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**TRANSPORT EQUIPMENT FOR AGRICULTURAL AND RURAL
DEVELOPMENT: THE EXPERIENCE OF CHINA**

Prepared by Liu Honglin*

*Chief Engineer, Bureau of Construction and Agricultural Machinery of the
Ministry of the Machinery and Electronics Industry, China.

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I. AGRICULTURE: THE ECONOMIC BASE OF CHINA

A. Natural and economic conditions

China is a country with an ancient civilization that can be traced back some four thousand years. It is also a big country, abounding in natural wealth and having a very large population. The land area is 9,600,000 square kilometers, which amounts to 6.5 per cent of the world's total, making China the third largest country. Both east to west and south to north the distance is more than 5,000 kilometers. The rivers that criss-cross the country and the extensive mountainous areas form a highly varied topography. Indeed, mountains, highlands and hills make up 65 per cent of the total area of the country, while cultivated land accounts for only 10.3 per cent of the total. The population of China is about 1.1 billion, which is equivalent to one fifth or more of the world's total. This makes for a population density of 114 people per square kilometer.

Cropping systems vary from place to place. About 70 per cent of the territory lies in the temperate or subtropical zones. In the Changjing River basin and in southern China, there are two or three crops per year. In most places in northern China, by contrast, there are three crops every two years, and in north-eastern China and the Inner Mongolia Autonomous Region there is but a single crop per year. The main crops are rice, wheat, corn and cotton.

China is a developing country whose economic base is very weak as a result of the country's long history of domination by feudal, semi-feudal and semi-colonial societies. In the 1930s there were few industries on a national scale. Modern industry made up only about 10 per cent of the national economy, while agriculture and handicrafts made up 90 per cent. In 1949, the gross value of industrial output was only 14 billion yuan renminbi, or \$US 3.8 billion, accounting for 30 per cent of the gross value of industrial/agricultural output.* Moreover, the industries were small and weak and concentrated in just a few coastal cities. Agriculture, which accounted for 70 per cent of the gross value of industrial/agricultural output, was also underdeveloped, as was the commodity economy. In fact, the economy of the vast rural area was more or less in a natural condition.

The founding of new China, in 1949, put an end to the semi-feudal, semi-colonial society, and a fairly comprehensive industrial system has been put in place during the last 40 years. In 1988, the gross value of industrial output amounted to ¥RMB 1,810 billion, or \$US 490 billion, approximately 130 times as much as in 1949, with the gross value of industrial output accounting for 76.3 per cent of the gross value of industrial/agricultural output. Other sectors of the economy developed at the same time. By 1988, the gross national product amounted to ¥RMB 1,385 billion, or \$US 374 billion, putting China in the front ranks of the world with respect to this particular statistic. However, owing to its large population, per capita production and income are still low, leaving China behind in this world ranking and giving it the status of a developing country.

B. Importance of agriculture

Since 1949, agriculture has developed considerably, together with other sectors of the economy. By 1988, the gross value of agricultural output amounted to ¥RMB 561.8 billion, or \$US 152 billion, 17 times the output in 1949, and the total production of food grain had increased by 250 per cent.

*¥RMB 1 = \$US 0.27 at the time this report was written.

This was true even though, as mentioned above, the percentage of the national economy accounted for by agriculture had decreased, owing to the rapid development of industry and the low value of agricultural products relative to industrial products. While the gross value of agricultural output accounted for only 23.7 per cent of the gross value of industrial/agricultural output in 1988, China still, for a number of reasons, considers agriculture to be the foundation of its national economy:

(a) In 1988, the gross value of rural output, ¥RMB 1,207.8 billion, or \$US 326 billion, made up a considerable share, 41 per cent, of the country's total. To counter the high density of population and the shortage of farmland, China has for many years had policies to control the increase in urban population. At the same time, it has encouraged the development of industries in the villages and towns; such industries employ redundant farm labourers and keep them from leaving the countryside for the cities. In 1987, the gross value of output of these industries at the village and town levels surpassed the gross value of agricultural output;

(b) China's rural areas, with their population of 800 million, make up 80 per cent of the total population of the country and form an extensive market for industrial products. Up to 57 per cent of the country's purchasing power and 60 per cent of its cash deposits are found in rural areas. Moreover, half of all retail goods are sold to the countryside. It is economic indicators such as these that favour the development of industry. In 1988, just the agricultural machinery sold to the countryside was valued at ¥RMB 15.9 billion, or \$US 4.3 billion.

(c) Rural areas are the main source of production factors, including raw materials and labour resources, for many different industries. For example, the gross value of the output of light industry makes up 37 per cent of the gross value of all industrial/agricultural output, and the value of the output of light industry that takes agricultural products as its raw material makes up 70 per cent of the gross value of the output of all light industry. At present, the countryside is not able to provide sufficient raw materials for industry, so some raw materials have to be imported. Furthermore, the countryside must also provide food grains and other foodstuffs for urban and other nonagricultural populations.

With its cultivated land accounting for only 6.8 per cent of the arable land of the world but supplying 21.8 per cent of the world's population, China is none the less managing to develop its economy and raise the living standard of its people by its own efforts. Historically, the growth rate of a country's economy has been mainly influenced by the growth rate of its agriculture. Whenever a bumper harvest has supplied more food and more raw materials, the growth rate of industry has quickened and the market has been stimulated. A poor harvest, by contrast, has always limited or even reduced the development of industry. China has, therefore, always attached importance to agriculture and regarded it as the foundation of the whole economy. This is still true, especially as industry is just beginning to grow.

C. Overview of the agricultural machinery industry

One of the important tasks of Chinese industry is to supply farmers with mechanical equipment to replace the animal-drawn and hand-operated equipment they have depended on for thousands of years. Accordingly, the Government has paid great attention to the development of agricultural machinery, and the industry developed rapidly after 1949. Initially, its capabilities were limited: it could only improve old farm implements and repair some imported farm machines. Now, 16 categories of equipment consisting of more than 3,200 kinds of agricultural machine are designed and manufactured in China itself.

A fairly comprehensive industrial system is in place covering 13 industries for making agricultural machinery, namely, tractors, internal combustion engines, tillage machinery, plant protection machinery, harvesting machinery, machinery for farmland capital construction, irrigation and drainage machinery, transportation machinery, animal husbandry machinery, fishery machinery, agricultural and sideline product processing machinery, food processing machinery and spare parts for tractors and internal combustion engines. The system is capable of carrying out tasks such as research and design, manufacturing, and selling and service. By the end of 1987, there were 2,422 agricultural machinery manufacturers with 1,220,000 staff and workers; the fixed assets of these manufacturers were valued at ¥RMB 12 billion or \$US 3.2 billion; and the gross value of their output amounted to ¥RMB 15.77 billion, or \$US 4.26 billion. These manufacturers are capable of producing tractors of 2.2-117.6 kW (3-160 ps) and their accessory implements; internal combustion engines of 0.74-1,470 kW (1-2,000 ps); grain combine harvesters of 8.8-110 kW (12-150 ps); large axial-flow pumps with impeller diameters of 4.5 m; complete sets of feed processing equipment with a capacity of 10,000 tonnes per year; complete sets of poultry-raising equipment for flocks of 100,000 birds; various kinds of transportation equipment and small mechanical or semi-mechanical farm machinery. Taken as a whole, this production basically meets the needs of agriculture in the country, and some machines have even been exported.

During the past 40 years China's agricultural machinery industry has produced machines and equipment valued at ¥RMB 110 billion, or \$US 30 billion, dramatically raising the technical level of the country's agricultural equipment and contributing to the modernization of the agricultural sector. By the end of 1987, the total power of agricultural machinery had reached 249 million kW. The number of large and medium-sized tractors in use and in stock had reached 883,000, small tractors had reached 5,296,000 units, agricultural pumps had reached 5,842,000 units and combine harvesters, 34,000 units.

II. THE ROLE OF TRANSPORTATION EQUIPMENT IN RURAL DEVELOPMENT

The rural transportation equipment referred to throughout this report is the equipment that is used, on the one hand, to collect and distribute agricultural output for storage, sale, processing or export and, on the other hand, to carry to the rural population means for production, such as fertilizer and tools, as well as basic consumer goods and building materials. Because rural transportation is such a labour-intensive task, its mechanization is an important component of the overall mechanization of agriculture. In recent years, as the rural economy diversified and the percentage of farm product sold as merchandise increased, the efficiency of transportation directly influenced not only the development of the rural economy but also farmers' incomes. Consequently, the industry that manufactures transportation machinery has developed even more rapidly. For example, in 1987 the gross value of the output of farm vehicles increased by 77 per cent over 1986, and in 1988, it increased another 58.1 per cent. While the gross value of the output of all agricultural machinery also increased, the increase was not nearly so great: 29.1 per cent and 29 per cent in the corresponding periods. In fact, the farm vehicles sector was the fastest growing of all the sectors in the agricultural machinery industry, and in respect of this rapid growth, a number of observations are worth noting.

First, the transportation of agricultural produce is the most labour-intensive of all agricultural operations, consuming 40-50 per cent of the total amount of labour expended in agriculture. This proportion becomes 55 per cent in vegetable-growing areas on the outskirts of big cities and

60 per cent in mountainous areas. The quantities transported vary greatly from place to place, ranging from tens of tonnes to hundreds of tonnes per hectare. Field transportation alone amounts to 9 billion tonnes per year, based on an estimated average transportation of 90 tonnes per hectare per year. Looked at in another way, each farm labourer is responsible for 30 tonnes of field transport every year. Since transportation is also a key link in forestry, animal husbandry and fisheries, here, too, both its mechanization and the improvement of its efficiency should be given the highest priority.

Secondly, rural transportation is an important link in the flow of goods and materials between cities, of which China has relatively few, and the countryside, which is vast. At the same time as food grains, cash crop products, animal and aquatic products and sideline products are being transported to the towns and cities, fertilizers, farm chemicals, petroleum products, farm machinery, building materials, daily necessities, fuels, processed foods etc. are being transported to the countryside. All of these goods and materials fall into one of four categories: agricultural and sideline products, means of agricultural production, basic consumer goods and building materials. According to various surveys, the total quantity of agricultural and sideline products transported every year between cities and rural areas amounts to about 400 million tonnes; means of agricultural production, about 200 million tonnes; daily consumer goods, about 400 million tonnes, and building materials about 2 billion tonnes. Altogether, these four categories of transportation total 3 billion tonnes. The volumes of building materials being transported are extremely high because China is now in a peak period of rebuilding old houses and building new ones. The flow of goods and materials will increase along with the development of rural resources, the growth of the commodity economy and the improvement in living standards, creating an even more urgent demand for transportation equipment.

Thirdly, rural transportation is essential to the development of industry in rural areas and towns, which goal is an explicit policy of the Government. Not only has the rapid rise of rural and town industry rationalized the rural industrial structure but it has also brought into play the potentialities of the production factors in rural areas. As rural industry and town industry develop, the rural economy has become more prosperous and farmers' incomes have increased, narrowing the gap between city and country. Furthermore, surplus farm labour has been absorbed by local industries, averting the disastrous consequences of large numbers of farm labourers pouring into the cities. The requirement for transportation has increased at the same pace. It has been calculated that for every ¥RMB 10,000 of rural and town industry output, 50 tonnes of goods must be transported. At this rate, the quantity of goods transported would have reached 2.5 billion tonnes in 1987. There is thus much scope for the development of transportation equipment.

Fourthly, the efficiency of rural transportation is an important factor in preventing losses of farm products, especially products susceptible to spoilage and decay. It is estimated that 10-15 per cent of fruit and a similar portion of aquatic products are lost yearly because they are not transported on time or in proper equipment. It is not enough to just increase the production of existing types of transportation equipment; specialized equipment must also be developed.

Lastly, better rural transportation is a prerequisite for the development of outlying and backward areas. The north-west and south-west parts of China are mountainous areas rich in mineral resources. They are, however, very backward and are also hard to reach owing to poor communications and transportation. To exploit the resources and promote the economy of these

remote districts, it is crucial to first build highways and improve communications. Only well-developed systems of this sort can facilitate the flow of information and the exchange of goods and materials, lifting the people out of poverty.

As a result of some important economic policies that were implemented in recent years, the initiative of farmers has been brought into play and the economy of rural areas and towns has been greatly diversified. Nevertheless, the backwardness of rural transportation continues to restrict economic growth.

III. DISTINGUISHING FEATURES OF RURAL TRANSPORT IN CHINA

A. Short distances

China has relatively little arable land and a vast population. The amount of farmland per labourer amounts to only 0.4 hectare, less than 1 per cent of the corresponding figure in the United States of America and in Western Europe. In most rural areas the agricultural commodity economy is underdeveloped and the agricultural management scale is fairly small. Exceptions are the state farms for commodity grains in the north-east and north-west and in the three river basins of north-east China, where the agricultural management scale is larger. Thus, the long-distance transport of large quantities of agricultural products makes up only a small share of all agricultural transport, much less than in countries where the commodity economy is highly developed, while short-distance transport makes up the largest share. In China, the main point for collecting and distributing agricultural materials is the supply and marketing co-operatives that have been set up in villages and towns. Means of production and livelihood, such as tools, fertilizers and farm equipment, are transported via the nation's commercial network to the supply and marketing co-operatives, then distributed to the rural users. Conversely, agricultural outputs are sold by farmers to the supply and marketing co-operatives, then transported via the commercial network to consumers at the other end. Since produce markets are held mainly in the villages and towns, rural transportation consists mostly of carrying the produce between the field and the nearest village or town. According to surveys, field transportation usually involves distances between 0.5 and 3 kilometres, while production equipment is transported only 20-40 kilometres. Less than 10 per cent of the total is transported more than 50 kilometres, although in terms of transportation turnover (tonne·kilometre), the proportion is 30 per cent.

B. Large variety, small quantities

The goods to be transported are assorted in kind and small in quantity because the manufacturers are relatively small and make their varied products in small batches. Still, equipment and tools are scarce. Since most of goods and materials are handled manually, a great deal of time is needed for the auxiliary work of transportation. Sometimes 80 per cent of the operational cycle is devoted to handling the goods or just standing idly by, waiting to handle them.

C. Seasonality

In the busy farming season, many operations, such as fertilizing, planting, harvesting, threshing and storage, have to be carried out at just the right time. Food grain, fresh produce and aquatic products will rot and the loss will be heavy if they cannot be transported on time. Transportation is therefore a highly seasonal operation. In general, the busy seasons are

March and April, June and July and October and November in the north and from May to June and September to November in the south. Investigations have shown that the ratio between the amount of agricultural transportation in the busy season and that in the slack season is 12:1.

D. Lack of good highways

The choice of transportation equipment and the performance of this equipment depend on road conditions. Although a great deal of attention has been paid to the construction of highways and considerable success has been achieved, the pace is still too slow to suit the growth of the national economy. At present there are 960,000 kilometres of highways in China, giving an average density of 0.1 kilometre per square kilometre. Highways in rural areas account for 70 per cent of the country's total, averaging 6.7 kilometres per 1,000 hectares of cultivated land, equal to only 10 or so per cent of the highway density in developed countries. The distribution of highways also varies from place to place. While there is bus service from one village to another on the plains, there is only infrequent service or no service at all between villages in hilly and mountainous areas.

The quality of roads is generally poor. The better highways, that is, first- and second-class highways, make up only 5 per cent of the total. About 70 per cent of the highways are very poor in quality. In rural areas, road conditions are even worse. Most of the highways running from country towns to the surrounding villages are paved with sand and cobblestones and are only 6-7 metres wide; in the few places where they are 8 metres wide and paved with asphalt, buses or trucks can get through, even in wet weather. Roads between villages are mostly of dirt and cobblestones and are 4-5 metres wide, except for a few 6-metre-wide asphalt and sand/cobblestone roads. Here, vehicles can get through only when the weather is good. Within the villages the roads are mostly dirt/cobblestone and are only 1.5-3 metres wide. While they are intended mainly for the movement of agricultural machinery, sometimes only walking tractors and hand-barrows can get through. It is still worse in mountainous areas, where there are even fewer roads and where they are often tortuous, steep and narrow. Even in pastoral areas on the prairie there are usually no good roads between villages and towns. To improve the rural roads as they should be improved, large investments would be needed and some cultivated land would have to be taken over, so this is not likely to happen in the foreseeable future. Since it is predicted that highways of poorer quality will still make up 60 per cent of China's total in the year 2000, it is reasonable to continue to choose machinery that is appropriate for these conditions.

E. Limited purchasing power

What kind of transportation machinery farmers choose depends largely on their incomes, which in recent years have increased rapidly. In 1987 the per capita net income of the rural population was ¥RMB 460, or \$US 124, a 240 per cent increase over income in 1979. However, that level is still very low compared with some other countries. Studies show that the expenses of a farm household of medium income are roughly as follows: 40 per cent for subsistence, 10 per cent for social burden, 30 per cent for simple reproduction and only 20 per cent for means of production and extended reproduction. Farmers still cannot afford to buy large, expensive transportation equipment. Rather, they will choose medium-size and small vehicles having medium and low carrying capacities and medium and low speeds. Such a vehicle should have high ground clearance, short turning radius, ample power reserve, good high climbing capacity and good passing ability. It should also be simple in structure, easy to operate, reliable and cheap.

IV. THE HISTORY AND CURRENT STATUS OF RURAL TRANSPORTATION EQUIPMENT

China's rural transportation machinery industry can be thought of as having evolved during four periods: before 1949, 1949-1958, 1958-1978 and after 1978.

A. Situation before 1949

Before 1949 there was not a single factory devoted to the manufacture of rural transportation machinery. Transportation in rural areas was primitive and was basically carried out by animals and people. In the north, where there were extensive flat-lands, horse-drawn carts were the most common kind of transportation equipment. In mountainous areas, the animals themselves were the main carriers. In the south, people carried goods and materials, mainly on their shoulders but sometimes also with single-wheeled wooden barrows. Boats propelled by people were used for short- and medium-distance transportation where there were waterways. Obviously, these age-old and crude transportation tools were not only inefficient but also labour-intensive.

B. Situation from 1949 to 1958

The first 10-year period after the founding of new China, that is from 1949 to 1958, can be considered as the initial stage in the development of rural transportation in China. At the time, animal-drawn and hand-operated transportation means, although they had been somewhat improved, still predominated in vast areas. Since the agricultural machinery industry had only just been set up, it was impossible to replace all the outdated equipment at once. Agricultural production entered a new era as land reform was accomplished and as agriculture was re-arranged on a co-operative basis. The volume of rural transportation also increased drastically. Neither the antiquated farm tools nor the outmoded transportation equipment could meet the new needs of agriculture.

A wave of innovation took place in 1956, not only with respect to farm tools and implements but also in respect to transportation equipment. The construction of irrigation schemes promoted the development of equipment for land transportation. The wooden wheels on hand-barrows and animal-drawn carts were replaced by inflatable rubber tyres and journal bearings were replaced by ball-bearings, improving the efficiency of transportation and making hand-barrows much more acceptable to the farmers. Water transportation also made headway. In 1957, wire-reinforced concrete boats were introduced. Not only were concrete boats more sturdy and durable than wooden boats, but the materials needed to build them were more easy to come by. Moreover, since it cost only 60 per cent as much to build concrete boats, such boats quickly became popular in places that were criss-crossed by rivers and canals.

C. Situation from 1958 to 1978

From 1958 to 1978, China's agricultural machinery industry forged ahead. Tractors and motorized boats started to be used. Nevertheless, because the economy of rural areas was still fairly weak, only a few mechanical devices could be afforded. Semi-mechanized equipment was still the most popular, especially rubber-tyred hand-barrows and animal-drawn carts, which were simple in structure, low in price, easy to maintain and energy-saving. Blueprints for two hand-barrows, one single-wheeled and tyred (Model 350) and the other two-wheel and tyred (Model 650), were standardized nationally in 1959, by which time the innovation of farm tools and implements was well under way. In that year, 259,000 wheels for tyred hand-barrows were produced. In 1961, the designs for these tyred barrows were modified to strengthen the axles and

spokes, and the bearings were upgraded; these modifications reduced the breakage of spokes by 90 per cent and prolonged the service life of the barrows by 500 per cent. The interchangeability of parts was also improved. By 1978, the yearly output of tyred barrows had reached 10,300,000 wheels and the number in use amounted to 29,630,000 wheels, a 900 per cent increase over 1959. At the same time, the number of animal-drawn tyred carts also grew rapidly: by 1978, the number in use was 2,488,000 units, an increase of 360 per cent since the end of the 1950s.

The popularization of tyred barrows and animal-drawn carts was just the first step in the development of rural transportation. It represented only a slight improvement in working conditions compared to carrying goods on the shoulders. To further relieve farmers of the heavy burdens of transportation and to modernize the entire rural transportation network, it was necessary for China to develop mechanical equipment suited to local conditions.

At that time, the system of people's communes and collective ownership was being put into practice. The production of food grain was given the highest priority, so diversification of the economy had to be deferred. Only a small portion of agricultural produce could be sold as a commodity. The agricultural machinery industry emphasized the development of large and medium-sized machinery for field operations such as tillage, planting and harvesting, so that mechanical transportation equipment was largely dependent on the tractor, which was the most common power unit on a farm. By the end of the 1950s a number of agricultural machinery factories had started to make trailers that could be attached to large and medium-sized tractors to provide rural transportation. In the 1970s, small tractors with matching trailers started to become popular. In 1978, the production of various farm trailers amounted to 365,000 units, an 800 per cent increase compared to 1970. In places that had networks of waterways, motorized boats soon came into widespread use. The number of motorized boats grew from 65,700 units in 1978 to 292,000 units by 1987, a 340 per cent increase.

D. Situation after 1978

Since 1979, comprehensive economic reform has been carried out in the rural areas of China. A system of contracted responsibility linking remuneration to production has been put into effect. Farmers have been encouraged to do their best, which has speeded the growth of the rural economy and greatly increased the output of food grains and other agricultural products. Rural and town industry has also grown and the economy has become much more diversified. Commodity agricultural production has kept pace. Rural transportation has thus been forced to develop at an unprecedented speed. Not only has the volume of transportation increased, its character has changed as well.

In addition to meeting the need for short-distance transportation of produce in the field and between village and town, a commercial long-distance transportation network has been developed to move capital construction equipment and road-building materials. To get better economic results and to enhance the capacity of the transportation system, farmers have opted increasingly for power-driven transportation equipment. In the seven years from 1980 to 1987, the total number of trailers, farm trucks and farm transport vehicles in use and in stock increased from 2,080,000 units to 5,140,000 units, an average annual growth rate of 13.8 per cent. During the same period, the total number of semi-mechanized transportation tools was stable. The number of animal-drawn tyred carts remained constant at 2-3 million and tyred hand-barrows stayed at 40-50 million units.

1. Economic reform and privatization

The pattern by which transportation operates has changed considerably. State-run and collective-run transportation systems have been turned into individually run businesses. In 1980, the number of tractors owned by the farmers themselves was 38,000, only 1.5 per cent of the total number of tractors. In 1982, however, farmer-owned tractors amounted to 991,000 units, or 33 per cent of the total; in 1985, they amounted to 3,940,000 units, or 84.5 per cent of the total; and by 1987, individually owned tractors amounted to 6,180,000 units, or 90 per cent of the total. Also in 1987, the number of private farm trucks, tyred carts and barrows owned by farmers accounted for 66 per cent, 96.4 per cent, and 98.4 per cent, respectively, of the country's totals in those categories. Overall, 73 per cent of the gross assets of agricultural machinery was held by farmers individually.

This significant change in the operation of rural transportation did not occur by chance but was the outcome of the economic reform that took place in the rural areas of China over the past 10 or so years. Besides having changed from a subsistence or semi-subsistence basis to a cash crop basis, farmers have also changed other aspects of their operations. In addition to producing food grains, they try to diversify into other crops so as to realize higher incomes. They often maximize the utility of their transportation equipment by putting it to other transport use after the field work has been done. On the other hand, the scale on which farmland is managed has become smaller as a result of the system of contracted responsibility which links remuneration to production. Ownership of agricultural machinery by the State or by collectives is not compatible with the new conditions, so farmers are allowed to own the means of production individually. Consequently, a number of farmers have turned to the business of transportation because it is a good way of becoming prosperous. In 1986, the country's revenues from the operation of agricultural machinery amounted to ¥RMB 31.5 billion, or \$US 8.5 billion, and the associated net profit was ¥RMB 14.87 billion, or \$US 4.02 billion, of which ¥RMB 25.93 billion and ¥RMB 12.88 billion (\$US 7 billion and 3.5 billion), respectively, were attributed to the operations of individual farmers, accounting for 82.2 per cent and 86.6 per cent of the respective totals. Revenues from transportation accounted for 70 per cent of farmers' gross revenues coming from private operations. At present, 1,020,000 households in rural areas are engaged in transportation operations.

As a result of these economic reforms and the ensuing development of rural areas, the rural transportation machinery industry has been established on a fairly sound base. In effect, various kinds of transportation machinery exist side by side. Small four-wheel tractors and their accessory trailers; farm trucks; farm transport vehicles; three-wheel farm vehicles; tyred hand-barrows and animal-drawn carts; outboard boats - each kind of equipment contributes its share, separately and harmoniously. The technical specifications of typical equipment in each of these categories are provided in annex I. Some leading manufacturers of such equipment are described in annex II.

2. Small tractors

The mix of rural transportation equipment has changed greatly, with small machinery having grown the most rapidly. One of the distinguishing features of rural transportation in China is that tractors, especially the small tractors that do such a large share of the transportation, are used not only on farms but also on highways. Looked at from the standpoint of the production of transportation machinery, the output of large and medium-sized tractors dropped from 97,000 units in 1980 to 44,000 units in 1987, an average

decrease of 10.7 per cent per year. The output of small tractors, on the other hand, increased dramatically, from 217,000 units to 1,067,000 units, an average increase of 25.5 per cent per year. Also, the number of large and medium-sized tractors in use increased at a rate of less than 2.5 per cent yearly, while that of small tractors increased at almost 16 per cent per year. In terms of total horsepower, the share of small tractors increased from 40.5 per cent to 62 per cent. By 1987, the number of small tractors in use amounted to 5,296,200 units, accounting for 85.7 per cent of all the tractors in use, and small tractors had become the main kind of tractor produced. Of the small tractors, small four-wheel tractors of 8.8-13.2 kW (12-18 ps), which are better suited to rural transportation, have developed unexpectedly fast. Although they have been in mass production for only a few years, the production of small four-wheel tractors exceeds that of walking tractors, which were put into production over 20 years ago. The former grew from 78,000 units in 1982 to 278,000 units in 1984 and 425,000 units in 1985, when it exceeded the production of walking tractors, i.e. 358,000 units. In 1987, the production of small four-wheel tractors reached 576,000 units, exceeding that of walking tractors by 93,000 units.

Small tractors have developed rapidly for several reasons:

(a) They are compact, manoeuvrable and simple in design. Also, they are easy for farmers to operate. They are well suited to the current scale of farming and to road conditions. Moreover, they are multipurpose in that they can be used for both field operation and transportation. The operating cost of small tractors is lower than that of manpower or animal power. Comparative studies have shown that the cost of transportation is ¥RMB 0.051, or \$US 0.014, per tonne-kilometre with a small four-wheel tractor of 8.8 kW (12 ps) and ¥RMB 0.078, or \$US 0.021, per tonne-kilometre with a horse-drawn cart. Since it costs only 14 per cent as much to transport fertilizer in the field by walking tractor as it does to transport it by hand-barrow, small tractors have been welcomed by farmers;

(b) Small tractors are sold at moderate prices that farmers can afford. For example, an 8.8 kW walking tractor is usually priced at ¥RMB 3,000 (\$US 810) or less and a small four-wheel tractor is priced at about ¥RMB 4,000 (\$US 1,075). Together, a small tractor and an accessory trailer cost ¥RMB 5,000-6,000 (\$US 1,350-1,620). The pay-back period is 6-8 months for small tractor-trailer sets engaged in rural transportation. The price of trucks, by contrast, is relatively high. Even a light truck usually costs ¥RMB 20,000-30,000 (\$US 5,400-8,100);

(c) Because of their low cost, it is economically effective to use small tractors for short-distance transportation. Larger investments are needed for trucks and they are less adaptable to the special conditions: the goods and materials are assorted in kind and small in quantity; the transportation distance is short; and the handling operation is not highly mechanized. In particular, it is difficult for trucks to run satisfactorily on poor roads. Comparative tests have shown that the fuel consumption per tonne-kilometre of a truck travelling on a sand/cobblestone road is 40 per cent higher than that of a truck travelling on an asphalt road.

Clearly, agricultural mechanization in China entered a new phase once farmers were allowed to choose and manage agricultural machinery on their own. What kind of machine a farmer chooses depends not only on the technical specifications of the machine but on whether it can bring an economic return. Above all, farmers prefer to buy machinery that they can afford and that they know how to operate. This accounts for the fact that small tractors are still the most widespread form of rural transportation in China.

3. Farm transport vehicles

Over the years, some inherent drawbacks of transportation done by small tractors became evident: the driving speed was too low, causing traffic blockages; the tractor and trailer unit was too long and had poor manoeuvrability and poor climbing ability; safety performance was not good enough owing to poor braking ability. The tractor-trailer sets also caused a great deal of vibration, noise and pollution. To remedy these problems, several steps were taken. At first, some structural modifications were made to small tractors to adapt them to the needs of rural transportation. Some manufacturers produced a new version of the walking tractor designed especially for transportation: they replaced the clutch with a differential and the control handle with a steering wheel. Other manufacturers produced a modified version of the walking tractor that had an articulated steering mechanism or even a specially designed articulated transport vehicle, both also for rural transportation. Then, to give farmers the better-performing, better-operating equipment they were looking for, special farm transport vehicles were developed. In 1984, 11,400 of these vehicles were produced, and in 1988, the number was 80,000.

China's farm transport vehicles differ from the vehicles used for field operations in some other countries. In China, they are used for both field and highway transportation, so that their performance and design is intermediate between that of trucks and tractors. Some of the specialized vehicles can carry out field operations such as irrigation and drainage, threshing and fertilizing after they have been modified or after optional devices have been attached. Some factories produce farm vehicles based on modified tractor components; others produce purpose-designed vehicles. The load-carrying capacities and maximum operating speeds of these farm transport vehicles are no more than 1.5 tonnes and 50 km/h, respectively. Most of the manufacturers equip their vehicles with hydraulic dumping devices. Sixty or more factories, 25 of them large ones, produce more than 40 versions of the basic farm transport vehicle.

4. Three-wheeled farm vehicles

Three-wheeled farm vehicles powered by small diesel engines of 3.7-5.9 kW (5-8 ps) are even simpler in design than farm transport vehicles. They have load-carrying capacities of about 0.5 tonne and maximum speeds of 40 km/h. They are sold for ¥RMB 3,000, or \$US 810, per unit, which makes them affordable for many farmers. The purchase price can be recouped within six months. There are now 13 large factories producing three-wheel farm transport vehicles. In 1988 the production amounted to 82,000 units.

In general, farm transport vehicles are relatively cheap and easy to operate and maintain, which makes them suitable for the technical and economic development level of the countryside. They operate at moderate speeds to better accommodate the poor road conditions, and they can do some field work, as was already mentioned. Compared to tractor-trailer sets, farm transport vehicles perform better at the transportation part of the task: they have better traction and better climbing ability and manoeuvrability; more suitable driving speeds; their braking and lighting systems are more advanced and therefore safer; they emit much less noise and exhaust; and they are more convenient to operate and handle, especially for transportation on roads with slopes.

5. Modified light trucks

Another class of rural transportation equipment, heavier than farm transport vehicles and three-wheel vehicles, is based on a modification of

the light truck. It uses the chassis of light truck model BJ130, which has been put into mass production. Many of the parts of this farm truck are exchangeable with those of the BJ130 truck. The former has a load-carrying capacity of 1.5-2 tonnes and a maximum operating speed of 75-85 km/h. It can be used for long-distance transportation in rural areas. Eight large factories now produce 10 versions of the farm truck, and in 1988, over 15,000 units were made.

6. Outboard motors

Along with the development of land transportation equipment, the outboard engine and propeller have been developed for water transportation. Installed at the end of a wooden or concrete boat, this combination device replaces human power to drive the boat. The power comes from small diesel engines of 4.4-8.8 kW (6-12 ps). The power transmission, propeller and steering functions are integrated into a single mechanism for easy installation and control. Since the price of outboard boats is low and their fuel consumption costs are only 25 per cent of those of trucks, they have been widely accepted by farmers in the south. Outboard boats also have found a wider market than other small motorized boats for civilian use. There are now more than 10 large factories producing 100,000 outboard engine and propeller units per year. According to the best estimates, by the end of 1986, there were about 500,000 units of outboard engines and propellers in use or in stock in China. Outboard boats have become a very important means of transportation in coastal areas and in the south, where there are many rivers and canals.

V. STRATEGIES FOR THE FURTHER DEVELOPMENT OF RURAL TRANSPORTATION MACHINERY

To develop the production of equipment for rural transportation and to modernize rural transportation will remain a major task for a long time to come. Experience has shown that policies for rural transportation equipment and plans for the development of products should be formulated to suit the special conditions that prevail in China. While the experience of other countries can become a point of reference, their example should not be blindly copied.

Because the purchasing power of China's farmers is low and their operating skills are still poor and because the economy is unevenly developed from place to place, diverse kinds of transportation equipment will continue to be used side by side, each contributing in its own way. Both mechanized and semi-mechanized equipment will be used, but the mechanized equipment will gain ground. Likewise, large machinery will co-exist with medium-size and small machinery, with the latter predominating. Both advanced and appropriate technology will be adopted, but the appropriate technology will have priority. Rural transportation machinery should be developed gradually, from lower cost to higher cost machinery.

There are many ways in which this diversity will come into play. As one example, large quantities of goods and materials should be transported over the major lines of communication mainly by trucks, but short-distance and sporadic transportation should be done by tractor-trailer sets, farm transport vehicles and tyred hand-barrows and animal-drawn carts. As another example, the short-term priority should be to develop machinery having low to medium power and low to medium load-carrying capacities and driving speeds, while at the same time larger and more efficient equipment should be vigorously developed for later use.

To achieve the modernization of rural transport, the following measures are proposed:

(a) The industry should spare no effort to serve the users of its equipment and should do its best to improve the quality and increase the variety of the equipment so as to enhance the overall economic impact of the industry. Also, it is important for the industry to produce machinery carefully tailored to local needs;

(b) The multi-cylinder diesel engine of small cylinder diameter, especially the three-cylinder diesel engine with a cylinder diameter of 75-80 millimetres, should be the power source of choice for farm transport vehicles. Such engines upgrade the overall dynamic performance and smoothness of operation and also reduce noise and exhausts. In addition, the overall design of the farm transport vehicle must be improved so as to rationalize the weight utilization factor and the power utilization factor. There must be research on ergonomics to create a safe and favourable working environment for operators and the main components of farm transport machinery should be standardized to make them interchangeable. The main improvements to be made in connection with the outboard engine and propeller entail a reduction of structural weight and noise, an increase in speed and the enhancement of manoeuvrability;

(c) To avoid the indiscriminate setting up of enterprises that make farm transport machinery and to keep goods of poor quality from being produced, the industry must be managed through overall planning, including the appraisal of farmers' needs and relevant regulations. Key manufacturers with good production facilities should be helped to carry out technical reform so they can produce farm transport machinery of the highest quality, thus raising the standard of the whole industry;

(d) Great importance should be attached to overall quality control. A quality certification system should be set up and standards and regulations mapped out. Qualified personnel should be trained in quality control. Channels for feedback on quality should be kept open. It would also be helpful to compare and evaluate different kinds of equipment and to make the results of these comparisons available to the public;

(e) To permit the setting up of mass production facilities and realize the associated economies of scale, economic alliances should be encouraged. The key enterprises will take the lead in producing top quality products. Production factors should be able to circulate rationally.

VI. INTERNATIONAL EXCHANGE AND CO-OPERATION

The opening up of China to the outside world is a cornerstone of the Government's policy. China has benefited greatly from the international exchange of technology and has itself exported a substantial number of products and technologies to other countries, on the basis of equality and mutual benefit. Not only is China able to export products per se, it is also able to contract for project design, to carry out research and development for new products, to set up training courses and to transfer technologies in the area of transportation equipment. In this connection, estimates have been prepared of the equipment and investments needed to set up factories that manufacture rural transportation machinery (annex III).

The Bureau of the Construction and Agricultural Machinery Industry, which comes under the Ministry of the Machinery and Electronics Industry,

administers the agricultural and construction machinery industry nation-wide. It bears responsibility for planning the development of that industry, laying out guidelines for the development of science and technology and formulating policies that will promote the industry. Production enterprises and research institutes in this field are under the supervision of the Bureau.

To promote the growth of China's domestic industry, the China National Agricultural Machinery Industry Association has been established. The Association is made up of several specialized associations, namely, the Farm Transport Vehicle Association, the Trailer and Tyred Barrow/Animal-drawn Cart Association, and the Outboard Engine and Propeller Association.

Annex I

MAIN PERFORMANCE PARAMETERS FOR SELECTED RURAL TRANSPORTATION ITEMS

A. Tyred hand-barrows/animal-drawn carts

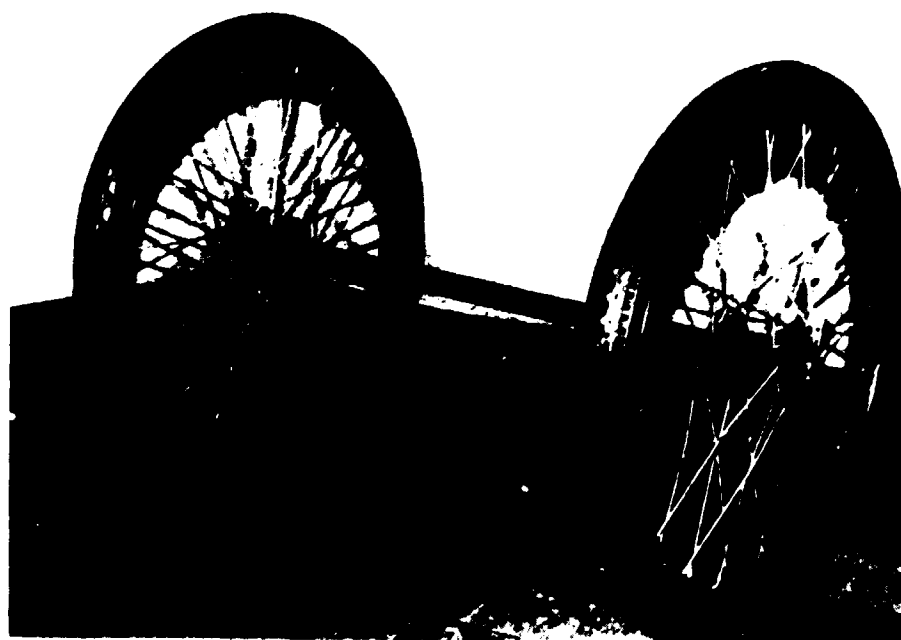
The specifications of two models of wheelbase, one-wheel and two-wheel, for tyred hand-barrows and animal-drawn carts are shown in table 1.

Table 1. Specifications for barrow/cart wheelbases

Model	Total length of axle (mm)	Rated load (N (kgf))	Tyre size (in.)
JL650 (two-wheel)	1 080, 1 040, 970	6 374 (650)	26 x 2.5
JL325 (one-wheel)	185	3 187 (325)	26 x 2.5

Model JL650 wheelbase, Meihua brand (figure 1), is produced by Qingdao Vehicle Factory. It is a base on which can be mounted a barrow or cart for short-distance transportation. Only the wheelbases are made in the factory. The bodies of the barrows or carts are constructed by the users to suit their own needs.

Figure 1. Model JL650 wheelbase for hand-barrow/animal-drawn cart, Meihua brand



Model JL650 consists of two wheels connected by an axle. It is to be used in making a barrow or cart that can operate on flat roads or in fields. The maximum loading capacity of the barrow is 650 kg, including the dead weight of the frame. The wheelbase is available in three axle shaft lengths, 1,080, 1,040 and 970 mm. The specification of the tyre(s) is 25 x 2.5 in., which conforms to the national standard. The main components are made of high-quality alloy steel: the axle shaft is 16Mn steel and the steel balls for the bearings are made to withstand 700,000 or more revolutions. The service life of the tyred barrow is more than 6,000 tonne·km. The surfaces exposed to the environment are treated by techniques such as electrophoretic coating, zinc plating and baked finishing to improve the anti-corrosivity. Wheelbase model JL650 has long been popular with users due to its high quality and low cost.

B. Tractors for transportation and accessory trailers

1. Walking tractors for transportation

The main performance parameters of walking tractors for transportation are shown in table 2.

Dongfeng-12

The Dongfeng-12 walking tractor (figure 2) is produced by Changzhou Tractor Factory, among others. It is a dual-purpose walking tractor used for both field tasks and on-road transport. It is compact, reliable, durable and manoeuvrable. It has good power, light weight and good passing ability. The Dongfeng-12 tractor is a riding tractor that is easy to operate. It can do a number of field tasks, including tillage, harrowing, and harvesting and stationary tasks, including irrigation and drainage and threshing. When an accessory one-tonne trailer is attached it can be used for transportation. The Dongfeng-12 tractor has been awarded a gold medal by the State. Tractors of this model sell well on the domestic market and have been exported to more than 50 countries.

Figure 2. Dongfeng-12 walking tractor

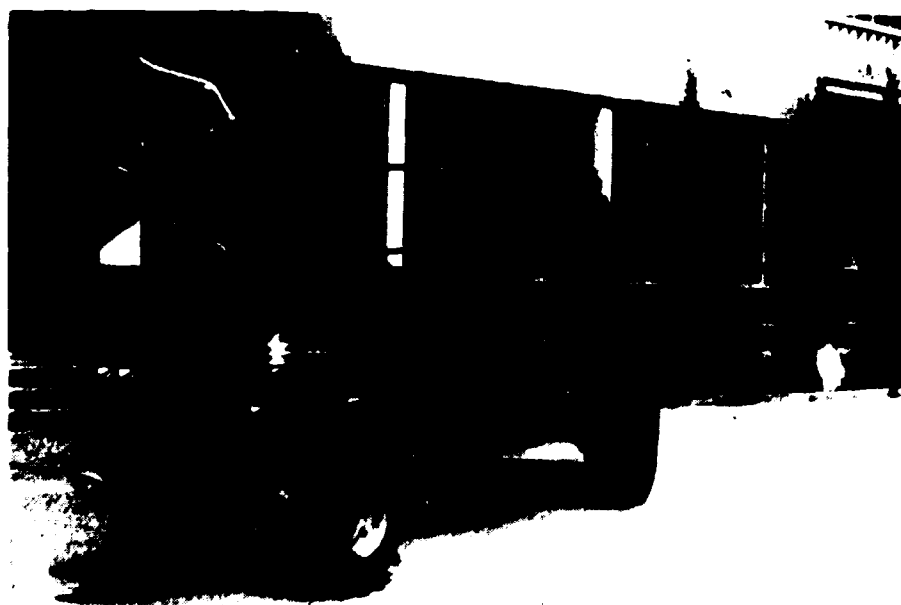


Table 2. Main performance parameters of walking tractors for transportation

Model	Manufacturer	Type	Drive	Engine			Structural weight (kg)	Wheel spacing (mm)	Minimum ground clearance (mm)	Speed (km/h)		
				Model	Power (kW (ps))	Rotation (rev/min)				Weight (kg)	Forward	Reverse
Gongnong-12	Yongkang Tractor Factory, Nanning Tractor Factory, others	Dual-purpose	Belt-driven	S195	8.8 (12)	2 000	135	540 g/	570-810	200	5 gears 1.55-17.10	2 gears 1.23-4.59
Dongfeng-12	Changzhou Tractor Factory, Jiangxi Walking Tractor Factory, others	Dual-purpose	Belt-driven	S195	8.8 (12)	2 000	145	350	657-800	182	6 gears 1.4-15.3	2 gears 1.0-3.8
Gongnong-12K	Xinhui Agricultural Machinery Factory, Hengyang Tractor Factory (produces Model Hengyang-12)	Dual-purpose	Direct-driven (by engine)	190	8.8 (12)	2 200	130	390	519-772	247	6 gears 1.43-15.7	2 gears 1.11-4.21
Gongnong-5	Yongkang Tractor Factory	Dual-purpose	Belt-driven	Z175	3.7 (5)	2 600	49	194	600-720	196	6 gears 1.80-16.96	2 gears 1.35-5.90

g/ With accessory rotary tiller.

The main performance parameters of the Dongfeng-12 walking tractor besides those listed in table 4 are as follows:

Dimensions (l x w x h): 2,680 x 960 x 1,250 mm

Engine: Model S195, horizontal, single-cylinder, four-stroke and evaporative-cooled diesel engine; cylinder diameter: 95 mm; stroke: 115 mm; vortex combustion chamber; fuel consumption: <251 g/kWh (185 g/hp·h)

Load-carrying capacity: 1 tonne

Gears: 6 forward, 2 reverse

<u>Direction</u>	<u>No.</u>	<u>Speed (km/h)</u>	<u>Traction (N (kgf))</u>
Forward	I	1.4	2 255.6 (230)
	II	2.5	2 255.6 (230)
	III	4.1	2 255.6 (230)
	IV	5.3	2 555.6 (230)
	V	9.4	2 059.5 (210)
	VI	15.3	1 186.6 (121)
Reverse	I	1.0	
	II	3.8	

Gongnong-12K, Jinfeng brand

The Gongnong-12K walking tractor (figure 3) is a single-axle, dual-purpose wheeled tractor, directly driven by an engine. This particular walking tractor was designed in China. It has a higher drive efficiency than a belt-driven tractor and is safer in operation. With different accessories the tractor can do tillage, rotary tilling, harvesting, furrowing and ridging. It can also perform stationary operations and short-distance transport. It is particularly suitable for mountainous and hilly areas. In 1988, 37,000 of these tractors were produced.

Figure 3. Gongnong-12K walking tractor, Jinfeng brand



The main performance parameters of the Gongnong-12K walking tractor besides those listed in table 2 are as follows:

Dimensions (l x w x h): 2,830 x 998 x 1,300 mm

Engine: Model 190, vertical, single-cylinder, water-cooled and four-stroke diesel engine; cylinder diameter: 90 mm; stroke: 110 mm; spherical combustion chamber; fuel consumption: <258g/kWh (190g/hp·h)

Load-carrying capacity: 1 tonne

Gears: 6 forward, 2 reverse

<u>Direction</u>	<u>No.</u>	<u>Speed (km/h)</u>	<u>Traction (N (kgf))</u>
Forward	I	1.43	2 677 (273)
	II	2.13	2 677 (273)
	III	4.21	2 677 (273)
	IV	5.24	2 677 (273)
	V	8.07	1 706 (174)
	VI	15.70	
Reverse	I	1.4	
	II	4.21	

2. Small four-wheel tractors for transportation

The main performance parameters of small four-wheel tractors for transportation are shown in table 3.

Fengshou-180

The Fengshou-180 tractor (figure 4) produced by Jiangxi Tractor Factory, is a relatively advanced series of wheeled tractors and is domestically designed. There are seven versions to meet different user needs. The Fengshou-180YS and Fengshou-180YS1 models are very economical and are meant especially for transportation. They are simple in design and cheap because no hydraulic pumps, hydraulic lifts, linkages or power-take-off are mounted on them. Since Fengshou-180 tractors are equipped with two-cylinder all-g geared engines, they are smoother and less noisy in operation than tractors with one-cylinder engines. They also have a wider range of speeds and a small turning radius and are easy to operate. The Fengshou-184, another model in the series, is a four-wheel drive tractor with greater traction and a better hold on the road. It is suitable for harsh working conditions. The Fengshou-180 series has sold well since it came out in 1983, and the tractors have been exported to a number of countries.

The main specifications of Fengshou-180 tractors besides those listed in table 3 are as follows:

Dimensions (l x w x h): 2,720 x 1,155 x 1,340 mm

Engine: Model J285T, vertical, two-cylinder, water-cooled and four-stroke diesel engine; cylinder diameter: 85 mm; stroke: 101.6 mm; vortex combustion chamber; fuel consumption <292g/kWh (215 g/hp·h)

Load-carrying capacity: 1.5 tonnes

Table 3. Main performance parameters of small four-wheel tractors for transportation

Model	Rated power (kw (ps))	Rated traction (N)	Structural weight (kg)	Speed (km/h)		Axle spacing (mm)	Wheel spacing (mm)		Ground clearance (mm)
				Forward	Reverse		Front	Rear	
Fengshou-180	13.2 (18)	2 942	880	8 gears 1.06-23.7	2 gears 1.2-6.5	1 400	900	950	300
Dongfanghong-150	11 (15)	3 430	950	8 gears 2.31-23.7	2 gears 3.06-8.58	1 400	900	960	251
Taishan-12	8.8 (12)	2 942	785	6 gears 1.9-22.17	1 gear 4.58	1 300	900	960	245
Xiugtai-120	8.8 (12)	2 942	650	6 gears 2.0-23.75	2 gears 2.0-7.59	1 300	900	960	275

Gears: 8 forward, 2 reverse

<u>Direction</u>	<u>No.</u>	<u>Speed (km/h)</u>
Forward	I	1.06
	II	1.40
	III	2.60
	IV	4.60
	V	5.50
	VI	7.4
	VII	13.5
	VIII	23.7
Reverse	I	1.2
	II	6.5

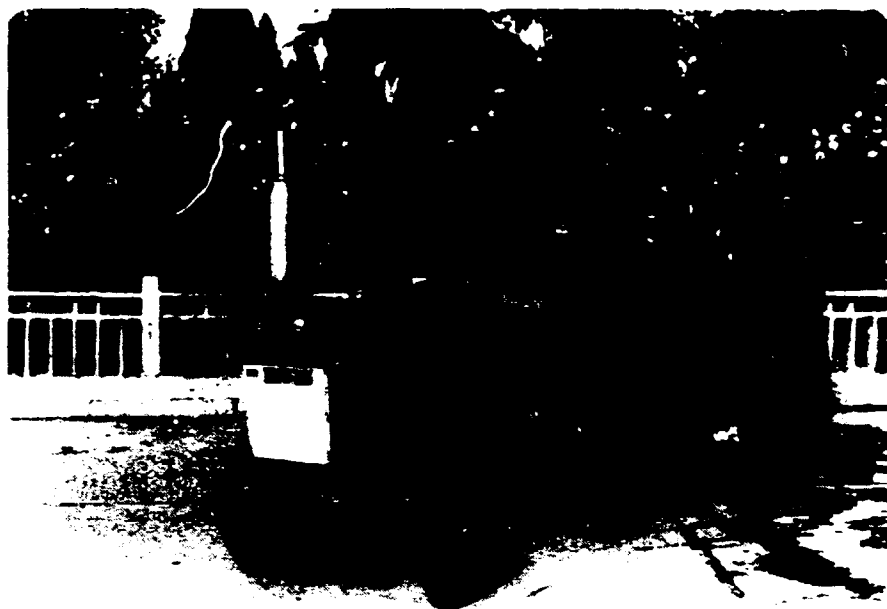
Figure 4. Fengshou-180 small four-wheel tractor



Dongfanghong-150

The small four-wheel tractor series Dongfanghong-150 (figure 5) is produced by the largest tractor factory in China, the No. 1 Tractor Factory. The series comes in eight different versions to meet different requirements. Model Dongfanghong-150J3 is especially designed for transportation. It is reliable, durable and easy to operate and maintain. Compared to other similar tractors, it has greater traction, lower fuel consumption, more gears for field operation and better climbing ability.

Figure 5. Dongfanghong-150 small four-wheel tractor



The main specifications of the Dongfanghong series besides those listed in table 3 are as follows:

Dimensions (l x w x h): 2,500 x 1,170 x 1,270 mm

Engine: Model S1100 or K1100, horizontal, single-cylinder, water-cooled and four-stroke diesel engine; cylinder diameter: 100 mm; stroke: 115 mm; vortex combustion chamber; fuel consumption: <251 g/kWh (185 g/hp·h)

Load-carrying capacity: 1.5 tonnes

Gears: 8 forward, 2 reverse

<u>Direction</u>	<u>No.</u>	<u>Speed (km/h)</u>	<u>Traction (N (kgf))</u>
Forward	I	2.31	3 432 (350)
	II	3.80	3 432 (350)
	III	5.43	3 432 (350)
	IV	6.48	3 432 (350)
	V	8.48	2 843 (289)
	VI	10.65	2 040 (208)
	VII	15.22	1 854 (189)
	VIII	23.77	1 177 (120)
Reverse	I	3.06	
	II	8.58	

Taishan-12

The small four-wheel Taishan-12 tractor (figure 6) is produced by Weifang Tractor Factory. Tractors of this model and of other models powered at 8.8 kw, the same power as Taishan-12, are now the most popular tractors in China. In 1988, 36,000 Taishan-12 tractors were produced. They have the advantage of a simple and compact structure and good manoeuvrability. Also, they are easy to operate and maintain, as well as low in price. With various accessory

implements, Taishan-12 tractors can carry out a number of field and stationary operations, and they serve for short-distance transportation as well.

The main specifications of Taishan-12 tractors besides those listed in table 3 are as follows:

Dimensions (l x w x h): 2,390 x 1,160 x 1,240 mm

Engine: Model 195, horizontal, single-cylinder, water-cooled and four-stroke diesel engine; cylinder diameter: 95 mm; stroke: 115 mm; vortex combustion chamber; fuel consumption: <251 g/kWh (185 g/hp·h)

Load-carrying capacity: 1 tonne

Gears: 6 forward, 1 reverse

<u>Direction</u>	<u>No.</u>	<u>Speed (km/h)</u>	<u>Traction (N(kgf))</u>
Forward	I	1.90	3 264 (332.8)
	II	4.43	3 264 (332.8)
	III	5.97	3 264 (332.8)
	IV	7.07	2 687 (274)
	V	13.90	863 (88)
	VI	22.17	870 (88.8)
Reverse	I	4.58	

Figure 6. Taishan-12 small four-wheel tractor



3. Medium-size wheeled tractors for transportation

The main performance parameters of medium-size (24-55 ps) tractors for transportation are shown in table 4.

Table 4. Main performance parameters of medium-size (24-55 ps) wheeled tractors for transportation

Model	Rated power (kW (ps))	Rated traction (N)	Structural weight (kg)	Speed (km/h)		Axle spacing (mm)	Wheel spacing (mm)	Ground clearance (mm)
				Forward	Reverse			
Hieniu-55	40.5 (55)	13 720	2 900	10 gears 1.37-22.3	2 gears 1.03-4.74	2 463	1 200-1 800	640
Shanghai-50	36.8 (50)	11 772	1 860	6 gears 2.15-26.86	2 gears 2.84-11.35	1 900	1 313-1 513	400 (on the road) 465 (in the field)
Jiangsu-50	36.8 (50)	11 768	1 920	8 gears 2.12-28.12	2 gears 2.79-11.16	1 950	1 260-1 750	370
Changchun-40	29.4 (40)	9 807		6 gears 4.15-28.67	2 gears 5.36-7.31		Front wheel, 1 340-1 700 Rear wheel, 1 300-1 800	
Taishan-25	17.7 (24)	5 390- 5 880	1 210	8 gears 19.7-25.15	2 gears 1.84-7.18	1 700	1 100-1 500	425
Shenniu-25	17.7 (24)	5 394- 6 375	1 120	8 gears 1.66-21.2	2 gears 1.55-6.06	1 500	1 000-1 400	345

Shanghai-50

The Shanghai-50 tractor (figure 7), produced by Shanghai Tractor Factory, is a medium-sized tractor that sells well. It comes in two versions, the general version and the four-wheel-drive version (model Shanghai-504). Shanghai-50 tractors have a compact design, good power, low fuel consumption and good manoeuvrability. Both are easy to operate and maintain. They have wide application in field operations such as ploughing, harrowing, cultivating, harvesting and transportation, both in rice fields and on dry land. The tractors designated as model Shanghai-504 have even better traction and a better hold on the road, so they are particularly suitable for tilling heavy clay soils and for transportation on muddy and uneven roads. The watertight front-drive axle housing makes tractors of the Shanghai-50 series ideal for operating in rice fields. Two entrants driving Shanghai-50 tractors, one a man and one a woman, tied for first place in an international tractor competition that took place in Australia in 1985.

Figure 7. Shanghai-50 medium-size four-wheel tractor



The main specifications of Shanghai-50 tractors besides those listed in table 4, are as follows:

Dimensions (l x w x h): 3,100 x 1,670 x 2,320 mm

Engine: Model 495A, vertical, single-row cylinder arrangement, four-cylinder, water-cooled and four-stroke diesel engine; cylinder diameter: 95 mm; stroke: 115 mm; spherical combustion chamber; fuel consumption: <244.8 g/kWh (180 g/hp·h)

Load-carrying capacity: 5 tonnes

Gears: 6 forward, 2 reverse

<u>Direction</u>	<u>No.</u>	<u>Speed (km/h)</u>	<u>Traction (N (kgf))</u>
Forward	I	2.15	10 248.3 (1 045)
	II	3.54	10 248.3 (1 045)
	III	6.71	10 248.3 (1 045)
	IV	8.58	10 248.3 (1 045)
	V	14.13	6 011.17 (613)
	VI	26.86	2 216.4 (226)
Reverse	I	2.84	
	II	11.35	

Jiangsu-50

The wheeled tractor model Jiangsu-50 (figure 8), produced by Qingjiang Tractor Factory, is a medium-size tractor for application both in rice fields and on dry land. When various accessory implements are attached, the tractor is able to carry out a number of tasks, such as ploughing, harrowing, planting, harvesting, shovelling and transportation. This tractor has the advantages of greater power, lower fuel consumption, lower weight/horsepower ratio, and a rational weight distribution ratio between the front and rear axles. Model Jiangsu-504 is a modified version of Jiangsu-50. Because it is equipped with an all-hydraulic steering mechanism and an all-sealed front-drive axle, it has better traction, a better hold on the road and better passing ability, and it is especially suited to operations in rice fields and transportation on muddy and uneven roads. In 1984, the Jiangsu-504 tractor won first prize in an international competition in Australia.

Figure 8. Jiangsu-50 medium-size four-wheel tractor



Its main specifications besides those listed in table 4 are as follows:

Dimensions (l x w x h): 3,350 x 1,660 x 1,650 mm

Engine: Model 495, four-cylinder, single-row cylinder arrangement, vertical, water-cooled and four-stroke diesel engine; cylinder diameter: 95 mm; stroke: 115 mm; vortex combustion chambers; fuel consumption: <265 g/kWh (195 g/hp·h)

Load-carrying capacity: 5 tonnes

Gears: 8 forward, 2 reverse

<u>Direction</u>	<u>No.</u>	<u>Speed (km/h)</u>	<u>Traction (N (kgf))</u>
Forward	I	2.12	11 768 (1 200)
	II	3.19	11 768 (1 200)
	III	5.21	11 768 (1 200)
	IV	7.03	11 768 (1 200)
	V	8.48	11 670 (1 190)
	VI	12.76	6 865 (700)
	VII	20.84	5 394 (550)
	VIII	28.12	3 825 (390)
Reverse	I	2.79	
	II	11.16	

Taishan-25

Wheeled tractor model Taishan-25 (figure 9), produced by Shandong Tractor Factory, is used in a number of field operations both in rice fields and on dry land. It can also be used for transportation and can serve as a power source for stationary operations. Because it is compact, easy to control and suitable for working small pieces of farmland and for transportation on narrow roads, it is especially popular with users in hilly and mountainous areas. The factory has a production capacity of 15,000 units yearly.

Figure 9. Taishan-25 medium-size four-wheel tractor



The main specifications of the Taishan-25 besides those listed in table 4 are as follows:

Dimensions (l x w x h): 3,005 x 1,335 x 1,470 mm

Engine: Model 295T, two-cylinder, in-line cylinder arrangement, vertical, water-cooled, four-stroke diesel engine; cylinder diameter: 95 mm; stroke: 115 mm; vortex combustion chamber; fuel consumption: <258g/kWh (190g/hp·h)

Load-carrying capacity: 2 tonnes

Gears: 8 forward, 2 reverse

<u>Direction</u>	<u>No.</u>	<u>Speed (km/h)</u>	<u>Traction (N (kgf))</u>
Forward	I	1.66	
	II	2.09	
	III	3.40	
	IV	5.40	8 826 (900)
	V	6.49	7 600 (775)
	VI	8.20	5 884 (600)
	VII	13.34	3 678 (375)
	VIII	21.20	2 236 (228)
Reverse	I	1.55	
	II	6.06	

4. Farm trailers

Farm trailers are widely used for transportation. They are drawn by walking tractors, small four-wheel tractors, large and medium-size tractors and trucks. They carry out about 60 per cent of the total volume of rural transportation in China. There are two categories of farm trailer: single-axle semi-trailers and two-axle full trailers.

The basic parameters of semi-trailers having load-carrying capacities of 0.5-4.0 tonnes are shown in table 5. The basic parameters of full trailers having load-carrying capacities of 2-9 tonnes are shown in table 6.

The one-tonne self-dumping farm trailer model 7CH-1, produced by Hangzhou Trailer Factory, is shown in figure 10.

The farm trailers models 7C4 and 7C5 (Huashan brand) produced by Baoji Vehicle Factory are shown in figure 11.

Figure 10. Model 7CH-1 self-dumping farm trailer



Figure 11. Models 7C4 and 7C5 self-dumping farm trailers, Huashan brand



Table 5. Basic parameters of single-axle semi-trailers having load-carrying capacities of 0.5-4 tonnes

	Load-carrying capacity (tonne)					
	0.5	1	1.5	2	3	4
Recommended size of trailer box (m)	0.3, 0.4	0.6, 0.7	1, 1.4	1.4, 1.8	2.6	3.4
Braking system	Pedal brake, mechanical		Pneumatic brake or pedal-operated hydraulic brake (for mountainous areas), slow application, mechanical (for plain)		Pneumatic brake	
Self-dumping characteristics	Rear-dumping, mechanical			Rear-dumping, hydraulic-cylinder-lifted		
Dumping angle	>42°			>45°		
Suspension	Leaf-spring or no suspension			Leaf-spring		

Table 6. Basic parameters of two-axle full trailers having load-carrying capacities of 2-6 tonnes

	Load-carrying capacity (tonne)						
	2	3	4	5	6	7	9
Recommended size of trailer box (m)	1.8	2.7	3.4	4.1	4.5	5.3	6.8
Braking system	Pneumatic brake or pedal-operated hydraulic brake		Pneumatic brake		Pneumatic clutch brake		
Self-dumping characteristics	Side-dumping, rear-dumping or 3-way dumping, lifted by hydraulic cylinder specified in standard NJ131-76						
Dumping angle	>45° for side-dumping and rear-dumping <75° for side-dumping of the three-way dumping trailer <40° for rear-dumping						
Suspension	Leaf-spring						
Steering	Articulated steering, ball-pivot bogie plate steering						

C. Three-wheel farm vehicles

Three-wheel farm vehicles form a category of small equipment for rural transportation having load-carrying capacities of 0.5-0.8 tonne. Because this kind of equipment is compact, manoeuvrable and cheap, it has found application for the short-distance transport of aquatic products, fresh produce and poultry products as well as for small quantities of means of agricultural production. These vehicles have sold well ever since they were introduced. At present there are two types of three-wheel farm vehicle in production. One is a motorcycle-type vehicle powered by a 4.4-5.9 kW (6-8 ps) single-cylinder diesel engine; it is chain-driven and manually steered. The other type is equipped with a cab for two persons, is powered by a 5.2-7.4 kW (7-10 ps) diesel engine, is driven by an axle shaft and has steering wheel control. The technical parameters of selected three-wheel farm vehicles are shown in table 7.

Three-wheel farm vehicles of different brands and manufacturers are shown in figures 12, 13 and 14, respectively: Tianmushan brand, Anji Mechanical Vehicle General Factory; Feicai brand, Wannan Mechanical Vehicle Factory; and Anle brand, Hefei Vehicle Factory.

Figure 12. Tianmushan brand three-wheel farm vehicle



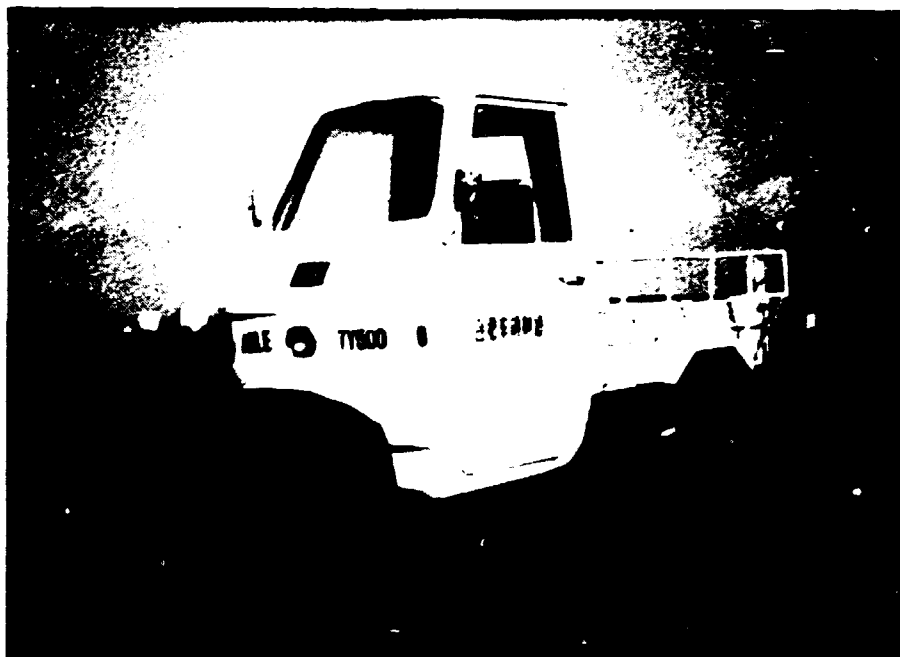
Table 7. Technical parameters of selected three-wheel farm vehicles

Model	Manufacturer	Dimensions l x w x h (cm)	Load- carrying capacity (kg)	Ground clearance (mm)	Maximum speed (km/h)	Fuel consumption (l/tonne·100 km)	Minimum turning radius (m)	Full-load climbing gradient (%)	Engine			
									Model	Cylinder diameter (mm)	Power (kW)	Rated revolutions (rev/min)
Tianmushan brand, model ADO21	Anji Mechanical Vehicle General Factory	306 x 125 x 128	500	170	35	2.5	2	15	R175 single- cylinder, water-cooled diesel engine	75	4.78	3 000
Faicai brand, model 7Y-500	Wannan Mechanical Vehicle Factory	305 x 125 x 178	500	150	35	2.8	3	20.4	R175 single- cylinder, water-cooled diesel engine	75	4.4	2 600
Anle brand, model 7Y-500	Hefei Vehicle Factory	313.2 x 122 x 130.8	500	180	35	2.5	2.5	20	R175 single- cylinder, water-cooled diesel engine	75	4.4	2 600

Figure 13. Feicai brand three-wheel farm vehicle



Figure 14. Anle brand three-wheel farm vehicle



D. Farm transport vehicles

This is the form of rural transportation equipment that has been developing most rapidly in recent years. It has a load-carrying capacity of 1-1.5 tonnes and is powered by single-cylinder or two-cylinder diesel engines with cylinder diameters of 85 mm, 90 mm or 100 mm. The maximum driving speeds are usually less than 50 km/h, although they sometimes reach 60 km/h. Farm transport vehicles have appropriate ground clearances, usually at least

200 mm, and good climbing ability, that is, they can handle climbing gradients of at least 20 per cent. They also usually have leaf-spring suspensions and rear-wheel drives. A number of the components of farm transport vehicles are interchangeable with those of light trucks or tractors. The technical parameters of selected farm transport vehicles are shown in table 8 and the vehicles are depicted in figures 15-24.

Figure 15. Ganjiang GJ-12 farm transport vehicle



Figure 16. Ganjiang GJ-2015 farm transport vehicle

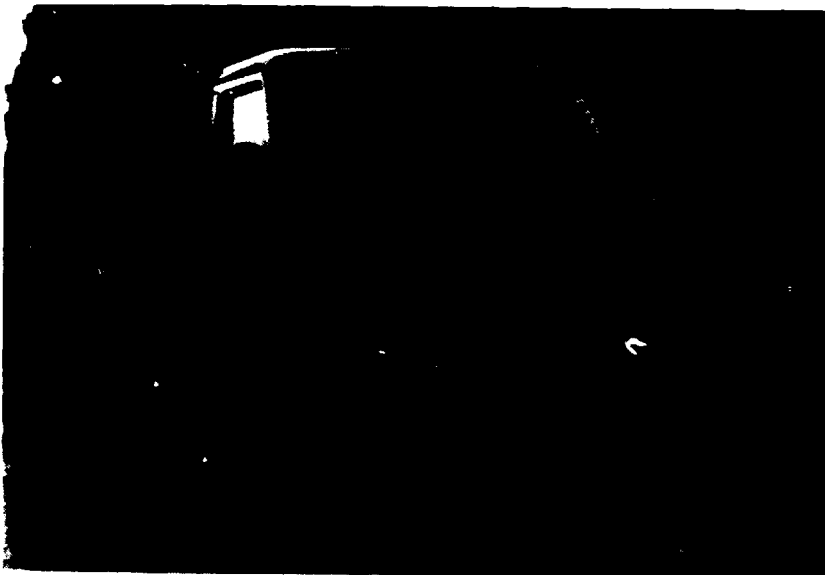


Table 8. Technical parameters of selected farm transport vehicles

Model	Manufacturer	Dimensions l x w x h (cm)	Load- carrying capacity (kg)	Ground clearance (mm)	Maximum speed (km/h)	Fuel consumption (l/tonne·100 km)	Minimum turning radius (m)	Full-load climbing gradient (%)	Engine			
									Model	Rated revolutions (rev/min)	Power (kW)	Figure no.
Ganjiang GJ-12	Jiangxi Walking Tractor Factory	319 x 132 x 175	1 000	220	20.8	2.3	3.2	26	S195	2 000	8.8	15
Ganjiang GJ-2015	Jiangxi Walking Tractor Factory	398 x 160 x 197	1 500	200	47	2.4	5	27	295J-Q	2 000	19.4	16
Longma 7Y-1	Longyan Trac- tor Factory of Fujian Province	383 x 156 x 206	1 000	210	31.8	2.4	5.3	25	S195	2 000	8.8	17
Longma 7Y-1.5	Longyan Trac- tor Factory of Fujian Province	399 x 170 x 201	1 500	200	39.2	2.4	5.5	25	290QM	2 600	20.2	18
Zhanjiang ZJ-12A	Three-Star Farm Vehicle Enterprise Group Corp. of Zhanjiang, Guangdong	455 x 165 x 197	1 250	185	51	2.6	5.8	23	290	2 200	18.4	19
Fengshou-2015	Jiangxi Trac- tor Factory	375 x 173 x 195	1 500	210	41	2.5	5	20	J285	2 450	14.7	20
Hanyue HT-2515D	Hengyang Trac- tor Factory	415 x 164 x 196	1 500	210	47	2.6	5.5	25	295Q	2 000	19.4	21
Songshan TY-2015	No. 2 Tractor Factory of Zhengzhou	403 x 166 x 189	1 500	200	50	2.6	5	25	290Q-1	2 200	18.4	22
Huashan BAJ-120	Baoji Vehicle Factory	404 x 164 x 196	1 500	200	60		5	20	290Q	3 000	22.1	23
YB-2012	Yibin Machin- ery Factory	424.5 x 162 x 179	1 000	220	50		5.5	25	290Q-1	2 200	17.6	24

Figure 17. Longma 7Y-1 farm transport vehicle



Figure 18. Longma 7Y-1.5 farm transport vehicle



Figure 19. Zhanjiang ZJ-12A farm transport vehicle



Figure 20. Fengshou-2015 farm transport vehicle



Figure 21. Nanyue HT-2515D farm transport vehicle



Figure 22. Songshan TY-2015 farm transport vehicle



Figure 23. Huashan BAJ-120 farm transport vehicle



Figure 24. Model YB-2012 farm transport vehicle



Ganjiang GJ-12

Farm transport vehicle Ganjiang GJ-12 (figure 15), produced by the Jiangxi Walking Tractor Factory, is a vehicle of simple design and was the first to undergo exhaustive testing and enter into mass production. It is powered by diesel engine model 195, which is specially designed for small tractors and to serve as a power source for stationary operations. Model 195 is a vertical, single-cylinder and water-cooled diesel engine, with a cylinder diameter of 95 mm, a stroke of 115 mm, a rated power of 8.8 kW and a fuel consumption 256.9 g per kWh. The vehicle is self-dumping with a dumping angle of 45°, and the load-carrying capacity is 1 tonne. At present, the GJ-12 farm transport vehicle is the vehicle produced in the largest quantity. The favourable reception accorded to this vehicle is a result of its simple structure, good manoeuvrability, good climbing ability and low price, and especially of the fact that the cab is mounted on the vehicle.

The factory also produces a version of this vehicle, model GJ-12A, that has more power and a higher operating speed. Another version is model GJ-2015, which is powered by a two-cylinder engine, further increasing the vehicle's power, speed and smoothness of operation. The GJ-2015 has a load-carrying capacity of 1.5 tonnes.

Nanyue HT-2515D

Farm transport vehicle Nanyue HT-2515D (figure 21), produced by Hengyang Tractor Factory, is a two-axled, rear-driven light truck. It is powered by a model 295Q vertical, two-cylinder, water-cooled, four-stroke diesel engine. The engine has a cylinder diameter of 95 mm, a stroke of 115 mm, a rated power of 19.4 kW, a fuel consumption of <257.1 g/kWh and rated revolutions of 2,000 rev/min. Owing to its two-cylinder engine, the vehicle operates more smoothly, makes less noise and emits less exhaust. This is a nice-looking vehicle with a wide field of vision, easy controllability, reliable braking and good manoeuvrability, and it has, accordingly, been developed more rapidly than comparable vehicles.

The Hengyang Tractor Factory has equipped this model with a hydraulic self-dumping system to lessen the labour requirements and improve the efficiency of handling.

E. Outboard engines and propellers

An outboard engine/propeller combination is a simple mechanical device to facilitate transport on the water. The source of power is a small diesel engine. The outboard engine/propeller combination can be installed at the end of a boat without having to modify the boat itself. The power transmission, propeller and steering mechanisms are integrated so as to simplify the device and make it easy to install and operate. Boats equipped with outboard engines and propellers can transport materials to villages that lighters cannot reach. They have, accordingly, become an important mode of transportation in the south of China, which is criss-crossed by rivers and canals.

The technical parameters of boats fitted with selected outboard engine/propeller combinations are listed in table 9.

Table 9. Technical parameters of boats fitted with selected outboard engine/propeller combinations

<u>Engine/propeller combination</u> Manufacturer	<u>Propeller model</u>	Power of diesel engine (kW)	Speed of empty boat (single) (km/h)	Cable traction (N (kgf))	Turning radius (times larger than length of boat)
Haian Machinery General Factory, Jiangsu Province	Huanqiu 7GJ12	8.8	12	1 912 (195)	<3
	Huanqiu 7G5	2.9-3.7	9.5	883 (90)	<2
No. 2 Agricultural Machinery Factory of Shunde, Guangdong Province	7GJ12	8.8	11.5	1 814 (185)	<3
Wenzhou Outboard Engine Factory, Zhejiang Province	7G6	4.4	10.5	1 030 (105)	<2
Ningbo Outboard Engine Factory, Zhejiang Province	NG-1	2.2-2.9	9-10	588 (60)	<2

Haian Machinery General Factory

The Haian Machinery General Factory of Jiangsu Province mainly produces adjustable-pitch outboard propeller Jiangsu 73, fixed-pitch propeller model 7GJ12 and propeller model 7G5, all with their corresponding engines.

Propeller Jiangsu 73

A boat equipped with outboard propeller Jiangsu 73 (figure 25) is propelled, stopped and reversed by changing the pitch of the blades. In 1982, the propeller was awarded a prize by the National Scientific Conference.

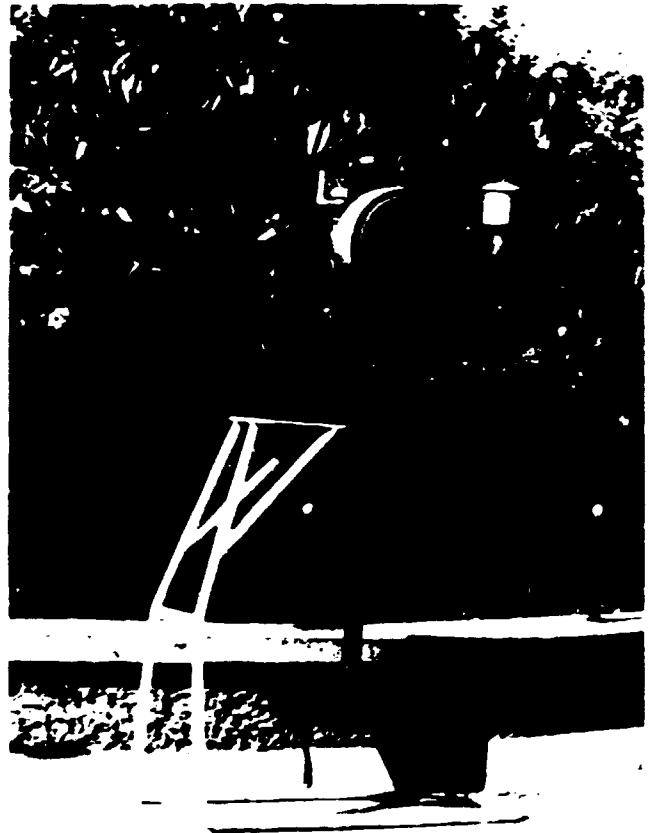
Propeller model 7GJ12

Model 7GJ12 outboard propeller with fixed pitch (figure 26) comes in several versions: 7GJ12-1000, 7GJ12-1400, 7GJ12-1800 and 7GJ12-2000. All these versions have the same length (1,566 mm) and the same width (500 mm) but different heights (2,316, 2,716, 3,116 and 3,316 mm, respectively). The corresponding engine has a power of 8.8 kW and a velocity of 2,000 rev/min. The three-bladed impeller has a diameter of 450 mm and velocity of 800 rev/min. The maximum traction is 195 kgf. The speed of the empty boat (single) is 12 km/h.

Figure 25. Jiangsu 73
outboard propeller



Figure 26. Model 7GJ12
outboard engine/propeller



Propeller model 7G5

Model 7G5 is a new, small outboard propeller with a fixed pitch (figure 27). It is suitable for transportation on rivers, lakes and reservoirs, for catching fish in such bodies of water and for stocking them with fish. This model comes in two versions with the same length (1,380 mm) and the same width (388 mm), but with different heights, of 1,470 and 1,670 mm. The matching engine has a power of 2.9-3.7 kW and a velocity of 2,600-3,000 rev/min. The three-bladed impeller has a diameter of 388 mm. The maximum traction is 90 kg. The speed of the empty boat (single) is 9.5 km/h.

Wenzhou Outboard Engine Factory

The Langhua brand outboard engine and propeller (figure 28) is produced by Wenzhou Outboard Engine Factory. This factory was one of the first to produce outboard engines and propellers. It makes three versions of the unit with different diesel engines, 165F, 170F and 175N, whose power ranges from 2.2 to 4.4 kW (3-6 ps). The dimensions (l x w x h) of the versions are 1,373 x 520 x 380 mm; 1,405 x 540 x 420 mm; and 1,660 x 570 x 430 mm, respectively. The units are installed on boats having carrying capacities of 2-5, 2-5 and 5-8 tonnes. The speeds of the empty boats are 7-9, 8-10 and 10-12 km/h, and the maximum cable tractions are 60, 75 and 105 kgf, respectively.

Figure 27. Model 75G outboard propeller



Figure 28. Langhua brand outboard engine/propeller



Annex II

DESCRIPTION OF SELECTED MANUFACTURERS OF RURAL TRANSPORTATION EQUIPMENT

A. Qingdao Vehicle Factory

Qingdao Vehicle Factory is located on the Jiaodong Peninsula, which is connected to the mainland by good roads. Established in 1956, the factory became the centre for the production of model JL650, Meihua brand wheelbases for tyred barrows and carts. In 1987, it produced wheelbases for 983,300 tyred hand-barrows/animal-drawn carts. These pieces of equipment are well-known for their high quality, economy and low cost. Since many farmers can afford to buy tyred barrows or animal-drawn carts, the products of this factory have always been in great demand.

This factory occupies an area of 34,000 m², of which 32,000 m² constitute the floor area of the building. The staff and workers of this factory number 1,430. The amount of tax on profit turned over to the State by the factory has been four times as much as the total investment in this factory since the establishment of the factory.

B. Changzhou Tractor Factory

Changzhou Tractor Factory is located on the western outskirts of the city of Changzhou in Jiangsu Province. The Grand Canal and railways border the factory on the south and the airport borders it on the west.

Changzhou Tractor Factory, which was built in 1952, was one of the earliest enterprises in China. It specialized in the manufacture of small tractors. Recently this factory was chosen as an enterprise of the second grade of the country. To increase production capacity, a tractor entity of 15 factories has been set up, with the Changzhou Tractor Factory at the centre. The total number of staff of the entity is over 5,300. Changzhou Tractor Factory itself occupies 186,000 m², of which 98,000 m² is the floor area of the buildings, and has a staff of 1,800, of whom 167 are technical personnel. The 424 production units include 16 automatic and semi-automatic production lines. The technological capabilities of this factory put it in the front ranks of this industry.

Changzhou Tractor Factory has produced five models of tractor in the Dongfeng series since the 1960s. The main product, walking tractor Dongfeng-12, has won a gold medal from the State. In 1988 this factory produced nearly 70,000 walking tractors. These tractors have not only been in great demand in China but have also been exported to more than 50 countries. At present, Changzhou Tractor Factory is vigorously developing advanced walking tractors as well as new four-wheel tractors.

C. Jiangxi Tractor Factory

Jiangxi Tractor Factory, located in the city of Nanchang, occupies 640,000 m². It produces more than 10,000 units yearly of its main product, the Fengshou-180 series of small all-gear-driven four-wheel tractors with a rated power of 13.8 kW. The Fengshou-184 series is a four-wheel-drive version of this model that has better traction and holds the road better. It also produces farm transport vehicle model Fengshou-2015 and mining scrapers. The Fengshou-2015 is equipped with the J285Y diesel engine, which is also the power source for all the Fengshou-180 tractors. More than 20 per cent of the chassis parts of this farm transport vehicle are interchangeable with those of

the Fengshou-180 tractor. In 1988 this factory produced more than 1,300 Fengshou-2015 farm transport vehicles.

In May 1988, the Fengshou Tractor Group of Thirty Enterprises was set up, centred on the Jiangxi Tractor Factory, which produces 15 models of tractors using standard and interchangeable components. Jiangxi Tractor Factory has a staff of nearly 5,500, about 480 of whom, or 8.7 per cent of the total, are engineers and technicians. The factory possesses 2,455 pieces of production equipment in all, of which 1,524 are key pieces, including 918 metal-cutting machine tools; 72 pieces of forging equipment; 70 casting machines; 138 hoisting machines; and 58 metallurgical and heat treatment furnaces. There are in this factory nine production lines mainly composed of modular machine tools for processing huge casings and seven production lines composed of general and technical equipment for processing axles, sleeves etc. The joining of engines, rear axles and gear boxes is done on a production line, as is the overall assembly. The products continue to have a reputation for high quality.

D. No. 1 Tractor Factory

No. 1 Tractor Factory, the largest tractor factory in China, is located in the historical city of Luoyang. It employs about 34,000 persons, of whom 3,200 are engineers and technicians. Equipment in the possession of this factory amounts to some 16,000 units, 1,600 or more of which meet advanced international standards. The 26 specialized plants in this factory undertake such tasks as casting, forging, machining, heat-treatment, general assembly, machine-tool-building and technological-equipment-building.

The No. 1 Tractor Factory was originally an enterprise that produced just crawler tractors. In recent years, however, it has been producing a great variety of products. In addition to crawlers and wheeled tractors, the factory also produces trucks, bicycles, and construction machinery such as bulldozers and road-rollers, in all, 30 versions of five basic kinds of products. The Dongfanghong-150 series of wheeled tractors specially suitable for transportation is made in eight versions, with a total annual production of 53,000 units. One of the versions in particular, Dongfanghong-150J3, intended for transportation, enjoys a reputation for high quality.

This factory has developed considerably with respect to both technological progress and the modernization of management. So far, it has produced 528,000 tractors of various kinds, more than 300,000 diesel engines, 840,000 oil pumps, 3,000 off-road vehicles, 25,000 generator sets and more than 2,000,000 bicycles. The cumulative total of tax on profit turned over to the State has amounted to ¥RMB 2.5 billion, or \$US 675 million, four times as much as the State's investment. Now, a larger entity, the Group of the No. 1 Tractor Factory, has been established to promote co-ordination of the various specialized enterprises.

E. Shanghai Tractor Factory

Shanghai Tractor Factory, one of the key enterprises of the Ministry of the Machinery and Electronics Industry, specializes in the production of medium-size wheeled tractors model Shanghai-50 and model Shanghai-504. In 1988, production amounted to 10,500 tractors yearly. At present, the factory has a staff of 3,000. For a long time, the factory has paid attention to the development of technology and the training of qualified technical personnel as well as to the expansion of its market. Also, it has made every effort to improve and update its products. A number of processing lines and a

comprehensive quality control system have been established. The reliability and quality of its products have made this the leading tractor factory, as measured by both the tax on profit turned over to the State and the overall production rate. Shanghai Tractor Factory places a high priority on serving the users of its products and has set up a comprehensive service network that offers not only spare parts but also advice. Shanghai-50 tractors have been very popular with farmers because of high quality and excellent service.

F. Anji Mechanical Vehicle General Factory

Anji Mechanical Vehicle General Factory is 80 km north-west of the scenic city of Hangzhou. Originally the factory produced small model 165F and 175F diesel engines. Then, in 1988, in response to the urgent need for rural transportation machinery, the factory started to produce diesel-powered three-wheel farm vehicles of AD series, Tianmushan brand. This production of three-wheel farm vehicles grew robustly year after year. Now, the factory has a production capacity of 12,000 vehicles yearly and has become specialized in three-wheel farm vehicles. Most of the vehicles it produces are powered by 4.4, 5.9 and 6.6 kW diesel engines, although a few are powered by 8.8 kW engines. Some of the vehicles have cabs and some do not. The factory produces 10 or so versions of the three-wheel farm vehicle in all.

Anji Mechanical Vehicle General Factory has a staff of 383 persons and occupies 57,000 m², of which 30,000 m² are the floor area of the buildings. The factory possesses 276 pieces of key production equipment and production lines for assembly, baking and spray-painting. The factory also has a fairly good system for quality inspection. In 1987, the three-wheel farm vehicle produced by this factory won a prize for reliability in the first national cross-country race of mechanical three-wheel farm vehicles.

G. Hengyang Tractor Factory

Hengyang Tractor Factory in central Hunan Province occupies a total area of 320,000 m², of which 162,000 m² are the floor areas of buildings, including 94,000 m² of production buildings. The factory has a staff of 2,453 persons, including 186 engineers and technicians. It possesses 832 major pieces of production equipment, including 445 machine tools, 56 pieces of forging and punching equipment and 34 casting machines. The equipment for punching, painting and assembling is the most advanced in China.

Before 1978, Hengyang Tractor Factory specialized in the production of walking tractors model Gongnong-10 (7.4 kW). In recent years, the factory developed three products in succession: first, model Nanyue-12 and model Nanyue-5 walking tractors; then, model HT-2515 farm transport vehicle, with a load-carrying capacity of 1.5 tonnes; and, lastly, the hydraulic self-dumping version of the latter. Its key products are the Nanyue-12 walking tractor and the HT-2515 farm transport vehicle. In 1988, production of these two products amounted to 27,000 units and 2,000 units, respectively. By the end of this century this factory will produce four new series of products: small tractors, rice field tractors, construction machinery, and new farm transport vehicles.

H. Baoji Vehicle Factory

Baoji Vehicle Factory specializes in transportation machinery, mainly producing farm transport vehicle model BAJ-120, Huashan brand, and truck and farm trailers with load-carrying capacities of 3-6 tonnes. The factory occupies 160,000 m², of which 73,000 m² are the floor area of buildings,

including 40,000 m² of production buildings. The factory has a staff of 1,480 persons, of whom 106 are engineers and technicians.

Baoji Vehicle Factory started to carry out a technological renovation in 1984. In 1988 the factory produced more than 2,000 model BAJ-120 farm transport vehicles, and by 1990 it should be able to produce 5,000 units. Owing to their compact structure, good manoeuvrability, low fuel consumption and low price, these vehicles have sold well to households specialized in transport and to rural and town industries. Huashan brand trailers, which have long been the main products of this factory, are produced in eight varieties and 16 models, to match the large and medium-size Jiefang and Dongfeng tractors of 20.6-40.4 kW (28-55 ps) and trucks. Since all the trailers have pneumatic brakes, operation is smooth and safe and the trailers are suitable for transportation not only in the plains but also in mountainous areas.

In recent years, the factory has developed rapidly, with the gross value of its output and profit growing at 25 per cent per year. It is expected that an association between a number of enterprises in this industry will be established in the near future.

I. Longyan Tractor Factory of Fujian Province

Longyan Tractor Factory is located at Longyan, a picturesque city. It specializes in the production of the farm transport vehicle known by the brand name Longma. The factory occupies an area of more than 100,000 m² and has a staff of nearly 1,000 persons, including 150 persons engaged in technical and management work. It has 300 machine tools of various kinds, a processing line and an assembly line, as well as sets of inspection and measuring apparatus. The management operations of this factory have been computerized.

Longyan Tractor Factory produces farm transport vehicles models 7Y-1 and 7Y-1.5, with load-carrying capacities of 1 and 1.5 tonnes, respectively. Model 7Y-1 has two versions equipped with single-cylinder diesel engines, with cylinder diameters of 95 mm or 100 mm. This farm transport vehicle was the first to be developed and is the most widespread in rural areas because it is compact and easy to maintain and operate and has better climbing ability than tractor-trailer sets of the same power. By the same token, it also has some problems, such as bumpy operation, excessive noise and exhaust and a low operating speed, due to the single-cylinder engine. Accordingly, the factory developed model 7Y-1.5, which has a two-cylinder engine of either 90 mm or 100 mm cylinder diameter. Model 7Y-1.5 has a greater load-carrying capacity, a higher operating speed and better overall performance. Both models, 7Y-1 and 7Y-1.5, are equipped with a closed cab, a steering mechanism, front and rear spring suspension, a hydraulic four-wheel brake system and a high-quality electrical signal system. In 1988, the factory produced more than 3,000 farm transport vehicles, and it is expected that production will rise to 5,000 units per year.

J. Haian Machinery General Factory of Jiangsu Province

Haian Machinery General Factory of Jiangsu Province is located in the town of Haian, in the economic zone of Shanghai. Established 30 years ago, it is specialized in the production of outboard engines and propellers. It occupies a building floor area of 5,180 m² and has a staff of 275 persons. The factory produces engine/propeller combinations, with engine powers ranging from 2.9 to 35.8 kW (4-50 ps). The production per year amounts to 15,000 units. The main parts and components, such as the upper and lower case, are made by special machine tools. The bevel drive gears and the impellers are made by a co-operative arrangement with other factories specialized in

such production. Haian Machinery General Factory has set up a quality assurance system, so quality is better than in other factories making this kind of equipment, and the factory has become the leading manufacturer of outboard engines and propellers in the country.

Since outboard engines and propellers are made of mainly cast iron, nodular cast iron, seamless steel tubing, medium thickness steel plate, carbon rounds and angle bars, their price is low, only about ¥RMB 410-600, or \$US 110-160, per unit. As water transportation develops and as the number of households specialized in this mode of transport increases, the market for outboard engines and propellers will continue to grow.

Annex III

**ESTIMATES OF THE EQUIPMENT AND INVESTMENT NEEDED FOR
THE MANUFACTURE OF RURAL TRANSPORTATION EQUIPMENT**

China has a fairly sound industrial base for rural transportation equipment. However, most of the manufacturers of this kind of equipment have evolved gradually, out of factories that were not originally designed to make transportation equipment. Moreover, they produce many different products, not just transportation equipment. It is, therefore, impossible to estimate the equipment and investment necessary for the production of rural transportation equipment on the basis of data on the equipment and accumulated investment of existing manufacturers. Instead, on-purpose estimates have been prepared for the setting up of factories producing nine kinds of rural transport equipment. These estimates are detailed in tables 11-19; table 10, an overview table, summarizes the equipment specifications and annual capacities for which the estimates have been made.

It is important to note in connection with these estimates that the investment will vary over time as prices change. Thus, the investment in fixed assets and the listings of materials are approximate and for reference purposes only. The investments do not, moreover, include costs of construction outside the factory, such as for housing or social services.

The production quantities of the nine products are the economically ideal quantities. Because no factory produces only farm transport vehicles, these vehicles are being made by tractor factories using, in part, components provided by other factories specialized in the relevant technologies. It is for this reason that no estimates have been prepared for farm transport vehicles.

Table 10. Index of tables containing investment estimates and equipment lists for various factories

Production item	Annual capacity	Specification	Table
Wheeled tractor	10 000 units	37 kW (50 ps)	11
Wheeled tractor	20 000 units	18 kW (25 ps)	12
Small four-wheel tractor	30 000 units	9-13 kW (12-15 ps)	13
Walking tractor	30 000 units	<9 kW (10-12 ps)	14
Farm truck	5 000 units	3-3.5 tonne load-carrying capacity	15
Farm tractor	2 000 units	1-2 tonne load-carrying capacity	16
Farm trailer	5 000 units	4-7 tonne load-carrying capacity	17
Three-wheeled farm vehicle	10 000 units	0.5-10 tonne load-carrying capacity	18
Tyred barrow/ animal-drawn cart	10 000 units	-	19

Table 11. Equipment list and estimate of investments for a factory producing 10,000 units per year of a wheeled tractor having a power of 37 kW (50 ps) a/

Item	Comment	Floor area of building (m ²)
Purchased parts and components	Engine, gears and spline shaft, steering system, hydraulic system, rims and spokes, radiator accessories, standard parts, electrical apparatus, non-metallic parts, electroplated parts, cast steel parts etc.	
Production departments	Annual capacity	
Foundry shop	14 000 tonnes	13 000-14 000
Forging shop	2 750 tonnes	4 900-5 100
Punching and welding shop	3 000 tonnes	4 200-4 500
Heat-treatment shop	2 020 tonnes	1 500-1 800
Paint department	Painted for punched and welded parts and general assemblies	3 500
Machine shop	200 categories/380 pieces	11 000-16 800
Assembly shop	10 000 units	6 000-8 000
Processing techniques	<p>Foundry: cupola furnace of 7-tonne capacity, separate moulding lines for large, medium-size and small working pieces.</p> <p>Die forging: working pieces of over 3 tonnes are purchased; combined punch shears for blanking; double-acting hydraulic sheet-metal stamping equipment for cover shields shaping; heat treatment: controlled-atmosphere modified treatment line, drip-feed, well-type, gas-carburizing furnace and high-frequency equipment.</p> <p>Welding: weld line, CO₂-shielded welding equipment.</p> <p>Painting: electrophoretic priming coating, electrostatic surface coating, continuous line.</p> <p>Machining: modular machine tool processing line.</p> <p>Assembly: forced assembly line</p>	
Productive labour coefficient	For machining: 70-90 unit·h/unit tractor	
Total pieces of equipment	1 310-1 480, including 345-390 machine tools	
Staff	3 120-3 800 persons, including 2 620-3 100 grade 4 (average) workers	
Total area	24-29 ha	
Floor area of building	70 800-85 600 m ²	

continued

Table 11 (continued)

Item	Comment
Utilities consumption	
Electrical installations capacity	12 140-15 700 kW
Water	1 240-1 370 m ³ /da
Steam	12.6-13.7 tonnes/h (max.)
Compressed air	6 100-6 860 m ³ /h (on average)
Raw materials consumption	
For production	13 050 tonnes metals
For construction	
Cement	21 000-24 200 tonnes
Steel	4 950-5 300 tonnes
Wood	14 300-15 500 m ³
Gross value of plant output b/	¥RMB 150 000 000 (¥RMB 15 000/unit)
Total investment in capital construction	¥RMB 89 300 000-102 000 000
Equipment installation	¥RMB 46 000 000-51 200 000
Construction engineering	¥RMB 30 000 000-36 400 000
Miscellaneous	¥RMB 13 300 000-14 400 000
Off-site construction and social services	Utilities outside the plant, such as water supply and drainage, power supply, roads, communications and welfare facilities, are provided by the municipality but not taken into account in this estimate
Main techno-economic indices	
Unit product investment	¥RMB 8 930-10 200
Overall productivity rate	¥RMB 39 470-48 000/man·year; 2.63-3.21 unit/man·year
Unit area output	0.12-0.14 unit/m ² building area

a/ This table provides a range of estimates for much of the data to allow for variations from one factory location to another.

b/ For the purpose of calculating the output value, the estimated price of the tractor has been increased by 10 per cent over the 1987 price.

Table 12. Equipment list and estimate of investments for a factory producing 20,000 units per year of a wheeled tractor having a power of 18 kW (25 ps) a/

Item	Comment	
Purchased parts and components	Engine, gears and spline shaft, steering system, hydraulic system, rims and spokes, radiator accessories, standard parts, electrical apparatus, non-metallic parts, cast steel parts etc.	
	Annual capacity	Floor area of building (m ²)
Production departments		
Foundry shop	16 000 tonnes	13 500-14 000
Forging shop	4 780 tonnes	5 500-5 800
Punching and welding shop	3 560 tonnes	4 900-5 200
Heat-treatment shop	3 230 tonnes	1 800-2 000
Paint department	Painting for punched and welded parts and general assemblies	
Machine shop	160 categories/310 pieces	10 350-15 400
Assembly shop	20,000 units	6 000-8 000
Processing techniques	<p>Foundry: cupola furnace of 7-tonne capacity, separate moulding lines for large, medium-size and small components</p> <p>Die forging: all pieces die-forged by the plant itself; combined punch shears for blanking; closed double-acting sheet-metal stamping equipment for work pieces shaping, flattened by fine pressing machine; heat treatment: controlled-atmosphere multi-purpose furnace; controlled-atmosphere modified treatment line.</p> <p>Welding: weld line; special-purpose equipment; CO₂-shielded welding equipment.</p> <p>Painting: electrophoretic priming coating, electrostatic surface coating, continuous line.</p> <p>Machining: modular machine tool processing line.</p> <p>Assembly: forced assembly line</p>	
Productive labour coefficient	For machining: 45-65 unit·h/unit tractor	
Total pieces of equipment	1 310-1 520, including 345-400 machine tools	
Staff	4 100-4 650 persons, including 3 250-3 680 grade 4 (average) workers	
Total area	30-35 ha	
Floor area of building	89 600-104 000 m ²	

continued

Table 12 (continued)

Item	Comment
Utilities consumption	
Electrical installations capacity	14 200-18 260 kW
Water	1 440-1 570 m ³ /d
Steam	17.6-18.6 tonnes/h (max.)
Compressed air	6 620-7 470 m ³ /h (on average)
Raw materials consumption	
For production	23 000 tonnes metals
For capital construction	
Cement	19 100-21 000 tonnes
Steel	4 950-5 300 tonnes
Wood	13 500-14 500 m ³
Gross value of plant output b/	¥RMB 164 000 000 (¥RMB 8 200/unit)
Total investment in capital construction	¥RMB 97 500 000-113 100 000
Equipment installation	¥RMB 44 200 000-52 300 000
Construction engineering	¥RMB 38 100 000-44 200 000
Miscellaneous	¥RMB 15 200 000-16 600 000
Off-site construction and social service	Utilities outside the plant, such as water supply and drainage, power supply, roads, communications and welfare facilities, are provided by the municipality but not taken into account in this estimate
Main techno-economic indices	
Unit product investment	¥RMB 4 875-5 655/unit
Overall productivity rate	¥RMB 35 276-40 000/man·year; 4.3-4.9 unit/man·year
Unit area output	0.19-0.22 unit/m ² building area
Unit investment output value	¥RMB 1.45-1.68/¥RMB investment in capital construction

a/ This table provides a range of estimates for much of the data to allow for variations from one factory location to another.

b/ For the purpose of calculating the output value, the estimated price of the tractor has been increased by 10 per cent over the 1987 price.

Table 13. Equipment list and estimate of investments for a factory producing 30,000 units per year of a small four-wheel tractor having a power of 9-13 kW (12-15 ps) a/

Item	Comment																
Purchased parts and components	Engine, gears and spline shaft, steering system, hydraulic system, rims and spokes, radiator accessories, standard parts, steel parts, electroplated parts, electrical apparatus, instruments, non-metallic parts.																
Production departments	<table border="1"> <thead> <tr> <th data-bbox="674 704 905 727">Annual capacity</th> <th data-bbox="1090 672 1429 727">Floor area of building (m²)</th> </tr> </thead> <tbody> <tr> <td data-bbox="289 832 478 855">Foundry shop</td> <td data-bbox="674 832 1352 855">11 000 tonnes 3 000-14 000</td> </tr> <tr> <td data-bbox="289 859 478 883">Forging shop</td> <td data-bbox="674 859 1336 883">1 800 tonnes 1 900-2 400</td> </tr> <tr> <td data-bbox="289 887 597 944">Punching and welding shop</td> <td data-bbox="674 919 1336 942">5 300 tonnes 4 500-5 000</td> </tr> <tr> <td data-bbox="289 949 582 972">Heat-treatment shop</td> <td data-bbox="674 949 1336 972">3 800 tonnes 1 800-2 500</td> </tr> <tr> <td data-bbox="289 976 478 1000">Machine shop</td> <td data-bbox="674 976 1290 1000">200 categories/380 pieces 10 000</td> </tr> <tr> <td data-bbox="289 1004 535 1027">Paint department</td> <td data-bbox="674 1004 1290 1070">Painting for punched and welded parts and general assemblies 3 300</td> </tr> <tr> <td data-bbox="289 1074 489 1098">Assembly shop</td> <td data-bbox="674 1074 1336 1098">30 000 units 5 000-6 500</td> </tr> </tbody> </table>	Annual capacity	Floor area of building (m ²)	Foundry shop	11 000 tonnes 3 000-14 000	Forging shop	1 800 tonnes 1 900-2 400	Punching and welding shop	5 300 tonnes 4 500-5 000	Heat-treatment shop	3 800 tonnes 1 800-2 500	Machine shop	200 categories/380 pieces 10 000	Paint department	Painting for punched and welded parts and general assemblies 3 300	Assembly shop	30 000 units 5 000-6 500
Annual capacity	Floor area of building (m ²)																
Foundry shop	11 000 tonnes 3 000-14 000																
Forging shop	1 800 tonnes 1 900-2 400																
Punching and welding shop	5 300 tonnes 4 500-5 000																
Heat-treatment shop	3 800 tonnes 1 800-2 500																
Machine shop	200 categories/380 pieces 10 000																
Paint department	Painting for punched and welded parts and general assemblies 3 300																
Assembly shop	30 000 units 5 000-6 500																
Processing techniques	<p>Foundry: cupola furnace of 5 and 7 tonnes capacity, separate moulding lines for small and medium-size working pieces.</p> <p>Forging: die forging, single-point double-acting press for large work piece shaping; heat treatment: controlled-atmosphere multi-purpose furnace; controlled-atmosphere modified treatment line, high-frequency equipment.</p> <p>Welding: CO₂-shielded welding fuel tanks are processed on processing line.</p> <p>Painting: electrophoretic priming coating, electrostatic surface coating, infra-red drying.</p> <p>Machining: modular machine tool processing line, partially automatic line.</p> <p>General assembly: forced assembly line.</p>																
Productive labour coefficient	For machining: 35-50 unit·h/unit tractor																
Total pieces of equipment	1 330-2 050, including 350-540 machine tools.																
Staff	2 750-3 000 persons, including 2 320-2 450 grade 4 (average) workers.																

continued

Table 13 (continued)

Item	Comment
Total area	21-24 ha
Floor area of building	63 300-71 650 m ²
Utilities consumption	
Electrical installations capacity	12 140-15 700 kW
Water	990-1 070 m ³ /d
Steam	13.11-13.86 tonnes/h (max.)
Compressed air	5 240-5 890 m ³ /h (average)
Raw materials consumption	
For production	26 000 tonnes metals
For capital construction	
Cement	15 800-17 200 tonnes
Steel	4 080-4 850 tonnes
Wood	11 500-13 430 m ³
Gross value of plant output b/	¥RMB 135 000 000 (¥RMB 4 500/unit)
Total investment in capital construction	¥RMB 73 600 000-83 700 000
Equipment installation	¥RMB 34 800 000-40 400 000
Construction engineering	¥RMB 26 900 000-30 500 000
Miscellaneous	¥RMB 11 900 000-12 800 000
Off-site construction and social services	Utilities outside the plant, such as water supply and drainage, power supply, roads, communication and welfare facilities, are provided by the municipality but are not taken into account in this estimate.
Main techno-economic indices	
Unit product investment	¥RMB 2 454-2 790/unit
Overall productivity rate	¥RMB 45 000-49 090/man·year
Unit area output	0.47-0.42 unit/m ² building area
Unit investment output value	¥RMB 1.61-1.83/¥RMB investment in capital construction

a/ This table provides a range of estimates for much of the data to allow for variations from one factory location to another.

b/ For the purpose of calculating the output value, the estimated price of the tractor has been increased by 10 per cent over the 1987 price.

Table 14. Equipment list and estimate of investment for a factory producing 30,000 units per year of a walking tractor having a power of <9 kW (10-12 ps) a/

Item	Comment
Purchased parts and components	Engine, gears and spline shaft, steering system, hydraulic system, radiator accessories, standard parts, rims and spokes, electroplated parts, electrical apparatus, non-metallic parts, cast steel parts.
Production departments	Floor area of building (m ²)
	Annual capacity
Foundry shop	11,000 tonnes 10 000-11 00 (establishment of branch of the plant is allowed)
Forging shop Punching and welding shop	3,140 tonnes 1 900-2 100
Heat-treatment shop	1,050 tonnes 3 700-3 900
Machining shop	2,200 tonnes 1 500-1 800
Paint department	100 categories/130 pieces 5 800-8 000
Assembly shop	Painting for punched and welded parts and general assemblies 2 600 30,000 units 3 500-4 000
Processing techniques	Foundry: cupola furnace of 5 and 7 tonnes capacity; separate moulding lines for small and medium-size working pieces. Forging: air hammer and friction press, acid dip before processing; single-point closed press for blanking, extruding and piercing, flattened by friction press; heat treatment: drip-feed, well-type, gas-carburizing furnace, controlled-atmosphere modified treatment line. Welding: general-purpose welding equipment. Machining: modular machine-tool processing line, partially automatic line. Painting: electrophoretic priming coating, electrostatic surface coating. General assembly: forced assembly line.
Productive labour coefficient	For machining: 33-50 unit·h/unit
Total pieces of equipment	875-945, including 230-270 machine tools

continued

Table 14 (continued)

Item	Comment
Staff	2 100-2 400 persons including 1 700-1 950 grade 4 (average) workers.
Total area	17-19 ha
Floor area of building	48 700-57 400 m ²
Utilities consumption	
Electrical installations capacity	9 860-11 500 kW
Water	1 570-1 670 m ³ /d
Steam	6.95-7.70 tonnes/h (max.)
Compressed air	4 640-5 140 m ³ /h
Raw materials consumption	
For production	7 600 tonnes metals
For capital construction	
Cement	14 200-15 600 tonnes
Steel	3 850-4 300 tonnes
Wood	9 700-9 950 m ³
Gross value of plant output b/	¥RMB 103 500 000 (¥RMB 3 450/unit)
Total investment in capital construction	¥RMB 53 900 000-60 900 000
Equipment installation	¥RMB 24 400 000-26 900 000
Construction engineering	¥RMB 21 200 000-25 000 000
Miscellaneous	¥RMB 8 300 000-9 000 000
Off-site construction and social services	Utilities outside the plant such as water supply and drainage, power supply, roads, communications and welfare facilities are provided by the municipality but are not included in this estimate.
Main techno-economic indices	
Unit product investment	¥RMB 1 797-2 030/unit
Overall productivity rate	¥RMB 43 130-49 300/man·year; 12.5-14.29 unit/man·year
Unit area output	0.52-0.62 unit/m ² building area
Unit investment output value	¥RMB 1.70-1.92/¥RMB investment in capital construction

a/ This table provides a range of estimates for much of the data to allow for variations from one factory location to another.

b/ For the purpose of calculating the output value, the estimated price of the tractor has been increased by 10 per cent over the 1987 price.

Table 15. Equipment list and estimate of investments for a factory producing 5,000 units (including 200 refitted units) per year of a farm truck having a load-carrying capacity of 3-3.5 tonnes

Item	Comment		
Purchased parts and components	Engine, gear box, drive shaft, front axle, rear axle, steering device, leaf-spring shock absorbers, wheels, standard parts, non-metallic parts, electrical apparatus.		
Production departments	Annual capacity	Floor area of building (m ²)	
	Punching shop	4 800 tonnes	4 600
	Welding shop	1 850 tonnes	2 200
	Baking finish shop	6 400 tonnes a/	3 600
	General assembly shop	13 500 tonnes	3 000
	Metal shop	880 tonnes	1 200
Processing techniques	Acid dip for rusty plate and shapes before processing; processing line for main pressings; sectional forming of platform of truck box by 8-tonne double-point press; girder forming by hydraulic press of 2 000 tonnes; frame blanking and punching by 1 250 tonne single-point press; semi-automatic CO ₂ -shielded welding; general assembly line.		
Productive labour coefficient	95 unit·h/unit truck 188 man·h/unit truck		
Total pieces of equipment	440, including 160 machine tools; pressing equipment, 20 units; welding equipment, 70 units; painting equipment, 20 units.		
Staff	1 980 persons, including 1 630 grade 3.5-4 (average) workers.		
Total area	13 ha		
Floor area of building	50 000 m ²		
Utilities consumption			
Electrical installations capacity	7 250 kW		
Water	900 m ³ /d		
Steam	13.0 tonnes/h (max.) b/		
Compressed air	4 200 m ³ /h (average)		

continued

Table 15 (continued)

Item	Comment
Raw materials consumption	
For production	7 500 tonnes metals, including sheet metal, 5 500 tonnes, and plate, 1 000 tonnes; fuel and chemicals, 780 tonnes.
For capital construction	
Cement	9 800 tonnes
Steel	3 200 tonnes
Wood	3 000 m ³
Gross value of plant output	¥RMB 70 000 000 (selling price ¥RMB 14,000/unit)
Total investment in capital construction	¥RMB 27 000 000
Equipment installation	¥RMB 14 800 000
Construction engineering	¥RMB 7 250 000
Miscellaneous	¥RMB 4 950 000
Off-site construction and social services	Utilities outside the plant such as power supply, water supply and drainage, roads, communications and some welfare facilities are provided by the municipality.
Main techno-economic indices	
Unit product investment	¥RMB 5 400/unit
Overall productivity rate	¥RMB 35 400/man·year; 2.53 unit/man·year
Unit area output	0.1 unit/m ² building area
Unit investment output value	¥RMB 2.6/¥RMB investment in fixed assets

a/ With a view to eventually expanding capacity to 20,000 units per year.

b/ Includes heating of shops.

Table 16. Equipment list and estimate of investments for a factory producing 2,500 units per year of a farm trailer having a load-carrying capacity of 1-2 tonnes

Item	Comment
Purchased parts and components	Brake system, rims, standard parts, bearings, tyres, rubber and plastic parts, cast steel parts.
Floor area of production departments	
Punching and welding shop	1 500 m ²
Leaf-spring shop	900 m ² (self-sufficient)
Metal shop	1 000 m ²
Assembly shop	1 400 m ²
Paint department	1 200 m ² (workshop of simple construction)
Processing techniques	Multi-variety, small batch production; acid dip for hot-rolled shapes and rusty materials; processing line for pressings; automatic or semi-automatic CO ₂ -shielded welding; hand painting and natural drying.
Productive labour coefficient	35 unit·h/unit, 50 man·h/unit
Total pieces of equipment	150 units, including punching and welding equipment, 50 units; machine tools, 40 units.
Staff	530 persons, including 430 grade 3-4 (average) workers.
Total area	about 3 ha
Floor area of building	14 000 m ²
Utilities consumption	
Electrical installations capacity	1 000 kW
Water capacity	50 tonnes/h
Steam	1.5 tonnes/h (max.)
Compressed air	760 m ³ /h (average)
Raw materials consumption	
For production	3,200 tonnes of various shapes and plates

continued

Table 16 (continued)

Item	Comment
For capital construction	
Cement	2 450 tonnes
Steel	900 tonnes
Wood	1 000 m ³
Gross value of plant output	¥RMB 8 500 000 (selling price ¥RMB 3 400/unit)
Total investment in capital construction	¥RMB 3 900 000
Equipment installation	¥RMB 2 050 000
Construction engineering	¥RMB 1 480 000
Miscellaneous	¥RMB 370 000
Off-site construction and social services	Power supply, water supply and drainage, roads, communications and welfare facilities are provided by the municipality.
Main techno-economic indices	
Unit product investment Overall productivity	¥RMB 1 560/unit
rate	¥RMB 16 000/man·year; 4.72 units/man·year
Unit area output	0.18 unit/m ² building area
Unit investment output value	¥RMB 2.18/¥RMB investment in fixed assets

Table 17. Equipment list and estimate of investments for a factory producing 5,000 units per year of a farm trailer having a load-carrying capacity of 4-7 tonnes

Item	Comment
Purchased parts and components	Brake system, rims, casts of steering wheel and hubs, a part of the requirement for leaf springs, standard bearings, tires, plastic and rubber parts, electrical apparatus.
Floor area of production departments	
Punching and welding shop	4 000 m ²
Metal shop	1 800 m ²
Leaf-spring shop a/	900 m ²
Assembly shop	1 400 m ²
Paint department b/	1 400 m ²
Processing techniques	Batch production of many varieties of products; acid dip for shapes and rusty plates; processing line for large pressings; girders are processed by a 2,000-tonne hydraulic press; automatic or semi-automatic CO ₂ -shielded welding; hand painting and natural drying, indoor operating.
Productive labour coefficient	42 unit·h/unit, 85 man·h/unit
Total pieces of equipment	280 units, including punching and welding equipment, 86 units, and 79 machine tools.
Staff	600 persons, including 480 grade 3-4 (average) workers.
Total area	4.6 ha
Floor area of building	15 500 m ²
Utilities consumption	
Electrical installations capacity	2 000 kW
Water	78 m ³ /h (average)
Steam	1.2 tonnes/h (max.)
Compressed air	430 m ³ /h (average)
Raw materials consumption	
For production	7 500 tonnes

continued

Table 17 (continued)

Item	Comment
For capital construction	
Cement	3 000 tonne
Steel	980 tonnes
Wood	1 200 m ³
Gross value of plant output	¥RMB 34 000 000 (¥RMB 6 500/unit)
Total investment in capital construction	¥RMB 6 600 000
Equipment installation	¥RMB 3 450 000
Construction engineering	¥RMB 2 410 000
Miscellaneous	¥RMB 740 000
Off-site construction and social services	Utilities, including power supply, water supply and drainage, roads, communications and welfare facilities, are provided by the municipality but not included in the estimate for capital construction.
Main techno-economic indices	
Unit product investment	¥RMB 1 320/unit
Overall productivity rate	¥RMB 56 700/man·year; 8.33 unit/man·year
Unit area output	0.32 unit/m ² building area
Unit investment output value	¥RMB 5.15/¥RMB investment in fixed assets

a/ Current capacity: 2,500 units per year.

b/ Simple constructed workshop.

Table 18. Equipment list and estimate of investments for a factory producing 10,000 units per year of a three-wheel motorized farm vehicle having a load-carrying capacity of 0.5-1.0 tonne a/

Item	Comment	
Purchased parts and components	Diesel engine, rear axle, steering-gear, gear-box, wheels, standard parts, electrical apparatus and tool case, cast parts.	
	Annual capacity	Floor area of building (m ²)
Production departments		
Punching shop	1 600 tonnes	1 200
Welding shop	2 000 tonnes	2 100
Metal shop	500 tonnes	600
Assembly shop	10 000 units	3 500
Paint department	10 000 units	1 000
		(workshop of simple construction)
Processing techniques	Pressings are produced in batches alternately; hand welding; forced assembly line; hand painting and natural drying.	
Productive labour coefficient	40 man·h/unit, including punching, welding, assembly and painting.	
Total pieces of equipment	285, including punching and welding equipment, 25 units; welding equipment, 20 units; machine tools, 20 units.	
Staff	650 persons, including 580 grade 3-3.5 (average) workers.	
Total area	1.2 ha	
Floor area of building	17 000 m ²	
Utilities consumption		
Electrical installation capacity	1 870 kW	
Water	100-150 m ³ /d	
Steam	1.5 tonnes/h (max.)	
Compressed air	400-450 m ³ /h	
Raw materials consumption		
For production	3 500 tonnes of steel	

continued

Table 18 (continued)

Item	Comment
For capital construction	
Cement	3 300 tonnes
Steel	950 tonnes
Wood	2 800 m ³
Gross value of plant output	¥RMB 35 000 000 (¥RMB 3 500/unit)
Total investment in capital construction	¥RMB 5 500 000-6 000 000
Equipment installation	¥RMB 2 700 000-3 000 000
Construction engineering	¥RMB 1 980 000-2 350 000
Miscellaneous	¥RMB 650 000-820 000
Off-site construction and social services	Utilities, including power supply, water supply and drainage, roads, communications and welfare facilities, are provided by the municipality but not included in this estimate.
Main techno-economic indices	
Unit product investment	¥RMB 550-600/unit
Overall productivity rate	¥RMB 53 850/man·year, 15.38 unit/man·year
Unit area output	0.59 unit/m ² building area
Unit investment output value	¥RMB 5.8-6.3/¥RMB investment in capital construction

a/ Estimates are based on data from motorcycle plants and three-wheel vehicle plants, for which the actual conditions vary. The plant to be constructed will produce a three-wheel farm vehicle equipped with chain-and-sprocket drive and a removeable canvas-roofed cab.

Table 19. Equipment list and estimates of investments for a factory producing 5,000 units per year of wheelbase for animal-drawn carts, 32 x 6, with load-carrying capacity of 2 tonnes, plus 5,000 units per year of wheelbases for two-wheel hand-barrows, model 350

Item	Comment
Purchased parts and components	Tyred wheel assembly, bearing assembly, standard parts, spokes, plastic and rubber parts.
	Floor area of building (m ²)
Production departments	Annual capacity
Punching shop	500 tonnes 1 100
Welding shop	1 200 tonnes 1 500
Assembly shop	10 000 units (mixed) 1 800
Paint department	10 000 units (mixed) 900
Processing techniques	Pressings are produced in batches alternately; hand welding, universal welding jig; free assembly, but flow operation for assembly can be used in case the batches are large; hand painting and natural drying.
Production labour coefficient	15 unit·h/unit; 35 man·h/unit
Total pieces of equipment	190 units, including punching equipment, 15 units, and welding equipment, 20 units
Staff	90 persons, including 30 workers of grade 3 (average)
Total area	1.5-2.0 ha
Floor area of building	10 000 m ²
Utilities consumption	
Electrical installation capacity	550 kW
Water	30 tonnes/d
Steam	0.8 tonnes/h (max.)
Compressed air	500 m ³ /h (average)
Raw materials consumption	1 300 tonnes of steel
For production	

continued

Table 19 (continued)

Item	Comment
For capital construction	
Cement	1 300 tonnes
Steel	300 tonnes
Wood	450 m ³
Gross value of plant output	¥RMB 3 500 000 (¥RMB 350/unit average)
Total investment in capital construction	¥RMB 3 500 000
Equipment installation	¥RMB 1 600 000
Construction engineering	¥RMB 1 300 000
Miscellaneous	¥RMB 600 000
Off-site construction and social services	Utilities, including power supply, water supply and drainage, roads, communications and welfare facilities, are provided by the municipality but are not included in this estimate.
Main techno-economic indices	
Unit product investment	¥RMB 350/unit
Overall productivity rate	¥RMB 38,900/man·year, 110 unit/man·year
Unit area output	1.0 unit/m ² building area
Unit investment output value	¥RMB 1.0/¥RMB investment in capital construction