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Comparison of Laser and Conventional Leveler on Some Technical Parameters in South West of Iran (Ahvaz Region)

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ABSTRACT

Agriculture is an important economic sector in the country and cereal has particular importance of among the crops then wheat accounted for self the highest cereal of under cultivation and it showed the importance of this valuable plant. Farmers emphasize particularly to the leveling operation of the farm, but unfortunately this practice is not done scientifically and using of appropriate tools. Today, farming without the use of agricultural machinery and tools meaningless because these devices can save time, improve quality and provide ease of doing business. Due to the dehydration crisis, leveling agricultural land with the use of special equipment leveling is very important. This research was performed for the first time in Khuzestan to determine an appropriate method of laser leveling (American Maskin Leveler) and conventional leveling (Shiraz Carefully cultivated) methods until to determine its effect on field capacity, fuel consumption, water use efficiency, volume of used water, leveling index (Li) and land uniformity coefficient (LUC) and leveling cost. This study done on a farm in a albajy village at 10 km north of Ahvaz at 2008-09 years. Soil is type of loamy-clay in most parts of the farm. In the project, the land boundaries to plot of 1 acre with seven replicates, the result of this test was conducted in 14 plots of 1 hectare. Then the tillage operations were performed. Used statistical software was SPSS in this study and Land leveling software is also Grade Plane**.** A comparison of means with method of the T-Student test showed that there is significant difference between laser and conventional leveler terms of field capacity, fuel consumption, volume of used, water use efficiency and costs. But there is not significant difference between laser and conventional leveler terms of wheat performance. Obtained leveling in the laser leveling Compared to conventional is closer to zero and As a result, leveling indicator is more appropriate and more acceptable at laser leveling. The land uniformity coefficient is closer to 1 in laser Leveler that show better uniformity coefficient and more accuracy at laser leveling than conventional is Leveler. In general, due to the advantages of laser leveler of technical indicators as well as the use of water resources could be recommended to farmers using the laser leveler in the khuzestan.

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INTRODUCTION

In Iran, the area under wheat cultivation will include over half of the land under cultivation of crops and its produces is about 11 million tons. 36% of the total land under cultivation in the country is irrigated agriculture and 64% of rain-fed agriculture (Sayahpour, 2008). In traditional methods of irrigation water, Farmers can use the amount of water that in addition to being wet all parts of the soil, a layer of water covers the field. Precise leveling is also important components in the field of water management. Due to the Careful removal of heights and depressions, this action causes to reduce the amount of irrigation water, especially the grounds that they are faced with water shortages and leads to increased irrigation efficiency. In areas where surface water is used for agriculture, leveling is one of the most essential activities for Agronomy.Water infiltration was uniformly in the leveling the field and it is very effective. Also possibility of water runoff and soil erosion significantly can be reduced (Dehghanian, 1999 and Mansourirad, 2000). Pal *et al*. (2004) reported that observations showed at level 71 farm in Otarpradesh province of India that application of laser leveler had significant effect on the efficiency

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of usage nitrogen in rotation rice-wheat. This amount of rice improved from 45.11 to 48.37 and in wheat from 34.71 to 36.9 kg grain per kg consumable nitrogen (Pal *et al*., 2004). Pal *et al*. (2003) observed that rice yield increased from 4.51 to 4.84 $t.ha^{-1}$ and wheat yield from 5.21 to 5.3 $t.ha^{-1}$ by precise leveling (Pal *et al*., 2003). Jat *et al*. (2003) reported that wheat yield was 4.6 tons per hectare in accurate leveling and 4.3 in the typical leveling (Jat *et al*., 2003). Asif *et al*. (2003) reported that there is not significant difference between the methods of laser and conventional leveler terms of wheat performance (Asif *et al*., 2003). Rickman (2002) showed that effect of land leveling on the yield of rice in the flat and rough fields in 1996 and 1999 in Cambodia, Performance of a specific variety of rice in a flat field is 24% higher than the roughly field (Rickman, 2002). Robbins *et al*. (1999) and Whitney *et al*. (1950) found leveling temporary effect on the growth and negative function and because it reduces food in the cut-off points and their accumulation in other points (Whitney *et al*., 1950, Rickman, 2002). Landon 1999 has announced the introduction of the laser levelers led to a gradual evolution in leveling sector in decade of 1970, also in this study, the researchers concluded that the use of these devices in land leveling to reduced water consumption by 20-30% (Landon, 1999). Studies by Walker (1989) showed that significant amounts of irrigation water wasted due to farm inappropriate designing and its roughness. For example elevation between the highest and lowest point in a rice field average is 160 mm that water should be stored in a field roughly 80-100 mm until the entire surface of farm is covered with water. This amount is equal to 10% of the total water required to grow rice (Whitney *et al*., 1950). Esfandiari (2004), the study concluded that irrigation time and amount of consumable water reduced in farms that have been laser leveling toward not leveling farms the rate of 4.45% and 4.54% (Esfandiari, 2004 and Majnoun Hoseini, 2006).

According to the records of the above research its objectives are:

1- Determination of one leveler between laser and conventional leveling that field capacity is higher.
2- Determination of one leveler between laser and conventional leveling that fuel consumption is lower.
3- Determination the effect of laser and conventional leveling on wheat yield
4- Compare to laser and conventional leveling of the leveling costing in cultivation of wheat
5- Compare to of laser and conventional leveling that reduced the volume of irrigation Water
6- Determination of one leveling method between laser and conventional methods that is a better leveling index (Li) and land uniformity coefficient (LUC).

Methodology:

Tools and equipment used:

1- Valtra Tractor
2- Conventional Leveler (Shiraz Carefully cultivated)
3- Laser Leveler (American Maskin)
4- Wood
5- Plaster
6- Shovel
7- Meter
8- Timer
9- Boundaries
10-Camera
11- Irrigation pump Engine
12- Box 1×1 m^2
13- Digital Scale
14- Combination Cultivator

Statistical Plan: In this study was used in the T-Student test that is one a comparative test, used statistical software was SPSS in this study and Land leveling software is also Grade Plane. This project was conducted in 2 leveling operations are:

1- Leveling with conventional Leveler
2- Leveling with laser Leveler and 7 Repeat 1 hectares were compared together at every level, the result of this test was conducted in 14 plots of 1 hectare.

Preliminary testing contained the soil Texture that 10 samples were taken at depths of 0 to 30 cm soil and indicated that the soil is composed of %41 clay, %48 loam and %11 sand, result in a soil is type of loamy-clay.

Chamran wheat crop was grown in the plan that the rate of 200 kg per hectare was cultivated by a Combination Cultivator.

Field capacity:

This parameter was calculated to level measuring and time of leveling operations and using the following equation, the time of operation is leveling time.

$$C_a = \frac{A}{t}$$

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Ca = Practical field capacity (ha/h)
A = Level of Cultivation (ha)
T = Time of leveling operations (Useful Time and Wasted Time) (h)

Fuel Consumption:

To measure the amount of fuel was used a full tank method in this study. In this case, before starting of leveling is filled the fuel tank of tractor completely and fill the tank again after the end of operation and its difference represents the amount of fuel consumed, this work was done for both laser and conventional leveler methods until determine the amount of fuel consumed.

Product Performance:

To compare the performance of the product are removed from each side of length 2 m in parts 1 ha of land bordering and then the 3 box $1\times1m^2$ were determined and taken the inner product, it has determined weight of grain, then we calculate the operation of grain on the %14 standard moisture.

Water Use Efficiency (WUE):

Calculated by the divide of production on volume of used water.

$$\text{Water Use Efficiency} = \frac{\text{Production (ha)}}{\text{Volume of used water } (m^2)}$$

Volume of Used Water:

By the water pump and timing of irrigation comes through the relationship of the flow of the water outlet pipe.

V = Q. t

$$Q = 0.022CA\frac{x}{\sqrt{y}}$$

In these equations:

Q = Tensity of flow (lit/s)

t = Duration of irrigation water until the water reaches the bottom of the plots (s)

C = Tensity Correction factor (the amount varies according to the aspect ratio of the tube, Full or half-full pipe and the rate of water throwing and the value of this coefficient for the filled tube is one)

X = The throw or horizontal spray of water (cm)

Y = The loss or downfall of water (cm)

A = Profile level of water inside pipe (cm^2) that is calculated from the following equation the

$$A = \frac{D^2}{8}(\theta - \sin\theta)$$

Above equation:

D = Diameter of the pump (cm)

Θ = Low angle of connection of maximum the water points inside pump and pump center (that will be calculated from the following equation)

$$\theta = 2ArcCos(\frac{r-d}{r})$$

d = Height of water inside the pomp (cm)

r = Pomp radius (cm)

Leveling index and Land uniformity coefficient:

Leveling index (Li) and Land uniformity coefficient (LUC) parameters were measured two parameters which are calculated according to the following equations.

$$LI = \frac{\sum|DLi - ALi|}{N}$$

$$LUC = \left(1 - \frac{\sum|DLi - ALi|}{\sum DLi}\right)$$

Where in:

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DLi = Depth of cut (or filling) before leveling at point i (cm)
Ali = Depth of cut (or filling) after leveling at point i (cm)
N= Number of points of network samples

The minimum of rate of LI is zero that the show is accurate leveling. Also LUC was between zero and one that whatever the number is closer to one are shown accurate leveling.

In all attendances before entering into the devices, laser leveler put in manual control mode and then leveler were placed in the grid points on the ground until the height difference between the points obtained. Then the numbers were picked due to the distance of 20 meter. Data were entered into the software and amount of excavation and embankment was determined at each point. These data are theoretical data (Dli). We repeat again the same procedure after leveling until the actual data achieved the rate of cutting (excavation and embankment) (Ali).

Calculation of costs:

The cost of planting machine operation was calculated as the RLS per Ha based on local fee, with reference of individuals and companies who provide services in method of conventional. Apart from the leveling, other operations were performed to the method of conventional in attendance of laser leveling and the total sum can be calculated as rails per ha. Fuel costs also was calculated as rials per ha after determining the amount of actual fuel and by multiplying the unit price per liter.

RESULTS AND DISCUSSION

Result of statistical analysis (T-Test) of field capacity are presented in Table 1.

Table 1: Comparison of means with the T-Student procedure in field capacity

Attendance	df	Average ($ha.h^{-1}$)	Standard Error	Standard Deviation
Conventional Leveler	6	0.97	0.97	0.037
Laser	6	0.11	0.005	0.002

T-Value =23.60^{**} **: significant difference in the level %1

As can be seen in the Table 1, the average of field capacity for conventional and laser leveler respectively were 0.97 and 0.11 hectare per hour and the statistical analysis shows that there are significant difference in the level %1 between the laser and the conventional leveler in terms of field capacity and argument is superior to conventional leveler. In other words, at the certain time, more land can be leveled with conventional leveler. Result of statistical analysis (T-Test) and comparison of means of fuel consumption are presented in Table 2.

Table 2: Comparison of means with the T-Student procedure in fuel consumption

Attendance	df	Average ($lit.ha^{-1}$)	Standard Error	Standard Deviation
Conventional Leveler	6	8	0.5	0.19
Laser	6	139	3.46	1.3

T-Value= - 99.03 **: significant difference in the level %1

As can be seen in the Table 2, the average of fuel consumption for conventional and laser Leveler respectively were 8 and 193 liter per hectare and there are significant difference in the level %1 between the laser and the conventional leveler in terms of fuel consumption and argument is superior to conventional leveler. In other words, at certain amount of fuel, more land can be leveled with conventional leveler.

Result of statistical analysis (T-Test) and comparison of means of product performance are presented in Table 3.

Table 3: Comparison of means with the T-Student procedure in wheat product performance

Attendance	df	Average ($ton.ha^{-1}$)	Standard Error	Standard Deviation
Conventional Leveler	6	3.87	0.20	0.07
Laser	6	3.92	0.18	0.06

T-Value = - 0.55^{ns} ^{ns}: There is not significant difference in the attendances

As can be seen in this table, there is not significant difference between laser and conventional leveler terms of performance. (Laser leveler performance is 3.92 tons per hectare and conventional leveler performance is 3.878 tons per hectare). In other words usage of the leveler conventional or laser for leveling of agricultural lands in the Northern Province Khuzestan has no effect on grain yield.

Result of statistical analysis (T-Test) and comparison of range of used water meansare presented in Table 4.

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Table 4: Comparison of means with the T-Student procedure in range of used water

Attendance	df	Average (1000 $m^3.ha^{-1}$)	Standard Error	Standard Deviation
Conventional Leveler	6	0.24	0.01	0.005
Laser Leveler	6	0.39	0.02	0.01

T-value = - 12.25** **: significant difference in the level %1

As you can see in the table above, there are significant difference in the level %1 between the laser and the conventional leveler in terms of water use efficiency and laser leveler (0.39) than conventional leveler (0.24) has a higher water use efficiency, this means that the amount of water in the lower to laser leveling have higher performance than conventional Leveler.

Data from the pomp tube and water tensity to calculate the volume of used water is as follows:

X = 220 cm

Y = 110 cm

D = 25/4 cm

D = 25/4 cm

r = 12/8 cm

According to the above information can be calculated from the relationship of irrigation water and water tensity.

$$\theta = 2Arc\cos\left(\frac{5'' - 10''}{5''}\right) - 1 = 360 \Rightarrow \theta = 2\pi$$

$$A = 3/14 \times \frac{(25/4)^2}{4} = 506/5cm^2 A = 506/5cm^2$$

Since the tube is filled with water: C = 1

$$Q = 0/0221 \times 506/5 \times \frac{220}{\sqrt{110}} = 233/72\ lit/s$$

The difference of irrigation time between the laser and conventional leveling:

Time difference = 2.34 42.4-16 .7

Reduction of irrigation time 2.34: 7.17 = 0.35

Saving Water:

Lit.s^{-1} 82 ≈ Lit.s^{-1} 81.8 = 233.72 × 0.35

Result of statistical analysis (T-Test) and comparison of volume of water averages are presented in Table 5.

Table 5: Comparison of means with the T-Student procedure in volume of water

Attendance	df	Average (1000$m^3.ha^{-1}$)	Standard Error	Standard Deviation
Conventional Leveler	6	16.75	0.34	0.13
Laser Leveler	6	10.81	0.28	0.11

T-Value =23.36** **: significant difference in the level %1

As can be seen in the table 5, the average volume of water for conventional and laser attendance respectively were 16.75 and 10.81 $m^3.ha^{-1}$ and there are significant difference in the level %1 between the laser and the conventional leveler in terms of volume of water, so that Laser Leveler spend less time in the water to reach the 1 ha plots from beginning to end and the amount of used water reduced Significantly (Unit of used water is 1000 $m^3.ha^{-1}$). Result of statistical analysis (T-Test) and comparison of means of leveling index are presented in Table 6.

Table 6: Comparison of means with the T-Student procedure in leveling index (Li)

Attendance	df	Average	Standard Error	Standard Deviation
Conventional Leveler	5	12.61	0.96	0.39
Laser Leveler	5	2.56	0.24	0.10

T-Value = 24.81** **: significant difference in the level %1

As can be seen in the Table 6, the average leveling index (Li) for conventional and laser methods respectively were 12.6 and 2.56 and there are significant difference in the level %1 between the laser and the conventional leveler in terms of leveling index (Li). Obtained leveling in the laser leveling compared to

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conventional is closer to zero and As a result, leveling indicator is more appropriate and more acceptable at laser leveling and argument is superior to laser leveler. In other words leveling by laser leveler with traditional decreased significantly leveling index. Result of statistical analysis (T-Test) and comparison of means of land uniformity coefficient are presented in Table 7.

Table 7: Comparison of means with the T-Student procedure on land uniformity coefficient (LUC)

Attendance	df	Average	Standard Error	Standard Deviation
Conventional Leveler	5	0.84	0.011	0.005
Laser Leveler	5	0.97	0.002	0.0009

T-Value= - 22.68** significant difference in the level %1; **

As can be seen in the Table 7, the average land uniformity coefficient (LUC) for conventional and laser methods respectively were 0.97 and 0.84 and there are significant difference in the level %1 between the laser and the conventional leveler in terms of land uniformity coefficient (LUC). The land uniformity coefficient is closer to 1 in laser leveler that show better uniformity coefficient and more accuracy at laser leveling than conventional is leveler and argument is superior to laser leveler. Compared with leveling of laser leveler to conventional is better uniformity coefficient and more accuracy.

Result of statistical analysis (T-Test) and Compare the costs are presented in Table 8.

Table 8: Compare the costs with the T-Student procedure in the laser and conventional leveling (Rials per hectare)

Attendance	df	Average	Standard Error	Standard Deviation
Conventional Leveler	6	201357	1.7	49.23
Laser Leveler	6	3002924	4.27	17.60

T-Value= -73.06** **: Significant difference in the level %1

As can be seen in the Table 8, although the cost of laser leveling is higher than conventional leveling, but influenced greatest impact on increasing water use efficiency that according to lack of water can be a significant factor in reducing the amount of water especially in the southern regions of country. From calculation of costs can be concluded in both laser and conventional leveling methods that laser leveling is much higher than conventional leveling in terms of the cost.

Conclusion:

Jat *et al*. (2003) reported that wheat yield was 4.6 tons per hectare in accurate leveling and 4/3 in the typical leveling. Obtained results in this study showed that that wheat yield was 3.92 tons per hectare in laser leveling and 3.78 in conventional leveling that the result of this project, confirms the obtained consequence by Jat *et al*. (2003), Asif *et al*. (2003) reported that there is not significant difference between the methods of laser and conventional leveler terms of wheat performance increased that obtained results in this study confirm the report of Asif *et al*. (2003), Playan *et al*. (1996) reported that precise leveling caused to uniform distribution of water and food. He also noted that the using of laser leveler caused increase 10% in water use efficiency. One of the results obtained in this thesis confirms the results obtained by the Playan *et al* (1996), Sayahpour (2008) reported that economic survey of the laser system indicates that the use of lasers by reducing the amount of needed water for irrigation will reduce the costs of farmer. The results obtained in this study also showed that the application of laser leveling to reduce the amount of used water per hectare and instead cause to increasing the costs of farmer, (About 15 times more) is higher than conventional leveling. Landon's investigation (1999) concluded that laser leveling has reduced water consumption for the amount of 20-30%. In this study, Reduce of water consumption by laser leveler (35 percent reduction in water consumption) confirm the report of land on in Khuzestan. Playan *et al*. (1996) reported that using of laser leveler reduce water consumption for the amount of 20%, that results obtained in this study also correspond with the results obtained by Playan *et al* (1996), Asif *et al*. (2003) reported that lands that leveled with low accuracy and they are roughness, they waste about 30% of irrigation water. Also obtained results about the amount of irrigation water consumption in this study confirm the report of Asif *et al*. (2003). So using of laser leveler is essential for agricultural land leveling to reduce water consumption.

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