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CONSTRAINTS IN DRIP IRRIGATION SYSTEM FOR POTATO IN RAJASTHAN

Jagadish Aditya Dinakar & I. P. Singh

Research Scholar, Institute of Agri Business Management, Swami Keshwanand Rajasthan Agricultural University, Bikaner, India

Professor, College of Agriculture, Swami Keshwan and Rajasthan Agricultural University, Bikaner, India

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ABSTRACT

This study tries to find out the major constraints faced by the farmers in zone Ib of Rajasthan. Zone Ib comprises of two districts, namely Sri Ganganagar and Hanumangarh districts known as the granary of Rajasthan. In 2019-20, Sri Ganganagar district and Hanumangarh districts cover 221.53 hectares and 103.96 hectares of land, respectively. The study was based on determining the constraints faced by farmers following drip irrigation in potato crop. The study was based on descriptive and exploratory research design which comprised of both primary and secondary data. Multistage stratified random sampling was used for the research. Eight major constraints faced by the farmers in drip irrigation system, were identified. Pre-structured schedule containing both open and close ended questions was prepared for the farmers to rank the constraints according to their preferences. The major constraint was found to be 'high initial cost for drip irrigation (Garrett score: 70.50)', followed by 'requirement of timely maintenance (Garrett score: 62.03)', 'lack of technical know-how (Garrett score: 56.33)', 'lack of adequate training (Garrett score:53.93)', 'non- availability of technical guidance in time (Garrett score:46.20)', 'non-availability of quality inputs (Garrett score:39.03)', 'inadequate & uncertain of power supply (Garrett score: 36.97)' and 'unsuitable climate (Garrett score: 35.00)'. There is a need to educate farmers to adopt drip irrigation as water is a limiting resource.

KEYWORDS: *Drip Irrigation, Challenges, Rajasthan*

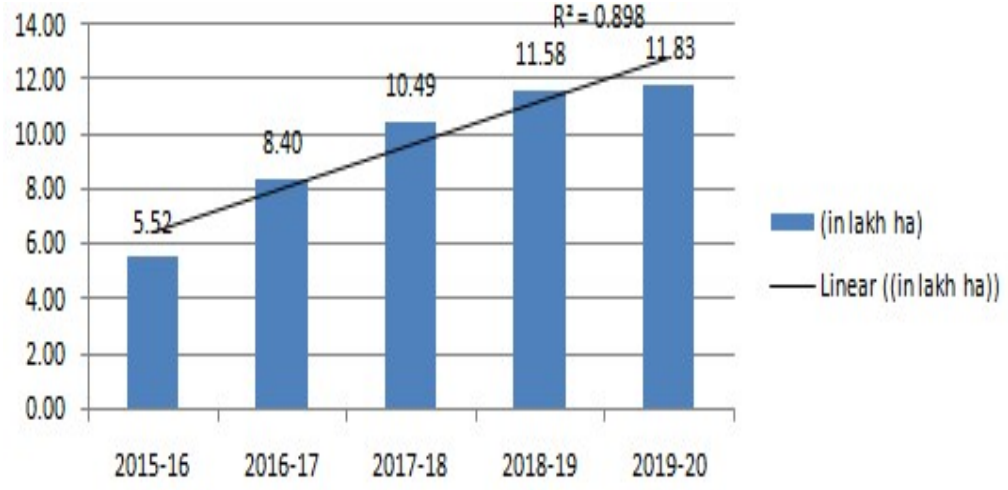
INTRODUCTION

Water is an indispensable resource responsible for the sustenance of life on earth. Food and agriculture are the largest consumers of water. Up to 70 per cent of the water taken from rivers and groundwater is utilised in irrigation, whereas about 20 per cent is utilised for industrial purposes and remaining 10 per cent for domestic purposes. Urbanisation along with increased utilisation of water resources to meet the requirements of the expanding population has constrained the important requirements of water in the dry and semi-arid regions of the country. As a result, it becomes crucial to effectively manage and administer the utilisation of water, at all levels to fulfil the requirements of food and fibre. Though unavoidable, the management of water resources at full scale level is time consuming and exceptionally costly. But water management at field level is tolerably cheap, more achievable and effectively useful, which can be executed within limited ability and time. As per the estimates of FAO, to meet the rising food demands of growing population, the global water requirement in agriculture will increase by about 50 per cent by the year 2050. Owing to climate change, inappropriate management and indiscriminate utilisation of water resources, fresh water is gradually becoming scare, worldwide. Shortage and quality issues of water in several regions of the world have posed severe challenges to ecological balance and

food security of the future. Since ancient times, water has been considered as blood for crops. As the over and under application of water can have detrimental effects on crop health, so arranging for suitable methods of irrigation is utmost important. Along with technical, the physical, economic and social considerations play significant role in determining the type of irrigation system in a region.

Micro Irrigation System in India

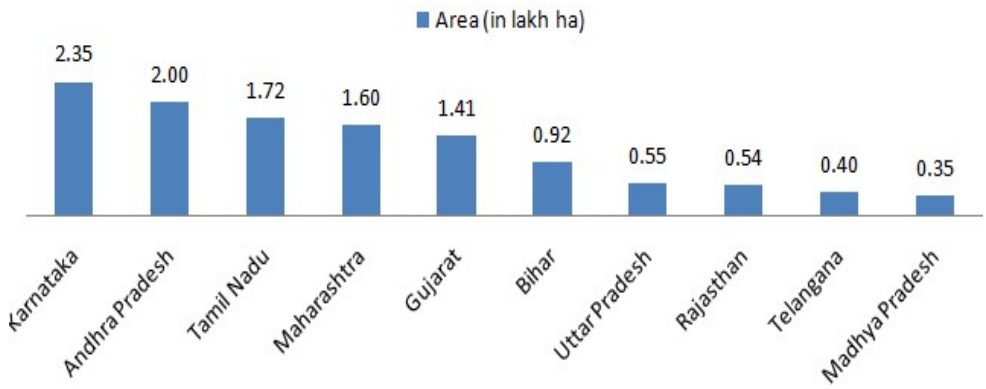
Out of the total annual net groundwater accessibility, about 90 per cent is utilised in water irrigation systems, and the rest 10 per cent is utilised for various mechanical and residential purposes. In 2014-15, the net flooded region in India increased to 26.50 mha from 12.46 mha in 1960-1961. The net range immersed underneath ground water expanded to 62.82 per cent of net irrigated area in 2015 from 32.6 per cent in 1960. This illustrated the escalating need for water required in farming, which could be achieved by increasing the efficacy of irrigation systems at cultivable level. An effective way to elevate water utilisation productivity in horticulture would be possible through the adoption of advanced micro irrigation techniques like trickle and sprinkler irrigation (Kiruthika & Kumar, 2020). During 2019-20, with the intervention of the Ministry of Agriculture and Farmers' welfare, around 11.83 lakh hectares of land was irrigated through micro irrigation system, in India. Promotion of micro irrigation system in India is highly dependent on the knowledge and level of awareness. Ganesan *et al.* (2018) revealed that the major constraint in adoption of drip irrigation was lack of awareness regarding the efficiency. The farmers should not be imposed to adopt a technology rather they should be motivated and made aware of the technology so that they would adopt it voluntarily. Figure 1 shows that there is an increasing trend in implementation of micro irrigation system in India. In 2019-20, India covered 11.83 lakh hectares of land under micro irrigation system.



Source: DAC&FW (2020) retrieved from https://pmksy.gov.in/mis/rptAchievement.aspx accessed as on 22.09.2020.

Figure 1: Area Coverage under Micro Irrigation in India.

As it can be observed from Figure 2 that, Karnataka covered highest in area under micro irrigation followed by Andhra Pradesh, Tamil Nadu, Maharashtra, Gujarat, Bihar, Uttar Pradesh, Rajasthan, Telangana, Madhya Pradesh and others.



Source: DAC&FW (2020) retrieved from https://pmksy.gov.in/mis/rptAchievement.aspx accessed as on 22.09.2020

Figure 2: Major State Wise Area Covered under Micro Irrigation in India (2018-19).

Shukla, (2020) discussed that Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Gujarat and Haryana are the six cover up more than 81 percent of the all out zone under micro irrigation system (sprinkler, drip, pivots, rain-guns etc.). Considering largest arid pockets in these particular areas and the states supporting micro-irrigation through subsidies, the central budgeted fund utilization has seen more progress in these states.

Source: DAC&FW (2020) retrieved from https://pmksy.gov.in/mis/rptAchievement.aspx accessed as on 22.09.2020.

Figure 3: Coverage under Drip & Sprinkler Irrigation in India (2018-19).

Figure 3 depicts that in India around 50 per cent of area is covered under both drip and sprinkler irrigation system from total area under micro irrigation. So, both the irrigation methods are of equal importance in the country.

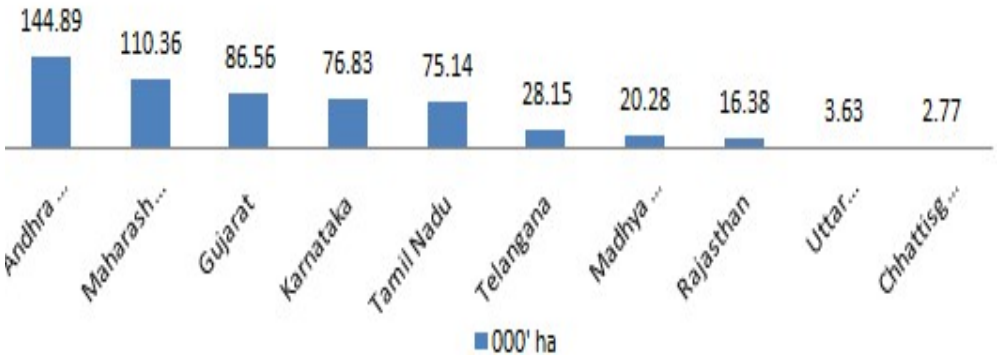
Importance of Drip Irrigation

Drip irrigation is an extremely efficient water irrigation system that helps in delivery of water and other nutrients directly at the crop root zone, at right time and right quantity for optimal plant growth. It is easy to control and helps in minimising water runoff, lost to evaporation. Drip irrigation system is an arrangement in which perforated tubes are placed on line row crops and with the help of low-pressure pump water is forced through the tubes, to irrigate the crops. At present, farmers are inclined toward sub surface drip irrigation systems as they are convenient irrigation systems for small and irregularly

shaped fields. For identifying the rapid decline of irrigation water potential and to meet the rising demand for water in various sectors, several demand management strategies and programs have been initiated to save water and improve the existing water use efficiency in Indian agriculture. The significance of drip irrigation system is as presented below:

- Increased / Improved consistent quality yield
- 100 per cent utilisation of land due to uniform irrigation in any kind of soil and topography
- Effective utilisation of chemical and crop protection, with no activity
- Reduced dependency on weather with higher stability and lower risks
- Smart soil aeration and no saturation
- Minimises high salinity due to excessive application of chemicals
- Foliage wetting is reduced leading to less diseases of the flora.

The major states following drip irrigation system are Andhra Pradesh, Maharashtra, Gujarat, Karnataka, Tamil Nadu, Telangana, Madhya Pradesh, Rajasthan, Uttar Pradesh, and Chhattisgarh as seen in Figure 4. Rajasthan covered 16.38 thousand hectares of land during 2018-19.



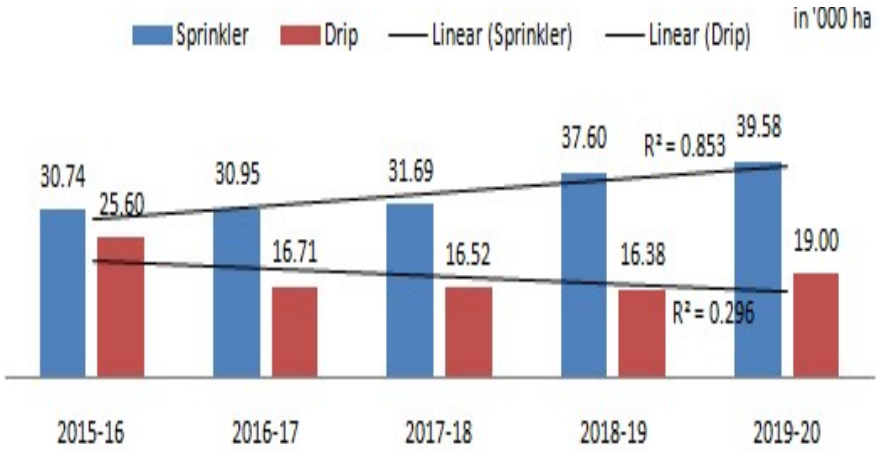
Source: DAC&FW (2020) retrieved from https://pmksy.gov.in/mis/rptAchievement.aspx accessed as on 22.09.2020.

Figure 4:Major State Wise Area Covered under Drip Irrigation in India (2018-19).

Drip and Sprinkler Irrigation System in Rajasthan

The adoption of advanced irrigation techniques like drip and sprinkler irrigation system, with about 90 per cent and 70-75 per cent efficiency respectively, can significantly help in increasing the overall water utilisation efficiency. With proper attention, there is huge scope of accelerating the efficiency of existing water irrigation projects in Rajasthan. On pilot basis, Water Use Associations (WUAs) have been constituted for various projects, by the Irrigation Department and Command Area Development & Water Utilization Department, Rajasthan. The WUAshave been considered asthe most vital elements of the proposed Rajasthan Water Sector Restructuring Project (RWSRP). The Rajasthan Govt. has planned to launch an intensive agriculture extension programme through the farmers' organisations, formed in the areas covered by RWSRP, in association with the agriculture department, in the initial stage with the objective to set up sprinkler or drip irrigation system in at least 0.5 lakh hectares out of the total command area of 5 lakh hectares, before completion of the project. It is

planned to extend the programme further, in the remaining command areas in the next phase, with the target to bring at least 0.2 lakh hectares of additional area under drip or sprinkler irrigation, each year, to attain the target of having pressure irrigation in about 20 per cent of the irrigated area in Rajasthan, by 2045. (GoR, 2020). The area covered under both drip and micro irrigation system in Rajasthan from 2015-2020 has been illustrated in Figure 5, in which the trend of sprinkler irrigation is found increasing, whereas that of drip irrigation is found decreasing.



Source: DAC&FW (2020) retrieved from https://pmksy.gov.in/mis/rptAchievement.aspx accessed as on 22.09.2020.

Figure 5: Status of Drip and Sprinkler Irrigation in Rajasthan.

From the above figures, it is clear that, there is a need to work on promotion of micro irrigation system; especially drip irrigation in the country. The reason behind the promotion of drip irrigation rather than of sprinkler irrigation is that, the drip irrigation system is found to be more efficientby giving more than 90 per cent water use efficiency. In Rajasthan, as there is a decreasing adoption of drip irrigation, the constraints need to be identified. This study tries to find out the major constraints faced by the farmers in zone Ib of Rajasthan. Zone Ib comprises of two districts, namely Sri Ganganagar and Hanumangarh districts, which is the known to be the granary of Rajasthan. These two districts cover considerable area in production of selected crop in Rajasthan. By observing, Table 1, the scenario of area under drip and sprinkler irrigation system can be perceived. In 2019-20, Sri Ganganagar district and Hanumangarh district cover 221.53 hectares and 103.96 hectares of land, respectively. As compared to sprinkler irrigation system, adoption of drip irrigation is very less.

Table 1: Status of Irrigation System in The Zone Ib.

Districts	Irrigation Type	Area (ha)
Sri Ganganagar	Drip Irrigation	221.53
	Sprinkler Irrigation	1637.57
	Total Micro Irrigation	1859.10
Hanumangarh	Drip Irrigation	103.96
	Sprinkler Irrigation	2848.00
	Total Micro Irrigation	2951.96

Source: DAC&FW (2020) retrieved from https://pmksy.gov.in/mis/rptAchievement.aspx accessed as on 22.09.2020.

Rajasthan only covers 4.95 per cent of area micro irrigation system in India. The coverage under micro irrigation system in Rajasthan was 58573 hectares during 2019-20 out of which Sri Ganganagar had 1859.10 hectares and Hanumangarh district had 2951.96 hectares of land covered under micro irrigation system.

Drip Irrigation in Potato

During 2015, with an annual production of 87,260,000 MT, China ranked top in the world potato production, followed by India with less than half of the total potato production of China. More than 80 per cent of world potato production is done by Asian and European nations. Potato is cultivated widely in almost all the states of India, with majority of production from states like West Bengal, Bihar, Madhya Pradesh, Gujarat, Maharashtra, Himachal Pradesh, Punjab, Uttar Pradesh, Karnataka and Assam. In Rajasthan, except Jodhpur, Jaisalmer and Barmer, potato is cultivated in almost all other districts. It is mostly grown in districts of Bharatpur, Kota, Dholpur, Sri Ganganagar, Hanumangarh, Sirohi and Jhalawar. The maximum area under potato crop belongs to the Bharatpur Region (1,442 ha), followed by Sri Ganganagar Region. In total, about 2412 hectares of land in Rajasthan is under potato cultivation, with a production reaching up to 27,797 tonnes. (Grant Thornton, 2016). Water is considered to be an essential input in the production of potato and the issue of water management varies from region to region. India occupies a unique position where potato cultivation is carried out in different parts of the country, throughout the year. Around 81 percent of the potato is grown in plains, under short day conditions of winter, 13 per cent in the hills, under long day conditions of summer and about 6 per cent of the potatoes is grown in plateaus, under almost equinox conditions during rainy season. Winter crops are consistently irrigated, whereas the summer and rainy season crops are vulnerable to drought and excessive irrigation at different stages of the crop growth (Grewal and Singh 1974). Potato cultivation in India requires an optimum temperature ranging from 15°C to 25 °C, i.e. maximum day temperature of not below 35°Cand night temperature not above 20 °C. Temperature less than 21°C results in tuberization. High-frequency water management through drip irrigation reduces soil as a storage reservoir for water, supplying daily requirements of water to root zone of each plant and retaining a high soil matric potential within the rhizosphere to minimise plant water stress (Phene and Sanders, 1976). Several studies have indicated drip irrigation to be suitable for row crop and potato cultivation (Shalhevet et al., 1983).Deriving maximum crop yield from available water resource, by optimization of irrigation frequency through suitably designed, managed and maintained irrigation system would yield higher economic benefits than any other modification in management. (King et al. 2003). This paper makes an attempt to identify the major constraints faced by farmers growing potato under drip irrigation in Zone Ib of Rajasthan.

RESEARCH METHODOLOGY

The research was confined to the Zone Ib, comprising of Sri Ganganagar and Hanumangarh districts of Rajasthan. The study was based on descriptive and exploratory research design which comprised of both primary and secondary data. Multistage stratified random sampling was used for the research. As the 1st unit, Zone Ib was purposively selected for the study as it covers considerable area in production of potato with 279.54 metric tonnes as per 4th advance estimates 2019-20, GoR. Also this area covers 339.76 ha out of 4589 ha of Rajasthan in drip irrigation as per the estimates. For 2nd unit, one *tehsil* from each district was randomly selected in such way that they would represent drip irrigation in potato. As 3rd unit,two villages from each selected *tehsils* were identified. 15 farmers were selected from each village based on probability proportional to size (PPS) method of sampling. The PPS method was based on standard land size classification viz. small farmers: up to 2 ha, medium farmers: 2 to 4 ha and large farmers: more than 4 ha. For the study, a total of 60 farmers were selected from the two districts. Cultivation of potato through drip irrigation system was found to be profitable for the farmers. Still, potato growers face a lot of problems in drip irrigation system. From literature review, eight major constraints faced by the farmers in drip irrigation system, were identified. Pre-structured schedule containing both open and close ended questions was prepared for the farmers to rank the constraints according to their preferences. The

identified constraints for analysis were 'high initial cost', 'requires timely maintenance', 'lack of technical know-how', 'lack of adequate training', 'non- availability of technical guidance in time', 'non-availability of quality inputs', 'inadequate and uncertain of power supply', and 'unsuitable climate'. For the analysis of the ranks, Garrett ranking technique was used to identify the major constraints in adoption of drip irrigation system in potato in the study area. Garrett's formula for converting ranks into per cent was given by,

$$\text{Percentage Position} = \frac{100\,(R_{ij}-0.5)}{N_j}$$

Where,

R_{ij}= Rank given for i^{th} item by j^{th} individual

N_j= Number of items ranked by j^{th} individuals

RESULTS AND DISCUSSIONS

By asking the farmers to rank the constraints according to the severity, the major constraints were analysed as below:

Table 2: Constraints in Adoption of Drip Irrigation (Potato).

S.No	Constraints	Average Garrett Score	Rank
1	High initial cost for drip irrigation	70.50	1
2	Requires timely maintenance	62.03	2
3	Lack of technical know-how	56.33	3
4	Lack of adequate training	53.93	4
5	Non- availability of technical guidance in time	46.20	5
6	Non-availability of quality inputs	39.03	6
7	Inadequate & uncertain of power supply	36.97	7
8	Unsuitable climate	35.00	8

Source: Researcher's computation from field data.

Table 2 depicts the major constraints faced in adoption of drip irrigation systemin the study area. Garrett ranking technique, as illustrated in Table 1, gives the Garrett scores of the constraints faced by the farmers. As per Table 1, the major constraint was found to be 'high initial cost for drip irrigation (Garrett score: 70.50)', followed by 'requires timely maintenance (Garrett score: 62.03)', 'lack of technical know-how (Garrett score: 56.33)','lack of adequate training (Garrett score:53.93)','non- availability of technical guidance in time (Garrett score:46.20)', 'non-availability of quality inputs (Garrett score:39.03)', 'inadequate & uncertain of power supply (Garrett score: 36.97)'and 'unsuitable climate (Garrett score: 35.00)'.

CONCLUSIONS

The major constraints faced by the farmers in the study area were identified as 'high initial cost for drip irrigation', 'requires timely maintenance', and 'lack of technical know-how', followed by others. So, this study suggests for the promotion of drip irrigation among farmers by effective training, so that the farmer should have confidence for adopting drip irrigation. The efficiency and advantages of drip irrigation can be promoted among farmers in the study area through field demonstrations. The water is a scarce resource and it should be sustainably used through which there will be effective management of wealth as well as nature.

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