FACTORS INFLUENCING THE FARMERS TO CULTIVATE CROPS UNDER DRIP IRRIGATION SYSTEM IN ERODE DISTRICT, TAMIL NADU

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ABSTRACT

Drip irrigation is not a substitute for other proven methods of irrigation. It is just another way of applying water. It is best suited to areas where water quality is marginal, land is steeply sloping or undulating and of poor quality, where water or labour are expensive, or where high value crops require frequent water applications. Many crops are irrigated by the drip method in India with the tree crops occupying the maximum percentage of the total area under drip irrigation, followed by vine crops, vegetables, field crops, flowers and other crops. The study to examine the factors influencing the farmers to cultivate crops under drip irrigation system in Erode district of Tamil Nadu. The statistical tools like KMO test and Bartlett's test of Sphericity, Factor Analysis, Mean Score and Mean Rank Analysis were used for analysing the data for the study.

Keywords: *Drip irrigation, Factor Analysis, soil moisture, Micro Irrigation System, etc.,*

1. INTRODUCTION

Drip irrigation is the most efficient water and nutrient delivery system for growing crops. It delivers water and nutrients directly to the plant's roots zone, in the right amounts, at the right time, so each plant gets exactly what it needs, when it needs it, to grow optimally. In this technique of drip irrigation water flows through a filter into special drip pipes, with emitters located at different spacing. Water is distributed through the emitters directly into the soil near the roots through a special slow-release device.

In India, the irrigated area consists of about 36 per cent of the net sown area. Presently, the agricultural sector accounts for about 83 per cent of all water usage. The remaining uses include 5,3,6 and 3 per cent respectively, by domestic, industrial and energy sectors and other consumers. Increasing competition with the other water users in the future would limit the water availability for expanding irrigated area. In traditional surface irrigation methods, the losses in water conveyance and application are large. These losses can be considerably reduced by adopting drip and sprinkler irrigation methods. Among all the irrigation methods, the drip irrigation is the most efficient and it can be practiced in a large variety of crops, especially in vegetables, orchard crops, flowers and plantation crops. In drip irrigation, water is applied near the plant root through emitters or drippers, on or below the soil surface, at a low rate varying from 2-20 litres per hour. The soil moisture is kept at an optimum level with frequent irrigations. Drip irrigation results in a very high water application efficiency of about 90-95 per cent.

The present study proposes to study the factors influencing the farmers to cultivate crops under drip irrigation system in Erode District, Tamil Nadu using KMO test and Bartlett's test of Sphericity, Factor Analysis, Mean Score and Mean Rank Analysis.

2. STATEMENT OF THE PROBLEM

Drip irrigation increases yield, saves water much better than flood irrigation, more land can be irrigated with the water thus saved, crop grows consistently healthier and matures fast, early maturity results in higher and faster returns on investment, fertiliser use efficiency increases, cost of fertilisers, inter-culturing and labour use gets reduced, fertilizer and chemical treatment can be given through Micro Irrigation System itself and undulating terrains, saline, water logged, sandy & hilly lands can also be brought under productive cultivation.

In India, there has been a tremendous growth in the area under drip irrigation during the last 15 years. At present, around 3.51akh ha area is under drip irrigation with the efforts of the Government of India, while it was only 40 ha in 1960. Maharashtra (94,000 ha), Karnataka (66,000 ha) and Tamil Nadu (55,000 ha) are some of the states where large areas have been brought under drip irrigation. Against this background, the present study makes an attempt to examine factors influencing the farmers to cultivate crops under drip irrigation system in Erode District, Tamil Nadu.

3. OBJECTIVE OF THE STUDY: The objective of the study is as follows:

- To examine the factors influencing the farmers to cultivate crops under drip irrigation system in Erode District, Tamil Nadu.

4. AREA AND PERIOD OF THE STUDY: The study on the factors influencing the farmers to cultivate crops under drip irrigation system is confined to Erode District only. The study was conducted from July 2019 to December 2019.

5. COLLECTION OF DATA: The study used both primary and secondary data. The required primary data are collected through well structured questionnaire. Secondary data are gathered through books, journals, magazines, websites and other research works.

6. SAMPLING DESIGN: To achieve the objectives of the study, Erode district has been purposively selected as the study area. The population of the research consists of all the farmers who cultivate their crops using drip irrigation system in Erode district with at least one year of experience in drip irrigation farming. The list of farmers cultivating crops using drip irrigation system could not be obtained. There are 10 Taluks in Erode district namely Anthiyur, Bhavani, Erode, Gobichettipalayam, Kodumudi, Modakurichi, Perundurai, Sathyamangalam, Thalavadi and Nambiyur. It has been decided to select 50 drip using farmers from each Taluk. The method of sampling used for selecting sample respondents for the study is non-probability convenience sampling method. Hence, the total sample size selected for the study is 500 farmers who cultivate crops using drip irrigation system for a minimum of 1 year.

7. TOOLS USED FOR DATA ANALYSIS: The statistical tools used for analysis are KMO test and Bartlett's test of Sphericity, Factor Analysis, Mean Score and Mean Rank Analysis.

8. FACTORS INFLUENCING THE FARMERS TO CULTIVATE CROPS UNDER DRIP IRRIGATION SYSTEM IN ERODE DISTRICT- FACTOR ANALYSIS

Factors influencing the farmers to cultivate crops under drip irrigation systemin Erode District are described here with the help of factor analysis. In order to explore the possibility of applying factor analysis to the data in hand, the inter-correlation matrix was first calculated by using Bartlett's test of Sphericity and Kaiser-Meyer-Olkin measure of sampling adequacy (KMO). The anti-image matrix was also calculated and the findings suggest that there is no need to drop any item and all the items should be included in the final factor analysis procedure. Principal component method, the most commonly used method, was used to find the initial solution. The initial solution suggests that the factors have an Eigen value greater than 1 and the factor pattern is consistent across the sample, which is easy to interpret since the items loaded heavily on a single factor.

Before applying factor analysis, it has been decided to use Kaiser-Meyer-Olkin (KMO) Measure and Bartlett's test. The KMO measure of sampling adequacy is an index used to examine the appropriateness of factor analysis. High values (between 0.5 and 1.0) indicate factor analysis is appropriate. Values below 0.5 imply that factor analysis may not be appropriate.

Bartlett's test of sphericity is a test statistic used to examine the hypothesis that the variables are uncorrelated in the population. In other words, the population correlation matrix is an identity matrix whereby each variable correlates perfectly with itself ($r = 1$) but has no correlation with the other variables ($r = 0$). To be appropriate, this test should have a significance value less than 0.05.

Factor Analysis technique has been applied to find the underlying dimensions (factors) that exists in the original variables. Table 1 shows the findings of KMO and Bartlett's test.

Table 1: Factors Influencing the Farmers to Cultivate Crops under Drip Irrigation System - KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.781
Bartlett's Test of Sphericity	Approx. Chi-square	1257.655
	Df	171
	Sig.	.000

Table 1 reveals that the calculated value of Kaiser-Meyer-Olkin measure of sampling adequacy is 0.781. It suggests that the factors extracted account for a substantial amount of variance. As this value is greater than 0.5, it has been decided to apply the factor analysis. KMO test yields a result of 0.781 which states that factor analysis can be carried out appropriately for these 17 variables which are taken for the study. The result of the test shows that with the significant value of .000 there is a significant relationship regarding the variables chosen. Furthermore, Bartlett's test of sphericity also suggests that the inter-correlation matrix is factorable and factor analysis can be applied to the current data as the correlation between different items is also statistically significant ($p<0.01$).

9. FACTOR EXTRACTION

Using the Principal Component Analysis seven factors have been extracted based on the variance (Eigen value greater than 1). Table 2 shows the percentage of variance, cumulative percentage and the total variance of the variable identified for the study.

10. PRINCIPAL COMPONENT ANALYSIS

Principal component analysis was a factor model in which the factors are based on the total variance. Another concept in factor analysis is the rotation of factors. Varimax rotations are one of the most popular methods used in the study to simplify the factor structure by maximizing the variance of a column of pattern matrix. Another technique called latent root criteria is used. An Eigen value is the column sum of squares for a factor. It represents the amount of variance in data. After determination of the common factors, factor scores are estimated for each other. The common factors themselves were expressed as linear combinations of the observed variables.

Various factors have been influencing the farmers while preferring drip irrigation system to cultivate crops. These ranges of factors begin with 1 to 5.Based on the review of previous studies and a detailed discussion with the farmers and agriculture officials, all the relevant influencing variables are included in the study. Seventeen variables are generated for measuring the attitude of the farmers towards preference of drip irrigation system in crop cultivation on a Likert's 5 point scale.

The seven factors extracted together account for 78.51 per cent of the total variance (information contained in the original seventeen variables). This is pretty good, because it is easy to economize on the number of variables (from 17 it has been reduced to 7 underlying factors), while there is a loss only about 21.49 per cent of the information content (78.51 per cent is retained by the 7 factors extracted out of the 17 original variables).

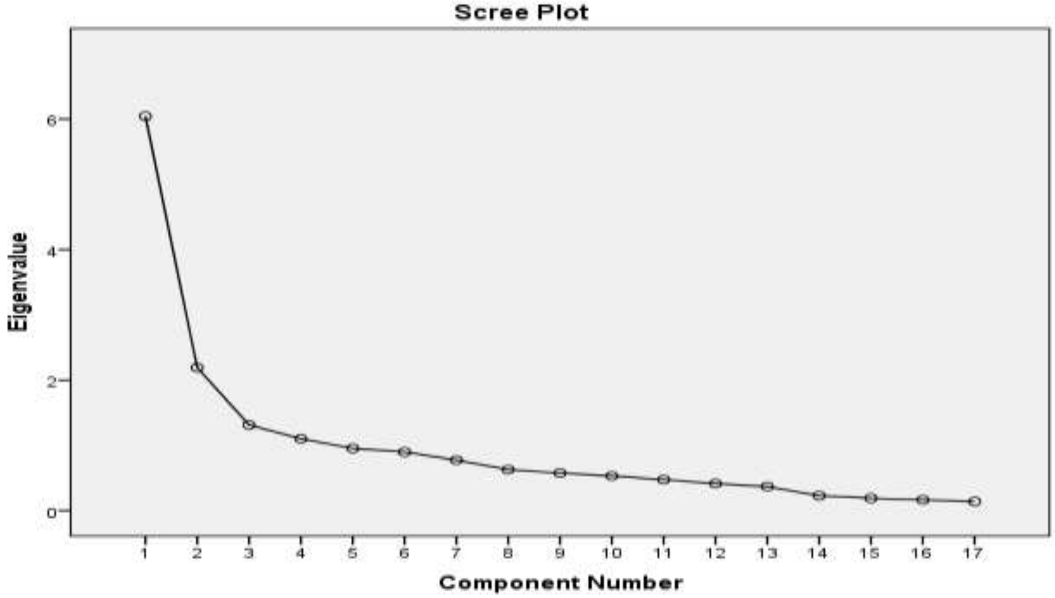
Table 2- : Factors Influencing the Farmers to Cultivate Crops under Drip Irrigation System -Total Variance Explained

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Component 1	5.539	29.155	29.155	5.539	29.155	29.155
Component 2	2.355	12.393	41.548	2.355	12.393	41.548
Component 3	1.836	9.663	51.211	1.836	9.663	51.211
Component 4	1.567	8.245	59.456	1.567	8.245	59.456
Component 5	1.339	7.045	66.501	1.339	7.045	66.501
Component 6	1.245	6.553	73.054	1.245	6.553	73.054
Component 7	1.036	5.455	78.509	1.036	5.455	78.509
Component 8	.864	4.548	83.057			
Component 9	.765	4.029	87.086			
Component 10	.562	2.957	90.043			
Component 11	.447	2.353	92.396			
Component 12	.392	2.061	94.457			
Component 13	.253	1.330	95.787			
Component 14	.248	1.303	97.091			
Component 15	.187	.985	98.076			
Component 16	.151	.797	98.873			
Component 17	.109	.576	99.448			

Extraction Method: Principal Component Analysis.

The following figure gives the screen plot for the 17 variables taken for the study.

Chart 1 - Screen Plot Showing Factors Influencing the Farmers to Cultivate Crops under Drip Irrigation System



11. ROTATED COMPONENT MATRIX

Since the idea of factor analysis is to identify the factors that meaningfully summarize the sets of closely related variables, the rotation phase of the factor analysis attempts to transfer initial matrix into one that is easier to interpret. The rotated component matrix is used to assign variables to factors and to interpret factors. This matrix should be viewed column wise for each column (factor) the variables which have high (close to 1) loading should be identified and a combined meaning for the factor found. This leads to a phrase which is the name given to the factor. The scores of the various factors influencing the farmers to cultivate crops under drip irrigation system have been included for the factor analysis. Varimax rotation method is used to extract meaningful factors. The rotated component matrixes for the influencing variables are given in Table 3.

Table 3: Factors Influencing the Farmers to Cultivate Crops under Drip Irrigation System -Rotated Component Matrix

Factors Influencing the Drip Irrigation System	Component						
	1	2	3	4	5	6	7
Getting subsidy from the government	**.789**	.081	.028	-.126	.155	-.188	.034
Easy fertiliser application	**.783**	-.444	-.025	-.110	.233	-.119	-.014
Useful if frequent power failure	**.689**	.463	.149	-.271	-.004	.188	.147
Flexibility	-.369	**.662**	-.141	.370	.209	-.088	.104
Water saving	-.094	**.645**	.264	.365	-.048	-.014	-.268
High yielding	-.427	**.532**	-.161	.293	-.330	-.271	-.258
Efficient and uniform irrigation	.265	.168	**.725**	-.108	-.068	.242	.372
No drainage requirements	.459	.488	**.543**	-.177	-.254	.084	.068
Reduction in weeds	-.437	.240	-.173	**.623**	-.060	.387	-.205
Can have good yield even in droughts	.386	-.280	-.047	**.585**	.089	.453	-.084
Highly effective in large farms	.262	.234	.305	**.566**	-.162	-.264	.016
Convenience in irrigation	.226	-.128	.278	-.120	**.690**	-.132	.424
Increase in cultivable area	-.217	-.240	.035	-.036	**.682**	.072	-.031
Long term usage	.185	.321	-.193	.337	-.262	**.668**	.133
Possibility of multirationing	.448	-.056	-.206	.413	.072	**.644**	-.301
Less labour requirements	.108	.358	-.380	.142	-.108	.000	**.683**
Minimum work	-.026	-.221	.540	.025	-.058	.052	**.633**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Table 3 clearly discloses that 'Getting subsidy from the government' 'Easy fertiliser application', 'Efficient and uniform irrigation', 'Convenience in irrigation', 'Useful if frequent power failure', 'Convenience in irrigation' and 'Less labour requirements' are the major factors influencing the farmers to cultivate crops under drip irrigation systemin the study region as the correlation coefficients are very high for these variables.

It is also noted from Table 3 that variables 'Getting subsidy from the government', 'Easy fertiliser application' and 'Useful if frequent power failure' are with the loadings of 0.789, 0.783 and 0.689 respectively on factor 1 and this suggests that factor 1 is a combination of these variables. At this point, a suitable phrase which captures the essence of the original variables to form the underlying concept, factor 1 could be named as 'SUBSIDY, FERTILISER & USEFUL DURING POWER CUTS'.

In case of the factor 2 columns, the variables 'Flexibility', 'Water saving' and 'High yielding' are with the loadings of 0.662, 0.645 and 0.532 respectively on factor 2 andthis suggests that factor 2 is a combination of these variables. At this point, a suitable phrase which captures the essence of the original variables to form the underlying concept, factor 2 could be named as 'FLEXIBILITY, WATER SAVING & YIELD'.

In case of the factor 3 columns, the variables 'Efficient and uniform irrigation' and 'No drainage requirements' are with the loadings of 0.725 and 0.543respectively on factor 3 and this suggests that factor 3 is a combination of these variables. At this point, a suitable phrase which captures the essence of the original variables to form the underlying concept, factor 3 could be named as 'IRRIGATION EFFICIENCY & NO DRAINAGE'.

In case of the factor 4 columns, 'Reduction in weeds', 'Can have good yield even in droughts' and 'Highly effective in large farms' are with the loadings of 0.623, 0.585 and 0.566 on factor 4 and this suggests that factor 4 is a combination of these variables. At this point, a suitable phrase which captures the essence of the original variables to form the underlying concept, factor 4 could be named as 'BENEFITS'.

In case of the factor 5 columns, 'Convenience in irrigation' and 'Increase in cultivable area' are with the loadings of 0.690 and 0.682 on factor 5 and this suggests that factor 5 is a combination of these variables. At this point, a suitable phrase which captures the essence of the original variables to form the underlying concept, factor 5 could be named as 'CONVENIENCE & EXPANSION OF CULTIVATION'.

In case of the factor 6 columns, 'Long term usage' and 'Possibility of multirationing' are with the loadings of 0.668 and 0.644 on factor 6 and this suggests that factor 6 is a combination of these variables. At this point, a suitable phrase which captures the essence of the original variables to form the underlying concept, factor 6 could be named as 'LONGEVITY & MULTIRATIONING'.

In case of the factor 7 columns, 'Less labour requirements' and 'Minimum work' are with the loadings of 0.683 and 0.633 on factor 7 and this suggests that factor 7 is a combination of these variables. At this point, a suitable phrase which captures the essence of the original variables to form the underlying concept, factor 7 could be named as 'MINIMUM LABOURS &WORK'.

The factor analysis explained the seventeen variables into seven factors namely Subsidy Fertiliser & Useful during Power Cuts, Flexibility Water Saving & Yield, Irrigation Efficiency & No Drainage, Benefits, Convenience & Expansion of Cultivation,Longevity & Multirationing and Minimum Labours &Work. The number of variables in each factor, Mean score and Rank, Eigen value and the per cent of variation explained by each factor are presented in Table 4. Mean value computed on the basis of each variable loaded in the components divided by the number of respondents. Rank has been computed on the basis of grand mean of each construct. Eigen value is the eligibility to be considered as factor. Minimum of 1 Eigen value required. Variance is the influence of factor for explaining the attitude of farmers.

Table 4: Factors Influencing the Farmers to Cultivate Crops under Drip Irrigation System - Principal Component Analysis

S.No.	Name of the Factors	No. of Variables	Mean Score	Mean Rank	Eigen Value	Per cent of Variation Explained	Cumulative Per cent of Variation Explained
1	Subsidy Fertiliser & Useful during Power Cuts	3	4.23	1	5.539	29.155	29.155
2	Flexibility Water Saving & Yield	3	3.01	2	2.355	12.393	41.548
3	Irrigation Efficiency & No Drainage	2	2.94	4	1.836	9.663	51.211
4	Benefits	3	2.96	3	1.567	8.245	59.456
5	Convenience & Expansion of Cultivation	2	2.27	6	1.339	7.045	66.501
6	Longevity & Multi-rationing	2	2.51	5	1.245	6.553	73.054
7	Minimum Labours &Work	2	2.23	7	1.036	5.455	78.509

The major factors influencing the farmers to cultivate crops under drip irrigation system are Subsidy, Fertiliser & Useful during Power Cuts and Flexibility, Water Saving & Yield as their Eigen values are 5.539 and 2.355 respectively as shown by Table 4. The Subsidy, Fertiliser & Useful during Power Cuts factor consists of 3 variables with the variation explained of 29.155 per cent. The Flexibility Water Saving & Yield factor consists of 3 variables explaining the variation to the extent of 12.393 per cent. The Irrigation Efficiency & No Drainage factor consists of 2 variables explaining the variation to the extent of 9.663 per cent. Benefits factor consists of 3 variables explaining the variation to the extent of 8.245 per cent. Convenience & Expansion of Cultivation factor consists of 2variables. The per cent of variation explained by this factor is 7.786 per cent. Longevity & Multi-rationing factor consists of 2 variables. The per cent of variation explained by this factor is 6.553 per cent. Minimum Labours &Work factor with 2 variables is identified as the least factor. The per cent of variation explained by this factor is 5.455 per cent.

The highly correlated variable of the Subsidy, Fertiliser & Useful during Power Cuts factor is Getting subsidy from the government. It has the factor loading of 0.789. The variable Flexibility is the highly correlated variable of the Flexibility, Water Saving & Yield factor as it has the highest factor loading of 0.662. Efficient and uniform irrigation variable of the Irrigation Efficiency & No Drainage factor has the highest factor loading of 0.725. Regarding the Benefits factor, the variable Reduction in weeds has the highest factor loading of 0.623. The highly correlated variable of the Convenience & Expansion of Cultivation factor is Convenience in irrigation. It has the factor loading of 0.690. The variable Long term usage the highly correlated variable of the Longevity & Multi-rationing factor as it has the highest factor loading of 0.668. Less labour requirements variable of the Minimum Labours &Work factor has the highest factor loading of 0.683.

According to Mean Rank analysis, Subsidy Fertiliser & Useful during Power Cuts factor is identified as the major factors influencing the farmers to cultivate crops under drip irrigation system with the highest mean score of 4.23 and Flexibility Water Saving & Yield factor is identified as the second major factors influencing the farmers to cultivate crops under drip irrigation system with the second highest mean score of 3.01 followed by Benefits factor (2.96), Irrigation Efficiency & No Drainage Factors (2.94) and Longevity & Multi-rationing (2.51). Convenience & Expansion of Cultivation (2.27) and Minimum Labours &Work (2.23) are identified as the least factors influencing the farmers to cultivate crops under drip irrigation system in the study region.

12. CONCLUSION

Results revealed that the major factors influencing the farmers to cultivate crops under drip irrigation system in the study region are 'Getting subsidy from the government' 'Easy fertiliser application', 'Efficient and uniform irrigation', 'Convenience in irrigation', 'Useful if frequent power failure', 'Convenience in irrigation' and 'Less labour requirements' as the correlation coefficients are very high for these variables. The major factors influencing the farmers to cultivate crops under drip irrigation system are Subsidy, Fertiliser & Useful during Power Cuts and Flexibility, Water Saving & Yield as their Eigen values are higher.

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