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RESEARCH PAPER

Prioritization of major constraints in micro-irrigation technology adoption encountered by the cotton growers in North Maharashtra

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Abstract : Proper utilization and efficient development of the limited water resources is the milestone for food security for the entire world. Micro-irrigation technology facilitates improvement in water saving, water use efficiency, yield of the crop, investment in and short payback periods. The data was collected from 60 adopter and 60 non-adopter farmers of Dhule and Nandurbar districts of Maharashtra, India by personal interview through a pre-tested questionnaire. The constraints faced by the farmers in adoption of micro-irrigation technology were identified and put before the sample farmers and the farmers were asked to list priority-wise major constraints they were facing in micro-irrigation technology adoption for construction of a Responses-Priority Index (RPI). High initial investment of micro-irrigation system, clogging and chocking of emitters, unavailability of subsidy on time, lack of technical knowhow of micro- irrigation system and complex and lengthy procedure of loan were most perceived constraints with RPI values of 0.97, 0.90, 0.77, 0.70 and 0.68, respectively influenced the decision of micro-irrigation technology adoption.

Key Words : Constraints, Responses-priority index (RPI), Micro-irrigation system, Cotton

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INTRODUCTION

Cotton, 'The white gold' or the 'King of fibres' is an important fibre crop of the tropical and subtropical countries of the world gaining importance all over the world. The annual world production of cotton is 25.92 million tons for 2019-2020. (Anonymous, 2020 a). Currently, India has the largest cotton area and production in the world with about 13.37 million hectares (38%) and 6.21 million tons (24%), respectively. In India, nearly 65% of cotton is produced under rainfed conditions and 35% on irrigated condition (Anonymous, 2020 b). In Maharashtra, cotton occupies an area of about 44.31 lakh hectares (33.13% of country) with production of 87 lakh bales (21.80%). The productivity of cotton in Maharashtra is 334 Kg/ha, which is 71.93% (464 kg/ha) of India's productivity and lower than 50% as compared with the World's cotton productivity (Anonymous, 2020

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c).

Micro irrigation (MI) allows application of water to root zone of the crops through specially designed equipment known as emitters, has already been adopted by many countries for transforming their agriculture. Presently, 11.4 M ha area of India is micro-irrigated, of which 53.1% and 46.9% area is under sprinkler irrigation (6.06 M ha) and drip irrigation system (5.35 M ha), respectively (Anonymous, 2019). Though the adoption of micro-irrigation technologies is increasing in India, the adoption rate is relatively less and upto 20%. Quite a few studies have analyzed the impact of micro-irrigation on water saving, water productivity, pattern of water use and labour use, cost of production and productivity etc. utilizing both field level and experimental data in Indian situation (Pawar *et al.*, 2013). In India, impact studies on the micro-irrigation technologies are available on several crops (Dingre *et al.*, 2016 and Pawar *et al.*, 2014) but particularly on micro-irrigated cotton a farmer's field data is rarely available.

Similarly, studies have not analysed the factors which influence the adoption of drip-irrigation in cotton. The main factors responsible for the limited spread of the technology have been documented by quite a few researchers. The strength of a technology is actually determined only if it is used efficiently at their own fields by the farmers. But many farmers could not use the technology efficiently due to number of constraints encountered in the way. Considering the advantages of micro-irrigation technology in efficient water management and studies focusing on these issues using field level survey data are not available, this study makes an attempt to fill this void using the data collected from farmers cultivating cotton under micro-irrigation in North Maharashtra.

Material and Methods

The research was conducted in Dhule and Nandurbar districts of North Maharashtra as it has the maximum area under cotton along with micro-irrigation. A three phase sampling method was used for structuring of sampling of the study. The first phase of sampling consists of the selection of tahsils from the selected district. The second phase consists of selection of villages from the selected tahsils followed by third phase of selection of farmers from the selected villages. During first phase of sampling, willingly all four Tahsils of Dhule district and two Tahsils of Nandurbar district were selected. From the data collected from the Superintendent Agriculture Officer's (SAO) office of Dhule and Nandurbar district, one village from each Tahsil was selected purposively completed the second phase of sampling. In the third phase of sampling, from each selected village, 10 cotton growers having drip irrigation system and 10 not having drip irrigation system were selected randomly. In this way a total of 120 farmers were considered as respondent.

Considering the objectives of the study, a pre-tested questionnaire was prepared for the collection of data from the respondent farmers. The data collection was done by personal interview. The constraints faced by the farmers in adoption of micro-irrigation technology were identified and put before the sample farmers and the farmers were asked to list priority-wise major constraints they were facing in micro-irrigation technology adoption. In the quantification of constraints expressed by the farmers, there was a problem, whether emphasis should be given for the number of responses to a particular priority or to the highest number of responses to a constraint in the first priority. But, both lead to different conclusions. To resolve this, a Responses-Priority Index (RPI) was constructed (Rama Rao, 2011) for the prioritization of the important constraints using following Eq.:

$$(\mathbf{RPI}) = \frac{\sum_{j-1}^{k} \mathbf{fij X}[(\mathbf{k}+1)-\mathbf{j}]}{\sum_{i-1}^{1} \sum_{j-1}^{k} \mathbf{fij}} 0 \le \mathbf{RPI} \ge 5$$

where,

(RPI) i = Response priority index for i^{th} constraint,

f ij = Number of responses for the j^{th} priority of the i^{th} constraint (i=1, 2… l; j= 1, 2, 3...k),

$\sum_{j-1}^{k}$ fij = Total number of responses for the i^{th} constraint, k = Number of priorities,

X [(k+1)-j] = Scores for the j^{th} priority,

$\sum_{i-1}^{1} \sum_{j-1}^{k}$ fij =Total number of responses to all constraints and

$\sum_{i=1}^{1} RPI_i$ = Summation of RP indices for all constraints.

Here, larger the RPI, higher was the importance for that constraint.

Results and Discussion

Highest responses in each priority were listed and considering the highest responses and their respective priority a Response Priority Index (RPI) was constructed.

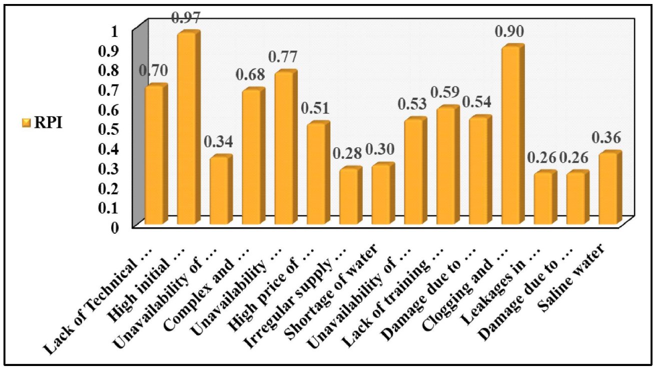

Fig. 1: Graphical presentation of response priority index (RPI) according to the constraints in micro- irrigation technologies adoption for cotton cultivation

It was presented in the Table 1 and Fig. 1.

Table 1 depicts that the upmost value of RPI (0.97) was for 'High initial investment of micro-irrigation system' and had occupied rank first, therefore most perceived constraint in the adoption of micro-irrigation technology in the study area was high initial investment of micro-irrigation system. 'Clogging and chocking of emitters' was second most important constraint, which was ranked second with RPI 0.90. Likewise, 'Unavailability of subsidy on time' (RPI 0.77), 'Lack of Technical Knowhow of micro-irrigation system' (RPI 0.70) and 'Complex and lengthy procedure of loan' (RPI 0.68) were perceived next important constraints by the respondent farmers and occupied III, IV and V rank, respectively.

Further it was observed that with RPI value of 0.59, the respondent farmers recognized 'Lack of training regarding micro-irrigation technology' as their main problem (VIth rank) followed by 'Damage due to rodents and others' (VIIth rank) with RPI 0.54, 'Unavailability of post-sale service by seller' was ranked VIIIth by the respondents with RPI 0.53, 'High price of components of micro-irrigation system' with RPI 0.51 was reported as IXth constraint by the farmers. 'Saline irrigation water' (RPI 0.36), 'Unavailability of components of micro-irrigation system at local market' (RPI 0.34), 'Shortage of water' (RPI 0.30), 'Irregular supply of electricity' (RPI 0.28), 'Damage due to interculturing operations' (RPI 0.26) and 'Leakages in the system' (RPI 0.26) were identified to be relatively less priority constraints and were ranked tenth, eleventh, twelfth, thirtieth, fourteenth and fifteenth, respectively.

It is observed from the above findings that maximum respondents noted that 'High initial investment of micro-irrigation system' is the main constraint in micro-irrigation adoption; therefore, marginal farmers could not bear the cost of micro-irrigation technology. This may be happened because of the reason that the adopters were not having the knowledge regarding economics, IRR, b:c ratio etc. of micro-irrigation system installation.

The outcomes are in line with the Rama Rao (2012), Panwar (2015), Kakde *et al.* (2015), Bhuriya *et al.* (2016), Chandran and Surendran (2016), Gajera (2016), Pandya and Dwivedi (2016), Parmar and Thorat (2016), Patel *et al.* (2017), Patidar (2016), Verma and Sharma (2017), Yadav *et al.* (2017), Gorain (2018), Karthikeyan

Table 1: Response priority index (RPI) for constraints in adoption of micro- irrigation technologies in cotton cultivation

Sr. No.	Constraint	Response priority index (RPI)	Rank
1.	Lack of technical knowhow of micro-irrigation	0.70	IV
2.	High initial investment of micro-irrigation system	0.97	I
3.	Unavailability of components of micro-irrigation system at local market	0.34	XI
4.	Complex and lengthy procedure of loan	0.68	V
5.	Unavailability of subsidy on time	0.77	III
6.	High price of components of micro-irrigation system	0.51	IX
7.	Irregular supply of electricity	0.28	XIII
8.	Shortage of water	0.30	XII
9.	Unavailability of post-sale service by seller	0.53	VIII
10.	Lack of training regarding micro-irrigation	0.59	VI
11.	Damage due to rodents and others	0.54	VII
12.	Clogging and chocking of emitters	0.90	II
13.	Leakages in the system	0.26	XV
14.	Damage due to interculturing operations	0.26	XIV
15.	Saline water	0.36	X

and Suresh (2019), Chand *et al.* (2020), Singh (2020) and Bhargav and Modi (2021) who reported that high initial investment of micro-irrigation system was the major constraint in adoption of micro-irrigation system.

'Clogging and chocking of emitters' has been judged as the second most crucial technical constraint in micro-irrigation system adoption. This may be happened because of the reason that in the study area mostly the source of irrigation is well and borewell. Hence, organic or inorganic materials like algae, sand, slime and other materials come along with the irrigation water. Also, the emitters and lateral lines are chocked due to the salt deposition which resulted into reduction in the rate of water discharge and uneven water distribution.

The finding is supported with the findings of Patel (2013), Kakde *et al.* (2015), Aravinda Kumar and Poddar (2015), Ojha and Singh (2015), Pawar *et al*. (2015), Chandran and Surendran (2016), Gajera (2016), Parmar and Thorat (2016), Verma and Sharma (2017), Yadav *et al*. (2017), Chand *et al*. (2020) and Singh (2020) who reported that clogging and chocking of emitters was the most important constraint in adoption of micro-irrigation system.

The constraint of 'Unavailability of subsidy on time' may because of the reason that allocation of subsidy is decided by State Government and it is totally depend on the budgetary provisions and related economic concerns. Decision on subsidy by Government is mostly taken at the end of financial year which is not matching with any crop season and it creates confusion amongst farmers.

The finding is in line with the findings of Patel (2013), Aravinda kumar and Poddar (2015), Pawar *et al*. (2015), Chandran and Surendran (2016), Gorain (2018), Karthikeyan and Suresh (2019) and Singh (2020) who reported that unavailability of subsidy on time was the most important constraint in adoption of micro-irrigation system.

'Lack of technical knowhow of micro-irrigation system' has been evaluated as the fourth important technical constraint in adoption of micro-irrigation system. As shared by the respondents that the technical support regarding micro-irrigation system adoption, operation and management was not sufficiently provided by extension workers and other government functionaries. Many times, dealers give this type of advice during the time of micro-irrigation system installation.

Present finding is in agreement with the findings of Patidar (2015), Bhuriya *et al*. (2016), Patel *et al*. (2017), Gorain (2018), Karthikeyan and Suresh (2019) and Singh (2020).

The 'Complex and lengthy procedure of loan' was observed as important financial constraint in adoption of micro-irrigation system by the farmers. It might be due to the fact that illiteracy and unawareness about the loan procedure and credit facilities available for farmers to micro-irrigation system adoption.

This result is in conformity with the results of Patel (2013), Manoj Kumar *et al*. (2014), Aravinda kumar and Poddar (2015), Patidar (2015), Bhuriya *et al*. (2016), Gajera (2016), Patel *et al*. (2017), Gorain (2018), Chand *et al*. (2020) and Singh (2020).

'Lack of training regarding micro-irrigation technology' experienced by the respondents may be ascribed due to the reality that ratio between farm families and extension workers was insufficient to fulfil the farming community needs, in respect of transfer of micro-irrigation system. Also, this might be due to facts that most peoples did not participate in the programme of micro-irrigation technology because they generally regarded it as a government programme or consider micro-irrigation as hi-tech and highly capital intensive technology not suitable for them.

This result was in accordance with the results of Manoj Kumar *et al*. (2014), Palanisami *et al*. (2014), Kakde *et al.* (2015), Panwar (2015), Bhuriya *et al*. (2016), Patidar (2016), Patel *et al*. (2017), Yadav *et al*. (2017), Gorain (2018), Chand *et al*. (2020), Singh (2020) and Bhargav and Modi (2021).

Similarly, the problem of 'Unavailability of post-sale service by seller' may because of the reason that the dealers may not employ the qualified personnel's having the detailed knowledge regarding micro-irrigation system due to their expensive services.

The outcomes of the study are in corroboration with earlier findings of Patel (2013), Aravinda kumar and Poddar (2015), Pawar *et al*. (2015), Yadav *et al*. (2017), Gorain (2018), Chand *et al*. (2020), Singh (2020) and Bhargav and Modi (2021).

The problem of 'High price of components of micro-irrigation system' may because of the reason that mostly the components required for maintenance of micro-irrigation systems were unavailable in the domestic market because of their high cost. Then, farmers had to get it from distant market, which increases the purchase cost.

This result is consistent with the findings of previous studies of Patel (2013), Palanisami *et al*. (2014), Aravinda kumar and Poddar (2015), Kakde *et al.* (2015), Gajera (2016), Pandya and Dwivedi (2016), Parmar and Thorat (2016), Patidar (2016), Patel *et al*. (2017), Yadav *et al*. (2017), Karthikeyan and Suresh (2019), Chand *et al*. (2020), Singh (2020) and Bhargav and Modi (2021).

The constraint like 'Saline source of irrigation water' may because of the reason that on some of the locations irrigation water source is highly saline, resulted into salt deposition in the openings of emitters may chocked the emitters and uneven water distribution, which requires repeated cleaning and maintenance of micro-irrigation system. Thus, due to highly saline irrigation water the farmers were low adopters.

The outcome was in line with the outcomes of Aravinda kumar and Poddar (2015), Karthikeyan and Suresh (2019) and Bhargav and Modi (2021).

The remaining constraints were not found much important in restricting micro-irrigation adoption in cotton cultivation.

The majority of cotton growers have confirmed that micro-irrigation system was not adopted primarily due to involvement of capital in various forms due to poor economic status. The solution to the scarcity of capital is the growth of production and savings. The farmers of the area have very little assets and less investment in the form of high yielding technology, irrigation and implements. These conditions neither permit intensive use of land and labour nor yield optimum production from agriculture sector. So, it is suggested that policy makers should plan for technological improvement in the area. Agro-based industries also have to come forward for providing supplementary part time employment to farmers and their families (Malik *et al.*, 2016).

Similarly, the non-adoption of micro-irrigation system in cotton is related to psychological and technological problems. Majority of the farmers suggested use of innovative extension methods for motivation of cotton growers. On the basis of above facts, for higher adoption of micro-irrigation system, it is suggested that exclusive education and training facilities need to be arranged for the farmers. Special focus on developing self confidence among cotton growers about this technology by arranging special programs in groups, organizing visits on the adopter farms of neighboring villages is needed so that farmers can exchange their experiences and observe the working of micro-irrigation system. This will enhance their vision and add the new experience and encourage them to adopt good farming practices on their own farm concerned with the micro-irrigation system (Galawat and Yabe, 2012 and Kiruthika, 2014).

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