EXPLORING THE COMPARATIVE ADVANTAGE OF NON-TIMBER FOREST PRODUCTS – THE CASE OF ZHEJIANG PROVINCE, CHINA

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Abstract

Non-timber forest products (NTFPs) play an important role in rural economic growth and farmers’ revenue increase. A key issue in NTFP development is the competitiveness of different products or the same product in different regions. Using production data for main NTFPs, such as citrus, bamboo shoots, waxberry and green-tea in Zhejiang, this paper estimates the Efficiency Advantage Index (EAI), Scale Advantage Index (SAI), and Aggregated Advantage Index (AAI) of different regions. It is found that there exist tremendous variations among these regions, suggesting that NTFPs should be chosen according to the regional conditions.

Keywords: Comparative advantage, non-timber forest products, Zhejiang province, China

Introduction

China is a mountainous country, hills and mountains account for about 69% of the terrain. Many farmers are still very poor in rural areas, especially in mountain areas, even though China’s economy has grown rapidly since the country decided to open to world trade at the end of the 1970s. Development of mountainous areas is key to increasing farmers’ revenues and achieving China's economic sustainability. Non-timber forest products (NTFPs) play an important role in rural economic growth and farmers’ revenue increase since the income from timber has decreased due to the implementation of Natural Forest Protection Program (NFPP) and Sloping Land Conversion Program (SLCP) in China. A key issue in NTFP development is the competitiveness of different products or the same product in different regions. Furthermore, owing to mountainous terrain and booming economic development, Zhejiang province has become the most advanced in developing NTFPs. The lessons and experiences of Zhejiang can be beneficial to other provinces in China and other developing countries all over the world. Therefore, it is interesting to study the comparative advantage of NTFPs in the Zhejiang province.

Several previous studies have evaluated the comparative advantage in agricultural production. Pearson and Mayer (1974) evaluated comparative advantages of the four main coffee growing countries of Africa. The study focused on calculating the Domestic Resource Cost (DRC) per...

unit of foreign exchange earned or saved. Findings showed that Uganda, Ethiopia, and Tanzania all had strong comparative advantages in coffee production, with very little deviation among each country’s respective indices. The study was one of the first to attempt to address the complexity of comparative advantages among four countries. The scope was relatively small and demonstrated a need for more data collection among producing regions.

Carter and Zhong (1991) used data on land productivity and empirical analysis to test for regional comparative advantage, providing empirical evidence on provincial comparative advantage in cotton versus grain production in China.

Grossman and Helpman (1990) analyzed a dynamic, two-country model of trade and growth, finding that long-run productivity gains stem from the external trading environment as well as trade and industrial policies.

Zhong et al. (2000) studied the comparative advantages in grain production across different regions of China. Several indicators--Net Social Profitability (NSP) and DRC, are used to measure price advantages or disadvantages, and Efficiency Advantage Index (EAI), Scale Advantage Index (SAI), and Aggregated Advantage Index (AAI)--were used. It found that advantages in main grain crops varied across different regions in China, and there was a potential to improve grain production efficiency in China through the reallocation of natural resources and restructuring of the grain sector. It concluded that China can still compete in grain production even if the country as a whole was at a disadvantage in a particular crop production.

Tuan et al. (2001) studied the trade competitiveness of major agricultural products in China. Several indicators, such as DRC, DRC coefficients (DRCC), NSP, Effective rate of protection (ERP) and Regional CAI (RCAI), were used to measure comparative advantages. The former two were used in varieties analysis while the latter two were used in region analysis.

Morgan and Langemeier (2003) examined sustained competitive advantage for a sample of Kansas farms by using whole-farm data for 224 farms with continuous data from 1982-2001. Overall efficiency was computed for each farm and year. Sixty farms exhibited significantly above average overall efficiency levels (top category) or had a competitive advantage. Farms in the top category were significantly larger, received relatively more of their gross farm income from dairy and swine production, had significantly lower expense ratios, and had significantly higher profit margins.

Bernhofen et al (2005) provided an empirical assessment of the comparative advantage gains from trade argument. Using Japan’s 19th-century opening up to world commerce as a natural experiment, they answered the counterfactual question: “By how much would real income have had to increase in Japan during its final years of autarky (1851-1853) to afford the consumption bundle the economy could have obtained if it were engaged in international trade during that period?” Then, using detailed historical data on trade flows, autarky prices, and Japan’s real GDP, they obtained upper bounds on the gains from trade of about 8-9 percent of Japan’s GDP.

Young et al. (2006) evaluated the comparative advantage of upland cotton production in different districts within Texas by using three different indices: EAI, SAI, and AAI. The study revealed
that the comparative advantage in upland cotton production varied considerably across the state. It would help to understand the performance and advantages of upland cotton production in different regions, and the disparities among different regions.

These are the earlier studies about the comparative advantage in a specific crop production. However, few have studied the comparative advantage in NTFPs, even though competitiveness is a key issue in NTFPs development. Therefore, our study focuses on NTFPs in the Zhejiang province.

**Study site and data**

Zhejiang is located in the southern wing of the Yangtze River Delta on the southeastern coast of China. It lies between 27°12’ and 31°31’ north latitude and 118°00’ and 123°00’ east longitude, on the south of Shanghai, the largest city in the country. It covers a total continental area of 101.8×10³ km², which is 1.06% of the country. The province possesses varied topography. Hills and mountains account for 70.4% of the total area in the province, plains and basins make up 23.2%, and the remaining 6.4% is water area composed of rivers and lakes. Arable land only accounts for 20.817 thousand square kilometers. Forest is 6679.7 thousand square hectares, which covers 57.4% of the province's total area and is listed among the front ranks in China. Zhejiang has 11 municipalities with 90 counties. It has a population of 46.47 million. According to the statistical bulletin of Zhejiang state economic and social development 2007, per capita gross domestic product is $4883 (middle rate is 7.604). Urban per capita disposable income is $2706 and rural per capita net income is $1087, both the highest in China.

Based upon its multi-mountain area and the fact that it is a comprehensive area of high output, many Zhejiang products, especially non-timber forest products (NTFPs), occupy important positions nationwide including citrus, tea, bamboo shoots and waxberry productions. NTFPs play an important role in rural economic growth and farmers’ revenue increase. For example, the output value of bamboo shoots is more than 20% of gross agricultural output value in Lin’an since 2000(Lin’an Forestry Bureau, 2006). More than 50% of rural farmers’ net income comes from citrus in Linhai county and Huangyan county. Farmers in Yuyao county obtain more than 30% income from waxberry while Kaihua farmers obtain more than 50% net income from tea. A key issue in NTFPs development is the competitiveness of different products or the same product in different regions.

Citrus has the largest growing area and production. Tea is one of the most important characteristic products of Zhejiang. Bamboo shoots are the most famous products while Waxberry is a special local product of Zhejiang that has had rapid growth in recent years. Thus, this paper will analyze these four productions. Table 1 is a summary of the main NTFPs in Zhejiang province.
Table 1. The quantities and ranks of Zhejiang’s main NTFPs (thousand tons, %)

<table>
<thead>
<tr>
<th></th>
<th>Citrus</th>
<th>Tea</th>
<th>Bamboo shoots</th>
<th>Waxberry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>14057.60</td>
<td>823.40</td>
<td>4312.25</td>
<td>-</td>
</tr>
<tr>
<td>Zhejiang</td>
<td>1725.03</td>
<td>138.58</td>
<td>1480.50</td>
<td>242.50</td>
</tr>
<tr>
<td>Ratio</td>
<td>12.27</td>
<td>16.83</td>
<td>34.33</td>
<td>-</td>
</tr>
<tr>
<td>Rank</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: China’s Agricultural yearbook and Zhejiang’s rural yearbook, 2003-2006
Note: the data are averages of yields among 2002-2005; the total yield of waxberry in China is absent.

Data used for the estimation comes from various sources. They include:

a. The output of NTFPs production from the publication entitled Zhejiang Noncun Tongji Nianjian (Zhejiang Rural Yearbook) and Statistic Yearbooks of the local counties 2003-2006.
b. The areas of NTFPs production. The total area of Zhejiang from Forest Assessment Report of Zhejiang, the others from Statistic Yearbooks and Forestry Bureau of the local counties.

In order to reduce the impact of weather and other random disturbances, 4-year (2002-2005) averages of yield and growing areas are used in calculating EAI, SAI and AAI. Table 2 shows the analyzed NTFPs and their counties.

Table 2. NTFPs and the counties

<table>
<thead>
<tr>
<th>NTFPs</th>
<th>Counties</th>
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<tbody>
<tr>
<td>Citrus</td>
<td>26 counties: Linhai, Changshan, Kecheng, Qujiang, Xiangshan, Liandu, Huangyan, Jiaide, Sanmen, Chun'an, Wenling, Jiangshan, Lanxi, Qingtian, Jindong, Longyou, Ninghai, Songyang, Yuhuan, Wucheng, Yueqing, Jiaojiang, Fenghua, Ouhai, Tiantai, Beilun</td>
</tr>
<tr>
<td>Tea</td>
<td>34 counties: Shengzhou, Chun'an, Zhuji, Anji, Shaoxing, Xinchang, Kaihua, Songyang, Suichang, Yuyao, Jiaide, Lin'an, Wuji, Tonglu, Taishun, Yuhang, Pan'an, Changxing, Ninghai, Shangyu, Dongyang, Jinyun, Pujiang, Wucheng, Fuyang, Tiantai, Jiangshan, Longyou, Lanxi, Xiangshan, Beilun, Fenghua, Yiwu, Deqing</td>
</tr>
<tr>
<td>Bamboo shoots</td>
<td>27 counties: Anji, Lin'an, Longquan, Qingyuan, Suichang, Fuyang, Qujiang, Deqing, Longyou, Yuhang, Yinzhout, Fenghua, Shengzhou, Tonglu, Liandu, Wuxing, Yuyao, Songyang, Ninghai, Pingyang, Chun'an, Shaoxing, Xinchang, Zhui, Kaihua, Changxing, Shangyu</td>
</tr>
<tr>
<td>Waxberry</td>
<td>24 counties: Xianju, Xiangshan, Qingtian, Yuyao, Huangyan, Cixi, Rui'an, Dinghai, Linhai, Ninghai, Yongjia, Lanxi, Yueqing, Wenling, Jinyun, Shangyu, Longwan, Pingyang, Ouhai, Fenghua</td>
</tr>
<tr>
<td>Total</td>
<td>60 counties</td>
</tr>
</tbody>
</table>
Methods

The NSP, DRC and DRCC only use production and cost data. They do not consider many factors, such as social and cultural factors, which may have some impact on producers’ decisions and hence should be considered as a part of regional comparative advantage. For a small region, these factors are not important as a certain degree of homogeneity is likely to exist. But this cannot be assumed to hold for the Zhejiang province. Therefore, this study uses a set of comparative advantage indices, which include Efficiency Advantage Index (EAI), Scale Advantage Index (SAI), and Aggregate Advantage Index (AAI) to measure the relative yield, scale and overall advantage of NTFPs within Zhejiang province, China.

Efficiency Advantage Index (EAI)

EAI is an indication of how efficiently an NTFP grows in one specific region. It is calculated by using the relative yield of a specific NTFP in a region divided by the average yield of all NTFPs in that same region, over the province’s average yield for that specific NTFP divided by the province’s average yield for all NTFPs. The EAI equation is expressed as:

\[
EAI_{ij} = \frac{Y_{ij}}{Y_{nj}} \times \frac{Y_i}{Y_n}
\]

Where:
- \(EAI_{ij}\) is the Efficiency Advantage Index of the \(j\)th NTFP in the \(i\)th region;
- \(Y_{ij}\) is the yield of the \(j\)th NTFP in the \(i\)th region;
- \(Y_i\) is the average yield of all NTFPs in the \(i\)th region;
- \(Y_{nj}\) is the provincial average yield of the \(j\)th NTFP;
- \(Y_n\) is the provincial average yield of all NTFPs.

If \(EAI_{ij} > 1\), then the yield of the \(j\)th NTFP in the \(i\)th region, relative to all other NTFPs growing in that same region, is higher than that of the provincial average. It can be interpreted that, in the \(j\)th region, there is a yield or an efficiency advantage in growing the \(i\)th NTFP, and vice versa. It can be interpreted, as in the \(j\)th region, that there is no yield or efficiency advantage in growing the \(i\)th NTFP.

By assuming a competitive market structure, no significant barriers for technology diffusion, and adoption in agricultural production in the country, \(EAI_{ij}\) can be taken as an indicator of relative efficiency due to natural resource endowments and other local economic, social and cultural factors. As such, it could be used as an indicator of comparative advantage as well (Zhong et al, 2000).

Scale Advantage Index (SAI)

The SAI indicates the extent of concentration of a certain NTFP growing in a region, relative to that of the same NTFP growing in the province. The equation for SAI is expressed as:
\[
\text{SAI}_{ij} = \frac{S_{ij}}{S_{nj}} / \frac{S_{i}}{S_{n}}
\]

Where:
\( \text{SAI}_{ij} \) = the Scale Advantage Index of the \( j \)th NTFP in the \( i \)th region;
\( S_{ij} \) = the grow area of the \( j \)th NTFP in the \( i \)th region;
\( S_{i} \) = the total grow area of all NTFPs in the \( i \)th region;
\( S_{nj} \) = the total grow area of the \( j \)th NTFP in the province;
\( S_{n} \) = the total grow area of all NTFPs in the province.

If the \( \text{SAI}_{ij} > 1 \), then the degree of concentration of the specified NTFP growing in that certain region is higher than the average concentration ratio in the province. It is an indicator that producers in that region prefer to grow more of that specific NTFP compared to other producers in the province, and vice versa.

Assuming a competitive market structure is in place and producers are able to adjust their NTFP mix quickly to respond to market prices as well as cost changes, the concentration level is determined by economic and profit level factors of a certain NTFP’s growth in the region.

A low SAI value implies producers are not willing to increase their share of that NTFP’s production in that region. This may be because the NTFP is less profitable than others or the region may be restricted by natural or other conditions. On the other hand, a high SAI value implies producers want to increase their share of that NTFP’s production in that particular region.

**Aggregate Advantage Index (AAI)**

The AAI is an aggregate indication of the overall comparative advantage of a certain NTFP in a specific region, relative to the province average. It can be calculated as the geometric average of the EAI and SAI. The equation is expressed as:

\[
\text{AAI}_{ij} = \sqrt{\text{EAI}_{ij} * \text{SAI}_{ij}}
\]

If \( \text{AAI}_{ij} > 1 \), the certain NTFP in that specific region is considered to have an overall comparative advantage over the province average, while \( \text{AAI}_{ij} < 1 \) indicates that the NTFP production in a specific region does not have an overall advantage over the province’s average (Young, 2006).

**Results**

**Regional comparative advantages for citrus**

Figure 1 is a summary of the calculation of comparative advantages for citrus. There are 7 counties which citrus share in growing areas increased more than 4% in the 26 analyzed counties.
Among the 7 major counties, Changshan and Qujiang have comparative advantages as their EAI, SAI and AAI values all exceed 1. Although the other 5 major counties (Linhai, Kecheng, Xiangshan, Liandu and Huangyan) have scale advantages and aggregate advantages, their EAI values are lower than 1. It seems that these counties have some problems in improving their efficiency.

Among the other 19 counties, 9 counties (Jiande, Chun’an, Lanxi, Longyou, Ninghai, Songyang, Wucheng, Fenghua and Beilun) have comparative advantages as their EAI, SAI and AAI values all exceed 1 (see figure 1 for details). Owing to the citrus having the widest spread production, 14 among the 26 analyzed counties are not efficient with EAI values less than 1. Kecheng has the highest SAI and AAI, in spite of the EAI being low. Beilun has the highest EAI due to the low share in growing areas. Yueqing has no available comparative advantage.

Comparative advantage in tea

Because tea production is widespread in Zhejiang, there are only 4 counties where the growing areas exceeded 4% of the provincial total. Figure 2 shows a summary of the calculations of comparative advantages for tea. It can be seen that, of the top 10 counties, 8 of them (all except Kaihua and Yuyao) have comparative advantages. In the 26 counties which have aggregate advantage, the highest is Shengzhou with an AAI of 2.52. The highest efficiency region is Longyou with an EAI of 3.38, which is 2.38 times higher than the provincial average. At the same time, Longyou is one of the lowest scale advantage regions with an SAI of 0.57. Xinchang is the number 1 in scale advantage with an SAI of 3.64 (see Figure 2 for details).
Figure 2. The comparative advantages for tea.
Note: the data are averages of outputs and grow areas among 2002-2005.

Comparative advantage in bamboo shoots

The comparative advantage in the Zhejiang province’s bamboo shoots production is rather significant, with 16 counties that have comparative advantages. Longquan also has a comparative advantage as its SAI and AAI values are greater than 1 and its EAI value is very close to 1. But there are still 3 (Qingyuan, Qujiang and Longyou) among 10 top producing counties that do not have comparative advantages. 19 counties among the 27 producing regions are considered to have an overall comparative advantage over the province average due to an AAI value of greater than 1 (see Figure 3 for details). Fenghua is the leading county in bamboo shoots production with an EAI of 2.74 and an AAI of 2.10, both of which are the highest indices. Meanwhile, Pingyang has the highest scale advantage with 1.66.

Comparative advantage in waxberry

Taking Zhejiang as a whole, waxberry production is obviously at an aggregate advantage as 21 counties have comparative advantages, with their AAI values being greater than 1 (see Figure 4 for details). There are 11 counties which have an efficiency advantage and 19 counties which have a scale advantage. When all the 3 indices are considered, only 8 counties – Huangyan, Cixi, Linhai, Yongjia, Lanxi, Yueqing, Pingyang and Fenghua – have comparative advantages. Although Anji County has the highest EAI, it does not have an obvious advantage due to its small growing area.
Figure 3. The comparative advantages for bamboo shoots.
Source: the output and areas of bamboo shoots are from Statistic Yearbooks and the Forestry Bureau of the local district and counties.
Note: the data are output and grow areas 2005.

Figure 4. The comparative advantages for waxberry.
Note: the data are averages of outputs and grow areas between 2002-2005.
Conclusions

The above analysis clearly indicates that the comparative advantages in main NTFPs vary significantly across the Zhejiang province of China. It implies that there exists great potential to improve resource allocation and production efficiency.

The analysis also indicates that many counties in the Zhejiang province have a clear comparative advantage, even if some of them have a disadvantage in producing some NTFPs. This implies that they can take full advantage of their natural resources to enhance production and profits.

Owing to different data sources, especially the growing areas of bamboo shoots production, derived from different local forestry bureaus, the calculated results may not be very accurate. It only reflects the production with its source, which may have several uncontrollable factors that may cause the variability of these indices.

There are two topics that need to be considered in the future. One is what determines comparative advantage and the other is the advantage variation in these NTFPs between Zhejiang and the other provinces in China.

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Literature Cited


