05</td>
<td>0.9</td>
<td>0.05</td>
</tr>
<tr>
<td>Normal</td>
<td></td>
<td>0.05</td>
<td>0.9</td>
<td>0.05</td>
<td>0</td>
</tr>
<tr>
<td>Bad</td>
<td></td>
<td>0.95</td>
<td>0.05</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

$U_2^* = \{U_{21}, U_{22}, U_{23}\} = \{0.6, 0.4, 0.2\}$

$U_3^* = \{U_{31}, U_{32}, U_{33}\} = \{0.3, 0.4, 0.3\}$

$U_4^* = \{U_{41}, U_{42}, U_{43}\} = \{0.3, 0.4, 0.3\}$

TABLE 5: Residents to the city sports construction satisfaction degree

<table>
<thead>
<tr>
<th>Investigation item</th>
<th>Satisfied</th>
<th>Normal</th>
<th>Dissatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community infrastructure</td>
<td>38</td>
<td>25</td>
<td>37</td>
</tr>
<tr>
<td>Special field</td>
<td>42</td>
<td>23</td>
<td>35</td>
</tr>
<tr>
<td>Fitness stadium</td>
<td>54</td>
<td>32</td>
<td>14</td>
</tr>
<tr>
<td>Government input intensity</td>
<td>25</td>
<td>45</td>
<td>30</td>
</tr>
</tbody>
</table>

$U_3 = \begin{bmatrix} 0.6 & 0.4 & 0.2 \\ 0.6 & 0.4 & 0.2 \\ 0.6 & 0.4 & 0.2 \\ 0.6 & 0.4 & 0.2 \end{bmatrix}$

$U_4 = \begin{bmatrix} 0.6 & 0.4 & 0.2 \\ 0.6 & 0.4 & 0.2 \\ 0.6 & 0.4 & 0.2 \\ 0.6 & 0.4 & 0.2 \end{bmatrix}$

$U_5 = \begin{bmatrix} 0.6 & 0.4 & 0.2 \\ 0.6 & 0.4 & 0.2 \\ 0.6 & 0.4 & 0.2 \\ 0.6 & 0.4 & 0.2 \end{bmatrix}$

TABLE 6: Chinese sports each indicator obtained evaluation value

<table>
<thead>
<tr>
<th>Each layer indicator</th>
<th>Evaluation value</th>
<th>Each layer indicator</th>
<th>Evaluation value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of facility $u_{11}$</td>
<td>Very good</td>
<td>Competition $u_{31}$</td>
<td>Very good</td>
</tr>
<tr>
<td>Facility maintaining $u_{12}$</td>
<td>Very good</td>
<td>Activity $u_{32}$</td>
<td>Good</td>
</tr>
<tr>
<td>Competition facilities construction $u_{13}$</td>
<td>Normal</td>
<td>Lecture $u_{33}$</td>
<td>Good</td>
</tr>
<tr>
<td>Daily facilities construction $u_{14}$</td>
<td>Normal</td>
<td>Outbound visiting $u_{34}$</td>
<td>Normal</td>
</tr>
<tr>
<td>Equipment maintaining and changing $u_{15}$</td>
<td>Normal</td>
<td>Introduction of stadium $u_{41}$</td>
<td>Good</td>
</tr>
<tr>
<td>Coaches’ cultivation $u_{21}$</td>
<td>Very good</td>
<td>High class stadium development $u_{42}$</td>
<td>Very good</td>
</tr>
<tr>
<td>Faculty cultivation $u_{22}$</td>
<td>Very good</td>
<td>High class stadium targeted group $u_{43}$</td>
<td>Normal</td>
</tr>
<tr>
<td>Introduction of foreign teachers $u_{23}$</td>
<td>Very good</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultivation expense $u_{24}$</td>
<td>Good</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$U_5 = \begin{bmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0.05 & 0.9 & 0.05 & 0 \end{bmatrix}$

$U_6 = \begin{bmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0.05 & 0.9 & 0.05 & 0 \end{bmatrix}$
Full Paper

High class stadium construction

\[
U_i = \begin{pmatrix}
0 & 0 & 0.05 & 0.95 \\
0 & 0.05 & 0.9 & 0.05 \\
0 & 0.05 & 0.9 & 0.05 \\
\end{pmatrix}
\]

\[B_i = A_i \cdot R_i\]

Make normalization processing with obtained \(B_i\), it gets fuzzy evaluation matrix:

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

It gets comprehensive evaluation value:

\[Z = U^* \cdot B = (0.38 \ 0.25 \ 0.22 \ 0.15)\]

CONCLUSION

Facility \(U_1\) is 38%, staff cultivation \(U_2\) is 25%, sports organization cultivation \(U_3\) is 22%, high class stadium construction \(U_4\) is 15%. Therefore, Chinese sports construction mainly surrounds sports facilities construction and sports staff as well as organization cultivation, so that can effective improve mass sports participation degree. For village and town sports construction, improve village and town areas’ economic development level, per capita income, improve fitness awareness and physical education; develop sports resources, enhance fitness sports ability.

REFERENCES


