Lecture No – 6 and 7 Tractor

Tractor types and their selection, fixed and operating cost of tractor power and attached implements with examples

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Tractor-Tractor is a self-propelled power unit having wheels or tracks for operating agricultural implements and machines including trailers. Tractor engine is used as a prime mover for active tools and stationary farm machinery through power take-off shaft (PTO) or belt pulley.

CLASSIFICATION OF TRACTORS

Tractors can be classified into three classes on the basis of structural-design:

(i) Wheel tractor: Tractors, having three of four pneumatic wheels are called *wheel tractors.* Four wheel tractors are most popular everywhere.

(ii) Crawler tractor: This is also called *track type tractor* or *chain type tractor*. In such tractors, there is endless chain or track in place of pneumatic wheels.

(iii**) Walking tractor (Power tiller):** Power tiller is a **walking type tractor**. This tractor is usually fitted with two wheels only. The direction of travel and its controls for field operation is performed by the operator, walking behind the tractor.

On the basis of purpose, wheeled tractor is classified into three groups:

(a) General purpose tractor: It is used for major farm operations; such as ploughing, harrowing, sowing, harvesting and transporting work. Such tractors have (i) low ground clearance (ii) increased engine power (iii) good adhesion and (iv) wide tyres.

(b) Row crop tractor: It is used for crop cultivation. Such tractor is provided with replaceable driving wheels of different tread widths. It has high ground clearance to save damage of crops. Wide wheel track can be adjusted to suit inter row distance.

(c) Special purpose tractor: It is used for definite jobs like cotton fields, marshy land, hillsides, garden etc. Special designs are there for special purpose tractor.

TRACTOR COMPONENTS

A tractor is made of following main components:

(1) I. C. engine, (2) Clutch (3) Transmission gears (4) Differential unit (5) Final drive (6) Rear wheels (7) Front wheels (8) Steering mechanism (9) Hydraulic control and hitch system (10) Brakes (11) Power take-off unit (12) Tractor pulley and (13) Control panel.

Every tractor is fitted with an I. C. engine, the engine may be carburetor type or diesel type but nowadays almost all the tractors are diesel tractors.

SELECTION OF TRACTOR

Selection of tractor depends upon following factors:

(1) Land holding: Under a single cropping pattern, it is normally recommended to consider 1 hp for every 1 hectares of land, In other words, one tractor of 20-25 hp is suitable for 40 hectares farm.

(2) Cropping pattern: Generally less than 1.0 hectare/hp have been recommended where adequate irrigation facilities are available and more than one crop is taken. So a 30-35 hp tractor is suitable for 40 hectares farm.

(3) Soil condition: A tractor with less wheel base, higher ground clearance and low overall weight may work successfully in lighter soil but it will not be able to give sufficient depth in black cotton soil.

(4) Climatic condition: For very hot zone and desert area, air cooled engines are preferred over Water-cooled engines. Similarly for higher altitude, air cooled engines are preferred because water is liable to be frozen at higher altitude.

(5) Repairing facilities: It should be ensured that the tractor to be purchased has a dealer at nearby place with all the technical skills for repair and maintenance of machine.

(6) Running cost: Tractors with less specific fuel consumption should be preferred over others so that running cost may be less.

(7) Initial cost and resale value: While keeping the resale value in mind, the initial cost should not be very high; otherwise higher amount of interest will have to be paid.

(8) Test report: Test report of tractors released from farm machinery testing stations should be consulted for guidance.

(9) Ground Clearance: It is the height of the lowest point of the tractor from the ground surface when the tractor is loaded to its maximum permissible weight. It should be high if the tractor is to be used in the standing field for the inter-culturing or spraying operations.

(10) Tread Spacing: It is the gap between the inner edge of the rear wheels and front wheels respectively. Almost all the tractors have the tread adjustment facility to adjust it according to the row spacing.

(11) Operator's Visibility: The operator seating in the tractor seat should be able to see the every control of the tractor, front wheels and at the rear up to the PTO shaft. Better the operator's visibility, safer the driving will be.

(12) Speed: Almost all the tractors have the facility to adjust the speed on the road and off the road. The speed adjustment should be enough to meet the requirement of the operator and the conditions in which it is running.

(13)Maneuverability(Planned movement of vehicle): Driving of the tractor should be easier. Every control of the tractor should be within the reach of the operator for it proper and timely control over the tractor operation.

Hitching system of Tractor Drawn Implements

Tractor drawn implements possess higher working capacity and are operated at higher speeds. These implements need more technical knowledge for operations and maintenance work. Tractor drawn implements may be a) Trailed type b) Semi-mounted type and c) Mounted type.

a) **Trailed type implement:** It is one that is pulled and guided from single hitch point but its weight is not supported by the tractor.

b) Semi-mounted type implement: This type of implement is one which is attached to the tractor along a hinge axis and not at a single hitch point. It is controlled directly by tractor steering unit but its weight is partly supported by the tractor.

c) Mounted type implement: A mounted implement is one which is attached to the tractor, such that it can be controlled directly by the tractor steering unit. The implement is carried fully by the tractor when out of work.

SOME IMPORTANT TERMS CONNECTED WITH TRACTORS

***Wheelbase*: Wheel base is the horizontal distance between the front and rear wheels of a tractor, measured at the ground contact.**

Ground clearance: It **is the height of the lowest point of die tractor from the ground surface, the tractor being loaded to its maximum permissible weight.**

Track: Track is the distance between the two wheels of the tractor on the same axle, measured at the point of ground contact.

Turning space: It is the diameter of the smallest circle, described by the outermost point of the tractor, while moving at a speed, not exceeding 2 km/hr with the steering wheels in full lock.

Cage wheel: It is a wheel or an attachment to a wheel with spaced cross bars for improving the traction of the tractor in a wet field. It is generally used in paddy fields.

Estimating the cost of tractor power

The cost of operation of tractor is divided under two heads known as ***Fixed cost and Operating cost.***

Fixed cost :

(i) Depreciation, (ii) Interest on the capital, (iii) Housing, (iv) Insurance and (v) Taxes.

Operating cost : (i) Fuel, (ii) Lubricants, (iii) Repairs and maintenance, and (iv) Wages.

1) **Fixed cost**

I. <u>Depreciation:</u>

It is the loss of value of a machine with the passing of time.

$$D = \frac{C - S}{L \times H}$$

Where,

D is the depreciation per year

C is the capital investment

S is the salvage value, 10% of capital

H is the number of working hours per year (tractor 1000hrs and implement 200 hrs)

L is the life of machine in years (for all 10 years)

II. <u>Interest:</u>

Interest is calculated on the average investment of the tractor taking into consideration the value of the tractor in first and last year.

$$I = \frac{C+S}{2} \times \frac{i}{H}$$

Where,
I is the interest per hour
i is the % rate of interest per year

III. Housing:

Housing cost is calculated on the basis of the prevailing rates in the locality. In general, it may be taken **as *1% of the initial cost of the tractor per year.***

IV. Insurance:

Insurance charge is calculated on the basis of the actual payment to the insurance company. In general, it may be taken **as *1% of the initial cost of the tractor per year.***

V. Taxes:

Taxes is calculated on the basis of the actual taxes paid per year. In general, it may be taken **as *1% of the initial cost of the tractor per year.***

2. Operating cost

I. Fuel cost:

It is calculated on the basis *of actual fuel consumption* in the tractor.

II. Lubricants:

Charges for lubricants should be calculated on the actual consumption. In general, it may be takes ***30 to 35% of the fuel cost.***

III. Repairs and maintenance:

It varies between ***5 to 10% of the initial cost*** of the tractor per year.

IV. Wages:

It is calculated on the basis **of *actual wages*** of the driver.

Problem 1:

Calculate the cost of operation of a 35 HP tractor per hour and hp hour. Initial cost is Rs. 5,50,000, life of the tractor is 10 years, number of working hours are 1000 per year, the salvage value, 10% of capital, interest on the capital is 10%, cost of the diesel is Rs. 60/- per litre, fuel consumption is 5 litres per hour, wages of the driver is Rs. 36,000/-, lubricants cost is 35% of the fuel cost, repairs and replacements is 10% of initial cost; housing, taxes and insurance is 1% each of the initial cost.

Solution: Data given:

C = Rs. 5,50,000/-
L = 10 years H = 1000 hours per year
i = 10%
Cost of diesel = Rs.60/- per litre
Fuel consumption = 5 litres/hour
Wages of the driver = Rs. 36000/- per year
Lubricants cost = 35% of fuel cost.
Repairs and replacements cost = 10% of initial cost
Housing, taxes and insurance = 1% each of the initial cost

Fixed cost

I Depreciation:

$$D = \frac{C - S}{L \times H} \quad , \; D = \frac{550000 - 55000}{10 \times 1000} = Rs.49.5 \; per\ hour$$

II. Interest:

$$I = \frac{C + S}{2} \times \frac{i}{H} \; , I = \frac{550000 + 55000}{2} \times \frac{10}{100} \times \frac{1}{1000} = Rs.30.25 \; per\ hour$$

III. Housing cost per hour

$$I = \frac{1}{100} \times 550000 \times \frac{1}{1000} = Rs.5.50 \, per\ hour$$

Similarly, Insurance is Rs. 5.50 and
Taxes are Rs. 5.50 per hour

Total fixed cost per hour

= 49.50+30.25+5.50+5.50+5.50 = Rs. 96.25

Operating cost/ running cost or variable cost

Fuel cost = 60 ×5 = Rs. 300.00 per hour

$$\text{Lubricants cost} = \frac{35}{100} \times 300 = \text{Rs. 105.00 per hour}$$

$$\text{Repairs and replacements cost} = \frac{10}{100} \times 550000 \times \frac{1}{1000} = \text{Rs. 55/-}$$

$$\text{Wages} = \frac{36000}{1000} = \text{Rs. 36.00}$$

Total operating cost per hour = 300+105+55+36 =Rs. 496/-

Total cost of operation per hour

= Total fixed cost + Total operating cost

= 96.25+ 496 = Rs. 592.25

Total cost of operation per hour

$$= \frac{592.25}{35} = Rs.16.92$$

Example:

A farmer purchased a tractor of 35 hp at cost of Rs. 5,50,000/- and three bottom 30 cm MB plough at Rs. 36000/- only. The *fuel consumption of tractor was 5 litres per hour at ploughing spped 5kmph. Calculate area ploughed per hour and cost of ploughing per hectare. Make necessary assumptions.*