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Economic Analysis of Laser Land Leveling Technology Water Use Efficiency and Crop Productivity of Wheat Crop in Sindh, Pakistan

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Abstract

Present study was designed to determine the economic analysis of laser land leveling technology on wheat crop, study shows that overall cost of wheat by laser leveling technology was high 35998 Rs/acre due to highest land leveling cost. Overall high yield was obtained 45mds/acre by using laser leveling technology, due to uniform irrigation and fertilizer application with laser leveling technology total revenue of wheat production was received by the laser leveling technology grower's 46260Rs/acre. Study results further indicate that laser leveling technology wheat growers obtained higher gross margin 23250Rs/acre, the mean time to irrigate an acre field was reduced from 2.26 hrs to 1.18 hrs means almost 50 percent time was saved to irrigate laser leveled fields. About 21 percent of irrigation was saved by the using of laser leveling technology, to survive in water shortage problem and utilize this saved water to increase land for more cultivation.

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 2013-14). 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). 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 et al., 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-leveled 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 used from 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 that there is need to evaluate the economic analysis of laser land leveling technology water use efficiency and crop productivity of wheat crop in wheat system of Sindh.

Objectives

The objectives of study were:

To assess the laser leveling technology on water use efficiency, on wheat crop in Sindh.

To analyze the laser leveling technology on the crop inputs and crop yields on wheat crop Sindh.

To develop a set of policy measures to enhance the use of 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. The study focused on the determinants affecting wheat yield on water use efficiency. The primary data was collected from wheat growers through the well structured pre-tested questionnaire. With the questionnaire of growers, information was collected about the laser leveler on water use efficiency and crop production. The research work was conducted in two major districts of wheat cropping zone of Sindh i.e. Mirpurkhas and Tando Allahyar. To accomplish the objectives mentioned above the specific analytical techniques was used to found the result. The proposed analytical techniques are as under. The farm cost analysis based on laser land leveling of wheat production. The results of this study were provides the total costs and returns of laser land leveling of wheat production. For the estimation and calculations, following procedure was adopted to examine the profitability and water saving techniques laser land leveling on wheat crop.

Averages (Average = ΣXi / n)	ΣXi= Sum of inputs, n= number of inputs
Percentages (Percentage = F / N* 100)	
Total Cost of Production TC=TFC+TVC+TOPC	TC= total costs, TFC= total fixed,
Total Revenue =Total physical *Price	TVC= total variable costs,
Net Returns NR = TR- TC	TOPC=total opportunity cost
Gross margin = Total return –variable costs	TR=total returns, TC=total costs

Production Technology Cost:

Table 1 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 cost of wheat by laser leveling technology was high Rs. 35998/acre. The wheat sowing by laser leveling technology has highest cash cost due to highest land leveling cost Rs. 23618/acre.

Table 1. Cost of Production of Wheat by Laser Leveling Technology (Rs/acre)

Cost	Laser leveling
Land Leveling	1921
Plough	2564
Harvesting	1784
Threshing	1126
Loading /Unloading	347
Total Labor Costs	7742
Seed Cost	2606
DAP	3147
Urea	3998
NP	991
Weedicide	515
Tube well irrigation	480
Threshing charges	2875
Transportation	656
Total Factor Costs	15268
Total Variable Costs	23010
water Charges	97
Govt. Land Taxes	207
Total Fixed Costs	304
Total Cash Costs	23618
Rent of Own Land	12016
Irrigation labor	355
Total Opportunity Costs	12371
Total Non-Cash Costs	12371
Total Costs	35998

Total Revenue of Wheat:

Table 2 shows the total revenue of wheat production; overall high yield was obtained 45mds/acre by using laser levelling technology. The regular and uniform irrigations, fertilizer application with laser leveling technology were the reasons of obtaining more yield was reported by wheat growers. Total revenue of wheat production was calculated and found that laser levelling technology growers received as 46260Rs/acre.

Table 2. Average Yield, Price and Total Revenue of Wheat Production by Technology

Average Yield (mds/ acre)	45
Average Price (Rs./mds)	1028
Total Revenue (Rs./acre)	46260
Opportunity Cost(Rs./acre)	12371
Total Cost(Rs./acre)	35998

Gross Margin of Wheat

The gross margin can be analysis by subtracting total variable costs from total revenue. Total variable costs are the summation of total labor costs and total factor cost. Table 3 shows that the wheat growers of laser levelling technology growers obtained higher gross margin 23250Rs/acre

Table 3. Gross Margin of Wheat by Technology during (Rs/Acre)

Total Revenue	46260
Total Variable Cost	23010
Average total labor cost	7742
Average total factor cost	15268
Average gross margin	23250

Impact of laser land leveling technology water use efficiency

Table 4 shows the information regarding to irrigation and time consumed on irrigation. Data indicate that number of irrigation applied by laser levelling technology growers were 6.16, whereas time to irrigate an acre field was reduced from 2.26 hrs to 1.18 hrs by the use of laser levelling technology reported by wheat growers. About 50 percent time was saved to irrigate laser levelled fields.

Results further shows that less average depth of water reported by laser levelling technology growers 2.79 inches.

Table 4. Number of Irrigations, Time Consumed on Irrigation and Average Depth of Water Applied for Wheat

Number of Irrigation	6.16
Time consumed (Hrs/Irrigation/acre)	1.18
Average Depth of Water Applied (inches)	2.79

Discussion

A research study carried out on scientific line can only reveal the best combination of inputs to be applied and proper land leveling provides higher crop yield of wheat. For obtaining high yield of wheat crop it is, therefore, considered meaningful to have brief discussion of area and production levels of laser leveling wheat in Sindh, Pakistan.

Study shows due to highest land leveling cost overall cost of wheat by laser leveling technology was high as 35998Rs/acre, However high yield was obtained by using laser leveling technology was 45mds/acre. The uniform irrigation and fertilizer application with laser leveling technology was the main reason of obtaining more yields was reported by wheat growers. Total revenue of wheat production was received by the laser leveling technology grower's 46260Rs/acre. Study results further indicate that laser leveling technology wheat growers obtained higher gross margin 23250Rs/acre, the mean time to irrigate an acre field was reduced from 2.26 hrs to 1.18 hrs means almost 50 percent time was saved to irrigate laser leveled fields. About 21 percent of irrigation was saved by the using of laser leveling technology, to survive in water shortage problem and utilize this saved water to increase operational holding. Due to water shortage majority of farmers willing to use of laser technology it gives high yield and save irrigation water. The study in compared with the study of Naresh et al (2014) who evaluated the laser leveled land leveling technology on crop yield and water use productivity in Western Uttar Pradesh, 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. While the total revenue by using laser leveler was 46260Rs/acre. Overall cost of wheat by laser leveling technology was high as 35998Rs/acre due to highest land leveling cost.

Conclusion

The study was carried out to assess the economic analysis of laser level technology water use efficiency and crop productivity in the wheat cropping zone of Sindh. The information was collected from selected wheat growers based on field survey. The primary data was collected through personal interviews and analyzed on Statistical Package for the Social Sciences (SPSS) software to access and found results i.e. farm cost analysis, gross margin analysis.

Study shows that overall cost of wheat by laser leveling technology was high as 35998Rs/acre due to highest land leveling cost. Overall high yield was obtained 45mds/acre by using laser leveling technology; 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. Study results further indicate that laser leveling technology wheat growers obtained higher gross margin 23250 Rs/acre, the mean time to irrigate an acre field was reduced from 2.26 hrs to 1.18 hrs means almost 50 percent time was saved to irrigate laser leveled fields. 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

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