

Evaluation of Tobacco Resource Allocation Based on Analytic Hierarchy Process

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Abstract: Based on the current situation of tobacco production resource allocation, this paper systematically analyzes the development level of tobacco industry and the local agricultural and rural economic development level, finds out the core indicators and key indicators, establishes the tobacco development index, and evaluates the tobacco development. It is found that at present, the planters in Guizhou Province are mainly specialized farmers or family farms with a certain scale. However, due to the high risk of planting tobacco and the difficulty of adjusting land transfer, cooperatives and large enterprises can be appropriately introduced to plant tobacco, so as to have more coordination ability and anti risk ability in land transfer and resource utilization. This paper carries out evaluation and diagnosis, scientific guidance and accurate regulation from the macro and micro levels to promote the transformation from extensive and qualitative decision-making to accurate and quantitative decision-making in tobacco production; Through the pilot application, improve the efficiency of resource allocation, optimize the mode of production organization, optimize policies and measures, and promote the high-quality development of tobacco leaves.

1. Research Background and Significance

The basis of high-quality development of tobacco industry is the high-quality development of tobacco industry. The main reason is the lack of effective methods and means to scientifically

evaluate the development of tobacco industry in the whole province and all production areas, natural resources, agricultural economic development level and other factors. The main reason is the lack of effective methods and means to scientifically evaluate the development of tobacco industry in the whole province and all production areas, the lack of quantitative analysis on the main factors and their proportion affecting the development of tobacco industry in the whole province and all production areas, and the allocation of tobacco production resources allocated and regulated is not systematic and targeted.

Through literature review, this paper expounds the importance and significance of using mathematical modeling method to study tobacco large-scale planting efficiency, and introduces the concept and model of analytic hierarchy process. The model analyzes the contribution and impact of various indicators on resource allocation, and investigates the problems of resource allocation, factor input mode, tobacco product planting degree and tobacco production mode.

2. Literature Review

From the research on the optimal planting scale and organization mode, only the development of appropriate scale management is an effective way to effectively solve the problem of low per unit yield of tobacco. The scattered small-scale production mode is not only inconsistent with the highly socialized organization form. The promotion of small-scale tobacco planting can no longer meet the needs of large market and large industry. We should actively explore and implement large-scale operation, and further improve and improve the socialized service system.

Starting with the best input mode of factors, tobacco production should innovate the input mode of production factors such as chemical fertilizer, pesticide and pest control. The main input modes are as follows: 1) Implement the project of replacing chemical fertilizer with organic fertilizer. New fertilizer with high efficiency and optimization shall be applied. 2) Promote the healthy cultivation of crops. 3) Implement green pest control.

We should conscientiously and comprehensively implement the basic national policy of building a resource-saving society, strengthen the government's macro-control, concentrate on the publicity of "three groups", that is, a group of farmers who are willing to receive training and have a cultural foundation will be trained into new professional farmers, and some farmers with low cultural quality who are not ready to receive training will be turned into industrial workers through organized industrial production, combined with rural I, II Integrate the three industries, transform and introduce a group of high-quality talents.

3. Research Model

3.1. Evaluation of Tobacco Resource Allocation

The method adopted is mainly analytic hierarchy process, supplemented by questionnaire survey to establish the tobacco resource allocation model.

Characteristics of questionnaire survey method: the survey method is a unified and strictly designed questionnaire. The survey process is that the investigator sends questionnaires to the respondents,, and then the respondents fill in the written answers. Therefore, the questionnaire survey method is obviously different from other survey methods. Advantages of questionnaire survey method: the survey is highly standardized. The contents of the survey forms issued by the investigators to the respondents are the same, and are not affected by educational background, gender and other factors; the questionnaire is very anonymous. Respondents do not need to fill in

personal information and have strong anonymity. They do not have to worry about being traced after filling in, and can rest assured to fill in the real answer; High investigation efficiency. A large number of personnel can be investigated at the same time, and the time is short, which saves cost and energy.

Disadvantages of questionnaire survey method: everything has two sides, so questionnaire survey method has some limitations in survey tools, survey procedures and so on. (1) The results of the questionnaire survey will be affected by personal senses and knowledge. Everyone has different ideas about the problem. For the same problem, the respondents have different understanding of the meaning and purpose of the problem, resulting in the final result can not be expressed objectively. (2) Because the survey method is limited to words, it is difficult to survey illiterate and less educated objects, and it is difficult to accurately understand the nature of the problem in the questionnaire survey. Therefore, only such research objects can be interviewed.(3) If the investigation procedure is not deepened, it will be difficult to fully comply with the initiative of the investigator. The investigation process of the questionnaire method is limited to the questionnaire itself. Because the investigator cannot understand the motivation and thoughts of the respondents on some questions, the data and information received in the survey are more vivid than the answers designed in the questionnaire before, and it is also difficult for the investigators to take the initiative.

Advantages of analytic hierarchy process: the process of analytic hierarchy process takes the research object as a system and makes decisions according to the thinking mode of decomposition, comparative judgment and synthesis. It is an important system analysis tool developed after mechanism analysis and statistical analysis. This method does not simply follow higher mathematics, nor does it pay one-sided attention to behavior, logic and demonstration, but combines organic qualitative methods with quantitative methods to decompose, mathematicize and systematize complex systems, so as to promote people's thinking process, To promote people to accept and integrate multi-objective systems, multi criteria and difficult to quantify decision-making problems are transformed into multi-level goal problems that are easy for decision-makers to understand and manage.

The disadvantage of analytic hierarchy process: The results of AHP are greatly affected by subjective components. If the decision-maker's judgment is excessively weakened by his subjective preference and the objective law is distorted, the result of AHP is obviously inconsistent with the facts.

3.2. Establish a Hierarchical Structure Model

Stratification of factors included in the problem: the highest level (the purpose of solving the problem); Intermediate level (various measures to achieve the overall goal, standards to be considered, etc.); the lowest level (various measures, schemes, etc. used to solve problems). Put various factors to be considered in an appropriate level, and the relationship between these factors is clearly expressed in the hierarchy.

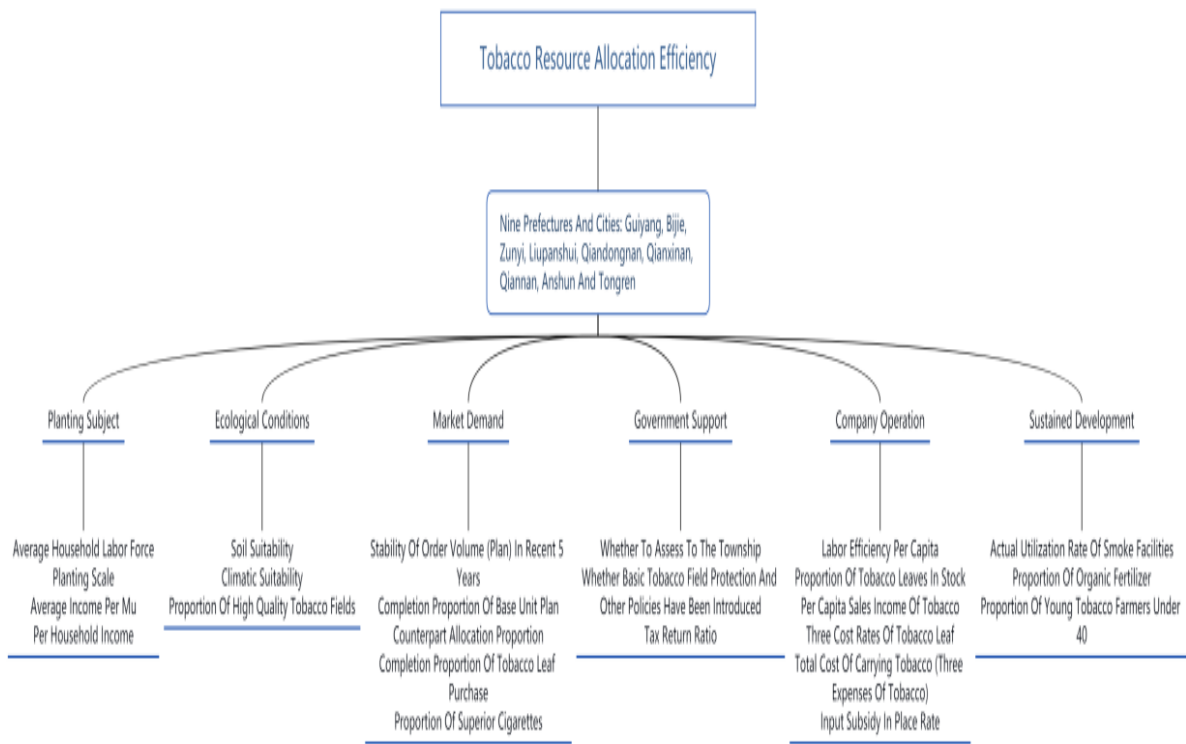


Figure 1. Stratification of factors

3.3. Construct a Contrast Matrix

When comparing the importance of the *i*th element with that of the *j*th element relative to a factor in the previous layer, it is described by quantitative relative weight a_{ij} . Assuming that there are *n* elements participating in the comparison, then $A = (a_{ij})_{n \times n}$ called the paired comparison matrix.

The value of a_{ij} in the paired comparison matrix can be assigned according to Satty's proposal. A_{ij} takes the value between 1-9 and its reciprocal.

- $a_{ij} = 1$, element *I* and element *j* have the same importance to the factors of the upper level;
 - $a_{ij} = 3$, element *I* is slightly more important than element *j*;
 - $a_{ij} = 5$, element *I* is more important than element *j*;
 - $a_{ij} = 7$, element *I* is much more important than element *j*;
 - $a_{ij} = 9$, element *I* is more important than element *j*;
- $a_{ij} = 2n$, $n=1,2,3,4$, and the importance of elements *I* and *j* is between $a_{ij}=2n-1$ and $a_{ij} = 2n+1$.

$$a_{ij} = \frac{1}{n}, \quad n=1,2,\dots,9, \text{ If and only if } a_{ji} = n.$$

Characteristics of paired comparison matrix: $a_{ij} > 0, a_{ij} = 1, a_{ij} = \frac{1}{a_{ji}}$. (note: when $i=j$, $a_{ij} = 1$)

3.4. Make Consistent Inspection

Theoretical analysis shows that if A is a completely consistent paired comparison matrix, there should be $a_{ij}a_{jk} = a_{ik}, 1 \leq i, j, k \leq n$.

However, when constructing the pairwise comparison matrix, it is actually impossible to satisfy many of the above equations. Therefore, the pairing matrix must have certain consistency, that is, there may be some inconsistency in the pairing matrix.

The steps to check the consistency of paired comparison matrix A are as follows:

Calculate the index CI to measure the inconsistency of a contrast matrix A ($n > 1$ order square matrix): $CI = \frac{\lambda_{max}(A) - n}{n - 1}$

RI is obtained as follows: for a fixed n, a comparison matrix a is created with the mechanism, in which a_{ij} is randomly selected from $1, 2, \dots, 9, 1/2, 1/3, \dots, 1/9$. Such a is inconsistent, and the average value of the maximum eigenvalue of a is obtained by taking a sufficiently large sub-sample

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Figure 2. The value of the RI

Comments:

According to the relevant data, the standard ri: ri is called the average random consistency index, which is only related to the matrix order n.

The random consistency ratio CR of the paired comparison matrix a is calculated according to the following formula: $CR = \frac{CI}{RI}$

The judgment method is as follows: when

$CR < 0.1$, it is judged that the paired comparison matrix A has satisfactory consistency, or its inconsistency degree is acceptable; Otherwise, the paired comparison matrix a is adjusted until satisfactory consistency is achieved.

For example, the matrix of Comparative Example 2

$$\begin{pmatrix} 1 & 2 & 7 & 5 & 5 \\ \frac{1}{2} & 1 & 4 & 3 & 3 \\ \frac{1}{7} & \frac{1}{4} & 1 & \frac{1}{2} & \frac{1}{3} \\ \frac{1}{5} & \frac{1}{3} & 2 & 1 & 1 \\ \frac{1}{5} & \frac{1}{3} & 3 & 1 & 1 \end{pmatrix}$$

Calculated to get $\lambda_{max}(A) = 5.073, CI = \frac{\lambda_{max}(A) - 5}{5 - 1} = 0.018$, With $RI = 1.12$,
 $CR = \frac{CI}{RI} = \frac{0.018}{1.12} = 0.016 < 0.1$

This shows that A is not a uniform matrix, but A has satisfactory consistency, and the degree of inconsistency of A is acceptable.

In practice, the following method can be used to calculate the maximum eigenvalue $\lambda_{max}(A)$ of paired comparison matrix $A = (a_{ij})$ and the approximate value of the corresponding eigenvector.

Definition

$$U_k = \frac{\sum_{j=1}^n a_{kj}}{\sum_{i=1}^n \sum_{j=1}^n a_{ij}}, U = (u_1, u_2, \dots, u_n)^z$$

It can be approximately regarded as the eigenvector of A corresponding to the maximum eigenvalue.

$$\text{Calculation } \lambda = \frac{1}{n} \sum_{i=1}^n \frac{(AU)_i}{u_i} = \frac{1}{n} \sum_{i=1}^n \frac{\sum_{j=1}^n a_{ij} u_j}{u_i}$$

It can be approximately regarded as the maximum eigenvalue of a. In practice, the consistency of matrix A can be judged by λ .

3.5. Application Procedures of Analytic Hierarchy Process

When determining the AHP method, the following four steps should be taken:

1. Establishment of hierarchical structure of the system;
2. Construct positive reciprocal matrix);
3. Calculate the weight of each alternative element of a specific standard;
4. Conduct consistency inspection.

3.6. Applying Analytic Hierarchy Process to Analyze the Index Weight of Resource Allocation Efficiency

3.6.1. Establish a Hierarchical Structure

Table 1. Scores given by experts (scale 1-9 points)

Characteristic index		Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9
Planting subject	Average household labor force									
	Planting scale									
	Average income per mu									
	Per household income									
Ecological conditions	Soil suitability									
	Climatic suitability									
	Proportion of high quality tobacco fields									
market demand	Stability of order volume (plan) in recent 5 years									
	Completion proportion of base unit plan									
	Counterpart allocation proportion									
	Completion									

	proportion of tobacco leaf purchase									
	Proportion of superior cigarettes									
Government support	Whether to assess to the township									
	Whether basic tobacco field protection and other policies have been introduced									
	Tax return ratio									
Company operation	Labor efficiency per capita									
	Proportion of tobacco leaves in stock									
	Per capita sales income of tobacco									
	Three cost rates of tobacco leaf									
	Total cost of tobacco (three expenses of tobacco)									
	Input subsidy in place rate									
Sustained development	Actual utilization rate of smoke facilities									
	Proportion of organic fertilizer									
	Proportion of young tobacco farmers under 40									

Get the specific score of each index η , after $\sum n$ (n is the number of indicators) compare twice and take an integer.

3.6.2. Construct Pairwise Comparison Judgment Matrix: (Positive Reciprocal Matrix)

After comparing each evaluation index, the relative advantages and disadvantages of each evaluation index are sorted according to the 9th percentile ratio, and the evaluation matrix of the evaluation index is reconstructed.

3.6.3. Calculate the Weight of Each Alternative Element for a Standard

There are two methods to calculate the weight of judgment matrix using spssau software, including geometric average method (root method) and standard column method (sum method).

Finally, the weight of each index is calculated by spssau software as follows:

Table 2. Index weight

Primary index	Secondary index	weight
Planting body (20.46%)	Average household labor force	2.25%
	Planting scale	3.86%
	Average income per mu	7.47%
	Per household income	6.88%
Ecological conditions (9.87%)	Soil suitability	4.41%
	Climatic suitability	3.39%
	Proportion of high quality tobacco fields	2.07%
Market demand (25.72%)	Stability of order volume (plan) in recent 5 years	13.31%
	Completion proportion of base unit plan	2.26%
	Counterpart allocation proportion	2.90%
	Completion proportion of tobacco leaf purchase	2.61%
	Proportion of superior cigarettes	4.64%
Government support (9.43%)	Whether to assess to the township	2.02%
	Whether basic tobacco field protection and other policies have been introduced	3.57%
	Tax return ratio	3.84%
Company operation (18.43%)	Labor efficiency per capita	5.06%
	Proportion of tobacco leaves in stock	2.92%
	Per capita sales income of tobacco	2.62%
	Three cost rates of tobacco leaf	1.69%
	Total cost of carrying tobacco (three expenses of tobacco)	1.16%
	Input subsidy in place rate	4.98%
Sustainable development (16.09%)	Actual utilization rate of smoke facilities	4.51%
	Proportion of organic fertilizer	5.72%
	Proportion of young tobacco farmers under 40	5.86%

Among the weight of various indicators, the primary indicator is 20.46% of the planting body, and among the secondary indicators of the planting body, the household average labor force is 2.25%, the planting scale is 3.86%, the average income per mu is 7.47%, and the average household income is 6.88%.

The ecological condition of the first index is 9.87%, and the soil suitability is 4.41%, the climate suitability is 3.39%, and the high-quality tobacco field accounts for 2.07%.

The market demand of primary indicators is 25.72%. Among the secondary indicators of market demand, the stability of order volume (plan) in recent five years is 13.31%, the completion proportion of base unit plan is 2.26%, the counterpart allocation proportion is 2.90%, the completion proportion of tobacco purchase volume is 2.61%, and the proportion of superior tobacco is 4.64%.

The first level indicators are supported by the government by 9.43%. Among the second level indicators supported by the government, whether the township is assessed by 2.02%, whether the basic tobacco field protection and other policies are introduced by 3.57%, and the tax return ratio is 3.84%.

The first level indicator is the company's operation of 18.43%. Among the second level

indicators operated by the company, the per capita (tobacco) labor efficiency is 5.06%, the proportion of stored tobacco leaves is 2.92%, the per capita sales income of tobacco leaves is 2.62%, the three cost rate of tobacco leaves is 1.69%, the total cost of tobacco (three cost of tobacco leaves) is 1.16%, and the input subsidy rate is 4.98%.

The primary indicators continued to develop by 16.09%. Among the secondary indicators of sustainable development, the actual utilization rate of tobacco facilities was 4.51%, the proportion of organic fertilizer was 5.72%, and young tobacco farmers under the age of 40 accounted for 5.86%.

3.6.4. Consistency Test

After creating the judgment matrix, you need to calculate the relative weight of each element in a given layer according to the judgment matrix and verify the consistency. Even if the judgment order in judgment matrix A is unnecessary, it cannot differ too much from the judgment order.

4. Conclusion

This paper establishes the evaluation index system of tobacco resource allocation, and selects representative tobacco resource evaluation indexes from target layer, standard layer to index layer. In order to further improve the scientificity of the research results, the analytic hierarchy process is improved accordingly. In the evaluation process, the inter class weight reflects the academic and experience differences of experts, so that the expert group with good consensus has a higher inter class weight; The logic of individual experts is reflected by the weight in the category, so the individual experts with rigorous thinking in the category have higher weight. Multiply the inter class weight and intra class weight to determine the weight corresponding to the academic, experience and logic of each expert, so as to make the weight of each evaluation index more scientific and reasonable, and provide a scientific basis for the decision-making of tobacco resource allocation.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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