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# Adoption of Drip Irrigation Technology by Sugarcane Growers of Rajasthan

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**ABSTRACT**

Drip Irrigation is an effective technology and efficient method of delivering irrigation water directly into the soil at root zone of plants and makes efficient use of water especially when compared to conventional methods of irrigation. To encourage the farmers for adopting drip irrigation technology, Drip Irrigation Programme is being implemented intensively in the Sri Ganganagar district by Rajasthan State Ganganagar Sugar Mills in collaboration with the Department of Agriculture, Rajasthan. The sugarcane is a major cash crop in some tehsils of Sri Ganganagar district. Sugarcane crop needed more water in cultivation so drip irrigation system plays a crucial role to fulfill the water need to crop. Three tehsils namely Srikaranpur, Sri Ganganagar and Raisinghnagar were selected purposely for the present investigation on the basis of highest area of sugarcane cultivation using drip irrigation system. The census method was used to select the user respondents. Further, equal number of non-beneficiary sugarcane growers from same tehsils were also selected randomly who have not benefited under Drip Irrigation Programme. Thus, total 60 beneficiary and 60 non-beneficiary sugarcane growers were selected from the above mentioned three tehsils for the present investigation. The total sample size from the selected three tehsils was 120 sugarcane growers. Data were collected with the help of pretested semi-structured interview schedule. The findings of the study revealed that majority of the respondents had medium level of adoption of drip irrigation technology. In respect of adoption aspects of the drip irrigation system, "spacing between two emitters and lateral" was widely adopted by the farmers. Whereas, the farmers had least adoption of "system information" regarding drip irrigation system. Beneficiary respondents had high adoption level as compared to non-beneficiary respondents. The results of the study also depicted that a positive and significant association found between the adoption of drip irrigation system with some selected characteristics like education, annual income, land holding and occupation.

**Key words:** Adoption, drip irrigation system, sugarcane growers, RSGSM

## INTRODUCTION

The increasing continuous of population has put tremendous pressure on the land to solve food grain problems which is a stroke of golden touch. To meet the projected food demands of 21st century and to harvest maximum benefits from every unit of available land, reproduce and other critical inputs needs to be exploited. Water is the most precious natural source, vitally important for agricultural development and day-to-day living of human beings. Intensive agriculture and over growing population are depleting the already available scarce resource of the 'Water'. This is challenging situation and the need of hour is to conserve 'water' and ensure its' efficient use because 'water' is our life and future of the nation (Yadav, 2015). Drip irrigation is an effective technology and efficient method of providing irrigation water directly into the soil at root zone of plants and it limits water requirement to the consumptive use of the plants. Thus, drip irrigation minimizes such conventional losses as deep percolation, run-off and soil evaporation. It has been experienced that there is saving of 40 to 70 per cent of water and an additional yield of 30 to 70 per cent under drop by drop water in the rooting zone of the crop (Prajapati *et al.,* 2016).

Sugarcane is most important commercial crop in India. In Rajasthan scenario the area and production of

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sugarcane is 6141 ha. and 531267 tons, respectively. The productivity of sugarcane per unit area can be increased by adopting drip irrigation technology and recommended scientific & sustainable management practices. Taking into account the above consideration, training was conducted by Rajasthan State Ganganagar Sugar Mills and Department of Agriculture in Sri Ganganagar district of Rajasthan for enhancing productivity of sugarcane. Generally, there is a time lag between origin of a technology and its adoption.

The drip irrigation technology in sugarcane cultivation is not fully adopted by the farmers and is mainly grown through traditional irrigation method. There is a need for the fully adoption of drip irrigation technology in sugarcane so that production and income of the farmers can be raised. Several research results have established that about 40 to 60 per cent irrigation water could be saved by adopting drip irrigation. Therefore, Government of India and Rajasthan has started giving 50 per cent subsidy for drip irrigation systems under "Pradhan Mantri Krishi Sinchayee Yojana" where 35 per cent given by Central Government and 15 per cent by Rajasthan State Government (Anonymous, 2015-16). Therefore, realizing the importance of drip irrigation technology in sugarcane cultivation, the present study was planned and executed with the objective to assess the extent of adoption of drip irrigation system by sugarcane growers.

## METHODOLOGY

The present study was conducted in Sri Ganganagar region as this region had highest area and production of sugarcane crop as compared to other regions of Rajasthan. Sri Ganganagar region comprises of two districts namely Sri Ganganagar and Hanumangarh. Sri Ganganagar district was selected purposely on the basis of highest area & production of sugarcane crop among all districts of the state and Rajasthan State Ganganagar Sugar Mills (RSGSM) is situated at Sri Ganganagar and RSGSM is also providing drip irrigation system to the sugarcane growers in the district.

Three tehsils namely Srikaranpur, Sri Ganganagar and Raisinghnagar were selected for the present study on the basis of highest area of sugarcane cultivation using drip irrigation system and Drip Irrigation Programme is also being implemented intensively by RSGSM in collaboration with Department of Agriculture, Rajasthan in these three tehsils only. The census method was used to select the user respondents and they were called as beneficiary of Drip Irrigation System because they have benefited under Drip Irrigation Programme by RSGSM. Further, equal number of non-beneficiary sugarcane growers from same tehsils were also selected randomly who have not benefited under Drip Irrigation Programme and they were called as non-beneficiary sugarcane growers. Thus, total 60 beneficiary and 60 non-beneficiary sugarcane growers were selected from the above mentioned three tehsils for the present investigation. Hence, the total sample size from the selected three tehsils was 120 sugarcane growers. The data were collected with the help of pretested semi-structured interview schedule. Analysis of the data was done with the help of different statistical tools like frequency distribution, percentage, mean, standard deviation, mean percent score, correlation coefficient(r), rank correlation, 'z' test, t-test as well as multiple linear regression.

## RESULTS AND DISCUSSION

Adoption is a mental process. It is a decision to make full use of new idea as the best course of action available. In the modern era, many new things are being invented by our agricultural scientists but all the innovations are not being adopted by many of the members of social system. Adoption of an innovation depends on many factors *viz.,* awareness and knowledge of adopters, innovativeness characteristics and perceived attributes of Innovation. It is generally assumed that if an individual has more knowledge about different aspects of technologies he or she is likely to adopt the innovations with higher speed. The term in this study was used to refer the regular use of drip irrigation technology by the farmers either fully or partially. The results regarding the extent of adoption of drip irrigation system have been presented in Table 1.

The perusal of data in Table 1 revealed that in case of beneficiary respondents majority of them (66.67%) had medium level of adoption followed by high (26.66%) and low (6.67%), respectively. Further, in case of non-beneficiary farmers, fifty per cent of the farmers found to be medium adopters and forty five per cent respondents were low adopters, while only five per cent of non-beneficiary respondents were categorized as high adopters of drip irrigation system. If we look at the data presented in the Table 1 as a whole irrespective of type of farmers *i.e.* beneficiary and non-beneficiary farmers, the data depicts that nearly sixty per cent of the farmers were medium adopters of drip irrigation system followed by low (25.83%) and high (15.83%) adopters of drip irrigation system respectively. The findings are in line with the findings of Katkar & Ahire (2006), Patel *et al.* (2017) and Yadav et al. (2019) who revealed that majority of farmers had medium extent of adoption of drip irrigation system.

**Table 1: Distribution of Respondents according to Extent of Adoption of Drip Irrigation System**

| Categories | Respondents | | | | | |
|---|---|---|---|---|---|---|
| | Beneficiary Respondents (n=60) | | Non-beneficiary Respondents (n=60) | | Overall Respondents (n =120) | |
| | f | % | f | % | f | % |
| Low (< 20 Score) | 04 | 06.67 | 27 | 45.00 | 31 | 25.83 |
| Medium ( 20 to 74 Score) | 40 | 66.67 | 30 | 50.00 | 70 | 58.34 |
| High (> 74 Score) | 16 | 26.66 | 03 | 5.00 | 19 | 15.83 |

Mean: 47 S.D.: 27

Further, the extent of adoption about various aspects of drip irrigation system was also analyzed separately. The relative importance of extent of adoption of all the seven aspects of drip irrigation system was highlighted by ranking them in descending order on the basis of Mean Per cent Score and results have been presented in Table 2.

The data in Table 2 showed that overall extent of adoption of drip irrigation system by beneficiary respondents was very good with 71.40 MPS. Thus, it can be concluded that in the study area beneficiary farmers were very conscious about various aspects of drip irrigation system such as area under drip irrigation, irrigation schedule, no. of emitters per plant, system information and spacing between two emitters & laterals with 100, 75.68, 73.73,70.20 and 70.00 MPS, respectively. They had low level of extent of adoption in case of fertigation and system operation & maintenance with 56.63 and 53.53 MPS, respectively.

**Table 2: Aspect-wise Extent of Adoption of Drip Irrigation System by the Respondents**

| Adoption Aspects | Respondents | | | | | |
|---|---|---|---|---|---|---|
| | Beneficiary Respondents (n=60) | | Non-beneficiary Respondents (n=60) | | Overall Respondents (n =120) | |
| | MPS | Rank | MPS | Rank | MPS | Rank |
| Area under drip irrigation | 100.00 | I | 08.33 | VII | 54.17 | II |
| System information | 70.20 | IV | 12.00 | V | 41.10 | VII |
| System operation and maintenance | 53.53 | VII | 31.90 | III | 42.72 | V |
| Spacing between two emitters and laterals | 70.00 | V | 40.13 | I | 55.07 | I |
| No. of emitters per plant | 73.73 | III | 25.09 | IV | 49.41 | III |
| Irrigation schedule | 75.68 | II | 08.38 | VI | 42.03 | VI |
| Fertigation | 56.63 | VI | 32.33 | II | 44.47 | IV |
| Pooled | 71.40 | | 29.73 | | 46.4 | |

rs= rank correlation
*significant at 0.05 level of probability
MPS= Mean Percent Score

rs= - 0.82
t = 3.22*

In case of non-beneficiary respondents, they possessed high adoption level regarding various aspects like spacing between two emitters & laterals, fertigation, and system operation & maintenance with 40.13, 32.33 and 31.90 MPS, respectively. They had low adoption level about no. of emitters per plant, system information, irrigation schedule and area under drip irrigation with 25.09, 12.00, 8.38, and 8.33 MPS, respectively. If we look at the data presented in the Table 2 irrespective of beneficiary and non-beneficiary farmers, then it is observed that overall respondents had very good adoption level regarding spacing between two emitters & laterals, area under drip irrigation, no. of emitters per plant and fertigation with 55.07, 54.17, 49.41 and 44.47MPS, respectively.

They had low adoption level in the aspects like system operation & maintenance, irrigation schedule and system information with 42.72, 42.03, and 41.10 MPS, respectively. Hence, it may be concluded that farmers were least bothered about these aspects of drip irrigation system. The overall extent of adoption of the beneficiary farmers (71.40 MPS) was higher than the non-beneficiary farmers (29.73 MPS).

The value of calculated rank correlation (rs) was 0.82 which was positive and significant at 0.05 per cent level of probability, leading to conclusion that there was a similarity in rank assignment pattern of adoption level of beneficiary and non-beneficiary farmers about drip irrigation system, though there was a difference in the magnitude of MPS of beneficiary and non-beneficiary farmers.

Table 3 elucidated that among the seven important aspects of drip irrigation system, only fertigation showed non-significant difference in the adoption level of beneficiary and non-beneficiary farmers. There was a highly significant difference found in the extent of adoption of beneficiary and non-beneficiary farmers in remaining six aspects of drip irrigation system i.e. area under drip irrigation, system information, system operation & maintenance, spacing between two emitters & laterals, no. of emitters per plant and irrigation schedule as their calculated 'Z' value was higher than the tabulated 'Z' value at 1 per cent level of significance. Overall calculated 'Z' value was higher than the tabulated value at 1 per cent level of significance leading to the conclusion that there was a noteworthy difference found in the extent of adoption of drip irrigation system between beneficiary and non-beneficiary respondents.

**Table 3: Aspect-wise Comparison of Extent of Adoption of Drip Irrigation System**

| Aspects | Beneficiary Respondents (n=60) | | Non-beneficiary Respondents (n=60) | | 'Z' Value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | S.D. | |
| Area under drip irrigation | 10.00 | | 00.67 | 2.52 | ∞ |
| System information | 07.02 | 1.87 | 00.60 | 1.36 | 13.38** |
| System operation and maintenance | 08.03 | 2.21 | 09.57 | 8.49 | 10.32** |
| Spacing between two emitters and laterals | 03.50 | 1.00 | 06.02 | 4.57 | 3.08** |
| No. of emitters per plant | 22.12 | 4.07 | 05.52 | 7.17 | 8.79** |
| Irrigation schedule | 16.65 | 3.64 | 00.67 | 1.97 | 11.87** |
| Fertigation | 04.53 | 1.56 | 03.23 | 4.24 | 1.44NS |
| Pooled | 10.26 | 2.05 | 03.75 | 4.33 | 6.98** |

*significant at 0.01 level of probability
NS= Non-significant, S.D. = Standard deviation

Thus, this is proved evidently that the adoption of drip irrigation system was more among beneficiary farmers as compared to non-beneficiary farmers as the significant difference found between beneficiary and non-beneficiary respondents about adoption of drip irrigation system in the study area. It might be due to the reason that beneficiary respondents remained in the continuous touch with the extension personnel throughout the session of the training so they might have acquired sufficient skill pertaining to drip irrigation system. Thus, they were more likely to practice the learnt skill in their fields.

**Regression Analysis between Socio-personal, Socio-economic and Communication Pattern Characteristics with Extent of Adoption of Respondents about Drip Irrigation System**

Adoption process consists of certain phases, after passing through which, an individual decides whether to adopt or reject the particular innovation. There might be some factors which are responsible for adoption of recommended drip irrigation technology. Therefore, it was tried to trace out these factors by finding out relationship between dependent variable *i.e.* extent of adoption and selected independent variables. The Table 4 illustrates the value of coefficient of determination (R2) in case of beneficiary farmers was estimated as 0.77 which means seventy seven per cent variation in the dependent variable *i.e*. adoption was due to the 14 independent variables taken for this investigation. Further, the't'-test of significance expressed that coefficient of regression of variables *viz.* education (3.27**), occupation (4.07**), annual income (4.18**) and land holding (4.06**) were found to be significant at one per cent level of significance. Whereas coefficient of regression was non-significant in case of other variables such as age, caste, family type, family size, social participation, source of credit, mass media exposure, information seeking behaviour, information sharing behaviour and extension agency contact in the adoption of drip irrigation system. Similarly, in case of non-beneficiary farmers' data in the Table 4 depicts that the value of coefficient of determination ($R^2$) was found as 0.82. The value of ($R^2$) shows that 82 per cent variation in the dependent variable was due to fourteen antecedent variables taken for the present investigation and remaining 18 per cent variation in the adoption of drip irrigation system by non-beneficiary farmers was due to other factors outside the purview of this investigation. Thus, the data in Table 4 indicates that education, occupation, annual income and land holding were the important contributing factors for the adoption of drip irrigation technology as education (3.66**) and annual income (4.12**) were positively and significantly associated with adoption at one per cent level of significance and occupation (2.32*) and land holding (2.92*) were found significant at five per cent level of significance. The other variables viz. age, caste, family type, family size, social participation, source of credit, mass media exposure, information seeking behaviour and information sharing behaviour were non-significantly associated with the extent of adoption of non-beneficiary respondents which means these variable have not shown any contribution to the multiple regression analysis leading to a conclusion that there was no association found between these selected variables with the extent of adoption of the drip irrigation system. Further, in case of overall respondents the data in Table 4 reveals that the value of coefficient of determination (R2) was calculated as 0.64 which means sixty four per cent variation in the dependent variable i.e. adoption was due to the 14 independent variables taken for this investigation. Thus, the regression analysis in Table 4 shows that education (3.50**), annual income (9.23**) and land holding (3.45**) were found to be positively and significantly associated with the adoption at one per cent level of significance and occupation (2.17*) was significantly associated with the adoption at five per cent level of significance. The other variables viz. age, caste, family type, family size, social participation, source of credit, mass media exposure, information seeking behaviour and information sharing behaviour were non-significantly associated with the extent of adoption of drip irrigation system by overall respondents. Thus, from the above findings it can be concluded that education, occupation, annual income and land holding emerged as important predictors of extent of adoption of drip irrigation system by the farmers. The other factors viz. age, caste, family type, family size, social participation, source of credit, mass media exposure, information seeking behaviour and information sharing behaviour have not shown any contribution to the multiple regression analysis and were non-significantly associated with the extent of adoption of drip irrigation system by the

farmers. The findings are in line with the findings of Katkar & Ahire (2006) and Kumar & Jitarwal (2012) observed that education, size of land holding and annual income of the respondents had positive and significant association with the adoption of drip irrigation system.

**Table 4: Regression Analysis between Socio-personal, Socio-economic and Communication Pattern Characteristics with Extent of Adoption of Respondents about Drip Irrigation System**

| Variables | Beneficiary Respondents (n=60) | | | Non-beneficiary Respondents ( n =60) | | | Pooled (n =120) | | |
|---|---|---|---|---|---|---|---|---|---|
| | b value | Standard error | t value | b value | Standard error | t value | b value | Standard error | t value |
| Socio-personal Characteristics | | | | | | | | | |
| Age | 0.00 | 0.00 | $0.02^{NS}$ | 0.20 | 0.13 | $1.52^{NS}$ | 0.00 | 0.00 | $1.02^{NS}$ |
| Caste | 0.04 | 0.11 | $0.35^{NS}$ | 0.01 | 0.06 | $0.11^{NS}$ | 0.07 | 0.06 | $1.26^{NS}$ |
| Education | 0.29 | 0.09 | $3.27^{**}$ | 0.01 | 0.00 | $3.66^{**}$ | 0.09 | 0.03 | $3.50^{**}$ |
| Family type | 0.03 | 0.11 | $0.31^{NS}$ | 0.13 | 0.13 | $0.97^{NS}$ | 0.08 | 0.10 | $0.84^{NS}$ |
| Family size | 0.15 | 0.23 | $0.66^{NS}$ | 0.04 | 0.11 | $0.32^{NS}$ | 0.07 | 0.10 | $0.73^{NS}$ |
| Social participation | 0.16 | 0.09 | $1.73^{NS}$ | 0.04 | 0.08 | $0.58^{NS}$ | 0.05 | 0.07 | $0.76^{NS}$ |
| Socio-economic Characteristics | | | | | | | | | |
| Occupation | 0.33 | 0.08 | $4.07^{**}$ | 0.23 | 0.10 | $2.32^{*}$ | 0.05 | 0.02 | $2.17^{*}$ |
| Annual income | 0.52 | 0.12 | $4.18^{**}$ | 0.50 | 0.12 | $4.12^{**}$ | 0.55 | 0.06 | $9.23^{**}$ |
| Land holding | 0.09 | 0.02 | $4.06^{**}$ | 0.24 | 0.08 | $2.92^{*}$ | 0.07 | 0.02 | $3.45^{**}$ |
| Source of credit | 0.03 | 0.15 | $0.21^{NS}$ | 0.01 | 0.04 | $0.29^{NS}$ | 0.04 | 0.04 | $0.93^{NS}$ |
| Communication Pattern | | | | | | | | | |
| Mass media exposure | 0.14 | 0.10 | $1.42^{NS}$ | 0.10 | 0.20 | $0.49^{NS}$ | 0.08 | 0.07 | $1.05^{NS}$ |
| Information seeking behavior | 0.09 | 0.13 | $0.65^{NS}$ | 0.03 | 0.02 | $1.22^{NS}$ | 0.00 | 0.00 | $0.33^{NS}$ |
| Information sharing behavior | 0.07 | 0.08 | $0.87^{NS}$ | 0.04 | 0.14 | $0.26^{NS}$ | 0.05 | 0.07 | $0.69^{NS}$ |
| Extension agency contact | 0.18 | 0.13 | $1.38^{NS}$ | 0.29 | 0.21 | $1.40^{NS}$ | 0.06 | 0.09 | $0.67^{NS}$ |
| | | $R^2 = 0.77$ | | | $R^2 = 0.82$ | | | $R^2 = 0.64$ | |

**Significant at 0.01 level of probability; *Significant at 0.05 level of probability; NS= Non-significant

## CONCLUSION

On the basis of major findings of the study, it can be concluded that in respect of adoption aspects of the drip irrigation system i.e. "spacing between two emitters and lateral" was widely adopted by the farmers. Whereas, the farmers had least adoption of "system information" about drip irrigation system. The result of the study shows that a positive and significant association found between adoption and some selected characteristics like education, annual income and land holding at one per cent level of significance and occupation was significantly associated with the adoption at five per cent level of significance. Hence, it can be said that farmers required regular trainings on these aspects to increase the adoption rate of drip irrigation technology. On the basis of the findings of the study, it was also found that most of the respondents in the study area had medium level of adoption of drip irrigation system. Thus, it is recommended that provision should be made to purchase drip irrigation system directly from open market and cost of essential input needs to be subsidized to accelerate adoption rate. During the discussion with the non-beneficiary farmers it was reported that due to the poor financial condition they could not implement the drip irrigation system. Hence, it is recommended that subsidy or loan provision may be increased to motivate the farmers and should be made available timely. Technical advice may also be provided by the specialists or other technical staff working in the field of extension regularly regarding the operational and maintenance aspects of drip irrigation technology.

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