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## Comparative cost and returns of tractor owned and hired farms in Tungabhadra project (TBP) area of Karnataka, India

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**Abstract:** 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. 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 machineries. The CHS 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 and 61.67 per cent of large farmers and 11.67 per cent of medium farmers own tractors. 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 and variable costs on tractor owning farms. The tractor charge was relatively same for all tractor drawn implements, it was ranging from ₹135.15/h to ₹142.11/h. The cost incurred was highest for rotavator (₹574.93/h) followed by cage wheel puddler (₹491.58/h) and MB plough (₹462.58/h). 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 CHS would constitute a reliable tool for implementing specific farming practices and obtaining a reasonable income.

**Keywords:** Custom hiring service, Farm machineries, Farming operations, Mechanization

### INTRODUCTION

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. But, 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 (Sharma *et al.*, 2005).

In 2007, the country had about 3.149 million agricultural tractors and 0.477 million combine harvesters and threshers. The country is experiencing rapid and expansive growth in the use of tractors. This demonstrates an increasing awareness and popularity of mechanized farming in the country. 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 (Kulkarni, 2009).

Custom hiring service (CHS) is a popular method of gaining short-term control of farm machineries. CHS may be available from a neighbor, a local dealer, or a business specializing in custom farming that performs

all types of field operations. The 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 from 69.6 in 1970-71 to 85 in 2010-11.

It is well known fact that farm mechanization enhances agricultural productivity but sometimes due to heavy fixed cost of farm machinery, net income of farmers get reduced. The yield of crops significantly higher on tractor owning farms and also on farms of 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 the 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 hired farms.

Under Indian condition, majority of farmers are small and marginal and hence CHS would act as a panacea for solving the farm mechanization problems. Further, it will help in making use of modern technology like combine harvester, tillage equipment and planting / sowing machinery. This would help them to improve the timeliness of operation, to increase farm productivity and increase economic returns. As a result the living standard of majority of villagers in the region will be improved. In this backdrop, the study would throw light on all these aspects and come out with meaningful policies related to CHS. Keeping this in view, the study was undertaken to find out the pattern and utilization of CHS across crop, farmers' category, farm operations and to assess cost and returns of CHS provided by public and private agencies.

## MATERIALS AND METHODS

The study was conducted purposively in Tungabhadra Project (TBP) command area of Karnataka, as the mechanization is relatively high in this irrigated area. TBP area is the largest command area of North-East Karnataka region. The multistage sampling technique was adopted for selection of sample farmers from TBP command area. In the first stage, top three taluks of TBP area namely Bellary and Hospet from Bellary district and Gangavati of Koppal district were selected based on more number of tractors. In the second stage, two villages were selected randomly from each se-

lected taluk. In the third stage, 30 farmers were selected from each village with equal representation of large, medium and small and 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.

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 costs and returns structure, profits and total benefits that the farmers received, *etc.* Simple statistics like averages, ratios and percentages were computed to interpret the results properly.

**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

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

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

S. N.	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
	Education (%)				
	i. Illiterate	40.33	38.00	27.00	35.11
	ii. Primary	23.00	22.67	27.00	24.22
	iii. High school	19.00	20.00	21.33	20.11
2	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
	Land holdings (Irrigated area in acres)				
4	(i) Own	3.39	7.33	19.16	9.96
	(ii) Leased in	1.60 (35)	2.23 (25)	7.78 (15)	3.05 (25)
	(iii) Total	3.95	7.88	20.33	10.72
5	i. Major crops	Paddy	Paddy	Paddy	Paddy
	ii. Other crops	Cotton, Sugar-cane, Chilli	Cotton, Sugarcane, Chilli	Cotton, Sugar-cane, Chilli	Cotton, Sugar-cane, Chilli
6	Proportion of farmers owning bullock pair	25.00	36.67	11.67	24.44
7	Proportion of farmers hiring 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 Tractor and farm implements (%)	83.33	93.33	48.33	75.00

Note: Figures in parentheses indicate percentage of farmers

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

S. N.	Cost components / Implements	MB Plough	Rotavator	Disc Harrow	Cage Wheel Puddler	Cultivator	Blade harrow	Ridger
<b>I 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
	Subtotal I	16.14	46.5	16.6	19.04	9.11	14.67	27.54
<b>II 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
	Subtotal 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>

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

S. N.	Implements / Crops	Paddy	Cotton	Sugarcane	Chilli
1	MB plough	1167.58	1107.14	1176	1177.78
2	Rotavator	1015.13	1016.07	1052.09	981.25
3	Disc harrow	645.55	610.71	-	625.83
4	Cage wheel puddler	1265.10	-	-	-
5	Cultivator	455.79	463.33	461.82	467.5
6	Blade harrow	427.87	406.39	425.88	415.00
7	Ridger	458.51	463.64	459.58	438.33
8	Combine harvester	2975.36	-	-	-
9	Thresher	1617.65	-	-	-

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

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

**Interest on investment:** According to the 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 (%)

**Insurance and taxes:** Insurance and taxes charges together are taken @ 2 % of the purchase. This is cal-

culated for 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

**Shelter /housing cost:** Shelter was essentially required against the 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.

**Fuel cost:** The fuel cost depends upon specific fuel consumption, horse power of tractor and fuel price and calculated by following relationships (Singh, 1996)

Fuel cost (₹/h) = S.F.C. × Rated horse power × Fuel price (₹/l)

where,

S.F.C. = Specific Fuel Consumption

**Table 4.** Field capacity of farm implements.

S. N.	Machineries/ Implements	Field efficiency (acre/h)
1	MB plough	0.52
2	Rotavator	0.80
3	Disc harrow	0.86
4	Cage wheel puddler	0.51
5	Cultivator	1.20
6	Blade harrow	1.26
7	Ridger	1.30

**Table 5.** Cost of cultivation of different crops between tractor owned and hired farmers (₹/acre).

S. N.	Particulars	Tractor owned farmers				Tractor hired farmers			
		Paddy	Cotton	Sugarcane*	Chilli	Paddy	Cotton	Sugarcane*	Chilli
1	Inputs	13703	12258	18320	18687	12663	11012	16749	17286
2	Labour cost	9516	11163	21104	15930	9207	9950	20223	15145
3	Machinery cost	4435**	767**	2401**	2276**	5913**	1841**	3135**	2381**
4	Total cost	27654	24188	41825	36893	27783	22803	40107	34812
5	Yield (q/acre)	29.14	12.38	53.11	11.67	28.18	11.47	51.58	10.4
6	Gross returns	51039.8	56156.3	117258	76261.1	48332.7	53187.2	112993	69784
7	Net returns	23385	31968	75432	39368	20549	30384	72886	34972

\* Sugarcane yield in tonnes/ acre; \*\* = Significant at 1 % level

For simplicity it was calculated as:

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

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

$$RM = (1\%) \times \text{Purchase price (₹/year)}$$

where,

RM = Repair and maintenance cost (₹/year)

**Lubrication cost:** It 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)

**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 the Table 1 indicated that almost all farmers fall under the category of middle age group (44.31 years). Education being source of knowledge is of prime importance for the development of economy. Education as it enhances the knowledge helps farmers in decision making regarding various farm business activities. With regard to educational status of sample farmers, it is to note that 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 machineries 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 influence 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 the mechanization in many cases. The average size of owned landholding was 3.39 for small farmers, 7.33 acres for medium farmers and 19.16 acres for large farmers. Owning tractor is economical for large farmers and it is to note that 61.67 per cent of large farmers and 11.67 per cent of medium farmers owning tractors. The custom hiring 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 machineries 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 on custom basis was worked out ultimately to assess the comparative cost incurred by the tractor owned and hired farmers in cultivating the different crops. The fixed and variable costs for different machineries 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 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 same for all the tractor drawn implements, it was ranging from ₹135.15/h to ₹142.11/h because the fixed and variable costs (Table 2) are almost same for commonly used tractors. 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 was found to be highest for MB plough fol-

lowed by rotavator, disc harrow, cultivator, blade harrow and ridger as presented in Table 3. This variation was due to variation in the field efficiency and nature of hire. The field capacity is the area covered by any machinery in an hour. The field capacity expressed in acre per hour of different farm machineries has been presented in Table 4. It is clear from the table that the field efficiency of different machines varied from 0.51 to 1.30 acres per hour depending upon the nature of operations accordingly the fuel and other costs get vary with the type of implements.

In paddy crop, custom hiring charges were highest for harvesting machines *viz.*, combine harvester ( ₹2975.36/acre) and thresher ( ₹1617.65/acre). Use of Combine harvester is a common practice for paddy crop for harvesting in the recent days due to shortage of labour and also it saves time. Among the other implements used for paddy crop, the hiring charge was highest for cage wheel puddler ( ₹1265.10/acre) followed by MB plough ( ₹1167.58/acre), rotavator ( ₹1015.13/acre), disc harrow ( ₹645.55/acre) and cultivator ( ₹455.79/acre). Hence the existence of different pattern of CHS across crops, category of farmers and farm operations was substantiated.

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. But, 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 ( ₹27,654/acre) compared to tractor hired farms ( ₹27783/acre). This was due to the lower material input and labour cost in tractor hired farms than large farms. But, 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. The similar findings were reported by Singh *et al.* (2013) wherein the net farm income is higher on tractor owning farms but input costs were low on custom hiring farms. It may be due to the high fixed costs and variable costs on tractor owning farms. For selected crops, the yield was highest in tractor owned farms compared to the tractor hired farms. The similar results were observed by Singh *et al.* (2002) who found that the yield of wheat was significantly higher on farms owning tractor than on farms hiring tractors (Table 5).

In present study, the net returns were little higher on tractor owned farms than on hired farms for all selected crops *i.e.* paddy (27783/ acre and 27654/ acre), cotton (31968/acre and 30384/acre), sugarcane (75432/acre and 72886/acre / acre) and chilli (39368/ acre and 34972/acre) crops. 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.

### Conclusion

It was concluded that the productivity of selected crops was higher for tractor owned farms compared to tractor hired farms. The net returns were higher for tractor owned farms compared to the tractor hired farms in all the selected crops. However, availability of CHS in the TBP command area has helped the small and marginal farmers in adopting mechanization in farm operations and thus helped in reaping the advantages of mechanization. The custom hiring service was confirmed as a viable alternative to the direct ownership of agricultural machinery. Under these circumstances, The use of machinery to carry out the farm operations can solve some of these problems facing the farmers besides saving in time.

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