A Study of the Moderate Scale Operation of China's Agriculture

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Abstract In order to promote the development of agricultural large-scale operation in China, this paper constructs a calculation model for agricultural moderate large-scale operation to estimate moderate operation scale of China's major crops and different agricultural varieties in different regions based on the analysis of present situation of agricultural moderate large-scale operation. The results show that the national average moderate operation area of grain is 7.3 ha; the average moderate operation area of vegetable, cotton and apple is 0.61, 21.42 and 0.37 ha, respectively; the average moderate scale of hog and sheep is 388 and 234.8, respectively. In addition, for different varieties of agricultural products, we estimate their moderate scale in different provinces. The study provides a scientific basis for speeding up agricultural land transfer and realizing moderate large-scale operation, and sets forth corresponding recommendations on this basis.

Key words Scale operation of agriculture, Moderate operation scale measurement, Different regions

1 Introduction

Since the reform and opening up, the basic operating system of agricultural production in China has always been the household contract responsibility system, which combines centralization with decentralization. At the initial stage of policy implementation, it greatly emancipated productivity of agricultural labor, and played an important role in protecting national food security, boosting agricultural production and increasing farmers' income[1-3]. However, since joining the WTO, single household operating mode has not been unable to guarantee the basic living needs of farmers in many regions[4-6], causing a tremendous threat to China's agricultural development, so traditional agriculture urgently needs to shift to modern agriculture. Central Document No. 1 in 2013 proposed encouraging and guiding the urban industrial and commercial capital to develop crop cultivation and aquaculture suitable for business-oriented operation in rural areas; guiding farmers to adopt advanced technology and modern factors of production according to scale, specialization and standardization requirements; accelerating the transformation of mode of agricultural production and operation, and focusing on supporting some new business entities such as family farms, farmer cooperatives, and "companies + cooperatives + farmers". This provides effective policy support for the transformation of agricultural production methods. Scale of operation will become a major business mode for China's agriculture to realize modernization in the future[7]. With the improvement of industrialization and urbanization levels and rapid development of rural market economy, the competition for resources used in agricultural and non-agricultural production will be much fiercer[4]. We measure the land input scale realizing moderate scale operation to provide a scientific basis for realizing the reasonable allocation of finite agricultural resources, giving full play to the optimum production potential, and enhancing economic efficiency of agriculture.

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2 Current situation of scale operation of China's agriculture

2.1 Current situation of scale operation of crop farming

According to the statistics of the Ministry of Agriculture, there were 8.874 million large farming households with operating area of 2 ha or more in 2012, and the total operating scale of land was more than 33 million ha[8]. However, the operating scale of the Chinese farming households is generally small. The rural households with arable land size of less than 0.33 ha account for 50%, while the rural households with arable land size of less than 0.67 ha account for 75%[9]. There are large differences in the arable land size for rural households between various regions of China. The rural households with arable land size of more than 1.3 ha account for more than 25% in Northeast, while the operating scale of agriculture is small in most southern regions[10-11].

2.2 Current situation of operating scale of animal husbandry Chinese animal husbandry is dominated by scattering raisers and the scale is small. The main supplier of pork in China is scattering hog raisers. In 2013, 30.1% of slaughtered hogs were provided by the scattering raisers with the scale of less than 50 slaughtered hogs per year[12]. Sichuan is a major producer of hog in China, but the development of scale breeding is slow[13]. The scattering raisers with the scale of less than 50 slaughtered hogs per year provide 75.45% of slaughtered hogs. China's main supplier of beef is also scattering cattle raiser, and the scattering raisers with the scale of 1 to 9 head of slaughtered cattle per year provide 54.9% of slaughtered cattle. The scattering raisers with the scale of 1 to 29 slaughtered sheep per year provide 42.7% of slaughtered sheep. The scattering raisers with the scale of less than 2000 slaughtered laying hens per year provide 31.7% of slaughtered laying hens. The scattering raisers with the scale of less than 2000 slaughtered broilers per year provide 14.4% of

slaughtered broilers[14].

3 Measurement and analysis of moderate scale operation of agriculture

The moderate scale operation of agriculture refers to the minimum scale of the agricultural industry under the premise of ensuring agricultural production and farmers' income, that's to say, the same income can be obtained either from agricultural production or from working outside the home[15-18].

3.1 Measurement model Due to different net profit, there are differences in the operating area of land which achieves agricultural moderate scale between different industries, years or regions. The operating area of land which achieves agricultural moderate scale is calculated using the net profit of one product per unit area to divide the income from local work in the same year. It is shown in equation (1).

$$S_{ijp} = IC_{ip}/RP_{jp} \quad (1)$$

where S is the moderate scale land operation area; i is year; j is the product category; p is the area; IC represents wage income; RP is net profit.

The premise for equation (1) is to be engaged in the specialized operation, that is, the farmers are only engaged in the production and operation of a class of products, without considering by-business and multiple cropping.

3.2 Measurement of moderate scale of main crops

3.2.1 Moderate scale operation of food crops. The moderate operation scale of food crops is about 7.3 ha, and farmers lack enthusiasm for growing food crops, because the grain income is difficult to meet the needs of life, far less than the wage income[19]. The fundamental starting point of measurement is that farmers' income from growing grain is basically equal to wage income. During 2009 – 2012, the annual per capita income of farmers was 17004, 20280, 24588 and 27480 yuan, respectively, with an average income of 22338 yuan (Table 1). If the scale operation is realized, the grain planting area during 2009 – 2012 needs to reach 5.87, 5.93, 6.53 and 10.87 ha, respectively. In 2012, profit margins of food crops per hectare were low (only 319.35 yuan for wheat), resulting in too large moderate scale. Without considering the cropping of the same arable land, the average moderate scale of grain, rice, wheat and corn is 7.33, 4.93, 29.4 and 6.93 ha, respectively (Table 1).

Table 1 The moderate scale area of main food crops in recent years

Year	Wage income	Grain		Rice		Wheat		Corn	
		Net profit	Scale	Net profit	Scale	Net profit	Scale	Net profit	Scale
	yuan	yuan	ha	yuan	ha	yuan	ha	yuan	ha
2009	17004	2885.25	5.87	3765.00	4.53	2257.65	7.53	2630.55	6.47
2010	20280	3407.55	5.93	4650.00	4.33	1982.55	10.20	3595.35	5.67
2011	24588	3761.40	6.53	5565.00	4.40	1768.80	13.93	3946.35	6.20
2012	27480	2526.00	10.87	4290.00	6.40	319.35	86.07	2965.20	9.27
Average	22338	3145.05	7.33	4567.65	4.93	1582.05	29.40	3285.00	6.93

Note: Annual wage income is from *National Monitoring and Survey Report on Migrant Workers* (2009 – 2012); net profit is from *National Agricultural Costs and Returns Compilation* (2013).

3.2.2 Moderate scale of main cash crops. Vegetable, cotton and apple are selected as the representatives of cash crops, and research shows that the moderate scale operation area of vegetables in large and medium-sized cities averages 0.61 ha; due to the impact of domestic and international markets, there are great fluctuations in moderate scale which averages 21.42 ha; the moderate scale area of apple is 0.37 ha.

3.2.3 Moderate scale of breeding industry. Due to data acquisition, the free-range hogs are selected as the representative of breeding industry. Due to great market impact, hog farming profits vary widely[20], and there was a loss in 2012; 148 hogs in 2011 reached moderate operation scale; the average moderate scale during 2009 – 2012 was 388 (Table 2).

Table 2 The changes in the moderate scale area of main cash crops in recent years

Year	Wage income	Grain		Rice		Wheat		Corn	
		Net profit	Scale	Net profit	Scale	Net profit	Scale	Net profit	Scale
	yuan	yuan	ha	yuan	ha	yuan	ha	yuan	ha
2009	17004	31317.45	0.54	4628.85	3.67	44119.20	0.39	37.86	449
2010	20280	41653.35	0.49	14759.55	1.37	75475.20	0.27	40.18	505
2011	24588	38365.05	0.64	3037.35	8.09	69179.85	0.35	166.05	148
2012	27480	36825.00	0.75	378.90	72.53	60403.35	0.45	-13.96	-
Average	22338	37040.25	0.61	5701.20	21.42	62294.40	0.37	57.53	388

Note: Annual wage income is from *National Monitoring and Survey Report on Migrant Workers* (2009 – 2012); net profit is from *National Agricultural Costs and Returns Compilation* (2013).

3.3 Analysis of moderate scale operation in different regions

3.3.1 Regional distribution of moderate scale operation of food crops. The national average scale operation area of early indica rice is 14.61 ha, the largest scale operation area of early indica rice is 30.60 ha in Fujian Province, and the smallest scale operation area of early indica rice is 8.87 ha in Anhui Province (Table

3). The national average scale operation area of medium indica rice is 5 ha, the largest scale operation area of medium indica rice is more than 69 ha in Guizhou Province, and the smallest scale operation area of medium indica rice is 3.08 ha in Hubei Province (Table 4). The national average scale operation area of late indica rice is 7.42 ha, the smallest scale operation area of late indica rice is 4.56 ha in Zhejiang Province, and the net profit in Hainan Province is negative (Table 5). The profit of japonica rice is significantly higher than that of indica rice. The national average scale operation area of japonica rice is 4.53 ha, the smallest scale operation area of japonica rice is 2.77 ha in Inner Mongolia, and the largest scale operation area of japonica rice is 10.39 ha in Hebei Province (Table 6). The profit of wheat is low, and negative in most provinces (Table 7). Corn is important grain and forage crop, and its profit is negative in Hubei, Guangxi, Chongqing, Guizhou and Yunnan (Table 8). The national average moderate scale operation area of soybean was 14.24 ha in 2012 (Table 9).

Table 3 The moderate scale operation area of early indica rice

Province	Net profit per hectare//yuan	Scale//ha
Zhejiang	2295.30	11.97
Anhui	3097.05	8.87
Fujian	898.05	30.60
Jiangxi	1632.30	16.83
Hubei	2529.90	10.86
Hunan	2805.60	9.79
Guangdong	985.05	27.90
Guangxi	1220.85	22.51
Hainan	3015.60	9.11
Average	1880.55	14.61

Table 4 The moderate scale operation area of medium indica rice

Province	Net profit per hectare//yuan	Scale//ha
Jiangsu	7223.55	3.81
Anhui	5869.20	4.68
Fujian	3202.05	8.58
Henan	6919.95	3.97
Hubei	8918.85	3.08
Hunan	5112.30	5.37
Chongqing	3186.15	8.63
Sichuan	6182.85	4.45
Guizhou	398.25	69.00
Yunnan	2440.65	11.26
Shaanxi	3973.20	6.91
Average	5494.80	5.00

Table 5 The moderate scale operation area of late indica rice

Province	Net profit per hectare//yuan	Scale//ha
Zhejiang	6023.70	4.56
Anhui	4980.45	5.52
Fujian	1242.15	22.12
Jiangxi	4705.65	5.84
Hubei	5092.65	5.39
Hunan	3885.75	7.07
Guangdong	3824.40	7.19
Guangxi	1420.50	19.35
Hainan	-641.40	-
Average	3702.60	7.42

Table 6 The moderate scale operation area of japonica rice

Province	Net profit per hectare//yuan	Scale//ha
Hebei	2643.60	10.39
Inner Mongolia	9912.75	2.77
Liaoning	6026.55	4.56
Jilin	5460.45	5.03
Heilongjiang	4536.75	6.06
Jiangsu	8921.40	3.08
Zhejiang	6928.50	3.97
Anhui	4862.25	5.65
Shandong	9700.80	2.83
Henan	4756.35	5.78
Hubei	6243.45	4.40
Yunnan	3822.15	7.19
Ningxia	5678.40	4.84
Average	6062.85	4.53

Table 7 The moderate scale operation area of wheat

Province	Net profit per hectare//yuan	Scale//ha
Hebei	748.05	36.73
Shanxi	-922.35	-
Inner Mongolia	-882.30	-
Heilongjiang	1817.10	15.12
Jiangsu	-70.35	-
Anhui	2317.35	11.86
Shandong	2496.15	11.01
Henan	-146.10	-
Hubei	-783.60	-
Sichuan	-3739.50	-
Yunnan	-5340.45	-
Shaanxi	224.25	122.54
Gansu	-2267.55	-
Ningxia	-929.40	-
Xinjiang	2356.65	11.66
Average	319.35	86.05

Table 8 The moderate scale operation area of corn

Province	Net profit per hectare//yuan	Scale//ha
Hebei	4962.60	5.54
Shanxi	6555.15	4.19
Inner Mongolia	5164.65	5.32
Liaoning	4019.10	6.84
Jilin	2400.90	11.45
Heilongjiang	3410.40	8.06
Jiangsu	3477.30	7.90
Anhui	3973.20	6.91
Shandong	4154.10	6.61
Henan	3473.70	7.91
Hubei	-565.80	-
Guangxi	-2052.00	-
Chongqing	-2766.90	-
Sichuan	1558.35	17.63
Guizhou	-1934.25	-
Yunnan	-3241.20	-
Shaanxi	258.75	106.20
Gansu	35.85	766.53
Ningxia	2679.00	10.26
Xinjiang	5418.30	5.07
Average	2965.20	9.27

Table 9 The moderate scale operation area of soybean

Province	Net profit per hectare//yuan	Scale//ha
Hebei	2374.95	11.57
Shanxi	104.70	262.47
Inner Mongolia	3279.90	8.38
Liaoning	4573.95	6.01
Jilin	2640.45	10.41
Heilongjiang	1260.90	21.79
Anhui	3692.25	7.44
Shandong	5610.75	4.90
Henan	909.90	30.20
Chongqing	-3149.55	-
Shaanxi	387.30	70.95
Average	1929.45	14.24

2.2.2 Regional distribution of moderate scale operation of cash crops. Cotton, apple and tomato are selected for the moderate scale operation analysis of regional cash crops. There are great fluctuations in cotton market. Most of regions suffered a loss in 2012, and only Gansu and Xinjiang had a great profit (Table 10). In 2012, the national average moderate scale operation area of apple was 0.45 ha; the smallest moderate scale operation area of apple was 0.25 ha in Beijing; the largest moderate scale operation area of apple was 1.03 ha in Liaoning (Table 11). The national average moderate scale operation area of tomato was 0.47 ha, and the largest moderate scale operation area of tomato was 1.71 ha in Inner Mongolia (Table 12).

Table 10 Moderate scale operation area of cotton

Province	Net profit per hectare//yuan	Scale//ha
Hebei	-4148.25	-
Shanxi	-7027.05	-
Jiangsu	-1587.75	-
Anhui	-3601.65	-
Jiangxi	-6067.65	-
Shandong	-5509.65	-
Henan	-3810.00	-
Hubei	261.00	105.27
Hunan	-1565.85	-
Shaanxi	-11654.25	-
Gansu	9457.50	2.93
Xinjiang	8825.70	3.13
Average	378.90	72.53

Table 11 Moderate scale operation area of apple

Province	Net profit per hectare//yuan	Scale//ha
Beijing	111499.05	0.25
Hebei	46195.50	0.59
Shanxi	31791.60	0.87
Liaoning	26544.15	1.03
Shandong	75983.85	0.36
Henan	34560.00	0.79
Shaanxi	94207.05	0.29
Gansu	38002.35	0.72
Ningxia	27380.10	1.01
Average	60403.35	0.45

Table 12 Moderate scale operation area of tomato

Province	Net profit per hectare//yuan	Scale//ha
Beijing	46540.65	0.59
Tianjin	31130.70	0.88
Hebei	105763.20	0.26
Shanxi	53712.30	0.51
Inner Mongolia	16103.10	1.71
Liaoning	63997.95	0.43
Heilongjiang	53935.05	0.51
Jiangsu	53349.90	0.51
Anhui	45838.20	0.60
Fujian	51809.70	0.53
Jiangxi	27158.55	1.01
Shandong	86478.30	0.32
Henan	53278.35	0.51
Hubei	101658.45	0.27
Guangdong	127701.30	0.21
Guangxi	58266.15	0.47
Hainan	111864.90	0.25
Chongqing	112001.85	0.25
Guizhou	60917.55	0.45
Yunnan	74818.05	0.37
Shaanxi	112483.35	0.25
Ningxia	28733.70	0.95
Xinjiang	65850.75	0.42
Average	58538.70	0.47

2.2.3 Regional distribution of moderate scale operation of livestock products. Because of data availability, we select sheep as the livestock product. In 2012, the national net profit per 100 sheep was 11706 yuan, and the average moderate scale was 234.8; the smallest scale was 54.3 in Ningxia; the scale of demand was largest in Inner Mongolia (Table 13).

Table 13 Moderate scale operation area of sheep

Province	Net profit per hectare//yuan	Scale//ha
Inner Mongolia	2947.93	932.2
Sichuan	14964.75	183.6
Gansu	45747.96	60.1
Qinghai	4623.66	594.3
Ningxia	50583.80	54.3
Xinjiang	22941.40	119.8
Average	11706.00	234.8

4 Conclusions and policy recommendations

4.1 Conclusions The operating scale of Chinese rural households is generally small. Expanding farmers' arable land scale can help farmers to concentrate on agricultural production and increase agricultural productivity. The larger the arable land scale of farmers, the higher the enthusiasm for production input. The yields rise with the expansion of cultivated land, but the scale of cultivated land must be appropriate. Through measurement and analysis, it is found that the moderate operation scale of grain is around 7.3 ha; the average moderate scale operation area of vegetables is about 0.6 ha in large and medium-sized cities; the moderate scale operation area of cotton is 21.4 ha; the moderate scale operation

area of apple is 0.37 ha. From 2009 to 2012, the average moderate scale of free-range hogs was 388. In 2012, the national average moderate scale of sheep was 234.8.

4.2 Policy recommendations

4.2.1 Encouraging farmers to transfer land and promoting the development of scale operation. It is necessary to focus on the construction of animal and plant disease control service system, agricultural product quality and safety service system, agricultural information-based service system, agricultural material service system, and farm machinery system[21-22].

4.2.2 Building a sound modern agricultural organization and management system. It is necessary to introduce the policies to support family farms, so that the production and management level of family farms is greatly enhanced[23]; guide skilled agricultural technicians, entrepreneurial talents and farming and breeding experts to transfer land to form large farming and breeding households or family farms.

4.2.3 Innovating upon the cooperative mechanism and strengthening the organizing role of cooperatives in modern agricultural development. It is necessary to actively innovate upon the cooperative operation, expand service capabilities, and focus on cultivating a number of farmers' cooperative business entities with large-scale operating scale, new operational mechanism and superior quality products to improve market competitiveness.

4.2.4 Enhancing the status of leading enterprises and playing the role of leading enterprises in modern agricultural development[24]. It is necessary to innovate upon scientific and technological innovation capacity and improve core competitiveness of leading enterprises; enhance modern operation level of management personnel and increase the soft power of leading enterprises; increase training for various types of personnel to improve their quality; increase financial support to improve the scale operation level of leading enterprises[25].

4.2.5 Forming the modern agriculture industry consortium with family farms as main body, cooperatives as link and enterprises as leader. It is necessary to use cooperatives to promote the family farms and enhance organizational capacity of farmers to form organized production body; play the role of leading enterprises, change the previous disorder and chaos of myriad family farms and large farming households faced by enterprises, and establish a production and management community between cooperatives and farmers.

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