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Comparative Analysis of Laser Land Levelling vis-a-vis Conventional Land Levelling in Karnal District of Haryana

Dinesh Kumar[1*], Dalip Kumar Bishnoi[1] and Vinay Mehla[1]

[1]Department of Agricultural Economics, CCSHAU, Hisar, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author DK designed the study, collected the primary data, performed the statistical analysis and wrote the first draft of the manuscript. Author VM managed the literature searches and author DKB finally edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Economic analysis of laser land levelling (LLL) in comparison with conventional land levelling (CLL) was exercised by the study. Karnal district was selected purposively only because it was having highest area under paddy-wheat cropping pattern in the state. Different cost concepts were used to analyse economic impact of laser land levelling. As laser land levelling has major impact on irrigation use efficiency that's why Karnal district was most appropriate for study because it was having major cropping pattern as paddy and wheat which incorporate water thirsty crops. Total cost under laser land levelling was Rs125392 and Rs95037 while under conventional land levelling it was Rs126918 and Rs 98667 for paddy and wheat respectively. Gross returns under LLL were Rs 155480 and Rs 115880 while under CLL they were Rs148228 and 113798 for paddy and wheat respectively. Net Returns under LLL were Rs 30088 and Rs 20843 while under CLL they were Rs 21310 and Rs 15132 for paddy and wheat respectively. Benefit cost ratio under LLL was 1.24 and 1.18 while under CLL it was 1.17 and 1.15 for paddy and wheat respectively. These results shows economic profitability of LLL over CLL and recommended to adopt LLL on wider scale and tap benefits of this resource conservation technology.

**Corresponding author: E-mail: ritulamba33@gmail.com;*

Keywords: Laser land levelling; profitability; water thirsty resource conservation technology.

1. INTRODUCTION

Water is most important life supporting input on planet earth. During last few decades its increasing scarcity has alarmed the issues of its efficient use and sustainabilityon mother Earth. 70 percent of Earth's surface is covered with water but surprisingly only 2.7 % of total water is available as freshwater. With increasing population, industrialisation and intensification of agriculture demand for water will rise manifold and major challenge for our generation will sustainable use this resource especially in agriculture sector. Most of the area in Haryana is irrigated. Especially paddy-wheat belt of Karnal is experiencing problem of declining water table due to over lifting of water for irrigation use. Thus, a suitable technology is need of hour to tackle with problem of water crisis. Laser land levelling is that such efficient Technology which can help in conservation of scarce resources without disturbing ecosystem and compromising with productivity. Kahlown et al. [1] conducted a study in the Rice-Wheat cropping system of Indo-Gangetic plain and revealed that about 10 to 25 per cent of irrigation water is wasted due to poor management and unevenness of the fields. Sapkal et al. [2] compared cost and returns of wheat and paddy cultivation in north-western Indo Gangetic Plains of Haryana under laser land levelling (LLL) and conventional land levelling (CLL). Also, Bisaliah decomposition model was used to study impact of technology and input use in increasing productivity. the study showed that laser land levelling (LLL) has potential to provide incremental income and conserve most scarce resource *i.e.* water. Results of study highlighted that 35244 of net incremental benefits was observed from using laser land levelling (LLL) operation. Also, Aryal et al. [3] tried to access impact of laser land levelling in rice-wheat cropping system of Northern India. Major outcomes of research revealed that laser land levelling reduced irrigation time in wheat and rice by 10-12 and 47-69 hours per hectare per season, respectively. Incremental productivity was observed due to use of laser land levelling (LLL) in rice-wheat was 7 per cent and 8.8 per cent, respectively. Study showed that laser land levelling (LLL) was a scale neutral technology. Also, it was experienced that due to reduction in irrigation time about 300 to 410 litres of diesel per hectare per year and 558 to 762 kilowatt hour of electricity per hectare per year was saved which ultimately decreased farmer's cost and environmental pollution. Laser land levelling provided annual USD 138 per hectare per year incremental benefits due to increased rice and wheat productivity. It was also estimated that even adopting laser land levelling (LLL) on 50 per cent of total area of Haryana and Punjab additional 987 million kg and 699 million kg of wheat and rice, respectively could be produced which could help in combating with food security issue. Also, there is continuous increase in area under paddy which is water intensive crop.Dominance of paddy- wheat crop rotation in the state has turned Haryana into a water scarce state from water surplus state. Hence, major focus of the study is to quantify economic impact of laser land levelling so that farmers may know its potential benefits and its adoption may be accelerated.

2. METHODOLOGY

2.1 Selection of Study Area

Study was focused in Karnal district of Haryana purposively because it has highest area under paddy-wheat cropping pattern relevant for quantifying economic impact of the study. Then, two blocks were selected at random and from each block 20 adopters and 10 non-adopters were selected at random. Thus, a total of 60 farmers were interviewed using pre tested interview schedule.

2.2 Collection of Data

The present study was based on primary as well as secondary data. To work out the cost and returns of laser land levelling practices in paddy-wheat and cotton-wheat cropping pattern in Karnal and Sirsa district of Haryana, data related to cost and returns component for crop year 2019-20 were collected by conducting personal interview from selected paddy-wheat and cotton-wheat growers on pretested interview schedule. Whereas, secondary data were collected from various published and unpublished sources i.e. Statistical Abstract of Haryana, Agricultural statistics at a glance etc.

2.3 Concepts Used

2.3.1 Family labour

It was computed with the help of prevailing wages at par with the hired labour for carrying

out different operations in cultivation of rice, wheat and cotton.

2.3.2 Seed

The cost of owned or purchased seed is computed by comparing with prevailing market prices.

2.3.3 Manures and fertilizers

Fertilizers as purchased from market so evaluated at market prices. But, farm yard manure can be of two types- produced at own farm or purchased from other fellow farmers. Farm yard manure purchased from fellow farmers was charged at prevailing market prices while produced at own farm then it is evaluated at local rates as told by respondents.

2.3.4 Plant protection chemicals

This includes cost of herbicides, pesticides, insecticides, nematodes etc. at prevailing market prices.

2.3.5 Interest on working capital

Interest rate was 7 per cent per annum (the rate at which nationalized banks provide short-term loans in the region) on the working capital *i.e.* cost measured on labour, seeds, manures, fertilizers, plant protection chemicals etc. The total was apportioned to the crop period.

2.3.6 Rental value of owned land

It was calculated at the prevailing rent of similar type of lands in the study area and apportioned to the crop period.

2.4 Variable Costs

Variable costs change with level of output. These include costs on seeds, manures, fertilizers, plant protection chemicals, irrigation charges, land revenues, miscellaneous expenses and wages of human labour, machine labour and animal labour.

2.5 Fixed Costs

Fixed cost doesn't change with level of output. These include costs on depreciation of implements, machinery, farm buildings, rental value of land and management charges.

2.6 Total Cost of Cultivation

It is computed by summation of total fixed costs and total variable costs.

2.6.1 Net returns

It is benefits left with farmer after deducting all costs. Net benefits = Total gross returns – Total Costs.

2.6.2 B-C Ratio

It is returns per unit of Rupee spent as cost. It is ratio of total gross returns to total costs.

2.6.3 Laser land levelling

It islevelling of field using a laser guided scraper up to optimum degree of slope throughout the field.

2.6.4 Cost of production

It is cost per unit of output produced. It is of two types: COP with by product and COP without by product. In case of COP without by product we deduct returns from by product from total costs.

2.6.5 Risk and management charges

Risk factor and management were incorporated in the study and calculated by taking 10 % of Total variable cost.

3. RESULTS AND DISCUSSION

3.1 Cost of Wheat Cultivation in Karnal District under LLL vis-à-vis CLL

Per hectare total cost of wheat cultivation under laser land levelling (Rs 95037.11) were obtained to be lower compared to conventional land levelling (Rs 98666.61). Variable and fixed cost contributed 36.51 (Rs 34693.95/ha) and 63.49 (Rs 60343.16/ha) of total cost, respectively under laser land levelling. Principle component of variable cost in decreasing order were fertilizer, straw making, irrigation and pesticide cost contributing 5.31, 4.67, 3.72 and 3.24 per cent to total cost, respectively. Major component of fixed cost in decreasing order were found to be rental value of land, management charge and risk factor contributing 54.77, 3.65 to total cost, respectively.

Under conventional land levelling, variable and fixed cost contributed 37.03(Rs 36537.80/ha) and 62.97(Rs 62128.81/ha) of total cost, respectively. Principle component of variable cost in decreasing order were observed to be fertilizer, straw making, irrigation and pesticide cost contributing 5.32, 4.62, 4.16 and 3.21 to total cost, respectively. Major component of fixed cost in decreasing order were found to be rental value of land, management charge and risk factor contributing 62.97, 3.70 to total cost, respectively in wheat cultivation in the study area (Table 1). Findings of Naresh et al. [4], Jat et al. [5], Bhatt et al. [6] and Aryal et al. [7].

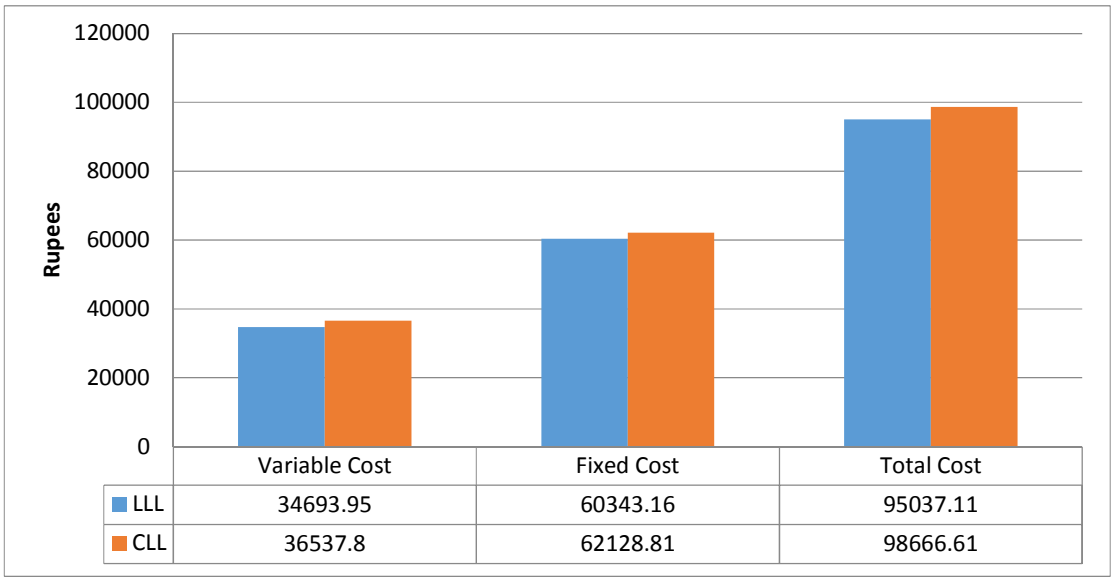

Fig. 1. Cost of Wheat cultivation under LLL and CLL in Karnal District of Haryana

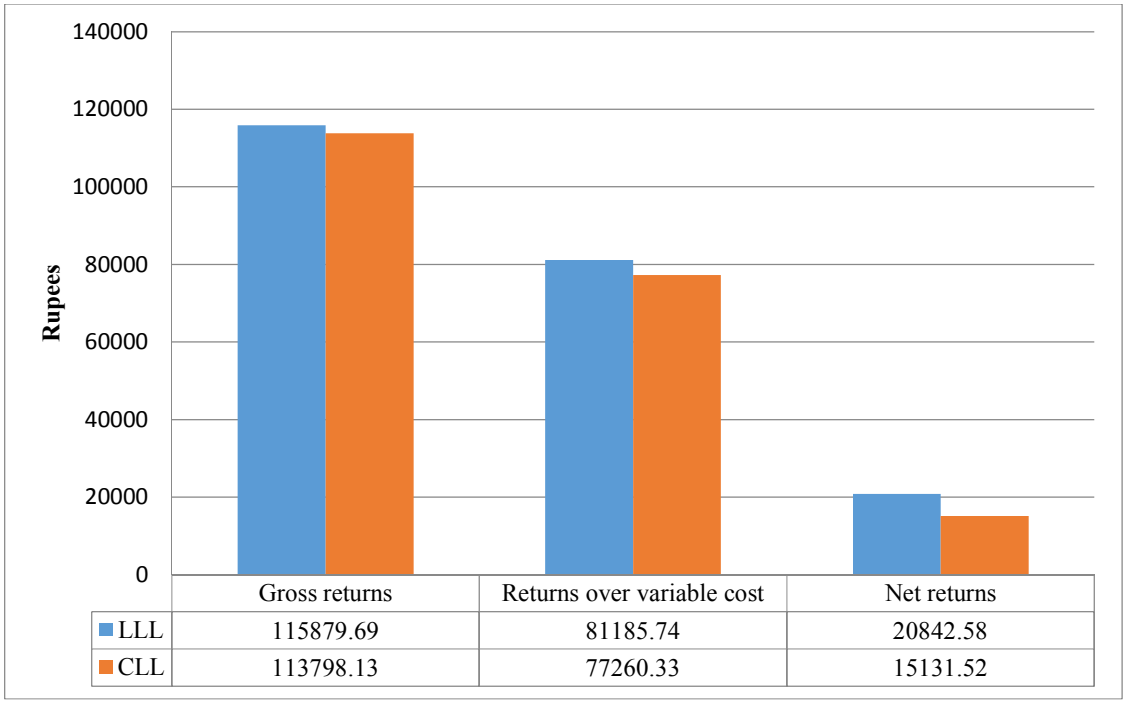

Fig. 2. Returns from wheat cultivation under LLL and CLL in Karnal district of Haryana

Table 1. Cost of wheat cultivation in Karnal district of Haryana

Sr.No.	Inputs	Laser Levelling			Conventional Levelling		
		No./Qty (ha)	Value (Rs/ha)	Per cent	No./Qty (ha)	Value (Rs/ha)	Per cent
1. (a)	Harrowing	2	1858.13	1.96	2.1	1903.75	1.93
(b)	Ploughing	2.2	1853.13	1.95	2.2	1907.50	1.93
(c)	Rotavator	1	2339.69	2.46	1.1	2405.00	2.44
2	Pre-sowing Irrigation		1054.69	1.11		1182.50	1.20
3	Seed (kg)	105.96	2241.88	2.36	110.44	2399.38	2.43
4	Seed Treatment		159.06	0.17		163.75	0.17
5	Sowing		1987.50	2.09		2048.75	2.08
6	Ridging		292.50	0.31		300.00	0.30
7	FYM (qtls)	13.56	491.56	0.52	14.28	510.00	0.52
8	Fertilizer Nutrients						
(a)	Urea (Kg)	345.58	2032.81	2.14	365.81	2151.88	2.18
(b)	DAP (Kg)	113.78	2275.63	2.39	116.72	2334.38	2.37
(c)	Potash (Kg)	22.85	326.56	0.34	23.8	339.38	0.34
(d)	Zinc Sulphate (Kg)	12.83	414.06	0.44	13.02	420.00	0.43
	Total	495.04	5049.06	5.31	519.35	5245.63	5.32
9	Fertilizer Application cost		476.88	0.50		481.25	0.49
10	Irrigation	4.1	3538.31	3.72	4.3	4103.75	4.16
11	Hoeing/ Weeding						
(a)	Chemical		2039.06	2.15		2232.50	2.26
(b)	Manual		0.00	0.00		0.00	0.00
12	Pesticide cost		1145.31	1.21		1170.63	1.19
13	Pesticides application cost		976.25	1.03		1013.13	1.03
14	Harvesting		3080.31	3.24		3164.38	3.21
15	Straw making		4440.63	4.67		4558.13	4.62
16	Miscellaneous		335.63	0.35		342.50	0.35
17	Total (1 to 16)		**33359.56**	**35.10**		**35132.50**	**35.61**
18	Interest on working capital @7%		1334.38	1.40		1405.30	1.42
19	Variable cost		**34693.95**	**36.51**		**36537.80**	**37.03**
20	Transportation		1355.00	1.43		1401.25	1.42
21	Management charges @10%		3469.39	3.65		3653.78	3.70
22	Risk factor @ 10%		3469.39	3.65		3653.78	3.70
23	Rental value of land		52049.38	54.77		53420.00	54.14

Table 2. Returns from wheat cultivation in Karnal district of Haryana

Sr.No.	Inputs	Laser levelling		Conventional levelling	
		No./Qty (ha)	Value (Rs/ha)	No./Qty (ha)	Value (Rs/ha
1	Production (qtls.)				
	(a) Main	56.33	105717.50	53.72	103368.75
	(b) By Product		10162.19		10429.38
2	Gross return (Rs)		115879.69		113798.13
3	Return over variable cost (Rs)		81185.74		77260.33
4	Net return (Rs)		20842.58		15131.52
5	B:C ratio		1.18		1.15
6	Cost of production without by product (Rs/q)		1730.52		1837.43
7	Cost of production with by product (Rs/q)		1545.48		1643.21

3.2 Returns from Wheat Cultivation in Karnal District under LLL vis-à-vis CLL

Returns from wheat cultivation in Karnal district of Haryana are presented in Table 2. The results of the study exhibited that per hectare wheat yield were obtained 56.33 and 53.72 quintals under laser land levelling and conventional land levelling, respectively. Gross returns under laser land levelling (Rs 115879.69/ha) were estimated to be higher in comparison to returns from conventional land levelling of wheat (Rs 113798.13/ha). Net returns under laser land levelling (Rs 20842.58/ha) were also found to be higher compared to net returns under conventional land levelling of wheat (Rs 15131.52/ha). Benefit cost ratio of wheat under LLL and CLL was 1.18 and 1.15 respectively indicating laser land levelling is economically beneficial in cultivation of wheat in the study area. Similar results were found by Ahmad et al. [8], Latif et al. [9], Naresh et al. [10], Thakar et al. [11] and Kaur et al. [12].

3.3 Cost of Paddy Cultivation in Karnal District under LLL vis-à-vis CLL

Costs of paddy cultivation in Karnal district of Haryana are presented in Table 3.The results of the indicated that per hectare total cost of paddy cultivation under laser land levelling (Rs 125391.54) were found to be lower than cost under conventional land levelling (Rs 126917.92). In case of laser land levelling, variable as well as fixed cost contributed 43.97 (Rs 55138.79/ha) and 56.03 (Rs 70252.76/ha) per cent of total cost, respectively. Principle component of variable cost in decreasing order were found to be harvesting, fertilizer, pesticide and transplanting contributing 9.80, 7.50, 5.28 and 4.93 to total cost, respectively. Major component of fixed cost in decreasing order were obtained rental value of land, management charge and risk factor contributing 46.08, 4.40 to total cost, respectively.

Similarly, in case of conventional land levelling, variable and fixed cost contributed 44.38 (Rs 56331.60/ha) and 55.62 (Rs 70586.32/ha) per cent of total cost, respectively. Principle component of variable cost in decreasing order were found to be harvesting, fertilizer, pesticide and transplanting contributing 9.69, 8.37, 5.43 and 4.87 per cent to total cost, respectively. Major component of fixed cost in decreasing order were rental value of land, management charge and risk factor contributing 30.09, 5.75 per cent to total cost , respectively in the study area. Similar findings were revealed by studies of Abdullaev et al. [13], Hosseini et al. [14], Jat et al. [15], Jat et al. [16], Singh T. [27] and Sindhu et al. [18].

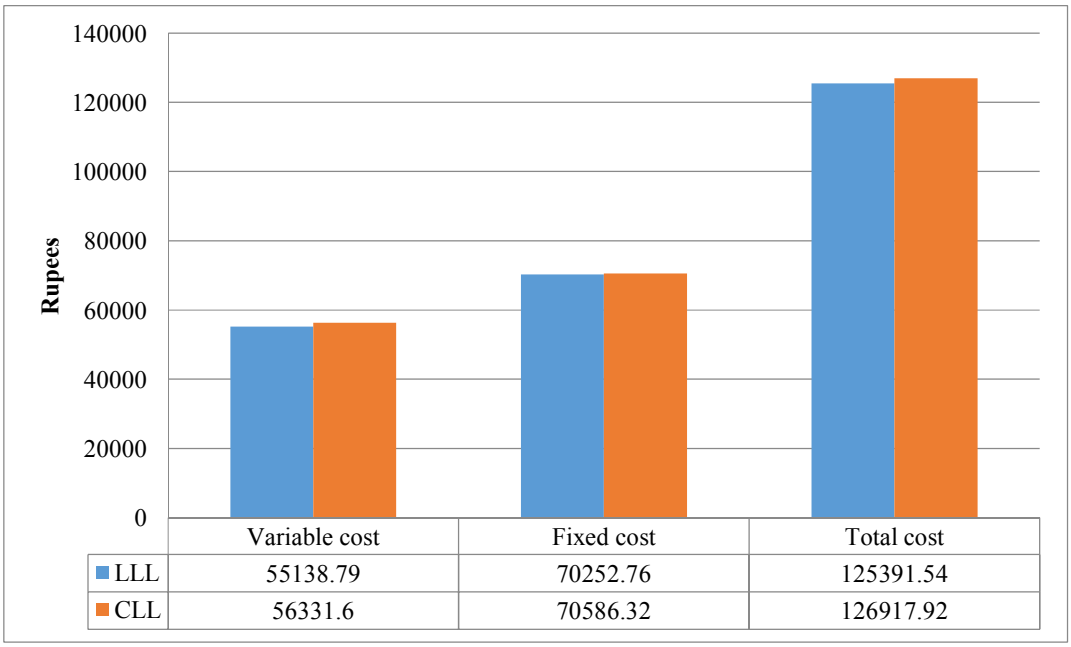

Fig. 3. Cost of paddy cultivation under LLL and CLL in Karnal district of Haryana

Table 3. Cost of paddy cultivation in Karnal district of Haryana

Sr. No.	Inputs	Laser Levelling			Conventional Levelling		
		No./Qty (ha)	Value (Rs/ha)	Per cent	No./Qty (ha)	Value (Rs/ha)	Per cent
1.(a)	LLL/CLL	1	2329.06	1.86	1	1407.50	1.11
(b)	Harrowing	1.8	1900.00	1.52	1.9	1996.25	1.49
(c)	Ploughing	1	931.25	0.74	1.2	938.13	0.74
(d)	Rotavator	1.1	2373.75	1.89	1.1	2378.13	1.87
2	Pre-sowing Irrigation		1040.63	0.83		1129.38	0.89
3	Seed (kg)	14.64	1910.50	1.52	15.24	1990.63	1.57
4	Seed Treatment		207.50	0.17		206.88	0.16
5	Transplanting		6177.19	4.93		6181.88	4.87
6	Ridging		352.50	0.28		353.13	0.28
7	FYM (qtls)	18.7	668.13	0.53	18.72	668.75	0.53
8	Fertilizer Nutrients						
(a)	Urea (Kg)	285.37	1678.63	1.34	322.25	1895.63	1.49
(b)	DAP (Kg)	66.36	1327.19	1.06	72.03	1440.63	1.14
(c)	Potash (Kg)	41.34	590.63	0.47	41.5	593.75	0.47
(d)	Zinc Sulphate (Kg)	18.54	598.13	0.48	18.4	597.50	0.47
	Total	411.61	4194.56	3.35	454.18	4527.50	3.57
9	Fertilizer Application cost		543.13	0.43		545.63	0.43
10	Irrigation	9.2	9403.94	7.50	10.6	10623.75	8.37
11	Hoeing/ Weeding						
(a)	Chemical		521.56	0.42		590.00	0.46
(b)	Manual		0.00	0.00		0.00	0.00
12	Pesticide cost		6625.94	5.28		6885.63	5.43
13	Pesticides application cost		1212.81	0.97		1207.50	0.95
14	Harvesting		12293.44	9.80		12303.75	9.69
15	Miscellaneous		332.19	0.26		330.63	0.26
16	Total (1 to 15)		**53018.06**	**42.28**		**54165.00**	**42.68**
17	Interest on working capital @7%		2120.72	1.69		2166.60	1.71
18	Variable cost		**55138.79**	**43.97**		**56331.60**	**44.38**
19	Transportation		1441.25	1.15		1439.38	1.13
20	Mgt. charges @10%		5513.88	4.40		5633.16	4.44
21	Risk factor @ 10%		5513.88	4.40		5633.16	4.44
22	Rental value of land		57783.75	46.08		57880.63	45.60
23	Total Fixed cost		70252.76	56.03		70586.32	55.62
24	Total cost		**125391.5**	**100.00**		**126917.9**	**100.00**

LLL = Laser land levelling, CLL = Convectional land leveling

Table 4. Returns from paddy cultivation in Karnal district of Haryana

Sr.No.	Inputs	Laser Levelling		Conventional levelling	
		No./Qty (ha)	Value (Rs/ha)	No./Qty (ha)	Value (Rs/ha)
1	Production (qtls.)				
	(a) Main	44.68	150571.25	42.54	143330.63
	(b) By Product		4908.75		4896.88
2	Gross return (Rs)		**155480.00**		**148227.50**
3	Return over variable cost (Rs)		100341.22		91895.90
4	Net return (Rs)		**30088.46**		**21309.58**
5	B:C ratio		**1.24**		**1.17**
6	Cost of production without by product (Rs/q)		2789.79		2966.39
7	Cost of production with by product (Rs/q)		2680.57		2851.94

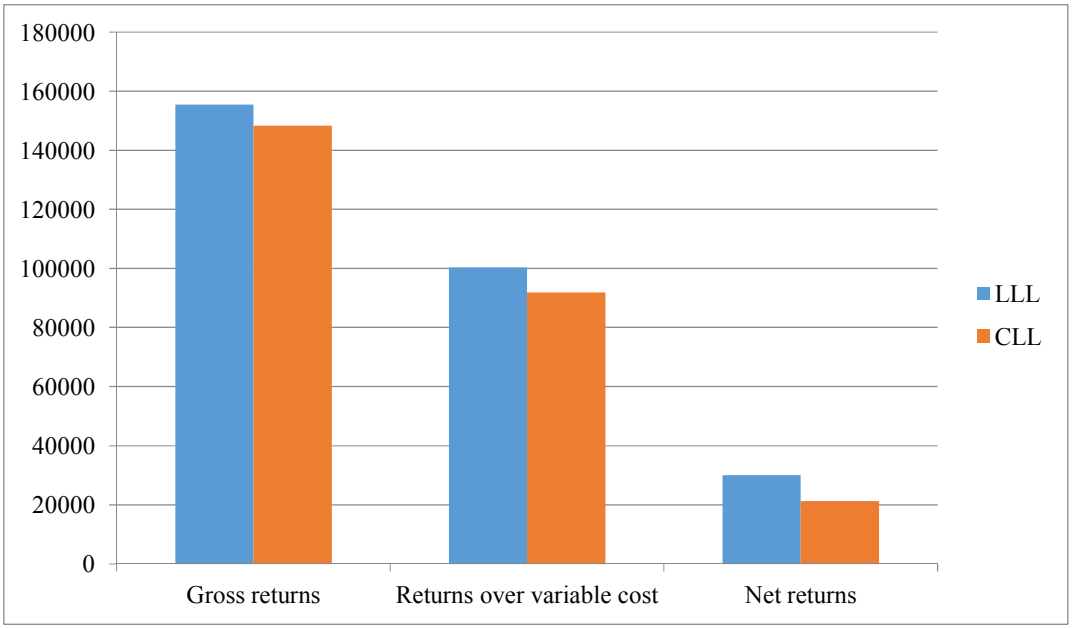

Fig. 4. Returns from paddy cultivation under LLL and CLL in Karnal district of Haryana

3.4 Returns from Paddy Cultivation in Karnal District under LLL vis-à-vis CLL

Returns from paddy cultivation in Karnal district of Haryana are presented in Table 4. Results of the table exhibited that per hectare yield of paddy cultivation under LLL and CLL were obtained to be 44.68 and 42.54 quintals, respectively. Gross returns under laser land levelling (Rs 155480.00/ha) were found to be higher than returns of paddy cultivation under conventional land levelling (Rs 148227.50/ha). Net returns under LLL (Rs 30088.46) were also found to be higher than net returns under CLL (Rs 21309.58). Benefit cost ratio of paddy cultivation under LLL and CLL was 1.24 and 1.17 respectively exhibiting that it is more profitable to grow paddy under LLL than under CLL in the study area. Results were confirmed by the studies of Naresh et al. [19], Rickman et al. [20], Begam et al. [21], Ali et al. [22] and Aggarwal et al. [23].

4. CONCLUSIONS

It can be concluded from results of the study that laser land levelling is an effective resource conservation technology to conserve scarce inputs and increase profitability. It was found that total cost of cultivation was lowered under LLL and net benefits, benefit cost ratio were improved under laser land levelling as compared to conventional land levelling. Reduction in seed rate shows that LLL helps in better germination. Also, irrigation and fertilizer were found to be reduced significantly under LLL. Karnal district was selected purposively because LLL has major impact on irrigation use efficiency and major cropping pattern in Karnal is paddy-wheat which incorporate water thirsty crops suitable for the study. Hence, it proves that irrigation is prerequisite for tapping potential benefits of LLL. Thus,LLL is an efficient resource conservation technology which can solve problem of low water use efficiency in case of irrigated areas. Also, it wasexamined that laser land levelling is a scale neutral technology, not biased towards large farmers and adopted by all categories of farmers. Therefore, study recommended to encourage farmers to adopt this ultimate technology specifically in irrigated belt of the state and government should provide financial assistance in form of subsidy to increase its accessibility during peak season.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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