Research on Brand Construction of characteristic Agricultural Products in Sichuan Province under the background of Rural Revitalization

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Abstract: Characteristic agricultural products refer to the agricultural products unique to a particular region. In recent years, the brand construction of agricultural products has been highly valued by all walks of life. Under the background of rural revitalization, agricultural development also faces unprecedented opportunities. In order to promote the high-quality development of agriculture and rural areas, it is very important to build the brand of characteristic agricultural products. In this study, the characteristic agricultural products of each district and county in Sichuan Province were selected for questionnaire survey, and the brand building level of agricultural products was evaluated by Topsis model from the aspects of natural factors, human factors and brand factors, and an evaluation system was established. Secondly, the results of the questionnaire were visualized and the factors affecting the brand building of agricultural products were explored through the evaluation model, among which the humanistic factors had the most profound impact. Finally, based on the analysis of the current situation and predicament, the paper explores the specific path of the brand construction of Sichuan featured agricultural products under the background of rural revitalization, and provides reference and suggestions for the brand construction of agricultural products in other regions.

Keywords: Rural revitalization; Characteristic agricultural products; Brand building; Linear regression; Evaluation model.

1. Introduction

As a primary industry for China's economic construction, agriculture has made outstanding contributions to the development of China (Li, 2022). With the strategy of revitalizing the countryside, agricultural development is facing unprecedented opportunities (Ren, 2023). A large number of farm products have emerged into the market, creating a situation of fierce and chaotic competition. Therefore, creating agricultural products with special characteristics and building agricultural brands is particularly important.

A distinctive agricultural product is unique to a particular region or one that is well-known in a particular area (Lv, 2022). Geographical indications (GI) are used to identify the origin of a

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product and indicate that the characteristics or quality of a certain product is the result of its geographical origin (Alvaro, 2021). In recent years, the branding of distinctive agricultural products and the identification of GI have received great attention from all sectors of society and governments at all levels. The No. 1 document of the Central Government points out that the construction of characteristic agricultural products and their regional brands should be vigorously promoted (Zheng, 2022). At present, China's high-quality agricultural development is in a situation of both crisis and opportunity (Fan, 2022). Branding agricultural products can effectively solve the problem of information asymmetry in the agricultural market, and better promote the high-quality development of agriculture and the rural economy (Xu, 2018).

As a major agricultural province, Sichuan has a significant regionalization of its agriculture and a wide range of agricultural products. And theoretical research and practice have proven that establishing regional brands for agricultural products is very important and will have a large impact on consumers' choice preferences and purchase intentions (Fan, 2022). How to stand out from the many products? A long-term mechanism for branding regional agricultural products and bringing geographical indications into play is indispensable.

Based on it, this paper selects agricultural products with characteristics from counties in Sichuan province for a questionnaire survey, evaluates the level of the brand building of agricultural products from three dimensions, and builds up an evaluation system of brand building level. Secondly, the results of the questionnaire analysis are visualized, and the factors affecting the brand-building effect are explored through the evaluation model. Finally, based on the analysis of the current situation and dilemmas, the specific paths for brand building of special agricultural products in Sichuan Province under the background of rural revitalization are explored, and reference values and constructive opinions are provided for the brand building of agricultural products in other regions.

2. Methodology

2.1 Data

In this experiment, online questionnaires and random sampling were used for investigation, and a total of 750 questionnaires were collected.

Questionnaire for each product to set the same problem and investigated respectively. The questions were designed as two parts: basic information and brand-building factors, and three specific elements: nature, humanity, and brand. Besides, the three factors are subdivided into questions, and different survey angles are set. The matrix scale is used according to the degree of identity of the respondents themselves, and the scale is 1-5 points. Score 1 for strongly disagree and 5 for strongly agree. The subdivided factors are shown in Table 1.

Table 1 Influence factors

Grouping variables		
Natural factors	Sichuan Province is located in the southwest inland and has the radiation range of characteristic agricultural products	Q_1

	Whether the soil, monsoon climate and varied topography of Sichuan Province are suitable for the planting of agricultural products	Q2
	Sichuan province is a large province of germplasm resources, whether it has a good material basis, and whether its resources have an impact on the characteristic agricultural products	Q3
Human factors	Whether the development of Sichuan characteristic agricultural products is affected by the background of rural revitalization and government policies	Q4
	Whether the number of breeding and production bases of characteristic agricultural products in Sichuan province has any influence on the cultivation of characteristic agricultural products	Q5
	The acceptance level and development space of Sichuan characteristic agricultural products market	Q6
	Whether the brand building consciousness of Sichuan characteristic agricultural products is weak and the level of brand value mining	Q7
Brand factors	Sichuan special agricultural products sales channels and promotion methods are diversified and differentiated	Q8
	Whether the characteristic agricultural products of Sichuan province should establish brand image and maintain brand reputation in the process of government strengthening, promotion and sales service	Q9
	Whether the quality control, logistics and after-sales system of Sichuan characteristic agricultural products is perfect	Q10
	Whether the quality control, logistics and after-sales system of Sichuan characteristic agricultural products is perfect	Q11

2.2 Experiment Design

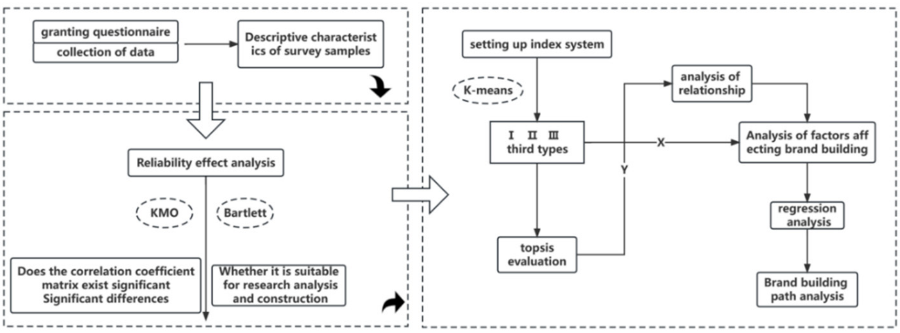

Figure 1 Experimental flowchart

Figure 1 shows the implementation process:

Step 1. Collecting data, sorting results, and describing sample characteristics.

Step 2. Through reliability and validity analysis, KMO and Bartlett tests are used to analyze whether there are significant differences among the correlation coefficient matrices of each item and whether it is suitable for research analysis and modeling.

Step 3. According to the three aspects to establish index system of agricultural products brand construction.

Step 4. Through K-means cluster analysis, all the research objects are divided into three categories. Then through the evaluation model, the entropy TOPSIS evaluation scores and ranks each category. Finally, regression analysis will be conducted to explore the factors affecting the effect of brand building.

2.3 Method

2.3.1 KMO test

In the reliability and validity analysis, the KMO test is based on the comparison of the relative size of the simple correlation coefficient and partial correlation coefficient between the original variables. When the sum of the squares of the partial correlation coefficients among all variables is much smaller than the sum of the squares of the simple correlation coefficients among all variables, the partial correlation coefficients between the variables are small, and the KMO value is close to 1. That means the variables are suitable for principal component analysis. The formula for calculating the KMO value is:

$$KMO = \frac{\sum\sum_{i\neq j} r_{ij}^2}{\sum\sum_{i\neq j} r_{ij}^2 + \sum\sum_{i\neq j} \alpha_{ij}^2} \tag{1}$$

Where denotes the simple correlation coefficient and denotes the partial correlation coefficient. It can be seen that, when $\alpha_{ij.1,2,3\ldots k}^2 \approx 1$, $KMO \approx 0$, the value of KMO is between 0 and 1. And the larger the calculated KMO value, the more suitable it is for principal component analysis.

2.3.2 Bartlett test

Bartlett's test is based on a matrix of correlation coefficients. Its null hypothesis is that the correlation coefficient matrix is an identity matrix, that is, all elements on the diagonal of the correlation coefficient matrix are 1, and all off-diagonal elements are zero. The statistics of the Bartlett test of sphericity are obtained from the determinant of the correlation coefficient matrix. If the value is large and the corresponding associated probability value is less than the specified significant level, reject the null hypothesis, and there is correlation between the original variables, which is suitable for principal component analysis.

In SPSS, there is an option for the Bartlett spherical test. If the sig value is less than 0.05, the data is spherically distributed.

2.3.3 K- means

K-means cluster analysis is mainly to explore the pros and cons of each brand. The K-means algorithm means clustering the k points in the space as the center and classifying the objects closest to them.

Selecting the number k of clusters, arbitrarily generate k clusters, and then determine the cluster centers, or directly generate k centers. Determine its cluster center point for each point. Then calculate its new cluster center. Repeat the above steps until the convergence requirements are met.

- k centroids from n sample data as the initial cluster centers. The centroid is recorded as

$$\mu_1^{(0)}\mu_2^{(0)}, \dots \mu_k^{(0)} \tag{2}$$

- Define optimization goals

$$J(c,\mu) = min \sum_{i=1}^{\mathcal{M}} \|x_i - \mu_k\|^2 \tag{3}$$

- Calculate the distance from each sample point to the centroid, assign the sample to which centroid is closer to whichever sample is closer, and get k clusters

$$c_i^t < -arg \ \min_k \|x_i - \mu_k^t\|^2 \tag{4}$$

- For each cluster, calculate the average distance of all sample points classified into the cluster as the new centroid

$$\mu_k^{(t+1)} < -arg \min_u \sum_{i:c_i^t=k}^{b} \|x_i - \mu_k^t\|^2 \tag{5}$$

2.3.4 Etropy -Topsis

The basic process of the TOPSIS method is to first unify the index type of the original data matrix (general forward processing) to obtain a normalized matrix and then standardize the normalized matrix. Then calculate the distance between each evaluation object and the optimal plan, also the worst plan. Finally, obtain the relative closeness of each evaluation object to the optimal plan, which is used as the basis for evaluating the pros and cons.

2.3.5 Linear regression

This paper uses linear regression to model and analyze the relationship between one or more independent variables and dependent variables (target values) using regression equations. Linear regression is a statistical analysis method to determine the quantitative relationship between two or more variables.

In linear regression, if there are more than 2 independent variables, it is called multivariate linear regression. In fact, there is always more than one factor affecting the dependent variable.

Therefore, it is more realistic to find the optimal combination of multiple independent variables to predict the dependent variable.

The first step is to select appropriate independent variables by calculating the correlation coefficient. After that, the coefficients can be determined by OLS to obtain the regression equation. But in fact, the calculation of coefficients is extremely complicated, and most of the results are generally calculated by computer software. The formula is shown below.

$$\mathcal{Y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p \tag{6}$$

In this experiment, we follow the following experimental procedure

- Collecting the raw data and obtain the variables
- Calculate the correlation coefficient
- Test the correlation (F-test)
- Calculate the coefficients (β)
- Test the coefficients (T-test)
- Collinear diagnostics (VIF)
- Build the equations
- Test the residuals

3. Results & Discussion

3.1 Reliability and validity analysis

Reliability validity analysis, also known as reliability analysis, is used to check whether the results of sample responses are reliable. In this study, 18 agricultural products were selected, and 11 indicators were set up for the brand building factors. As shown in Table 2, the standardized Cronbach alpha coefficient for agricultural products was greater than 0.7, the KMO value was greater than 0.6 and the p-value was less than 0.05, all of which passed the reliability and validity tests and were more reliable as raw data.

Table 2 Results of the reliability validity analysis

Brand	**Standardized Cronbach alpha coefficient**	**KMO value**	**Bart spherical value**	**df**	**p-value**
Luzhou glutinous red sorghum	0.762	0.783	470.582	78	0
AoPing ligusticum wallichii	0.933	0.828	498.893	78	0
Deyang Shu Road vegetables	0.848	0.686	242.379	78	0

Chengdu Jintang morels	0.794	0.617	207.02	78	0
Yanbian mulberry cocoon	0.761	0.8	485.984	78	0
Tongjiang silver fungus	0.755	0.624	186.496	78	0
Hanyuan peppercorns	0.950	0.799	704.125	78	0
Suining wild pig	0.947	0.888	480.101	78	0
Mengding camellia	0.897	0.79	361.559	78	0
Nanjiang mongolian gazelle	0.914	0.898	377.956	78	0
Xuanpin the world's beef cattle	0.962	0.927	576.544	78	0
Ehime jelly orange	0.844	0.778	325.713	78	0
Chaotian walnuts	0.925	0.804	500.775	78	0
Huili pomegranate	0.921	0.904	695.52	78	0
Pixian Douban	0.918	0.866	697.052	78	0
Yanyuan apples	0.906	0.887	562.483	78	0
Liangshan tobacco leaves	0.788	0.808	432.049	78	0
Weiyuan figs	0.936	0.7	704.774	78	0

3.2 Cluster analysis

This study was based on the SPSS program for analysis, and K-means cluster analysis was chosen to classify the products into three categories from the perspective of comprehensive analysis. In the case of uniform indicators of the questionnaire, a score of 5 was set as the most satisfactory and 1 as the least satisfactory, and the average value of each indicator was calculated from the results of the scoring. As shown in Table 4, the 18 agricultural products were divided into three categories based on the effect of the clustering results.

Category 1: Mongolian gazelle, Beef cattle, Wild pigs, Pomegranate, Ligusticum wallichii, Tobacco leaves, Sorghum, Mulberry cocoon, Morel, Dou ban, Apple

Category 2: Pepper, Walnut, Fig

Category 3: Vegetables, Silver fungus, Mengding camellia, Orange

The data from the three categories are divided into groups to find the mean values of the indicators and observe their characteristics. From the data in Table 3, it is clear that category 1 is mainly for special grain and economic crops and livestock products, category 2 is mainly for special forestry products and category 3 is mainly for special horticultural products. The branding of agricultural products in category 2 is influenced by three major factors, and 11 indicators are at a high level, and each indicator is the highest among the three categories. Combined with the specific agricultural products in each category, it is found that forestry products in category 2 need more reliable brand support to facilitate the promotion and development of the products; grain and economic crops and livestock products are influenced by certain brand factors because they are needed in people's daily life, and people's brand requirements for horticultural products are slightly lower than those of the other two categories.

Table 3 Cluster Member Analysis Table

Case number	Agricultural products	Cluster	Distance
1	Pepper	2	.412
2	Walnut	2	.718
3	Fig	2	.409
4	Mongolian gazelle	1	.236
5	Beef cattle	1	.313
6	Wild pigs	1	.512
7	Vegetables	3	.615
8	Silver fungus	3	.414
9	Pomegranate	1	.471
10	Mengding camellia	3	.553
11	Ligusticum wallichii	1	.589
12	Tobacco leaves	1	.447
13	Sorghum	1	.604
14	Mulberry cocoon	1	.755
15	Morel	1	.839
16	Douban	1	.375
17	Apple	1	.398
18	Orange	3	.720

3.3 TOPSIS analysis

For regression analysis, the independent variable X and the dependent variable Y are required, whereas the questionnaire in this study only investigated the value of X and lacked statistics on Y. To fill this gap at the time of the survey, a TOPSIS evaluation was required.

In this study, the entropy weighting method and TOPSIS analysis were combined and applied to calculate the weight coefficients of each evaluation index, and the data were weighted with the weight values as new data for the TOPSIS method, and finally, the analysis was completed and the results obtained are shown in Table 4 and Table 5 below.

Table 4 Summary of the results of the entropy method for calculating weights

Summary of Weight Calculation Results by Entropy Method			
Item	**Information entropy value e**	**Information utility value d**	**Weight coefficient w**
Q1	0.9985	0.0015	9.82%
Q3	0.9983	0.0017	11.13%
Q2	0.9989	0.0011	7.09%
Q4	0.9985	0.0015	9.61%

Q6	0.9988	0.0012	7.74%
Q5	0.9990	0.0010	6.41%
Q7	0.9989	0.0011	7.18%
Q9	0.9986	0.0014	8.98%
Q10	0.9984	0.0016	10.74%
Q8	0.9980	0.0020	13.04%
Q11	0.9987	0.0013	8.27%

Table 5 TOPSIS evaluation calculation results

TOPSIS evaluation results				
Item	**Positive ideal solution distance D_+**	**Negative ideal solution distance D_-**	**Relative approach degree C**	**Ranking results**
Pepper	0.110	0.323	0.746	3
Walnut	0.018	0.426	0.960	1
Fig	0.104	0.341	0.766	2
Mongolian gazelle	0.197	0.241	0.550	8
Beef cattle	0.221	0.220	0.498	11
Wild pigs	0.187	0.261	0.583	6
Vegetables	0.341	0.125	0.269	15
Silver fungus	0.383	0.065	0.145	17
Pomegranate	0.164	0.272	0.624	4
Mengding camellia	0.337	0.113	0.250	16
Ligusticum wallichii	0.171	0.270	0.612	5
Tobacco leaves	0.207	0.241	0.538	9
Sorghum	0.244	0.214	0.467	12
Mulberry cocoon	0.253	0.193	0.432	13
Morel	0.280	0.168	0.376	14
Douban	0.187	0.257	0.579	7
Apple	0.205	0.236	0.535	10
Orange	0.423	0.016	0.036	18

It is worth stating that when using the data generated by post-entropy weighting for TOPSIS analysis, it is important to first ensure that the evaluation indicators are equally positive trending, i.e. the larger the value the better. As we have set all indicators in the questionnaire to be scored as close to 5 the higher the value the better, there is no need to positively normalize the indicators and they can be calculated directly. In the Table 5, D_+ and D- denote the distance between the evaluation object and the positive and negative ideal solutions respectively, the smaller the D_+ the better, the larger the D- the better; C denotes the proximity of the evaluation object to the optimal solution, the larger the proximity to 1 the better, i.e. the dependent variable Y for the regression analysis in this study. According to the ranking results, the relative proximity of Walnut, Fig, and Pepper is high, while Orange, Silver fungus, and Mengding gazelle is low.

3.4 Correlation analysis

The correlation analysis was conducted to determine which factors would have a significant impact on Y. As shown in Table 6 below, the closer the Pearson correlation is to 1, the higher the correlation is. The high Pearson correlation coefficients for Q_2、Q_4、Q_5 and Q_6 indicate a high degree of influence on the TOPSIS evaluation scores. Among the human factors, "rural revitalization and local policy's promotion", "'Internet+' infrastructure construction" and "market acceptance of agricultural products" have a high degree of influence on brand building. This result is reasonable in light of the actual situation. In addition, the statistical significance is 0.000, which means that all correlation coefficients are statistically significant.

Table 6 Correlation coefficients

correlation		Q^1	Q^2	Q^3	Q^4	Q^5	Q^6	Q^7	Q^8	Q^9	Q^{10}	Q^{11}	**y**
y	**pearson correlation**	.904**	.944**	.914**	.946**	.945**	.950**	.896**	.918**	.906**	.913**	.880**	1
	Sig.(double-stern)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	

3.5 Regression analysis

In linear regression, there is often more than one factor affecting the dependent variable, so it is more realistic to find the optimal combination of multiple factors to predict the dependent variable. To find the most appropriate independent variables, we initially calculate the correlation coefficients between 11 indicators (X) and the associated proximity C (Y), test the combinations of all independent variables through t-tests, and find the best model. Stepwise regression was used in this study and the final regression results are shown in Table 7 below. Through testing, this model has an R-squared of 0.992 and an adjusted R-squared of 0.990, which is highly close to 1. The fit is good and therefore the model is considered optimal.

Table 7 Model a coefficients

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	**constant**	-2.055	.065		-31.676	.000
	Q_6	.201	.037	.335	5.440	.000

Q_8	.204	.029	.317	6.945	.000
Q_1	.121	0.30	.198	4.094	.001
Q_5	.142	.042	.215	3.360	.005

3.6 Result analysis

According to the aforementioned findings, natural characteristics are ideal from the perspective of customers, which is a vital guarantee for the product's quality. Additionally, governmental and institutional supports are the external driving forces behind agricultural product brand building. Infrastructure development is a key supporting factor in the creation of agricultural product brands. Humanistic elements such as market acceptability and agricultural product development space are also important determinants of customers' brand identification level.

As a result, based on the current state of brand construction at three different levels, we can conclude that the brand construction has yielded some results but also has flaws:

- The existing brands have a small market share and little influence. In Sichuan province, agricultural products are small in scale, with many brands and serious homogenization. Seasonal fruits like Ehime Jelly orange have obvious seasonality and strong substitutability, which leads to low market share due to the lack of certain core competitiveness.

- The government does not place enough emphasis on the distinctive agricultural product brand. Brand parties lack in-depth cooperation with authoritative subjects, and if their own brand lacks credibility, it will further reduce customer credibility. For example, due to a lack of leading enterprises and scientific and technological support, some growers lead to backward planting technology, efficiency, and quality, resulting in a sluggish market and difficult industrial expansion.

- A limited range of communication and radiation results from poor brand image recognition. The fundamental embodiment of brand value and the image is regional characteristics and cultural connotation. Liangshan organic tobacco does not thoroughly excavate and integrate cultural elements, so excellent cultural elements are fragmented, so the brand communication effect is frequently poor people.

Considering the foregoing research, we propose the following brand-building optimization recommendations for distinctive agricultural products from Sichuan:

- Deep exploration of regional resources to create distinct differentiation advantages. Regional natural and cultural factors play a significant role in the development of distinctive agricultural product brands. Extract elements to create a positive image that highlights the local characteristics of regional brands, develops comparative advantages, and increases awareness and recognition of the brand.

- Align the rural revitalization strategy and government policies as much as possible and boost brand authority letters and influence. National strategy and industry policy are the foundation for the development of agricultural products brand, giving priority to agricultural producers, improving agricultural cooperation organization, cooperating with the government, making full use of the policy dividend for R&D investment and infrastructure construction, promoting the development of the agricultural scale, standardization, and the brand.

- Improve market share and influence by establishing a regional public brand for agricultural products. Utilize the resource advantages of regional public agricultural product brands to achieve agricultural industry clusters and production expansion and quality improvement. Agricultural products brand profitability through ascension, and booster industries, thus promoting rural revitalization.

- Integrate cultural resources for the brand and promote brand communication in various ways. Combine the brand with regional resources along the route to gain brand reputation and economic benefits. Engage actively in social welfare activities to demonstrate brand responsibility and a positive image. Flexible use of new media for digital marketing to boost the brand's overall competitiveness. Communicate with industry experts, raise brand awareness, and increase the degree of brand value mining.

4. Conclusion

In summary, this study primarily collected, processed, and analyzed consumer questionnaire data using data analysis software like SPSS before creating a structural equation model to investigate the link between brand building level and customer intention. Once the KMO and Bartlett tests confirmed that factor analysis could be performed, it first performed a thorough analysis of numerous dimensions of the brand-building level of Sichuan featured agricultural products by K-means clustering and divided that level into three categories. This paper analyzed the status quo of low-level brands and found that the brands lack differentiation advantage, low influence, weak brand communication, and other problems, and put forward suggestions based on TOPSIS evaluation and correlation analysis. Second, a correlation analysis of the indicators affecting the level of the brand building was performed, with an emphasis on the factors that have the most influence, namely the humanistic factors. Finally, stepwise regression analysis was used to identify the best combination of multiple factors and create a standardized model.

This paper makes the following contributions: (1) The agricultural product brand construction level evaluation model was established. (2) The influence factors of a brand building level of Sichuan characteristic agricultural products were analyzed. (3) Mainly analyzed the current situation of low-level brand construction, and proposed solutions. (4) Offer experience and inspiration for other domestic counties to develop brand route, promote rural regeneration, and achieve "brand strong agriculture".

References

[1] Alvaro Luis Lamas Cassago, et al. (2021). "Metabolomics as a marketing tool for geographical indication products: a literature review." *European Food Research and Technology* .

[2] Dayong Xu. (2018). "RESEARCH ON BRAND CONSTRUCTION AND DEVELOPMENT OF AGRICULTURAL PRODUCTS IN GUIZHOU." *Engineering Heritage Journal 2*.2

[3] Liu Fan, et al. (2022). "Data-driven evaluation of regional agricultural production efficiency for sustainable development." *Journal of Intelligent & Fuzzy Systems 43.6.*

[4] Lv Dongqin. (2022)."Research on the Construction Strategy of Characteristic Agricultural Products Brand in Tai'an." *International Journal of Agricultural Economics* 7.4

[5] Mo Fan, and Chee Weiming. (2022)."An Qualitative Research on Regional Brand Image and

Its Effect on Purchase Intention." *Asian Journal of Agricultural Extension, Economics & Sociology* .
[6] Ren Jingmei, et al. (2023)."Research on taxation policies for agricultural development under the rural revitalization strategy." *SHS Web of Conferences 154*.
[7] Yiran Li, and Ming Liu. (2022). "Influence of Agricultural Structure Adjustment on Economic Growth in Sichuan Province." *Journal of Global Economy, Business and Finance 4*.7
[8] Zheng Xiaoping, Huang Qiuyi,and Zheng Shuangyu. (2022). "The Identification and Applicability of Regional Brand-Driving Modes for Agricultural Products ." *Agriculture 12*.8