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Issues in Adoption of Drip and Conventional Irrigation Methods in Banana: A Socio-Economic Analysis of South Gujarat Region

Deepa Hiremath[1*] and J.J. Makadia[2]

[1]College of Agriculture, Navsari Agricultural University, Bharuch, Gujarat, India
[2]N.M. C.A., Navsari Agricultural University, Navsari, Gujarat, India

*Corresponding author: dbhiremath@nau.in (**ORCID ID:** 0000-0001-9457-1645)

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ABSTRACT

Irrigation water management is a key input as well as a major constraint for assured and successful crop production. The adoption of drip irrigation method among the farmers of South Gujarat in water loving crops like banana is a wise tool for conservation of resources. However, this method has its own limitations which were ranked using the Garrett ranking technique. The study revealed that high initial capital investment, clogging of emitters due to water salinity and frequent damage of the system due to rodents, pigs and other animals were identified as the top three major problems faced by the farmers with a Garrett score of 81.59, 74.15 and 68.19, respectively. The farmers practicing conventional method of irrigation were of the opinion that wastage of water in the form of excess irrigation was the most acute problem and was ranked first with a Garrett score of 80.21, followed by high electricity usage (73.68) and problem of water logging (67.03). Hence, based on the ranking of these major constraints in adoption of drip irrigation technology; the study suggested ways and means to address these issues which would in turn help to reduce the considerable gap in the estimated achieved and achievable water savings.

HIGHLIGHTS

- The top three constraints in case of drip irrigation method were high initial investment, clogging of emitters due to water salinity and frequent damage of the system due to rodents and other animals with a Garrett score of 81.59, 74.15 and 68.19, respectively.
- Similarly, in case of conventional irrigation methods wastage of water (80.21), followed by high electricity usage (73.68) and problem of water logging (67.03) were the major constraints identified.

Keywords: Constraints, Drip irrigation technology, Conventional irrigation methods, Garrett ranking technique

The alarming water scarcity in the Gujarat state justifies the adoption of water efficient technologies like micro-irrigation. Since, groundwater is a common pool resource with unregulated withdrawal as well as absence of marginal pricing for water, over-extraction and inefficient allocation are quite widely observed in the state Kishore (2013). Hence, micro-irrigation is extensively promoted in Gujarat which is also in line with the National Mission on Micro-Irrigation. These improved water management technologies have been recognized as important resource conservation and demand management strategies as conventional irrigation methods have found to have some inherent constraints. The common conventional methods of irrigation being followed by farmers are predominantly flood and furrow irrigation methods. Among the two, flood

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irrigation is one of the oldest and ancient method of irrigation. It was probably the first form of irrigation since the time man began cultivating crops and even today is one of the most commonly used methods of irrigation. The flood irrigation method generally assumes that only half of the water applied is actually used by the crop; the other half is lost through evaporation, run off, infiltration in uncultivated areas, transpiration through the leaves of weeds, anaerobic conditions in the soil and around crop root zone as well as deep percolation below the crop root zone that is unavailable to the plants. In furrow irrigation, the water is applied to the top end of each furrow and flows down the field through gravity. Furrows may vary in their dimensions depending on the soil type, location and crop type. In this method, water can take a considerable period of time to reach the other end as water has been infiltrating for longer period of time at the top end of the field. This results in non-uniformity in distribution with high application at the top end and lower application at the bottom end. These conventional methods of irrigation may not only reduce crop production and soil fertility but also cause ecological hazards like water logging and soil salinity. The application of irrigation water by conventional methods causes upto 30 per cent loss of water through deep percolation depending on the soil type. Furthermore, available estimates indicate that the water use efficiency under flood method of irrigation is only about 35 to 40 percent because of huge conveyance and distribution losses Rosegrant (1997), INCID (1994). Thus, micro-irrigation technologies such as drip and sprinkler are key interventions in water saving and improving crop productivity. The successful adoption of micro-irrigation requires, in addition to technical and economic efficiency, two additional preconditions, *viz.*, technical knowledge about the technologies and accessibility of technologies through institutional support systems Namara *et al.* (2005).

In India, micro-irrigation technologies have been in the scenario for more than two decades. The main vehicle of government policies to promote micro-irrigation systems are product subsidies—in certain cases up to 90 percent. However, there has been a lukewarm response to such initiatives from farmers, especially smallholders many areas. Studies show that despite active promotion, the appeal of these technologies are confined to 'gentlemen farmers'—wealthier farmers who produce commercial crops. Hence, the present study was undertaken to examine the constraints faced by the farmers in adoption of drip and conventional methods of irrigation in a water intensive and commercial crop like banana so as to increase its effectiveness in production and also to give appropriate suggestions to the policy makers. It gives us the way to plan policies for betterment of the farmers.

MATERIALS AND METHODS

The study covered South Gujarat region. It was purposively restricted to Bharuch and Narmada districts on the basis of highest area covered by banana crop in South Gujarat region. The technique of multistage random sampling was followed for the selection of districts, talukas, villages and farmers.

For the purpose of investigation, two major talukas were selected randomly from each district *i.e.* Jhagadiya and Bharuch talukas from Bharuch district and Nandod and Garudeshwar talukas from Narmada district, respectively. So, in all a total of four talukas were selected for the study. Subsequently, from each taluka, five villages based on the availability of banana growers practicing both drip and conventional methods of irrigation were selected. From each selected village, six farmers practicing drip and six farmers practicing conventional method of irrigation were randomly selected. Thus, on the whole, 240 (120 drip and 120 non-drip) banana growers were selected for the purpose of the study.

To understand the constraints in adoption and maintenance of different irrigation systems in banana the Garrett's ranking technique was used. This technique gives the change in orders of constraints and advantages into numerical scores. The major advantage of this technique as compared to simple frequency distribution is that the constraints and advantages are arranged based on their importance from the view point of the respondents. Hence, the same number of respondents on two or more constraints may have been given different ranks.

Garrett's formula for converting ranks into per cent is given by;

$$\text{Per cent position} = 100^{*} (R_{ij} - 0.5) / N_{j}$$

Where,

R_{ij} = rank given for i^{th} factor by j^{th} individual; N_j = number of factors ranked by j^{th} individual.

The per cent position of each rank was converted into scores referring to the table given by Garrett and Woodsworth (1969). For each factor, the scores of individual respondents were added together and divided by the total number of the respondents for whom scores were added. These mean scores for all the factors were arranged in descending order, ranks were given and the most important factors were identified.

RESULTS AND DISCUSSION

It is important to understand the constraints faced by the farmers in adoption of drip and conventional methods of irrigation in banana cultivation so as to increase its effectiveness. Therefore, the information regarding the constraints faced by the farmers in adoption and maintenance of drip irrigation system in banana was procured. The constraints were identified in consultation with the concerned experts and the farmers were asked to rank the problems proposed to them. Later, the Garrett's ranking technique was used in the analysis which provided the change in orders of constraints and advantages into numerical scores.

The results presented in Table 1 and Fig. 1 indicate the various challenges/constraints experienced by the banana growers in the adoption and maintenance of drip irrigation system in the study area. Although, there were many factors that influenced the farmers in adoption of drip method of irrigation, there were several constraints too out of which the twelve major ones were identified. These were lack of technical information about design, layout and operation of drip irrigation system (DIS), high initial capital investment, insufficient and delay in sanction of subsidy by government, inadequate/ fluctuations in power supply, clogging of emitters due to water salinity, damage to the system during field operations/ hindrance to farming operations, frequent damage of the system due to rodents, pigs and other animals, unsatisfactory after sales service, crop specificity and limits crop diversification, maintenance problems, irrigation to be done more frequently and the problem of theft.

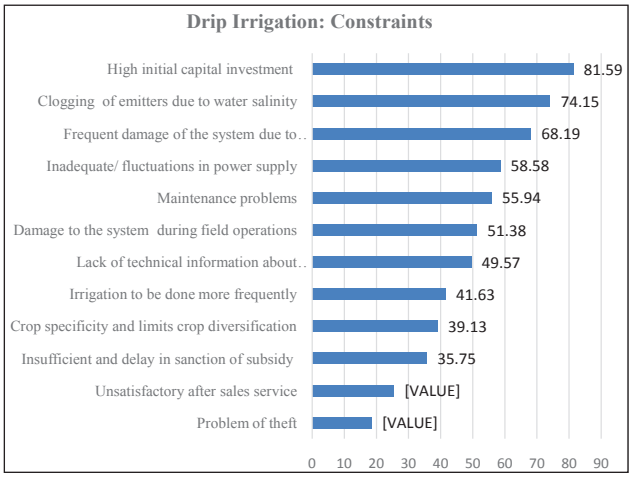

Fig. 1: Constraints faced by drip irrigation farmers

Table 1: Constraints in adoption and maintenance of drip irrigation system (n=120)

Sl. No.	Particulars	Drip Irrigation Method	
		Garrett Score	Rank
1	Lack of technical information about design, layout and operation of DIS	49.57	VII
2	High initial capital investment	81.59	I
3	Insufficient and delay in sanction of subsidy by Government	35.75	X
4	Inadequate/ fluctuations in power supply	58.58	IV
5	Clogging of emitters due to water salinity	74.15	II
6	Damage to the system during field operations/ Hindrance to farming operations	51.38	VI
7	Frequent damage of the system due to rodents, pigs and other animals	68.19	III
8	Unsatisfactory after sales service	25.50	XI
9	Crop specificity and limits crop diversification	39.13	IX
10	Maintenance problems	55.94	V
11	Irrigation to be done more frequently	41.63	VIII
12	Problem of theft	18.50	XII

A close study from Table 1 revealed that among all the constraints listed above, the most important constraint in banana cultivation under drip method of irrigation was high initial capital investment which was ranked first with a Garrett score of 81.59. This finding was supported in a study by Gulkari *et al.* (2017) which revealed that high initial cost incurred was the main constraint in drip irrigated banana cultivation and it was mainly due heavy cost of installation of drip irrigation system, high cost of fuel to use engines for irrigation as well as high cost of spare parts of the drip irrigation system.

Similarly, a study conducted by Pandya and Dwivedi (2018) revealed that 92.00 per cent adopters of drip irrigation had indicated high initial investment as a major constraint. According to the study, in spite of many relative advantages of drip irrigation system, the high material cost may prevent many farmers from adopting the drip method of irrigation as installation of a drip irrigation system required an initial investment of up to ₹ 125000 per hectare (as per rates set by Gujarat Green Revolution Company) depending upon the nature of crops (wide or narrow spaced) and the quality of material used for the system. The high initial costs at times made the technology economically infeasible in the initial years especially for small and marginal farmers even with financial support by the government in terms of subsidy. Thamban *et al.* (2004) also reported that high initial investment secured first rank among the constraints for the non-adoption of drip irrigation system by the farmers in Kerala and that the cost of the system per unit area was higher for small size of farms as cost of head unit was generally fixed. Kakde *et al.* (2014) also found that the major economic constraint was high initial investment of drip system and high cost of spare parts for banana in Maharashtra. An important alternative suggestion to reduce the initial cost was proposed by Malik and Rathore (2012) regarding a subsidy scheme of direct delivery of drip subsidy to farmers which may outweigh the existing subsidy scheme of subsidizing the manufacturers and providers of drip systems in the name of the farmers.

Moreover, the next two major constraints that followed in order of rank were the clogging of emitters due to water salinity and frequent damage of the system due to rodents, pigs and other animals with a Garrett score of 74.15 and 68.19, respectively. Similar results were reported in a study by Narayanmoorthy (2009), according to which the clogging of drippers was mainly due to poor quality of water which has been an inherent problem observed in certain parts of the country. It was realised that normal acid treatment does not help to mitigate the problem. Therefore, studies needed to be carried out to devise de-logging measures in such areas. Likewise, Senarathna and Pathmarajah (2007) in Kurunegala district witnessed that 44.00 per cent of the farmers faced the problem of system damages caused by animals and rodents like rats, squirrels, porcupines *etc*.

These constraints were subsequently followed by inadequate/ fluctuations in power supply (58.58), maintenance problems (55.94), damage to the system during field operations/ hindrance to farming operation (51.38), lack of technical information about design, layout and operation of DIS (49.57), irrigation to be done more frequently (41.63), crop specificity and limits crop diversification (39.13), insufficient and delay in sanction of subsidy by government (35.75), unsatisfactory after sales service (25.50), and the problem of theft (18.50). Similar work related to the present investigation was also carried out by Zala (2008), Durga (2009), Trivedi (2009) and Dave (2011).

The constraints faced by the farmers in cultivation of banana under conventional method of irrigation are depicted in Table 2 and Fig. 2.

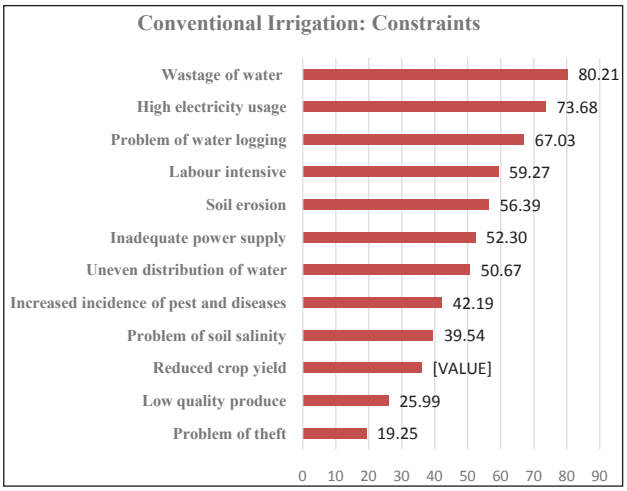

Fig. 2: Constraints faced by conventional irrigation farmers

A perusal of Table 2 revealed that, among all the constraints listed above, the most serious constraint in cultivation of banana under conventional method

Table 2: Constraints faced by the farmers under conventional irrigation method (n=120)

Sl. No.	Particulars	Conventional Irrigation Method	
		Garrett Score	Rank
1	Problem of water logging	67.03	III
2	Inadequate power supply	52.30	VI
3	Wastage of water	80.21	I
4	High electricity usage	73.68	II
5	Soil erosion	56.39	V
6	Labour intensive	59.27	IV
7	Increased incidence of pest and disease	42.19	VIII
8	Uneven distribution of water	50.67	VII
9	Reduced crop yield	36.00	X
10	Problem of soil salinity	39.54	IX
11	Problem of theft	19.25	XII
12	Low quality produce	25.99	XI

of irrigation was wastage of water which ranked first with a Garrett score of 80.21. This was followed by high electricity usage (73.68), problem of water logging (67.03), labour intensive (59.27), soil erosion (56.39), inadequate power supply (52.30), uneven distribution of water (50.67), increased incidence of pest and diseases (42.19), problem of soil salinity (39.54), reduced crop yield (36.00), low quality produce (25.99) and problem of theft (19.25).

Thus, it is evident from the figure above that, wastage of water, high electricity usage and problem of water logging were the top three major problems. The wastage of water was ranked first mainly due to the fact that under conventional method of irrigation, water was lost due to evaporation, run off, infiltration in uncultivated areas, transpiration through the leaves of weeds, anaerobic conditions in the soil and around crop root zone as well as deep percolation below the crop root zone that was unavailable to the plants and infiltrated for longer period of time at the top end of the field as compared to the other end. The results were in conformity with the findings of Rudrapur (2016).

SUGGESTIONS AND POLICY IMPLICATIONS

The major suggestions which emerged from the study are:

One of the major constraints in the growth of area under drip irrigation is the high initial capital investment. In spite of availability of subsidy from state agencies, many of the farmers are hesitant to invest in drip irrigation system even in horticulture crops like banana, which are highly suitable for drip irrigation. If drip irrigation set is made available at low cost, area under drip irrigation can be augmented at a more rapid rate. Hence, there is a need for primary measures to be taken to reduce the fixed cost in drip irrigation by promoting research and development undertakings. Moreover, by recognizing drip industry as an infrastructure industry as well as providing tax holiday for specific time periods to all those drip set industries which produce genuine drip materials, the competition can be increased that will ultimately bring down the cost of the system.

Moreover, there is a need to redesign low cost drip irrigation systems to suit the needs of small and marginal farmers. There is a good scope for reducing the system cost by slight modifications in the agro-techniques to suit small and medium farms like paired row planting.

Clogging of drippers mainly due to poor quality of water (saline water) has been an inherent problem observed in many parts of the study area. It was realised that the normal acid treatment does not help to completely mitigate the problem. Therefore, studies need to be carried out to devise suitable de-clogging measures in such areas. It is also recommended that system suppliers should make the suitable acid available to the growers as a part of their after sales service obligation.

Moreover, the promotion of sub-surface drip irrigation system could play an important role as it helps to eliminate the clogging problem as well as the damage to the system due to rodents, pigs and other animals to a large extent.

Although the government is providing subsidy for micro-irrigation systems to all categories of the farmers, many of the farmers are still reluctant to adopt the technology. Hence, the study has highlighted several implications for extension work currently operated primarily by the Government agencies to augment and improvise their transfer of technology mechanism as well as initiate awareness campaigns to sensitize farming community about micro-irrigation technology. The target beneficiaries need to be made aware or provided knowledge about the technical and economic superiority of this technology. This may be achieved through extension services in the form of demonstrations, campaigns, workshops, *etc*. Farmers' own attributes such as level of education may also augment or complement the public extension services as educated farmers are active information seekers and experimenters.

There is a need to consider the technological alternatives among which crop geometry modification is the most significant one. Presently, the system is designed for one crop. At times, due to differential crop geometry the system may not be as effective as it should be for the subsequent crop. Hence, it is suggested that the design may be made for a sustainable cropping sequence instead of only one crop. This could improve the final cost benefit ratio. Likewise, drip irrigation system should be tailored made *i.e.* drip irrigation system should be planned and designed based firmly on location specific parameters and enough orientation needs to be given to the manufacturers, dealers and farmers such that the most economic crop specific design can be made to reduce the cost of installation.

Many farmers had less knowledge regarding the fertigation and the selection of appropriate fertilizers. More awareness trainings with regard to different aspects of fertigation may be conducted.

Moreover, it was observed that the cost of drip irrigation accessories such as emitters, laterals, filters, *etc.* vary between shops and places. Sometimes, farmers do face problem getting spare parts in time. It is necessary to provide quality materials in time for farmers for the rapid adoption of drip irrigation technology.

CONCLUSION

The adoption of drip irrigation technology particularly in water intensive crops like banana is an important tool for wise usage of resources. However, this technology has its own set of limitations. With regard to the constraints faced by the farmers in adoption and maintenance of drip irrigation system in banana cultivation high initial capital investment, clogging of emitters due to water salinity and frequent damage of the system due to rodents, pigs and other animals were identified as the top three major problems faced by the farmers with a Garrett score of 81.59, 74.15 and 68.19, respectively. Moreover, the farmers practicing conventional method of irrigation were of the opinion that wastage of water in the form of excess irrigation was the most acute problem and was ranked first with a Garrett score of 80.21, followed by high electricity usage (73.68) and problem of water logging (67.03).

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