Analysis of Vegetable Production Trends and Dominant Varieties in Zhangjiakou City of Hebei Province

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Abstract Based on the production data during 2008 and 2017 of 16 main vegetables in Zhangjiakou City of Hebei Province, the comparative advantage model was used to analyze the superior varieties in the main producing areas. The results indicate that there are seven main vegetable producing areas in Zhangjiakou City, and the development of main producing areas tends to become balanced; white radish, celery, leaf lettuce, and carrot of Shangyi, sweet pepper and tomato of Chongli, lettuce and Chinese cabbage of Kangbao, spinach, broccoli, carrots, and cauliflower of Guyuan, spinach and eggplant of Xuanhua, Chinese cabbage and lettuce of Zhangbei. These vegetables have a strong competitiveness.

Key words Vegetable production, Superior varieties, Zhangjiakou City

1 Introduction With the coordinated development of Beijing–Tianjin–Hebei and the construction of the one-hour logistics circle around Beijing and Tianjin, the development of vegetable industry in Zhangjiakou City of Hebei Province is playing an increasingly important role in the vegetable market in Beijing. Although the vegetable industry in Zhangjiakou City has developed to a certain level and achieved a significant increase in both the yield and output value [1], there are still some problems, such as the lack of scientific analysis of the vegetable market, the problem of following the trend, the lack of vegetable brand, no definite superior varieties, and no differentiated and complementary development. Based on the production data during 2008 and 2017 of 16 main vegetables in Zhangjiakou City of Hebei Province, we analyzed the changes in vegetable production in Zhangjiakou City and the changes in the main producing areas, in order to guide the scientific production and market sales of vegetables in Zhangjiakou City, increase the self-sufficiency rate of vegetables in Beijing–Tianjin–Hebei region, and ultimately promote the transformation and upgrading of the vegetable industry in Zhangjiakou City.

2 Data source and analysis method 2.1 Data source and preprocessing We mainly selected the data of annual report of vegetable production in Zhangjiakou City during 2008 and 2017 provided by Agricultural Information Center of Zhangjiakou City, including the data of 16 major vegetable varieties in 19 counties and districts of Zhangjiakou City. The potato is taken as the main food crop, thus the vegetable production report did not include the relevant data of the potato. Besides, there are changes in the administrative division of Zhangjiakou City during 2008 and 2017. To keep the data consistent, we made a preprocessing of the data. Specifically, we included the data of Xuanhua County into the data of Xuanhua District, included the data of Qiaodong District and Qiaoxi District into Zhangjiakou High-tech Industrial Development Zone, included Saibe Management District into Guyuan County, and Chabei Management District into Zhangbei County.

2.2 Comparative advantage analysis When calculating comparative advantages and relative position, the ratio variable is more meaningful than original value of the data. Therefore, we took the unit output ratio and area ratio as two basic variables, and the selected indicators are efficiency advantage, scale advantage and comprehensive advantage [2]. The efficiency advantage index (EAI) mainly refers to the comparative advantage of vegetable production efficiency and specialization level [3].

\[
EAI = \frac{AP_u/AP}{{(AP_u/AP)}}
\]

where \(EAI\) denotes the comparative advantage of vegetable production efficiency of a certain vegetable in a certain county (district), \(AP_u\) denotes the per unit area yield of this vegetable in this county (district), \(AP\) denotes the average per unit area yield of all vegetables in this county (district), \(AP_u\) denotes the average per unit area yield of this vegetable in this county (district), and \(AP\) denotes the average per unit area yield of all vegetables in this county (district).

The scale advantage index (SAI) reflects the specialization level of a certain vegetable production in a certain county (district).

\[
SAI = \frac{GS_u/GS}{{(GS_u/GS)}}
\]

where \(SAI\) denotes the scale advantage index of a certain vegeta-
ble in certain county (district), \(G_{s}\) denotes the sown area of this vegetable in this county (district), \(G_{s}\) denotes the sown area of all vegetables in this county (district), \(G_{r}\) denotes the sown area of this vegetable in the region, and \(G_{r}\) denotes the sown area of all vegetables in the region. Aggregated advantage index (AAI) fully reflects the comparative advantage of a certain vegetable production in a certain county (district).

\[
AAI_{p} = \left( EAI_{p} \times SAL_{p} \right)^{1/2}
\]

3 Current development situation of vegetable industry in Zhangjiakou

The vegetable producing area in Zhangjiakou has excellent environment without industrial pollution. The unique climate and geographical environment have created the excellent quality of vegetables in Zhangjiakou. For the climate, Zhangjiakou is cool. It can complement the vegetable shortage in dull season of other places, so it is a main production base of summer and autumn vegetables in China\(^{[4]}\). In recent years, the vegetable planting area in Zhangjiakou City has remained at around 100,000 ha (Fig. 1). In 2017, the planting area was 103,100 ha and the yield reached 5,703,100 t. The pollution-free vegetables and season-staggered vegetables are the characteristics of the vegetable industry in Zhangjiakou. Every year, during July and September, the share of vegetable of Zhangjiakou in Beijing market is up to 45%, the annual sales of vegetables to Beijing is more than 2.4 million t, so Zhangjiakou City is a real “back garden” of Beijing. During 2014 and 2017, the production and sales of vegetables in Zhangjiakou were good, and the production and sales rate remained at above 92% (Table 1), and in 2017 it was 93.87%, reaching a historical peak, indicating that the coordinated development of Beijing–Tianjin–Hebei and the construction of the one-hour logistics circle around Beijing and Tianjin, as well as the green channel for vegetable transportation in sales season provide a powerful guarantee for rapid transportation and sales of vegetables of Zhangjiakou.

<table>
<thead>
<tr>
<th>Year</th>
<th>Yield//10^4 t</th>
<th>Sales//10^3 t</th>
<th>Rate of production and sales/%</th>
<th>Output value//10^8 yuan</th>
<th>Sales revenue//10^8 yuan</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>582.20</td>
<td>539.04</td>
<td>92.59</td>
<td>60.87</td>
<td>58.58</td>
</tr>
<tr>
<td>2015</td>
<td>541.40</td>
<td>502.10</td>
<td>92.74</td>
<td>92.35</td>
<td>86.36</td>
</tr>
<tr>
<td>2016</td>
<td>572.71</td>
<td>528.43</td>
<td>92.27</td>
<td>86.33</td>
<td>79.09</td>
</tr>
<tr>
<td>2017</td>
<td>570.31</td>
<td>535.34</td>
<td>93.87</td>
<td>87.83</td>
<td>82.37</td>
</tr>
</tbody>
</table>

Note: data were selected from the annual report of vegetable production in Zhangjiakou City provided by Agricultural Information Center of Zhangjiakou City, and the same below.

![Fig. 1 Planting area and yield of vegetables in Zhangjiakou during 2008 and 2017](image)

4 Trend of changes in main producing areas of vegetables in Zhangjiakou

We took the counties (districts) with the sum of annual vegetable yield accounting for more than 75% of the total vegetable yield of Zhangjiakou as main producing counties (districts). We analyzed the vegetable production data during 2008 and 2017 of Zhangjiakou and determined seven main producing counties (districts): Zhangbei, Kangbao, Guyuan, Shangyi, Chongli, Chicheng, and Xuanhua. Among them, Guyuan, Kangbao, Zhangbei, Chongli, and Shangyi are designated as the key vegetable production counties in the national vegetable industry development plan. Chongli, Chicheng, Zhuolu, and Huailai are determined as the vegetable industry demonstration counties of Hebei Province. The percentage of yield of these seven vegetable producing counties (districts) is illustrated in Fig. 2.

From Fig. 2, it can be seen that there were great differences in the percentage of yield of vegetables between main producing areas of Zhangjiakou in 2008, and Zhangbei and Kangbao had obvious yield advantages. Later, the differences started to shrink year by year. By 2017, the differences in percentage of yield between main producing areas were within 5%. It indicates that the main producing areas of vegetables in Zhangjiakou tend to become balanced in development. The overall vegetable production of Zhangjiakou could be divided into high level areas (with percentage of vegetable yield higher than 5%) and low level areas (with

![Fig. 2 Changes in the percentage of vegetable yield in main producing areas of Zhangjiakou during 2008 and 2017](image)
percentage of vegetable yield lower than 5%). Northern counties (districts) are generally high level areas, while southern counties (districts) are generally low level areas. Using the percentage of vegetable yield, we analyzed the spatial distribution of vegetable production in counties (districts) of Zhangjiakou (Fig. 3). In 2008, Basha area, especially Zhangbei County, had prominent advantage of vegetable yield, and there was obvious difference between southern and northern areas (high in north and low in south); in 2012, the gap between southern and northern areas shrank, and the percentage of yield of Kangbao County ranked first; the percentage of yield of southern areas further increased, and the vegetable production of Zhangjiakou took on a trend of balanced development and benign competition.

Fig. 3 Spatial distribution of vegetable producing areas of Zhangjiakou in 2008, 2012, and 2017 (percentage of vegetable yield)

With many years of development, the vegetable production in Zhangjiakou has established three spatial modes. (i) Harmless season-staggered vegetable production areas in four counties in Bashang region. Vegetable production in this region is mainly open field and plastic film cultivation, and vegetables go on the market from the middle of July. (ii) Harmless season-staggered vegetable production areas in Baxia low hilly region. Vegetable production in this region is mainly open field cultivation, and vegetables are put into market from June. (iii) Season-staggered characteristic vegetable production areas in Baxia mountain areas. Vegetable production in this region focuses on developing color pepper, tomato, kidney bean, cabbage, and cauliflower.

5 Analysis on superior vegetable varieties of Zhangjiakou
Vegetables planted in Zhangjiakou are various, about 36 species and 400 varieties, including traditional Chinese cabbage, cabbage, white radish, carrots, celery, as well as distinctive color peppers, leaf lettuce (lettuce), broccoli, which can meet the diversified market demands. Fig. 4 is the scatter diagram plotted using the efficiency advantage index, scale advantage index, and aggregated advantage index, for 16 major vegetables (Chinese cabbage, cabbage, celery, kidney bean, white radish, cauliflower, tomato, eggplant, sweet pepper, lettuce, broccoli, cucurbita pepo, spinach, carrot, and cucumber) of seven main producing areas in Zhangjiakou in 2016. The abscissa represents the efficiency advantage, and the ordinate represents the scale advantage, and the size of scatter points represents the aggregated advantage. According to the comparative advantage study method, we set two indicator lines; if the efficiency advantage is greater than 0.8 and the scale advantage is greater than 2.0, it indicates powerful competitiveness.

Fig. 4 Superior vegetable varieties of main producing area in Zhangjiakou in 2016

Note: the size of scatter point represents the aggregated advantage.

From Fig. 4, it can be seen that white radish, celery, leaf lettuce, and carrot of Shangyi, sweet pepper and tomato of Chongli, lettuce and Chinese cabbage of Kangbao, spinach, broccoli, carrots, and cauliflower of Guyuan, spinach and eggplant of Xuanhua, Chinese cabbage and lettuce of Zhangbei. These vegetables are highly competitive.

6 Conclusions
(i) During 2008 and 2017, the planting area and yield of vegetable in Zhangjiakou fluctuated with rise. In recent years, the fluctuation and growth speed slowed down, vegetable planting area became stable, and the production and sales rate remained above
92%, and reached the historical peak value in 2017, the industrial advantage was obvious, indicating that with the integrated development of Beijing–Tianjin–Hebei, the vegetable sales channel of Zhangjiakou will be more smooth.

(ii) From the perspective of spatial distribution, the unbalanced development of vegetable production in Zhangjiakou City has been gradually alleviated in recent years. The difference in vegetable production between the north and the south is gradually shrunk. In 2017, the yield percentage of the main vegetable producing areas in Guyuan, Kangbao, Zhangbei, Chicheng, Shangyi, Chongli and Xuanhua tended to become balanced, and the gap in the advantages between producing areas is gradually narrowed.

(iii) According to analysis of superior vegetable varieties in Zhangjiakou, white radish, celery, leaf lettuce, and carrot of Shangyi, sweet pepper and tomato of Chongli, lettuce and Chinese cabbage of Kangbao, spinach, broccoli, carrots, and cauliflower of Guyuan, spinach and eggplant of Xuanhua, Chinese cabbage and lettuce of Zhangbei. These vegetables are highly competitive.

7 Recommendations

The vegetable industry distribution of Zhangjiakou City should take overall consideration of the natural endowment, planting habits, technical level and market network to further optimize the existing vegetable regional distribution, and create superior areas with full utilization of natural resources, outstanding core competitiveness and distinctive characteristics. Under the condition of slow growth of vegetable planting area, government should increase the proportion of vegetable cultivation and improve the vegetable quality and yield. Besides, in view of different superior vegetable varieties in different counties (districts), government should guide all counties (districts) to raise the specialization and intensification level, build vegetable brands, raise technical level and supply capacity of vegetable production in Zhangjiakou, so as to gradually establish the modern vegetable production system with high efficiency, high quality, and safe production technology as the leading part.

The brand value, quality characteristics and product standards of geographical indication vegetables fully meet the development trend of brand-based, specialization and standardization. The vegetable industry in Zhangjiakou City may consider the use of geographical indication vegetables as a breakthrough, adapt to local conditions, highlight local characteristics, and bring into play comparative advantages to promote the development of “one product for one county” specialty vegetables. In addition, the varieties of different districts (counties) are different, which is favorable for the complementary and balanced development of the vegetable industry in Zhangjiakou City. The determination of the superior vegetable types in each district and county is also favorable for the creation of vegetable brands. On this basis, it is recommended to improve the circulation and processing links, increase the added value of vegetables, to form superior vegetable industry of respective districts and counties.

References