How to reduce the cost of cotton cultivation? A Case Study of Xinjiang, China

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Abstract

The competitiveness of cotton in Xinjiang, China's largest cotton-growing region, is declining due to rising cultivation costs. The purpose of this paper is to find strategies to reduce the cost of cotton cultivation by analyzing the relationship between material cost and profit and comparing the cost of hand-picked cotton and machine-picked cotton. The results showed that under 5% significance, the net profit of Xinjiang had a negative correlation with chemical fertilizers and pesticides and a positive correlation with farm manure. In 2018, the total cost of cotton picking by machine in Xinjiang was 35.85% lower than that by hand. In the future, Xinjiang cotton cultivation should reduce the input of chemical fertilizer and pesticide, increase the input of agricultural fertilizer; at the same time, promote mechanical cotton harvesting, accelerate the construction of integrated system of mechanical cotton harvesting technology, achieve the goal of reducing costs and increasing profits, and improve the competitiveness of Xinjiang cotton.

Keywords: Xinjiang. Cotton. Cost. Hand-picked cotton. Machine-picked cotton

1. Introduction

Cotton is an important cash crop in developing countries (Sharma S K, Bugalya K.,2014). Cotton is an important industrial raw material and economical crop in China. It involves the income of nearly 100 million cotton farmers and the employment of over 20 million textile workers (Yu Shuxun, et al.,2015). The cotton planting area in Xinjiang in 2014 accounted for 46.77% of China's total cotton planting area in 2014, which increased to 69.41% in 2017. The total cotton production in China increased from 58.37% in 2014 to 80.77% in 2017. From the two aspects of planting area and yield, Xinjiang has become the

most important cotton planting area in China (China Statistical Yearbook,2015-2018).

Cotton is an important part of Xinjiang's economic and social development, and cotton planting is the main source of income for farmers in Xinjiang. The local cotton planting areas in Xinjiang are mainly distributed in more than 60 counties (cities) in southern and northern Xinjiang. More than 90% of counties (cities) in southern Xinjiang grow cotton. About 35% of farmers' per capita net income comes from cotton planting, and the main production areas account for 50-70% (Jin Wei,2014).

With the rapid development of urbanization and industrialization in China, a large number of the rural labor force to urban work and life. Traditional cotton planting belongs to labor-intensive industry, which leads to the shortage of labor supply and demand, the rise of labor costs, and the gradual weakening of the competitiveness of the cotton industry. At the same time, after China's entry into WTO, the price of cotton has been affected by the international market and the domestic market, and the income space for farmers to grow cotton has gradually narrowed. As the largest cotton growing area in China, Xinjiang is also an economically underdeveloped area with a large number of poor people, most of the state-level poverty-stricken counties in Xinjiang are located in the three prefectures of southern Xinjiang (Zhu Jinhe and Cui, Dengfeng,2011). Cotton planting is one of the industrial supports to solve the poverty problem in Xinjiang. So it is particularly urgent to reduce cotton planting cost and improve cotton competitiveness. This is very important for the livelihood of farmers in Xinjiang and the stable development of China's economy and society.

In this study, Xinjiang is taken as the research area. By combining statistical data and comparing Hand-picked cotton with Machine-picked cotton, the cost of each link from cotton planting to harvesting is analyzed to find out the place to reduce the cost of cotton production in Xinjiang. At the end of the paper, the research conclusions are summarized and the countermeasures and suggestions for reducing the cotton production cost in Xinjiang are put forward.

2. Literature Review

Cost is a significant aspect of measuring cotton competitiveness. Studies on the cost and competitiveness of cotton cultivation in various countries or regions in the world are as follows: Oliveira, J.R. DE.et.al (2012) studies show that environmental costs have a great impact on the economic performance of cotton production enterprises in Southern Mato Grosso. When making decisions, cotton production enterprises must consider environmental

costs and their impact on cotton production costs. Elepu G and W. Ekere(2013)studies that organic cotton in Uganda is more cost-return competitive than traditional cotton. Tian Liwen (2016) believes that the cost of cotton planting in Brazil is only 16,000 yuan per hectare, while the lowest cost of cotton production in Xinjiang is 25,000 yuan per hectare (excluding opportunities and social responsibility). The cost of cotton production in Brazil is much lower than that in Xinjiang. Dalazoana, F.M. de L.; Binotto, E.; Lopez, A.V.; Gimenes, R.M.T(2017) research shows that the main source of cotton yarn production cost is the cost of cotton raw materials. Semerci, A.; Çelik, A.D. (2018) taking cotton production in Hatay province of Turkey as an example, the impact of agricultural subsidies on cotton production cost was analyzed.

The representative studies on the cost-benefit analysis of cotton planting in China are: Pang Shoulin (2006) compared the differences in the cost structure of cotton production between China and the United States. It was suggested that China should increase investment in science and technology in cotton production to promote the development and use of cotton planting machinery. Based on the data from 1999 to 2011, Zhang Lijie and Wang Bin (2013) believes that the change of China's cotton price is related to the change of domestic cotton production, but has little correlation with the change of world cotton production. The cotton price fluctuation coefficient has no significant correlation with domestic and international cotton output, indicating that the cotton price fluctuation is irrelevant to the total cotton output at home and abroad. There is a significant positive correlation between cotton price and production cost. ZHAI Xueling, et al. (2017) compared the costs of cotton production in China, the United States, and India and concluded that Chinese cotton was completely uncompetitive with that in the United States and India. Among them, labor costs in China and India continue to rise in the total cost of cotton production, and material and service costs continue to grow. But the American machinery operation expense is high; the material input is relatively stable, the labor cost is quite small. Although the cost of cotton production in India also increased rapidly, the total cost was low. Among the cost structure, labor cost accounts for the largest proportion.

The representative studies on the cost-benefit analysis of cotton planting in Xinjiang include:Huo Yuan, et al(2011) made an investigation and analysis on the cotton planting costs of farmers with different income levels in different regions of Xinjiang, and believed that farmers in Xinjiang should adopt mechanical operations as far as possible, such as mechanical farming, cotton picking with cotton pickers, and irrigation with drip irrigation equipment to

reduce input and increase income. Zhou Jie and Ma Qiong (2014) analyzed the change of cotton production cost per mu in Xinjiang from 2002 to 2011 and believed that the material and service costs, labor costs and production costs showed an overall growth trend, and the speed first slowed down and then increased. Tang Wen, et al. (2018) analyzed the total cost data of Xinjiang cotton from 2002 to 2016 and believed that the production cost accounted for a large proportion and was rising in the fluctuation. Material and service costs and labor costs accounted for roughly the same proportion of production costs, the latter showing an upward trend.

At present, many scholars have studied the production cost and competitiveness of cotton, including the impact of cotton production cost on cotton yarn, and the changes of input factors of various cotton production costs. But their research did not distinguish between different harvesting patterns. There are two ways to grow cotton in Xinjiang, China. One is to pick cotton by hand; the other is to pick cotton by machine. The purpose of this study is to explore the relationship between direct input cost and net profit and to compare the cost of manual cotton picking with that of machine cotton picking, so as to find a way to reduce the cost of cotton production in Xinjiang.

3. Material and Methods

Xinjiang has the natural advantages of cotton production: First, the light, heat, water and soil conditions are suitable for the growth of cotton, especially the climate in this region is dry and less rain, boll shedding and autumn rotten peach, disease and insect pests are also lighter than other regions in China; Secondly, due to the dry climate, less rain, long sunshine time and big temperature difference between day and night, Xinjiang cotton has the advantages of large boll, long fiber, white color, and excellent quality; Third, Xinjiang flat terrain, suitable for large areas of mechanical operations(Zhu Huiyi).

Machine-picked cotton is a comprehensive supporting technology of cotton production, including variety selection, research, and development, field management, defoliation, ripening, picking, hauling, cleaning and processing (Xinmin Zhao, et al.). Now in the cotton planting in Xinjiang, there have been a series of advanced planting technologies, such as automatic cotton seeding, organic liquid fertilizer, GPS UAV spraying defoliant, automatic cotton harvesting and packing, etc., which belong to the region with the highest level of cotton planting technology, informatization and mechanization in China (Cheng Wenming , et al.).

For consistency of data sources, the relevant data involved in this study are mainly from China's statistics bureau, China rural statistical yearbook, Xinjiang statistical yearbook, and compilation of China's agricultural product cost benefit.

The cost of cotton production in this paper is as follows:

$$\textit{Total cash cost} = \textit{Material cost} + \textit{Labor cost} \quad (1)$$

In China, the statistics of agricultural production cost are mainly carried out from various production links. The main production cost items of cotton can be divided into seed cost, fertilizer cost, plastic film cost, machine farming cost, pesticide cost, land contract cost, agricultural insurance cost, drip irrigation belt cost, water cost, labor cost, etc. (Huo Yuan, et al).

Net profit refers to the balance of the output value of a product minus the cost of all factors of production such as cash, goods, labor, and land investments in the production process, which reflects the net return of all resources consumed in production (National Compilation of Cost-Benefit Data of Agricultural Products,2018). The calculation formula is as follows:

$$\textit{Net Profit} = \textit{Total Output Value} - \textit{Total Cash Cost} \quad (2)$$

Total gross output value refers to the sum of the income from the sale of the main product by producers through various channels and the possible income from the retained main product (National Compilation of Cost-Benefit Data of Agricultural Products,2018).

$$\textit{Profit ratio of cost} = \textit{Total Net profit} / \textit{Total Production Cost} \quad (3)$$

Spearman correlation coefficient and Pearson correlation coefficient can measure the relationship between the two variables, but Spielman correlation coefficient can be used more widely. Spearman's rank correlation coefficient is used to measure the relationship between two variables when the data are not normal distribution (Kumar, J. A., & Abirami, S.). The calculation formula of Spearman's rank correlation coefficient is as follows:

$$r_s = \frac{1 - 6\sum_{i=1}^{n} d_i^2}{n^3 - n} \quad (4)$$

Where d_i is the difference between ranks for each x_i, y_i data pair and n is the number of data pairs (Gauthier, T. D.). The value of r_s goes from +1 to 1. If r_s = +1, it means complete positive correlation. If r_s= -1, it means a complete negative correlation (Kumar, J. A., & Abirami, S.). If r_s is equal to 0, it doesn't relationship (Prion, S., & Haerling, K. A.).

4 Results and analysis

4.1. Introduction of agricultural structure in Xinjiang

From Figure 1, we can see that the cotton planting area in Xinjiang increased gradually from 1978 to 2017, and became the largest crop in Xinjiang by 2017. The wheat planting decreased from the first crop in 1978 to the second crop in 2017. Because of the large increase of cotton planting area, corn changed from the second crop in 1978 to the third crop, and the planting area has been relatively stable.

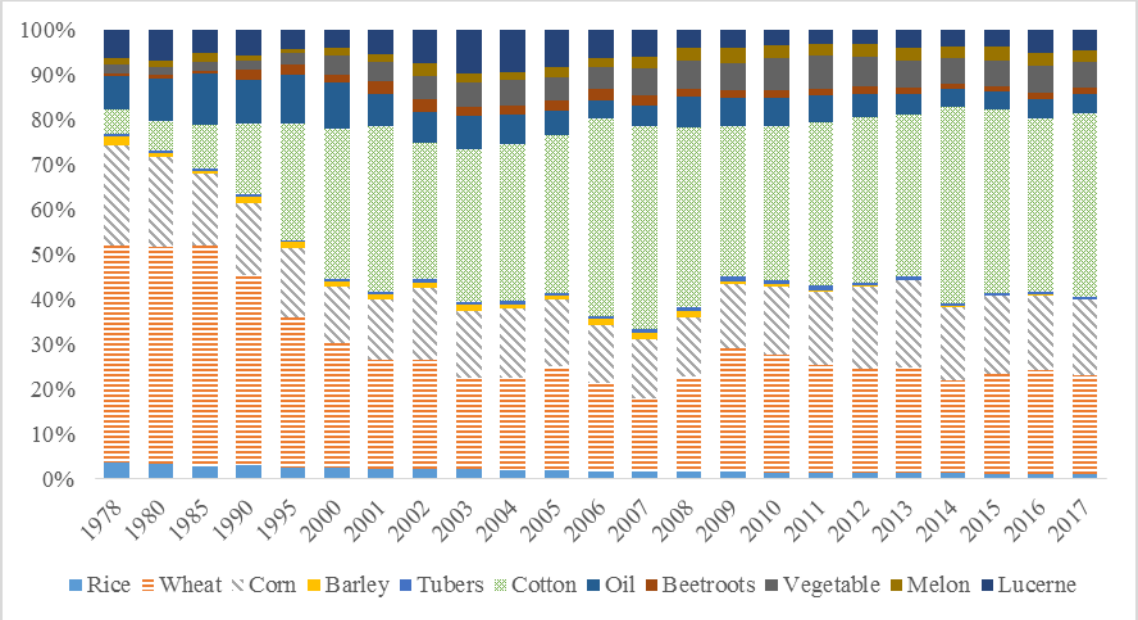

Fig. 1: Change of planting structure in Xinjiang from 1978 to 2017
Note: Data are from Xinjiang Statistical Yearbook 2018

Table 1 shows that the cotton planting area in Xinjiang in 2017 is 2217.47 hectares, accounting for 36.58% of the total crop planting area in Xinjiang, which is the largest crop in Xinjiang; the wheat planting area accounts for 19.71% and the corn planting area accounts for 15.06%.

Table 1: Comparison of Agricultural Planting Area and Proportion in Xinjiang in 1978 and 2017(1000 hectares, %)

	1978		2017	
	Area (1000 hectares)	**Share (%)**	**Area (1000 hectares)**	**Share (%)**
Rice	105.59	3,49	61,81	1,02
Wheat	1348.82	44,64	1194,95	19,71
Corn	621.39	20,56	912,89	15,06
Barley	50.01	1,66	4,63	0,08
Tubers	23.09	0,76	29,2	0,48
Cotton	150.42	4,98	2217,47	36,58
Oil	202.13	6,69	240,33	3,96

Beetroots	17.67	0,58	72,94	1,20
Vegetable	55.12	1,82	318,4	5,25
Melon	41.95	1,39	134,69	2,22
Lucerne	174.9	5,79	248,25	4,10
Others	230.58	7,63	626,51	10,33
TOTAL	**3021.67**	**100**	**6062.07**	**100**

Source: Xinjiang Statistical Yearbook 2018, p.318

4.2. Current Situation of Cotton Planting in Xinjiang

Since 2014, the target price subsidy policy for cotton started to be piloted in Xinjiang, which has become the main policy supporting cotton in Xinjiang. Considering that the data sources are almost the same under the same policy background, we select the data after 2014 for status analysis.

Table 2 shows that the cotton planting area in Xinjiang has increased from 1953.30 hectares in 2014 to 2217.47 hectares in 2017, and the proportion of planting area in China has increased from 46.77% to 69.41%. Xinjiang's cotton output rose from 3.677 million tons in 2014 to 4.566 million tons in 2017, accounting for 80.77% of China's cotton output, up from 58.37%. From the perspective of area and yield, Xinjiang has become the largest cotton planting area in China.

Table 2: Cotton sown area and yield in Xinjiang, 2014-2017(1000 hectares, 10000 tons)

Year	Aera	Yield
2014	1953.30（46.77%）	367.712（58.37%）
2015	1904.30（50.45%）	350.30（59.30%）
2016	1805.15（56.44%）	359.38（67.26%）
2017	2217.47（69.41%）	456.60（80.77%）

Note The proportion of China in brackets; Data from China Statistical Yearbook, 2015-2018.

Because the price level of each place is different, the artificial cost is very different, and the cotton and the hand mining cotton is less than the artificial cost, so we choose to analyze the relationship between the material cost and the net profit of the direct input.

Data from Table 3 exclude government subsidies. Since 2014, the cost of cotton planting per mu in Xinjiang has exceeded 2100 yuan, which is a very high-cost area. In 2015, the per capita cotton planting cost in Xinjiang decreased slightly compared with that in 2014. However, since 2015, the cost of cotton planting in Xinjiang has increased from 2140.09 yuan to 2219.49 yuan, an increase of 79.4 yuan, an obvious increase.

From the perspective of net profit, the net profit of cotton farmers in Xinjiang during the period 2014-2017 fluctuated greatly, from - 345.04 yuan in 2014 to - 653.78 yuan in 2015,

and then continued to rise, from 6.60 yuan to 93.68 yuan.

Table 3: 2014-2017 Xinjiang cotton planting cost and profit (yuan/mu, %)

Year	Total cash cost per mu	Net profit	Profit ratio of cost
2014	2193.06	-345.04	-15.3
2015	2140.09	-653.78	-30.55
2016	2151.97	6.60	0.31
2017	2219.49	93.68	4.22

Note: data comes from the compilation of national agricultural product cost and income in 2015-2018; 1mu=667m^2.

From the perspective of the Profit ratio of cost, the lowest cost profit rate of Xinjiang cotton from 2014 to 2017 was -30.55%, and the highest was 4.22% in 2017. The cost profit rate of Xinjiang cotton production fluctuated greatly, and the cost profit rate was relatively low, indicating that Xinjiang cotton has no cost comparative advantage in planting.

4.3. The correlation between material input costs and net benefits of cotton production in Xinjiang

From Table 4, the Spearman correlation coefficient shows that the net profit of cotton in Xinjiang is negatively correlated with the cost of fertilizer and pesticide below 5%. When the significant level was 5%, the net profit was positively correlated with farm manure. These factors are the main factors contributing to the net profit of cotton production in Xinjiang. There is no significant statistical relationship between the cost of other materials and net profit of cotton production in Xinjiang.

Table 4: Spearman Rank Correlations – Material input cost and Profit of Cotton Production

	Seed	Fertilizer	Farm manure	Pesticide	Film
Coefficient	-0.424	**-0.582***	**0.631***	**-0.569***	-0.499
P Value	0.131	0.029	0.016	0.034	0.069
	Irrigation and drainage	Animal fee	Fuel and power	Tools and materials	Other costs
Coefficient	-0.402	0.519	-0.459	-0.279	0.055
P Value	0.154	0.057	0.098	0.334	0.851

Note: * When the confidence level (double test) is 0.05, the correlation is significant. ** When the confidence level (double test) is 0.01, the correlation is significant.

4.4. Comparison of cotton product cost between Hand-picked and Machine-picked in Xinjiang

Although it has been 20 years since machine cotton picking was carried out in

Xinjiang, there are few systematic investigations on the production cost of machine cotton picking. In December 2018, China's national cotton market monitoring system conducted an investigation and statistics on cotton planting cost, as shown in table 4.

Hand-picked cotton: The cost of cotton planting is 1869 yuan/mu, of which the total production cost is 655 yuan/mu, the total labor cost is 1010 yuan/mu, the total cost of mechanical operation is 160 yuan/mu, and the other cost is 45 yuan/mu, accounting for 35%, 54%, 8.6% and 2.4% of the total cost, respectively. Generally speaking, the labor cost of flower picking accounts for the largest proportion, 43.3%, followed by chemical fertilizer and water and electricity costs, which are 13.4% and 10.3% respectively. Labor costs are the most expensive part of Hand-picked cotton.

Machine-picked cotton: The cost of cotton planting is 1199 yuan/mu, including 655 yuan/mu of gross production cost, 138 yuan/mu of total labor cost, 350 yuan/mu of total mechanical operation cost and 56 yuan/mu of other costs, accounting for 54.6%, 11.5%, 29.2% and 4.7% of total cost, respectively. Overall, the proportion of chemical fertilizer was the largest, accounting for 21%, followed by the cost of hydropower and machinery, accounting for 16% and 15.8% respectively. The total cost of machine-picked cotton is 35.85% lower than that of hand-picked cotton.

Table 4: Comparisons of total cotton planting costs between hand-picked cotton and machine-picked cotton in Xinjiang's own land in 2018(Yuan/mu)

	Hand-picked cotton	Machine-picked cotton	Difference
Material cost	655	655	0
Cotton seed	59	59	0
Film	56	56	0
Pesticides	96	96	0
chemical fertilizer	251	251	0
Water and electricity	192	192	0
Labor cost	1010	138	872
Field management fees	138	138	0
Irrigation Manpower Fee	61	-	61
Pick up expenses	810	-	810
Machinery operating expenses	160	350	-190
Mechanical pick-up costs	-	189	-189
Other costs	45	56	-11
Total cash cost	**1869**	**1199**	**670**

Note: US$1 = 6.8854 Yuan, China Foreign Exchange Center, December 2018;1mu=667m^2
Source: China cotton reserve information center (access reporthttps://mp.weixin.qq.com/s/b5McipPrlZ7riEZBAdz6MA)

5. Conclusion and the strategy of reducing the cotton production cost

Cotton planting is an important part of the income source for farmers in Xinjiang. In recent years, the cost of cotton planting in Xinjiang has been rising continuously. Influenced by the international and domestic markets of China, the profit of cotton planting of farmers fluctuates greatly, which affects the agricultural production and life of farmers. Reducing the cost of cotton production has become one of the important things to be faced with at present. The results show that there is a statistically negative correlation between the net profit and the fertilizer, pesticide cost in Xinjiang under the significance of 5%. There was a statistically positive relationship between net profit and farmyard manure at the significance level of 5%. The total cost of machine-picked cotton is 35.85% lower than that of hand-picked cotton.

Based on the analysis of the relationship between cotton cost and net profit in Xinjiang, and the comparison of the cost of mechanized cotton picking and manual cotton picking, we put forward the following strategies to reduce the cotton production cost in Xinjiang in the future.

1. Actively promote Machine-picked cotton. Machine picking is the trend of cotton industry development in the future. The popularization of machine picking can significantly reduce the labor cost in cotton production and increase the income space for farmers. At the same time, the use of machine picking is helpful for cotton quality management, improving the consistency of cotton quality, and has many benefits for subsequent cotton processing and textile.

2. Reduce fertilizer, pesticide input, increase the use of Farmyard manure, Change the existing structure of factor input. For example, increase the input of Farm fat, reduce the use of fertilizer and pesticide. Long-term use of chemical fertilizers destroys the internal balance of the soil, leading to an increase of some chemical elements and the decline of soil fertility. Moreover, excessive use of chemical fertilizers will pollute groundwater and drinking water, affecting the safety of drinking water of residents. At the same time, large amounts of chemical fertilizer and pesticide will cause air pollution. (Fang Lei). According to the study of Tang Mingyao, the average amount of organic fertilizer per unit area in Xinjiang cotton field is 12256.43 kg hm-2, but there is a great regional difference between North and South Xinjiang. Organic fertilizer is seldom applied in a cotton field in North Xinjiang, which is only 2023.63 kg hm-2, while organic fertilizer is more common in South Xinjiang, which is 22551.40 kg hm-2. The application rate of chemical fertilizer per unit area of a cotton field in

Xinjiang was 462.90 kg/hm-2, which was much higher than 120 kg/hm-2 of global application rate of chemical fertilizer per unit area of the crop (Mingyao Tang, et.al.).Use organic fertilizer, not only reduce the economic cost of investment, and conduce to the protection of the natural environment, can have the effect that improves people living environment.

3. Precision cotton planting was implemented. Now Xinjiang's cotton planting only in the seeding link to achieve precision seeding. Although the technology in drip irrigation, fertilizer, defoliant spraying, and other aspects is very advanced, it has not achieved accurate use. The advantages of implementing precision agriculture include reducing equipment input, improving work efficiency, saving working time, flexible employment of labor force and rational arrangement of input of production factors (Rob Hogan, et.al.).

4. Accelerate the construction of an integrated system of Machine-picked cotton technology. Although there are many advanced technologies in the new frontier cotton peanut production, each production link is out of touch in practical applications, not closely, and has not formed a highly integrated system. For example, cotton selection and machine Settings do not match, adding a lot of additional costs, affecting the efficiency and economic benefits of cotton planting.

6. References

CHENG, W.M. WANG, B. WANG, P. Study on Cotton Farmers' Willingness to Use Organic Liquid Fertilizer under C-TAM-TPB Framework：Based on the survey of 516 cotton planters in the 8th Division of Xinjiang Production and Construction Corps. *Xinjiang State Farms Economy,* n.1, p.57-65,2019.

DALAZOANA, F.M. DE L.; BINOTTO, E.; LOPEZ, A.V.; GIMENES, R.M.T. Gestão de custos na produção de fios de algodão. *Custos e @gronegócio on line*, v.13, n.3, p.287-311,2017.

ELEPU G, W. EKERE. Competitiveness of Cotton in Organic and Conventional Production Systems in Uganda. *Journal of Rural Economics & Development*, v.18, n.1, 2013.

FANG, L. Cotton Field Ecosystem Pollution in China and Its Control Measures. *Anhui Agricultural Science Bulletin.* n.12, p.56-58, 2007.

GAUTHIER, T. D. Detecting trends using Spearman's rank correlation coefficient. *Environmental Forensics*, v.2, n.4, p. 359-362, 2001.

HUO, Y. ZHANG, M. WANG, H. Cost and economic benefit of cotton in Xinjiang. *Arid Land*

Geography., v. 34, n. 05, p. 838-842. 2011.

JIN W. New cotton policy in Xinjiang. *China business times*, 10-14, 010. 2014

KUMAR, J. A., & ABIRAMI, S. Aspect-based opinion ranking framework for product reviews using a Spearman's rank correlation coefficient method. *Information Sciences*, v. 460, p.23-41, 2018.

LIJIE ZHANG, BIN WANG. Study on the Correlations of Cotton Price with Cotton Yield and Production Cost. *Hubei Agricultural Sciences*, v.52, n.16, p.4002-4005, 2013.

MINGYAO TANG, BO LAI, ZE ZHAO. Investigation and evaluation on fertilization status of a cotton field in Xinjiang. *Xinjiang Agricultural Science and Technology,* n.2, p.48-50, 2016.

National Bureau of Statistics of China, China Statistical Yearbook 2015-2018.China Statistics Press.

NATIONAL DEVELOPMENT AND REFORM COMMISSION. National Compilation of Cost-Benefit Data of Agricultural Products 2018.China Statistics Press.

OLIVEIRA, J.R. DE; RECH, I. J; CARNEIRO JÚNIOR, J.B.A; NIVEIROS, S.I. Environmental cost on cotton: a case study in the southern region of Mato Grosso. *Custos e @gronegócio on line*, v.8, n.3, p. 46-69, 2012.

PRION, S., & HAERLING, K. A. Making Sense of Methods and Measurement: Spearman-Rho Ranked-Order Correlation Coefficient. *Coefficient. Clinical Simulation in Nursing*, v.10, n.10, p.535-536, 2014.

ROB HOGAN, SCOTT STILES, KELLY J. BRYANT, MARK J. COCHRAN. Reducing the Cost of Cotton Production. https://www.uaex.edu/farm-ranch/crops-commercial-horticulture/cotton/Reducing%20Costs%20of%20Cotton%20Production.pdf

SEMERCI, A.; ÇELIK, A.D. Gross profit analysis in cotton production and effects of agricultural subsidies on product cost: a case study of Hatay Region-Turkey. *Custos e @gronegócio on line*, v.14, n.1, p. 2-21, 2018.

SHARMA S K, BUGALYA K. Competitiveness of Indian agriculture sector: A case study of cotton crop. *Procedia-Social and Behavioral Sciences*, v.133, p.320-335, 2014.

PANG, S.L. Operating Leverage Effect of the Difference in Cost Structure of Cotton Production between China and America. *Chinese Rural Economy*.n.9, p. 33-37+44, 2006

TANG W, LI, X.X., LU, N. Analysis of the Change of Cotton Production Cost and Benefit and Study on the Planting Countermeasures in Xinjiang —Empirical Analysis Based on Annual Data in 2002–2016, *China Cotton*, v. 45, n. 10, 9-15. 2018.

TIAN, L.W. LIN, T. TIAN, C.H.ET AL. A retrospective analysis of the development status and history of natural resources and cotton in Brazil cotton region. World Agriculture, n. 11, p. 128-135. 2016.

YU, S.X. ZHANG, L, FENG W.J. Easy and Enjoyable Cotton Cultivation: Developments in China's Cotton Production. *Cotton Science*. v. 27, n. 3, p. 283-290, 2015.

ZHAI, X.L, YUAN, R.L, XU, G.D. Analysis of the Cost and Benefit of Cotton Production in China and International Comparison. *China Cotton*, v. 44, n.11, p.1-7+11, 2017.

ZHAO, X.M., ZHANG, J., WANG, L. Development of Machine Picking Cotton in Corps: Current Situation, Problems, and Countermeasures. *Issues in Agricultural Economy*, v. 34, n.3, p. 87-94, 2013.

ZHOU, J. MA, Q. Analysis of cotton cost variation in Xinjiang. *Xinjiang State Farms Economy,* n. 05, p. 22-24. 2014.

ZHU, H.Y. The underlying cause for the concentration of China's cotton production in Xinjiang. *Geographical Research*, v. 32, n. 4, p.744-754, 2013.

ZHU, J.H, CUI, D.F, Study on Poverty Types and Countermeasures of State Poverty Countries in Xinjiang Under New Situation. *Research of Agricultural Modernization*, v. 32, n. 3, p.276-280, 2011.

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