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The Perception of Farmers about Laser Land Levelling as an Appropriate Technology in Agricultural Sector of Iran

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Authors' contributions

This work was carried out in collaboration between all authors. Author SJFH designed the study, wrote the protocol and wrote the first draft of the manuscript. Author MB performed the data analysis and author SR managed the literature review. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

A descriptive survey research was undertaken to assess laser land levelling appropriateness as perceived by farmers in Marvdasht county of Fars province**.** The research population included farmers that implement laser land Levelling in their fields in Marvdasht County. Using random sampling, a sample of 111 was constituted. Data were collected using a questionnaire, which was validated by a panel of experts and the reliability index was established by a Cronbach's coefficient. Questions were designed to determine the level of change based on Bennett's Hierarchy of effects. The results indicated that there is a significant positive relationship between knowledge, attitude, opinion, and motivation factors and laser land levelling appropriateness. Multiple regressions indicated that 60 percent of the variance in the appropriateness could be explained by knowledge and attitude factors and it provides an important role for knowledge and attitude factors in laser land levelling appropriateness.

Keywords: Laser land leveling; farmers; innovation; Marvdasht County; Iran.

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1. INTRODUCTION

Precision land levelling using laser assisted land leveler equipped with drag scrapper is a process of smoothening the land surface within ±2 cm of its average micro-elevation. It is assumed that laser levelers may play a significant role in improving resource use efficiency under surface irrigated systems. Improvement in operational efficiency, weed control efficiency, water use efficiency, nutrient use efficiency, crop productivity and economic returns, and environmental benefits been reported as a result of precision land levelling when compared to conventional practice of land levelling [1]. It saves nutrients and agro-chemicals, too. Laser land levelling system is also likely to increase the cultivable area in the range of 3-6% (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 [2]. Precision land levelling helps distribution of soluble salts in salt-affected soils [3].

Effective land levelling reduces the work in crop establishment and crop management and increases the yield and quality [4]. Even, it is a process for ensuring that the depths and discharge variations over the field are relatively uniform and as a result, that water distributions in the root zone are also uniform [5].

There are two land levelling philosophies: (1) to provide a slope which fits a water supply and (2) to level the field to its best condition with minimal earth movement and then vary the water supply for the field condition. The second philosophy is generally the most feasible. Because land levelling is expensive and large earth movements may leave significant areas of the field without fertile topsoil, this second philosophy is also generally the most economic approach [6].

Different laser land levelling programs have been implemented in the many countries around world. For example laser land levelling for level basins is an active and growing program implemented in Pakistan that is spreading rapidly. The level basins are combined with watercourse improvement and improved productivity emphases. Farmers valued the water saved and appreciated the increased productivity achieved through an effective program. Egypt is another example and it has an ongoing program in Meskia (watercourse) improvement, creation of water users associations, laser land levelling, and improved water delivery with farmer participation that have had effective results. The success of laser leveled, level basins for cotton, alfalfa, and other crops with water savings and increased yields were also documented in Arizona [7].

Some studies reported about benefits of laser land levelling. For example Jat et al. in a study show that how land levelling and crop establishment practices can be modified to be more efficient in water use through layering of precision- conservation crop management techniques. The wheat yield was about 16.6% higher with nearly 50% less irrigation water with layering precision land levelling and raised bed planting compared to conventional practices (conventional land levelling with flat planting). The agronomic and uptake efficiency (UE) of N, P and K were significantly improved under precision land levelling with raised bed planting technique compared to other practices [1].

Aggarwal et al. in their study observed that water saving through precision land levelling at farmer field varies from 22 to 33% for different crops. And it was conducted that by 100% adoption of laser leveler in rice-wheat system, the groundwater draft can be reduced by 19 cm [8].

Jat et al. indicated that the total water use in wheat and rice in laser leveled field was reduced to 49.5% and 31.7%, respectively and reduction in weed population in wheat after 30 days of sowing was recorded under laser leveled fields in comparison to conventional leveled fields [9].

Choudhary et al. observed higher fertilizer use efficiency in wheat in fields under laser land levelling compared to conventional levelling [10].

The study of Rickman showed 24% increase in yield of rice due to precision land levelling over conventional land levelling at the same level of variety and fertilizer use and he reported 10-15% reduction in operating time of agricultural machinery in the laser-leveled fields as compared to conventional levelling [4].

Khodaverdi and Bakhshoodeh examined the effective factors which influenced adoption of laser land levelling in the Fars province. The results show that variables farmers' age, working experience, educational level and participation in the educational classes, land measurements, agricultural income, economic factors and awareness of laser land levelling had influenced the adoption of laser land levelling [11].

Fars province is one of the most important regions of Iran in term of agricultural production. Farmers in this province, due to their educational level and their commercial farming have always been pioneer in application of new technology. Fars has been among the first provinces in which laser land levelling was introduced to farmers. However, there has not been any assessment about perception of farmers about this technology. This research was conducted to find out the perception of farmers about appropriateness of the laser land levelling in the Marvdasht Township.

2. METHODOLOGY

The methodology used in this study involved a combination of descriptive and analytical method and included the use of correlation, regression and descriptive analysis as data processing methods. A questionnaire was developed based on relevant literature. The questionnaire included fixed choice questions. A five-point Likert scale was used to measure the perception of respondents. The respondents were asked to indicate their agreements with statements by marking their response on a five point Likert-type scale. Content and face validity were established by a panel of experts consisting of faculty members at Science and Research Branch, Islamic Azad University. Minor wording and structuring of the instrument were made based on the recommendation of the panel of experts. A pilot study was conducted with 20 farmers in a village (not included in the sample population), to determine the reliability of the questionnaire. Computed Cronbach’s alpha score were 68% to 89%, which indicated that the questionnaire was highly reliable. The research population included farmers that implemented laser land levelling in their fields in the Marvdasht Township. Using random sampling, a sample of 111 was constituted. All survey data were analyzed using the Statistical Package for Social Sciences (SPSS 16.0).

3. RESULTS AND DISCUSSION

The results of study showed that the average age of respondents was 53 years old and majority of respondents (45%) were between 47 to 57 years old. Majority of respondents indicated that they have had working experience between 16 to 28 years (43.2%) that the

average working experience was 24 years. The answers to field size show that 51.4% of farmers have 3 to 14 hectare and 47.7% of implementing laser land levelling were in category of 3 to 13 hectares (Table 1).

Table 1. Frequency distribution characteristics of farmers

Characteristic	Groups	Frequency	Percent	Cumulative percent
Age (years)	36-46	25	22.5	22.5
	47-57	50	45.0	67.6
	58-68	30	27.0	94.6
	69 plus	6	5.4	100
	Total	**111**	**100**	
Working Experience(years)	3-15	22	19.9	19.9
	16-28	48	43.2	63.1
	29-41	35	31.5	94.6
	42-54	6	5.4	100
	Total	**111**	**100**	
Field size(hectare)	3-14	57	51.4	51.4
	15-26	36	32.4	83.8
	27-38	8	7.2	91
	39-50	8	7.2	98.2
	51-62	2	1.8	100
	Total	**111**	**100**	
Laser land levelling size	3-13	53	47.7	47.7
	14-24	35	31.5	79.3
	25-35	10	9.0	88.3
	36-46	9	8.1	96.4
	47-57	4	3.6	100

The respondents were asked to indicate how they were being informed about laser land levelling. Majority reported that participation in educational classes have helped them to find out about this technology (N=30) (Table 2).

Table 2. Information channels that helped farmers to be aware of technology

Channels	Frequency	Percent	Cumulative percent
Participation in educational classes	30	27	27
Other farmers	22	19.8	46.8
Printed material	7	6.3	53.2
Television	8	7.2	60.4
Participation in educational classes and other farmers	6	5.4	65.8
Participation in educational classes and printed material	5	4.5	70.3
Participation in educational classes and television	14	12.6	82.9
Other farmers and printed materials	12	10.8	93.7
Other farmers and television	7	6.3	100

Respondents were asked to determine their knowledge about laser land levelling. The highest mean refers to knowledge about appropriate time for laser land levelling (mean=4.32) and the lowest mean was knowledge about different methods of levelling (mean=4.20) (Table 3).

Table 3. Means of respondents' views about their knowledge about laser land levelling (1=very little; 5=very much)

Statement	Mean	SD
Appropriate time of laser land levelling	4.32	0.59
Advantages of laser levelling	4.32	0.59
Knowledge about laser land levelling equipment	4.25	0.63
Different methods of farm levelling	4.20	0.78

Table 4 shows the opinions of respondents about laser land levelling. Respondents were asked to respond to five statements. The results show that the opinion of respondents about role of this technology was highly positive, while decreasing water waste was determined to be relatively positive (mean=3.98).

Table 4. Means of respondents' views about their opinion about laser land levelling (1=highly negative; 5=highly positive)

Farmers' opinion	Mean	SD
Increasing production	4.38	0.57
Reducing irrigation cost	4.18	0.66
Generating income opportunities	4.07	0.74
Decreasing water waste	3.98	0.86
Replacing conventional method of land levelling problems	4.11	0.97

Table 5 shows the means of respondents' views about motivational factors which influence the application of laser land levelling. As can be seen from this table, the highest mean refers to providing modern irrigation system to those farmers who utilize this technology (mean=4.24) and the lowest mean to support by government (mean=3.96).

Table 5. Means of respondents' views about role of motivational factors in affecting the application of laser land levelling (1=very little; 5=very much)

Farmers' motivation	Mean	SD
Providing modern irrigation systems to farmers	4.24	0.70
Approving laws in order to apply laser land levelling	4.13	0.74
Providing Governmental support to farmers	3.96	0.74
Considering tax exempt for farmers	4.17	0.81

Table 6 shows the means of respondents' views about attitude factors which influence the application of laser land levelling. As indicated in the Table 6, the highest mean refers to replacing laser land levelling instead of conventional method (mean=4.30) and the lowest mean to satisfaction of laser land levelling (mean=4.09).

Table 6. Means of respondents' views about their attitude about laser land levelling (1= very little; 5=very much)

Farmers' attitude	Mean	SD
Replacing laser land levelling instead of conventional method	4.30	0.64
Improvement in farm condition	4.15	0.72
Farmers economical ability	4.11	0.73
Application of laser levelling to solve farm problems	4.22	0.75
Satisfaction of laser land levelling	4.09	0.77

Table 7 shows the respondents' views about contextual factors in the application of laser land levelling. Respondents were asked to respond to eight statements. The results show that the economical benefits of laser levelling was highly positive, while decreasing plant and harvest problems was determined to be relatively positive (mean=3.91).

Table 7. Means of respondents' views about contextual factors in application of laser land levelling (1=very little; 5= very much)

Statement	Mean	SD
Economical benefits of laser levelling	4.32	0.59
Accessibility of laser levelling machinery	4.25	0.63
Increasing income	4.28	0.70
The number of laser levelling machinery	4.21	0.75
Decrease irrigation problems	4.14	0.85
Laser levelling enforceable	4.05	0.87
Availability of laser levelling machinery	4.02	0.89
Decreasing plant and harvest problems	3.91	0.92

Respondents were asked to rank the obstacles in application of laser land levelling. The results show that economical factors were determined as the most important (mean=3.97) and the least important was amount of time to implement this technology (mean=3.37) (Table 8).

Table 8. Means of respondents' views about obstacles in application of laser land levelling (1=least important; 5=most important)

Obstacles	Mean	SD
Economical limitations	3.97	1.02
Lack of supportive services	3.43	0.93
Lack of laser levelling machinery and equipments	3.45	0.94
Lack of advisory services to farmers about laser land levelling	3.77	1.06
Laser land levelling incompatible to farmers' situation	3.68	1.07
Risk prone technology	3.52	1.04
Time consuming	3.37	1.00
Lack of farmers' information about laser levelling advantages	3.48	1.08
Farmers illiteracy	3.80	1.21

Pearson coefficient was used to measure the relationship between independent variables and dependent variable. Table 9 shows that there was relationship between perception of

respondents about appropriateness of laser land levelling as dependent variable and knowledge, attitude, opinion of farmers and motivational factors as independent variables.

Table 9. Determination relationship between requirements and laser levelling appropriateness

Dependent variable	Independent variables	Correlation coefficient
Laser levelling appropriateness	Knowledge	0.738**
	Attitude	0.464**
	Opinion	0.340**
	Motivation	0.535**

*** Significant level of 0.01*

Table 10 shows the result for regression analysis by stepwise method. The result implies that 60% of the variance in the perception of respondents could be explained by knowledge of farmers (Beta coefficient: 0.657, sig.: 0.000) and attitudes of farmers (Beta coefficient: 0.286, sig.: 0.000). Other variables were not statistically significant.

Table 10. Multivariate Regression Analysis (laser levelling appropriateness as dependent variable)

	B	Beta	T	Sig
Constant	0.486	----	1.326	0.188
Knowledge	0.766	0.657	10.60	0.000
Attitude	0.327	0.286	4.621	0.000

$R^2_{adj}=0.60$

4. CONCLUSION

The results show that there is a significant positive relationship between knowledge, attitude, opinion and motivation factors and laser land levelling appropriateness. Based on the results of regression analysis, knowledge and attitudes of farmers about laser land levelling caused 60% of variance on the perception of respondents regarding this technology. It was also reported that attending educational classes was considered the most important communication channels which make farmers aware of this technology. Economic limitation is considered the main barriers in applying this technology, so it's recommended that government provide financial facilities to cover the cost of equipment for the interested farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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