Lecture No.1

Sources of farm power in India

Farm Power: Power required to carry out farm operations is called as Farm Power.

India is a vast country, covering about 329 million hectare Geographical area, in which about 166 million hectare is cultivable land and net area sown is 142 million hectare. The farm holdings in India are classified as i) Marginal < 1ha ii) Small 1-2 ha iii) Semi-medium 2-4 ha iv) Medium 4-10 ha v) Large> 10 ha

More than 75% farmer belong to marginal and small category. Various types of agricultural operations performed on a farm can be broadly classified as

(1) **Tractive work** such as seed bed preparation, cultivation, harvesting, sowing, spraying, interculturing ,weeding and transportation, and
(2) **Stationary work** like silage cutting, feed grinding, threshing, winnowing and lifting of irrigation water.
These operations are done by different sources of power, namely human, animal, oil engine, tractor, power tiller, electricity and renewable energy (biogas, solar and wind).

At the end of 20^{th} century, average power available in India was 1.15 kw/ha. As compared to Japan, UK, USA and other developed countries it is only about 20- 30 percent. Hence power availability on Indian farms has to be increased to increase productivities.

HUMAN POWER: Human power is the main source for operating small implements and tools at the farm. Stationary work like chaff cutting, lifting, water, threshing, winnowing etc are also done by manual labour. **An average man can develop maximum power of about 0.1 hp /0.075 kw/ 75 watt for doing farm work.**

Highly mechanized countries like Australia, Japan, USA engage less than one worker per hectare and more than 5 worker per hectare are engaged in Bhutan and China.

In India on an average about 1.5 worker of arable land is reported to be available for use.

MERITS AND DEMERITS :

MERITS

1. Easily available.
2. Used for all types of work.

DEMERITS

1. Costliest power compared to all other forms of power.

2 . Very low efficiency.

3. Requires full maintenance when not in use.

4 . Affected by weather condition and seasons.

ANIMAL POWER: Power developed by an average pair of bullocks about 1 hp for usual farm work. Bullocks are employed for all types farm work in all seasons.Besides bullocks, other animals like camels, buffaloes, horses, donkeys, mules and elephants are also used at some places. The average force a draft animal can exert is nearly one-tenth of its body weight.

For small farms of developing countries of Asia, Africa and Latin America, the animal power is the major source. With reference to Indian agriculture, draught animals (DA), provide the major tractive force for field operations. It is estimated that about 2/3 rd of the total cultivated area is managed by DA'S. The remaining 1/3 rd is cultivated with other sources namely tractors, power tillers, human labour and so on.

The power output of animals is highly variable depending upon the size of animals, breed, age, duration of working, environmental factors, method of harnessing and so on.

MERITS

1. Easily available.

2. Used for all types of work.

3. Low initial investment.

4. Supplies manure to the field and fuels to farmers.

5. Live on farm produce.

Disadvantages:

1. Not very efficient.

2. Seasons and weather affect the efficiency.

3. Cannot work at a stretch.

4. Require full maintenance when there is no farm work.

5. Creates unhealthy and dirty atmosphere near the residence.

6. Very slow in doing work.

Mechanical Power: Mechanical Power is the main source of power in Indian agriculture. The majority of engine used for agriculture operations vary in the power range of 3 and 35 kw. It includes stationary oil engines, tractors, power tillers and self propelled combines. Internal combustion engine is a good device for converting liquid fuel into useful work(mechanical work).**The thermal efficiency of diesel engine varies from 32 to 38 per cent whereas that of petrol engine varies from 25 to 32 per cent.** Almost all the tractors and power tillers are operated by diesel engines. Diesel engines are used for operating irrigation pumps, flour mills, oil ghanis, cotton gins, chaff cutter, sugarcane crusher, threshers, winnowers etc.

The most popular tractor is found in 31-40 hp segment which accounts for about 60% of total sales in the country. Tractor manufacturing was started in India in the year 1961 by first manufacturer M/S Eicher Good Earth. The number of tractors increased from about 2 lakh in 1971 to about 3 millions at present.

At the end of 20^{th} century, different caterogies of mechanical power units which are in use on Indian farms are estimated. i) Tractor-2.4 million ii) Power tillers-110 thousand iii) Self propelled combines- 8 thousand iv) Diesel pump sets- 6million v) Agro processing machines- 200 thousand vi) Power sprayers/Dusters- 250 thousand vii) Tractor drawn combines- 22 thousand

MERITS AND DEMERITS :

MERITS:

1. Efficiency is high.
2. Not affected by weather.
3. Can run at a stretch.
4. Requires less space.
5. Cheaper form of power.

DEMERITS:

1. Initial capital investment high.
2. Fuel is costly.
3. Repairs and maintenance needs technical knowledge

ELECTRICAL POWER: Electricity is the most efficient and clean source of power used on agricultural farms. In India, availability of electricity per capita is extremely low as compared to the developed nations**.** Most of electrical power generated in the country is used in Urban settlements and industrial complexes**.**

Electrical power is used mostly in the form of electrical motors on the farms. Motor is a very useful machine for farmers. It is clean,quite and smooth running. Its maintenance and operation needs less attention and care. Electrical power is used for water pumping, diary industry, cold storage, farm product processing, fruit industry and many similar things. The total rural consumption is about 30% of generated power.

MERITS:

1. Very cheap form of power.
2. High efficiency.
3. Can work at a stretch.
4. Maintenance and operating cost is very low.
5. Not affected by seasons.

DEMERITS:

1. Initial capital investment is high
2. Require good amount of technical knowledge
3. It causes great danger, if handled without care.

WIND POWER: Wind energy has been in use for thousands of years to propel boats and ships and to provide rotary wind mill power for lifting water and grinding grain. The traditional wind mills were mostly made of locally available materials like Bamboo, woode planks or combination of these. Wind velocity for running wind mill should be more than 30 kmph. The availability of wind power for farm work is quite limited. Even today in India the wind power has not been fully harnessed. The most important reason is its uncertainty.

Experimental results show that a wind mill having 3.6 diameter wheel mounted on 12.0 mtower is able to produce from 0.1 to 0.9 hp with the wind velocity varying from 6.4 to 37km/h. Thus the average capacity of a wind mill would be about 0.50 hp. There are about 2540mills installed in India. Hence the total output may be about 1250 hp only, but it is one of the cheapest sources of farm power available in the country.

HYDRO-POWER: Flowing water in canals, rivers and stream can be harnessed to convert hydro power into mechanical or electrical power system. Hydro power is an important source of generating electricity in India.

SOLAR POWER: It is important source of renewable energy. The silicon cells are used for converting solar energy into electrical energy. On the solar panel the small pumps upto 1to 3 HP can be operated having discharge of 1 to 2.5 lit/sec.

The solar power can be used in solar water heaters, solar dryers, solar cookers, and solar pumps for water lifting.

BIOGAS: It is also renewable source of power. It is mixture of methane (55 to 65%),CO_2(30 to 40%), rest impurities (H2,H2s and some N2) which is produced by decomposition of animal, plant and human waste. It is clean and slow burning gas having Calorific value of 5000 to 5500 kcal/kg. It can be directly used for cooking, domestic lighting and also in internal combustion engine as fuel.

Farm Mechanization: The main concept of farm mechanization is to apply the principles of engineering and technology to do the agricultural operations in a better way to increase crop yield. This includes the development, application and management of all mechanical aids for field operation, water control, material handling, storage and processing. Mechanical aids include hand tools, animal drawn implements, power tillers, tractors, engines, electric motors, grain processing and hauling equipments. Farm mechanization does not mean the use of only big machines and tractors for farm work.

SCOPE OF FARM MECHANIZATION: It is quite true that the Indian farmers have the lowest earnings per capita because of the low yield per hectare they get from their holdings. One of the few important means of increasing farm production per hectare is to mechanize it. Mechanization in India may have to be done at various levels. Broadly, it can be done in three different ways:

I. By introducing the improved agricultural implements on small size holdings to be operated by bullocks.

II. By using the small tractors, tractor-drawn machines and power tillers on medium holdings to supplement existing sources.

III. By using the large size tractors and machines on the remaining holdings to supplement animal power source.

But many people are of the opinion that Indian agriculture cannot be fully mechanized. Only the improved animal-drawn implements should be introduced. It is felt that

1. There is a surplus of agricultural labour in India.
2. There are enough draft animals available in the country to do the farm work effectively.
3. The size of farm holdings of the majority of the Indian farmers is too small to justify the use of a tractor on their farms.
4. The investing capacity, of the farmers is too poor to buy a tractor and tractor-drawn implements.
5. The technical know-how of the people in the country is low.
6. In the absence of suitable farm road system, the tractor and tractor-drawn machines cannot be effectively utilized under the present conditions.
7. It will not be possible to increase the yield by using mechanical power.
8. Mechanization will not result in lowering the cost of production.
9. It will not be possible to mechanize every bit of farm operation.
10. A large labour force will get displaced from agriculture.

The technical know-how of the people in the country is quite satisfactory. It always develops with the opportunities and experience. The repair, maintenance and overhaul facilities for tractors and other machines are expanding, even in the small towns, with the expansion of rural electrification in the country. Drudgery and physical exertion are typical of much Indian agriculture today. It scares away men of intelligence and ability from agriculture. All people would favour minimizing this to a considerable extent. The development of improved riding type animal drawn machines can improve the present condition, but they cannot be a substitute for the tractor drawn machines. By using mechanical power, man will be able to control larger areas and as such his family members will get more free time.

More power is essential in carrying out operations effectively at the right time and for changing the attitudes and uplifting the social status and dignity of those who work in agriculture. There are three ways in which progress can be made towards increased power, all of which must be worked on simultaneously in combination with integrated and matched implements.

1. By improving bullock harness and hitches;
2. By developing and introducing small tractors;
3. By increasing the number of large horsepower tractors.

BENEFITS OF FARM MECHANIZATION:

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

CONSTRAINTS IN FARM MECHANISATION (LIMITING FACTORS IN FARM MECHANIZATION):

1) Small land holdings
2) Less investing capacity of farmers
3) Adequate availability of draft animals

4) Lack of suitable farm machine for different operations
5) Lack of repair and servicing facilities for machines
6) Lack of trained man power
7) Lack of coordination between research organization and manufacturer
8) High cost of machines
9) Inadequate quality control of machine

Comparison of Tractor and Animal Power:

Sr. No.	**Basis**	**Tractor /Power Tiller**	**Animal Power**
1	Availability	Only large size tractors above 25 hp size are available. Tillers up to 12 hp size are available	They are available in plenty.
2	Overload capacity Very high	Limited overload capacity	overload capacity for short time.
3	Acceptability	Not very common because of high initial investment	The most important source of power at present.
4	Tractive work	This the best source of power for any traction job. With cage wheels it can be use for puddling also.	They are quite suitable for all kind of farm work.
5	Stationary work	All kinds of stationary works can be performed	Bullocks have limited use for such works.
6	Transport work	It is a quick means of medium distance transport.	Bullocks are also used for short and medium distance transport work.
7	Initial investment	Though cost per horsepower is low but overall investment per unit area is very high.	Cost per horsepower is high but overall investment is less.
8	Cost of maintenance	Reasonable	Very high.
9	Rate of depreciation .	It is about I0 per cent year.	In fact the value increases in the beginning and then decreases
10	Cost of operation	Cheaper per horsepower hour.	It is costlier than tractor.

11	Limitations	The technical knowhow of the people in general is low and as such farmers get discouraged to buy a tractor. This may no longer be valid in next 20 years. Tractor gives low field efficiency in small fields.	Constant care is required to keep the animal in good health.To some extent medical facilities are now available and as such it is not very difficult to cure a sick animal in rural areas.
12	Idleness .	It does not consume any fuel or lubricant while not in use	Even during Idle period, it needs care, feed and fodder. But, on the other hand, it provides manure for the crops.
13	Output	Very high and suitable for timely operations.	Low output.