



UNIT I

Objectives of Farm Mechanization, Scope of farm mechanization and classification of farm operations and its sequence-
farm machines



FARM MECHANIZATION

- Farm mechanization is the application of engineering and technology in agricultural operations, to do a job in a better way to improve productivity.
- Includes development application and management of all mechanical aids for field production, water control, material handling, storing and processing.
- Mechanical aids include hand tools, animal drawn equipment, power tillers, tractors, engines, electric motors, processing and hauling equipment.
- Farm mechanization does not mean the use of only big machines and tractors.
- Mechanization is a need based process which provide sufficient time gap for self adjustment for various inputs with out causing sudden impact of changes



SOURCES OF FARM POWER AND MECHANIZATION

Various types of agricultural operations performed on a farm classified as:

- ▶ Tractive work such as seed bed preparation, cultivation, harvesting and transportation,
- ▶ Stationary work like silage cutting, feed grinding, threshing, winnowing and lifting of irrigation water.

These operations are performed by different sources of power namely, human, animal, stationary engine, tractor, power tiller, electricity, solar and wind.

For doing these operations different types of power available is classified as:

- ▶ Human power
- ▶ Animal power
- ▶ Mechanical power
- ▶ Electrical power
- ▶ Wind power



Population Dynamics of Indian Agricultural Workers (No in Million)					
Particulars	1991	2001	2011	2020	2050
Country's Population	846.4	1,028.7	1,210.7	1,323	1,612
Total Number of Workers	313.7	402.2	481.7	566	787
Workers' Percentage of Population	37.1%	39.1%	39.8%	42.8%	48.8%
Number of agricultural workers	185.3	234.1	263	230	202
Including: Cultivators	110.7	127.3	118.7	110	000
Including: Agricultural Labours	74.6	106.8	144.3	120	000
Agricultural Workers' percentage of Total Number of Workers	59.1%	58.2%	54.6%	40.6%	25.7%

Source : Vision 2050 Document of Central Institute of Agricultural Engineering, Bhopal, 2015



SCOPE OF FARM MECHANIZATION:

There is a good scope of farm mechanization in India due to the factors:

- 1) Improved irrigation facility in the country.
- 2) Introduction of high yielding varieties of seeds.
- 3) Introduction of high dose of fertilizers & pesticides for different crops.
- 4) Introduction of new crops in different parts of the country.
- 5) Multiple cropping system & intensive cultivation in different parts of the country.



BENEFITS OF FARM MECHANIZATION:

- 1) Timeliness of operation
- 2) Precision of operation
- 3) Improvement of work environment
- 4) Enhancement of safety
- 5) Reduction of drudgery of labour
- 6) Reduction of loss of crops and food products
- 7) Increased productivity of land
- 8) Increased economic return to farmers
- 9) Improved dignity of farmers
- 10) Progress and prosperity in rural areas



Benefits from Farm Mechanization



Economical Benefits

Factor Affected by Mechanization	Potential Improvement
Labor productivity	Farm family can cultivate 1–2 ha by hand; >2 ha with DAP; >8 ha with tractor
Land productivity	Increased production through better placement of seed and fertilizer, better weed control through line-planting and improved timeliness
Value chain development	Holistic improved mechanization along the value chain from producer to consumer can greatly improve productivity and improve livelihoods
Timeliness of operations	Approximately 1% reduction of yield per day of delay in planting
Drudgery Reduction	Reducing the need for women's muscle power especially hand-hoeing and transport

Social Benefits

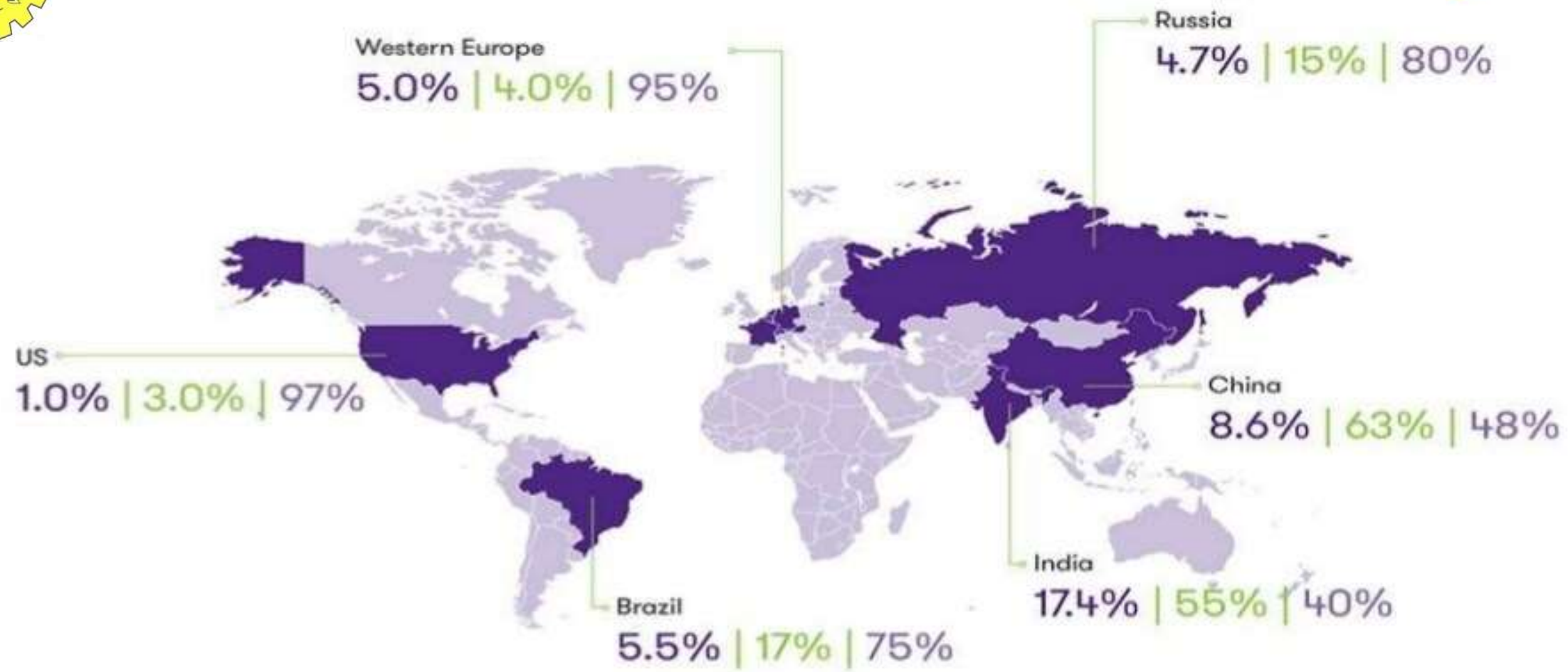
- Improvement of work environment
- Enhancement of safety
- Decrease in workload on women
- Helps in encouraging the youth to join farming and attract more people to work and live in rural areas



PRESENT STATUS OF FARM MECHANIZATION:

- a) Improved manual tools.
- b) Improved animal drawn implements.
- c) Tractor operated implements.
- d) Custom hiring units on the farm.
- e) Stationary equipments like threshers, irrigation pumps, sprayers, dusters etc.

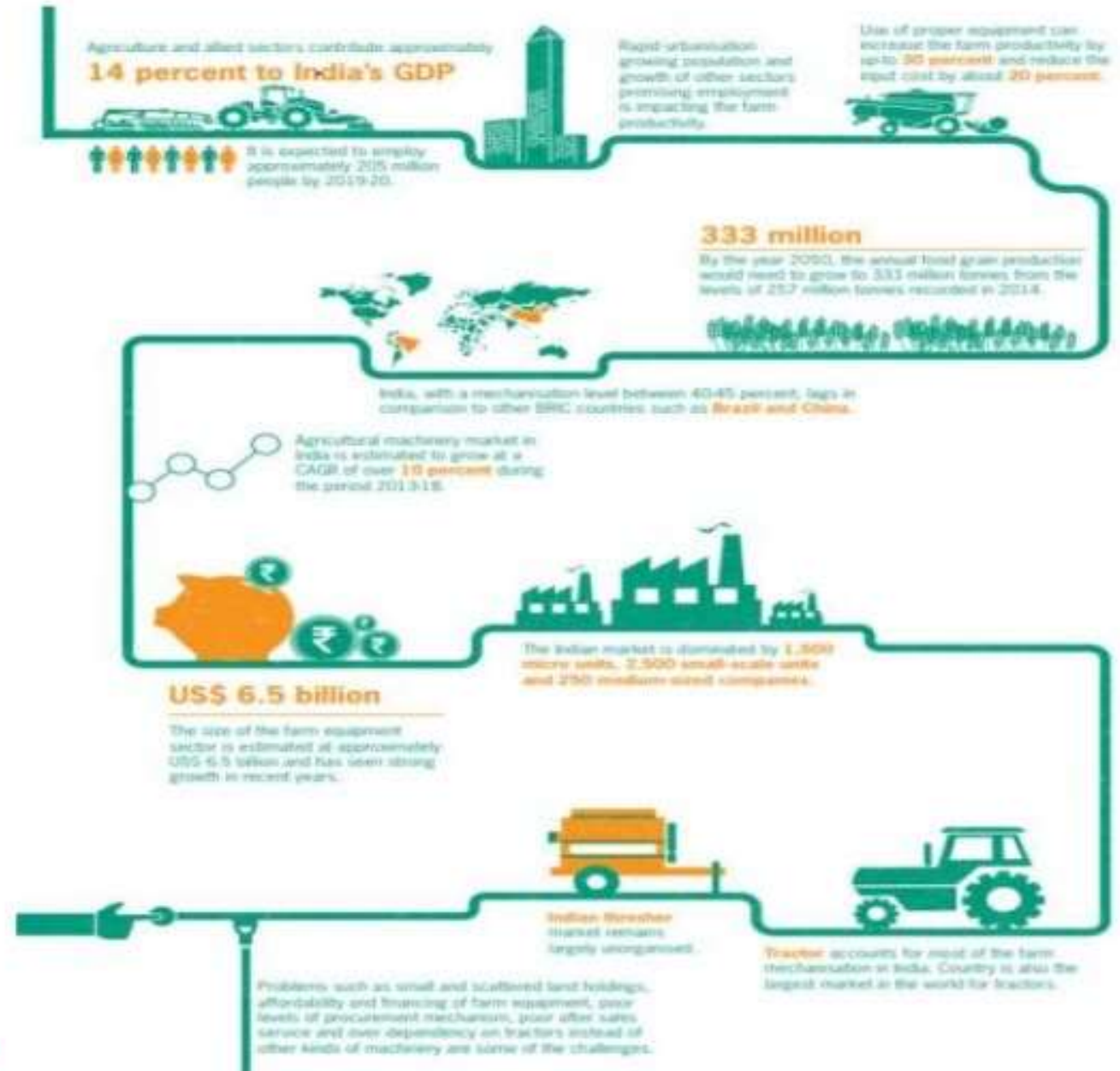
Current Status of Farm Mechanization in the World



Agriculture share in GDP (%) | Pop. engaged in Agriculture (%) | Mechanisation Rate (%)

Current Status of Farm Mechanization in India

- Agriculture and allied sector contribute approximately 14% on India's GDP.
- Use of proper equipment can increase the farm productivity up to 30%.
- India mechanization level: 40-45%
- The size of the farm equipment sector is estimated at approximately US\$ 6.5 billion. (Currently US\$ 8.5 billion)
- Tractor accounts for most of the farm mechanization in India.



Extent of Mechanization at Various Level of Farming



Soil working and
seedbed preparation

40%



Irrigation

37%



Plant Protection

34%



Seeding & planting

29%



Harvesting
& threshing

60-70%

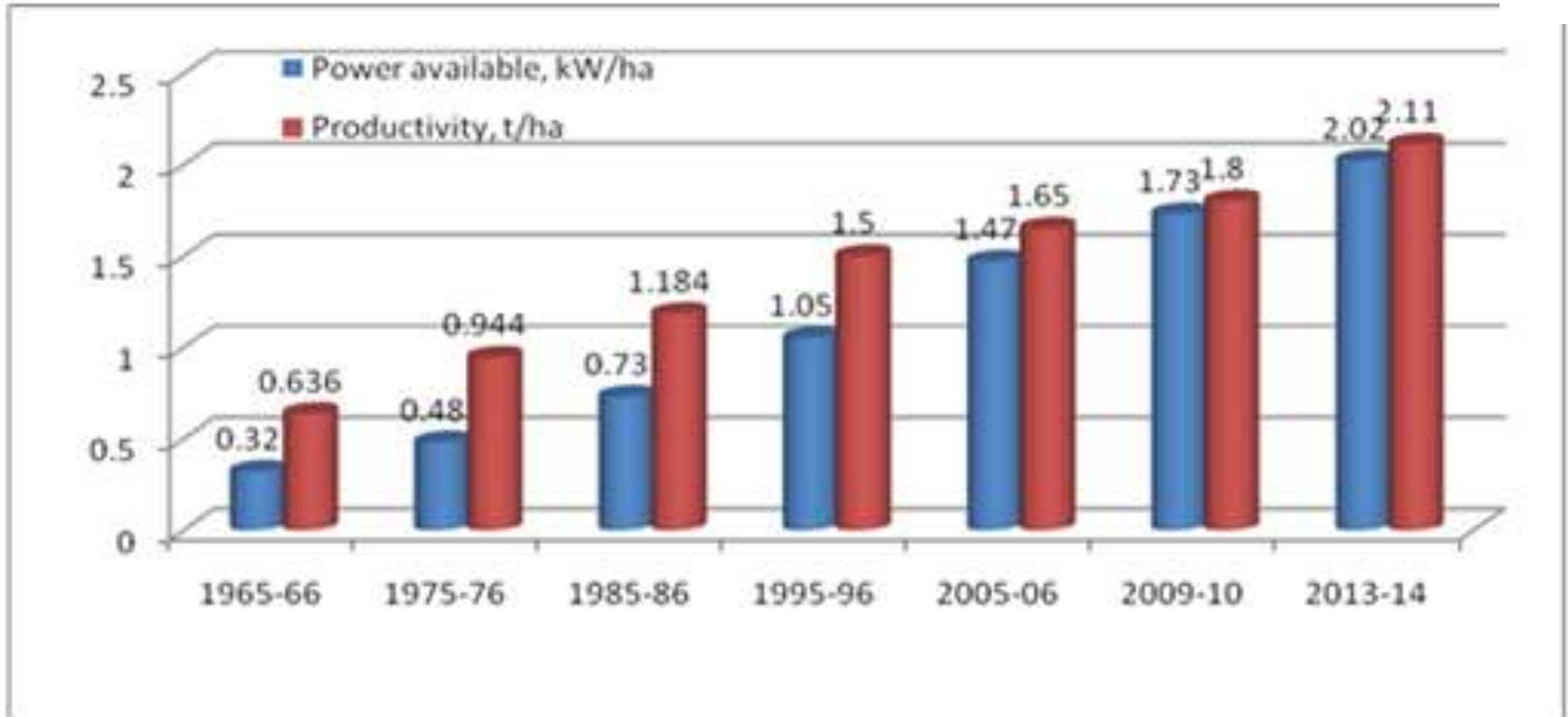


Fig. 1: Farm power availability and food grain productivity from 1965-66 to 2013-14.

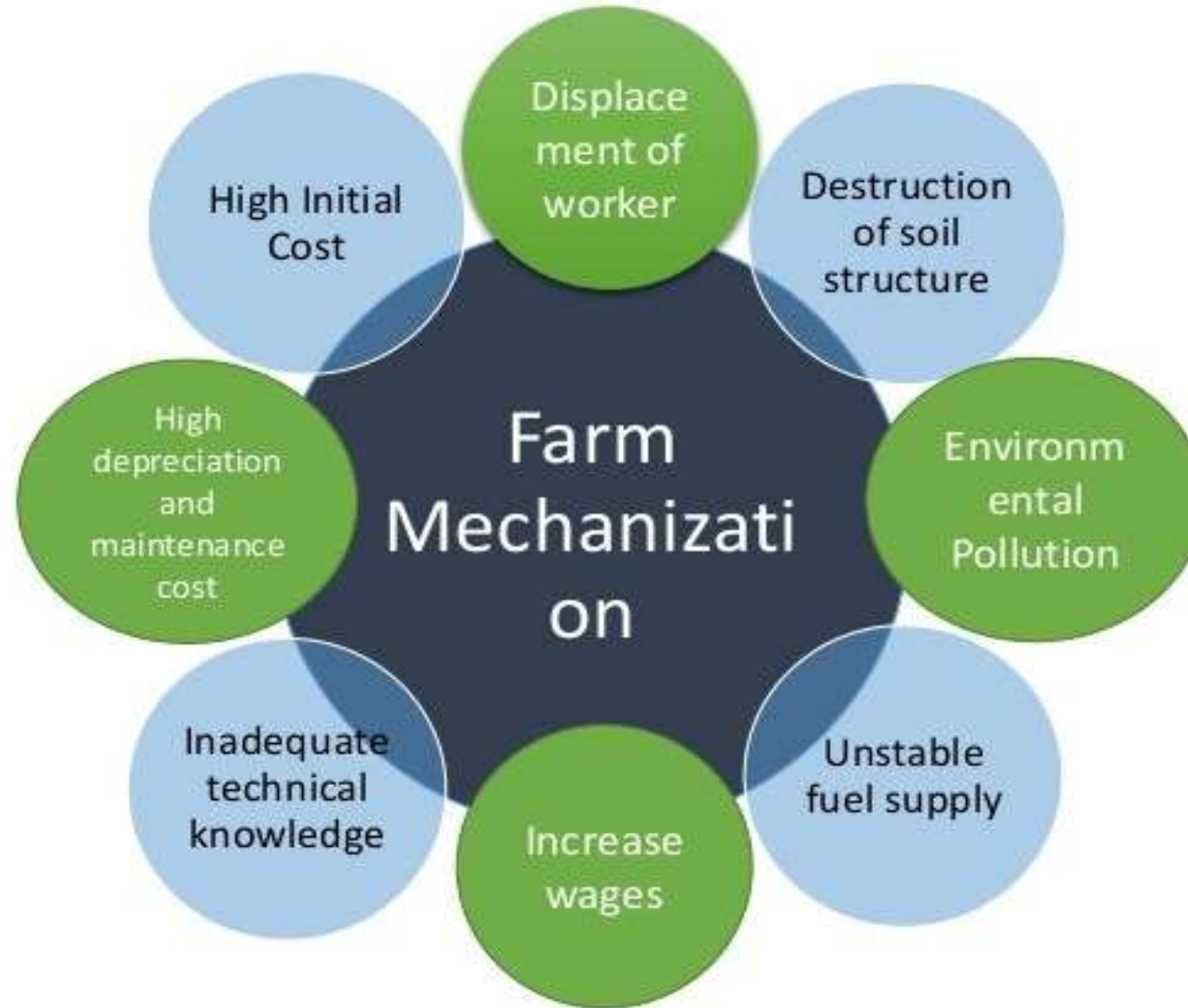


Major Farm Machinery Used in India



Name of Machinery	Market Size Annually (Units)	Annual Industry Size (In cr.)
Tractor	6,00,000	34,200
Power Tiller	56,000	706
Combine Harvester	4,000-5,000	770
Thresher	1,00,000	1,230
Rotavators	60,000-80,000	693
Rice Transplanters	1,500-1,600	62
Self Propelled Reapers	4,000 - 5,000	45
Zero Till Seed Drills	25,000 - 30,000	132
Multi-Crop Planters	1,000 - 2,000	8
Laser Land Levellers	3,000 - 4,000	129
Weeders	25,000	1,275

Disadvantages of Farm Mechanization





LIMITING FACTORS IN FARM MECHANIZATION:

Various limitations in adopting farm mechanization:

- 1) Small and fragmented land holdings.
- 2) Less investing capacity of farmers.
- 3) Agricultural labour is easily available.
- 4) Adequate draught animals are available in the country.
- 5) Lack of availability of suitable farm machines for different operations.
- 6) Lack of repair and servicing facilities for machines.
- 7) Lack of trained man power.
- 8) Lack of co-ordination between research organization and manufacturers.
- 9) High cost of machines.
- 10) Inadequate quality control of machines.

BOTTLENECKS IN INDIAN FARM MECHANIZATION SYSTEM

- Low annual use of tractors (only 500-600 hrs/year against recommended 1000 hrs/yr).
- Non availability of matching equipment.
- Cumbersome and energy inefficient designs.
- Poor reliability, frequent breakdowns and high repair and maintenance cost.
- Low quality.
- Use of ungraded materials, absence of inter-changeability of components.
- Inadequate R&D, Testing & Training facilities and inadequate Research funding.
- Inadequate user education.
- Lack of standardization.
- Non-availability of relevant literature like operator's manual, parts catalogues etc.

SUGGESTIONS FOR FURTHER IMPROVEMENT

- ▶ No Farm Machinery research/development project should be initiated without conducting a market survey to assess the client needs and perceptions.
- ▶ Greater industry-institution collaboration by undertaking joint research projects and use of reverse engineering would be helpful for speedy development and commercialization of new equipment.
- ▶ Computer Aided Design (CAD) must be used for optimum design, cost reduction and reliability. All R&D organizations must have a CAD facility with latest design packages. Train R&D engineers to develop proficiency in computer aided design.
- ▶ R&D engineers must ensure compatibility of their designs with BIS/ISO standards, norms and practices.
- ▶ Standardization of critical components to ensure quality, durability and interchangeability is essential.
- ▶ Up gradation of manufacturing technology to upgrade quality and reduce the cost.
- ▶ Establishment of testing centers

PRIORITY AREAS FOR INDIAN AGRICULTURAL MECHANIZATION

- ▶ Intensification of R & D to introduce energy efficient machines for relatively un-mechanized crops such as cotton, sugarcane, oil seeds, pulses, vegetables & fruits.
- ▶ Use reverse engineering and enforce close collaboration with farm machinery manufacturers.
- ▶ Assist Indian manufacturers in seeking collaboration with well known foreign firms wherever desired engineering technologies are not available.
- ▶ Intensify research in the area of tractor design engineering due to their extensive use in Indian farming. India is now the largest tractor manufacturer in the world. TMA needs to be involved in this task.
- ▶ Farm machinery management research to find out use patterns, annual usage, breakdown frequencies, repair & maintenance cost and above all reliability.
- ▶ Research on safety, comfort, exhaust emissions and health hazards in the use of mechanical power sources and machines needs to be expedited.
- ▶ Emphasis be laid on conservation farming and energy saving/energy efficient tools and machines.

- ▶ Research on alternate engine /tractor fuels including bio-diesel, ethanol, producer gas need to be intensified.
- ▶ Greater emphasis be laid on design, manufacture of high capacity and precision machines for multi farm use, for corporate/contract farming, for custom hiring through Agri. Business Centres promoted by GoI for the benefit of rural youths.
- ▶ Equipment for post harvest transport, bulk handling, cleaning grading drying milling packaging and storage are need. Imported wherever non-existent.
- ▶ Next revolution in agriculture in the area of efficient food processing & agro industries to transform the rural areas & utilize the surpluses. Mechanization packages will be crucial to ensure success of contract/corporate farming.
- ▶ Mechanization of hill-agriculture (20% total cultivated area), horticulture and floriculture, forage production and handling equipment, forestry mechanization, and efficient transport equipment are some important areas.
- ▶ Women-friendly tools and gadgets need to be evolved by modifying the existing ones and designing the new tools to reduce drudgery to women workers.



- ▶ Nearly two-third of the cultivated area is rainfed. Farm power available in these areas is barely 0.3 kW/ha. Hence, mechanization of these areas should be undertaken on priority basis. Large horse power tractors and suitable equipment for conservation of soil moisture, seed bed preparation, seeding/planting, harvesting etc., are required.
- ▶ Benefits of farm mechanization have so far remained confined to mainly wheat-based cropping systems. Need to be expanded to all cropping systems (horticulture).
- ▶ Present credit policy based on land mortgage is not favourable to small farmers to own mechanical prime movers. It excludes them from the benefits of farm mechanization and supplementing their incomes through hiring out their spare operational capacity. Instead of land mortgage, viability and hypothecation of the machinery may be better criteria.



- ▶ For precision farming, precision equipment for planting and plant protection are required.
- ▶ Increasing emphasis on Integrated Pest management and Organic farming would require use of efficient cultivation machinery for weeding and hoeing.
- ▶ Research in this area would be necessary to evolve optimum planting geometry and practices.
- ▶ Under the WTO regime with liberalization of markets foreign countries might take advantage of dumping their machinery in India, especially such equipment as sugarcane harvesters, paddy transplanters, potato combines, cotton pickers, horticultural machinery, sprayers unless required equipment are expeditiously developed indigenously and have cost and quality competitiveness.
- ▶ Joint projects by R&D organizations and Indian firms would be desirable.