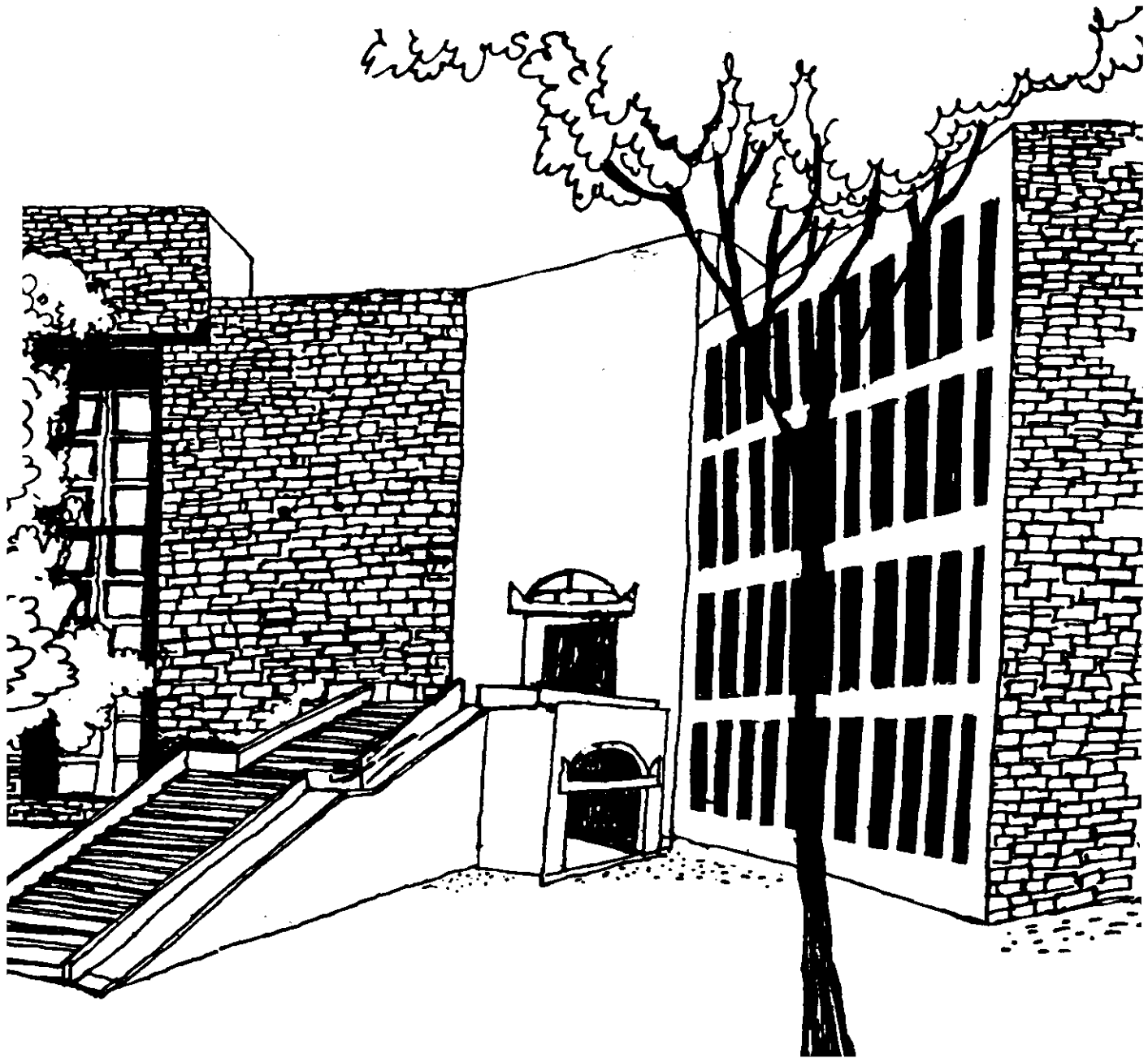




Working Paper



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AGRICULTURAL MECHANIZATION, RELATED
INDUSTRY AND EDUCATION AND RESEARCH
INSTITUTIONS IN CHINA

By

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Abstract

Based on the papers presented at the Seminar 'Farm Mechanisation for Small Scale Peasant Farming' held in Hangzhou, People's Republic of China (June 1982), the information obtained from a tour of Southern China undertaken by the author and published sources, the status of farm mechanisation was assessed. The current level of farm power available in China works out to 1.3 h/hect. If irrigation equipment is included this will go up to 2.68. There is variation in power use in different regions. The number of 4-W tractors also is nearly equal in both countries. The power tillers are now well established in China. In India however these have not gained wide acceptance and usage.

Both the countries started mechanisation process nearly at the same time and with similar base. Use of machines seems to have grown faster in China compared to India. Perhaps, one of the reasons is that land has been gradually socialised in China, whereas in India, there are vast number of small holdings, individually owned and operated.

An outline of farm machinery industry and research and education institutions in China has also been developed.

AGRICULTURAL MECHANIZATION, RELATED INDUSTRY AND EDUCATION
AND RESEARCH INSTITUTIONS IN CHINA

Girja Sheran

1. Introductory

In this paper attempt is made to draw an outline of agricultural mechanization in China as it emerged in the post-liberation period. The information used here is based on the papers presented in an international seminar on farm mechanization held in June 1982, in Hangzhou, China, in which the author was a participant. Chinese agricultural engineers and economists presented papers in the seminar as did others from Asian countries, Europe, Australia and the USA. The seminar gave an opportunity of interaction and somewhat wider discussions with the Chinese scholars in the course of stay in Hangzhou. Equally, and in some ways, even more useful was the ten-day tour of southern China that the author undertook following the seminar. In the course of the tour the author visited farms, communes, brigades and production teams, farm machinery factories, research institutions etc. The tour itinerary is given in the appendix. The information was supplemented by review of published literature on agro-machinery in China.

2. Socialisation of Agriculture

The process of agricultural mechanisation in China will have been influenced by the process of socialisation of land and other

farm assets that was carried out after the liberation. A brief description of land reform and phased collectivisation is therefore given here with special reference to the farm machinery and draft animals. This section relies heavily on the works of Bandopadhyaya(1), Kuo (2) and Chao (3).

The first step in the series of changes in agrarian structure and relations, brought forth after 1949 was the land reform. The main elements of this reform set into Agrarian Reform Law (1950) was confiscation of land, draft animals, farm implements surplus grains and houses of the landlords; and their redistribution among peasants. Such reforms were carried out in northern part earlier. By 1952, the task was completed in the entire country. Thus 1949-52 may be termed as the phase of establishment of individually owned peasant farming.

Subsequently, a phased program of collectivisation was launched. At first, the formation of mutual aid teams was encouraged. These teams had rudiments of collective farming. The teams were of two types, the temporary and permanent. The temporary mutual aid teams consisted of 3 to 4, in cases 7 to 8 households which cooperated among themselves during peak agricultural season such as harvesting. The households with surplus labour helped others and those with draft animals and implements shared these with others. In permanent teams, this arrangement was on year-round basis.

Later, the cooperatives were formed. In the 'lower stage co-operatives' land of members was merged and was cultivated as single unit. The tools and implements and draft animals were still individually held. In advanced cooperatives the land ownership was dispensed with, the tools, implements and animals put at the disposal of the cooperative. The individual members were allowed only small plots for private cultivation. Generally, the extent of private plot area was less than 5% of the land. The phase of cooperatives was completed by 1956.

Then came the people's commune. The communes combined in their organisation, peasants, workers, businessmen, students and militia. These became the basic units of social structure combining industries, agriculture, trade, education and military affairs. By 1958, the 7,40,000 agricultural cooperatives were organised into 26,000 people's communes. Table (1) gives the stage wise summary of the socialisation process.

The people's communes are divided into production brigades and these in turn into production teams. At the time of their formation in 1958, an average commune consisted of nearly 5000 households and 64,000 mou* (10,667 acres) of land. Since their formation, the number and accordingly the size of communes has changed. At the end of 1960, there were 24000 communes, 500000 production brigades and 3 million production teams. At the time of our visit, the total number of communes was frequently mentioned as 52000.

Table (1) Development of Socialist Agriculture in the PRC, 1950-1965, 1972

Year	Mutual Aid Teams	Primary APCs	Advanced APCs	Rural communes	State Farms	% of farm Households in Socialist Agriculture
1950	2,724,000	18	1	---	n.a.	10.7
1951	4,675,000	129	1	---	n.a.	19.2
1952	8,025,000	3,634	10	---	404	40.0
1953	7,450,000	15,053	15	---	n.a.	39.5
1954	9,931,000	114,165	201	---	n.a.	60.3
1955	7,147,000	633,213	529	---	n.a.	64.9
1956	---	682,000	312,000	---	n.a.	96.3
1957	---	72,022	680,081	---	710	97.0
1958	---	---	---	26,578	1,442	99.1
1959	---	---	---	24,000	n.a.	n.a.
1960	---	---	---	n.a.	2,490	n.a.
1961	---	---	---	26,000	2,500	n.a.
1962	---	---	---	n.a.	n.a.	n.a.
1963	---	---	---	n.a.	n.a.	n.a.
1964	---	---	---	n.a.	n.a.	n.a.
1965	---	---	---	74,000	n.a.	n.a.
1972	---	---	---	n.a.	2,000	n.a.
				50,000	n.a.	n.a.

Source: Kuo (2), --- not applicable
n.a. not available.

Not only the number, but also the roles and relative importance of the commune, the brigade and the teams has been undergoing modifications. The production team are now the basic units, for economic accounting. The teams plan their production and distribute incomes. Again at the time of visit, there were strong indications that a new modifications, the 'individual or group responsibility system' is being instituted, where a small group of households, even individuals will be made responsible for specific production related tasks.

The total population is now about 1000 m. The latest census was being conducted beginning July 1, 1982, which happened to be during our visit. Nearly 80% of the population is engaged in agriculture, grouped in communes mentioned above. On the basis of the above, the average size of population in a commune works out to about 15000. There will be variation. For instance, among those we visited, the Puyan Commune had 29529 residents, Da li Commune had 72000.

The total number of production teams was 5.66 m. in 1980. The size of a team in terms of population will be, on an average 140 persons/ team or about 30 to 50 households. Again there will be variation. The Puyan Commune had 9 brigades and 169 teams, the Da li Commune had 19 brigades and 231 teams. What criteria was used in the beginning to define the demographic, territorial size and resource base of communes? We did ask this question in several places, but no consistent answer emerged.

3. Land Under Cultivation

Table (2) gives the land use pattern in China

Table (2) Land Use in People's Republic of China

	Thousand Mou	Percent of Total
Arable Land	2,200,000	15.28
Cultivated	1,650,000	11.46
Uncultivated	550,000	3.82
Forest Area	1,140,000	7.92
Land Suitable for Afforestation	4,500,000	31.25
Grass Land	4,000,000	27.28
Others (desert etc.)	2,560,000	17.77
Total	14,400,000	100.00

Source: Kuo (2)

The area under cultivation has been increasing. The increase has not been large and by now the general belief is, it may have reached the maximum possible extent. At the time of visit, the area of cultivated land was quoted in many papers to be 100 mh. This is very close to that reported by Kuo and shown in table (2). The land extension having reached a limit, the important aim is to increase land productivity, yield etc. Mechanisation too is being looked upon in this perspective.

The land is owned by the communes, a small part about 4 mh belongs to the state farms. And another part is given for private cultivation. The land cultivated by the communes is about 70 mh.

4. Mechanisation in Agriculture

The extent of the use of mechanical power units is one important index of mechanisation. The availability of new power units gives impetus to the process of development of new and wider range of tools and equipment. The number and type of equipment for new power units are other important measures of mechanisation. In the U.S. the replacement of animal draft power began in the first decade of this century, with the introduction of internal combustion engine based tractors. By 1960, draft animals were almost totally substituted as source of farm power. In Japan, the two wheel tractors (power tillers) were introduced in mid-thirties. In about forty years these had totally replaced draft animals. In China and India such a total substitution is yet a long way off. However, it is interesting to examine the pace at which mechanisation has been taking place.

4.1 Mechanical Power Units for Traction

(a) Tractors

In 1949 the number of tractors in China was 401, which can be considered negligible. The use of tractors increased rapidly, first in the state farms. The state farms owned and operated their own tractors. To the peasants, cooperative and later to the communes, the use of tractors was extended first through the tractor

or agricultural machine stations (AMS). The communes did own and operate their own tractors but the proportion of tractor stock owned by them was smaller than that of the state farms and AMSS. In the late sixties, it was thought more advantageous to hand ^{over} the tractors

from AMSS, to the communes. Table (3) give the tractors in use and their ownership upto 1965. Kuo (2) has also reported the number of tractors for years 1949-65 and 1970-72. In the latter years the number of tractors was 306,322 in 1970; 700,732 in 1971 and 770,805 standard units in 1972.

According to some of the papers presented in the seminar the number of 4 wheel tractors in China now is about 750000 standard units (a standard unit is equal to 15 horse power). This is surprising, as the number even in 1972 (Table 3) had reached 770805.

(b) Power Tillers

Experiments on the usefulness of power tillers were conducted in early 60's and after being found suitable, mass production was begun in 1964 (Chao). Chao also indicated that their production was stepped up very rapidly as these proved very popular among the farmers particularly in paddy areas.

By now the total number of power tillers in use is reported to be 1,875,000.

Table (3) Distribution of Farm Tractors by Ownership 1949 - 1965

(Standard Units 15 hp each)

Year	Total Number in Use	Owned by State Farms Stations	Owned by Agri. Mach.	Owned by Agril. Co Ops. Communes Research Institutes
1949	401	401	0	0
1950	1,286	1,160	30	96
1951	1,410	-	30	-
1952	2,006	1,745	30	231
1953	2,719	1,801	68	850
1954	5,061	2,766	778	1517
1955	8,094	4,036	2363	1695
1956	19,367	7,243	9862	2262
1957	24,629	10,177	12036	2416
1958	45,330	16,955	10995	17380
1959	59,000	21,000	17300	20700
1960	79,000	-	-	-
1961	90,000	-	-	-
1962	103,400	-	-	-
1963	115,000	34,000	68040	12960
1964	123,000	39,400	71500	12100
1965	130,500	40,000	79300	11200

Source: Chao (3)

(c) Boat Tractors

The latest type of mobile farm power unit to make appearance is the 'boat tractor'. This is a noteworthy Chinese innovation. Essentially, a power tiller is placed on a boat-shaped chassis with two steel wheels in the rear for thrust. There is a small wheel in front for steering. This is stated to be more effective in deep muddy soils, flooded paddy fields. When operating in the field, the front wheel is removed. The steering is achieved through two separate clutches in the rear wheels.

It was reported in the seminar that by now a total of 110,000 boat tractors are in use.

4.2 Mechanical/Electrical Units for stationary use:

The above three are examples, of mechanical power units for traction and mobile farm operations. There are others, stationery power units for specific operations. One such is irrigation and drainage equipment, that has grown perhaps even more rapidly than the tractors.

(a) Irrigation and Drainage Equipment

In 1949, the area irrigated was only 240 m mou, 16.3% of the area cultivated. By 1965, it has been increased to 520 m. mou, 32% of the area cultivated. During the same year the area irrigated through power equipment was 84 m. mou. Thus, in 1965 power irrigated area constituted 16% of the total effectively irrigated area. About the same time (1964) the type of irrigation was as follows:

	Mill. mou
Gravity: Large Canals	278.0
Gravity: Small ditches and aqueducts	
Farm Ponds and Weirs	82.0
Pumping with electrical mechanical power	86.0
Wells, ground water sources	34.0
	<u>480.0</u>

Source: Chao (3)

In the seminar it was reported that the power irrigated area now is 43 m.h. and that it is 56% of the area under effective irrigation. This will mean that the total area under effective irrigation now is about 76 m.h. which will in turn mean that 76% of the area under cultivation is irrigated.

It was also reported that there are now 5.9 m. powered pumps in operation. The mechanical/electrical power added to the farms through the irrigation and drainage equipment will obviously be a substantial component.

(b) Bio-gas plants

There are now 7 m. concrete digesters of 6-10 m³ capacity in operation.

(c) Self-powered farm equipment

This category can include farm trucks, self-propelled combines, threshers and any other machine with own power unit. Increase in the number of such equipment has also been substantial in the past 30 years.

(d) Rural Electrification

The use and reach of electricity in rural areas in 1949 was negligible. By 1965, Kuo estimated that electricity was available in most of the villages of 1300 hsien (out of total 2126) in China. The electricity in rural area is used for processing, irrigation and drainage, and to a very limited extent in farm operations.

4.3 Farm Power

As stated earlier, the first index of mechanisation is the total farm power, particularly the animate component of it. For the purpose of computing this index we have considered the manual, draft animals and electrical/mechanical power sources used for traction and irrigation and drainage. We have ignored the others such as farm trucks, biogas etc. The computations for 1949 and 1980 are given in table (4)

Table (4) Farm Power in China

(In million)

	1949		1980	
	No.	Hp.	No.	H.P.
1. Manual Labour	173.17	17.3	300	30
2. Draft cattle	60.0	30	94.0	47.0
3. Mobile Tractive Farm power				
(i) 4 wheel tractors	491.	-	.75	11.25
(ii) Power tillers	-	0.11	1.875	13.125
(iii) Boat tractors	-	-	0.11	0.77
Total				
<u>Totale</u>				
(a) Animate (1 + 2)		47.3		77.0
(b) Inanimate		0.11		54.6
(a) + (b)		47.41		131.6
(5) hp per hect. cultivated land		0.48		1.31

It is seen that the power available on farm has increased 2.7 times since 1949. Further whereas in 1949 the farm power consisted almost entirely of animate sources, the proportion of inanimate source was 41.5% in 1980.

Hua Goujhu (7) has given a similar estimate. According to him, the power contributed by electrical mechanical sources in 1980 was 191.8 mill. hp. the total number of draft cattle was 95 mill. heads, and manual labour 294.29 million. On this basis the total power per hectare of cultivated area will be 2.68 hp. This is two times higher than our estimate above. The reason perhaps is that Goujhu has included in his estimate also the irrigation and drainage equipment.

It would appear that there is considerable variation in the availability of power in various provinces. In Zhejiang province the power available on farms now is 3.5 hp/h. In this province 60% of the tractors are owned by production team, 34% by brigades and 6% by communes. The average arable land per brigade is 44 h. In Shanghai region the power available on farms is even higher 7.5 hp/h.

The magnitude of power available on Chinese farms is higher than that of India if we take Hua's estimate. According to our estimate however the difference is marginal.

The major component (40.4%) of electrical mechanical power on Chinese farm is for irrigation and drainage purpose. It will mean that the power for other farm operations that required mobile

source, is mainly from animal and human sources. The absence of animal driven improved implements at three exhibitions visited therefore was surprising. In our travel through the country side, it was observed; even in Shanghai region, the tillage operations that were being done at the time, were more often with the help of buffaloes. It was less common to see power tillers and even more rare the use of tractors, perhaps, the exhibitions were intended to be more export oriented.

That, the animal and human sources will remain relevant in China for a long time yet, is also seen by the data given by Hua Guojhu (7) (Table 5). While the electrical mechanical component has steadily grown, the number of draft animals has not materially declined.

Table (5) Contribution of Human Animal and Mechanical Sources of Farm power in China
(In million)

Year	Farm Labourers	Draft animals	Mech/Elec.Power (mill. hp.)
1949	-	60.02	0.11
1952	173.17	76.46	0.25
1957	193.10	83.82	1.65
1960	-	73.36	8.01
1965	233.98	84.27	14.94
1970	-	94.36	29.44
1975	294.60	96.86	161.67
1979	294.25	94.59	181.90
1980	-	95.25	191.80

Source: Hua Guojhu (7)

The Chinese use single animal yokes, whereas in India the most common practice is to use a pair. In southern China buffaloes appear to be the most common draft animal.

However, an aspect of transformation of farm power scene must be noted. India produces and uses 4 wheel and 2 wheel tractors. The latter, power tillers, are however much less successful in India. In China these number 2.5 times the 4 wheel tractors. The power tillers thus are now well established in China as a source of mobile mechanical farm power.

As entirely new development in paddy areas is the use of 'boat tractors' in China. This prime mover, as stated earlier, a combination of power tiller and boat, is a Chinese innovation. It is reportedly becoming increasingly popular among paddy farmers in South China. Already there operate 110,000 sets of these in China. The Chinese engineers are working on perfecting this machine further (12).

5. Farm Equipment and Extent of Mechanisation

5.1 Extent of Tractor Use

As new power units are introduced, the development and use of new associated equipment receives impetus. The second important index of mechanisation, therefore is the extent of use of new equipment. Since the 4 wheel tractors and power tillers were introduced in 1950s and '60s respectively, one can expect the growth of related equipment to have been stimulated from these times.

Aims of mechanisation, the timing, and the type of mechanisation have been intensely debated in China. Mechanisation has been thought of as a means to raise yields, to make farm work more efficient, to complete farm work in time, to battle against natural disasters like drought, flood, pests. It is also seen as a means to reduce costs and to release labour for other sectors of economy and to release land otherwise used to grow cattle feed. It has been realised now that China is vast country with varying soils, climate and topography. The aims of mechanisation will accordingly vary from region to region. It is also realised that along with large machines, there will be need to improve manual and animal drawn equipment. Above realisation, it will appear from literature has not come about smoothly, but rather after many costly experiments and turn of policies.

The area cultivated by tractors has been growing. Chao reported the area cultivated by tractors upto 1964 (shown below). During the seminar, it was reported that by now the area tilled by tractors and power tillers has increased to 43 mh. that is 43% of the total cultivated. The power sown area was reported to be 15.3%, power harvested area only 4.3%. Considering the country as a whole, it will appear

Area cultivated by Tractors

<u>Year</u>	<u>Area (1000 mou)</u>
1954	1,225
1955	4,900
1956	28,720
1959	81,000
1964	162,000 (10% of total cultivation)

Source: Chao (3)

that use of tractor has grown most rapidly in tillage, in other farm operations such as sowing and harvest its use is still small and there is still a vast domain of animal and manual equipment. Within the country, of course there will be variation from region to region.

In Jianigsu province (10) the area of rice transplanted mechanically was about 1.3% in 1979. The paddy harvested mechanically was also 1.3% in 1979. But the threshing now is almost entirely done with power threshers. Tilling is also mechanised to a large degree.

Zhu Lu-kun et al (9) described the process of mechanisation in Shanghai rural area. They divided the process in 4 stages, first from 1952-62, second 1962-1970, third 1970-1976, and fourth 1976 onwards. "During first stage simple, small, semi-mechanised equipment and animal drawn implements were feasible. The later part of this phase saw introduction of power-irrigation with the help of state investment. During the second stage tillage was mechanised, so also was (more of) irrigation, drainage, crop protection, threshing, food and fodder processing. By the end of this stage mechanised tillage was 50% and irrigation 88%. The use of rice planter came into a limited extent. In the third stage, the earlier tendencies of the previous stage were intensified. The fourth stage saw introduction of full fledged combines, with mechanical harvesting reaching 50%. Green houses were built, more wheat equipment was brought in."

In Zhejiang province (where seminar was held) 80.5% of the arable land is under rice (8). The power available from machines is now 3.7 hp/h. The farm machines makes 50% of the total fixed assets in possession of the peasants. Mechanically cultivated land by 1981 was over 60% of arable area. Mechanised irrigation and drainage covered 85% of arable area. Processing of grain, cotton, oilseeds, tea and forage are 'basically mechanised.' Threshing by power and manually operated threshers is common. Crop protection is however by manual sprayers, only partly by motorised ones. Farm transport is now by tyred barrows and tractors. Transport by water relies on manual/wind driven boats. Power driven boats are still only the auxiliaries.

5.2 Equipment

Systematically categorised, year-wise figure of agricultural equipment are not easily available. The need for improvement in equipment has been emphasised on several occasions in the policies after 1949. At the time of liberation, the extent of improved implement was insignificant. Chao (3) reports that even in 1957 there were only 13 major items of improved implements. By 1964, the list of improved implements has grown to 64 items. It was reported in a seminar paper that China now produces about 2000 varieties of small equipment (Table 6).

Some additional information for specific provinces emerged at the seminar. Table (7) shows the number of some equipment in Jhajiang province.

China has made effort to introduce innovations. The boat tractor; and earlier the cable drawn plow for paddy lands are noteworthy examples. An example of failed effort is the double wheel animal drawn plow of Russian design that was tried in the fifties and later abandoned. Ding (11) reported to the seminar the varieties of mechanical equipment introduced for the pond fishery. The mechanical pond aerator was particularly noteworthy.

Table (6) Implements in Chinese Agriculture
(000' units)

Item	1949	1957	1964	1970	1980
All Improved Implements		4680			
Semi-mechanised implements			30000		
Improved Animal Drawn implements		4680			
Rakes		76			
Seeders		56			
Hand Sprayers					20000
Harvesters		20			
Threshers		318			
Processing implements		258			
Combines					20
Farm Trucks					130
Powered pumps					5,900

Source: Figures upto 1964 are from Chau(3) others are drawn from papers presented in Hangzhou Seminar

Table (7) Farm Machines in Zhejiang Province

1. Tractors (No.)	125,000
(a) Of these below 12 hp (No.)	115,000
2. Sets of Irrigation and drainage equipment (average power per set 11.2 hp.)	130,941
3. No. of sprinkle irrigation equipment (driven by 3-12 hp diesel engines, av. hp. 5 hp)	29,800
4. Motorised threshers (driven by 3 hp diesel)	340,000
5. Motorised sprayers (3 hp and 1.6 hp)	42,000
6. Transport equipment	1,866,000
(Tyred barrows and small tractor trailers)	

Source: Liang (8)

6. Mechanisation in China and India

The mechanical power units (tractors) were introduced in China at about the same time as in India, 1945-50. Before that the only farm power in both the countries was from manual, animal sources.

Subsequently, two more, new types of power units appeared in China. The power tillers were introduced in mid-sixties. The work on boat tractors began in early sixties. Perhaps production at small scale began only in the seventies. In India too, power tillers began to appear in the mid-sixties.

The number of 4-W tractors now operating in China, 0.75 m standard units, is comparable to that of India, 0.78 m standard units (1979). In contrast however, the power tillers have gotten well established in China with nearly 1.0 m sets operating there now. In India for a variety of reasons the power tillers have not gained acceptance. There are only a few thousand sets operating in India. Since the land under cultivation in China (100 mh.) is smaller than that of India (140 mh.) the above will translate into greater power availability on Chinese farms in general.

The profile of mechanization in China and India is somewhat similar. In both the countries a very large proportion of mechanical power is being utilised for irrigation.

The next major item that has been mechanised is the tillage. The other operation like sowing, plant protection are much less mechanised.

There were 350,680 wheat threshers and 10245 power threshers for crops in India by 1977. We do not have the figure for threshers in China for that year. But even by 1957, there were 318000 threshers in China. In all likelihood the number of threshers in China will have caught with that of India much by now.

Harvesting in both countries is still at a very low level of mechanisation. Although, again the number of combines reportedly in use in China is much larger (20000). In 1977, the number of combines in India was only 1268.

Another operation in which the chinese have comparatively much greater improvement is on the farm transport. In addition to 130000 farm trucks, the number of improved wheel barrows runs into millions. In India too, the number of carts, the major means of farm transport was 12.7 m by 1977. The types of barrows and carts in use in China would seem to be longer.

7. Farm Power and Machinery Industry

On the eve of liberation just as there were only a few hundreds of tractors and a limited number of irrigation and drainage units, there was also hardly any agricultural machinery industry. Some units existed for the manufacture of small equipment. The tractors and irrigation equipment in use then were imported.

The construction of Luoyang First Tractor Works - the largest plant in China - began in 1953. It went into production in 1959. By now (1982) China can mass produce 75 hp., 100 hp. and 150 hp. tractors, and also the crawlers. There are now 1900 farm machinery manufacturing concerns. There are also 2400 county-run farm machinery manufacturing and repairing plants, with each county having one. It is reported that barring a few complicated machinery, China now produces all the types that it needs. It has been stated earlier that nearly 2000 types of small agricultural machinery is being produced.

We were able to visit three exhibitions of export oriented agro-machinery in Jhejiang, Fujian and Guandong provinces. A list of machinery on display is given in Appendix (8). All the three provinces fall in the southern part of China which is predominantly paddy growing area. Hence the emphasis on paddy related equipment in the exhibitions. The equipment displayed in the exhibitions generally was drawn from factories and workshops of the respective provinces. The Jhejiang province, has 114 factories for the manufacture of farm machines and equipment. A total of 50,000 persons are employed in these.

The factories and workshops we actually visited were the following:

- (a) Puyan Commune machinery repair and crank shaft manufacturing unit.

This unit had 275 workers. It undertook repair of machinery and had diversified into fabrication of structural steel items such as window frames and manufacturing of crankshafts. It was equipped with welding units, a foundry and a machine shop. The unit employed workers largely from within the commune. The training of technicians and workers also mostly took place on the job.

(b) The Agro-machinery Manufacturing Unit.

This was a much larger plant, located on 46 hect. site; and employed 3400 workers. It manufactured marine gear boxes.

(c) Kui Shan Commune Agricultural Machinery Factory

This was established in 1968, began with a staff of 50, drawn from among the local artisans and technical hands. Initially it manufactured manual tools. By 1982, it had 300 workers, 16 shops, built on a 13000 sq. m. site. It had sheet metal shop, casting unit etc. It now manufactures machinery for paper mills.

(d) Chen Mein Commune Fishery Machinery Factory

Established in 1953, is a commune run enterprise manufacturing fishery equipment. It has diversified into valve manufacturing now. Nearly 250 types of valves are manufactured. It had 153 workers.

(e) Fujian Tractor Manufacturing Unit

Established in 1956, manufactures 9 types of 4 wheel tractors and 2 wheel tractors. Last year (1981) it produced 12000 sets of 2 w tractors. It employed a staff of 2000 including 150 engineers. The plant is located on a 5000 sq. m. site.

It has one division for research and development, one for testing. The power range of 4 types of 4 wheel, and 5 types of 2 wheel tractors produced here in 3 to 50 hp. range.

The director of the factory indicated that recent trend is for 2 wheel tractors which are used in paddy fields, small dry-land fields and on vegetable cultivation.

Their products go to other provinces of China and also some are exported to African and Asian countries.

(f) Fujhou Engine Works

This is an old unit working since 1911. It has 1000 staff and workers; situated on a 20000 sq.m. site; among the employees are 50 engineers. It produces three sizes of internally cooled diesel engines of 5.24 and 36 hp. It has diversified into industrial sewing machines. The engines produced here are used for power generation, tractors, rice mills etc.

(g) Foshan Agricultural Machinery Factory (No.2)

Small factory, 300 workers, produces farm equipment. These include hand reapers, wire loop drum type motorised and foot pedal operated paddy threshers, small manual tools, and hand operated blowers.

Since the South is rice country, the predominance of rice equipment is understandable. However, it was somewhat surprising that animal driven and manual equipment was not much in display. In some of the plants visited such as one in Kuishan Commune, while the name continues to be 'agricultural machines factory,' the line of production has changed considerably away from the original.

8. Financing of Agro-machinery

It was seen in Table (6) that until 1965, only a very small proportion of tractors were owned by the communes. Majority of the tractors were owned by state farms for their own use. A much large proportion was owned by AMSs and rent out to communes. Subsequently it would appear, there has been transfer of tractors from AMSs to the communes. During the seminar, nothing was heard of the AMSs. It was indicated in some of the papers that now ownerships of agricultural implement and machinery is generally at three levels, the production team, production brigade and the communes. The teams own smaller equipment (threshers, small pumps, crop protection equipment) of their need. The brigades own medium size equipment (food and fodder process equipment, pumps stations etc.) and the communes, the bigger, high cost machines (tractors).

Apparently, the state has helped finance mechanisation to a large extent in early stages. Now, the state funds are limited and financing is expected to be done by the communes with their internal funds.

Jhu, et. al (9) discussed the relationship between need for finance of machinery and the surplus generated by agriculture and industrial activity in communes in Shanghai region. In the recent past, in Shanghai region the annual accumulation of funds for investment has been about Y 30/mu of cultivated land. This is insufficient to purchase machines. There is need therefore they state,

to encourage commune industries and buy tractors from surpluses generated from industrial and 'side-line' enterprises of the communes. This area is close to the big city and has certain advantages. It can be inferred that in the hinterland the pace of fund accumulation will be even slower, and peasant's purchasing power smaller. Therefore, difficulties are emerging in financing of mechanisation, particularly if the machines required are large and expensive.

In Zhejiang province, the proportion of tractors run by communes, production brigade and production team is respectively 6%, 34% and 60%. However, the average size of land per team is only 6 h; which is proving too small for the machines. Looked at the brigade level however, the land will be about 44 h., which makes it imperative that facilities such as pump stations be managed by the brigade. In the province the cash for purchase of machinery is self-provided by the commune, brigade and teams. During the last three years the cash from within was 67% and bank loans 33% (8). In this region the annual accumulation has been only of Y 180/h. of land; in richer parts it was y 270/h. and in poorer parts only Y 100/h. Usually only 1/3 of the accumulation can be used to buy farm machines. Additionally, a part of commune's industrial accumulation can also be used to buy machines.

9. Education and Research in Farm Machinery

In the past 30 years, China has built a new-work of institutions for education, research and development in farm machinery and education.

A separate ministry, called Ministry of Agricultural Mechanisation Sciences were established in 1959. A little later, in 1961, the Chinese Academy of Agricultural Mechanisation was established. Also in 1961, two major national level research institutions were started, Luoyang Tractor Research Institute and Shanghai Research Institute of Internal Combustion Engines. Simultaneously, a large number of research centres were started in provinces, counties and prefectures. Fisheries Machinery and Instrument Institute came into being in 1963.

By now (1981) the network has grown in dimension. A total of 11 colleges of agricultural engineering are now in operation 7 of these being directly under the Ministry of Agricultural Mechanisation Sciences.

There are 58 departments of agricultural machinery operating in agricultural or engineering colleges. The total enrollment in these is 27500.

The strength of teaching staff of the 7 agricultural machinery colleges (under ministry) mentioned above numbers 3400; including 325 professors and associate professors, 1887 lecturers.

It was reported in one of the papers that now a total of 100,000 persons are engaged in design and development of agricultural machinery. In another paper however it was stated that 20,000 persons are now engaged in research and development in farm machinery and extension of advanced techniques.

Our visit took us to some of the research institutes. The Fujian Agricultural Machinery Research Institute is located in Fujhou city. This institution conducts research in agricultural machinery, hydraulics and also tests equipment.

Also located here was the Fujian Water Turbine Pump Research Station, It is a national level institution and has done good work on turbine pumps, combine harvesters, rice puddling equipment etc. The Institute also trains technical personnel.

Quandong Institute of Agricultural Machinery Research is located on the outskirts of Guangjhou (former ly Canton). This has several departments, workshops, animal drawn equipment department, crop drying department etc. A round of the departments revealed that research was being done on development of 12 hp. 4 wheel tractor, rotary reapers threshers, head feeder-combine, paddy dryers, chicken feed mixers, tobacco dryer etc.

South China Agricultural College (Xiejing University) also located in Guangjhou, has an agricultural engineering department. It has a full-fledged undergraduate programme (4 years) with nearly 400 students. They have also recently started a master level programme in farm machinery; first set of graduates were shortly to emerge. The number of faculty is 100. There was research being conducted in rice planter, performance of rotary blades etc. The masters' programme consists of 7 courses and theses research.

10. Some Lessons

Agricultural mechanisation is considered necessary in China and is likely to gain momentum. Future growth of mechanisation will be conditioned by three main factors (a) the ownership of arable land being small machinery among the production teams, it is small machinery and matching equipment that is likely to be more in demand (b) the human labour and draft animals still constitute a large proportion of farm power; the pace of mechanisation will be conditioned by the pace at which the industrial activity is developed in and around the communes. Machines that replace draft animals will grow more rapidly (c) the financial surplus needed for purchase of machinery will be a constraint, effecting this pace.

Wu (13) has made a comprehensive assessment of the energy situation and future need in rural area. He indicated that while potential reserves conventional energy are large in China, there is need to develop suitable policy and priority for mechanisation from the point of view of energy use. He advocates mechanising the critical operations, puddling, plant protection, irrigation, harvest and transport. For the rest he advocates use of animate sources with improved implements. Improvement is needed much more in use of energy in domestic life in rural area. Energy use also therefore will be a factor in shaping mechanisation strategy.

All land in China is socialised; with major portion under the management of communes. In communes it has been the production teams nearly 5.8 m in number are the basic production units. In India, land is privately owned, divided into nearly 70 m holdings. The average size of land under production team would be about 12 h whereas the average holding size in India is / much less. This feature may be the major reason why growth of machinery usage has been more rapid. This is a difference which cannot be easily bridged. Yet there are lessons that can be useful.

The concept of mutual and teams that preceded the formation of cooperatives can be useful in bringing benefits of equipment and machinery among small and marginal farmers.

The development of boat tractor as it was revealed in the seminar has had an interesting beginning. At first the idea was suggested by some paddy farmers who had tried the cattle pulled plow. The engineers who worked closely with the farmers, then gave it a concrete form and developed it. Closeness of professional scientist to working peasants is another feature that needs to be built or reinforced in the country.

When one speaks of mechanisation in agriculture in India, normally it refers to cultivation. In China, mechanisation has not been thought of in this sense. They include in this , the agro-industries fisheries and forestry.

Since the above sectors are allied to agriculture or very close to it, it does appear sensible not to think of mechanisation only in relation to farming. The Engineers who are concerned with cultivation must also concern themselves with allied sectors. This will mean that their training has to be broadened to include the problems of these sectors should not be difficult to do.

In India debate on mechanisation has been somewhat narrowly confined to question of displacement of labour. This is no doubt important. Chinese Society which is more deeply committed to worker welfare, than many has pointed out that farm mechanisation is useful from the point of view of stabilising yields, reducing vulnerability of agriculture to natural hazards like droughts, pests etc. Mechanisation can have multiplicity, of aims, depending on the natural, social and economic circumstances. In the use of biogas too, for which China has nearly 7 m digesters, there can be useful lessons for this country.

The Tour Itinerary

Date	Visits To
June 22, 1982	<p>The Puyan Commune</p> <ul style="list-style-type: none">(a) The Agricultural machinery repairs working and Crank Shaft Factory of the Commune(b) The grain processing unit of the Commune(c) The Knitting Unit of the Commune(d) Some households of the Commune members(e) Field Demonstration of some agro-machinery including boat tractor, power tiller, 4 wheel tractor, working in paddy field; sprinklers(f) Agro-machinery manufacturing factory - making marine gear boxes, etc.(g) Agro-machinery exhibition
June 23-26	Seminar
June 27	Travel to Shanghai by train, stay overnight
June 28	Travel to Fujhou, by plane
June 29	<p>Eluei Commune</p> <ul style="list-style-type: none">(a) Eluei Tidal Water Turbine Pump Station(b) Chen Mein Shoe Factory(c) Limin Brigade (Hongshan Commune)(d) Kui Shan Commune Agricultural Machinery Factory
June 30	<ul style="list-style-type: none">(a) Fujian Tractor Manufacturing Co.(b) Fujhou Engine Works
July 1	<ul style="list-style-type: none">(a) Gu Shan Buddhist Temple (Morning)(b) Fujian Machinery Export and Import Corporation
July 2	<ul style="list-style-type: none">(a) Gujian Agricultural Machinery Research Institute

The Tour Itinerary (Cont.d)

Date	Visits to
July 3	Travel to Guangjbou
July 4	(a) Da Li Commune (b) Ten Pien Brigade (c) A Peasant Household (d) Foshan Agricultural Machinery Factory No.2 (e) Foshan Temple (Tao)
July 5	(a) Guandong Institute of Agricultural Machinery Research (b) South China Agricultural College (Xijing University, Department of Agricultural Engineering, Agricultural Economics)
July 6	Guandong Province Agricultural Machinery Exhibition

List of Farm Machines Displayed in the Three Exhibitions

Sl.No.	Name of the Machine	Size
1.	Long Jiang Combine Harvester	12 hp 1200 mm cutter width
2.	Minsung Paddy Field Leveller - Power Tiller driven (12 hp)	Working width = 3500 mm.
3.	Rice Polishing Machine (Motor powered, 4 kw.)	275 - 300 kg/hr.
4.	Hand Pump	
5.	Paddy Thresher (Wire loop type) peddle operated	
6.	Two Wheel Tractor - Dong Fend - 12	12 hp
7.	Diesel Engines (model 295, 395)	24 - 36 hp
8.	All purpose mill (motor driven 4 kw)	
9.	Diesel - generator sets-several models and sizes	
10.	Boat Tractor - Model Dong Fend -12	12 hp
11.	Turbine Pumps (5) sizes	
12.	Sprinklers	
13.	Eastern Walking Tractor	12 hp
14.	Paddy field plow - 4b (Tractor driven)	30, 40, 50 hp.
15.	6 Bottom Tractor mounted plow	54 - 75 hp
16.	Brush and Bog Single Bottom plow (tractor)	54 hp

List of Farm Machines Displayed in the Three Exhibitions (Cont.d)

Sl. No.	Name of the Machine	Size
17.	Rice seedling Transplanter 4 hp tractor driven	
18.	Grain Combine Harvesters (tractor)	75 hp
19.	Water sprayers (6 -7 hp)	
20.	Knap sack sprayers	
21.	Motorised rice threshers	
22.	Sugarcane crushers (14 hp)	
23.	Rice Mill	
24.	Oil press (10 kw)	
25.	Trailers	
26.	Drills for excavation	
27.	Sea water pumps	
28.	Petrol engines - several sizes, models	
29.	Kerosene engines - several sizes	
30.	Windrovers (Power Tiller)	
31.	Needle processing machine	
32.	Disc mower	
33.	Spades, hoes, Scissors, Sickles, Axe, Chisels, rakes	
34.	Fodder clupping machine	
35.	Centrifugal pumps	
36.	Rotary tillers	

List of Farm Machines Displayed in the Three Exhibitions (Cont.d)

Sl. No.	Name of the Machine	Size
37.	Submersible pumps	
38.	Rock drills	
39.	Marine outboard motors - several sizes	
40.	Piston - Diaphragm pumps	
41.	Tea rolling machine	
42.	Tea plantation tractor	

Source: The equipment catalogues distributed at the Exhibitions

12. Xie Zhen-Kun, Wang Wen-Lung, Zhou Yong-Guan and Chen Zhen-Gao.,
The Adaptability and Economy of Boat Tractors, ISMSSF Paper
13. Wu, Xiang - gun., China's Agricultural Mechanisation in Relation to Rural Energy, ISMSSF Paper.
14. Liu, Wen duo., Interplanting and Intercropping System in North China And Adaptability of 5 Hp. Power Unit for It., ISMSSF Paper.
15. Sharn, Girja. Agricultural Mechanisation in Gujarat, ISMSSF Paper

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9. Zhu Lu-Kun, Boo Jheng-Le, Zhou Wen-Fang, Liu Si-Dong and Ling Yan, Interaction Between Farm Mechanisation And Commune-run Industry in Shanghai Rural Areas, ISMSSF Paper.
10. Gu, Qianan , Study on Use of Small Farm Machines in Rice Production in Taihu Area, Jiangsu, PRC., ISMSSF Paper.
11. Ding Yongliang, A Survey of the Mechanisation of Pond Culture of Fishery in China, ISMSSF Paper