

Adoption of Drip Irrigation in Sugarcane – A Performance Analysis

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ABSTRACT

The present investigation was carried out to analyze the socio-economic status of the sugarcane growers who laid drip irrigation system, to know their perception of advantages related with the technology in sugarcane, and to identify the constraints in adoption by interviewing 60 growers from the command area of Kallakurichi Cooperative Sugar Mills, Tamil Nadu. It was found that drip irrigation technology was popularized among the farmers of all income levels and low-income level was not a constraint for adoption of this technology due to loan arrangements from financial institutions. The water saving measures apart from drip irrigation adopted by the respondents included trash mulching, application of additional potash and alternate furrow irrigation. However, after adopting drip irrigation, all the respondents realized water and labour saving and 98.33 per cent obtained higher cane yield than conventional flood irrigation with reduced impact of drought. On an average, the respondents got 29.75 per cent increase in cane yield compared to normal irrigation methods. The constraints encountered by most of the respondents in adoption were clogging of drippers, damage of lateral tubes during harvest, rat damage and poor after sales service. In spite of these constraints, all the farmers favoured the continued adoption of this technology. The study also helps to get a better understanding of the performance of drip irrigation in farmer's fields and their apprehensions of this fast spreading technology in sugarcane.

Keywords: Sugarcane; Drip irrigation system; Advantages; Constraints; Economics;

Sugarcane originated in the wet tropics and so to achieve maximum yield, it requires an abundant supply of water, either as rainfall, irrigation or a combination of both. Under normal growing conditions, around 10 tonnes of cane is produced for each mega litre of soil water used. Conversely, moisture stress reduces cane yield to a significant level. Consequently, managing available water resources is one of the keys to profitable sugarcane production (Rogers, 2014).

Water is a precious natural resource in the world and of the available water, major share is used for agriculture and allied activities (Karpagam et al., 2013; Swetha et al., 2019). Given the water scarcity for irrigation and fast decline of available irrigation potential, it is a matter of concern whether cultivating sugarcane under conventional surface method irrigation is desirable for achieving sustainable agricultural development. One of the methods recently introduced in Indian agriculture

to increase water use efficiency is drip system of irrigation. Unlike conventional flood irrigation, under drip method of irrigation, water is supplied directly to the root zone of the crops through a network of pipes, which saves enormous amount of water by reducing evaporation and distribution losses (Rajula Shanthi and Ramanjaneyalu 2016).

In Tamil Nadu state, area under sugarcane has declined due to continuous drought, and production has also declined considerably. Recent trend in Tamil Nadu shows a stagnated yield level of around 100 t/ha and tends to decline further due to inadequate irrigation water and erratic monsoon. This situation has created a need to improve sugarcane productivity in the state to meet the increasing rate of domestic consumption requirement.

Sociological studies among cane growers have revealed the prevalence of wide technological gap as

well as yield gap in sugarcane that leads to reduced production and productivity (Rajula Shanthy and Senthil Kumar, 2010). It is possible to increase the productivity of sugarcane crop through adoption of recommended scientific modern technologies, of which micro irrigation is promising (Rajula Shanthy, 2011). This technology is not just to save irrigation water, but it is meant for high productivity particularly when it is being combined with fertigation. Keeping this in view, the present investigation attempted to know the profile of drip laid farmers, their perception related with the technology in sugarcane, the profit/loss incurred due to laying of drip irrigation system and further to help to understand the field level problems in drip irrigation.

METHODOLOGY

The study was conducted among the registered cane growers of Kallakurichi Cooperative Sugar Mills, Tamil Nadu who laid drip irrigation. The average cane yield level recorded in the reserved area of the mill was 80.00 t / ha as against the state average yield of 98 tons per hectare during 2018-19. This area was purposively selected because this area normally recorded moderate level of sugarcane yield. The other considerations were, that drip irrigation system (DIS) for sugarcane was laid since 2015, and there is an urgent need to assess the feedback from farmers to fine-tune the system, and popularize it among other registered cane growers to increase the productivity of sugarcane. The area of operation of the sugar mill is divided into eight cane divisions, of which four divisions viz., (Kallakuruchi (North), Kallakuruchi (South), Chinnasalem, Moorarpalayam) were selected at random and 60 respondents were selected from the four divisions. The particulars were collected using an interview schedule, sociological appraisal was done through focus group discussions/ observations, and yield data were recorded from the individual farms. The data collected were tabulated and analyzed using descriptive statistics.

RESULTS AND DISCUSSION

Demographic profile of sugarcane farmers adopting drip irrigation system: Demographic profile of the respondents indicated that they were mostly middle aged (35-50 years: 40.00%) to old aged (>50 years: 26.73%) and literates with up to secondary education (73.66%); Agriculture was the main occupation for all the

respondent farmers and 53.33 per cent had up to 25 years of farming experience; 33.3 per cent had 21-25 years of experience in sugarcane farming. Majority of them (76.3%) owned 2-4 acres of land. Over half of the respondents (55%) were self-sufficient in implement possession while others either fully or partially depended on hiring. Crop rotation was followed by all the respondents with paddy, pulses, sesamum or cotton. Over three-fourth (78.33%) of the respondents owned livestock such as cows, buffaloes, draught animals and poultry for additional source of income, apart from their own use; Mass media channels used by the respondents were radio, television and newspaper; All the respondents possessed radio/television, and a great majority of them (97%) watch/listen television/radio regularly. This indicated a deep penetration of radio and television in rural areas and television was the main entertainment for them. Regarding newspapers, it was observed that around 63.33 per cent of respondents were regular subscribers of newspapers. Majority (68.3%) of them had medium level of social participation as they were more into agriculture.

Water saving measures adopted by the respondents: Drip irrigation is a technology introduced in the sugar mill area in 2015, though drip irrigation for sugarcane was recommended from 2002 itself in Tamil Nadu. The water saving measures as adopted by the respondents' are given in Table 1.

Table 1. Adoption of various water saving measures (N=60)

Water saving measures	No.	%
Trash mulching	30	50.00
Application of additional potash	8	13.33
Alternate furrow irrigation	35	58.33
Drip irrigation	60	100

Table 1 reveals that all the respondents adopted drip irrigation system, as the respondents were drip laid farmers. More than half (58.33%) of the respondents followed alternate furrow irrigation and half (50%) of the respondents follow trash mulching to conserve water. Though application of additional potash (60 kg) to mitigate drought was very well popularized among the respondents, only a meagre of 13.33 per cent followed additional potash application to withstand the drought. Nevertheless, drip irrigation was accepted as the best water saving measure than trash mulching, additional potash application and alternate furrow irrigation. These

findings are in line with that of *Haplin et al., 2008* and *Kaushal et al., 2012* wherein they reported that adoption of drip irrigation (surface or subsurface) system in sugarcane is technically feasible, economically viable and needs to be strongly followed by the growers.

Sources of information about drip irrigation: Various sources are available to disseminate a new technology in agriculture such as mass media like radio, television, newspapers, magazines, posters, literatures, meetings and extension agencies like agricultural department, sugar mill cane department, sales department of drip irrigation company and scientists from various institutions. This study indicated that all the respondents got information about DIS from cane department officials of the sugar mills (Cane Officers and Cane Assistants). Role of agricultural department officials was very little (30%). They adopted DIS mainly due to the efforts taken by the sugar mill officials.

After laying DIS, the respondents had doubts regarding the function and maintenance of DIS; Majority of the respondents (83.33%) contacted Cane Assistants and Cane Officers of sugar mills for additional information about drip irrigation technology. However, the respondents depended fully on drip irrigation company officials for trouble shooting; but many times they did not get timely help to clarify their doubts.

Advantages of drip irrigation: For any new innovation, there are some advantages and disadvantages during and after adoption. If the farmers perceived that the advantages of the new technology are more than its disadvantages, then it leads to adoption of that technology. In this study, the respondents were asked to enlist the advantages in drip irrigation with an open ended schedule (Table 2).

Table 2. Perception of the respondents regarding advantages of drip irrigation technology (N=60)

Advantages	No.	%	Rank
Saving in labour cost	60	100.00	I
Huge water saving	60	100.00	I
Higher cane yield than normal irrigation	59	98.33	II
Reduced impact of drought	59	98.33	II
Efficient use of fertilizer	58	96.67	III
Availability of water for raising another crop	57	95.00	IV
Less evaporation loss of water	57	95.00	V
Avoidance/Minimize weeds	55	91.67	IV
Possibility of multiratooning	26	43.33	VI
Drip system handling is easy irrigation	10	16.66	VII

The advantages were perceived by the respondents after laying DIS and they have more than two years of exposure in DIS. The technology was popularized by mainly focusing on water saving and yield increase concepts and accordingly, the respondents perceived its main advantages were water and labour saving in guiding irrigation. Labour saving was ranked first among the advantages of drip irrigation. The district experiences a huge shortage in labour force for agricultural operations due to industrialization. So, the respondents perceived labour saving was the main advantage and it reduced the drudgery of the agricultural labours as well as labour cost.

Water saving is also prime among the advantages of drip irrigation. All the respondents felt that, they experienced around 30-40 per cent water saving by adopting DIS. The respondents were able to irrigate their entire crop even during summer months and whenever they experienced severe drought, protective irrigation was made possible.

Much emphasis is given on the yield increase compared to conventional irrigation system and the respondents also had a similar perception. Almost all the respondents accepted yield increase in sugarcane due to the adoption of drip irrigation. Hardly one respondent got a reduced yield compared to conventional irrigation method and this was due to lack of proper maintenance of drip system and lack of fertigation. Yield increase is also governed by several biotic/ abiotic factors, not under the control of respondents. Studies have indicated a possibility of getting up to 220 t/ha yield under drip fertigation system. *Narayanamoorthy (2005)* reported very high productivity gain under drip micro irrigation system when compared to flood method of irrigation in sugarcane from Tamil Nadu. *Surendranet al., (2016)* also showed that cane yield and water productivity were significantly increased in both plant and ratoon crop of sugarcane under DIS. *Singandhupe et al., (2008)* reported that drip irrigation in Maharashtra produced 13-20 per cent higher cane yield than furrow irrigation with high water use efficiency.

The respondents also felt that application of fertilizers through drip irrigation was very easy and economical though they did not realize it prior to adoption. The respondents applied urea and white potash through DIS and felt it to be labour saving and economical. Flexibility in fertigation time was also a main reason for adoption. The respondents were able to

fertigate their crop even during night hours, and even a woman family member could fertigate the entire drip laid field. It also avoided wastage of fertilizers, and increased fertilizer use efficiency.

Even though majority of respondents were having large land holdings, they restricted their cultivated area due to lack of irrigation water and difficulties in managing their entire farm. Most of them adopted DIS in a part of their land. The respondents were able to increase their cultivable area due to adoption of DIS and it was realized by 95 per cent of respondents.

Limited wetting of soil though drip irrigation has minimized weed growth. Also, reduced hand weeding resulted in labour saving and effective utilization of water and nutrients by sugarcane crop by avoiding weed compaction. Nearly 91.67 per cent of the respondents perceived that there was reduction in weed growth compared to conventional irrigation methods. Understanding level of this advantage among respondents was low because of the normal weed growth later during monsoon months. This finding is in accordance with *Narayanamoorthy (2005)*.

The respondents felt that multi-ratooning was possible through drip irrigation. As the life of the drip system was 10 years as assured by the micro irrigation company officials, at least six ratoons need to be taken through drip irrigated fields.

Table 3. Constraints of drip irrigation (N=60)

Constraints	No.	%
Clogging in drippers	30	50.00
Lateral damage during harvest	26	43.30
Rat damage	18	30.00
Poor after sales service	12	20.00
Yield not up to expected level	10	16.70
Cost benefit ratio not economical	08	13.30
Sand filter damaged within a year	04	06.70
Poor quality valves	02	03.30
Non availability of white potash	02	03.30
Pressure reduction at ends	02	03.30

Constraints in drip irrigation: Generally, when farmers adopt a new technology on a large scale, they face a lot of problems which they may or may not realize. Any attempt made by the researchers to eliminate these constraints will result in increased adoption of technologies of recommended package of practices which will ultimately lead to increase in production, productivity and also improve the sugar recovery percentage. Thus farmers will get monetary

benefits with reduction in cost of production. The constraints faced by the respondent farmers in adopting DIS are given in Table 3.

Clogging in drippers : Half of the respondents felt that clogging in lateral drippers was the main constraint; Even though majority of the respondents were using good quality irrigation water, clogging is inevitable. Presence of certain salts can cause either partial (or) complete blockage of drip system. Respondents felt this as the major constraint due to lack of availability of acid for treatment, lack of knowledge about the acid treatment and iron fertilizer tank provided by some companies were not suitable for acid treatment.

Lateral damage during harvest : Around 43.3 per cent of respondents indicated that damage of laterals during sugarcane harvest was yet another major constraint. Sugarcane was harvested mainly on contract basis, and the cutting labourers never bothered about the damage of laterals during harvest. Non-detashed plot and lodged cane added to the severity of the problem. Removal of laterals before harvest was also not possible due to lodging nature of the cane.

Rat damage: Nearly one-third of the respondents (30%) expressed rat damage as a serious problem in DIS. Sugarcane field is an important breeding habitat for rats, as it provides an undisturbed environment. Moreover, after paddy harvest, rats migrate from paddy field and shelter within the cane field. They cut the laterals, that leads to stoppage of irrigation water after the point of cut and cane starts drying in patches. During later stage of crop growth, the respondents could not go inside the field and verification of drippers was found very difficult. Hence, all end caps had to be removed and checked periodically to access any rat damage in laterals.

Poor after sales service: One fifth (20%) of the respondents experienced poor after sales service by the drip irrigation company after installation. Some companies never turned up for after sales service after installing their system.

Yield not upto expected level: The respondents adopted DIS with an expectation of increase in sugarcane yield compared to normal irrigation. But 16.7 per cent of the respondents complained that, the yield increase was not up to their expected level. Various factors are involved in the yield of sugarcane crop, not under the control of respondents.

Cost benefits ratio not economical : Laying of DIS involves huge capital investment, and incur expenditure

on maintenance of the system as well. Around 13 per cent of respondents felt that, the cost benefit ratio was not economical.

Sand filter damaged within a year : Around 7 per cent of the respondents reported that the sand filter was damaged within a year due to rust. This showed the inferior quality materials supplied by the Drip Irrigation Company and poor after sales service.

Miscellaneous constraints: Some micro irrigation companies supplied very poor quality valves which broke due to frequent handling and the designing was also not proper.

- Non availability of soluble white potash leads to non-application of potassium fertilizer. Some respondents observed that, the drip water was not sufficient for sugarcane crop due to poor outflow from drippers and sandy nature of the soil. Few respondents observed that, the distance between laterals was very wide. In this study area, distance between laterals adopted was 1.95 to 2.10m. Respondents observed that due to wider spacing between dual rows, cane population reduced leading to reduction in yield. Few respondents have modified the lateral spacing to one-meter single row planting.
- Another constraint noted by the respondents was reduced water pressure at lateral ends. This leads to insufficient wetting at the end of the field. Lateral pressure should be maintained at not less than 0.8 kg/cm² by checking with a hand-held pressure gauge periodically.

Table 4. Relationship between profile characteristics of sugarcane farmers with level of adoption of drip irrigation system (N=60)

Independent variables	Correlation coefficient ('r' value)
Age	0.148 ^{NS}
Educational status	0.254 ^{NS}
Occupational status	0.428*
Size of land holding	0.517*
Experience in farming	0.145 ^{NS}
Experience in sugarcane cultivation	0.382*
Economic motivation	0.274 ^{NS}
Crop rotation followed	-0.024 ^{NS}
Farm implement possession	0.521*
Income level	0.079 ^{NS}
Mass media exposure	0.573*
Social participation	0.326*

*Significant at 0.01 percent level; NS Non-Significant

Relationship between socio-economic profile of respondents and adoption of DIS : Correlation analysis was done to find out the relationship between the socio-economic characteristics of the respondents with their level of adoption of drip irrigation as given in Table 4.

Twelve independent variables were selected for the study, of which except crop rotation followed, all the other eleven variables had positive correlation with the level of adoption of drip irrigation. Crop rotation followed generally depends on the water available for irrigation and demand for the produce in local markets. Though the respondents had a wide choice of crops, a negative relation was seen.

Independent variables viz., occupational status, size of land holding, experience in sugarcane cultivation, farm implement possession, mass media exposure and social participation showed positive significant relation with adoption of DIS. Farmers with more than 15 years of experience in sugarcane farming were widely prevalent in the sample and they tried to increase cane productivity by following the latest technologies. Over half of the respondents had owned almost all the farm implements needed for sugarcane cultivation and others hired from neighbours. Messages gained through mass media help to create awareness on new technologies as reflected in the analysis. Nearly two-third of the respondents were members at least in any social organization in the village leading to exchange of information and thereby increased awareness and adoption.

Table 5. Yield increase with drip irrigation compared to normal irrigation (n=60)

Range of yield increase (t/ha)	No.	%
1-10	11	18.33
11-20	26	43.33
21-30	13	21.67
31-40	7	11.67
41-50	1	1.67
Total	58	96.67

Economics involved in drip irrigation: Relative economic advantage is an important criterion for adoption of a high cost new technology. The yield increase in drip irrigation field (average of one plant and one ratoon crop) was compared with yield obtained in previous years under conventional irrigation methods (Table 5).

Table 5 indicates that 96.67 per cent of the respondents obtained increased cane yield under DIS

compared to normal flood irrigation that proved the feasibility and relative advantage of this technology. Convincingly, 65 per cent of the respondents could get 11-30 t/ha additional cane yield and 11.67 per cent got 31-40 t/ha increased yield. The range of increased yield obtained by respondents was 2 to 42 per cent.

Overall yield analysis (n=60)

- Average yield obtained by the respondents through conventional irrigation = 92.20 t/ha
- Average yield obtained by the respondents through drip irrigation = 119.63 t/ha
- Yield increase = 27.43 t/ha
- Percentage of yield increase due to adoption of drip irrigation = 29.75 per cent

It could be seen that the respondents, on an average could get 29.75 per cent yield increase due to adoption of drip irrigation.

CONCLUSION

Drip irrigation for sugarcane cultivation is perceived as an essential foundation for sustainable sugarcane cultivation as water is becoming a scarce commodity. As evinced in this study, drip irrigation is an important viable technology for water conservation, labour saving and to overcome water stress during drought situations. Hence, feasibility of drip irrigation in sugarcane should be assessed and utilized along with other advanced technologies for increased productivity and judicious use of water.

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