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Effect of Drip Irrigation on Sugarcane Production: A Case Study

Kalyankar Pandurang Marotrao¹

¹Associate Professor, Department of Economics, Shri Sant Savta Mali Gramin Mahavidyalaya,
Phulambri, Dist. Aurangabad, Maharashtra, India
E-mail: pandurangkalyankar@gmail.com

Abstract: New Technology is helpful to increase the productivity of each sector. Agricultural sector is no exception to this. In India more than 55 per cent working population still depends on agricultural sector for their livelihood. To increase per acre and per labour productivity, there is a need of adoption of new, advance and modern technology. In India 46.9 per cent (2011-12) of total gross cropped area was under irrigation. It means that still 53 per cent area remain un-irrigated. In this context Maharashtra state is very lagging behind as compared to national average. Only 17.7 per cent (2008-09) of total gross cropped area was under irrigation in Maharashtra, which is less than half of national average. In this scenario there is need to increase not only the irrigation capacity but also need of efficient use of available water stock.

Drip irrigation technique is helpful for efficient use of irrigation capacity. In the worst irrigation capacity states like Maharashtra, there is need of giving much more emphasis on use of this irrigation technique to bring more agricultural cropped land under irrigation. The present studies try to find out the answers of following questions:

What is the effect of use of drip irrigation technique on per acre productivity of Sugar Cane? Are the farmers tending to increase the use of this technique in their fields? To find out the answers of above problems a survey is conducted in Phulambri Taluka of Aurangabad district of Maharashtra State.

We found that by using drip irrigation technique for the Sugar Cane the production increased by 2.01 times as compared to conventional irrigation method, cost of production increased by 1.28 times, the gross income increased by 1.54 times and profit by 1.75 times.

INTRODUCTION

Irrigation plays a paramount role in increasing the use of inputs and enhancing cropping intensity as well as productivity of a crop. Irrigation development also helps in increasing the employment opportunities and wage rate of the agricultural labour. However water is becoming increasingly scarce worldwide due to various reasons. With the fast decline of the irrigation water potential and continued expansion of population and economic activity in most of the countries the problem of water scarcity is expanded to be aggregated further.

Despite having the largest irrigated area in the world, India too has started facing severe water scarcity in different regions. The agricultural sector, which currently consumes over 80 per cent of the available water in India, continues to be the major water consuming sector due to the intensification of agriculture. Though India has the largest irrigated area in the world, the coverage of irrigation is only about 47 per cent of the gross cropped area in 2011-12. One of the main reasons for the low coverage of irrigation is poor water use efficiency under the flood method of irrigation, which is predominantly practiced in Indian agriculture. Considering the water availability for future use and the increasing demand for water from different sectors, a number of demand and supply management strategies have been introduced in India to augment the supply as well as to control the demand for water. One of the demand management strategies introduced recently to control water consumption in Indian agriculture is drip technique of irrigation.

Drip irrigation, also known as trickle irrigation or micro irrigation or localized irrigation, is an irrigation technique which saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters. It is done with the help of narrow tubes which delivers water directly to the base of the plant.

In aim of the present study is find out the effect of drip irrigation technique on the Sugarcane productivity of Phulambri taluka? Is this technique economically viable for this cash crop producer, at current market prices?

REVIEW OF LITERATURE

1. Studies carried out based on experimental data suggested that the productivity of crop cultivated under DMI can be increased by 40 to 50 per cent over the crop cultivated under FMI especially in crop like bottle gourd, sweet potato, potato, tomato and chilies. Significant improvement in productivity of papaya (77 per cent), banana (52 per cent), grapes (23 per cent), mosambi (50 per cent) and pomegranate (98 per cent) has also been reported (INCID, 1994 and Sivanappan, 1994).
2. Single cane weight, cane girth, cane length, numbers of internodes, leaf length and leaf breadth were also found to be higher with sugarcane cultivated under drip method of irrigation when compared to the same cultivated under flood method of irrigation. (Venugopal and Rajkumar, 1998).
3. A relatively complex technology such as drip kits should not be part of short term relief programs, but should instead be embedded in long term developmental programs that involve both the public and private sector (Belder *et. al.*, 2006)
4. Micro-Irrigation technologies can improve the food and nutritional security of small cultivator households that have adopted the technology. In the study there was a marked improvement in house hold food security and nutritional intake for woman small cultivators who adopted bucket and drip irrigation for homestead vegetable cultivation. (Varma, S. *et. al.*, 2006).
5. Study carried out by Narayanamoorthy *i.e.* "Efficiency of Irrigation: A case of Drip

irrigation” try to find out the effect of drip irrigation on productivity of Sugarcane, Grapes and Banana crops. Maharashtra State was selected for this study. To find out the effect of Drip irrigation on productivity of Sugarcane Baramati and Shirampur blocks were selected from Pune and Ahemadnagar districts respectively, for Banana crop Raver from Jalgaon district and Niphad block from Nashik district for Grapes crop were selected. The study is based on field survey covered 200 farmers. After comparing DMI adopted and FMI adopted farmers the main result is the productivity difference in absolute term between the adopters and the non adopters of drip method of irrigation comes to nearly 259 quintals per hectare of Sugarcane *i.e.* productivity of Sugarcane cultivated under drip method of irrigation is higher by about 23 per cent. In case of Grapes the productivity difference between DMI and FMI irrigated crops comes about 19 per cent (about 39 quintals) the same comes to 29 per cent (about 153 quintals) in case of Banana crop. (Narayanamoorthy, A. 2005).

Above study's shows that drip irrigation method is not only effect on productivity of particular crop but also its effects on many parts of society. So it interesting to know what is the effect of drip irrigation on the Sugarcane productivity of Phulambri taluka of Aurangabad district. It is the one of taluka of backward Maharthawada region of Maharashtra State in India.

OBJECTIVES

The following are the main objectives of this study

1. To study the effect of drip irrigation technique on productivity of Sugarcane crop of Phulambri taluka.
2. To find out economic viability of Sugarcane under drip irrigation technique.

3. To suggest concrete policy to cover almost Sugarcane cultivation area under drip irrigation method.

RESEARCH METHODOLOGY

The present study mainly depends upon primary data. Data has collected through schedules canvassed among Sugarcane cash crops producer's farmers. To compare productivity of Sugarcane cash crops under different irrigation techniques schedules are filled from both types of farmers. A case study method has been adopted for this research. Field survey has conducted in Phulambri taluka of Aurangabad district in Maharashtra in August and September month 2014. But the data which is collected is related to 2013-14 year. Drip installation cost is spread over 06 years. Secondary data is collected from various Government publications.

To find out the actual effect of drip irrigation on Sugarcane cash crops per acre productivity, farmers who have adopted drip irrigation method (DIM) for Sugarcane cash crop and who have adopted flood irrigation method (FIM) for this crop are covered in this study. This study is covered total 26 Sugar Cane cash crop producer farmers, from which 13 farmers who have adopted drip irrigation Method (DIM) for Sugarcane cash crop and 13 farmers who have adopted flood irrigation method (FIM) for this crop are canvassed in this study.

Gross Irrigated Area in Major States of India

To avoid more dependency of agricultural on monsoon there is need of creation of water stocks. It is interesting to know what are the efforts has been done by various states of India in this regards.

From Table 1 we conclude that the per centage of irrigated area in Maharashtra state is very low as compared to Punjab and Haryana states of India. It is not just half to the National average too. So there is need to give serious attention to increase the use of modern water saving technique like drip irrigation.

Table 1
Gross Irrigated Area in Major States of India
(Figure shows % to gross cropped area)

| Sr. No. | State | Gross Irrigated Area | |
|---------|----------------|----------------------|---------|
| | | 2008-09 | 2011-12 |
| 1. | Punjab | 97.6 | 98.3 |
| 2. | Harayana | 85.3 | 87.5 |
| 3. | Uttar Pradesh | 76.4 | 76.7 |
| 4. | Bihar | 61.0 | 67.4 |
| 5. | Tamil Nadu | 58.3 | 59.7 |
| 6. | West Bangal | 56.2 | 58.1 |
| 7. | Andhra Pradesh | 48.7 | 49.3 |
| 8. | Gujrat | 45.6 | 48.2 |
| 9. | Maharashtra | 17.7 | N.A. |
| | India | 45.3 | 46.9 |

Source: Economics Survey of Maharashtra 2011-2012, p. 242, 2014-2015, p. 217.

Sugarcane Production in World

Table 2 shows that Brazil led the world in sugarcane production in 2013 with a 739267 TMT harvest and 39.38 per centage in world Sugarcane production. India was the second largest producer with 341200 TMT tons and India's share in world production was 18.18 per centage, and China the third largest producer with 125 536 TMT tons harvest and 6.69 per centage share in world production.

Brazil uses sugarcane to produce sugar and ethanol for gasoline-ethanol blends (gasohol), a locally popular transportation fuel. In India, sugarcane is used to produce sugar, jaggery and alcoholic beverages.

Largest Sugarcane Producer States in India

Table 3 indicate that Uttar Pradesh, Maharashtra, Karnataka are the largest sugarcane producers state in India. The cumulative share of these states in total Sugarcane production of India was 70.7 per cent in 2011-12.

Table 2
Top Ten Sugarcane Producers Countries (2013)

| Sr. No. | Country | Production (Thousand metric tons, TMT) | Per centage to World Production |
|---------|---------------|--|---------------------------------|
| 1. | Brazil | 739267 | 39.38 |
| 2. | India | 341200 | 18.18 |
| 3. | China | 125536 | 6.69 |
| 4. | Thailand | 100096 | 5.33 |
| 5. | Pakistan | 63750 | 3.40 |
| 6. | Mexico | 61182 | 3.26 |
| 7. | Colombia | 34876 | 1.86 |
| 8. | Indonesia | 33700 | 1.79 |
| 9. | Philippines | 31874 | 1.70 |
| 10. | United States | 27906 | 1.49 |
| | World | 1877105 | 100.00 |

Source: Food And Agricultural Organization of United Nations: Economic And Social Department: The Statistical Division.

Table 3
Largest Sugarcane Producer States in India 2013-14
(Production in million Tonnes)

| Sr. No. | State | Production | Per centShare Production to all India | Cumulative per centshare |
|---------|---------------|------------|---------------------------------------|--------------------------|
| 1. | Uttar Pradesh | 135.2 | 38.6 | 38.6 |
| 2. | Maharashtra | 76.6 | 21.9 | 60.5 |
| 3. | Karnataka | 35.9 | 10.3 | 70.7 |

Source: Government of India, Economic Survey 2014-15, Vol.II, p A-27.

Sprinkler and Drip Irrigation in Maharashtra

The State gives 60 per centsubsidy to small and marginal farmers and 50 per centsubsidy to other farmers for purchase of sprinkler and drip irrigation equipments. Year wise sprinkler and drip irrigation sets distributed and expenditure incurred are given in Table 4.

About Phulambri Taluka

Phulambri is one of taluka in Aurangabad district of Maharashtra state which is established as new

Table 4
Sprinkler and Drip irrigation sets distributed by State Government

| Year | Sprinkler | | Drip | | Expenditure incurred (in Crore) |
|---------|-------------|-----------|-------------|-----------|---------------------------------|
| | No. of sets | Area (ha) | No. of sets | Area (ha) | |
| 2009-10 | 36,329 | 37,552 | 91,058 | 81,660 | 192.11 |
| 2010-11 | 38,030 | 38,029 | 1,40,764 | 1,27,967 | 407.88 |
| 2011-12 | 38,959 | 37,904 | 1,77,150 | 1,50,995 | 448.04 |
| 2012-13 | 79,630 | 79,630 | 1,78,310 | 1,62,100 | 574.85 |
| 2013-14 | 30,296 | 30,296 | 89,108 | 81,008 | 305.57 |
| 2014-15 | 52,180 | 43,098 | 2,00,496 | 170719 | 688.41 |

Source: Economic Survey of Maharashtra 2014-15, p-82, 2015-16, p.83.

taluka with 88 villages in 26 June, 1999. Phulambri is located on Aurangabad–Jalgaon, Maharashtra State Highway No.8, and 25 km from Aurangabad. The total area of this taluka is 658.98 Sq. Km. According 2011 census total population of Phulambri taluka was 1.60 lakh the number of family were 23809. Sex Ratio of this taluka of was 917 which were low with compare to national average 943. Out of 66279 hectares total land of Phulambri taluka 48704 hectares land utilized for agriculture. It means that net area sown is 73.48 per cent. Cotton, Maze and Sugarcane are the main cash crop. In 2011-2012 total area under these crops are 28500 hectares, 19000 hectares and 1000 hectares respectively. Average rainfall days are 27 days and rainfall is 454.7 mm both are low with compare to district level average. Up to 2012 there are 01 medium, 22 minor and 39 percolation dam and 51 Kholhapuri dam in this area. In 2011-12 the per centage of gross agriculture area to grass cultivated land was 26.17 per cent which was greater than state average but bellow national average.

Development of Drip in Phulambri

Government of Maharashtra is gives subsidy for drip irrigation. Table 5 shows in Phulambri taluka the number of beneficiary and area covered under drip irrigation increased from 2008-09 to 2012-13. Price of ISI mark drip irrigation sets are higher with compare to non ISI mark sets and polyethylene drip

Table 5
Drip Subsidy in Phulambri

| Sr. No. | Year | Beneficiary | Area (Hector) |
|---------|---------|-------------|---------------|
| 1. | 2008-09 | 176 | 133.30 |
| 2. | 2009-10 | 532 | 379.49 |
| 3. | 2011-12 | 814 | 495.69 |
| 4. | 2012-13 | 911 | 592.88 |
| 5. | 2013-14 | 592 | N.A. |
| 6. | 2014-15 | 870 | N.A. |

Source: Agriculture Department, Phulambri Taluka.

sets. Government is giving subsidy only ISI mark drip sets. So many farmers are purchasing non ISI mark or polyethylene drip by their one money. That's way the numbers of beneficiary of drip subsidy has decreased after 2012-13.

RESULTS AND DISCUSSION

The result and discussion is divided in to the two main parts. First is concern with Production cost of Sugarcane crop and second one is concern with Profitability of Sugarcane crop under Drip Irrigation Method.

(A) Production Cost of Sugarcane Crop

The cost of production of Sugarcane Crop was different under the drip irrigation method and flood irrigation method. Production cost of Sugarcane

Table 6
Cost of Sugarcane cultivation under Drip Irrigation System (Rs./Acre)

| <i>Sr. No.</i> | <i>Drip Installation cost</i> | <i>Land Preparation Cost</i> | <i>Seed and Sowing</i> | <i>Manures Fertilizers, Pest Management Cost</i> | <i>Inter Season Cultivation Cost</i> | <i>Cutting and Transport Cost</i> | <i>Total Cost</i> |
|----------------|-------------------------------|------------------------------|------------------------|--|--------------------------------------|-----------------------------------|-------------------|
| 1. | 7500 | 6600 | 11500 | 24000 | 5600 | 800 | 56000 |
| 2. | 6667 | 3600 | 8000 | 20250 | 3000 | 46350 | 87867 |
| 3. | 4167 | 3400 | 11000 | 13650 | 3800 | 0 | 36017 |
| 4. | 6667 | 5200 | 9000 | 17900 | 6500 | 0 | 45267 |
| 5. | 6667 | 4800 | 9000 | 17000 | 4100 | 0 | 41567 |
| 6. | 6667 | 5200 | 7000 | 25500 | 5500 | 0 | 49867 |
| 7. | 6667 | 4000 | 9500 | 15300 | 3000 | 0 | 38467 |
| 8. | 6670 | 4200 | 8500 | 8200 | 1500 | 1700 | 30770 |
| 9. | 4333 | 5600 | 12000 | 12000 | 6000 | 0 | 39933 |
| 10. | 5000 | 4800 | 8500 | 20000 | 5000 | 0 | 43300 |
| 11. | 5333 | 4400 | 6500 | 13700 | 2000 | 0 | 31933 |
| 12. | 8333 | 7800 | 8000 | 8600 | 3100 | 0 | 35833 |
| 13. | 7000 | 6000 | 6500 | 17900 | 4000 | 0 | 41400 |
| <i>Aver.</i> | 6282.38 | 5046.15 | 8846.15 | 16461.53 | 4084.61 | 3757.7 | 44478.04 |

Source: Field Survey.

Table 7
Cost of Sugarcane Cultivation under Flood Irrigation System (Rs/Acre)

| <i>Sr. No.</i> | <i>Drip Installation cost</i> | <i>Land Preparation Cost</i> | <i>Seed and Sowing</i> | <i>Manures Fertilizers, Pest Management Cost</i> | <i>Inter Season Cultivation Cost</i> | <i>Cutting and Transport Cost</i> | <i>Total Cost</i> |
|----------------|-------------------------------|------------------------------|------------------------|--|--------------------------------------|-----------------------------------|-------------------|
| 1. | NIL | 5100 | 15000 | 12266 | 4000 | 0 | 36366 |
| 2 | NIL | 5600 | 10000 | 15000 | 6000 | 2000 | 38600 |
| 3 | NIL | 3200 | 11000 | 3850 | 600 | 3000 | 21650 |
| 4 | NIL | 4200 | 8000 | 15600 | 8100 | 2000 | 37900 |
| 5 | NIL | 4200 | 13473 | 24021 | 9079 | 0 | 50773 |
| 6 | NIL | 4100 | 9800 | 8999 | 5000 | 5000 | 32899 |
| 7 | NIL | 5200 | 12900 | 16055 | 9000 | 0 | 43155 |
| 8 | NIL | 7200 | 7860 | 9600 | 5000 | 1667 | 31327 |
| 9 | NIL | 3800 | 10000 | 4000 | 5000 | 500 | 23300 |
| 10 | NIL | 4400 | 10700 | 5000 | 3400 | 2800 | 26300 |
| 11 | NIL | 3400 | 12500 | 7000 | 4500 | 2000 | 29400 |
| 12 | NIL | 5900 | 10800 | 12500 | 6500 | 0 | 35700 |
| 13 | NIL | 3500 | 6400 | 12500 | 5400 | 0 | 27800 |
| <i>Aver</i> | – | 4600 | 10648.69 | 11260.84 | 5506 | 1459 | 33474.62 |

Source: Field Survey.

incurred from land preparation to marketing is divided into 06 categories. Table 6 and 7 shows Cost of Sugar Cane cultivation under drip irrigation method and flood irrigation method respectively. Comparative discussions of production cost of Sugar cane cultivation costs under both methods are as below:

Drip Installation Cost

Sugarcane producers in Phulambri taluka have adopted drip irrigation method on a large scale. Considering the average life of a drip irrigation set, its installation cost was spread over six year's periods. The average per acre cost of drip irrigation was Rs. 6282. It ranged between Rs. 4167 and Rs. 8333 per acre in the case of surveyed farmers. The farmers using flood irrigation method for Sugarcane cultivation did not spend any money on drip irrigation.

Preparation of Land

Land preparation is the important thing for Sugarcane crop cultivation. The land has to be ploughed twice or thrice and harrowed once or twice to take this crop. Soil is rotated by rotavator which cane fixed to tractor. The cost of per acre land preparation was found to have ranged from 3400 to 7800 per acre. Under the drip irrigation method the average per acre cost on this item was Rs. 5046. The cost of land preparation was found to have ranged between Rs. 3200 to Rs. 7200 per acre in the case of farmer growing Sugarcane crop under flood irrigation system. Per acre average cost was estimated at Rs. 4600. The average cost per acre on land preparation was marginally high (1.10 times) under the drip irrigation method.

Seed and Sowing cost

The seed quantity for per acre was found to be as high as three ten. Seed sowing cost of per acre found to be different in flood irrigation and drip irrigation method. So the per acre cost on this item was found

to have ranged between Rs. 6500 to Rs. 12000 under the drip irrigation method. Per acre average cost on seed and sowing was estimated at Rs. 8846 under the drip irrigation method. This cost was found to have ranged between Rs. 6400 to Rs. 15000 and averaged at Rs. 10648 per acre in the case of farmers using flood irrigation method. The above discussion reveals that cost incurred on Seed and Sowing was higher under the flood irrigation system (1.20 times) as compared that under the drip irrigation method in the study area.

Manures, Fertilizer and Pest Management cost

As Sugarcane is cash crop, to achieve higher production some farmers using Manures for Sugarcane crop. A mixer of chemical fertilizers is applied into land before the plantation of this crop. Pesticides are sprayed on the crop plants to protect them from pests and diseases. Some farmers are also giving Chemical fertilizers to the crop through drip water for proper growth of plants. So the cost per acre on this item was found to have ranged from Rs. 8200 to Rs. 25500 per acre. Under the drip irrigation method, the average per acre cost on this item was Rs. 16461. The cost of manures, fertilizers as pest management was found to have ranged between Rs. 3850 to Rs. 16055 per acre in the case of farmers growing Sugar Cane crop under flood irrigation system. Per acre average cost was estimated at Rs. 11261. Thus, it is clear that the average cost per acre on this item was higher by 1.46 times under the drip irrigation method, in the study area.

Inter-season Cultivation Cost

Inter season cultivation cost is important in Sugarcane crop. This is help to remove unneeded grass and also maintain good soil health. So the cost per acre on this item was found to have ranged from Rs. 1500 to Rs. 6500 per acre. Under the drip irrigation method, the average per acre cost on this item was Rs. 4084. The cost of inter season cultivation was found to

have ranged between Rs. 600 to Rs. 9079 per acre in the case of farmers growing Sugarcane crop under flood irrigation system. Per acre average cost was estimated at Rs. 5506. Thus, it is clear that the average cost per acre on this item was higher by 1.35 times under the flood irrigation method, in the study area.

Cutting and Transport cost

The crop duration for Sugarcane is 12 months. The farmer who has sold their Sugarcane to sugar factory has no cutting and transport cost. But some farmers have paid some money to the truck driver for fast lifting of the Sugarcane from field. The farmers who have sold their crop to the sugar Juice Centers located in Aurangabad City have bear cutting and travelling cost. Some farmers sold Sugarcane to other farmers as grass for cattle. Purchaser’s farmers bear cutting and travelling cost. So the cost per acre on this item was found to have ranged from Rs. 00 to Rs. 46350 per acre. Under the drip irrigation method, the average per acre cost on this item was Rs. 3757.70. The cost of cutting and travelling was found to have ranged between Rs. 00 to Rs. 5000 per acre in the case of farmers growing Sugarcane crop under flood irrigation system. Only 3 out of 13 Sugar grower farmers under drip irrigation method and 8 out of 13 flood irrigation methods bear cutting and travelling cost.

Total cost

Manures, fertilizers, pest management cost is the important cost of Sugarcane under the both types of irrigation methods. Per centage of this cost to total cost is 37.01 per centage in DIM and 33.64 per centages in FIM. Seed Purchasing and Seed Sowing Cost is another important cost of Sugar Cane. Per centage of this cost to total cost is 19.89 per centages in DIM and 31.81 per centages in FIM. About DIM adopted farmers drip installation cost is third important cost in Sugarcane production with 14.12 per centage vice versa Inter Season cultivation cost about FIM farmers (16.45 %). The per acre total cost of Sugarcane production was estimated at Rs. 44478 in the case of drip irrigation using Sugarcane growers as against Rs. 33474 in the case of flood irrigation method using Sugarcane growers in the study area. It means that per acre cost of Sugarcane production was higher by 1.33 times under the drip irrigation method in the study region.

(B) Per Acre Sugarcane production and Profit

Table 9 and 10 shows Profitability of Sugarcane Crop under drip irrigation method and flood irrigation method respectively. Comparative discussions of Profitability of Sugarcane Crop under both methods are as below:

Table 8
Average Sugar Cane Production Cost

| Sr. No. | Types of Cost | Under DIM | Per centage to total cost under DIM | Under FIM | Per centage to total cost under FIM |
|---------|---|-----------|-------------------------------------|-----------|-------------------------------------|
| 1. | Drip Installation Cost | 6282.38 | 14.12 | 000 | 0.00 |
| 2. | Land Preparation Cost | 5046.15 | 11.35 | 4600 | 13.74 |
| 3. | Seed and Sowing Cost | 8846.15 | 19.89 | 10648.69 | 31.81 |
| 4. | Manures Fertilizers, Pest Management Cost | 16461.53 | 37.01 | 11260.84 | 33.64 |
| 5. | Inter Season Cultivation Cost | 4084.61 | 9.18 | 5506.07 | 16.45 |
| 6. | Cutting and Transport Cost | 3757.7 | 8.45 | 1459 | 4.36 |
| | Total Cost | 44478.04 | 100.00 | 33474.62 | 100.00 |

Source: Table 6 and 7.

Table 9
Profitability of Sugarcane Crop under Drip Irrigation Method

| Sr. No. | Production (Ton) | Price (Rupees) | Total income (Rupees) | Total cost (Rupees) | Net income (Rupees) |
|---------|------------------|----------------|-----------------------|---------------------|---------------------|
| 1. | 45 | 1750 | 78750 | 56000 | 22750 |
| 2. | 60 | 4500 | 270000 | 103317 | 182133 |
| 3. | 50 | 1900 | 95000 | 36017 | 58983 |
| 4. | 35 | 1500 | 52500 | 45267 | 7233 |
| 5. | 45 | 2200 | 99000 | 41567 | 57433 |
| 6. | 30 | 1800 | 54000 | 49867 | 4133 |
| 7. | 60 | 2000 | 120000 | 38467 | 81533 |
| 8. | 80 | 1500 | 120000 | 30770 | 89230 |
| 9. | 40 | 2000 | 80000 | 39933 | 40067 |
| 10. | 55 | 1800 | 99000 | 43300 | 55700 |
| 11. | 38 | 1700 | 64600 | 31933 | 32667 |
| 12. | 45 | 2000 | 90000 | 35833 | 54167 |
| 13. | 58 | 1800 | 104400 | 41400 | 63000 |
| Average | 49.31 | 2034.61 | 102096.2 | 45667 | 57617.62 |

Source: Field Survey.

Table 10
Profitability of Sugarcane Crop under Flood Irrigation Method

| Sr. No. | Production (Ton) | Price (Rupees) | Total income (Rupees) | Total cost (Rupees) | Net income (Rupees) |
|---------|------------------|----------------|-----------------------|---------------------|---------------------|
| 1. | 66.67 | 1800 | 120006 | 36366 | 83640 |
| 2. | 30 | 1800 | 54000 | 38600 | 15400 |
| 3. | 32.8 | 1900 | 62320 | 21650 | 40670 |
| 4. | 48 | 2150 | 103200 | 37900 | 65300 |
| 5. | 35.78 | 2200 | 78716 | 50773 | 27943 |
| 6. | 37.33 | 1505 | 56181.65 | 32899 | 23282.65 |
| 7. | 34 | 2000 | 68000 | 43155 | 24845 |
| 8. | 40 | 1000 | 40000 | 31327 | 8673 |
| 9. | 35 | 1800 | 63000 | 23300 | 39700 |
| 10. | 30 | 1150 | 34500 | 26300 | 8200 |
| 11. | 30 | 1810 | 54300 | 29400 | 24900 |
| 12. | 45 | 1450 | 65250 | 35700 | 29550 |
| 13. | 35 | 1800 | 63000 | 27800 | 35200 |
| Average | 38.43 | 1720.38 | 66344.13 | 33474.62 | 32869.51 |

Source: Field Survey.

Production

The study revealed that per acre production of Sugarcane was 49.31 ton under the drip irrigation method as against 38.43 ton under the flood irrigation method in the study region. It means that per acre production of Sugarcane was 1.28 times higher under the drip irrigation method. From this it is clear that adoption of drip irrigation method has enhanced productivity of Sugarcane crop in the study region.

Sugarcane Price

The surveyed farmers had sold their output at the different prices mostly ranging from Rs. 1000 and Rs. 2200 per quintal. One farmer sold his Sugarcane to Sugar Juice Center at Rs. 4500 price. Due to early closed of Sugar factory in the year 2014 farmer have to sell their crop at low price.

Total Income

Total income is not only depending upon per acre output but also on price of Sugar Cane. The study indicated that the per acre average gross income from Sugarcane cultivation was Rs. 102096 in the case of farmers using drip irrigation method. Per acre average gross income was Rs. 66344 in the case of farmers adopting flood irrigation method, in the study region. It means that the per acre gross income from Sugarcane cultivation was higher by 1.54 times under the drip irrigation method as compared to per acre gross income under flood irrigation method.

Net Income

The per acre average profit from Sugarcane cultivation was 57617 rupees under the drip irrigation method. Per acre average profit was Rs. 32869 under the flood irrigation method. From the above, it is clear that per acre profit from Sugarcane cultivation was higher by Rs. 24748 under the drip irrigation method as compared to the flood irrigation method. It means that the per acre net income from Sugarcane

cultivation was higher by 1.75 times under the drip irrigation method as compared to per acre net income under flood irrigation method.

This means that adoption of drip irrigation method has increased the profitability of Sugarcane crop in the study region.

CONCLUSION

1. Average cost of per acre on land preparation for Sugarcane cultivation was marginally high (1.10 times) under the drip irrigation method.
2. The cost incurred on Seed and Sowing was higher under the flood irrigation system (1.20 times) as compared that under the drip irrigation method for Sugarcane cultivation in the study area.
3. The average cost per acre on Manures, Fertilizer and Pest Management cost was higher by 1.46 times under the drip irrigation method for Sugarcane cultivation in the study area.
4. Inter season cultivation cost was higher by 1.35 times under the flood irrigation method for Sugarcane cultivation, in the study area.
5. The per acre cost of Sugarcane cultivation was higher by 1.33 times under the drip irrigation method in the study region.
6. Per acre production of Sugarcane was 1.28 times higher under the drip irrigation method as compared to flood irrigation method.
7. The per acre gross income from Sugarcane cultivation was higher by 1.54 times under the drip irrigation method as compared to per acre gross income under flood irrigation method.
8. The per acre net income from Sugarcane cultivation was higher by 1.75 times under the drip irrigation method as compared to per acre net income under flood irrigation method.
9. Single Sugarcane length increased from 11 feet to 15 feet by using drip irrigation method.

10. Weight of single Sugarcane increased from 2.5 Kg to 4.5kg by adopting drip irrigation method.
11. The numbers of buds has increased from 13-14 to 20-22 by adopting drip irrigation method.

It means that adoption of drip irrigation method has increased the profitability of Sugarcane crop in the study region.

Policy Measures

1. Lack of availability of capital is main obstacle in the path of marginal farmers in the adoption of drip irrigation system. So there is need of special and easily available subside scheme for marginal farmers.
2. Until yet some farmers are ignorant about the use of drip irrigation in water scarcity situation. They have miss understanding that drip irrigation system is water consuming. So there is need to create awareness among the farmers regarding the benefits of drip irrigation system.
3. Due to delay in receiving amount of Government subsidy, Now days the Government of Maharashtra have adopted method of direct subsidy to farmer, but from last two year the farmers have not received the subsidy installment . Due to delay in receiving amount of Government subsidy drip set installation cost is high and total beard by farmers. So there is need fast Government decision in this direction.

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