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A study on factors influencing the adoption of micro irrigation system in Vellore district

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Abstract
As worldwide concerns about water scarcity and food security develop, micro-irrigation will become more popular as a way to fulfil rising food demands. Micro-irrigation systems have a number of advantages over traditional irrigation methods, including the capacity to distribute small amounts of water directly to the crop root zone, the ability to incorporate fertigation, reduced weed and pest infestation, and lower capital and operational expenses. The aim of this paper is to look into the elements that influence micro irrigation system in the Vellore area. The data was collected from 90 farmers, and the data was analysed using discriminant analysis and percentage analysis. The findings of this study suggest that problems such as difficulty in maintaining, uneven terrain, and a lack of trust in micro irrigation system are the significant determinants of micro irrigation system adoption. .

Keywords: adoption, discriminant analysis, micro irrigation system

1. Introduction
India is confronted with two issues: water scarcity and population increase. The current water crisis has impacted nearly 600 million people and is only expected to worsen. The population of the country is predicted to reach 1.6 billion by 2050. The agriculture sector in India is the country's largest water consumer. It accounts for almost 90% of the country's 761,000 billion litres of freshwater withdrawals each year. The agriculture industry uses 4,913 to 5,800 kilolitres of water per capita per year. When the issue of farmer suicides roiled Parliament, micro-irrigation gained popular. Micro-irrigation system can increase yields while saving money on water, fertiliser and labour. By supplying water directly to the root zone, the method reduces water loss due to conveyance, run-off, deep percolation, and evaporation. Traditional irrigation methods can't prevent these losses, but micro-irrigation system has cleared the way for better water quality [1].

Micro irrigation system has gained popularity in recent years due to its ability to boost yields while reducing water, fertiliser, and labour requirements if correctly managed. Water and fertiliser can be given directly to individual plants or trees using Micro irrigation system systems, which reduce the wetted area by just watering a portion of the soil surface, allowing water to reach the root zone. Micro irrigation system is a low-pressure, low-volume irrigation method that is ideal for crops with a high return on investment, such as fruits and vegetables. Micro irrigation system, when done correctly, can enhance yields while lowering water, fertiliser, and labour costs. The water is just applied to the plan with micro irrigation [2].

2. Review of Literature
This chapter discusses principles and reviews of previous research that are relevant to the current study. Reviewing the available literature on the subject is necessary to justify the current study. As a result, an effort was undertaken to analyse the available literature on the subject in order to identify the research gap.

Trevor Brikenholtz *et al*. (2017) he examined the farmer's recent embrace of drip irrigation in one administrative area of Rajasthan, India, where drip irrigation is being expanded. It did so by demonstrating the operation of the Jevons paradox in drip irrigation systems, in which the political economy of groundwater-led agriculture incentivizes intensification, which, rather than reducing groundwater demand, exacerbates groundwater over-extraction. Narayana Moorthy A, *et al*. (2018) [4] proved that drip method of irrigation is a cost-effective and ecologically friendly alternative to traditional flood irrigation. Although data suggests that drip irrigation is cost-effective, the initial outlay necessary to implement drip method of irrigation is out of reach for most small farms.

Furthermore, irrigation becomes problematic in dry places with insufficient rainfall. Rashmi Shivamurthy Kabbur *et al.* (2020) [5] studied the institutional financing, the power of the pump used to raise groundwater, the average distance between two neighbouring borewells and the average distance from a farm to the nearest water source all influence the adoption of drip irrigation technology. Drip irrigation saves groundwater as compared to traditional irrigation methods.

3. Objective of the study
To study different factors influencing the adoption of Micro irrigation system in Vellore district

4. Methodology
The farmers were chosen using a two-stage random sampling process. In the initial step, three blocks in Vellore district were chosen based on the highest area under micro irrigation. In the second step, thirty farmers were chosen at random from each block. As a result, a total of 90 farmers were chosen to constitute the final sample size. A well-structured, comprehensive questionnaire was used to collect data.

In order to arrive better results, different tools and techniques were used Discriminant analysis (DA) is a multivariate technique that uses variables measured on each experimental unit (sample) to separate two or more groups of observations (individuals) and determine the contribution of each variable in separating the groups. The goal of discriminant analysis is to create discriminant functions, which are simply a linear combination of independent variables that perfectly discriminate between the dependent variable's categories. SPSS software was used to perform the discriminant analysis.

5. Results and Discussion
With the use of discriminant analysis, the adopted and non-adopted farmers were separated into groups by using of various variables such as age, education, experience, landholding and annual income. Discriminant analysis has a lot of categories like group statistics, Eigen's value and Wilk's lambda, etc.

5.1 Adoption and Non adoption of micro irrigation systems among sample respondents.

Table 1: Adoption and Non adoption of micro irrigation systems among sample respondents

Group Statistics					
Adoption		Mean	Std. Deviation	Valid N (listwise)	
				Unweighted	Weighted
Non-adopted	Age	61.1053	5.76471	38	38.000
	Edu	2.3684	1.23946	38	38.000
	Land holdings	4.9211	3.66047	38	38.000
	Farming experience	9.2895	6.09789	38	38.000
	Annual income	218421.0526	64116.71434	38	38.000
Adopted	Age	40.6346	7.50171	52	52.000
	Edu	10.3846	2.93828	52	52.000
	Land holdings	6.3010	4.85427	52	52.000
	Farming experience	12.4231	5.97822	52	52.000
	Annual income	451923.0769	75382.38369	52	52.000

Table 2: Eigen values for micro irrigation system

Eigen values				
Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	7.053a	100.0	100.0	.936
A. First 1 canonical discriminant functions were used in the analysis.				

The group statistics (table 1) showed that there was a difference in mean values assigned by the adopter and non-adopters of the micro irrigation system.

The primary premise of discriminant function is to maximise the variance between groups in relation to group variance, which is represented by the "Eigen value" ratio. It is usually preferable to have a higher Eigen value. The Eigen values for variables that influence the adoption of a micro irrigation system are listed in Table 2. The Eigen values for the discriminant function of the micro irrigation system were found to be 7.053 in Table 2. The Eigen value for the function revealed the likelihood that micro irrigation system adopters and non-adopters differed considerably for certain farmer characteristics. The value of "canonical correlation," which is a simple correlation between discriminant score and their corresponding group membership, is also shown in the table (adopters and non-adopters). Wilk's Lambda was used to test the canonical correlation, which was 0.936 and square of this value was 0.876 which means that about 87.6% of variance in discriminating model between adopters and non-adopters was due to various variables of farmers.

Table 3: Test of equality of group means for micro irrigation system

Tests of Equality of Group Means					
	Wilks' Lambda	F	Df1	Df2	Sig.
Age	.308	197.490	1	88	.000
Education	.261	249.733	1	88	.000
Land holdings	.976	2.167	1	88	.145
Farming experience	.937	5.932	1	88	.017
Annual income	.270	238.381	1	88	.000

On the basis of information given in Table 3, the discriminant function for the adoption of micro irrigation can be written as Equation (1): Y= -1.801+(-.059*A)+ 0.273*E+(-0.046)*L+0.012*F+0.000*AI

5.2 Test of equality of group means for micro irrigation system
Table 3 shows that Wilk's Lambda was found to be significant for each attribute with a significance value of less than 0.05. Except for the farmer's landholdings, the data showed that the means of both groups were significantly different for all micro irrigation system characteristics. If the number of responses in both categories is equal, the cut off score can be calculated using the average of both groups. However, in this study, 52 farmers were classed as adopters, whereas 38 were labelled as non-adopters, and the cut-off score was derived using Eqn.

C=n1y1+n2y2/n1+n2

Where Y1 and Y2 are the discriminant scores for group 1 (non-adopters) and group 2 (adopters), respectively, and n1 and n2 are the group sizes. The cut off score for the discrimination function was 2.80 after substituting the numbers in the formula. As a result, every respondent with a score of more than 2.80 is categorised as an adopter, while those with a score of less than 2.80 are labelled as non-adopters. Significance of the discriminating function should be checked to ensure the reliability of the discrimination observed.

This is done with the help of a statistic called Wilk's Lambda. The Wilk's Lambda Statistic is described in full in Table 3. Wilk's Lambda is calculated as a ratio of within group sum of squares to total sum of squares, with the dependent variable being the discriminant score of individual respondents and the independent variable being the category to which they belong. It can have a value of "0 to 1," with 0 denoting perfect discrimination and 1 denoting no discrimination at all.

5.3 Canonical discriminant function coefficients

Table 4 also shows that standardised Canonical Function Coefficients are unit-independent and are comparable to "beta" coefficients in regression. The predictors are ranked using these standardised coefficients, and the variable with the highest value is deemed to contribute the most to discrimination. Another technique to interpret the relative contributions of individual predictor variables is to use the structure matrix coefficient. The correlations generated by correlating the discriminant score with each of the independent variables are known as structural coefficients. Table 4 shows that criteria including landholding, farming experience, and age had the greatest impact on discriminating.

Table 4: Canonical discriminant function coefficients

Variables	Canonical Discriminant Function Coefficients (unstandardized)	Standardized Canonical Discriminant Function Coefficients	Structure Matrix
Age	-.059	-.404	-.564
Education	.273	.649	.634
Land holdings	-.046	-.202	.059
Farming experience	.012	.073	.098
Annual income	.000	.589	.620
(Constant)	-1.801		

5.4 Functions at group centroid

Table 5: Functions at group centroid

Micro irrigation system	Function
Adopters	2.245
Non-adopters	-3.072

The estimated unstandardized discriminating function has been given in table 4. As the scores are unstandardized; the scores in original unit of measurement should be used.

The average score for adopters and non-adopters was calculated separately, and this was referred to as group centroid. Table 5 shows the value of the group centroid. Table 5 shows that the group centroid value for micro irrigation system adopters was 2.245, whereas the value for non-adopters was -3.072. This value can be used as a criterion for categorising respondents as adopters or non-adopters.

5.5 Wilk's lambda statistic for micro irrigation system

A modest Lambda value is always welcome because it indicates that discrimination exists. The statistic should be considered significant at all times (as insignificant value indicates the difference among the groups exists because of sampling error). The Chi-square test is used to determine the relevance of Wilk's Lambda. Wilk's Lambda of the discriminant function was found to be 0.124, corresponding to a Chi-square statistic of 178.354. (Table 6). The significance of Wilk's Lambda statistic was determined using the Chi-square test statistic and a significance value of 0.000, which was less than 0.05. As a result, it was determined that the discriminant function adequately explained group membership.

Table 6: Wilk's lambda statistic for micro irrigation system

Test of function	Wilk's lambda	Chi-square	Df	Sig
Dimension 0 1	0.124	178.354	5	0.000

5.6 Classification for micro irrigation system

The accuracy of the discriminant function classification was assessed using the classification matrix shown in Table 7. It can be seen from table 7 that discriminant function correctly classifies the 100 percent of the respondents of current study. The figure was arrived at by calculating the hit ratio (i.e., ratio of no. Of correct predictions/ total number of cases). So, it was concluded from the study that farmer's variables like age, education and annual income successfully discriminated the most towards the adoption of micro irrigation system. In other words, it can be said that age, education and annual income majorly influence the adoption of micro irrigation system in farmers.

6. Conclusion

The study validates that fact that adopting of micro irrigation system is no longer unidirectional process and there are various variables that influencing the adoption of micro irrigation system. The study discovered that there are distinct and major variables that account for the adoption of micro irrigation systems, such as education, age, and annual income. This research found that a single variable cannot affect a farmer's decision to use a micro irrigation system. The study demonstrates the fact that farming experience is the important variable that make farmers think about the adoption of micro irrigation system.

Table 7: Classifications for micro irrigation system

Classification results	Micro irrigation system	Predicted group membership		
		Non-adopters	Adopters	Total
Original	Non-adopters(count)	38	0	38
	Adopters (count)	0	52	52
	Non-adopters (percentage)	100.0	.0	100.0
	Adopters (percentage)	.0	100.0	100.0

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