

# A Comparative Economics of Farm Machinery Ownership and Hiring for Farming

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## Abstract

*Farm mechanization helps to ensure timely field operations to increase productivity, reduce crop losses and improve the quality of grain or produce, increase use of land and other inputs more effectively and increase labour productivity by using labour saving and drudgery reducing devices. At present, in India, tractors are being used for tillage on about 22.78 per cent of the total land area and sowing about 21.30 per cent of total area. Custom hiring service (CHS) is a popular method of gaining short-term control of farm machinery among farmers who do not own them. Custom hiring gained importance mainly due to rise in the cropping intensity and drop in average landholdings. The productivity of major crops is higher on the tractor owning farms due to timely and sufficient availability of tractor services. Net farm income is higher on tractor owning farms but input costs are low on custom hiring farms. This may be due to the high fixed costs as well as repair and maintenance costs on tractor owning farms. The small and medium tractor hiring farms earned more net income. This shows that it is better for smaller farms to hire in tractor services rather to have their own tractor. On the other hand owning a tractor is economically beneficial for larger farmers.*

## Introduction

Farm mechanization saves time in completing different operations, which gives the crop more time to mature, allows the farmer to be more flexible in his farming operations and facilitates multi cropping. This transition from animal power to mechanical power has made agriculture capital intensive. However, it has played a key role in modernization of Indian agriculture due to its benefits of improved labour efficiency and productivity, efficient use of expensive farm inputs, reduction of human drudgery and timeliness of operations.

Custom hiring service (CHS) is a popular method of gaining short-term control of farm machinery. CHS may be available from a neighbor, a local dealer, or a business specializing in custom farming that performs all types of field operations. Custom hiring gained importance mainly due to rise in the cropping intensity and drop in average landholdings. In India, the proportion of marginal and small size landholding increased

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from 69.6 per cent in 1970-71 to 85 per cent in 2010-11.

It is a well known fact that farm mechanization enhances agricultural productivity but sometimes due to heavy fixed cost of farm machinery, net income of farmers gets reduced. The yield of crops is significantly higher on farms owning tractors and on farms custom hiring tractors. The small and medium tractor hiring farms earned more net income. This shows that it is better for smaller farms to hire tractor services rather to have their own tractor. On the other hand owning a tractor is economically beneficial for larger farmers (Singh *et al.*, 2013).

CHS would constitute a reliable tool for implementing specific farming practices and obtaining a reasonable income. To cope with the difficulties involved in securing a cheaper workforce and necessary operating capital convinced the farmers that a professional custom hire business would be useful for achieving sustainable agriculture and custom hire service is confirmed as a viable alternative to the direct ownership of agricultural machinery (Masayuki, 2009). With this background an attempt has been made in the present paper to assess the comparative costs and returns of tractor owned and tractor hiring farms.

## **Data and Methodology**

The study was conducted purposively in Tungabhadra Project (TBP) Command area of Karnataka, as mechanization is relatively high in irrigated area and TBP is the largest command area of North-East Karnataka region. The numbers of tractors were more in the study area (20.58 Tractors/1000 ha) compared to the state of Karnataka (18.60 Tractors/1000ha). Multistage sampling technique was adopted for selection of sample farmers from TBP command area. In the first stage, the top three taluks of TBP area namely Bellary and Hospet from Bellary district and Gangavati of Koppal district were selected based on the highest number of tractors. In the second stage, two villages were selected randomly from each selected taluk. In the third stage, 30 farmers were selected from each village with equal representation of large, medium, and small & marginal farmers. In all, 60 large, 60 medium and 60 small & marginal farmers were selected. Thus, the total sample size comprised of 180 farmers for the study. Both primary and secondary data were collected to fulfill the objectives of the study. Primary data was obtained from sample farmers while secondary data was obtained from reports of Joint Director of Agriculture and District Statistical Office of respective selected districts with regard to details of CHS and the operational modalities followed in implementation of CHS and other sources like Ministry of Agriculture, Govt. of India, statistical database like India Stat, etc. The study pertains to the year 2013-14.

The data collected were presented in tabular form to facilitate easy comparison. This technique of tabular presentation was employed to compile the general and socio-economic characteristics of sample farmers, extent of use of custom hiring services by small, medium and large farmers and also the cost structure, returns, profit and total benefits that the farmers received, etc. Simple statistics like averages, ratios and percentages were computed to interpret the results.

### Accounting of Farm Machinery Cost

The cost of operation of farm machinery is divided into two components (1) Fixed cost and (2) Variable cost, where fixed cost is independent of operational use while variable cost varies proportionally with the amount of use.

#### Annual Fixed Cost

##### i) Depreciation

Depreciation expense accounts for the deterioration in the value of machinery because of age or technological obsolescence. Depreciation is usually estimated using a straight-line method for the purpose of estimating budget costs.

According to Kepner *et al.* (2005), the depreciation per hour can be calculated by the following expression:

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

Where,

D = Depreciation (₹ /h)

P = Purchase price

S = Salvage value, 10 % of purchase price

L = Life of the machine in years

H = Number of working hours per year

##### ii) Interest on Investment

According to Kepner *et al.* (2005), interest per hour is calculated on an average investment by using the prevailing interest rate by the following formula:

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

Where,

I = Annual interest charge (₹ /h)

i = Interest rate (%)

**iii) Insurance and Taxes**

Insurance charges and taxes together are taken @ 2% of the purchase. This is calculated for the tractor not for the tractor drawn implements.

$$\text{Insurance and taxes (Rs. /h)} = \frac{2\% \text{ of } P}{H}$$

Where,

P = Purchase price

H = Number of working hours per year

**iv) Shelter /housing cost**

Shelter was essentially required against weather changes. Shelter cost has been calculated at 1% of the average purchase price.

$$\text{Shelter (Rs. /h)} = \frac{1\% \text{ of } P}{H}$$

Where,

P = Purchase price

H = Number of working hours per year

Therefore, Total Fixed Cost (TFC) = Depreciation + Interest on the investment + Insurance and taxes + Shelter charges.

**Operating cost**

Operating costs generally include those costs that are incurred as a direct result of the machine being used. These costs vary as machine use varies.

**i) Fuel cost**

The fuel cost depends upon specific fuel consumption, horse power of tractor and fuel price and is calculated by the following relationship (Singh, 1996)

$$\text{Fuel cost (₹ /h)} = \text{S.F.C.} \times \text{Rated horse power} \times \text{Fuel price (₹ /l)}$$

where,

S.F.C. = Specific Fuel Consumption

For simplicity it was calculated as:

Fuel cost (₹ /h) = Fuel price (₹ /l) × Fuel consumption (l/h)

### ii) Repair and Maintenance cost

The repair and maintenance was estimated by taking a percentage of the purchase price. The repair and maintenance was a product of the machine's cost price and repair and maintenance percentage factor (0.01) and expressed as follows:

RM = (1 %) × Purchase price (₹ /year)

where,

RM = Repair and maintenance cost (₹ /year)

### iii) Lubrication cost

This can be determined depending upon the maintenance cost or depending upon the oil price or oil consumption.

Average lubrication cost = 20% of fuel cost (₹ /h)

### iv) Operator or Driver Wages

The cost of operator was calculated from the actual labour charges paid in rupees per day at the prevailing rates in the study area and generally number of hours worked taken as 8 hours.

$$\text{Driver charge} = \frac{\text{Wage rate for driver}}{\text{Number of hours worked}}$$

Therefore,

Total Variable cost (TVC) = Fuel cost + Repair and maintenance cost + Lubrication cost + Operator or driver wages.

Total Cost (TC) of Farm Machinery = Total Fixed Cost (TFC) + Total Variable Cost (TVC)

## Results and Discussion

The general characteristic features presented in Table 1 indicate that almost all farmers fall under the category of middle age group (44.31 years). Education being the source of knowledge is of prime importance for the development of the economy. Education as it enhances knowledge helps farmers in decision making regarding various farm business activities. With regard to educational status of sample farmers, literacy rate was considerably high in sample farmers (64.88 %). Thus, it can be concluded that the literacy levels of farmers had positive association with utilization of farm machinery on CHS basis. This emphasizes the fact that education helps in understanding and adopting new technologies in carrying out farm operations.

Landholding size is one of the crucial factors, which strongly influences decision making regarding the magnitude of production and cropping pattern etc. Similarly, the size of farm holding has a significant influence on mechanization of farm operations, since the farm size restricts mechanization in many cases. The average size of owned landholding was 1.37 ha for small farmers, 2.97 ha for medium farmers and 7.76 ha for large farmers. Owning tractor is economical for large farmers and it is to be noted that 61.67 per cent of large farmers and 11.67 per cent of medium farmers owned tractors.

Custom hiring in of tractor and farm implements was common among small (83.33%) and medium farmers (93.33%). This indicated that availability of CHS in the command area has helped the small and marginal farmers in adopting mechanization in farm operations.

CHS of farm machinery has tremendous impact on the whole of the economy because it normally leads to proper use of land resource, augments agricultural surpluses and higher farm income. In this direction an effort has been made to assess the cost incurred by the CHS providers in maintaining the machinery and implements and the charges paid by the farmers to avail the farm machinery and implements in cultivating the different crops.

**Table 1. General characteristics of sample farmers**

S. No.	Particulars	Small farmers (n=60)	Medium farmers (n=60)	Large farmers (n=60)	Overall (n=180)
1	Average age (Years)	43.45	43.48	45.70	44.31
2	Education (%)				
	i. Illiterate	40.33	38.00	27.00	35.11
	ii. Primary	23.00	22.67	27.00	24.22

S. No.	Particulars	Small farmers (n=60)	Medium farmers (n=60)	Large farmers (n=60)	Overall (n=180)
	iii. High school	19.00	20.00	21.33	20.11
	iii. College	12.33	13.00	15.33	13.55
	iv. Degree	5.33	6.33	9.33	7.00
	Overall literate	59.66	62.00	72.99	64.88
	Total	100.00	100.00	100.00	100.00
3	Average family size (No.)	5.55	5.72	6.75	6.00
4	Land holdings (Irrigated area in ha.)				
	(i) Own	1.37	2.97	7.76	4.03
	(ii) Leased in	0.65 (35)	0.90 (25)	3.15 (15)	1.23 (25)
	(iii) Total	1.60	3.19	8.23	4.34
5	i. Major crops	Paddy	Paddy	Paddy	Paddy
	ii. Other crops	Cotton, Sugarcane, Chilli	Cotton, Sugarcane, Chilli	Cotton, Sugarcane, Chilli	Cotton, Sugarcane, Chilli
6	Proportion of farmers owning bullock pair (%)	25.00	36.67	11.67	24.44
7	Proportion of farmers hiring in bullock pair (%)	18.33	31.67	8.33	19.44
8	Proportion of farmers owning tractor or CHS providers (%)	0.00	11.67	61.67	24.45
9	Proportion of farmers hiring in Tractor and farm implements (%)	83.33	93.33	48.33	75.00

Note: Figures in parentheses indicate percentage of farmers

The fixed and variable costs for different machinery are computed per hour. The cost incurred was highest for rotavator (₹ 574.93/h) due to high cost of machinery (on an average of ₹ 74,000 per piece) and lower economic life (8 years) compared to other implements which commonly have an economic life of 10 years. The cost was lowest for blade harrow (₹ 391.55/h) due to low cost of the implement (on an average of ₹ 17380 per blade harrow). The tractor charge was relatively the same for all the tractor drawn implements, ranging from ₹ 135.15/h to ₹ 142.11/h because the fixed and variable costs (Table 2) are almost the same for commonly used tractors.

**Table 2. Cost incurred by CHS providers for tractor and tractor drawn implements** (₹/h)

S. No.	Cost components / Implements	MB Plough	Rotavator	Disc Harrow	Cage Wheel Puddler	Cultivator	Blade harrow	Ridger
<b>I</b>	<b>Fixed cost</b>							
1	Depreciation	8.75	27.75	9.00	10.32	4.94	7.96	13.68
2	Interest	6.42	16.28	6.60	7.57	3.62	5.83	12.04
3	Shelter	0.97	2.47	1.00	1.15	0.55	0.88	1.82
	Sub Total I	16.14	46.5	16.6	19.04	9.11	14.67	27.54
<b>II</b>	<b>Variable cost</b>							
4	Repair and maintenance	9.72	24.67	10.00	11.46	5.48	8.84	18.25
5	Fuel cost	225.27	275.33	188.64	241.36	195.00	166.40	189.06
6	Lubricants	45.05	55.07	37.73	48.27	39.00	33.28	37.81
7	Tractor charges	135.15	142.11	138.77	140.20	136.88	137.11	135.37
8	Driver charges	31.25	31.25	31.25	31.25	31.25	31.25	31.25
	Sub Total II	446.44	528.43	406.39	472.54	407.61	376.88	411.74
	<b>Total (I+II)</b>	<b>462.58</b>	<b>574.93</b>	<b>422.99</b>	<b>491.58</b>	<b>416.72</b>	<b>391.55</b>	<b>439.28</b>

The hiring charges paid by the farmers (non-owners of tractor) for different operations revealed that there was difference in hiring charges paid by the farmers for different operations. However, there was not much difference in hiring charges paid by farmers across the crops. Among the different operations, the hiring charges were found to be highest for MB plough followed by rotavator, disc harrow, cultivator, blade harrow and ridger as presented in Table 3.

In paddy crop, custom hiring charges were highest for harvesting machines viz., combine harvester (₹ 7349/ ha) and thresher (₹ 3996/ ha). Use of Combine harvester is a common practice for paddy crop for harvesting in recent days due to shortage of labour and it also saves time. Among the other implements used for paddy crop, the hiring charge was highest for cage wheel puddler (₹ 3125/ ha) followed by MB plough (₹ 2884/ ha), rotavator (₹ 2507/ ha), disc harrow (₹ 1595/ ha) and cultivator (₹ 1126/ ha). Hence the existence of different pattern of CHS across crops, category of farmers and farm operations was substantiated.

**Table 3. Custom hiring charges paid by farmers****(₹/ha)**

Sl.No.	Implements / Crops	Paddy	Cotton	Sugarcane	Chilli
1	MB plough	2884	2735	2905	2909
2	Rotavator	2507	2510	2599	2424
3	Disc harrow	1595	1508	-	1546
4	Cage wheel puddler	3125	-	-	-
5	Cultivator	1126	1144	1141	1155
6	Blade harrow	1057	1004	1052	1025
7	Ridger	1133	1145	1135	1083
8	Combine/harvester	7349	-	-	-
9	Thresher	3996	-	-	-

For all selected crops, the input and labour costs were marginally higher on tractor owned farms compared to tractor hired farms because the tractor owned farms commonly have large land holdings and they have the capacity to bear the extra cost and more over the availability of on-farm resources for application especially farm yard manure is higher compared to small farms. However, the machinery cost was higher for tractor hired farms when compared to tractor owned farms because the hired farms get the tractor service from others and pay the hiring charges which includes the cost incurred by them and margin of profit. The total cost incurred by tractor owned farms for paddy was found to be marginally low (₹ 68305/ ha) compared to tractor hired farms (₹ 68624/ ha). However, the total cost was relatively more for tractor owned farms as compared to tractor hired farms in case of cotton, sugarcane and chilli crops due to high capacity of investment. The net returns were higher for tractor owned farms compared to the tractor hired farms in all the selected crops. Similar findings were reported by Singh et al. (2013). The net farm income is higher on tractor owning farms but input costs are low on custom hiring farms. It may be due to the high fixed costs as well as repair and maintenance costs on tractor owning farms. For selected crops, the yield was highest in tractor owned farms compared to the tractor hired farms. Similar results were reported by Singh et al. (2002). The yield of wheat came to be significantly higher on farms owning tractor than on farms hiring tractors.

The net returns were a little higher on tractor owned farms than on hired farms for paddy (₹ 57761/ ha and ₹ 50756/ ha), cotton (₹ 78961/ ha and ₹ 75048/ ha), sugarcane (₹ 186317/ ha and ₹ 180028/ ha) and chilli (₹ 97239/ ha and ₹ 86381/ ha) crops (Table 4). The net returns were marginally higher in tractor owned farms. The availability of hiring services in the study villages is an opportunity to the small and marginal farmers to get the benefit of farm mechanization as timeliness of operations especially sowing and intercultural operations has significance for good crop stand and sustained productivity of crops.

**Table 4. Cost of cultivation of different crops between tractor owned and hiring farms**

(₹/ha)

Sl. No.	Particulars	Tractor owned farms				Tractor hired farms			
		Paddy	Cotton	Sugarcane*	Chilli	Paddy	Cotton	Sugarcane*	Chilli
1	Inputs	33846	30277	45250	46157	31278	27200	41370	42696
2	Labour cost	23505	27573	52127	39347	22741	24577	49951	37408
3	Machinery cost	10954**	1894**	5930**	5622**	14605**	4547**	7743**	5881**
4	Total cost	68305	59744	103308	91126	68624	56323	99064	85986
5	Yield (q/ha)	71.98	30.58	131.18	28.82	69.60	28.33	127.40	25.69
6	Gross returns	126068	138706	289627	188365	119382	131372	279093	172366
7	Net returns	57761	78961	186317	97239	50756	75048	180028	86381

\* Sugarcane yield in tonnes/ ha

\*\* = Significant at 1 % level

## Conclusion

Farm mechanization increases crop productivity and is also helpful in increasing the use of land and other inputs effectively. CHS is very helpful for small and marginal farmers and is a popular method for short term control of farm machinery. CHS has a very important role in efficient use of resources and saves time in different farm operations. The study has confirmed that utilization of private CHS is common among medium and small category of farmers. The utilization of CHS was relatively higher in medium (93.33 %) and small (83.33 %) farmers as compared to large farmers (48.33 %). Under Indian conditions, majority of farmers are small and marginal and hence CHS would act as a panacea for solving farm mechanization problems.

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