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Comparative Economic Analysis of Laser Land Leveling and Conventional Land Leveling on Wheat Crop in Sindh, Pakistan

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Abstract.
Present study was designed to compare of laser land leveling technology with conventional land leveling method on wheat crop. Compared with conventional method overall cost of wheat by laser leveling technology was high, due to highest land leveling cost. Overall high yield was obtained 45mds/acre by using laser leveling technology compared with conventional method of sowing as 38mds/acre. Due to uniform irrigation and fertilizer application with laser leveling technology total revenue of wheat production was received by the laser leveling technology growers Rs. 46260Rs/acre and conventional grower's 39178Rs/acre. Study results further indicate that by using laser leveling technology wheat growers obtained higher gross margin 23250 Rs/acre, as compared to conventional growers 17576 Rs/acre. About 21 percent of irrigation was saved by the adoption of laser leveling technology, to survive in water shortage problem and utilize this saved water to increase operational holding.

Introduction

Wheat is a leading food grain of Pakistan and being the staple diet of the people and occupies a central position in Agricultural policies. Wheat contributes 10.3 percent to value added in Agriculture and 2.2 percent to GDP, the area under wheat crop was 9039 thousand hectares and the production was 25.3 million tones (Economic Survey of Pakistan 2013). Greater importance of bread wheat can be expected as a main source of food for solving the increasing population's emergency of the world. In arid and semiarid regions with Mediterranean climate, wheat crops usually encounter drought during the grain filling period.

Traditional methods of land leveling are, time consuming and expensive, so more and more farmers are turning to modern methods to level the land. Laser leveling is a process of smoothing the land surface (± 2 cm) from its average elevation using laser-equipped drag buckets. This technique is well known for achieving higher levels of accuracy in land leveling and offers great potential for water savings and higher grain yields (Jat M. L., 2006). Effective land leveling reduces the work involved with crop establishment and crop management. It increases yield, improves uniformity of crop maturity and reduces weeds and the amount of water needed for land preparation. Laser land leveling when applied under various crops and cropping patterns has resulted in water savings up to 15-30% (conserveagri.org, 2009). Deficit irrigation is a way for maximizing water use efficiency, it means obtaining higher yields per unit of irrigation water applied. The crops are exposed to a certain level of water stress either during a particular period or throughout the whole growing season. The expectation is that any yield reduction will be insignificant compared with the benefits gained through diverting the saved water to irrigate other crops (Kirda, 2000).

Nearly 50 percent of the total available irrigation water is lost in transit in tertiary level irrigation system and at the farm during application to crops (Gill, 1998). A significant amount of irrigation water is wasted due to undulated fields and due to field ditches.

Effective land leveling 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 leveling increased crop yield by 24 per cent and reduced weed problems up to 40 per cent (Rickman, 2002).

Laser leveling of agricultural land is a recent resource conservation technology in India. Its results are quite encouraging. Precision land leveling may increase the water application efficiency and consequently increase the yield of crops (Ahmed etal., 2001).

Laser-assisted precision land leveling 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 leveling farmers could save irrigation water and energy by 24 percent and obtained 4.25 per cent

higher yields. The irrigation cost reduced by 44 per cent over the conventional practice, and water productivity improved by 39 per cent (Kaur B et al., 2012).

The crop productivity of the country is very low as majority of the farmers are still practicing traditional farming techniques. Moreover, cost of production has increased many times due to rising prices of fuel and other agricultural inputs. The existing crop production technologies do not offer effective and efficient utilization of natural resources, particularly that of water. Extremely low efficiency of input use has led to wastage and depletion of natural resources besides environmental degradation (Hobbs, et al. 1997).

Effective land leveling is meant to optimize water-use efficiency, improve crop establishment, reduce the irrigation time and effort required to manage crop. The Manual for Laser Land Leveling seeks to explain the benefits of land leveling in fields, particularly rice fields, and help develop skills of farmers and operators in using laser technology to achieve a level field surface. It is also intended to enable the users to identify and understand the working of the various components of a laser-controlled land leveling system; undertake a topographic survey using a laser system; set up and use a laser-controlled leveling system and troubleshoot a laser-controlled leveling system. It is hoped that the users (farmers and service providers) will find this manual useful in adopting this important resource conserving technology as a precursor to several other improved agronomic, soil and crop management practices. Laser technology can ensure very accurate and precision land leveling to extent of +2 cm (Waker, 1998).

Laser leveling was adopting last few years by some growers in Sindh. However, necessary data to support its effects on crop yield and water use efficiency are scarce. It was therefore, felt imperative need to compare the effect of laser and traditional land leveling technologies on wheat productivity in wheat system of Sindh.

Objectives

The specific objectives of study were:

To compare economic analysis of laser leveling technology and conventional land leveling of wheat crop in Sindh.

To assess input costs, fertilizer use efficiency, weed control and crop yields.

To develop a set of policy measures and program initiatives to enhance the laser land leveling technology in Sindh.

Methodology

The study was conducted through primary data collection from growers of Wheat cropping zone in Sindh. The methodology includes data source, study area, data collection and data analysis procedure. Finally, it ends up with the farm cost calculation of crop production.

Data Source

The data source of this study consists of primary sources. The primary data was collected from wheat growers through the well structured pre-tested questionnaire. Data was collected during the crop year 2012-13. With the questionnaire of growers, information was collected about the impact of laser leveler on water use efficiency and crop production.

Study Area

The research work was conducted in two major districts of wheat cropping zone of Sindh i.e. Mirpurkhas and Tando Allahyar. The selection of growers has been carried out based on the criteria that they had used laser leveler technology on their farm.

Data analysis

After completion of field work, the data were edited and transferred from the questionnaires into worksheet as a database file. The variable names within the database base refer to the numbers of each question in the questionnaire. To measure impact of laser leveling technology on water uses efficiency and crop productivity. To compare the productivity of both conventional and laser leveling technology through production cost analysis which is explained below.

Farm Costs Analysis

The farm cost analysis is based on conventional and laser leveling technology. The results of this study will provide for the comparison of total costs and returns of laser leveling technology with conventional methods. Total costs consist of expenditure from the profit and loss account (cash costs, depreciation, etc.), and opportunity costs for farm-owned factors of production (family labor, own land, own capital).

Total revenue

Total revenue is the total money received from the sale of any given quantity of output. The total revenue is calculated by taking the price of the sale times the quantity sold. (Total revenue = price x quantity) (Biz 2002).

Total costs

Total Cost is the sum of the fixed cost and total variable cost for any given level of production, i.e., fixed cost plus total variable cost. Agricultural costs are often divided into various categories. Some of the more commonly used cost concepts are as follows.

Total fixed costs

Total fixed costs are the costs that do not change with the level of production. For example, the cost of owning a building is incurred regardless of whether the building is empty, half full, or overflowing.

Total variable costs

Total variable costs are the costs that change in direct proportion to changes in volume. For example, the cost of feed to feed animals is a variable cost. If the animal is not purchased, no feed costs are incurred, but the fixed costs of the livestock building are still incurred.

Opportunity costs

Opportunity costs are the cost of using a resource based on what it could have earned if used for the next best alternative. For example, the opportunity cost of farming his own land is the amount he could have received by renting it to someone else (Hofstrand 2005).

Profit

Profit calculates by gross revenue minus total costs.

Profit=GR-TC

GR=Grass Revenue

TC=Total Costs

Accounting profit

Accounting profit is the value that remains after all expenses except opportunity costs have been subtracted from gross income. It is the same as "net farm income".

Economic profit

Economic profit is the value that remains after all costs, including the opportunity costs of the operator's labor and capital, have been subtracted from gross income. It is as same as "return to management" (Hofstrand 2005).

Gross margin

A gross margin is calculated by taking variable costs away from the gross income earned from an enterprise. Gross margins are often reported on a per rupees basis for cropping enterprises.

GM=TR-TVC

GM=Gross Margin

TR=Total Returns

TVC=Total Variable Costs

Result

Cropping Patterns

There are two distinct cropping seasons i.e. Rabi and Kharif. Rabi season begins from October and ends in March. The Kharif season begins from April/May and ends in September. Type of crops cultivated in the study area in Rabi season about 34.66 percent of area was under wheat crop.

Table 1. Cropping Patterns

Seasons	Area (acres)	percentage of Operational holding
Rabi		
Wheat	20.9	34.66
Sugarcane	14.1	23.38
Rabi fodder	2.6	4.31
Rapeseed	3.46	5.74
Oil seed	2.33	3.86
Vegetable	3.62	5.34
Orchard	4.67	10.40
Fallow land	8.62	14.30
Kharif		
Cotton	21.5	35.66
Sugarcane	13.9	23.05
Kharif fodder	2.56	4.25
Rice	0.31	0.51
Vegetable	7.26	12.04
Orchard	5.67	9.40
Fallow land	9.1	15.09

Production Technology Cost

Table 2 represents the results of cost of production, costs have been broken down in a cash costs and non-cash cost (depreciation and opportunity) costs for production factors that are owned by the wheat growers. The overall cash costs of wheat sowing on laser leveling technology was high Rs. 20,314/acre, as compared to on

conventional sowing of wheat Rs. 18906/acre. The wheat sowing by laser leveling technology has highest cash cost due to highest land leveling cost Rs. 1721/acre as compared to Rs. 970/acre on convention wheat sowing.

Table 2. Cost of Production of Wheat by Conventional and Laser Leveling Technology (Rs/acre)

Costs				Conventional	Laser leveling
Cash Costs	Variable Costs	Labour Cost	Land Leveling	1170	1921
			Plough	2445	2564
			Harvesting	1790	1784
			Threshing	1116	1126
			Loading /Unloading	314	347
			Total Labour Costs	6835	7742
		Factor Costs	Seed Cost	2548	2606
			Fertilizer		
			DAP	3060	3147
			Urea	3882	3998
			NP	987	991
			Weedicide	492	515
			Tube well irrigation	640	480
			Threshing charges	2562	2875
			Transportation	596	656
			Total Factor Costs	14767	15268
		Total Variable Costs		21602	23010
	Fixed Costs		water Charges	97	97
			Govt. Land Taxes	207	207
			Total Fixed Costs	304	304
	Total Cash Costs			22210	23618
Non-Cash Costs	Opportunity Costs		Rent of Own Land	12016	12016
			Irrigation labour	545	355
			Total Opportunity Costs	12561	12371
	Total Non-Cash Costs			12561	12371
Total Costs				34771	35998

Total Revenue of Wheat:

Table 3 shows the total revenue of wheat production; overall high yield was obtained 45mds/acre by using laser leveling technology as compared to 38mds/acre by conventional method of wheat cultivation. The regular and uniform irrigations, fertilizer application with laser leveling technology were the reasons of obtaining more yield was reported by wheat growers. While as the conventional and laser leveling technology growers received prices for wheat Rs.1031/mds and RS.1028/mds respectively.

Total revenue of wheat production was calculated and found that laser leveling technology growers received higher Rs. 46260 /acre, followed by conventional growers Rs. 39178/acre.

Table 3. Average Yield, Price and Total Revenue of Wheat Production by Technology during, 2012-13

	Conventional	Laser leveling
Average Yield (Mds/ Acre)	38	45
Average Price (Rs./mds)	1031	1028
Total Revenue (Rs./acre)	39178	46260

Profit of Wheat by Technology

Table 4 shows that the average accounting and economic profit of wheat production. The results show that laser leveling technology growers received highest accounting as well economic profit Rs. 22642/acre and Rs. 10262/acre respectively. Whereas, conventional growers were received accounting and economic profits Rs. 16968/acre and Rs.4407/acre respectively.

Table 4. Profit of Wheat Production by Technology (Rs./acre)

	Conventional	Laser leveling
Total Revenue	39178	46260
Total Cost	34771	35998
Opportunity Cost	12561	12371
Accounting Profit	16968	22642
Economic Profit	4407	10262

1 . - Total Cost = Cash cost + Non cash cost, (Total cost is already included opportunity cost).

Gross Margin of Wheat

The gross margin can be analyzed by subtracting total variable costs from total revenue. Total variable costs are the summation of total labor costs and total factor cost.

Table 5 shows that the wheat growers of laser leveling technology obtained higher gross margin was Rs. 23250/acre, whereas gross margin of conventional growers who seem to be lower Rs. 17576/acre.

Table 5. Gross Margin of Wheat by Technology during (Rs/Acre)

	Conventional	Laser leveling
Total Revenue(Rs/Acre)	39178	46260
Total Variable Cost(Rs/Acre)	21602	23010
Average total labor cost(Rs/Acre)	6835	7742
Average total factor cost(Rs/Acre)	14767	15268
Average gross margin(Rs/Acre)	17576	23250

Discussion

Production of any crop depends upon Biotic and Abiotic conditions, and social organization, availability of resources and favorable marketing system. It is, therefore, considered meaningful to have brief discussion of area and production levels of laser leveling and conventional leveling wheat in various in Sindh, Pakistan.

Study shows that overall cost of wheat by laser leveling technology was high as compared to on conventional wheat due to highest land leveling cost. Overall high yield was obtained 45mds/acre by using laser leveling technology compared with conventional method of sowing as 38mds/acre. The reason of obtaining more yields was reported by wheat growers is the uniform irrigation and fertilizer application with laser leveling technology. Total revenue of wheat production was received by the laser leveling technology growers Rs. 46260Rs/acre and conventional grower's 39178Rs/acre. Study results further indicate that laser leveling technology wheat growers obtained higher gross margin 23250 Rs/acre, as compared to conventional grower's 17576Rs/acre. Due to water shortage majority of farmers willing to use of laser technology it gives high yield and save irrigation water. The study is compared with the study of Naresh et al. (2014) that evaluated the laser leveled land leveling technology on crop yield and water use productivity in Western Uttar Pradesh , study has been conducted for 3 year on impacts of the laser land leveling versus traditional land leveling on water use productivity and crop yields. The major concerns were effectiveness of laser land leveling as a water saving tool in the new context of land use and ownership, affordability of laser land leveling for farmers and the economic viability of this technology. The result indicated that with laser leveling, farmers could save irrigation water 21%, energy by 31% and obtained 6.6, 5.4 and 10.9% in rice, wheat and sugarcane higher yields. The total irrigation duration and applied water depth was reduced to 10.9, 14.7% in rice; 13.7, 13.3% in wheat and 13.5, 20.3% in sugar-cane as compared to traditional leveled fields. The laser leveled fields exhibited the highest water use efficiency (WUE), which was 48, 47 and 49% higher in precisely leveled field than control (unleveled), 22, 19 and 20% higher than traditionally leveling fields, respectively. The average water productivity in rice, wheat

and sugarcane has improved by 33%. The average annual net income from the laser field was 14, 13.5 and 23.8% in rice, wheat, sugarcane higher than that from the traditional leveled field. It was concluded that the use of laser land leveling increases yield and saves irrigation water as compared to traditional method of leveling in different cropping system prevailing in western U.P.

Therefore result shows that majority of farmers willing to use laser leveler technology, overall high yield was obtained 45mds/acre by using laser leveling technology compared with conventional method of sowing as 38mds/acre. While the total revenue by using laser leveler was 46260Rs/acre compared with conventional method as 39178Rs/acre. Overall cost of wheat by laser leveling technology was high as 35998Rs/Acre compared with conventional wheat sowing method 34771Rs/Acre due to highest land leveling cost.

Conclusion

The study was carried out the comparison of laser leveler technology and conventional methods of wheat crop of Sindh. The information was collected from selected wheat growers based on field survey. The primary data was collected through personal interviews. Number of analytical techniques was used to access comparative economic analysis of laser leveling technology and conventional land leveling technology of wheat crop in Sindh i.e. farm cost analysis, gross margin analysis.

Study shows that overall cost of wheat by laser leveling technology was high as compared to conventional wheat due to highest land leveling cost. Overall high yield was obtained 45mds/acre by using laser leveling technology compared with conventional method of sowing as 38mds/acre. The reason of obtaining more yields was reported by wheat growers is the uniform irrigation and fertilizer application with laser leveling technology. Total revenue of wheat production was received by the laser leveling technology growers Rs. 46260Rs/acre and conventional grower's 39178Rs/acre. Study results further indicate that laser leveling technology wheat growers obtained higher gross margin 23250 Rs/acre, as compared to conventional growers 17576 Rs/acre

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