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How to Adjust XPCC's Planting Structure of Grain, Cotton, Oil and Sugar?

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Abstract XPCC has long shouldered the mission of exploitation of virgin land in border area, but the special geographic distribution leads to regional segmentation and administrative division in the planting structure of grain, cotton, oil and sugar for XPCC. Since 1980, XPCC's total planting area of grain, cotton, oil and sugar has increased steadily year by year. The yield levels show a unimodal trend; the total yield of cotton has been showing a geometric growth trend; the total yield of oil crops and sugar beet shows a fluctuating growth trend, but the total yield of grain crops shows a bimodal growth trend. XPCC's grain crops are mainly in the farms of Division 4 in Ili Valley and Division 6 in Changji; cotton production in South and North Xinjiang is basically the same, and the yield in South Xinjiang is slightly higher than in North Xinjiang, but cotton can not be planted in most farms of Division 9 and Division 10; oil crops are grown mainly in cold regions; sugar beet is mainly in the farms of Division 2, Division 4, Division 7 and Division 9. Some factors are limiting XPCC's farming development such as unreasonable agricultural structure, quite different regional production levels and great grain crop yield fluctuations. Therefore, it is recommended to optimize regional distribution, increase efforts to promote new technologies, and strengthen brand building to help XPCC to give play to the agricultural resource advantages.

Key words XPCC, Grain, Cotton, Oil and sugar, Planting structure, Constraints

1 Introduction

XPCC (Xinjiang Production and Construction Corps), or Bingtuan for short, is a unique economic and semi-military governmental organization in the Xinjiang Uyghur Autonomous Region of the People's Republic of China^[1]. The XPCC has administrative authority over several medium-sized cities as well as settlements and farms in Xinjiang. It has its own administrative structure, fulfilling governmental functions such as healthcare and education for areas under its jurisdiction. The Government of Xinjiang Uyghur Autonomous Region does not usually interfere in the administration of these areas. The XPCC consists of 14 divisions which are then subdivided into 185 regiment-level entities (including regiments, farms, and ranches), scattered throughout Xinjiang, mostly in previously unpopulated or sparsely populated areas. It has long played an irreplaceable role in shouldering the mission of reclamation and consolidating frontier defense, promoting national unity and developing local economy^[2]. Overall, the Altai Mountains and Kunlun Mountains are interspersed with 10 XPCC regiment-level entities; the Tianshan valley and basin are dotted with 54 regiment-level entities and the alluvial plain in the north and south of the Tianshan Mountains has 90 regiment-level entities; there are 20 regiment-level entities distributed in the wind-erosion terrain of North Xinjiang. The special geographical distribution^[3–4], as well as "vassal separatism" of soldiers and local governments, has led to regional segmentation and administrative division in the XPCC's

planting structure of grain, cotton, oil and sugar, making XPCC fail to fully play the its advantages in agricultural resources^[5]. Therefore, in the context of accelerating transformation of XPCC's agricultural development pattern and improving the industrial structure, studying the structural adjustment of grain, cotton, oil and sugar in Xinjiang has important practical significance to promoting the structural adjustment of agricultural industry, ensuring food security and promoting healthy rural economic development.

2 Evolution of XPCC's planting structure of grain, cotton, oil and sugar

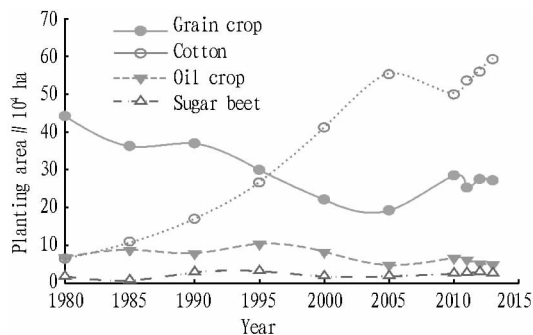
2.1 Nearly three decades of evolution of planting area of grain, cotton, oil and sugar Since 1980, XPCC's total planting area of grain, cotton, oil and sugar has shown a stable growing trend, from 593960 ha in 1980 to 939200 ha in 2013, a net increase of 345240 ha and a growth rate of 58.1%. The planting area of grain crops first declined but then climbed. In 2005, it reached the lowest point of 192060 ha, only 43% of that in 1980; after 2010, it rebounded to 270000 ha, an increase of more than 40% compared with 2005, but only 61.5% of that in 1980. Since 1980, the planting area of cotton has shown an increasing trend year by year, an increase of nine times in thirty years, and there was only a slight fluctuation in 2009 and 2010. The planting area of oil and sugar crops has remained relatively stable, but there was great volatility in some years.

2.2 Nearly three decades of evolution of yield of grain, cotton, oil and sugar Since 1980, XPCC's yield levels of grain, cotton, oil and sugar have shown a unimodal trend. The yield of grain crops has increased by three times over three decades. The yield of wheat increased from 1936 kg/ha in 1980 to 6345 kg/ha in 2013, but the increase was small during 2005–2013. The yield

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Note: Data are from *XPCC Statistical Yearbook* and Division Farm Bureau, the same below.

Fig. 1 XPCC's planting area of grain, cotton, oil and sugar in nearly 30 years

of corn increased from 2625 kg/ha in 1980 to 9230 kg/ha in 2013, and it increased greatly during 1985 – 1990. In 1980, the yield of cotton showed a stable increasing trend, from 535 kg/ha in 1980 to 2480 kg/ha in 2013. Since 2000, with the application of cotton drip irrigation and integration of water and fertilizer, the cotton yields have increased rapidly. The yield of oil crops increased from 579 kg/ha in 1980 to 3399 kg/ha in 2013, and the yield increased rapidly after 2000. The yield of sugar beet increased from 16571 kg/ha in 1980 to 81477 kg/ha in 2013, an increase of 3.9 times, but slowed down after 2000.

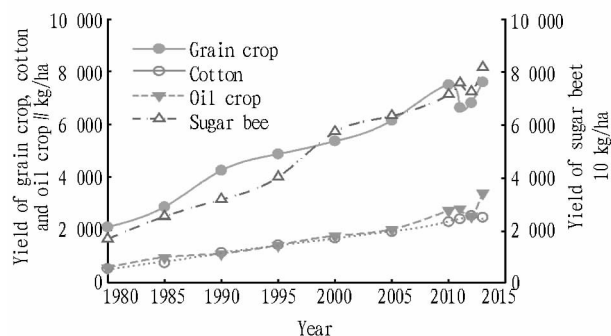


Fig. 2 XPCC's yield of grain, cotton, oil and sugar in nearly 30 years

2.3 Nearly three decades of evolution of total yield of grain, cotton, oil and sugar Since 1980, the total yield of grain crops has shown a bimodal trend, but there are great fluctuations in some years, and the first total yield peak appeared around 1990, with total yield of 2.1735 million t. After 1990, with the decrease in the planting area of grain crops, the total yield of grain crops also declined, and it decreased to 0.9435 million t during 2000 – 2005, close to the level in 1980. In 2005, with the increase in yield of grain crops and planting area of corn, the total yield of grain crops gradually increased. After 2000, it basically reached more than 2 million t. The total yield of cotton always showed a geometric growth trend, and increased slowly after 2005. From 1980 to 2003, oil crops showed a fluctuating growth trend, but it declined significantly from 2004 to 2007, and with the increase in planting area and yield of oil crops, the total yield of oil crops reverted to a record high level after 2008. The total yield of sugar

beet showed a rapid growth trend during 1985 – 1990, while the total yield of sugar beet showed a fluctuating growth trend after 1990.

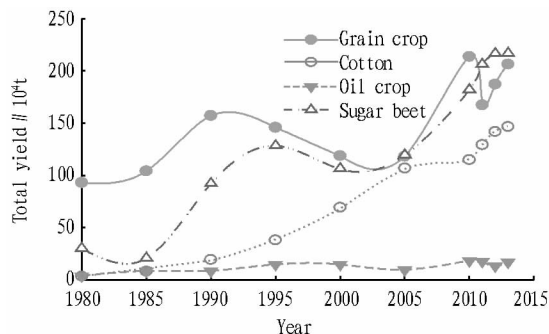


Fig. 3 XPCC's total yield of grain, cotton, oil and sugar in nearly 30 years

3 XPCC's planting of grain, cotton, oil and sugar

3.1 Planting of grain crops In the past five years, the planting area and total yield of grain crops have been largest and highest in Division 4 which is located in the Ili River valley, accounting for 20.04% and 27.17%, respectively, followed by Division 6 which is located in Changji, accounting for 19.04% and 22.51%, respectively. The planting area and total yield of eight divisions in North Xinjiang account for 77.08% and 82.67%, respectively; the planting area and total yield of four divisions in South Xinjiang account for 21.24% and 15.67%, respectively; the planting area and total yield of Division 13 in East Xinjiang account for 1.68% and 1.66%, respectively. The yield is highest in Division 1 and 6, higher than 8000 kg, followed by Division 4 and Division 7, and the yield is lowest in Division 14 in Hotan. To sum up, XPCC's grain crop production in North Xinjiang is mainly concentrated in the cold Ili River valley and the Qitai area; the size of XPCC is small in South Xinjiang and East Xinjiang featuring cotton and characteristic fruits, and the planting area of grain crop is small.

3.2 Planting of cotton Over the past five years, the planting area and total yield of cotton have been largest and highest in Division 8, accounting for 28.04% and 28.14%, respectively, followed by Division 1 which is located in Aksu, accounting for 22.33% and 23.97%, respectively. In North Xinjiang, Division 9 does not plant it; only Corps 184 in Division 10 plants a small amount of cotton; Division 12 around Urumqi also plants a small amount of cotton. For seven divisions in North Xinjiang, the cotton planting area and total yield account for 59.43% and 58.28%, respectively; for four divisions in South Xinjiang, the cotton planting area and total yield account for 38.78% and 39.81%, respectively; for Division 13 in East Xinjiang, the proportion is only 1.79% and 1.94%, respectively. For Division 5 in Bole, the cotton yield per hectare is highest (2717 kg), followed by Division 2 and 13 (higher than 2600 kg); for Division 10 and 12, the cotton yield per hectare is lower than 1500 kg. In summary, XPCC's cotton production in South and North Xinjiang is basically the same, and the production level in South Xinjiang is high-

er than in North Xinjiang, possibly due to long growing season of crop and high accumulated temperature in South Xinjiang; for some farms of divisions in North Xinjiang, the effective accumula-

ted temperature is low, unable to meet the cotton growth demand, so Division 9 and Division 10 (except Corps 184) do not plant cotton.

Table 1 XPCC's planting of grain crops

Unit	Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7	Division 8	Division 9	Division 10	Division 12	Division 13	Division 14
Planting area//10 ³ ha	22.66	9.66	22.20	64.51	14.53	51.07	20.45	17.84	27.39	8.24	2.76	4.51	2.50
The proportion of planting area in XPCC//%	8.44	3.6	8.27	24.04	5.42	19.04	7.62	6.65	10.21	3.07	1.03	1.68	0.93
Total yield//t	133103	57997	88353	501588	94867	415496	158183	109855	173893	55300	16881	30565	9778
The proportion of total yield in XPCC//%	7.21	3.14	4.79	27.17	5.14	22.51	8.57	5.95	9.42	3.00	0.91	1.66	0.53
Yield per hectare//kg	8242	6009	5103	7704	6537	8141	7560	6151	6301	6577	5801	6786	4047

Table 2 XPCC's planting of cotton

Unit	Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7	Division 8	Division 9	Division 10	Division 12	Division 13	Division 14
Planting area//10 ³ ha	22.66	9.66	22.20	64.51	14.53	51.07	20.45	17.84	27.39	8.24	2.76	4.51	2.50
Planting area//103 ha	121.87	33.00	55.83	12.31	34.66	60.95	55.89	152.99	0.00	7.23	0.32	9.75	0.93
The proportion of planting area in XPCC//%	22.33	6.05	10.23	2.25	6.35	11.17	10.24	28.04	0.00	1.32	0.06	1.79	0.17
Total yield//t	313861	66275	139141	22760	94156	136782	129487	368473	0	10464	465	25420	1942
The proportion of total yield in XPCC//%	23.97	5.06	10.63	1.74	7.19	10.45	9.89	28.14	0.00	0.80	0.04	1.94	0.15
Yield per hectare//kg	2575	2656	2487	1831	2717	2233	2304	2416	0	1439	1372	2604	2081

3.3 Planting of oil crops XPCC plants oil crops mainly in the cold areas. For Division 4 in the Ili River valley, Division 10 in Altay and Division 9 in Tacheng, the planting area of oil crops accounts for 38.66% , 21.17% and 11.57% , respectively, and the total yield accounts for 36.18% , 22.56% and 7.35% , respectively. The combined planting area and total yield of the three divisions account for 71.39% and 66.10% , respectively. For Division 1, 2, 3 and 14 in South Xinjiang and Division 13 in East

Xinjiang, the total planting area is less than 1000 ha, and the total yield is only 2777 t, accounting for 1.62% and 1.69% , respectively. For Division 3, 6, 7, 8 and 10, the yield per hectare is higher than 3000 kg; for Division 1 and 9, the yield per hectare is lower than 2000 kg. In summary, XPCC's oil crops are mainly produced in the cold areas of North Xinjiang; due to small area of corps in South Xinjiang and East Xinjiang featuring cotton and characteristic fruits, the planting area of oil crops is small.

Table 3 XPCC's planting of oil crops

Unit	Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7	Division 8	Division 9	Division 10	Division 12	Division 13	Division 14
Planting area//10 ³ ha	0.09	0.31	0.28	22.27	2.90	5.72	5.06	1.15	6.67	12.20	0.72	0.15	0.11
The proportion of planting area in XPCC//%	0.15	0.54	0.49	38.66	5.03	9.92	8.79	1.99	11.57	21.17	1.25	0.26	0.18
Total yield//t	178	803	1181	59512	7222	21105	15891	5880	12095	37115	2885	414	202
The proportion of total yield in XPCC//%	0.11	0.49	0.72	36.18	4.39	12.83	9.66	3.57	7.35	22.56	1.75	0.25	0.12
Yield per hectare//kg	1995	2584	4077	2696	2499	3755	3439	4493	1782	3051	2714	2815	2173

Table 4 XPCC's planting of sugar beet

Unit	Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7	Division 8	Division 9	Division 10	Division 12	Division 13	Division 14
Planting area//10 ³ ha	0.00	4.68	0.00	5.53	2.22	0.79	3.80	0.13	8.49	1.48	0.07	0.00	0.00
The proportion of planting area in XPCC//%	0.00	17.21	0.00	20.33	8.15	2.91	13.98	0.48	31.23	5.45	0.26	0.00	0.00
Total yield//t	0	383512	0	477182	147403	66827	332905	5363	520110	111775	4773	0	1
The proportion of total yield in XPCC//%	0.00	18.71	0.00	23.28	7.19	3.26	16.24	0.26	25.37	5.45	0.23	0.00	0.00
Yield per hectare//kg	0	81998	0	86521	57115	85452	87603	47651	61322	74991	34291	0	188

3.4 Planting of sugar beet XPCC's sugar beet is mainly planted by Division 2 in South Xinjiang and Division 4, 7 and 9 in

North Xinjiang. Both the total planting area and total yield of sugar beet in the four divisions are more than 80% in the entire XPCC. The planting area and total yield of Division 9 account for 31.23% and 25.37%, respectively, but Division 1, 3 and 14 in South Xinjiang and Division 13 in East Xinjiang do not plant sugar beet; for the other five divisions in North Xinjiang, the planting area and total yield are at a low level. For Division 2, 4, 6 and 7, the yield per hectare is higher than 80000 kg, but the yield per hectare of Division 9 with the largest planting area of sugar beet, is only 61322 kg, having great room for improvement.

4 The problems in XPCC's planting of grain, cotton, oil and sugar

4.1 Unreasonable agricultural industry structure XPCC's planting area of cotton accounts for 62.91% of that of four crops, and 50.32% of that of all crops; the planting area of grain crops accounts for 28.89% of that of four crops; the planting area of oil crops and sugar accounts for 5.37% and 2.83% of that of four crops, respectively. The internal proportion of grain, cotton, oil and sugar industries is unbalanced, and the proportion of oil and sugar is very low. In accordance with the basic principles of "stabilizing grain, optimizing cotton, increasing fruits, developing animal husbandry, and vigorously developing processing of agricultural products"^[6], it is necessary to further adjust and optimize the planting structure.

4.2 Quite different regional production levels The yield of grain crops per hectare is highest in Division 1 (8242 kg), and it is 5103 kg and 4047 kg in Division 3 and 14, respectively, a difference of more than 3000 kg; the yield is more than 2600 kg in Division 5, 2 and 13, while the yield is less than 1500 kg in Division 10 and 12; the yield of oil crops per hectare is more than 4000 kg in Division 3 and 8, while it is less than 2000 kg in Division 1 and 9; the yield of sugar beet per hectare is more than 80000 kg in four divisions, but it is only 61322 kg in Division 9 with the largest growing area of sugar beet. The "vassal separatism" of soldiers and local governments has led to regional segmentation and administrative division in the XPCC's planting structure, which restricts the overall improvement of XPCC's farming level.

4.3 Great fluctuations in grain crop yield In the past decade, the highest total yield of grain crops was 2.1735 million t while the lowest total yield of grain crops was 0.9453 million t in XPCC. However, XPCC's total population always remains at 2.5 million to 2.6 million, and the total grain output instability will affect XPCC's food security. Therefore, under the premise of ensuring self-sufficiency and keeping a slight surplus, it is necessary to stabilize the planting scale of grain crops and improve the level and efficiency of cultivation.

5 Recommendations

5.1 Optimizing regional distribution and adjusting industrial structure In accordance with the basic principles of "stabilizing

grain, optimizing cotton, increasing fruits, developing animal husbandry, and vigorously developing processing of agricultural products", it is necessary to give play to the obvious advantages of XPCC's agricultural products in the domestic market and optimize the regional distribution of agricultural products based on market demand, industrial development and actual production conditions^[8]. At the same time, it is necessary to adjust the product structure, introduce and promote high quality varieties suitable for local areas, continuously improve the yield and quality of agricultural products, integrate the agricultural resources and industry cluster with characteristics, and accelerate the transformation of agricultural operating mode.

5.2 Increasing efforts to promote new technologies According to the regional planting structure, it is necessary to strengthen the promotion of drip irrigation under film and integration of water and fertilizer in the main grain and oil crop producing areas such as Qitai, Zhaosu and Taer. It is necessary to establish the full cotton mechanization extension base and promote the mechanized harvest, cleaning and processing technology and equipment, in the key cotton producing divisions and corps. In the grain and oil crop producing areas, there is a need to accelerate the full crop mechanization, and promote no-till conservation tillage, mulching, returning straw to field, rainwater harvesting for irrigation and other modern agricultural technologies, in order to preserve moisture and fertility of soil and raise cropland production level^[9-10].

5.3 Strengthening brand building It is necessary to conduct a survey of the geographical indication agricultural products in the distribution areas of special and excellent crops, develop production and technological standards, and determine the unique quality characteristics, product quality and safety, packaging and labeling. This will promote the reporting of geographical indication agricultural products and propel the formation of XPCC's brands with geographical characteristics. It is necessary to build unified XPCC brand^[11], develop scientific, standardized and systematic brand planning and brand promotion programs, and rely on the demonstration of the producing areas with superior advantages to accelerate the modernization of XPCC's farming.

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information can not effectively solve the technical difficulties of these farmers. Meanwhile, the results of relevant research institutions are not efficiently applied, and extension services are difficult to produce new scientific and technological achievements. Under the traditional mode of extension, the technical problems encountered in the work are not timely fed back to the scientific research departments, resulting in low conversion rate of food science and technology information.

5 Recommendations

5.1 Vigorously promoting the production-learning-research cooperation model and promoting scientific research to be closely combined with economic development

There are a lot of researches annually on food production in Hubei, but they are rarely used in the actual production. Firstly, the research evaluation mechanism must be improved and innovated, and there is a need to attach importance to the actual ability to apply. Secondly, it is necessary to integrate and reasonably allocate the existing food science and technology resources, vigorously promote collaborative innovation model of production and research, strengthen mutual cooperation between universities or research institutions and enterprises, and fully improve benefit-sharing and risk-sharing awareness of universities, enterprises and research institutions, to closely combine scientific research with economic development.

5.2 Innovating food science and technology management system and guiding the direction of development of food science and technology

To guarantee the smooth progress of food science and technology innovation, we must improve and innovate the management mechanism of food science and technology, which is a prerequisite for promoting the effective implementation of food science and technology innovation. Firstly, since food science and technology personnel are the main subject of food of technological innovation, it is necessary to fully mobilize the enthusiasm of the food science and technology personnel to create a good working environment, stimulate their potential and innovate talent evaluation and incentive mechanism. Secondly, as a carrier of the whole management activities of food technological innovation, management organization plays a role in the integration and allocation of resources, as well as assignment of personnel^[5]. It is necessary to optimize the management structure to improve decision-making efficiency, construction quality and professional management team. Finally, it is necessary to innovate food science and technology management system, and scientific research departments at all lev-

els need to cooperate with each other to coordinate and guide the rational flow of scientific and technological resources for food industry, and increase research funds to promote food science and technology innovation.

5.3 Increasing food science and technology promotion service platform and establishing diversified promotion body

Food science and technology promotion department, as an important support system of food science and technology innovation, needs to develop its platform. Firstly, it is necessary to make full use of technology to enhance service capability of food science and technology promotion department, and vigorously promote the rural construction. Secondly, it is necessary to strengthen the linking between various food innovation entities, increase scientific and technological exchanges and cooperation between researchers, industries, or regions, and provide technical guidance and information services, to promote food science and technology innovation. Finally, it is necessary to establish a diversified extension system in food science and technology promotion agencies. Cooperative organizations in rural areas, food research and education institutions, food associations and nonprofit organizations can be developed for the promotion of science and technology^[6]. There is a need to increase efforts to promote food science and technology and strive to make every farmer enjoy the income from food science and technology innovation.

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