

Participant Handbook

Sector
Agriculture and Allied

Sub-Sector
Agriculture Crop Production

Occupation
**Farm Machinery and Equipment
Operation and Maintenance**

Reference ID: **AGR/Q1101, Version 1.0**
NSQF Level 4



Tractor Operator

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Shri Narendra Modi
Prime Minister of India

“ Skilling is building a better India.
If we have to move India towards
development then Skill Development
should be our mission. ”



Certificate

COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

AGRICULTURE SECTOR SKILL COUNCIL

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
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It is expected that this publication would meet the complete requirements of QP/NOS based training delivery, we welcome the suggestions from users, Industry experts and other stakeholders for any improvement in future.

About this book

A Tractor Operator is a person who is responsible for the operation of the tractors for agriculture purposes and also is responsible for the maintenance of the same. The person continuously keeps the vehicle free of any complaints, takes up basic repairs wherever feasible and is necessary and also would take up various agriculture activities as per the needs of the farmers. A Tractor Operator should have the ability to work independently, sensitive to farmer's needs and must have the ability to take up maintenance and repairs (minor) of the tractor as and when necessary. Should possess basic understanding and acumen towards crop cultivation. The individual should be result oriented and is responsible for his own working and learning. The trainee will enhance his/her knowledge under the guidance of the trainer in the following skills:

- **Knowledge and Understanding:** Adequate operational knowledge and understanding to perform the required task
- **Performance Criteria:** Gain the required skills through hands on training and perform the required operations within the specified standards
- **Professional Skills:** Ability to make operational decisions pertaining to the area of work.

The handbook incorporates well-defined roles of Tractor Operator like Tractor operation, pre check prior to operation, maintenance of tractor, hazards & risks at the work place, health & safety at the work place etc. The participant should be result oriented and responsible for his/her own working and learning. The participant should also be able to demonstrate skills of using various tools and decision making for instant problem solving.

We wishes all the best for your future in the Agriculture Farm Machinery Sector

Symbols Used



Key Learning Outcomes



Steps



Time



Tips



Notes



Unit Objectives



Exercise

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1. Introduction

Unit 1.1 - Role of agricultural mechanization in India and abroad

Unit 1.2 - History of tractors

Unit 1.3 - Tractor market in India and abroad

Unit 1.4 - Glossary of terms and symbols

Unit 1.5 - Know your tractor and implements/machines

Unit 1.6 - Glossary of terms and symbols



Key Learning Outcomes

At the end of this module, you will be able to:

- Understand the role of Agricultural Mechanization in India and abroad History of Tractors.
- Understand Tractor and implements Glossary of terms and symbols.

UNIT 1.1: Role of Agricultural Mechanization in India and Abroad

Unit Objectives

At the end of this unit, you will be able to:

- Understand the role of Agricultural Mechanization in India and abroad History of Tractors.

1.1.1 Introduction

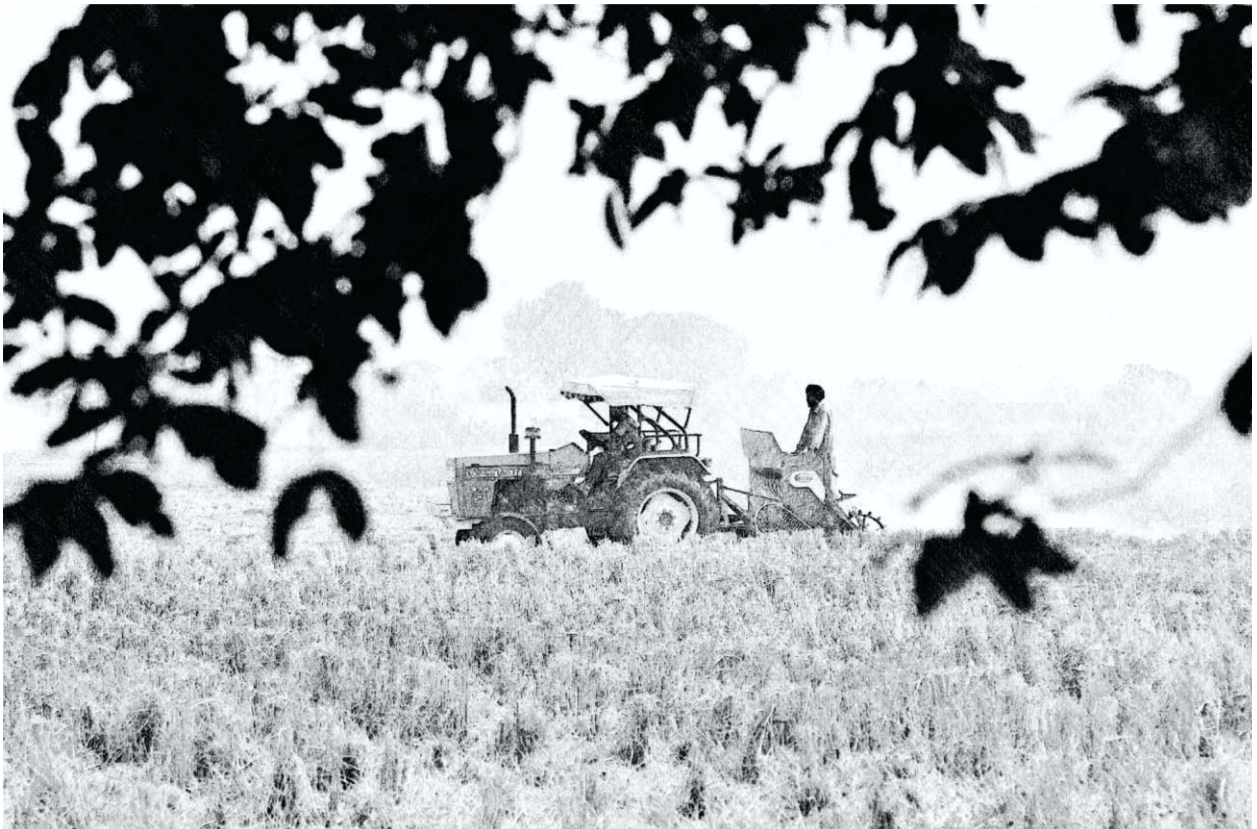


Fig 1.1.1 Role of Agricultural Mechanization in India and Abroad

Indian agriculture has been a success story and the country has been able to hold its head high on account of self-sufficiency in food. Coordination of Governmental policies, scientific efforts and farmers' action made it possible. India today is the net exporter of food and the country has come a long way from the begging bowl situation that existed sixty years ago.

Agriculture in India has tremendous potential for further growth through suitable policy framework coupled with enhanced investment in infrastructure. Indian agriculture has several natural and man-made peculiarities: majority of small and tiny land holdings, poor soil conditions, inadequate irrigation, floods, draughts, poor-quality agro-chemicals, lack of tools and equipment, etc. Nearly 62 per cent of the estimated 142 m ha area is rainfed. Average size of land holding in India is 1.1 ha with 80 per cent of the farm holdings less than 1.0 ha. After independence till 1965, the increase in production was achieved mainly through increase in cultivated area without mechanization. But during the Green Revolution phase of 1965-75, the use of high yielding varieties, fertilizer, chemicals and improved agricultural practices improved the cropping intensity and productivity of the crops. Compared to 51 million tonnes of food grain production in 1950-51, the country-achieved production of 265 million tonne in year 2013-14. However, country could achieve the cropping intensity of only 140% in about 6 decades.

Indian agriculture has been under tremendous pressure today since it is not profitable. Given the choice, many present day farmers would leave farming. Therefore, the challenge is to achieve the higher input use efficiency and improve the profitability of agriculture. Apart from achieving the food grain production of 307 million tonne by year 2020-21, production levels of other associated crops such as oilseed, and horticultural crops also need to be raised for a population of 1.39 billion at that time.

To achieve such higher levels, the projected annual agricultural growth has to be 4-5%. With no possibility of increase in net cultivated area, intensive agriculture with higher input use efficiency coupled with better management practices and value addition of products in production catchments will hold the key. This will require farm machines to ensure timeliness of operation, precise and judicious application of inputs, protected cultivation, handling, storage and value addition to farm produce in production catchments. Any quantum jump in production, productivity, and profitability could be brought about by a combination of factors; farm mechanization will be essential in addition to seeds, fertilizers and water.

Agricultural Mechanization

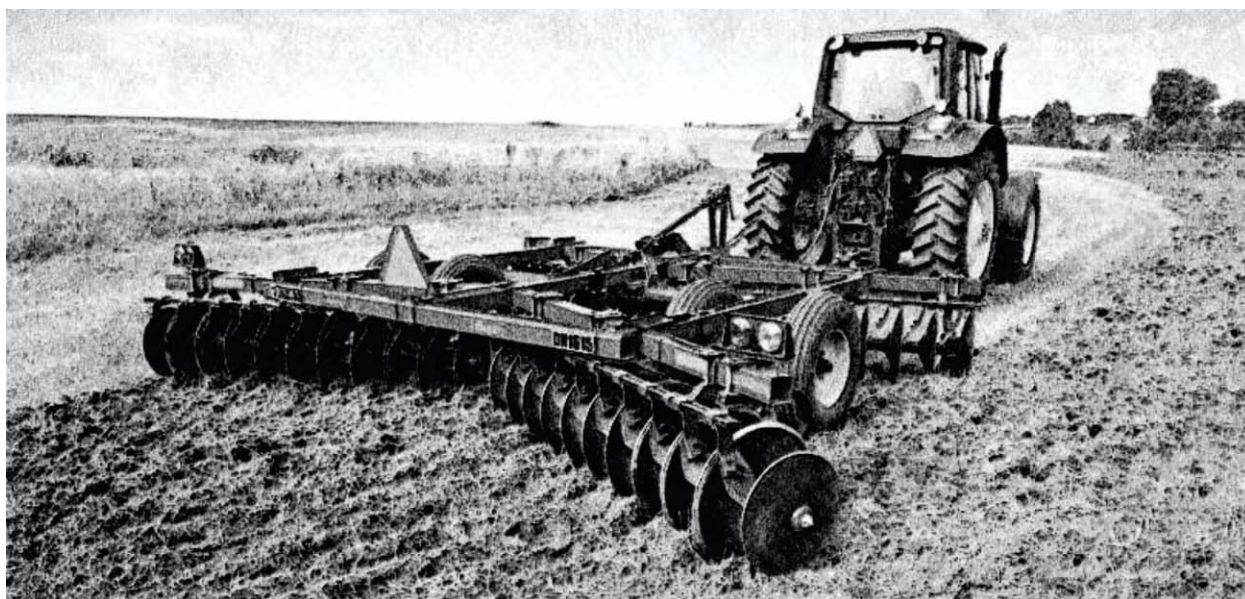


Fig 1.1.1 Agricultural Mechanization

Mechanization not only refers to interjection of machinery between men and materials handled by them but it has to address the core issues of timeliness of operation, reducing the time required for farm operation, increasing the input use efficiency and minimizing the losses of produce. Traditionally farm family incomes were centered on farming alone. However, with present status of dwindling profitability of the farming sector and increased awareness, farmers take-up other non-farm ventures to improve their family income. Time required to perform agricultural operations, therefore, becomes critical.

Mechanization has varied connotations. While in the developed world it tends to be synonymous to automation but in developing countries, like India mechanization is now demand driven. With diminishing labour availability and increasing labour wages the farmers, specially medium and large ones, are looking for labour saving devices to remain competitive. With preponderance of marginal and small farms, custom servicing in farm operations is in vogue and rightly so because individual ownership is not affordable.

What farm mechanization can do to a developing economy is evident from the history of the agriculture in the USA. In 1900, 41 percent of US labour force was engaged in agriculture and two farmers produced food for five American citizens. In 1930, only 21.5% labour force was engaged in agriculture and the share of agricultural GDP was 7.7%. In 1945, the labour force in agriculture got further reduced to 16% and the share of agricultural GDP reduced to 6.8%. In 1970, the agricultural labour force was down to just 4% and the GDP share was reduced to 2.3%. In the year 2000, the labour force was just 1.9 % and the share of agricultural GDP was just 0.7%. Today, a US farmer feeds 155 persons in his own country as well as out of the USA. This transformation occurred on the strength of farm mechanization. The labour force freed from agriculture were employed by the industry leading to economic growth and higher individual income.

Farm mechanization is often been criticized for displacement of employment opportunities in a labour abundant economy. It is also true that the wages of farm labour have not grown as much as those of industrial labour. With the Indian economy growing faster than agricultural economy and

implementation of Mahatma Gandhi Rural Employment Guarantee Act, labour availability for agriculture is in fact falling short. Therefore, mechanization of Indian agriculture is an eventuality without any misgivings of labour displacement. Potential of mechanization on improving productivity and profitability of farming sector can be well realized by Drudgery Productivity Time

Figure: Effect of power source on agricultural productivity careful analysis of the existing level of farm mechanization in the country, farm power available and future perspective of improving the farm mechanization level.

The above figure clearly explains that the traditional agriculture with only manual labour is a low productivity and high drudgery enterprise. Supplementation with draft animal power reduces drudgery and improves productivity. However, it is the application of mechanical power that minimizes the human drudgery and maximizes the agricultural productivity.

Level of Mechanization

The assessment of level of mechanization is very cumbersome exercise due to diverse agriculture being practiced in the country. For now, a simple estimate would be the percent of cultivated area utilizing a power operated mechanical device to carry out a particular farm operation. A rough estimate for the level of mechanization at present is 40% which is based on the following data.

Soil working and seed bed preparation	42%
Seeding and planting	29%
Plant protection	34%
Irrigation.	37%
Harvesting & Threshing	60%-70%

It is clear from the following Table that India has a long journey to make as far as increasing the intensity of farm mechanization to a respectable level is concerned. Moreover as the economy grows, the relative share of agriculture in the total economy of the country keeps going down. Projections for Indian economy for the year 2050 suggest that the agricultural GDP would reduce to only 2%-3% of the country's GDP. The labour force engaged in agriculture would come down to <10%.

Country	Level of Mechanization	Agricultural GDP as percent of national GDP
USA	95%	0.7
Western Europe	95%	<5.0
Russia	80%	4.0
Brazil	75%	5.0
India	40%	13.9
China	61%	9.2

Table 1.1.1 Level of Farm Mechanization and Agricultural GDP in selected Countries

We need to appreciate that crop yields in India are much lower than the yields in other countries. While it points towards the potential for much higher food production in the country, it also suggests that effective growth strategy needs to be envisaged to actualize the potential.

Country	Crop Productivity
USA	7340
France	7074
Japan	6105
Canada	4170
China	5891
India	2961

Table 1.1.1 Relative Crop Productivity in different Countries

The farm mechanization includes availability of farm power at farm level, utilization of farm machinery including type and numbers, and availability of infrastructural support for farm machinery. The different aspects of mechanization have been discussed below.

Farm Power Availability

In Indian agriculture, human, animal and mechanical power is utilized for different on-farm and off-farm activities. It has been found that agricultural productivity has direct correlation with farm power availability. The total farm power availability in 1951-52 was 0.20 kW/ha which increased to 1.01 kW/ha(cultivated area) in 2001-02 and estimated to be 2.02 kW/ha in year 2013-14. As compared to developed countries the farm power availability in India is very low. Mechanical and electrical resources are contributing more than 80 % of the available power. Out of which more than half of the power is being utilized for stationary operations of water lifting. Only 35% of the mechanical power is being utilized for tractive purpose. The contribution of animal power has reduced over the years. The human power has limitation and full of drudgery. Therefore, a proper strategy needs to be adopted for increasing farm power availability.

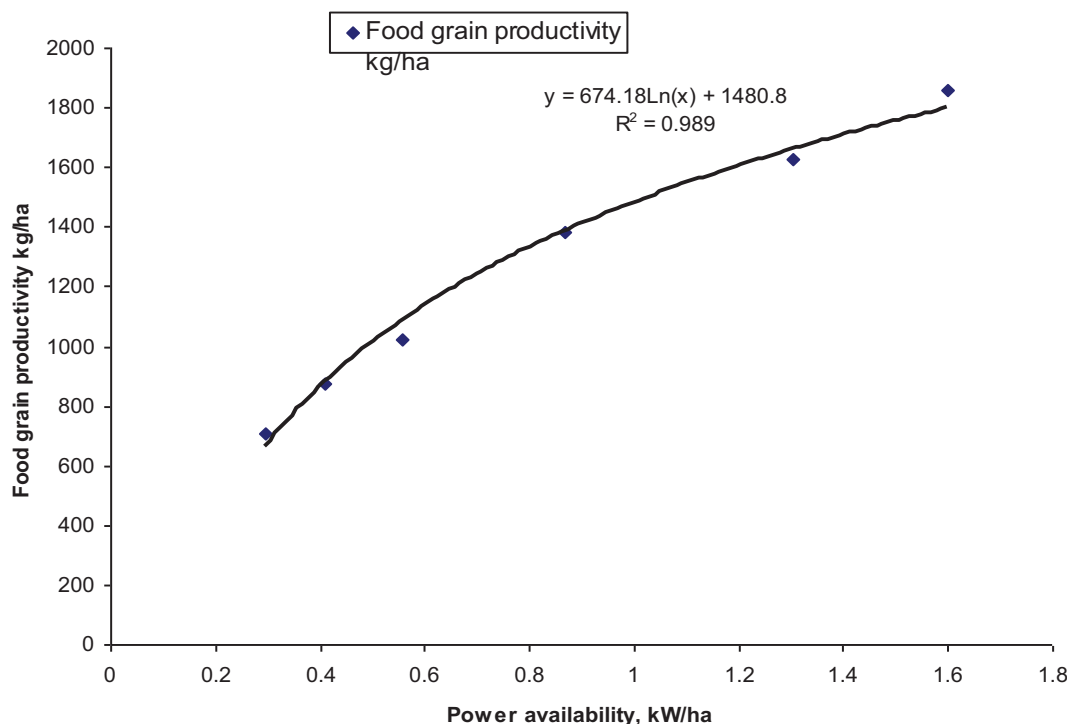


Fig 1.1.1 Relation of farm power availability and food grain productivity

Tractors in India were introduced through importation. In 1951 only 8500 tractors were there. Tractor production in India started in year 1961-62 with 880 no/year. Today India is manufacturing more than 600,000 tractors per year with estimated population of 5.0 million. Power tiller was introduced in the country in sixties but could not gain popularity due to its limitation in field and on-road use as well as ergonomic weaknesses.

The use of power tillers is presently more in rice and sugarcane producing areas of Tamil Nadu, Andhra Pradesh, Kerala, Karnataka, West Bengal, Orissa, Maharashtra and north eastern states. The yearly production is about 50,000 units. Diesel engines and electric motors are used for stationary operations especially for lifting water from irrigation and operating grain mills, oil ghanis, sugarcane crushers, power threshers and chaff cutters. The government incentives for irrigation hardware have played an important role in their popularization. Electric pumps are preferred over diesel engine operated pumps in electrified areas due to low recurring cost and maintenance requirements. It is estimated that about 12 million motors with potential power availability of 44..24 M kW in 2005-06 were in use. Similarly diesel engines have potential power availability of 37.15 M kW.

India at present has farm power availability of about 2.02 kW/ha. On the other hand, farm power availability in Japan, USA, UK, and France is more than 5.0 kW/ha. Even China has about 4.0 kW/ha power availability. The question, therefore, is whether we should set our farm power availability target at 5.0 kW/ha or lower. At present, the consensus is that we should target at 3.0 kW/ha and adopt measures for conservation and higher efficiency for long term sustainability.

The state-wise farm power availability from mechanical power sources has been presented in Table 2. The mechanical power availability among various states shows a large variation across the states of the country more than 80 per cent of the cropped area of country has farm power availability less than 1kW/ha. Only four states namely, Punjab, Haryana, Kerela and Uttar Pradesh has farm power availability more than 1 kW/ha. States of north eastern hill region and Assam have farm power availability of just 0.04-0.05 kW/ha. Therefore, based on farm power availability status, the states could be divided in to three broad groups of states having mechanized agriculture, states with mix of mechanized and animate power source and states heavily dependent upon animate source of energy. The rural electrification programme till date has concentrated on providing power for irrigation purposes. Therefore, to improve the farm power availability, specific policy frame work needs to be put in place. It should include ensuring a continuous supply of electricity and promoting use of it for local level agricultural enterprises. This will not only help in ensuring power availability to farm but ensure local level employment generation at rural level such as small scale value addition, ensuring better storage and quick transportation of food products at rural level. A large scale infrastructural support will

be needed to ensure the continuous supply of electricity at farm level. Till 1960-61 composition of available farm power in India was essentially animate: draft animals 68.7% and humans 20.7%. However, mechanization in India after Green Revolution has changed the scenario,

Tractors	44.3%
Engines	19.3%
Electric Motors	26.2%
Humans	5.0%
Draft animals	5.2%

S. No.	Name of the State	Farm Power Availability (kW/ha)	Food grain productivity (kg/ha)
1	Punjab	3.50	4032
2	Haryana	2.25	3088
3	Uttar Pradesh	1.75	2105
4	Andhra Pradesh	1.60	1995
5	Uttaranchal	1.60	1712
6	West Bengal	1.25	2217
7	Tamil Nadu	0.90	2262
8	Karnataka	0.90	1406
9	Kerala	0.80	2162
10	Assam	0.80	1443
11	Bihar	0.80	1622
12	Gujarat	0.80	1169
13	Madhya Pradesh	0.80	907
14	Himachal Pradesh	0.70	1500
15	Maharashtra	0.70	757
16	Rajasthan	0.65	884
17	Jharkhand	0.60	1095
18	Jammu & Kashmir	0.60	1050
19	Orissa	0.60	799
20	Chhattisgarh	0.60	799
	All India	1.35	1723

Table 1.1.1 Farm Power Availability and Average Productivity of Food grains in Different States of India

Agricultural Machinery Market

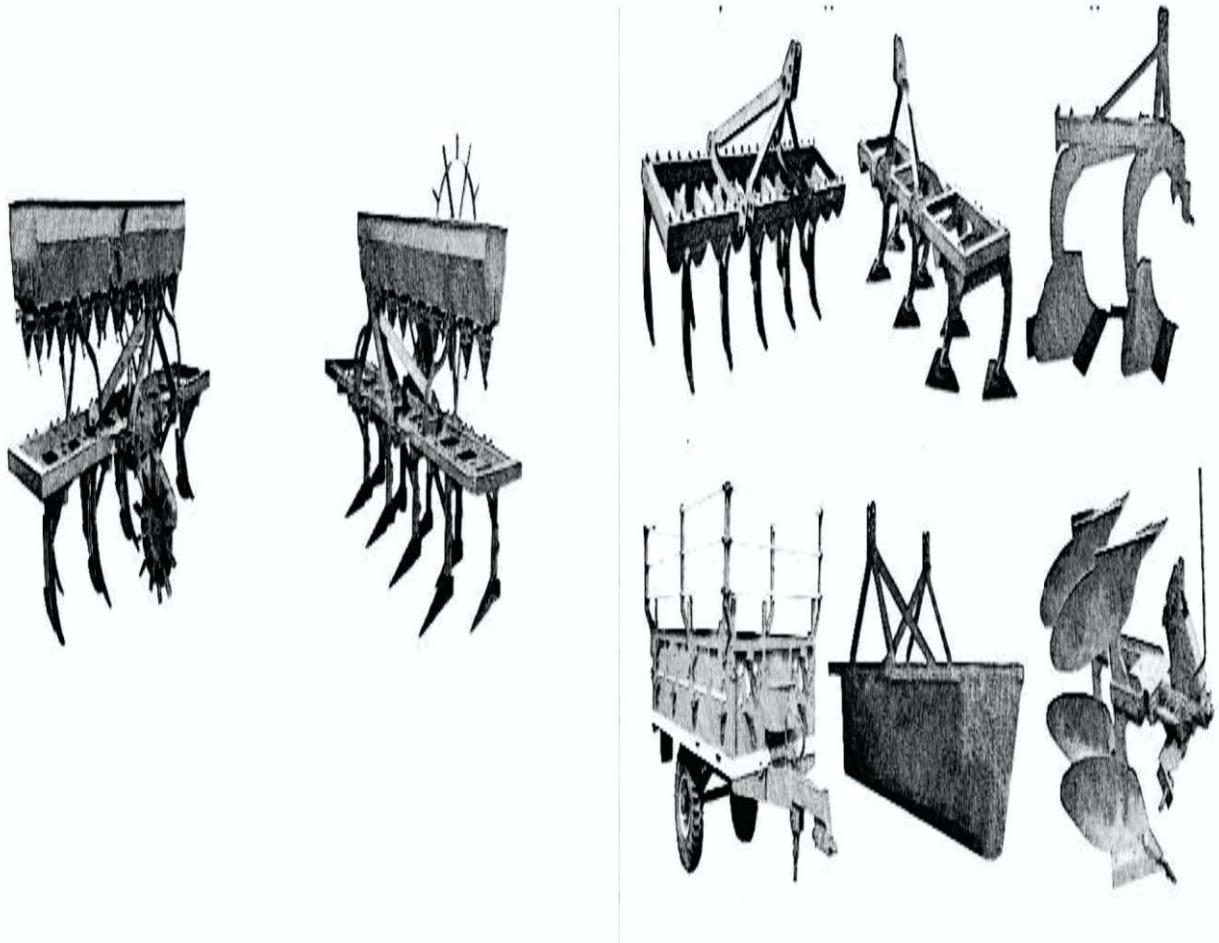


Fig 1.1.1 Agriculture Machinery market

Agricultural machinery market globally at present is equivalent to USD 137 billion and is expected to be USD 200 billion by 2020. In India, agricultural machinery market India today is valued at about USD 8.0 billion and is growing at a CAGR of 10%. The agricultural machinery market is shrinking in European Union as well as North America.

Asia- Pacific represents the largest as well as the fastest growing regional market. The region is projected to register a CAGR of 7.9% in the near future. The market would be driven by greater farm mechanization in highly populous markets of India and China, which hold enormous potential due to the relatively lower levels of mechanization and inefficient farm equipment. Growing incomes and

mechanization of agricultural sectors across developing economies is expected to bestow significant growth and profits for the agricultural implements and machinery industry in the near future. In addition, countries such as Indonesia, Thailand, Brazil and Russia are expected to post robust growth due to increased use of machinery. Further, governments in these countries are increasingly placing greater emphasis on enhancing productivity through automation or mechanizing traditional processes.

Improved Implements and Machines for Farm Mechanization

Improved tools, implements, and machines have always been means for advancing agriculture since prehistoric period. As knowledge about farming, metals, metallurgy, craftsmanship advanced agricultural equipment got refined in India. Incidences of famines and starvations compelled colonial masters to pay attention to agriculture. They imported and tried western animal drawn farm implements like mould board ploughs, harrows, cultivators, seed drills. A few indigenous manufacturers adopted some of those implements. However, these did not become very popular but steadily created awareness about improved agricultural implements and machines, largely as labour saving devices. Traditional *Hal* (wooden wedge plough with its regional variation), *Bakhar*, *Dufan*, and *Tifan* in vertisol region in Malwa and Gujarat, wooden planker for clod breaking and levelling etc. continued to dominate and are still used by marginal and small farmers. Major developments have occurred in post-independence period more so after on-set of Green Revolution in late 1960s.

State Agricultural Universities and their Faculties of Agricultural Engineering, ICAR Institutes took lead in agricultural mechanization. Establishment of Central Institute of Agricultural Engineering (CIAE) at Bhopal, M.P. was a major step with a view to carry out organized R&D in the areas of agricultural mechanization and allied issues. ICAR launched a number of All Indian Coordinated Schemes - Farm Implements and Machines; Energy Requirement in Intensive Agriculture; Power tillers; Optimization of Ground Water Use through Wells and Pumps; Agricultural Drainage; Utilization of Animal Energy with Enhanced System Efficiency; Renewable Energy Sources; Human Engineering and Safety; and Harvest and Post-Harvest Technology which contributed a great deal in adoption, development, commercialization and pilot introduction of improved implements and machines. Field worthy designs were multiplied through prototype multiplication workshops for test marketing and pilot introduction. Eventually linkages were developed with State Departments of Agriculture and Directorates of Agricultural Engineering, manufacturers, furthering the cause of mechanization. Department of Agriculture and Cooperation (DAC), Govt. of India promoted agricultural mechanization. To protect farmers' interest it established Tractor Testing and Training Stations. However, there is a long waiting (3-10 years) in testing of tractors, self propelled machines, combines etc. DAC also launched promotional schemes providing subsidy to the farmers, bank-loans for the tractor and other machinery. It also established Central Farm Machinery Review and Release Committee. Promotional efforts towards agricultural mechanization are still on. Every year there is interaction meet between DAC and ICAR where agricultural mechanization and on-farm processing and value addition related equipment, practices, and required promotional measures are discussed, progress monitored and future action