Cluster Analysis of Agricultural Production in ASEAN Free Trade Area

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Abstract. Agriculture is the foundation of human existence. The agricultural output of a country is related to the national economy and the people’s livelihood. ASEAN is Chinese important economic and trade cooperation zone. In recent years, agricultural trade is more frequent in China and ASEAN countries. The level of agricultural development can be seen by analyzing the cluster of per capita agricultural production in ASEAN Free Trade Area. In this paper, we use the cluster analysis method to analyze the data of agricultural production in ASEAN countries, and obtain the agricultural productivity spectrum of ASEAN countries, to reflect the agricultural production differences of ASEAN countries.

Introduction

Agriculture is one of the national industries, and agricultural production occupies an important position in economic output. A country’s agricultural output is related to the national economy and the people’s livelihood. Agricultural growth can promote farmers’ income, improve the quality of life of farmers, and improve the living standards of farmers. In recent years, the cooperation between China and ASEAN has been deepening. This process must pay attention to the imbalance of agricultural development in ASEAN countries. With the development of productive forces in various countries, agriculture has made great progress, in the ASEAN countries, the level of agricultural development is not the same, and the per capita agricultural production is also different. Therefore, the study of agricultural production in China and ASEAN countries can provide a theoretical basis for its agricultural import and export trade.

In 2008, Tang Shengyao adopted a large number of numerical analysis, comprehensive and in-depth analysis of China and ASEAN agricultural production and agricultural products comparative advantage [1]. In 2009, Chen Qianheng surveyed agricultural cooperation projects carried by China in ASEAN countries [2]. In 2009, using a systematic analysis, Zhou Xuechun comprehensively analyzed the impact of China-ASEAN agricultural cooperation on both sides [3]. In 2011, Pan Xiaoyan analyzed the investment cooperation situation, characteristics and existing problems of investment in ASEAN investment, and finally proposed solutions to the related issues [4]. In 2011, Wang Xiangdong analyzed the advantages of Hainan agriculture and the challenges it faced, and put forward corresponding countermeasures according to the actual situation of Hainan Province [5]. In 2007, Sun Lin used the Spearman rank correlation coefficient to analyze and compare the change trend of the ability of export structure adjustment of agricultural products between China and ASEAN [6].

In 2007, Yang Jun analyzed and predicted the impact of China-ASEAN Free Trade Area on the overall bilateral economy and regional agriculture in China, in the prediction of China-ASEAN Free Trade Area on Chinese economic region and agriculture [7]. In 2010, according to the cluster analysis theory, Li Yerong used SPSS statistical analysis software, the agricultural comprehensive strength cluster analysis was carried out in 31 provinces and autonomous regions [8]. Through several major agricultural economic indicators, research 31 provinces and municipalities, autonomous regions, the level of agricultural types, in theory, to explore the strength of its overall agricultural strength.
In this paper, the cluster analysis of agricultural production in China and ASEAN countries is carried out, and the per capita agricultural yield spectrum is obtained to reflect the difference of per capita agricultural output.

1. Cluster Analysis Theory

1.1 Clustering analysis method

Cluster analysis is based on the similarity or dissimilarity between the data of the objects under study, and treats these similar or dissimilar data as a measure of the distance between the subjects. At present, multivariate statistical clustering method has been widely used in various fields of natural sciences and social sciences. The basic idea of clustering analysis is: first, we need define the statistics of similarity between variables, and obtain the measure of the similarity. Then according to the degree of similarity, the variables are classified. The close variables relate to the aggregation of a small classification unit, with a large collection of variables that are associated with the aggregation of variables, until all the variables are aggregated. The different types are divided one by one, and format a small to large classification system. Finally, according to the classification system to draw a group diagram, called affinity diagram. Cluster analysis provides a variety of classification methods, but this paper is a systematic clustering method, the system clustering method: first, \( n \) sample as \( n \) class, and then the two closest to the nature combine into a new class, get the \( n-1 \) class, and recomputed the distance and similarity measure between the new class and other classes after the merge. This process continues until all objects are classified as a class, and the class process can be described by a phylogenetic cluster graph.

1.2 The common methods of cluster analysis

In the study of the similarity and dissimilarity of data, we used the shortest distance method, the longest distance method, the middle-distance method, the average method, center of gravity method, and deviation square sum method to study the distance between the data. First of all, each of the samples as a class, and then the nearest two types combine into a new class, and set the distance \( d_{ij} \) between the \( i \) sample and the \( j \) sample, \( G_1, G_2, \ldots \) denotes a class, and \( D_{KL} \) denotes a distance between \( G_K \) and \( G_L \). In the study of data similarity and dissimilarity, it commonly uses shortest distance method, the longest distance method, the middle-distance method, class average method, gravity method to study the distance between the data. And it specifies the distance between the samples and the distance between classes. The distances include the Minkowski distance, the absolute distance, the Euclidean distance, and the Bishoff distance.

Minkowski distance: \( d_q (x) = \left[ \sum_{k=1}^{p} \left| x_{ik} - x_{jk} \right|^q \right]^{\frac{1}{q}} \). \( q \) is a natural number. Minkowski distance has the following three special shapes:

\[ q = 1, \quad d_q (1) = \sum_{k=1}^{p} \left| x_{ik} - x_{jk} \right| \text{ is called absolute distance, and is often called vividly as “city blocks”;} \]

\[ q = 2, \quad d_q (2) = \left[ \sum_{k=1}^{p} \left| x_{ik} - x_{jk} \right|^2 \right]^{\frac{1}{2}} \text{ is called Euclidean distance, which is the most commonly used distance method in cluster analysis;} \]

\[ q = \infty, \quad d_q (\infty) = \max_{1 \leq k \leq p} \left| x_{ik} - x_{jk} \right| \text{ is called Chebyshev distance.} \]

The longest distance method refers to the distance between the sample and the sample as the distance between the class and class. Using the formula:

\[ D_{KL} = \max \{ d_{ij} \mid i \in G_K, j \in G_L \} \]  \hspace{1cm} (1)

After a certain step, after the \( G_K \) class and the \( G_M \) class are merged into the new \( G_M \) class,
according to the longest distance method to calculate the distance between the new \( G_M \) class and the \( G_j \) class of other classes, the recurrence formula is: 
\[
D_{MJ} = \max \{D_{KJ}, D_{LJ}\}.
\]

2. Data Processing and Analysis

2.1 Selection of indicators

ASEAN Free Trade Area is rich in agricultural resources. Agriculture, the proportion of total economic output is larger than the rest of the world, with strong competitiveness. In this paper, agricultural crops such as cereals, rice, peanuts, fruits, sugarcane, and rhizomes in the China-ASEAN Statistical Handbook 2011 are selected as indicators to measure the per capita agricultural output of the ASEAN countries. The data are as follows:

Table 1. Crop production of China - ASEAN countries.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample</th>
<th>Grain</th>
<th>Rice</th>
<th>Peanut</th>
<th>Fruit</th>
<th>Sugarcane</th>
<th>Rootstock crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>3207</td>
<td>1481</td>
<td>117</td>
<td>98</td>
<td>842</td>
<td>1243</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>2366</td>
<td>1668</td>
<td>3</td>
<td>1613</td>
<td>3400</td>
<td>299</td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>1086</td>
<td>1066</td>
<td>19</td>
<td>431</td>
<td>320</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>6218</td>
<td>5415</td>
<td>7</td>
<td>2049</td>
<td>1502</td>
<td>3503</td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>3354</td>
<td>2645</td>
<td>27</td>
<td>526</td>
<td>976</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Brunei</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>153</td>
<td>102</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Viet Nam</td>
<td>5224</td>
<td>470</td>
<td>5</td>
<td>73</td>
<td>130</td>
<td>1171.5</td>
<td></td>
</tr>
<tr>
<td>Myanmar</td>
<td>6763</td>
<td>6380</td>
<td>276</td>
<td>481</td>
<td>240</td>
<td>123.6</td>
<td></td>
</tr>
<tr>
<td>Laos</td>
<td>694</td>
<td>5110</td>
<td>38</td>
<td>416</td>
<td>1683</td>
<td>101.3</td>
<td></td>
</tr>
<tr>
<td>Cambodia</td>
<td>6247</td>
<td>5773</td>
<td>15</td>
<td>245</td>
<td>2951</td>
<td>448.7</td>
<td></td>
</tr>
</tbody>
</table>

This paper obtains the results of cluster analysis based on the longest distance method, and divides the ASEAN Free Trade Area into five categories: (1) Philippines; (2) Malaysia, Brunei, China, Indonesia, Vietnam; (3) Myanmar; (4) Thailand; (5) Laos, Cambodia.

2.2 Analysis and recommendations

As can be seen from the results, most of the countries’ agricultural development is more concentrated, but there are some countries, uneven agricultural development. For example: the Philippines per capita agricultural production ratio is significantly higher than other countries. At the same time, there is a problem of unbalanced agricultural development in ASEAN countries, because different countries have their own economic systems. Some countries have agricultural trade as the main economic income, some countries are rich in mineral resources, some countries have a large proportion of agricultural population in the total population, some countries have more arable land per capita, and some countries have a high degree of agricultural mechanization. For example, the Philippine agricultural population covers two-thirds of the total population, and fruit export is one of the largest countries in the world. Agriculture is the basis of the national economy in Myanmar, which is the world’s largest teak production country, but other agricultural production of teak less. Agriculture is the mainstay of Laos, its agricultural population accounts for more than 90% of the total population, 80% of the territory of mountain and plateau, and are covered by forests; Cambodia forestry, fisheries, animal husbandry, agricultural production is low; Brunei is a developed country, oil and natural gas as the main source of income, agriculture is relatively weak; Vietnam is a traditional agricultural country. Thailand is a traditional agricultural country, is the world’s leading producer and exporter of rice, agricultural products are the main source of foreign exchange earnings; Chinese farming industry is an important type of agricultural production, the country’s agricultural production is the main agricultural production, agriculture plays a major role in the economic structure.

According to the characteristics of economic development in various countries, we must attach
importance to agriculture while promoting the development of other industries. Therefore, the state should adopt corresponding policies, strengthen organization and leadership, strengthen support and protection of agriculture, deepen agricultural and rural reform, improve the legal protection of agriculture, and further expand the opening up of agriculture.

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