



RESEARCH ARTICLE

IMPACT OF LASER LEVELING IN PEARL MILLETS: A CASE STUDY OF MEWAT  
DISTRICT OF HARYANA

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ABSTRACT

Water is a key factor in increasing agricultural production; its increasing scarcity has resulted into the emergence of various innovative and efficient water management techniques. The present study has been undertaken to assess the impact of laser leveling in crop cultivation for Mewat district of Haryana state. The study is based on the primary data collected from 16 farmers of 7 villages of Mewat selected under NAIP project. The selected farmers cultivated pearl millet in the fields where LLL was applied. It has been observed that laser leveling saves 32.18 percent of water in irrigation and decreases weed occurrence of about 27.81 percent. Pearl millets yield increased by 52.77 percent and net profit increased by 141.57 per cent. So laser leveling was found very effective in water conservation as well as increasing the crop productivity. The major constraint in the adoption of this technology is huge investment on laser leveler, so collective effort or custom hiring can help in this regards.

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INTRODUCTION

To increase productivity of crops, various types of efforts have been made by the farmers and agricultural researchers from time to time. It cannot be denied that productivity has augmented for most of the crops with the help of high yielding varieties, seeds, fertilizers, pesticides, machinery and research & development (R&D). But for sustainable agriculture the need is to increase the agricultural crops productivity as well conservation of natural resources including water saving, controlled use of fertilizers and pesticides. India would need more 37 per cent wheat and rice by 2025 with less irrigation availability from 9 per cent to 7 percent (Jat, et al., 2000) Shrinking water resources owing to over exploitation of ground water threatens the maintenance of agricultural productivity. As a result, the water table is falling. To arrest this dangerous trend of ground water exploitation, there is an urgent need to conserve irrigation water through various on-farm water conservation practices. Land leveling through Laser Levelers is one such proven technology that is highly useful in conservation of irrigation water.

Precision land leveling may increase the water application efficiency and consequently increase the yield of crops (Ahmed et al., 2001) for meeting the increasing food demand. In Haryana State of India, agriculture is practiced on nearly 80 percent of the state's total geographical area accounting for 4.42 million hectares. Haryana is the second largest contributor of food grains with 18.34 MT during 2011-12 to the national food basket. But in this developed state, Mewat district is a district where agriculture production measured in terms of crop yield per hectare is comparatively low. Mewat has distinct topographic features with flat alluvial plains over most of the region, with long and narrow piedmonts and local undulations caused by windblown sands at the foot hill zones and over much of the plains. The main source of the irrigation in the district is tube-well which constitute 98% of the total irrigated area. But the desperate use of underground water has depleted the ground water to the level of over-exploited category. The soils of the area are generally sandy loam to loam. In parts of the low lying areas, they are clayey and saline. The quality of ground water over 75% of the area is poor (brackish) and unsuitable for irrigation. Due to increased pumping of fresh ground water, aquifer levels are falling at an average rate of 0.35 m per year. The most common type of irrigation is hallowing tube wells built and operated by farmers themselves.

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**Table 1. Socio-Economic Features of Sample Household**

Particulars	Par cent
Average Age of male head of family	53.2
Education of male Head of family (Years)	7.5
Age of head of female in the family	50.5
Average Education of female head of family (Years)	2.3
Size of family	5.8
Family income Rs (annually)	217187.5

**Table 2. Land holding pattern before and after use of lesser Levelling**

Particulars	Use of laser levelling		Difference
	Before	After	
Average land holding Household (acres)	5.19	5.19	0
Average Irrigated area (acres)	4.93	5.19	-0.25
Gross cultivated area	9.4375	11.3125	1.875
Spread of Irrigation Area	67.8125	100	32.1875
Crop establishment before	70.31	100	29.69
Irrigation cost	1240.625	923.75	316.875
Occurrence of weed (per cent)	35.3125	7.5	27.8125

**Table 3. Comparative economic analysis of crop cultivation (pearl millet) in conventional v/s laser levelled farms in Mewat**

Particulars	Particulars	Laser level	Conventional	Difference
Land Preparation	Ploughing / Laser levelling	1256	534	722
Seed	Sowing	303	303	0
	Seed cost	322	322	0
	Seed treatment cost	56	0	56
Fertilizers	FYM Cost	325	325	0
	DAP Kg	675	675	0
	Urea ( Kg)	232	232	0
	Zinc (Kg)	90	90	0
Irrigation	Electric motor / diesel	924	1240	-316
Weed control	Manual weeding	80	560	-480
Harvesting	Manual	1040	1040	0
Thresher	Power thresher	394	394	0
	Manual	1040	1040	0
Transportation	Market / Village	245	245	0
Total Cost of Cultivation		5960	5942	18
Output	Main in q /acre	7.15	4.68	2.47
	By product q/ acre	24.37	16.93	7.44
	Main product value in (Rs)	8278	5556	2722
	By product value (Rs)	4875	3387	1488
Gross return in (Rs)		13153	8943	4210
Net return in (Rs)		7211	2985	4226

**Table 4. Cropping Pattern**

S. No.	Crop Rotation Before laser levelling	Crop Rotation After laserlevelling
1.	Pearl millets- Mustard - Kasni crop rotation followed by 15farmers	Gauwar- wheat- moong crop rotation followed by 16farmers
2.	Pearl millets - Mustard - green gram crop rotation followed by 15 farmers	Sesame - Mustard - Kasni crop rotation followed by 16 farmers
3.	Pearl millets- Mustard , Gaur - Wheat crop rotation followed by 1 farmers	

**Table 5. Benefits of Laser Levelling in Pearl millet cultivation of Sample Farmers in Haryana**

Particulars	Conventional field	Laser levelled field	Gain	t-statistic
Reduction in irrigation cost (Rs)	1240.62	923.75	316.87	26.88*
Occurrence of weed (%)	35.31	7.5	27.81	15.75*
Gross income (Rs)	8943	13153	4210	-13.11*

Therefore, the laser leveling intervention was introduced for the precision leveling of field so as to save precious irrigation water and leaching of salt by rainwater after leveling and bundling of the fields.

## Review and literature

Laser levelling of agricultural land is a resource conservation

technology which saves irrigation water, nutrients and agro-chemicals. It also enhances environmental quality and crop yields, (M.L. Jat, *et al.*, 2006). The study at farmers' fields, research stations and demo field shows that on an average laser land levelling saves 30% irrigation water, improves yields by 17%, saving in operational time of farm machinery, and increase in net sown area due to removal of bunds and

channels (post levelling increased plot size for irrigation) in different cropping systems of Haryana. RCTs provide a wide array of benefits, including higher yields, lower production costs; improved water and fertilizer use efficiency, better control of pests and diseases, and reduced greenhouse gas emissions (see Azeem Khan *et al.*, 2002, Mehta and Randhir Singh 2002, Sidhu 2003, and Zubair Anwar *et al.*, 2002). In the face of increasing competition for water from industrial and domestic users, concerns are being raised about the productivity of water used in agriculture. Negative environmental effects related to irrigation are also increasing as overexploitation of groundwater and poor water management lead to dropping water tables in some areas and increased water logging and salinity in others to arrest this dangerous trend of ground water exploitation, there is an urgent need to conserve irrigation water through various on-farm water conservation practices. Land Levelling through Laser leveler is one such proven technology that is highly useful in conservation of irrigation water.

At present task of policy maker's review of the studies shows that investment cost, water savings, fuel prices, yield benefits and the planning horizon also effect investment profitability with laser levelling technique. Again, the study of (Jat *et al.*, 2006) indicates that Laser-assisted precision land levelling "Precision land levelling with laser leveller is a recent resource conservation technology and has been proven to save water and energy to the extent of 25 per cent, and increase in paddy yield by 4 per cent over the conventional method. The incremental per hectare increase in gross margins of the technology adopters has been to the tune of Rs 3244/ha. The adoption of this technology has reduced irrigation cost by ₹720/ ha which is about 44 per cent over the conventional practice.

The water productivity on laser-levelled fields has been found to be higher by about 39 per cent over the conventional field. Evenly distributed irrigation water on laser-levelled field could reduce the emergence of weeds in the paddy field which has further reduced the cost of using weedicides by about 13 per cent over the farmers' practice. Hence, this technology has a great potential for optimizing the water-use efficiency in paddy cultivation without any disturbing and harmful effect on the productivity of paddy crop", (Baljinder Kaur *et al.*). Laser levelling also saves the fossil fuel by various agriculture activities, study reported that two million hectare levelled land has saved the diesel consumption up to 200 million litres and hence reduces the green houses gasses emission up to 500 million kg, (Rickman 2002). Furthermore, fertilizers and pesticide are less effective in the undulated land, because of fertilizers and pesticide washed out from higher level to lower level with irrigation as well raining season. of laser-assisted precision land levelling system to just two million hectares of area under rice-wheat system could save 1.5 M ha-m of irrigation water and save diesel up to 200 million litres (valued at US \$1400million), and improve crop yields amounting to US\$. 500 million in three years and reduce green houses gases (GHG) emissions equivalent to 500 million kg. Laser-assisted precision land levelling system is also likely to enhance the cultivable area in the range of 3-6 per cent (due to reduction in bunds and channels in the field). Furthermore, on laser-levelled

fields, the performance of different crop establishment options such as of zero tillage, raised bed planting, and surface seeding are known to improve significantly (Jat *et al.*, 2006). Laser levelling in rice field brings down the water-use by 36.19 cm along with the yield improvement of 0.78 t/ha. Further, by adoption of this technology the Punjab state could achieve 0.99 M ha-m (million hectare metre) water saving and can save 583.51 million kilo watt hour of electricity (Sidhu *et al.*, 2010). Effective land levelling is meant to optimize water use efficiency, improve crop establishment, reduce irrigation time and effort required to manage the crop. Research conducted at PAU, Ludhiana has shown that proper field levelling increased crop yield by 24 percent and reduced weed problems up to 40 per cent (Rickman, 2002).

Our current paper is based on laser levelling and its impact on agricultural crop productivity. How this technique is helpful for farmer as well conservation of natural resources. At present, Haryana counts as developed state; per capita income was Rs94680.00 in 2010-2011. The total population of Mewat according to the 2001 Census was 9, 93,617 of which 4.64% was urban and 95.36% was rural. The average household size in rural Mewat was 7 people per family. The Meows (Muslims) is the predominant population group and is virtually completely agriculturist. The agriculture in Mewat is mostly rain fed except in small pockets where canal irrigation is available. What are the reasons, why behind the less growth rate of the Mewat district compared to other districts of Haryana? It was found that under developed agricultural and industries are there in Mewat district. Again, question arises why agriculture is underdeveloped in Mewat, while the Haryana is one of the agricultural developed states of India. It is important to mention that there is undulated land as well as low quality water availability for irrigation in the Mewat district. Mewat farmers have not enough money to carry out the laser levelling in their fields for convert their undulated land to plain and levelled land. So government introduced the laser level technique at selected village through NAIP project for solve the problem of undulated land. Finally our study is conducted in the seven village of Mewat district of Haryana.

### Objectives

- To examine and analyses the socio-economic conditions of the sample households.
- To assess the impact of laser levelling technology on agricultural productivity and resource conservation.
- To assess the impact of laser levelling on the rural household economy.

### MATERIALS AND METHODS

To conduct the study we collected the sample of 16 households using the laser level technique in their fields, survey was done in 7 villages (Mubarakapur, Khedla, Ranika, GumatBihari, Mandikhera, Jhimrawat and Mohalka) of Mewat district selected where laser levelling intervention was provided to 16 farmer. The data were collected on well-structured schedules through personal interviews. For getting the results we used the simple percentage and average method.

For access the impact of laser level on gross income, irrigation and weed occurrence we used the paired sample t-test.

## RESULTS AND DISCUSSION

### How to calculate weed occurrences

It is noticed that the average land holding was same in under conventional as well leaser level, the figure stand is 5.19 acres. It is important to mention that the area under irrigation has risen from 67.81 per cent to 100 per cent; the miracle change possible is with the help of laser level, without the level of land it was difficult to attain the 100 per cent irrigation spread. Productivity was also less where the plant was unable to get irrigation. Moreover, it is not unimportant to mention that cost of irrigation has been also reduced, and saving observed Rs 316.8 per acre. In other words, the saving of irrigation is 32.18 per cent after using the laser levelling technique. At the same time, results shows that the weed occurrence has been reduced from 35.31 per cent to 7.5 per cent due to proper irrigation.

Comparative Economic Analysis of Crop Cultivation of pearl millet in Conventional and Laser Leveled Farms revealed that there is not much difference in cost of cultivation in both of techniques, because of the rented cost of laser level also include, but the productivity of crop pearl millet and by-product has increased from 4.68 quintal to 7.15 quintal and 16.93 quintal to 24.37 quintal respectively due to an appropriate irrigation availability to even single plant of crop with the laser level. Obviously, if increased the output, gross return will also increase, observed statics shows that gross return was Rs8943 before level of land and Rs 13153 after leveled the land. It is noticed that at an irrigation time as well raining time the fertilizers washed out from higher level to lower level also reduced the productivity in conventional field.

Table 4 shows that crop rotation is also possible with the laser level; it is observed that Pearl millets, Mustard and kasni area converted under Gauwar, wheat and green gram by selected sample laser level households. No doubt the level land is necessary for every crop but some of the crops are more sensitive, like wheat, green gram to need balanced irrigation. It is noticed that more need of irrigation for the crops on undulated land because farmers want to cover up the higher level part of land as resulted more than required inundated at lower level part of land, again as resulted that lower place stands crop damaged, on the other hand side if farmers do not cover the higher level part of land then this part become the drought effected. Another harmful impact of uneven land is noticed that in the raining season water departs from higher level to lower level as a result lower level crops are damaged with water logging. So, level land is essential to crops for the proper irrigation and growth.

The results of the t-test (Table 5) indicate t-statistic as 26.884 with 19 degree of freedom. The two tail t test p-value is 0.000, which is less than the conventional method at of 1% significance level, meaning that the average cost of irrigation has changed after using the Laser Levelling. The value is positive, which means that with the use of Laser leveler, the cost of irrigation has decreased. In case of occurrence of weed,

the t-test shows t-statistic as 15.750 with 15 degree of freedom. The two tail test p-value is 0.000, which is less than the conventional of 1% significance level, It means that the occurrence of weed has changed after applied the Laser level the significant reduction in occurrence of weeds has been recorded. Moreover, in case of income, table shows that the two tails tailed p-value is 0.000, this is highly significant, it means the income of the farmers has changed after using the Laser Levelers. Gain in income (Rs 4210/acre) is highly significant, in other words, incomes of farmers have increased by more than four thousand per acre by adopting Laser Levelling.

### Conclusion

Study found some important findings which are beneficial for increasing productivity of crops to meet the increases demands of food along with conservation of natural resources. Briefly, results show that the average land holding was 5.19 acres before and after application of laser level technique. Area under irrigation has enhanced from 67.81 per cent to 100 per cent. Moreover, saving of irrigation cost is observed Rs 316.8 per acre. At the same time, results shows that the weed occurrence has been reduced from 35.31 per cent to 7.5 per cent due to proper irrigation. Again, pearl millets, mustard and kasni area converted under Gauwar, wheat and green gram by selected sample laser level households. In an overall sense we can say's that added advantages of using laser levelling are Optimization of water use efficiency, Better crop establishment, less time and water required in irrigation, less effort in crop management, less weed problems, uniformity in crop maturity, time efficiency in completion of task, easy land preparation, reduced chemicals and fuel cost and consumption, increase in farming area, assist top soil management, saves fuel / electricity used in irrigation, more uniform moisture environment for crops, Good germination rate of crops, better growth of crop and Improved field traffic ability for the subsequent field operations.

At the same time few constraints were noticed. Laser level technique is very costly for the marginal and small farmers, also observed that even out of range for some of the medium farmer to combat it government should provide the laser level technique to farmers at nominal rent through co-operative societies, agriculture departments. Farmers also need to be trained to operator, set/adjust laser level using it on filed in a way fields are made more efficient for use. Again, the maximum area of the farm land should be covered under the laser level technique.

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