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RESEARCH ARTICLE

An Impact of Drip Irrigated Chili Cultivation at Khammam

Ramu Y, Karthikeyan C*, and Shantha Sheela M

Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Coimbatore-641 003

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ABSTRACT

Considering contemporary conditions such as global warming and groundwater depletion, making sustainable use of available resources is critical. Water conservation solutions such as drip irrigation reduce water exploitation and boost irrigation efficiency. The Thirumalayapalem block of Khammam district in Telangana state was chosen for research. Three villages were purposively chosen for investigation in a designated block, all of which used drip irrigation. A set of ten people was chosen at random from each village. As a result, the sample for the study consisted of 30 farmers who used drip irrigation. The primary data was gathered using a pre-tested and well-structured questionnaire. The influence of drip irrigation increased yield by 61 percent over the previous year without drip irrigation. The average number of irrigation days increased to 40.3 days from 25.1 days due to the impact of drip irrigation, it boosted the yield approximately to 61 percent. The difference in labour use efficiency before and after drip irrigation was 47.96. The overall efficiency of input-expenditure was 64%. The reduced power consumption of drip irrigation was just 11.57 kW, contrasted to 33.76 kW before its adoption. During the adoption of technology, total Income climbed by 50 per cent.

Keywords: *Drip irrigation; Chili; Income; Yield; Efficiency; Khammam; Impact*

INTRODUCTION

In terms of chili output, India is the world's leading country. With 14,268 ha in 2020, the Khammam district in Telangana ranked top in chili production (Anonymous, 2020). Throughout the growing process, chili needs a lot of fertilizers and irrigation. Khammam district had an average rainfall of 754.8 mm (Telangana State Development Planning Society, 2020). Irrigation at regular intervals through drip irrigation can help to compensate the monsoon's shortage, increasing productivity (Mahajan *et al*., 2007). Paddy, chili, cotton and maize were the main crops farmed across the Khammam area. Paddy consumes most of the available water compared to other crops. As a result, drip irrigation is a good fit for the current circumstances regarding precise and consistent irrigation in chili. Water conservation and irrigation efficiency are in great demand because of global warming. Sustainable agriculture can accomplish this, with water and resource conservation being the most important factors. It can be done efficiently by using drip irrigation to increase revenues and improve cropping patterns (Gupta *et al*., 2010). Furthermore, drip fertilization aids in increased productivity. Drip irrigation improves water usage, plant growth development, and irrigation scheduling flexibility. It also reduced tillage requirements, produced higher-quality products, increased crop yields, and improved fertilizer use efficiency (Qureshi *et al*., 2001). It is especially susceptible to drought stress due to its large leaf area, high stomatal conductance, and shallow root structure. Crop loss occurs because of improper irrigation during peak seasons such as blossoming. It is possible to apply accurate irrigation at regular intervals using drip irrigation. Developing countries like India belongs to arid and semi-arid zone have the common policy of developing infrastructure for water resources and their management. According to a study conducted by the International Water Management Institute (IWMI), increasing the effectiveness of micro-irrigation can meet the increasing demand for water by around 50% by the end of 2025. (Seckler *et al*., 1998). Drip irrigation eliminates the negative effects of conventional irrigation such as salinity, waterlogging, and the movement of top fertile soil (Narayanamoorthy, 1997). Drip irrigation can help to reduce groundwater overexploitation which occurs because of conventional irrigation. Drip irrigation

Corresponding author mail id: karthikeyanextn@yahoo.com

saves water in the range of 40% to 70% compared to conventional irrigation. Considering the past, a study on the impact of drip irrigation in chili on yield, Income, water usage, input expenditure, energy, and labor efficiency was conducted in the Khammam district.

MATERIAL AND METHODS

The research was carried out in Telangana's Khammam district, where water scarcity and fierce competition for available water is prevalent, and black soils predominate. Thirumalayapalem block was chosen for the study because drip irrigation adoption is higher than the other Khammam district blocks. Three villages were chosen from the selected block where drip irrigation's influence could be studied more thoroughly. Ten farmers were chosen at random from among the chili crop drip users in each village. As a result, a group of 30 farmers was chosen to study the impact of drip irrigation on chili yield, Income, input expenditure, water use, energy efficiency, and labour efficiency. For the current study, an ex post facto research design was used. The data on farmers, who implemented drip irrigation in chili was compiled from the Department of Horticulture a list of farmers who have implemented drip irrigation in chili was compiled from private merchants and locals. The primary data was gathered through a well-structured and pre-tested interview.

RESULTS AND DISCUSSION

Impact of Drip Irrigation

In this study author's main aim was to find the significant difference between before and after the adoption of the drip-irrigated system in chili on various parameters *viz*., Income, yield, water usage, labor use efficiency input use efficiency, energy use efficiency.

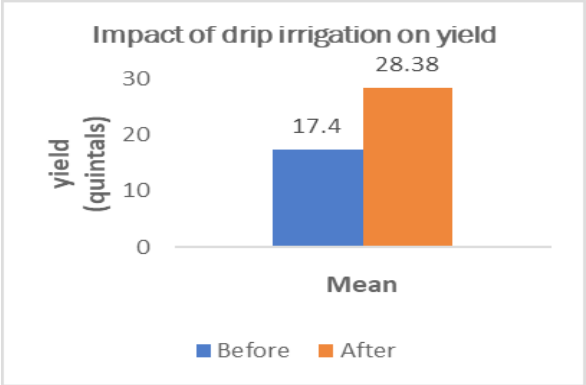
1. Impact of drip irrigation system in chili on yield

Table1. Impact of drip irrigation system in chili on yield

Yield (Quintals per acre)	Paired samples		
	Before	After	Paired difference
Mean	17.40	28.38	10.99
Standard deviation	2.41	2.23	1.65
Standard error	0.44	0.40	0.30

t value = 36.053*

Figure 1. Impact of drip irrigation system on yield



Drip irrigation was used in chili and had a positive effect on yield. According to table 1 and figure 1, there was a significant mean difference between the mean yield values before and after the adoption of the technology. It is primarily due to lower evapotranspiration losses in drip irrigation compared to conventional irrigation. As a result, drip irrigation was more efficient in terms of water usage while using the same amount of water.

Farmers produced 61 % less yield before using drip irrigation than after using drip irrigation. The average yield of chili before the use of drip irrigation was 17.4 quintals per acre, while the average yield harvested after drip irrigation was 28.3 quintals per acre. The result is similar to those of Patel *et al.*, 2007. Due to farmers' ability to cultivate in more areas, large farmers' Income increased comparatively faster than that of small and marginal farmers.

2. Impact of drip irrigation system in chili on water usage (Number of days irrigated)

Table 2. Impact of drip irrigation system in chili on water usage

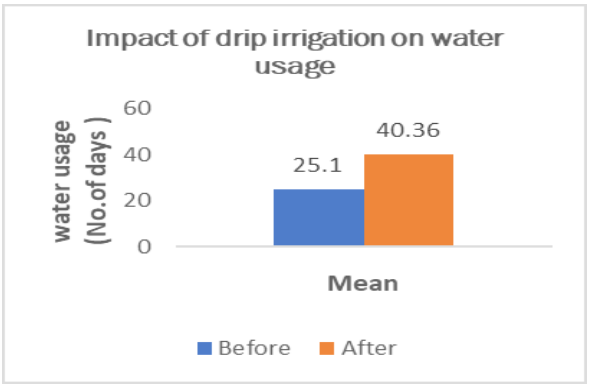
Water Usage (No. of days)	Paired Samples		
	Before	After	Difference
Mean	25.10	40.36	15.26
Standard deviation	6.42	7.00	7.10
Standard error mean	1.17	1.27	1.30

t value=11.769*

Drip irrigation positively influences water usage based on the number of days watered. There is a large mean change in water usage before and after technology adoption, as shown in table 2. and figure

2. Farmers using the traditional method used more water, lengthening the time between irrigation and reducing the number of irrigations per month. Water is applied drop by drop after the drip system was installed. As a result, there was an increase in the number of irrigation per month and a decrease in the time between two irrigation.

Figure 2. Impact of drip irrigation on water usage



Before installation, the average number of irrigation days was 25.1 days, after installation, the average number of days of irrigation was 40.3 days. Farmers explained the consequences. The main reason for this was that there were no percolation losses, the usage of available moisture was high, and soil pores were emptied faster following drip irrigation, resulting in more irrigation days with shorter intervals. However, due to the availability of more water in furrow-based irrigation, more percolation losses through water flow and usage of available moisture were low, resulting in soil pores not being emptied quickly. As a result, there were fewer total irrigation days and longer intervals between irrigations.

3. Impact of drip irrigation system in chili on labour use efficiency

Table 3. Impact of drip irrigation system in chili on labour use efficiency

Labour use efficiency (No. of hours)	Paired samples		
	Before	After	Paired Difference
Mean	68.06	20.10	47.96
Standard deviation	6.81	5.48	7.88
Standard error mean	1.24	1.01	1.43

t value = 33.320*

The drip irrigation system reduced the overall amount of work required for cultivation procedures by a significant amount. table 3 and figure 3. show a substantial mean difference in labor efficiency (47.96) before and after using drip irrigation. Previously, an average of 68.06 hours of labor was used, however, this was later reduced to an average of 20.1 hours for all procedures.

According to farmers, weeding, fertilizer application, pesticide/ fungicide spraying and intercultural operations all took much less labour. Except in the areas left uncovered by the mulch sheet, there was no weed emergence when drip irrigation was paired with mulching. Most of the fertilizers used in manuring were in liquid form. So, drip irrigation was used to fertigate them. As a result, the farmer can operate manuring for several times applications depending on the need. Weed germination was low, and their growth was stunted due to lack of moisture. Hence farmers required only an average of 3 to 4 labor for weeding per acre. Occasionally, there was no requirement of labor for weeding. Due to suppressed growth of weeds, pest emergence was controlled, resulting in less labor allocation for pesticide application.

The maximum labor allocated for entire operations was 87 days per acre members during the conventional method. While during the drip irrigation, a minimum number of labor was allotted. The labor efficiency was increased to 29 per cent after the adoption of drip irrigation.

4. Impact of drip irrigation system in chili on input expenditure

Table. 4. Impact of drip irrigation system in chili on input expenditure.

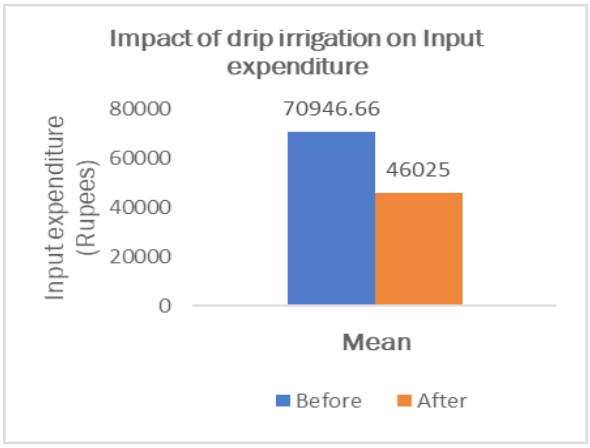
Input expenditure (Rs. Per acre)	Paired samples		
	Before	After	Difference
Mean	70946.66	46025.00	24921.66
Standard deviation	2704.87	2511.99	3820.31
Standard error mean	493.84	456.62	697.49

t value = 35.730*

The impact of drip irrigation on total input expenditure was negative, indicating that expenditures were reduced when drip irrigation was implemented. There was a mean difference of Rs. 24921.6 in total expenditure on inputs, as shown in table 4 and figure 4. In drip irrigation, input costs such as seed, manures, and plant protection products were lowered. There was no substantial difference in average seed material expenditures before and after implementing drip irrigation. However, there were minor variations based on the farmer's preferences.

Because of the enhanced efficiency of manures and the reduced amount of manures applied, expenditure on manures and manuring was lowered with the adoption of drip irrigation. The cost of hiring workers for manuring was reduced, resulting in lowered input expenditure in drip irrigation.

Figure 4. Impact of drip irrigation on input expenditure



Drip irrigation lowered the amount of money spent on plant protection materials since pests and insects were less likely to attack, resulting in decreased fungal infections. The amount required for installing pheromone traps and sticky traps was also reduced to a considerable amount.

After applying drip irrigation in chili, there was a 64 per cent efficiency on the expenditure of plant protection supplies. Following the implementation of drip irrigation, the average input expense was reduced to Rs. 46025 from Rs. 70946.67. During the conventional way of irrigation, the maximum spending of plant protection materials detected was Rs.77,200, whereas the minimum expenditure of plant protection materials noticed was Rs. 41,900 following drip irrigation installation.

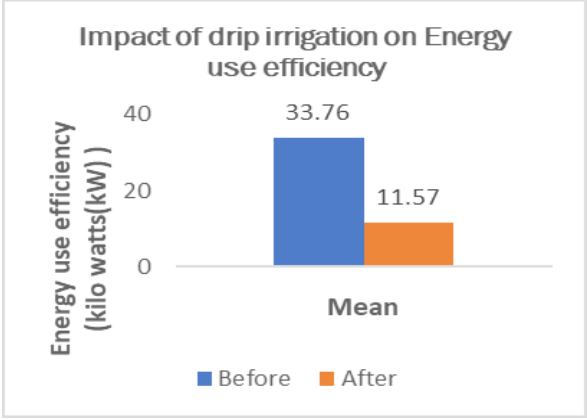
Table 5. Impact of drip irrigation system in chili on Energy use efficiency(kW).

Energy use efficiency(kW)	Paired samples		
	Before	After	Difference
Mean	33.76	11.57	22.19
Standard deviation	2.27	2.39	2.33
Standard error mean	0.41	0.43	0.42

t value=52.036*

Both irrigation types have drastically different energy use efficiency during irrigation hours. There was a mean difference of 22.19 in the energy efficiencies of both irrigation systems, as shown in table 5 and figure 5. The main reason for this was that the quantity of energy consumed is directly proportional to the length of irrigation administered to the crop, and the interval between two irrigation was shorter. However, it may be overlooked because the energy used is not dependent on the time but rather on the total irrigation hours. Compared to drip irrigation, the number of irrigation hours in traditional irrigation was higher. Also, water requirement is less in drip irrigation due to fewer percolation losses and fewer evapotranspiration losses.

Figure 5. Impact of drip irrigation on energy use efficiency



In comparison to conventional irrigation, drip irrigation requires more energy. The use of drip irrigation resulted in a 34% increase in energy efficiency. The average amount of energy used for total irrigation during conventional irrigation was 33.76 kW, while drip irrigation used just 11.57 kW. Within a sample of 30, the energy consumed was 37 kW during conventional irrigation, and the least energy consumed was 7 kW during drip irrigation.

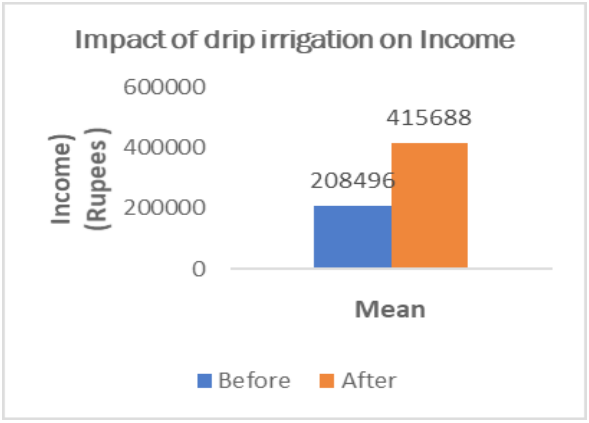
Table 6. Impact of drip irrigation system in chili on income

Income (Rs. Per acre)	Paired samples		
	Before	After	Difference
Mean	208496.66	415688.33	207191.7
Standard deviation	310401.7	40089.1	27037.9
Standard error mean	5733.15	7319.24	4936.42

t value = 41.92*

Drip irrigation had a different effect on Income than other methods. There was a mean difference of Rs.207019.7 between the two irrigation, as shown in table 6 and figure 6. In the opinion of the farmers, income is the driving force behind the use of drip irrigation. Many variables drove the increase in Income with the use of drip irrigation, including a decrease in cultivation costs per acre and an almost two-fold increase in the price of chili. This is due to the high quality of the harvest, low pest and weed incidence, good fertilizer and manure efficiency, and high mineral efficiency All of these elements contribute to the weight and quality of berries increasing.

Figure 6. Impact of drip irrigation on Income



After implementing drip irrigation, total Income increased by 50%, followed by net Income. Before the adoption, the average Income of the sample (30) was Rs. 208496.66. However, it was increased by an average of Rs. 415688.33. Within the sample, the largest difference in Income before and after the adoption was Rs. 2.64 lakhs, while the least difference was Rs. 1.72 lakhs.

CONCLUSION

According to the current study, drip irrigation boosted efficiency in several elements of chili production, including yield, input cost, energy, water usage, labor and Income. By raising the value of exports, these variables may encourage both farmers and politicians. The improved quality of berries can attract customers, and farmers can charge a greater price for them than for chili berries cultivated with traditional irrigation. However, the initial budget, which many farmers backed, was a big stumbling block. Because the bulk of Indian farmers are small and marginal in landholding and annual revenue, they cannot afford such a large initial outlay. Government involvement is required to encourage the use of drip irrigation. This can be accomplished by subsidizing the cost of drip irrigation tools and the installation process. Drip irrigation is the best option for water constraints in areas where droughts are common. This device could be recommended to water-scarce areas to maximize irrigation efficiency. Farmers can benefit from drip irrigation combined with mulching by improving net Income and minimizing weed occurrence. The use of drip irrigation has gained significant relevance because of contemporary climatic changes, such as erratic rainfall patterns and labor shortages.

Ethics statement

Specific permits were not required for the above field studies because no human or animal subjects were involved in this research.

Consent for publication

All the authors agreed to publish the content.

Competing interests

There was no conflict of interest in the publication of this content.

Data availability

All the data of this manuscript are included in the manuscript. No separate external data source is required. If anything is required from the manuscript, certainly, this will be extended by communicating with the corresponding author through corresponding official mail karthikeyanextn@yahoo.com

REFERENCES

Anonymous. 2021. Season and Crop coverage Report. Department of Agriculture. Government of Telangana. India.

Gupta, A.J., Ahmad, M.F. and F.N. Bhat. 2010. Studies on yield, quality, water, and fertilizer use efficiency of capsicum under drip irrigation and fertigation. *Ind. J. Horti*.,67(2): 213-218.

Mahajan, G., Singh, K.G., Gharda, R. and M. Siag. 2007. Response or redhot pepper (*Capsicum annum* L.) to water and nitrogen under drip and check basin method of irrigation. *Asian J. Plant Sci., 6(5)*: 815-820.

Patel, N., Gupta, N., Singh, M., and K.S. Bhargav. 2017. Impact of Drip Irrigation System among the Chili Growers of Madhya Pradesh. *Inter. J. Pure App Biosci., 5(4)*: 2130-2133. DOI: http://dx.doi.org /10.18782/2320-7051.3082.

Qureshi, M.E., Wegener, M.K., Harrison, S.R. and K.L. Bristow. 2001.Economic evaluation of alternate irrigation systems for sugarcane in the Burdekin delta in North Queensland, Australia, In Water Resource Management, WIT Press, *Boston pp.* 47-57.

Seckler, David, Amarasinghe, Upali, Molden, David, de Silva, Radhika and Barker, Randolph 1998. World Water Demand and Supply,1990 to 2025: Scenarios and Issues, Research Report 19. International Water Management Institute (IWMI), Colombo, Sri Lanka.

Telangana State Development Planning Society. 2020. Retrieved from https://tsdps.telangana.gov.in/. (Accessed on 24th September 2021).