



Research Article

ECONOMICS OF MECHANICAL VERSUS MANUAL HARVESTING OF TUR IN NORTH KARNATAKA

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Abstract- The present study attempted to estimate the cost of cultivation of Tur, identify methods of harvesting and document constraints faced by Tur growers in mechanical harvesting in two major Tur growing districts of north Karnataka *i.e.*, Vijayapur and Bagalakote. Multistage sampling procedure was followed for selection of 120 Tur growers. The data pertained to the agricultural year 2013-14. Farm budgeting and Garrett ranking techniques were used to analyze the data. The net returns per hectare for Tur cultivation for manual harvesting and mechanical threshing and mechanical harvesting cum threshing was found to be ₹27588.17 and ₹35181.82 leading to undiscounted benefit cost ratios of 1.45 and 1.62, respectively. The two major methods for harvesting and threshing of Tur in the study area were using human labour for harvesting, bullock pair for transportation and machine for threshing and using combined harvesters for harvesting and threshing, of which, mechanical harvesting cum threshing of Tur was found to be economical to the extent of ₹3041.40 per ha in Vijayapur district and ₹2960.25 per ha in Bagalakote district. The major problems faced in mechanical harvesting and threshing of Tur were non-availability of machines during requirement, splitting of grains, loss of fodder and absence of standard price for area harvested.

Keywords- Economics, Mechanical harvesting, Threshing, Combined harvesters, Constraints

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Introduction

Tur or pigeonpea (*Cajanus cajan* L mill.sp.) is the most important Kharif pulse crop of northern Karnataka. It is largely grown especially in Gulbarga, Vijayapur and Bidar districts of the state. The state occupies an area of about 0.77 million hectare with a production of 0.36 million tonne, with an average productivity of 556 kg per ha [1].

Manual harvesting of Tur demands considerable amount of labour, drudgery, time and adds cost to the harvest. It was estimated that harvesting operation consumed about 25 to 30 per cent of total labour requirement of the Tur crop production system. The shortage of labour during on-season and vagaries of weather were the major problems faced in cultivation of all crops in general and Tur in particular before introduction of machines. The timely harvest of crop is vital to reduce the yield loss and increase quality of produce [2].

In recent years, in view of introduction of various schemes (MGNREGA and Annabhagya) for the benefit of rural people, the farmers are facing scarcity of labour for taking up various agricultural operations in general and harvesting and threshing of crops in particular. The shortage of labour can be bridged by mechanization. Mechanical power has become more economical and indispensable to meet targets of timeliness and efficient utilization of natural resources and input use. There is need for mechanization of various agricultural operations due to non-availability of labour during requirement, high cost incurred on labour component and timely harvest of crops by machines with reduced cost. Mechanical harvesting and threshing of numerous crops in general and Tur in particular is getting popular among large as well as medium scale farmers of northern Karnataka in view of farmers facing acute shortage of labour and time

during harvesting [3].

Various implications of machine harvesting and threshing of Tur in two major tur growing districts namely, Vijayapur and Bagalakote of northern Karnataka were studied with the specific objectives: To estimate the cost and returns in tur cultivation in north Karnataka, to identify different methods of harvesting of tur, to assess the economics of major harvesting methods of tur and to document the constraints in mechanical harvesting of tur in the region [4].

Materials and methods

Two major Tur growing districts of northern dry zone of Karnataka *i.e.*, Vijayapur and Bagalakote, which are under the jurisdiction of UAS, Dharwad were selected for the study. The primary data was collected on general characteristics of farmers, costs, returns, yields, harvesting methods and constraints faced in mechanical harvesting of Tur. The primary data collected pertained to the agricultural year 2013-14. Multistage sampling procedure was used for selection of districts, taluks and villages. Two major Tur growing taluks were selected from each selected district based on highest area under Tur. Accordingly, Muddebihal and Sindagi taluks of Vijayapur district and Badami and Hunagund taluks of Bagalakote district were selected for the purpose of the study. From each selected taluk, three villages were chosen. From each village, 10 farmers growing Tur were randomly selected. In all, 120 Tur growers were selected. Tabular analysis was done to identify socio-economic profile of the respondents and to identify major harvesting and threshing methods. Farm budgeting technique was used to estimate the cost and return structure and to assess the economics of major harvesting methods of Tur. The documentation of the constraints in mechanical

harvesting in the region was done using Garrett's ranking technique.

Results and Discussion

General characteristics of the sample respondents:

The general characteristics of Tur growers of the study area are presented in [Table-1]. The average age of the sample adopters of manual harvesting and mechanical threshing (traditional farmers) was 58 years, whereas the average age of adopters of mechanical harvesting and threshing was 48.4 years. This might be due to the fact that, the youngsters were not involved in the agricultural professions as they were looking for job opportunities in more lucrative service sector. Among the traditional farmers, 60 per cent were illiterate and as a result they are unaware of the positive impacts of mechanical harvesting. With this it

could be concluded that, manual harvesting and mechanical threshing of Tur was followed by the middle age farmers, with little educational background. All the sample farmers depended on agriculture and allied activities as their main occupation. The average annual income of traditional farmers and adopters of mechanical harvesting was ₹53900 and ₹119500, respectively. The average area under Tur crop for traditional farmers was 1.75 hectare and that for adopters of mechanical harvesting was 3.78 hectare. This was probably due to the preference of machine operators for larger area under the crop. The combined harvesters don't work efficiently in scattered and small land holdings due to the bunds present in the field [5].

Table-1 General characteristics of the sample respondents

Sl. No.	Particulars	Unit	Manual harvesting and mechanical threshing (n=60)	Mechanical harvesting and threshing (n=60)
I	Age of the farmers	Years	58	48.4
II	Education	Number		
	Illiterate		36 (60.00)	14 (23.33)
	Primary		20 (33.33)	4 (13.33)
	Secondary		4 (6.67)	20 (33.33)
	PUC		-	6 (10.00)
	Degree		-	12 (20.00)
	Sub total		60 (100.00)	60 (100.00)
III	Family Type	Number		
	Nucleus		22 (36.67)	16 (26.67)
	Joint		38 (63.33)	44 (73.33)
	Sub total		60 (100.00)	60 (100.00)
IV	Family Composition	Number		
	Male		3.80 (52.05)	4.31 (55.91)
	Female		3.50 (47.45)	3.40 (44.09)
	Average family size		7.30 (100.00)	7.71 (100.00)
V	Association with social organization	Number		
	ZP		-	2 (3.33)
	TP		-	-
	VP		4 (6.67)	4 (6.67)
	NGO		-	2 (3.33)
	SHG		-	-
	Water use groups		-	-
VI	Agriculture as occupation	Number		
	Main		60 (100.00)	60 (100.00)
	Subsidiary		-	-
VII	Average Annual Income	Rupee		
	Main		53900	119500
	Subsidiary		-	-
	Sub total		53900	119500
VIII	Average area under Tur crop	Hectare	1.75	3.78

Cost and returns structure in Tur cultivation

The net returns realized in Tur cultivation was analyzed by computing per hectare costs and returns and the results are presented in [Table-2]. Of the total cost, the expenditure incurred on male labour utilized for various cultivation operations accounted for 23.38 per cent of the total cost of cultivation (₹14094.00) followed by bullock labour (14.21 %) and FYM (8.64 %). Input cost of ₹15039.28 was spent by the traditional Tur growers. The total fixed cost was ₹12857.61. Among the fixed costs, the share contributed by rental value of owned land was 16.59 per cent. The total cost of cultivation per hectare of traditional Tur growers was found to be ₹60260.37. In case of adopters of mechanical harvesting of Tur, the total cost of cultivation of was found to be ₹55861.65 of which, total labour cost was ₹28478.25, total input cost was ₹14762.10 and total fixed cost was ₹12621.30. Of the total cost, the expenditure on male labour was ₹11797.60 accounting for 21.12 per cent followed by bullock labour (11.01%), machine labour (9.66%) and FYM (9.56%).

The analysis of yield and return of Tur cultivation revealed that, yield per hectare in case of traditional Tur growers and adopters of mechanical harvesting were 15.08 quintals and 14.90 quintals, respectively. The average price received by the sample farmers per quintal of Tur in case of traditional Tur growers and adopters of mechanical harvesting was ₹5825.50 and ₹6110.30 respectively. The total cost

of cultivation for traditional Tur growers was ₹60260.37 whereas for adopters of mechanical harvesting, it was ₹55861.65. The net returns realized per hectare for these two categories found to be ₹27588.17 and ₹35181.82, leading to an undiscounted benefit to cost ratio of 1.45 and 1.62, respectively. In spite of more yield and higher price of output, the net returns for traditional Tur growers was less due to their higher cost on labour services for carrying out various farm operations. Similar results were reported by Radha and Choudhry (2005) [6], in their study on cost of commercial and seed production of cotton in Karnool district of Andhra Pradesh [6].

Methods of harvesting and threshing of Tur

The harvesting and threshing of Tur are the most important activities to realize higher yield and income. The different methods followed by the sample farmers for harvesting and threshing of Tur as presented in [Table-3]. Use of only human labour for harvesting and threshing of Tur was not observed in the study area due to labour scarcity and higher labour wages as a result of implementation of MGNREGA during crop seasons (In line with the results obtained by Ramesh, 2006). The two major methods for harvesting and threshing of Tur in the study area were i) utilization of human labour for harvesting, bullock pair for

transportation and machine for threshing (40.00%) and, ii) use of machine/ combined harvesters for harvesting and threshing (50.00%).

Table-2 Cost and returns structure in Tur cultivation (₹/ha)

Sl. No.	Particulars	Manual harvesting and mechanical threshing (n=60)		Mechanical harvesting and threshing (n=60)	
		Amount (₹)	Percentage to total	Amount (₹)	Percentage to total
A	Variable cost				
I.	Labour cost				
1	Male (man days)	14094.00	23.38	11797.60	21.12
2	Female (woman days)	5901.10	9.79	5130.18	9.18
3	Machine (hours): Harvester	-	-	2378.65	4.25
	Thresher	1109.30	1.84	-	-
	Tractor/others	2712.50	4.50	3022.20	5.41
4	Bullock (pair days)	8546.58	14.21	6149.63	11.01
	Sub-Total (I)	32363.48	53.70	28478.25	50.97
II.	Input cost				
1	Seeds (kg)	1064.85	1.76	1113.50	1.99
2	FYM (t)	5207.32	8.64	5341.77	9.56
3	Fertilizers (bags)				
a.	Urea	1092.00	1.81	957.35	1.71
b.	DAP	3484.17	5.78	3662.10	6.55
4	Plant Protection chemicals (l/kg)	3207.07	5.32	2721.63	4.87
	Interest on working capital @ 7 %	983.87	1.63	965.75	1.72
	Sub-Total (II)	15039.28	24.95	14762.10	26.42
B	Fixed costs				
1	Land revenue (Rs)	25.00	0.004	25.00	0.005
2	Rental value of owned land (Rs)	10000	16.59	10000	17.90
3	Depreciation (Rs)	1353.42	2.24	1144.30	2.04
4	Interest on fixed capital @ 13 %	1479.19	2.45	1452.00	2.59
	Sub-total	12857.61	21.33	12621.30	22.59
	Total Cost (A+B)	26945.16	60260.37	100.00	55861.65
Returns from Tur cultivation					
	Yield (quintal/ha)	15.08		14.90	
	Average price received (₹/quintal)	5825.50		6110.30	
	Gross returns (₹/ha)	87848.54		91043.47	
	Total Cost of cultivation (₹/ha)	60260.37		55861.65	
	Net returns (₹/ha)	27588.17		35181.82	
	Undiscounted Benefit Cost Ratio	1.45		1.62	

Note: One bag of fertilizer=50 kg

Table-3 Methods of harvesting and threshing of Tur

Sl. No.	Particulars	Vijayapur (n=60)		Bagalkot (n=60)		Total (n=120)	
		Number	Percentage	Number	Percentage	Number	Percentage
1	Use of human labour and bullock pair	4	6.67	8	13.33	12	10.00
2	Use of human labour for harvesting, bullock pair for transportation and machine for threshing	26	43.33	22	36.67	48	40.00
3	Machine/Combined harvesters for harvesting and threshing	30	50.00	30	50.00	60	50.00
	Total	60	100.00	60	100.00	120	100.00

Economics of harvesting and threshing of Tur

The economics of two major methods of harvesting and threshing Tur (Mechanical harvesting cum threshing and Manual harvesting and mechanical threshing) in Vijayapur and Bagalakote district are depicted in [Tables-4 and 5], respectively. The total cost incurred per hectare of manual harvesting and mechanical threshing of Tur crop was ₹5669.60. The cost involved in harvesting and threshing of Tur by combined harvester was ₹1993.75 per hectare followed by labour cost of ₹634.45 for bagging, leading to a total cost of ₹2628.20. Thus, the net additional benefit of mechanical harvesting cum threshing over manual harvesting and mechanical threshing per hectare was ₹3041.40 for Vijayapur district. The total cost in manual harvesting and mechanical threshing of Tur crop per hectare was ₹6042.75. The cost involved in harvesting and threshing of Tur crop using combined harvester was ₹2125.60 per hectare followed by labour cost of ₹956.90 for bagging, leading to a total cost of ₹3082.50. Thus, the net additional benefit of mechanical harvesting cum threshing over manual harvesting and mechanical threshing per hectare was ₹2960.25 for Bagalakote district. In both the districts, mechanical harvesting cum threshing in Tur was found economic alover manual harvesting and mechanical threshing. It was due to high

labour cost in the study area. Similar trend was observed in the findings of Mundinamani *et al.* (2013) [3] for mechanical harvesting of chickpea in north Karnataka and Viswanatha (2007) [8] for threshing methods of Maize in Karnataka.

Constraints faced in mechanical harvesting and threshing of Tur

From the results presented in [Table-6], it is revealed that, the major constraints faced in mechanical harvesting and threshing of Tur were high cost of machine charges, non-availability of machines as and when required for harvesting when crop was ready, splitting of grains, loss of fodder and absence of standard price per unit harvested/ threshed. Majority of the sample respondents opined that the mechanical harvesting and threshing of Tur leads to the problem of splitting of grains (Garrett score=69.17) followed by absence of standard price per unit area harvested/threshed (58.83) and non-availability of machines during requirement/ crop harvesting period (47.00). Loss of fodder (44.00) and high cost of machine charges (31.50) were placed at fourth and fifth place respectively. As most of the machines come from Punjab, non-availability of machines during requirement

becomes a major problem. To avoid splitting of grains, a modified harvester should be developed by agricultural engineers for tur crop.

Table-4 Economics of manual versus mechanical harvesting of Tur in Vijayapur (perha)

Sl. No.	Particulars	No of labours		Machine		Total cost (₹)
		Men	Women	₹/Hr	Avg No. of hours	
I	Manual Harvesting					
a)	Cutting matured Tur Plants	5.25	2.30	-	-	1660.10
b)	Transportation and heaping	2.50	8.32	-	-	1752.42
II	Machine Threshing					
a)	Shelling (grain separation from pods & plants)					
b)	Winnowing and cleaning					
c)	Drying/bagging					
d)	Transportation					
		5.80	6.33	110.52	6.83	2257.08
	Total cost (I + II)					5669.60
III	Mechanical harvesting cum threshing					
a)	Harvesting and threshing by machine					1993.75
b)	Labour for bagging					634.45
	Total cost of harvesting and threshing by machine					2628.20
IV	Increase in cost for (I +II) over III					3041.40
	Net additional returns/benefit of mechanical harvesting & threshing over manual harvesting and machine threshing					3041.40

Table-5 Economics of manual versus mechanical harvesting of Tur in Bagalakote (perha)

Sl. No.	Particulars	No of labours		Machine		Totalcost (₹)
		Men	Women	₹/Hr	Avg No. of hours	
I	Manual Harvesting					
a)	Cutting matured Tur Plants	7.07	0.00	-	-	1779.33
b)	Transportation and heaping	3.65	5.70	-	-	1743.02
II	Machine Threshing					
a)	Shelling (grain separation from pods & plants)					
b)	Winnowing and cleaning					
c)	Drying/bagging					
d)	Transportation					
		6.25	5.35	140.90	6.33	2520.40
	Total cost (I + II)					6042.75
III	Mechanical harvesting cum threshing					
a)	Harvesting and threshing by machine					2125.60
b)	Labour for bagging					956.90
	Total cost of harvesting and threshing by machine					3082.50
IV	Increase in cost for (I +II) over III					2960.25
	Net additional returns/benefit of mechanical harvesting & threshing over manual harvesting and machine threshing					2960.25

Table-6 Constraints faced in mechanical harvesting and threshing of Tur

Sl. No.	Constraints	Garrett score	Rank
1	High cost of machine charges	58.83	II
2	Non-availability of machines when required	47.00	III
3	Loss of grains/ Splitting of grains	69.17	I
4	Loss of fodder	44.00	IV
5	No standard price for unit harvested/ threshed	31.50	V

Conclusion

Tur or pigeon pea (*Cajanus cajan* L. mill. sp.) is the most important Kharif pulse crop of northern Karnataka. The net returns per hectare for Tur cultivation for manual harvesting and mechanical threshing and mechanical harvesting cum threshing was found to be ₹27588.17 and ₹35181.82 leading to undiscounted benefit cost ratios of 1.45 and 1.62, respectively. Hence, Tur can be taken up in larger area in the study area which will add to the pulse production of the country. Mechanical harvesting cum threshing of Tur was found to be economical in the study area. Custom hiring of agricultural machineries would help the farmers by their easy availability and standard price per unit area harvested /threshed /operated.

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Author Contributions

The paper is a part of the M.sc (Agri) thesis of the first author under the research guidance of the second author. The third author assisted in data collection and the provided the agronomic details and sources of cost in cultivation of the crop. The fourth and fifth authors helped in preparation of the manuscript.

Abbreviations

FYM- Farm Yard Manure

Ha- Hectare

MGNREGA- Mahatma Gandhi National Rural Employment Guarantee Act

UAS, Dharwad- University of Agricultural Sciences, Dharwad

Conflict of Interest: None declared

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