Analysis on Internal Growth Potential of Agriculture Under the Agricultural Structure Adjustment in Xinjiang

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Abstract Agricultural structure adjustment has always been the important factors influencing Xinjiang agricultural internal income growth. On the basis of the planting scale, productivity and price in 2010, the paper measured the contributions made by agricultural structure adjustment to Xinjiang agricultural internal income growth through structural optimization. Linear programming model was established by Lingo software, to optimize the structure of planting, horticulture, animal husbandry in Xinjiang and analyze the internal agricultural income growth potential. After structure optimization, Xinjiang agricultural production value will reach 1231.44×10^8 yuan and the farmers' income of production and management will reach 9851yuan. The greatest potential for Xinjiang agricultural internal income growth was husbandry accounting for 41.33% of the total production value. The next one was horticulture, whose share of the total production value has raised to 17.43% from 10%. Fruit industry and animal husbandry will become the pillars of future income growth. There are still some income growth spaces in Xinjiang internal agriculture though the agricultural structure adjustment. The agricultural production value will increase by 44.32% and farmers' production and management income will increase by 68.83%. That will be one of the most important ways to tap the future potential of agriculture internal income growth.

Key words Xinjiang, Agricultural structure adjustment, Internal agriculture, Income growth potential

At present, agriculture in China is experiencing the transformation from traditional agriculture to modern agriculture and it is facing the bottleneck of increasing farmers' income. How to determine and fully tap the internal development of Xinjiang agriculture to solve the problems of decreasing agricultural efficiency, low income level, widening gap between farmers' income level of Xinjiang and that of the whole nation, tapping the agricultural efficiency potential and optimizing the role played by agricultural production system in ecomomic development and farmers' income growth, has become a major issue faced by Xinjiang in agricultural development research. Fully tapping the internal agriculture income growth potential has become one of the major ways to promote rural economic development and increase farmers' income, which is helpful to promote agricultural structure adjustment. The process of tapping income growth plays a positive role in the transformation of agricultural growth mode and agricultural modernization. In 2007, the rural work conference document of autonomous region party committee had clearly proposed that Xinjiang possessed great agriculture internal income growth potential. As one of the food safety reserve bases and important commodity cotton bases in China, how to make rational distribution of grain, cotton, fruit, animal husbandry under the premise of ensuring national food security and how to push forward the predominance regional planning of agricultural products, further develop the agriculture with local characteristics and improve the quality and safety of agricultural products and market competitiveness, are the problems that must be solved in the Xinjiang agricultural industry structure adjustment. Besides, these problems provide crucial ways for tapping agricultural internal income growth potential. There are many researches on quantitative and qualitative analysis of the agricultural structure adjustment[1-2] and qualitative analysis of agricultural internal income growth potential[3-5], but the quantitative research on the internal income growth potential of agriculture is absent. Based on the theory of system engineering, the paper optimized the Xinjiang agricultural production structure and accounted the potential considering nature, water and soil, productivity condition, *etc.* as a whole.

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1 Materials and Methods

1.1 Research method Build the linear programming model by using the Lingo software [6]. The flow chart was shown as Fig. 1.

1.2 Model building

1.2.1 Objective Function. According to the goal of this research, the model set the output increment maximization as the goal function, which can be expressed as follows:

$$\text{Max}\triangle Z'(t) = \triangle V'_1 + \triangle V'_2 + \triangle V'_3 + \triangle V'4 \quad (1)$$

where $\triangle V'$ represents each output increment. Of which 1 representsfarming, 2 represents animal husbandry and aquatic product, 3 represents services of farming, forestry, animal husbandry and fishery. Among those:

$$\triangle V' = V_i - V_i^0 \quad (2)$$

Wherein V_i represents Output Prediction, V_i^0 represents the present production;

$$V_{1,2} = \sum_{i=1}^{m}\sum_{j=1}^{n} S_{ij}(t) \times E_{ij}(t) \times P_{ij}(t) ; \quad (3)$$

$$V_{3,4} = \sum_{i=1}^{m}\sum_{j=1}^{n} V_{ij}(t) \times r_{ij}(t); \quad (4)$$

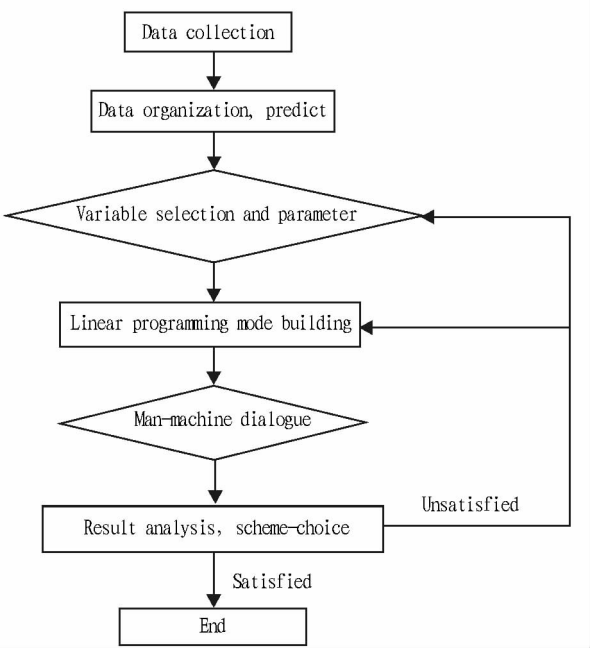

Fig. 1 Technical model flow

Wherein: $S_{ij}(t)$ represents the planting area or the number of livestock in the t time and in one state; $E_{ij}(t)$ represents the yield per unit of agricultural and animal products in the t time and in one state; P_j represents the production value in the t time and in one state; $r_{ij}(t)$ represents the growth rate of t period. $i=1,2,3,\cdots 14$, represent the 14 states. j represent crop species and livestock: wheat, red jujube, sheep and so on.

1.2.2 Constraint Condition. To make the model to compute, propose the constraint conditions as follows:

Total planting area in Xinjiang:

$$\sum_{i=1}^{m}\sum_{j=1}^{n} S_{ij}(t) \leqslant LS_{ij}(t) \quad (5)$$

In Eq. 5: LSij (t) represents the biggest limit area of the whole Xinjiang crops in a certain period of time;

The total planting area of all the states:

$$\sum_{j=1}^{n} S_{ij}(t) \leqslant LS_i(t) \quad (6)$$

In Eq. 6: $LS_i(t)$ represents the biggest limit area of crops of one state in a certain period of time;

The areas of different crops

$$\sum_{i=1}^{m} S_{ij}(t) \leqslant LS_j(t) \quad (7)$$

In Eq. 7: $LS_j(t)$ represents the biggest limit area of some crop of the whole Xinjiang in a certain period of time;

The maximum raising number of livestock = $\sum_{i=1}^{m} S_{ij}(t) \times (1 + Ra(t)/2) \leqslant 1.2$ a hundred million standard livestock (8)

In Eq. 8: $Ra(t)$ represents the slaughter rate; the standard number of 120 million is maximum load – bearing capacity of the Xinjiang meadow;

Available forage grass which can be used for livestock breeding ⩽ natural pasture + artificial grassland + wheat, corn, straw

Available fodder for livestock ⩽ corn + bran + soyabean

Each crop's planting area of every state, scale of livestock and aquaculture ⩾ present scale

Meanwhile, this paper assumed the plans are as follows: (1) Planting scale to maintain the status quo, that is, keep the planting scale 574.39 × 10^4 hm^2 (86.1591 million acres), of which crops, fruit and animal husbandry scale can be determined by optimization. (2) The price and per unit area yield of agricultural products both maintain the status quo. (3) The loss rate in the agricultural product production is between 10% to 15%. (4) Set the minimum of agricultural product output.

2 Result and Analysis

2.1 Model simulation results By establishing linear programming model and using the Lingo software, this paper optimized the Xinjiang agricultural internal structure and the agricultural production and operation production value will reach 1231.44 × 10^8 yuan, marking an increase of 545.79 × 10^8 yuan over 2009, with the increase of 79.60 % from 2009, in which, farming production value reached 482.22 × 10^8 yuan, 52.88% of the total agriculture production value, 17% lower than the status quo, of which, fruit industry production value reached 169.02 × 10^8 yuan, 13.73% of the total agriculture production value with the potential of a new 17.066 billion yuan; Animal husbandry production value reached 500.96 × 10^8 yuan, 40.68% of the total agriculture production value, 16% than the status quo, with the potential of a new 33.541 billion yuan. Forestry production value reached 41.77 × 10^8 yuan, 3.39% of the total agriculture production value, with the potential of a new 27 × 10^8 yuan; Fishery production value reached 3.04 × 10^8 yuan, 0.25% of the total agriculture production value, with the potential of a new 0.33 × 10^8 yuan; Service industry production value reached 34.43 × 10^8 yuan, 2.80% of the total agriculture production value, with the potential of a new 11.72 × 10^8 yuan.

Agricultural output has been greatly improved after the structure optimization, with the total output of 8544 × 10^4 tons. Among them, grain, cotton, oil and other agricultural output reached 6051.31 × 10^4 tons, the grain output of which reached 2008 × 10^4 tons, marking an increase of 721 × 10^4 tons over 2009; Cotton output reached 310.78 × 10^4 tons, marking an increase of 59 × 10^4 tons over the status quo. Fruit products output reached 838.91 × 10^4 tons, marking an increase of 373 × 10^4 tons than 2009. Livestock production reached 2485.14 × 10^4 tons, marking an increase of 2217 × 10^4 tons more than 2009. Output of aquatic products reached 7.8 × 10^4 tons, marking an increase of 0.46 × 10^4 tons over 2009.

Farmers' production and operation income reached 9 851 yuan after the agricultural structure optimization, marking an increase of 6 781 yuan over 2009. Wherein, crop farming income reached 5 210 yuan, 3 069 yuan in new revenue, fruit industry income of which reached 1 352 yuan, 752 yuan in new revenue; animal husbandry income reached 4 008 yuan, 3 490 yuan in new revenue; forestry income reached 334 yuan, 202 yuan in new revenue; fishery income reached 24 yuan, 4 yuan in new revenue; service industry income reached 275 yuan, 16 yuan in new reve-

nue. (Table 1)

It can be seen that Xinjiang agricultural structure adjustment played a crucial role in improving agriculture efficiency and farmers' income growth.

Table 1 The Income Growth Potential of Structural Adjustment

Items	Total	Farming			Forestry	Animal husbandry	Fisheries	Service industry
		Subtotal	Food cash crops	Forestry and fruit industry				
Total Production(10^4 t)	8 544	6 051.34	5 212.43	838.91		2 485.14	7.81	
Total value(10^4 yuan)	12 314 469	6 512 400	482 2236	1 690 164	417 686	500 9574	30 455	344 354
Newly added value(10^4 yuan)	5 457 869	1 706 600			276 586	335 4074	3 355	117 254
Income(yuan)	9 851	5 210		1 352	334	4008	24	275
Newly added income(yuan)	6 781	3 069		752	202	3490	4	16

2.2 Sensitivity analysis This paper took advantage of the objective function coefficient of linear programming model and the constant term, V_1 and V_2 at the right end of the constraint conditions to conduct the sensitivity analysis. The result is as follows:

2.2.1 Analysis on Cost Coefficient Variance. The original cost coefficient in the objective function V_1 was supposed to be 1, allowed to be increased by 0.459 and be reduced by 0.427, which suggested that the optimum solution remains unchanged when V_1 varied in the range [1.459, 0.573].

The original cost coefficient in the objective function V_2 was supposed to be 1, allowed to be increased by 0.39 and be reduced by 0.164, which suggested that the optimum solution remains unchanged when V_2 varied in the range [1.39, 0.863].

2.2.2 Variance Analysis of the right hand items of constraint condition. V_1 constraint item right end item was supposed to be 37217.40 and optimal basis remained the same when it varied in the range [37 217.40 − ∞ ,37 217.40 − 0.124 902 2E + 08]. V_2 constraint item right end item was supposed to be 144325.06 and optimal basis remained the same when it varied in the range [144 325.06 − ∞ ,144 325.06 − 9 633 796].

3 Conclusions

Xinjiang agricultural potential will increase by 54.579 billion yuan through the agricultural structure adjustment. Thereinto, planting potential (including horticulture) was adding about 17.06 billion yuan, the animal husbandry was 33.541 billion yuan, the forestry was 2.7 billion yuan, the fishery was 0.33 million yuan, the service industry was 1.172 billion yuan. Under the condition of the existing farming scale, structure optimization in Xinjiang led to a 79.60% increase in the production value of agricultural production and operation and a 68.83% increase in farmers' income. As the key factor of income growth, the impact of price could not be ignored and according to sensitivity analysis, the optimization's range of price variation is 0.573 − 1.459 which shows that the scheme reliability is strong.

The largest internal income potential of Xinjiang agricultural was animal husbandry, accounting for 41.33% of the total production value. The second was horticulture, accounting for 17.43% of the status total value of output from 10%. The biggest contribution to the internal value of animal husbandry were cows and the next were sheep; The biggest contribution to fruit products was the red jujube and the second are the walnuts. Each region has their own advantages: the northern Xinjiang area mainly developed animal husbandry and the southern Xinjiang area mainly developed special woods. To fully tap the Xinjiang agricultural internal income growth potential, we should strengthen the production base construction of fruit products and stockbreeding with Xinjiang scale advantage and production advantage in the future.

To sum up, structural adjustment was of great significance to tapping Xinjiang agricultural internal income growth potential and was the important way of agricultural efficiency and farmers' income growth.

4 Discussion

This paper is to the exploratory research, in which the optimization objective function of the internal agriculture was the maximum production value on the premise of ensuring the four bases construction in Xinjiang, the bearing capacity of grassland and ecological environment construction.

The minimum constraint of total grain consumption, the maximum bearing capacity of natural pasture in the research were determined according to the former studies, so the data may have, time limit. In the process of model stimulation, this paper only chose the major agricultural products and adopted the yield per unit and price of agricultural products in small size. Therefore, data collection should be more detailed in the further study.

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