

Status and Prospects of Farm Mechanization in China

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【 Abstract】 China has a big population(22% of the world) and small cultivated land(only 7% of the world). Agriculture is very important and it has solved the problem of people's eating and wearing, and now it is creating favourable conditions for the state modernization and people's comparatively well-off. Farm mechanization plays an role in agriculture and has primarily developed. But the development is complicated since the big rural labour force and the small per capita cultivated land. The development and features of farm mechanization in China was summarized and the future task and its countermeasure was discussed in this paper.

Keywords: farm mechanization, China, Status, Prospect.

1. Introduction

China is a developing country with a big population. The population is 1.143 billion in 1990 and its 80% in rural area. The cultivated land is only one tenth of the national territory which is 9.60 million km² and the per capita cultivated land is only 0.08 ha.. Total agriculture output is 766.2 billion RMB Yuan which is 20% of the total output. The GNP is 1768.6 billion RMB Yuan (309.2 bil. US \$) and the per capita GNP is 1262 RMB Yuan (270 US \$). Agriculture is very important and it has solved the problem of people's eating and wearing, and now it is creating favourable conditions for the state modernization and people's comparatively well-off. Farm mechanization has primarily developed and it plays an role in agriculture development and farmers' income. But the development course is complicated since the more rural population and less cultivated land as well as the relatively backward economic basis.

2. Status and Features of Farm Mechanization

Farm production has been on the development through rural land reform, economic cooperation, land construction and production forces increase since the founding of New China in 1949. And people's enthusiasm was aroused, farm production increased rapidly and rural economy grew overall since the rural economy reform, responsibility system setting up in production from 1979.

2.1 Agriculture Before discussing farm mechanization, it may be worthwhile to deal briefly with Chinese agriculture in general. The total rural output is 1661.9 billion

RMB Yuan in 1990, increased by 177% over 1980. Among them, agriculture output is 766.2 which is 46.1% of total rural output and 20% of the national. Among agriculture output, the planting takes 58.5%, forestry, animal husbandry, sideline, and fishery respectively 4.3%, 25.6%, 6.2% and 5.4%. In comparison with 1980, the proportion in planting decreased but increased rapidly in animal husbandry, sideline and fishery (refer to Table 1).

The national crops sowing area in 1990 is 148 million ha. and the multiple crop index is 1.55. Grain takes 76.5% of the area, covers 113 million ha. and the total grain yield is 446 million T, ranking the first in the world but only 390 kg per capita. Rice, wheat and maize are three main crops, and their sowing area occupies respectively 29.1%, 27.1% and 18.9% and the yield 42.4%, 22% and 21.6% (refer to Table 2).

2.2 Farm Mechanization Chinese government always attaches great importance to the reform and development of agriculture production means. The power machinery and implement was imported to be tested, modeled and improved, to seek the utilization and management experience, develop farm machinery industry and pursue farm mechanization gradually from the founding of New China. Farm mechanization was developed gradually from 1970. Prior to 1970, agriculture in China developed on the basis of agricultural cooperatives. Machinery and electrical power for rural use increased rapidly. A large proportion of farm machinery power was used for tillage, irrigation and drainage. From 1979 onwards, agriculture in China was carried out on a contract system of responsibility linked to production, hence agricultural production was based on farm households. Agricultural production developed rapidly and the monoculture structure in grain production has changed into diversified economy. The farmers need more small-sized agricultural machinery; more livestock machinery, farm products processing machinery and transportation machinery. By the end of 1990, the total national farm power has been 287 million Kw and the power per hectare of cultivated land been 3.08 Kw, farm power occupied 76.4% of the sum of rural labour, draught animal and mechanical & electrical power, and the farm machinery types in operation reached to 3200. Farm machinery has been the important material base of rural development.

2.3 Features of Farm Mechanization The primary development of Chinese farm mechanization can be summarized as follows:

1). Up to now, the utilization of farm machinery in China is mainly for strengthening the labour's function, increasing agricultural production, raising farmers' income and using resources effectively.

Fig. 1 and Table 4 indicated that farm power was on the increase, and meanwhile, the rural labour and the draught animal was not decreased. From 1970 to 1990, farm power increased by 1200%, rural labour and draught animal respectively 50% and 54%. The increase in farm power did not replace the rural labour and draught animal.

The reason is that it made up the lack of rural labour and draught animal due to agriculture development and rural economy growth. It can do such beneficial work that the rural labour and draught animal could not complete in time as power-irrigation, tractor-ploughing and sowing, harvesting, threshing and plant protection mechanically. Farm mechanization can complete farm work in the right season, optimize growth condition and do some more beneficial work, eg., transportation and processing, so it can achieve the goal of increasing product and income and using resources effectively. Irrigation, ploughing, harvesting, threshing and plant protection with machinery in 1990 reaches respectively to 56.3%, 50.4%, 14.5%, 7.4%, 57.6% and 6.07% (refer to Table 5). It was shown by research [4] that the contribution of farm mechanization inputting is 16% in yields increase in planting for the recent ten years. The income in transportation occupied 52% of farm machinery management in 1990.

In recent years, the mini-tillage and non-tillage was developed. Such working as wheat-sowing with rotary ploughing in rotation of rice and wheat, maize-precisely-sowing in wheat stubble dry land with non-ploughing, batch-raising of seedlings, deep applying of fertilize by machine, sprinkling and drip irrigation etc. not only increases yields but also saves material(water, seed and fertilize, etc.) and energy.

2) Different strategy was chosen in different area. China is vast in territory. It crosses frigid & temperat zone, temperat zone, subtropical zone and the equator. There is a big difference in natural condition such as topography and landforms, and in crops composition, industrial composition and farming system. There is a better economic condition in East China than it in West China, and the difference is large. Farm mechanization was developed differently due to the different natural, economic conditions and agricultural requirements in different areas. Nine farm mechanization regions were divided (five regions mainly for planting, three for animal husbandry and one for sea product). Different stress on farm mechanization was put in different regions. Taking planting mechanization as an example, rice was taken as the key in Southern China; beginning with irrigation and processing, the plant protection, ploughing and threshing was developed. But as in Northern China and Northern-West, the dry land farming was chosen as the key; beginning with irrigation and ploughing, the processing, plant protection, transportation, threshing and harvesting was developed. While in Northern-East, it began with ploughing and sowing, the transportation, harvesting was developed due to its large area and less population. As for East China and in the suburbs of larger cities, since economy was advanced and farm labour was transferred quickly, farm mechanization is at a higher level, the planting and breeding got developed rapidly in order to meet requirements of city residents.

3) A full kinds of farm machinery industry was made in China. 98% of farm machinery used in rural area and state farms are home made. The number of factories to

manufacture farm machinery was over 2600 and staffs 1.26 million at the end of 1990 and the total output was 21 billion RMB Yuan. Besides that, there are nearly 1700 manufacturing and repairing factories at county level and staffs 290 thousand and the total output is 3 billion RMB Yuan. 44 farm machinery research institutes at and above the level of Province grade which engaged in researching and developing all kinds of farm machinery can manufacture and develop in China. Some medium-and-small-sized farm implement with the features of good function, simple structure, easy operation and repair and low cost etc. meets the requirement and purchasing power of many developing countries and the export is on the increase. Some machine such as large-sized tractors, combines and special machine which are either not produced or not met the supply is imported.

4) Farmer's purchasing and using of farm machinery with the collective's management was combined. The family responsibility contract system was taken as the dominant factor and the using of farm machinery was mainly by the household. There were 16 million households, about 7% of the national, purchased farm machine in 1990; the total amount of machinery possessed by households occupied 75% of the national; the number of small-sized tractor possessed by households was 6.69 million unit and occupied 95.8% of the national, and the large-and-medium-sized tractor 0.565 million unit and occupied 71.8%.

Production scale by household unit is very small. The cultivated land area is only 0.44 ha. per household. Meanwhile, the utilization is low. In order to raise the utilization of farm machinery, so as to harvest in unified stubble, plough in unified neighbour area, guided cooperation and unified management was adopted and the large-and-medium-sized power machinery was purchased and managed by collectives and specialized households. There are 0.33 million farm machinery service stations in rural area, 1.09 million service organization and 1.35 million specialized households in farm machinery in the whole nation, to serve the farmers. The rural farm machinery management organization, supplying and maintenance network, safety supervising, mechanization training, research and extensions organization was set up mainly by collectives and the state. The network is primarily formed (refer to Table 6).

3. Task and Countermeasure of Development in Farm Mechanization

The second strategic task for the Chinese modern construction within ten years from 1991 to 2000 is to make GNP double and the people's living level to comparatively well-off. So, the high yields, high quality and effective agriculture will be developed, ie. to increase the product yields and develop high quality product, optimize the distribution and utilization of rural resources and protect ecosystem as well. It requires the total grain yields to be increased up to 500 million T from 446 million T, at an average rate of 2 percent per year. Crops, forestry, animal husbandry, sideline and fishery will

be developed faster and the total agriculture output will be increased at an rate of 3.5 percent per year. Rural economy will keep in increasing completely , the total rural output and per capita income will be double, increasing at an rate of 7.2 percent per year.

Developing agriculture depends on policy, science and technology as well as inputting. The economy reform will be carrying out for rural area according to the requirement of socialism economy market system. Cooperative management will be increased on the basis of improved household management. The policy of *Never Slack Grain Production, Enthusiastically Develop Diversified Economy* will be continued carrying out to develop rural economy completely. It is estimated that there will be another 100 million farm labour to be transferred to non-agriculture industry. Farm labour will be decreased due to its natural growth less than the transferred number.

With the increase of material, science and technology inputting to agriculture and expanding of farm construction, the comprehensive agriculture productive forces will be strengthened. Raising productivity of land will be taken as the key, and the productivity and utilization rate of rural resources will be raised.

3.1 Main task in farm mechanization development As the main means in raising productivity, farm machinery is to be in the service of developing high yields, high quality and effective agriculture, transforming low yields land, and raising multiple crop index. It is also to give a complete service to agriculture, animal husbandry, sideline and fishery before production, under production and after production. Farm mechanization will continue playing an role in strengthening labour to increase yields and farmer's benefit and save agricultural material, meanwhile, it plays an role of "replacing", too, and will come into an quickly developing period.

Key points in developing farm mechanization at the present are as follows:

1) Production mechanization and seed processing mechanization for rice, wheat, maize, cotton and vegetables etc..

2) Production mechanization for raising poultry, pig, cattle and aquatic, and feed gathering and processing etc..

3) Processing, transporting and fresh keeping mechanization for product of agriculture, animal husbandry and fishery; developing and utilizing mechanization for the by-product and waste of agriculture, animal husbandry and fishery.

4) Mechanization in low yield land transforming, moisture keeping tillage in dry land, terraced fields building in slopes and rice field draining.

5) Technology for improving product quality (reliability etc.), operating condition and reducing energy consumption.

3.2 Countermeasure in developing farm mechanization

1) On the premise of economic benefit, multiple ownership and diversified economy are co-existed. Farmer was taken as the first for purchasing and utilizing of farm

machinery and the small-sized equipment would still be the key point of development. While the large-and-medium-sized equipment was managed and purchased mainly by the state and collective. The investing for purchasing machinery by farmers in 1980's took about 2% of the year's net income. It would be increased slightly in 1990's by forecasting; the new power and the matched implement purchased per year would be about 30 million Kw; and the mechanization level for ploughing, sowing and harvesting would have increased by 20-25% by the year of 2000.

2) Different place with different key developing policy. The following places would be in the lead in development: advanced economy area, the area of agriculture transferred faster to other industries, suburbs of large city, the state-owned farm, animal husbandry and fishery, commodity grain and cotton area. The medium-and-low yields area with great potential would be mainly supported.

3) Amplify the mechanization service system of farm machinery management, safety supervising, sales, maintenance, training and technology extension. Measures are taken to stable working staff and raise their quality and improve service condition in order to strengthen the guide and service to the utilization of farm machinery.

4) Consolidate and raise farm machinery industry as well as science and technology development undertakings. Taking the requirements of agriculture as the goal, farm machinery should adjust its product composition, increase the output of well-sold machinery, speed up the development of combine for rice, maize and greenfeed and non-till seeder, and put the imported advanced technique of large-and-medium-sized tractor into production as well. Improving the quality of products as the key link, strengthen the technology reforming of farm machinery enterprises. Adjust well the price of farm machinery products and improve its management in order to increase its adaptability to market.

5) Extend the international exchange and cooperation. Chinese farm machinery circle has established relation and cooperation with more than one hundred countries and areas of the world. To strengthen the manufacturing capability of farm machinery, the advanced product design and manufacturing technologies will be introduced, cooperative manufacture or joint development will be increased. Meanwhile, the exporting of medium-and-small-sized farm implements which is with the features of good performance, easy operation and low cost will be expanded. The technology exchange and friendship contacts to promote understanding and cooperation will be on the further extension. China is going to join GATT. The international trade and cooperation will be enlarged with it.

4. Conclusion

1) With the reason of more population and less cultivated land and in order to increase grain yields and cotton output, improve diet composition and raise farmer's

income, farm mechanization was gradually made and will continue to be further advance and such mechanic working items as irrigation, ploughing, threshing, transporting and processing of farm products and feed, which is hard for labour and draught animal or the benefit is not high, were taking as key to be developed to make up the seasonal labour lack of. The mechanic proportion of these working items is over 50% already and farm machinery power has occupied more than 75% of the total rural power.

2) Owing to the state modernization and the requirement of raising people's living quality, rural planting, breeding, processing and rural enterprises will be developed thoroughly. Farm labour will be decreased per year with the increase of its transfer; the labour-and-draught-animal replacing function, strengthening function and saving function of mechanization will give a full play. The product composition of farm machinery industry is to be on the adjustment and technology reforming of factory is to be strengthened, so that the developing, manufacturing and spreading of appropriate farm machinery could speed up.

3) From the practical requirement and condition of view, to develop farm mechanization needs to pay attention to economic results. It should be undertaken with choice, different strategies in different area, early or late and slow or fast, but not in one way.

To raise the utilization effect of farm machinery managed by small-scaled households, more attention is devoted to guide cooperative utilization and improving social farm machinery service network.

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Table 1 Rural Industrial Composition and Proportion

Indicators	1970		1980			1990	
	Output Billion Yuan	Proportion %	Output Billion Yuan	Proportion %	Output Billion Yuan	Proportion %	
GNP			447		126.9		
Total Output	380	100	853.4	100	3800	100	
Total Rural Output			279	100	1662	100	
Agriculture	102.1	27	192.3	23	766.2	20	
–Planting	78.3	76.7	137.5	71.7	448.2	58.5	
–Forestry	2.9	2.8	8.1	4.2	33	4.3	
–Animal Husbandry	13.7	13.4	35.4	18.4	196	25.6	
–Sideline	5.5	5.4	7.6	4.0	48	6.2	
–Fishery	1.7	1.7	3.3	1.7	41	5.4	
Rural Industry			54.4	19.5	572	40.4	
Rural Trade, Transportation ect.			32.5	10.1	224	1.35	

Table 2 Main Crops Composition

Indicators	1970		1980			1990		
	Area Mha.	Proportion %	Area Mha.	Proportion %	Area Mha.	Proportion %		
Crops	143.5	100	146.4	100	148.4	100		
Grain	119.3	83.2	117.2	100	113.5	76.5		
Rice	32.4	27.2	33.9		33.1	29.1		
Wheat	25.5	21.4	29.2		30.8	27.1		
Maize	15.8	13.2	20.4		21.4	18.9		
Cotton	5.0	3.5	4.9		5.6	3.8		
Multiple Crop Index (%)	142		146.6			155		
Yields	Total		Per Unit Area		Total		Per Unit Area	
	MT	%	T / ha	MT	%	T / ha	MT	%
Grain	240	100	2.01	321	100	2.73	446	100
Rice	110	45.8	3.4	140	43.6	4.13	189	42.4
Wheat	29.2	12.2	1.15	55.2	17.2	1.89	98.2	22
Maize	33	13.8	2.09	62.7	19.6	3.08	96.8	21.6
Cotton	2.3		0.46	2.7		0.55	4.5	0.8

Table 3 Main Animal Husbandry Composition

Indicators		1970	1980	1990	
Amount of Livestock (Million)	Pig	On Hand	206.1	305.4	362.4
		Out Hand	125.9	198.6	309.9
	Cattle		73.6	71.7	102.9
		Milk Cow	0.9	1.1	2.7
		Sheep	147	187.3	210
Product Output (Mil. T)	Meat		5.97	12.1	25.1
		Pork			22.81
		Beef			1.26
		Lamb			1.07
	Poltry Meat			3.23	
	Milk			4.16	
	Egg	3.33	2.57	7.95	
	Aquatic Product	3.18	4.5	12.4	

Table 4 Rural Power and Main Farm Machinery Composition

Indicators		1970	1980	1990	1991
Rural Power	Rural Labour(mil.)	281	318.3	420.1	430.9
	—in Farm (mil.)	278	291	340	342
	Draught Animal (mil.)	44.3	50.9	76.1	76.8
	Mechanical & Electrical Power(mil. Kw)	21.6	145	287	294
	—in tillage (mil. Kw)	4.34	39.8	89.8	93.4
	—in Irrigation (mil. Kw)	13.4	54.8	71.4	72.7
	—in Processing (mil. Kw)			43.4	43.3
Farm Machinery	Tractor(>17.7Kw) (Thou.)	125	744	814	784
	Tractor(< 14.7 Kw) (Thou.)	78	1875	6980	7303
	Combine (Thou.)	8.0	26.5	39.6	440
	Truck (Thou.)	15.6	132	602	617
	Transporter (Thou.)			232	303
	Motor Boat (Thou.)	2.8	108	351	363

Table 5 Development of Farm Mechanization

Indicators		1970	1980	1990	1991
Mechanical Power Inputted (Kw / ha)		0.214	1.465	3.00	3.08
Proportion of Mechanized Working (% Area)	Tillage	18.0	41.3	50.4	52.5
	Sowing		10.2	14.5	16.5
	–Rice		0.6	1.2	1.6
	–Wheat			40.8	45.7
	–Maize			17.9	22.6
	Harvesting		3.1	7.4	7.8
	–Rice			0.9	1.25
	–Wheat			28.7	31
	Grain Threshing		55.5	56.8	56.1
	Irrigation and Drainage	41.6	56.6	57.3	57.8
Plant Protection			9.2	11.4	

Table 6 Allied Organizations for Farm Mechanization in 1991

Indicators	Amount						
	State	Province	Prefecture	County	District	Town	Village
Farm Machinery Station				145	2100	21374	315531
Service Organization						108674	
Management Organ	1	30	292	2216	1308	28530	
Sales Company	2	30	317	2311		15000	
Fuel Supply Station						20349	
Repairing				1690		127309	
Safety Supervising		29	329	2363			
Technical Extension	1	13	122	1693			
Research	4	38	185				
Testing and Apprising	1	25	18				
College and Faculty	2	38					
Technical School		27	95				
Training School		8	148	2045			

Table 7 Rural Development Task in 90's

Indicators	1990	2000(est.)	Per Year Increasement (%)
Total Grain Yield (mil. T)	446	500	~ 2
Total Cotton Yield (mil. T)	4.5	5.25	~ 2
Total Agriculture Output (billion Yuan)	766.2		~ 3.5
GRP(billion Yuan)	1662		~ 7.2
Comprehensive Mechanization Level	40	50~ 55	1~ 1.5
Tractor-Ploughing Proportion	50.4	~ 70	~ 2
Machine-Sowing Proportion	14.5	30~ 35	2~ 2.5
Machine-Harvesting Proportion	7.4	25~ 30	2~ 2.5
Machine-Threshing Proportion	56	70~ 80	1.5~ 2
Machine-Irrigation Proportion	57.3	~ 60	

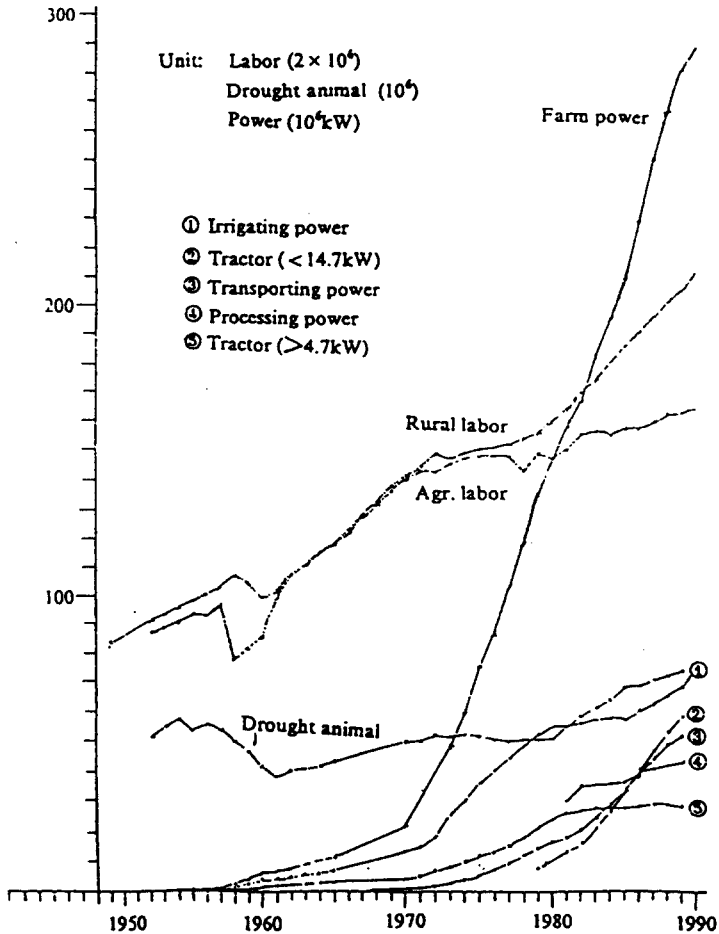


Fig.1 Diffusion History of Rural Labour, Draught Animal and Farm Power