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Research Paper

Economics of farm mechanisation in bengalgram cultivation in Northern Dry Zone of Karnataka

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ABSTRACT : This paper attempts to evaluate the impact of mechanisation in bengalgram cultivation in northern dry zone of Karnataka. The study was based on primary data, obtained through personal interview method using well-structured and pre-tested schedules. The total sample size was 60. The data pertained to the year 2017-18. The budgeting technique and output decomposition model were used to evaluate the impact of mechanization. Extent of reduction in human labour and bullock labour was 18.30 man days and 13.00 pair days by adopting mechanization. The expenditure of non-mechanised farmers was Rs. 4,497.95 higher than mechanised farmers in cultivating bengalgram. The mechanised farms used slightly fewer quantities of inputs compared to non-mechanised farms. Yield was observed to be higher in mechanised farms (9.49 q/ha). While the non-mechanised farmers incurred loss due to higher cost of cultivation. The cost of cultivation was Rs. 124.71 higher than gross return. The output decomposition model revealed that mechanised farms produced 47.23 per cent higher income in bengalgram than that in non-mechanised farms. The mechanisation alone contributed 50.10 per cent increase in income, while fewer labour use of inputs depressed the income marginally.

KEY WORDS : Mechanisation, Non-mechanisation, Output decomposition analysis

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INTRODUCTION :

Indian agriculture has achieved tremendous growth in production and productivity of crops after Independence. Between 1950-51 and 2009-10, production of food grains increased from 51 million tonnes (MT) to 233 MT, while oilseeds production increased from 5.16 mt to 29.76 mt. Similar growth has also been achieved in sugarcane, cotton, fruits, vegetables and other crops (Government of India, 2009). Per capita availability of these commodities has also increased. The increased volume of crop output, which resulted from the intensification of agriculture after the introduction of green revolution during the mid-sixties, helped to increase the wage rate and generate more employment opportunities in the rural areas particularly for the landless labourers (Dev and Ranade, 1998; Saleth *et al.*, 2003 and Narayanamoorthy and Deshpande, 2003). The incidence of rural poverty has also reduced considerably from 56.44 per cent during 1972-73 to 28.33 per cent in 2004- 05 mainly because of the improved production of agricultural commodities, as proved by a number of studies (Ahluwalia, 1978; Narayanamoorthy, 2001 and Saleth *et al.,* 2003). These achievements would not have been

possible without the incisive role of Indian farmers (Swaminathan, 2008).

The country was facing acute food shortages till eighties and has now become not only self-sufficient but also a net exporter of food grains. This has been made possible due to evolution of high yielding crop varieties, increased use of chemical fertilizers, development of irrigation facilities and plant protection measures accompanied by effective price support programmes for farm products. The increased use of purchased inputs in agriculture necessitated the increased use of human and bullock labour. But the rising wage rates and non-availability of farm labour made the case of farm mechanization stronger.

Over the years, the farmers are shifting towards cultivation of cash crops for a number of reasons including non availability of farm labour. This has led to decrease in area under field crops. Thus, there is strong need for mechanization of agricultural operations. The factors that justify the strengthening of farm mechanization in the country can be numerous. The timeliness of operations has assumed greater significant in obtaining optimal yield, which has been possible by way of mechanization. The quality and precision of the operations are equally significant for realizing higher yields. The various operations such as land leveling, irrigation, sowing and planting, use of fertilizers, plant protection, harvesting and threshing need a high degree of precision to increase the efficiency of the inputs and reduce the losses.

India is the largest producer, consumer and importer of bengalgram in the world. In India, it is mainly grown in Maharashtra, Andhra Pradesh and Karnataka. The projected pulse requirement for the year 2030 is 32 million tons with an anticipated required growth rate of 4.2 per cent as per IIPR Vision 2030 (Anonymous, 2014). India has to produce not only enough pulses but also remain competitive to protect the indigenous pulse production. From mechanisation in bengalgram could help in enhancing the area under this crop.

With this backdrop, the current study was carried out in northern dry zone of Karnataka with the specific objective of analysing the profitability of bengalgram crop in mechanised and non-mechanised farms.

MATERIALS AND METHODS :

The present study was conducted in northern dry zone of Karnataka. Among 35 taluks in northern dry zone, Dharwad taluk was selected in view highest concentration of agricultural equipments and the area under bengalgram is also more in the zone. From Dharwad taluk three villages were selected namely Annigeri, Ibrahimpur and Shalwadi and from each village 10 mechanised and 10 non-mechanised farms were randomly selected. Thus, the total sample size was 60. Mechanised farm is defined as the farm where the use of machines, whether mobile or immobile, small or large, run by power and used for tillage operations to harvesting and thrashing whereas non-mechanised is one where the use of human labour and bullock labour are used in cultivation of cops in agriculture, without using any machinery. The data pertained to the crop year 2017-18. The primary data on various aspects of labour use in production of bengalgram, use of mechanization and its impact on yield, income were obtained from respondents. For the purpose of achieving the objectives and to draw meaningful interpretations and inferences, the data were analyzed using the budgeting technique and output decomposition analysis.

For output decomposition analysis the following type of Cobb-Douglaus production function was defined.

$$Y = aX_1^{b1} X_2^{b2} e^u$$

where, Y= Gross income in Rs./ha

X_1= Energy in joules/ha

X_2= Value of inputs in Rs./ha

u= Random error term.

Using subscripts 'm and n' the production functions defining relationship between input and output were defined separately for mechanised (m) and non-mechanised (n) farms as follows:

$$Y_m = a_m X_{1m}^{b1m} X_{2m}^{b2m} e^{um}$$

$$Y_n = a_n X_{1n}^{b1n} X_{2n}^{b2n} e^{un}$$

On log (ln) transformation and algebraic manipulation of the above production functions, the following output decomposition model was obtained.

$$(\ln Y_m - \ln Y_n) = (\ln a_m - \ln a_n) + \sum_{i=1}^{j} (b_{im} - b_{in}) \ln X_{in} + \sum_{i=1}^{j} b_{im} (\ln X_{im} - \ln X_{in})$$

The above decomposition equation was approximately a measure of percentage change in output/ income with the adoption of mechanization. The first bracketed expression of the right hand side is the measure of percentage change in income due to shift in scale parameter (A) of the production function. The second bracketed expression is the difference between output

elasticities each weighted by natural logarithms of the volume of that input used under non-mechanised farm, a measure of change in income due to shift in slope parameters (output elasticities) of the production function. The third bracketed expression is the sum of the natural logarithms of the ratio of each input of mechanised to non-mechanised farms, each weighted by the output elasticity of that input. This expression is a measure of change in output due to change in the per hectare quantities of input used.

RESULTS AND DATA ANALYSIS :

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Labour use and cost associated in mechanised and non- mechanised farms:

The mechanised farmers have used 16.16 man days of human labour, 16.40 hours of machine labour and they have not used bullock labours (Table 1). While the non-mechanised farmers have used more of both human labour (34.46 man days) and bullock labour (13.00 pair days) compared to mechanised farmers. Operations like land preparation, sowing and intercultivation was done by bullock labour in non-mechanised farmers, this was due to majority of these farmers owned bullock for cultivation. However, if farmers move from non-mechanised to mechanised, the extent of reduction in human labour and bullock labour was 18.30 man days and 13.00 pair days, respectively. This was mainly due to the fact that the non-mechanisation of bengalgram involves more number of labours at the time of weeding and harvesting, intensive usage of human labour in hand weeding than mechanisation as it usually follows less number of times of hand weeding due to less intensity of weeds in mechanised farms than non-mechanised farms. The findings of the study are in agreement with Sujatha *et al.* (2006) reported that organic cultivation of rice and cotton was labour intensive than inorganic cultivation.

It is evident from Table 1 that, the total expenditure made by mechanised farmers towards human labour and machine labour was Rs. 3,485.38 and Rs. 5,713.26, respectively. Where as non-mechanised farmers incurred Rs. 7,983.33 and Rs. 10,728.33 towards human labour and bullock labour. The expenditure of non-mechanised farmers was Rs. 4,497.95 higher than mechanized farmers. This was mainly due to the reason that, in mechanised farms operations were performed with own machinery which increased the efficiency of machine labour and also reduced the cost of operation with increase in the farm size. Bengalgram crop demanded higher human labour and bullock labour for operations

Table 1: Pattern of labour use and operation wise labour cost of bengalgram cultivation **(Per ha)**

Sr. No.	Particulars	Mechanised (n=30)		Non-mechanised (n=30)		Difference	
I	**Human labour (Man days)**	Quantity	Value (Rs.)	Quantity	Value (Rs.)	Quantity	Value (Rs.)
1.	Land preparation	1.80(11.13)	158.85 (4.56)	2.20 (6.38)	550.00 (6.89)	-0.40	-391.15
2.	Sowing and intercultivation	10.23 (63.30)	2,233.20 (64.07)	18.40 (53.38)	3,680.00 (46.10)	-8.17	-1,446.80
3.	Manure and fertilizer application	1.13 (7.01)	283.33 (8.13)	1.73 (5.03)	433.33 (5.43)	-0.60	-150.00
4.	Harvesting and threshing	3.00 (18.56)	810.00 (23.24)	12.13 (35.20)	3,320.00 (41.59)	-9.13	-2,510.00
	Total	16.16 (100.00)	3,485.38 (100.00)	34.46 (100.00)	7,983.33 (100.00)	-18.30	-4,497.95
II	**Machine labour (Hours)**						
1.	Land preparation	5.57 (33.98)	2,857.79 (50.02)	0 (0.00)	0 (0.00)	5.58	2,857.79
2.	Sowing and inter cultivation	7.66 (46.72)	1,860.47 (32.56)	0 (0.00)	0 (0.00)	7.67	1,860.47
3.	Harvesting and threshing	3.16 (19.30)	995.00 (17.42)	0 (0.00)	0 (0.00)	3.17	995.00
	Total	16.40 (100.00)	5,713.26 (100.00)	0 (0.00)	0 (0.00)	16.41	5,713.26
III	**Bullock labour (Pair days)**						
1.	Land preparation	0 (0.00)	0 (0.00)	3.5026.92)	2,395.00 (22.32)	-3.50	-2,395.00
2.	Sowing and inter cultivation	0 (0.00)	0 (0.00)	7.00 (53.85)	5,758.33 (53.67)	-7.00	-5,758.33
3.	Threshing	0 (0.00)	0 (0.00)	2.50 (19.23)	2,575.00 (24.00)	-2.50	-2,575.00
	Total	0 (0.00)	0 (0.00)	13.00 (100.00)	10,728.33 (100.00)	-13.00	-10,728.33
	Total labour cost		9,198.64		18,711.66		-9,513.02

like sowing, weeding, intercultivation, spraying, harvesting and threshing in non-mechanised farms. Use of machines in mechanised farmers has reduced human labour cost Rs. 4,497.95 than non-mechanised farmers respectively. Results found are similar with findings of Lavanya (2014).

Input use, cost and returns under mechanised and non-mechanised farms

It can be observed from Table 2 that, the average per hectare utilisation of seeds among the different methods was highest in case of non-mechanised farmers (63.50 kg/ha) compared to mechanised farmers (52.50ka/ha). The bullock labour used under non-mechanisation was 13.00 pair days. This was due to frequent intercultivation, weeding, higher application of fertilizers and marginally higher output which demand more labour. Highest yield was observed by mechanised farmers compared to non-mechanised farmers mainly due modern technologies and scientific agronomic practices adopted by mechanised farmers has increased yield.

The total variable cost (Table 2) incurred per hectare under non-mechanisation was highest (Rs. 35,241.37/ha) compared to mechanised farmers. This was due to expenditure on chemical fertilizers and plant protection chemicals applied per hectare in the study area was more. The distribution pattern of operational cost under various inputs revealed that the cost of human labour also was highest in two types of farms. Fixed cost ranges from 14-30 per cent to the total cost in both categories farmers. Thus, the cultivation of bengalgram crop in the study area was found to be highly profitable under mechanisation. Net returns from non-mechanisation was

Table 2: Input use, cost and returns in bengalgram cultivation **(Per ha)**

Sr. No.	Particulars	Mechanised (n=30)		Non-mechanised (n=30)		Difference	
		Quantity	Value (Rs.)	Quantity	Value (Rs.)	Quantity	Value (Rs.)
A	**Variable cost**						
1.	Human labour (man days)	16.16	3,485.38	34.46	7,983.33	-18.30	-4,497.95
2.	Bullock labour (Pair days)	0.00	0.00	13.00	10,728.33	-13.00	-10,728.33
3.	Machine labour (hours)	16.40	5,713.26	0.00	0.00	16.41	5,713.26
4.	Seeds (Kg)	52.50	2,612.50	63.50	3,132.50	-11.00	-520.00
5.	**Chemical fertilizers (Qtl.)**						
	Urea	0.65	410.50	0.95	597.02	-0.30	-186.52
	DAP	1.50	3,214.02	2.14	5,049.60	-0.64	-1835.58
	Total	2.15	3,624.52	3.09	5,646.62	-0.94	-2022.1
6.	**Plant protection chemicals (lit/kg)**						
	Pesticide	0.72	475.62	1.13	719.62	-0.41	-244
7.	Interest on working capital @7%		1,113.78		1,974.728		-860.948
A	Total variable cost (Rs.)		17,025.31 (69.52)		30,185.59 (85.62)		-13,160.28
B	Fixed cost (Rs.)		7,463.35 (30.48)		5,055.78 (14.35)		3806.78
I (A+B)	Total cost (Rs.)		24,488.66 (100.00)		35,241.37 (100.00)		-14598.41*
II	**Returns (Rs.)**						
	Gross returns (Rs.)		57,217.92		35,116.67		22,101.25*
II-I	Net returns (Rs.)		32,729.25		-124.71		32,853.96*

Note: * and ** indicate significance of values at P=0.01 and 0.05, respectively

Table 3 : Decomposition of total change in per hectare income between mechanised and non-mechanised farms **(%)**

Sr. No.	Particulars	Pigeonpea
	Total change in measured income	47.23
1.	Technology component	44.68
	Neutral component	75.40
	Non-neutral component	-30.71
2.	Input contribution	-2.55

Rs. -124.71 which was lesser than mechanised (Rs. 32,729.25) because the land preparation, sowing and intercultivation involved more bullock labour and further, the attack of pest and diseases were slightly more in bengalgram cultivation in non-mechanised farmers.

Similar results were observed in the study conducted Lavanya (2014). Yield and gross returns were higher on large farms, while the cost of production was decreased with increase in the farm size in bengalgram with mechanisation of farm operations. The net income and various farm income measures were more on large farms followed by small and medium farms but the overall farm business of bengalgram was not profitable as revealed by the negative net returns in all size groups of the farm.

Decomposition of total change in per hectare income between mechanised and non-mechanised farms:

Mechanised farms produced 47.23 per cent higher income in bengalgram (Table 3) production than in non-mechanised farms. The change in income was further decomposed into different sources of change *viz.*, change in income due to mechanisation and due to change in inputs used. In mechanised farms, mechanisation alone contributed 44.68 per cent increase in income. The contribution of change in input levels was found to be negative (-2.55 %). It was interesting to note that the change in income due to mechanisation was non-neutral to scale implying that the benefits of mechanisation can be exploited fully by extending area under cultivation on a large scale. This result is in conformity with the Rathore (2012) and Vinayak and Reddy (2015).

Conclusion:

It could be inferred from the results that, bengalgram cultivation in study area was found to be more profitable under mechanisation. Mechanisation has led to human labour saving to the tune of 18.30 man days and 13.00 pair days of bullock labour. Use of machines in mechanised farmers has reduced human labour cost by Rs. 4,497.95. Mechanised farmers produced 47.23 per cent higher income in bengalgram production than in non-mechanised farmers. Hence, the farmers need to be encouraged to adopt mechanisation in cultivation of selected crop to overcome the problem of scarcity of labour and to reduce the total cost of cultivation.

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