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Comprehensive Evaluation on Agricultural Structure and Correlation of Agricultural Internal Structure

—A Case of Yimeng Mountainous Area

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Abstract According to the relevant data from *Chinese Statistical Yearbook*, the overall agricultural structure and the internal structure of agriculture in Yimeng Mountainous area are analyzed. The status quo of the agricultural and the internal structure of agriculture in Yimeng Mountainous area are analyzed through the method of comprehensive appraisal of the improved factors. The safety coefficient of the comprehensive appraisal is from 2.626 696 to 4.987 546, which is exclude in the safety extent, so it needs adjusting. At the same time, the internal relations of the internal structure of agriculture in Yimeng Mountainous area are studied by using the relativity analysis. The overall agricultural structure of Yimeng Mountainous area is in negative correlation to planting structure and forestry structure, and in positive correlation to livestock breeding industry; the plating structure is in negative correlation to livestock breeding structure and in positive correlation to forestry structure and the forestry structure is in negative correlation to livestock breeding structure.

Key words Yimeng Mountainous area, Agricultural structure, Comprehensive appraisal method, Correlation, China

Yimeng Mountainous area boasts rich agricultural resources and agricultural products. In the area, the agricultural production has many advantages and it is flexible in market competition. However, as a result of the weak agricultural basis and imbalanced developmental level, the agricultural economy still at the "climbing" stage and there are still many conflicts and problems. The existence of problems is caused by the improper agricultural structure in Yimeng Mountainous area. In order to fully display the comparative advantages of Yimeng Mountainous area and implement the excellent and strong no-equilibrium developmental strategy, the agricultural structure of Yimeng Mountainous area should be well adjusted. At the same time, improving the agricultural structure is not only the strategic way of enhancing the comprehensive competitiveness and the productivity of Yimeng Mountainous area, but also an important way of increasing farmers' income^[1]. Through the comprehensive evaluation of the agricultural structure in Yimeng Mountainous area, the necessity and feasibility of adjusting the agricultural structure of Yimeng Mountainous area is defined. Based on it, the internal relations of agricultural structure of the Yimeng Mountainous area are studied by using the relevance analysis, which provides empirical evidence for the adjustment of agricultural structure of Yimeng Mountainous area from the macro-level.

1 The status quo of agricultural structure in Yimeng Mountainous area

1.1 Analysis on the overall agricultural structure of Yimeng Mountainous area According to the data from *Chinese*

Statistical Yearbook^[2], the changes of the agricultural output structure of Yimeng Mountainous area from 2002 to 2008 are listed (Table 1).

It can be seen from Table 1 that after 2002, from the overall agricultural structure of Yimeng Mountainous area, the proportion taken by the planting increased and decreased gradually; that of the animal husbandry decreased and then increased continuously; that of the forestry decreased continuously and that of fishery changed slightly. But the prior agriculture is planting and animal husbandry.

Planting is still the pillar industry in the development of mountainous area, and the proportion of the planting in the whole agricultural structure maintains around 60%. The output value of planting has increased from 12.192 billion yuan in 2002 to 25.482 billion yuan in 2008, and the annual growth rate has achieved 18.1%. The proportion taken by planting increased steadily before 2007, but in 2008, the proportion decreased greatly. In 2006 and 2007, as a result of the decrease of the animal husbandry, the proportion of planting has ever increased to 63.83%. From the perspective of the development of animal husbandry, the total value has increased from 6.297 billion yuan in the primary stage to 13.462 billion yuan in 2008, with the annual increase of 16.25%. The proportion of animal husbandry lingers around 31%, after 2007, the proportion has the tendency of rapid increase. The proportion of forestry and fishery is small, in 2008; the proportions of them were 5.33% and 2.57% respectively. The proportion of forestry has decreased 1.18%, but the proportion of fishery was stable. In this period, the total output value of forestry and fishery has increased 0.934 billion yuan and 0.620 billion yuan respectively and the proportion remains stable^[3]. According to the analysis above, the prior agriculture in Yimeng Mountainous area is planting,

but the productivity of planting is low and it still has not shaken off the positive fate of harvesting at the mercy of weather. If it comes to the bad year, a large number of grains will be cut, in the end, the added value of plantation will decrease, and the proportion of the primary industry in the GDP will decrease.

1.2 Analysis on the internal structure of agriculture in Yimeng Mountainous area

1.2.1 Plantation. According to the date from the *China Statistical Yearbook*^[2], the variation of the internal structure of plantation in Yimeng Mountainous area from 2002 to 2008 is listed

Table 1 Structural variation of the agricultural output value in Yimeng Mountainous areas from 2002 to 2008

Year	Planting		Forestry		Animal husbandry		Fishery	
	Output value × 10 ⁸ yuan	Proportion %	Output value × 10 ⁸ yuan	Proportion %	Output value × 10 ⁸ yuan	Proportion %	Output value × 10 ⁸ yuan	Proportion %
2002	121.925 4	60.13	13.197 3	6.51	62.975 0	31.06	4.668 4	2.30
2003	133.334 8	60.64	13.312 4	6.05	67.702 4	30.79	5.532 8	2.52
2004	155.322 6	59.24	14.797 9	5.64	85.506 3	32.61	6.577 6	2.51
2005	180.438 4	61.11	15.598 7	5.28	92.083 7	31.18	7.166 2	2.43
2006	201.629 1	63.83	15.382 8	4.87	90.894 3	28.77	7.972 3	2.53
2007	223.945 3	63.08	19.603 3	5.52	102.149 8	28.78	9.294 1	2.62
2008	254.819 9	60.26	22.543 6	5.33	134.623 5	31.84	10.867 6	2.57

Table 2 Internal structural variation of planting in Yimeng mountainous areas from 2002 to 2008

Year	Total area × 10 ⁴ hm ²	Grain crops		Cash crops		Fruits and vegetables	
		Area// × 10 ⁴ hm ²	Proportion//%	Area// × 10 ⁴ hm ²	Proportion//%	Area// × 10 ⁴ hm ²	Proportion//%
2002	101.460 4	70.094 8	69.08	17.109 2	18.84	12.256 4	12.08
2003	99.369 3	63.129 9	63.53	23.050 1	23.40	13.189 3	13.27
2004	100.466 4	63.524 2	63.27	23.506 7	23.36	13.435 5	13.37
2005	105.727 8	70.357 4	66.55	22.241 9	21.03	13.128 5	12.42
2006	107.058 1	71.041 7	66.36	22.326 5	20.85	13.689 9	12.79
2007	106.701 0	70.294 2	65.88	22.995 3	21.55	13.411 5	12.57
2008	108.075 4	70.883 2	65.59	23.717 5	21.94	13.474 7	12.47

Table 3 Proportion of the sown area of various grain crops in Yimeng mountainous areas from 2003 to 2008 %

Year	Wheat	Rice	Corn	Millet	Sorghum	Legume	Potato
2003	41.78	7.47	28.29	0.42	0.39	4.86	16.70
2004	42.44	7.49	29.78	0.31	0.32	4.93	14.64
2005	45.48	6.85	30.72	0.30	0.31	4.65	11.61
2006	46.09	6.81	31.48	0.27	0.27	4.56	10.43
2007	45.83	6.91	32.28	0.25	0.23	4.41	10.01
2008	47.14	6.62	32.59	0.21	0.17	4.50	8.71

It can be seen from Table 3 that the principal grain crops in Yimeng Mountainous area were wheat and corn, and the proportion of the sown acreage of wheat and corn increased continuously, but the sown acreage of potatoes showed the obviously tend of decrease, which has decreased from 16.7% in 2003 to 8.71% in 2008, with the decrease range of 8%. Two reasons were accountable for the decrease. For one thing, the overall sown acreage of grain has decreased; for another thing, the market competitiveness of potato was weak and the economic income was not so significant. The proportion of other crops such as millet and sorghum decreased, but the responsive capability to market of the crops with small sown acreage was strong, so from the overall perspective, they had

(Table 2) and the proportion of the sown acreage of each grain in Yimeng Mountainous area from 2003 to 2008 is listed (Table 3).

It can be seen from Table 2 that, the grain crops in Yimeng Mountainous area are the major crops of plantation, the proportion of sown acreage is around 65%, and the grain crops still take a larger proportion. Although the sown acreage of other cash crops, fruits and vegetable increases annually, the range of growth is small. It is directly related to the natural conditions in the Yimeng Mountainous area, as well as the overall economic strategy of Shangdong Province and its demand on food.

small impact on the agricultural economic development of the whole Yimeng Mountainous area.

1.2.2 Livestock breeding. According to the data from *China Statistical Yearbook*^[2], the yield of livestock breeding in Yimeng Mountainous area from 2002 to 2008, the structural changes of livestock breeding and the comparison of the changes were listed (Table 4).

It can be seen from Table 4 that, from the perspective of the whole livestock breeding, the overall proportion of meat decreased; the proportion of dairy products and aquatic products increased rapidly; the proportion of bird eggs maintained still; and the whole livestock breeding took meat products as the priority. The proportion of the output of meat products still maintained over 52%, followed by the egg products. From the perspective of output, the increase of dairy and aquatic products was rather fast, which increased from 54 911 and 86 773 in 2003 to 109 493 and 115 956 in 2008, respectively, with the annual growth rate of 16.5% and 5.6% respectively. The output of eggs increased greatly in 2008, 46 287 t more than the previous year, which had great potential.

1.2.3 Forestry. From 2003 to 2008, the afforestation area in Yimeng Mountainous area and the whole country changes unceasingly (Table 5)^[2], the overall area of timber forest was de-

creasing, but that in the whole country was increasing. The overall area of economic forest was decreasing as well, but the area of shelterbelt forest was increasing. Especially, in 2007 and 2008, the area of shelter forest in Yimeng Mountainous area showed the trend of multiplied growth, Comparing with that in

2003, the area of them has increased 5 000 hm² and 1 610 000 hm² respectively. The phenomenon showed that China has paid more and more importance to the ecological economy and taken the way of sustainable development of agricultural economy.

Table 4 Output and structural variation of the breeding industry in Yimeng mountainous areas from 2002 to 2008

Year	Meat		Milk		Egg		Aquatic products	
	Yield// ×10 ⁴ t	Proportion//%	Yield// ×10 ⁴ t	Proportion//%	Yield// ×10 ⁴ t	Proportion//%	Yield// ×10 ⁴ t	Proportion//%
2003	58.109 7	59.39	5.491 1	5.61	25.571 1	26.13	8.677 3	8.87
2004	59.928 7	58.44	6.968 7	6.80	26.164 5	25.52	9.480 2	9.25
2005	65.848 3	59.72	7.684 8	6.97	26.666 1	24.18	10.067 3	9.13
2006	62.677 0	60.16	6.982 2	6.70	23.509 8	22.57	11.008 4	10.57
2007	52.407 0	54.11	9.366 9	9.67	23.468 4	24.23	11.605 8	11.98
2008	57.338 2	53.10	10.949 3	10.14	28.097 1	26.02	11.595 6	10.74

Table 5 Change of the afforestation area in Yimeng mountainous areas and whole China from 2003 to 2008 ×10⁴ hm²

Year	Timber forest		Economic forest		Shelterbelt forest	
	Yimeng mountainous area	The Whole China	Yimeng mountainous area	The Whole China	Yimeng mountainous area	The Whole China
2003	3.490 2	64	1.586 8	52	0.377 9	178
2004	0.823 2	70	0.506 2	59	0.241 9	165
2005	0.601 0	78	0.339 0	50	0.245 2	186
2006	0.559 6	102	0.486 4	47	0.218 6	137
2007	0.714 5	82	0.223 1	75	0.853 1	330
2008	0.824 3	129	0.248 9	43	0.862 8	339

2 Comprehensive evaluation on the agricultural structure in Yimeng mountainous area

2.1 Method for the comprehensive evaluation on agricultural structure In view of the integrity of the evaluation elements^[4], the evaluation method should be established on the basis of the comprehensive elements, so the comprehensive appraisal was adopted in the research. The element comprehensive evaluation method was mainly applied in evaluating the security of resource and environment. However, if the method was altered, it could be used for evaluating other things. The agricultural structure in Yimeng mountainous area should be evaluated by improving the elements. The formula is as follows:

$$SI = \sum F_i / P$$

(1)

In the formula, *SI* is the security coefficient of agricultural structure; *F_i* is the ratio of element indictors of agricultural structure in the area of per unit area of land to the relevant indicator of the whole country; *P* is the ratio of regional density of population to the average density of population of the whole country.

All the weights of the elements participated the appraisal were valued as 1, which was based on the consideration of two parts: in the first place, considering the integrity of agricultural structure, in the process of agricultural economic social development, not one of the basic elements of agricultural structure was dispensable; in the second place, the comparability of the security of agricultural structure was taken into consideration.

2.2 Standard for evaluating the security coefficient of agricultural structure The security coefficient *SI* ≥ 5 is the high

security area, and the agricultural structure of the area is reasonable, so this kind of area is called the first class area with high security. Security coefficient *SI* < 5 is the area with low security degree and its security coefficient is lower than 5, the average level of the nation. Agricultural structure in this area is unreasonable, it needs to be adjusted.

From the perspective of the low security coefficient, three subclasses can be divided: the first class: 3 ≤ *SI* < 5, belongs to the area with low security degree. In the area, although the basis of the agricultural structure is lower than that in the area with high security degree, it still has the elasticity to adjust. The second class: 1 ≤ *SI* < 3, belongs to the sub low security degree area. In the area, the elasticity degree of agricultural structure in this area is insufficient, especially in terms of the structure of agricultural infrastructure. The third class, *SI* < 1, belongs to the area with low security degree. It indicates that there is no space for adjusting agricultural structure or there is no meaning to adjust it. The survival and development of the area have to rely on the external situations.

2.3 Evaluation result of agricultural structure of Yimeng mountainous area In order to appraisal the security degree of agricultural structure in Yimeng mountainous area reasonably, the evaluation is divided into four parts: the overall comprehensive appraisal of agricultural structure in Yimeng mountainous area, the overall comprehensive appraisal of livestock breeding in Yimeng mountainous area, the overall comprehensive appraisal of plantation structure in Yimeng mountainous area and the comprehensive appraisal of forestry structure in Yimeng mountainous area. According to the data from the above five tables and form the relevant statistical yearbook^[2] and by using formula(1), the comprehensive appraisal results of agri-

culture and the internal industrial structure of Yimeng mountainous area from 2003 to 2008 can be calculated(Table 6).

Table 6 Comprehensive evaluation results of the safety coefficient of agriculture and its internal structural in Yimeng mountainous areas from 2003 to 2008

Year	Agricultural structure	Planting structure	Structure of breeding industry	Forestry structure
2003	3.424 300	2.626 696	3.996 961	4.236 540
2004	3.424 355	2.656 527	4.610 751	3.875 641
2005	3.473 750	2.663 243	4.626 951	4.012 341
2006	3.399 730	2.830 488	4.336 945	4.147 890
2007	3.335 980	2.815 228	4.185 375	4.987 546
2008	3.349 071	2.735 397	4.366 779	4.256 492

2.3.1 The overall comprehensive appraisal of agricultural structure in Yimeng mountainous area. The following appraisal elements are applied to evaluate the overall agricultural structure of Yimeng mountainous area. the output value of Yimeng mountainous area; the output value of forestry in Yimeng mountainous area; the output value of fishery in Yimeng mountainous area and the national average output value of agriculture, forestry, livestock breeding and fishery.

It can be seen from Table 6 that, from 2003 to 2008, the appraisal coefficient of agricultural structure is from 3.335 980 to 3.473 750, which indicates that the agricultural structure of Yimeng mountainous area stays in the stage of low security degree. According to the evaluation standard of security coefficient, although the basis of agricultural structure in this *S/I* interval is lower than that in the area with high security degree, it still has space to adjust. If the government adopts the reasonable measures to adjust, the fundament of agricultural structure in Yimeng mountainous area can be adjusted and allocated. From 2003 to 2008, the comprehensive evaluation coefficient *S/I* of the agricultural structure in this area shows the downward trend, especially in 2007, the security coefficient is 3.335 98, which indicates that in 2007, the security coefficient of agricultural, forestry, livestock breeding and fishery structures are close to the sub-security interval. If it can not be immediately adjusted, the elastic space of structural security will be insufficient; form 2007 to 2008, the security coefficient of it showed the upward trend, which indicated that the government has adopted certain remedial measures.

2.3.2 Comprehensive evaluation on the internal structure of agriculture in Yimeng mountainous area. The internal structure of agriculture in Yimeng mountainous area is comprehensively evaluated according to the characteristics of the internal structure of Yimeng mountainous area. The evaluation mainly includes the comprehensive evaluation on the plantation structure of Yimeng mountainous area, comprehensive evolution on the livestock breeding of Yimeng mountainous area, comprehensive evaluation on forestry in Yimeng mountainous area. The fishery of Yimeng mountainous area is included in the livestock breeding, so the comprehensive evaluation is not conducted on it.

2.3.2.1 Plantation. The comprehensive evaluation on the plantation of Yimeng mountainous area chooses the plantation

area for grain, area of cash crops, the area of fruits and vegetables and the average area of them in the country as the indicators. The results of the evaluation can be seen on Table 6.

It can be seen from Table 6 that, the comprehensive evaluation coefficient of plantation structure from 2003 to 2008 was 2.626 696 – 2.830 488, which indicated that the structure of plantation in Yimeng mountainous area stayed on the general sub-low state. According to the evaluation standard of security coefficient, the elastic space of security of agricultural structure in the area is insufficient obviously. The government should adopt reasonable measures to adjust and allocate the plantation structure in Yimeng mountainous area. From 2003 to 2008, the comprehensive evaluation coefficient of plantation structure in the area showed the upward trend on the whole, especially from 2005 to 2006, its upward range was fairly large, in 2006, it came to the peak(2.830 488), which was close to 3. It indicated that in 2006, the security coefficient of plantation structure in Yimeng mountainous area was close to the interval of low security degree, which indicated that in 2006, the plantation structure would go to the adjust elastic interval. From 2003 to 2008, the comprehensive evaluation coefficient of plantation in this area keeps the upward trend, but the range is small, which indicates that the measures taken by the government are not strong enough, so the government should strengthen the structural adjustment.

2.3.2.2 Livestock breeding. The indicators including the output of meat, milk, bird's egg and aquatic products and the average output of the nation are chosen to evaluate the structure of livestock breeding of Yimeng mountainous area. The results of the evaluation can be seen on Table 6.

It can be seen from Table 6 that from 2003 to 2008, the comprehensive evaluation coefficient of the livestock breeding structure in Yimeng mountainous area was from 3.996 961 to 4.626 95, which indicates that the livestock breeding in Yimeng mountainous area stays at the area with low security degree. According to the evaluation standard of security coefficient, the structural fundament of livestock breeding in the interval is lower than that in the area with high security degree, but there is still elasticity for adjustment. If the government adopts reasonable measures to adjust and allocate the structure of livestock breeding in Yimeng mountainous area, the elasticity space could be expanded. However, from 2003 to 2008, the comprehensive evaluation coefficient of plantation structure in the area showed the downward trend, especially from 2005 to 2007, its range of downward trend is wide. But on the whole, the effort paid by the government to adjust the livestock breeding in the area works^[5].

2.3.2.3 Forestry. The evaluation on the forestry structure of Yimeng mountainous area chooses the newly added area of economic forests, the newly added area of shelter belt forest, newly added area of timer forest and the newly added area of national average forest as the indicators. The results of the evaluation can be seen on Table 6.

It can be seen from Table 6 that from 2003 to 2008, the comprehensive evaluation coefficient of forestry structure is

from 3. 875 641 to 4. 987 546. It indicates that the forestry structure in Yimeng mountainous area stays on the area with general low security degree. According to the evaluation standard of security coefficient, the forestry structure has relatively large elastic space. The government should adopt the reasonable measures to adjust and allocate the structure of forestry in Yimeng mountainous area to enlarge its elastic space. From 2003 to 2008, the overall change trend of comprehensive evaluation coefficient of plantation structure in the area was stable, which indicated that the adjustment range of the government to the structure of forestry was small.

3 Analysis on the correlation of the agricultural structure in Yimeng mountainous area

By using the Eviews software, the correlation of agriculture in Yimeng mountainous area and its internal structure and the correlation among the internal structure are analyzed. The following indicators are adopted: the evaluation coefficient of overall agricultural structure (*SINY*), the evaluation coefficient of plantation structure (*SIZZ*), evaluation coefficient of livestock breeding (*SIYZ*) and evaluation coefficient of forestry structure (*SILY*). The specific statistics can be seen on Table 7.

Table 7 Correlation coefficient of the comprehensive evaluation on agriculture and its internal structure in Yimeng mountainous areas from 2003 to 2008

Year	<i>SINY</i>	<i>SIZZ</i>	<i>SIYZ</i>	<i>SILY</i>
2003	3. 424 300	2. 626 696	3. 996 961	4. 236 540
2004	3. 424 355	2. 656 527	4. 610 751	3. 875 641
2005	3. 473 750	2. 663 243	4. 626 951	4. 012 341
2006	3. 399 730	2. 830 488	4. 336 945	4. 147 890
2007	3. 335 980	2. 815 228	4. 185 375	4. 987 546
2008	3. 349 071	2. 735 397	4. 366 779	4. 256 492

By using the evaluation coefficient on Table 7, the correlation coefficient matrix of each indicator can be calculated by using the Eviews software (Table 8).

Table 8 Correlation coefficient matrix of each indicator

Indicator	<i>SINY</i>	<i>SIZZ</i>	<i>SIYZ</i>	<i>SILY</i>
<i>SINY</i>	1	−0. 668 213 3	0. 443 275 7	−0. 745 276 1
<i>SIZZ</i>	−0. 668 213 3	1	−0. 153 838 0	0. 581 457 2
<i>SIYZ</i>	0. 443 275 7	−0. 153 838 0	1	−0. 590 298 4
<i>SILY</i>	−0. 745 276 1	0. 581 457 2	−0. 590 298 4	1

It can be seem from Table 8 that, the overall agricultural structure in Yimeng mountainous area is in negative correlation to the plantation structure and forestry structure, but it is in positive correlation with positive livestock breeding; the plantation structure in Yimeng mountainous area is in negative correlation to the livestock breeding, but in positive correlation to forestry structure; the forestry structure is in negative correlation to the livestock breeding.

4 Discussions and suggestions

The agricultural structure of Yimeng mountainous area is unreasonable, so it is necessary to adjust it. It is showed that whenever from the perspective of the comprehensive evaluation of overall agricultural structure or the internal structure of agriculture, its security coefficient of comprehensive evaluation is from 2. 626 696 −4. 987 546, which is not in the area with high security degree, so it is necessary to adjust it.

The agricultural structure of Yimeng mountainous area has the elastic space for adjustment from no matter the overall or the internal aspects ($2 < SI < 5$), so it is feasible to adjust it. At the same time, the mutual relations among each internal structure should be taken into consideration when adjusting agricultural structure in Yimeng mountainous area. In the first place, the structure of livestock breeding should be adjusted firstly when adjusting agricultural structure in Yimeng mountainous area (the correlation coefficient is 0. 443 275 7), the plantation structure can not be adjusted (correlation coefficient is −0. 668 213 3) and forestry structure (the correlation coefficient is −0. 745 276 1). If the government adjusts the structure of plantation and the structure of forestry simultaneously, the effects would be bad and even no effectiveless. In the second place, the adjustment of plantation structure and the adjustment of forestry structure in Yimeng mountainous area is in positive correlation (the relevant correlation coefficient is 0. 581 457 2), which indicates that the adjustment of plantation structure in Yimeng mountainous area is favorable to the adjustment of forestry structure or the adjustment of forestry structure in Yimeng mountainous area is favorable to the adjustment of plantation structure. The two aspects are complementary. In the third place, the adjustment of forestry structure in Yimeng mountainous area goes against the adjustment of the stock breeding structure, the two aspects show negative correlation (correlation coefficient is −0. 590 298 4), therefore, when adjusting the structure of the two aspects, the contradictory elements of the two parties should be taken into consideration.

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