

## **IV RESULTS AND DISCUSSION**

Based on objectives and methodology as mentioned in previous chapters, a systematic study was conducted and results obtained from analysis of data have been presented in this chapter as follows.

4.1 Socio-economic characteristics of sugarcane growers

4.2 Costs and returns of sugarcane cultivation

4.3 Resource use efficiency of sugarcane cultivation

4.4 Contribution of drip technology on output growth

4.5 Constraints faced by sugarcane growers

### **4.1 Socio-economic characteristics of sample farmers**

The details of the average age, family size and literacy are presented in Table 4.1. The results revealed that, average age was higher in case of surface irrigated sugarcane cultivation farmers (45.66 years) compared to drip irrigated sugarcane cultivation farmers (37.90 years). Young generation group adopt new technology immediately compared to age old group.

Educational status of head of the family influences the decision making ability regarding adoption of new technologies in farming. Among the sample respondents adopting drip irrigation and flood irrigation, no farmers were illiterates and degree holders. Majority of the respondents in drip irrigation had PU (38.33 %) and secondary (35.00 %) and primary (26.67 %) level of education. More than two fifth (41.67 %) of farmers practicing surface irrigation completed primary level of education and 28.33 per cent, 30.00 per cent of farmers had secondary, PU education, respectively. Hence, higher education score in case of drip sugarcane growers was observed as highly educated group of farmers adopt immediately new technology or improved packages of practices (Table 4.1).

Regarding size of family, among farmers following drip irrigation, medium size families were greater (63.33 %) in proportion compared to large (20.00 %) and small (16.67 %) families. More than half of the farmers practicing surface irrigation were large sized (63.33 %) followed by medium sized (36.37 %) and no farmers practicing surface irrigation belonged to small family group (Table 4.1).

Regarding occupational score, it was highest in drip (1.72) as compared to surface growers because drip sugarcane growers were having more than one occupation, where as in case of surface sugarcane grower had only one agriculture occupation that's why the

occupation score was more in drip as compared to surface sugarcane growers.

**Table 4.1: Socio-economic characters of drip and surface Sugarcane growers**

Sl. No.	Particulars	Drip (n=60)	Surface(n=60)	chi-square value
1	Age of farmer (year)	37.9	45.66	
2	Educational level (5 quantum score)			
	Illiterate (0 years)	00 (0.00)	00 (0.00)	
	Primary (1-5 years)	16 (26.67)	25 (41.67)	
	Secondary (6-10 years)	21 (35.00)	17 (28.33)	
	PUC (11-12 years)	23 (38.33)	18 (30.00)	
	Degree (>12 years)	0 (0.00)	0 (0.00)	
3	Family size (No.)			
	Small(1-3)	10 (16.67)	00 (0.00)	
	Medium(4-5)	38 (63.33)	22 (36.67)	
	Large(>5)	12 (20.00)	38 (63.33)	
4	Occupational level (3 quantum score)	1.61	1.32	

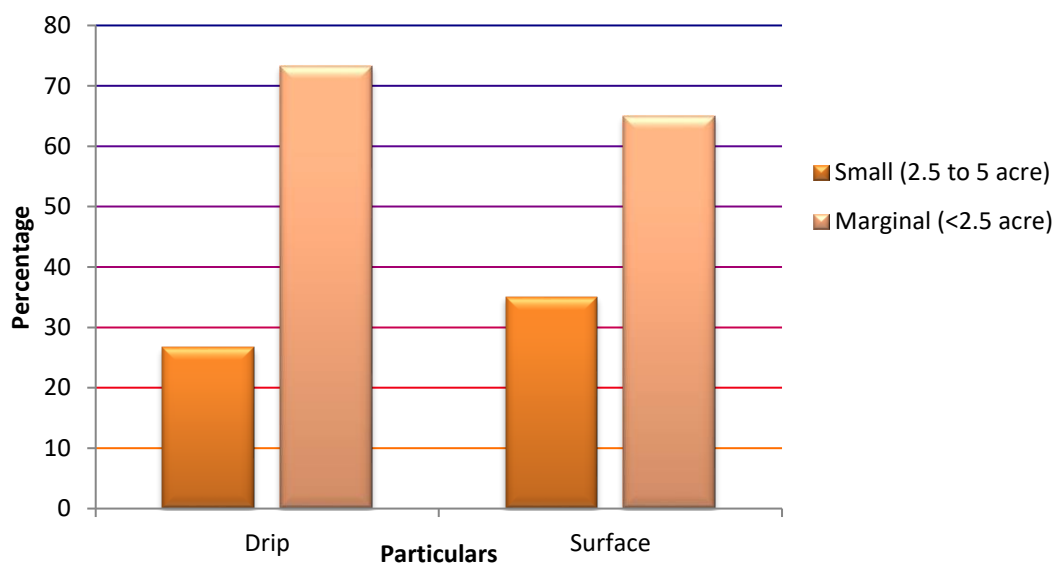
Note: Figures in the parentheses indicate percentage to total respondents.

#### **4.1.2: Land holdings (acre) of drip and surface Sugarcane growers**

Land holdings (acre) of drip and surface irrigation sugarcane growers are represented in the Table 4.2. With respect to the total land holdings of farmers cultivating sugarcane with drip irrigation, 73.33 per cent were marginal farmers and 26.67 per cent were small farmers. Farmers cultivating sugarcane by surface irrigation comprised of marginal and small farmers accounting for 65 per cent and 35 per cent, respectively. Marginal farmers were found higher under drip irrigation (73.33 %) compared to surface irrigation (65.00 %) sugarcane growers. Out of 120 farmers, majority of them were to marginal farmers (69 %) compared to small farmers (30.83 %).

**Table 4.2: Land holdings (acre) of drip and surface Sugarcane growers**

Sl. No.	Particulars	Drip (n=60)	Surface (n=60)	
		No of farmers	No of farmers	Total
1	Small (2.5 to 5 acre)	16 (26.67)	21 (35.00)	37 (30.83)
2	Marginal (<2.5 acre)	44 (73.33)	39 (65.00)	83 (69.00)

**Figure 1: Land holdings (acre) of drip and surface Sugarcane growers (in per cent)****4.1.3 Cropping pattern of drip and surface sugarcane growers**

The results of cropping pattern of drip irrigated sugarcane farmers are presented in Table 4.3

The main crops grown by drip irrigated sugarcane farmers were sugarcane, red gram, jowar, groundnut. The total gross cropped area was 775 acres, out of which sugarcane was grown in 180 acres in all the three seasons. Red gram, Jowar, groundnut was grown in 58 acres, 47 acres 34 acres in kharif season respectively, and wheat was grown in 52 acres and gram was grown in 44 acres in rabi. The total net cropped area (NCA) and cropping intensity for the drip sugarcane growers was 456 acres and 169.95 acres percent respectively.

In surface sugarcane growers the crops like sugarcane, red gram, jowar, groundnut. The total gross cropped area was 856 acres, out of which sugarcane was grown in acres in all the three seasons. Red gram, Jowar, groundnut was grown in 62 acres, 52 acres 28 acres in kharif season respectively, and wheat was grown in 46

acres and gram was grown in 38 acres in rabi. The total net cropped area (NCA) and cropping intensity for the drip sugarcane growers was 504 acres and 169.84 acres percent respectively.

The difference found in cropping pattern and cropping intensity between two water use regimes was only due to the differences in the sources and availability of water.

**Table 4.3 Cropping pattern of drip and surface sugarcane growers**

(Area in acre)

Sl. No.	Particulars	Drip sugarcane growers (n=60)	Surface sugarcane growers (n=60)
<b>Kharif</b>			
1	Red gram	58 (7.48)	62 (8.00)
2	Jowar	47 (6.06)	52 (6.70)
3	Groundnut	34 (4.39)	28 (3.61)
4	Sugarcane	180 (23.33)	210 (27.09)
<b>Rabi</b>			
1	Wheat	52 (6.71)	46 (5.93)
2	Gram	44 (5.68)	38 (4.09)
3	Sugarcane	180 (23.33)	210 (27.09)
<b>Summer</b>			
1	Sugarcane	180 (23.33)	210 (27.09)
Gross cropped area(GCA)		775 (100.00)	856 (100.00)
Net cropped area (NCA)		456	504
Cropping intensity		169.95	169.84

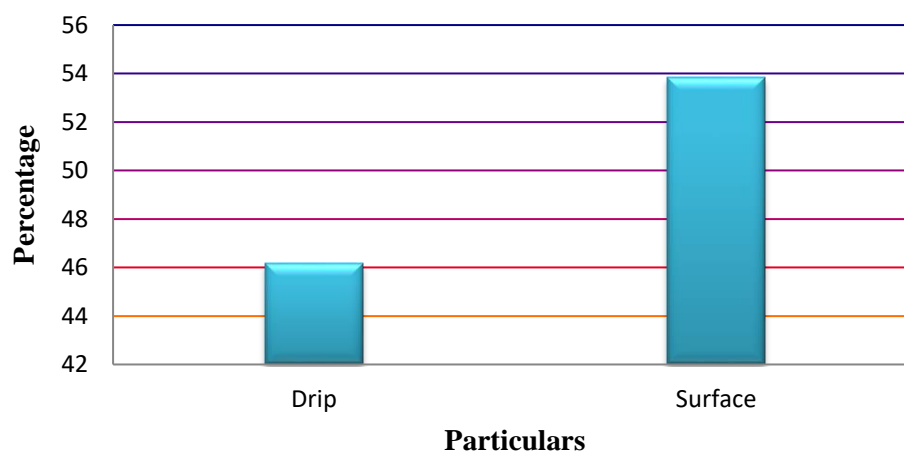
Note: Figures in the parentheses indicate percentage to total respondents.

#### **4.1.4 The area under drip and surface irrigation**

The area under drip and surface irrigation is represented in Table 4.4. Of total land holding (390 acre), drip irrigated sugarcane growers had 180 acre (46.15 %) and surface irrigated sugarcane growers had 210 acre (53.84 %). Area under sugarcane crop was found highest in surface compared to drip irrigated sugarcane growers.

**Table 4.4: The area under drip and surface irrigation**

Sl. No.	Particulars	Total land holding (acre)	Percentage
1	Drip	180	46.15
2	Surface	210	53.84
3	Total	390	100.00

**Figure 2: The area of percentage under drip and surface irrigation**

#### **4.1.5: Livestock assets of respondents cultivating Sugarcane**

The details of livestock assets of respondents cultivating sugarcane are presented in Table 4.5. The dairy animals, bullock pair, buffalo, sheep/goat and poultry birds with drip irrigated sugarcane growers were higher in number *i.e.*, 25 (41.67 %), 17 (28.33 %), 28 (46.67 %), 16 (26.67 %) and 21 (35 %), respectively, compared to surface irrigated sugarcane growers where the dairy animals, bullock pair, buffalo, sheep/goat and poultry were 21 (35 %), 12 (20 %), 19 (31.67 %), 13 (21.67 %), and 18 (30 %), respectively. Livestock assets were higher in drip irrigated sugarcane growers compared to surface irrigated sugarcane growers *i.e.*, occupational level of drip irrigated sugarcane growers was more as compared to surface irrigated sugarcane growers.

**Table 4.5: Livestock assets of respondents cultivating Sugarcane**

Sl. No.	Particulars	Drip (n=60)		Surface (n=60)	
		No of farmers	Per cent	No of farmers	Per cent
1	Dairy animals	25	41.67	21	35.00
2	Bullock pair (No.)	17	28.33	12	20.00
3	Buffalo	28	46.67	19	31.67
4	Sheep/ Goat	16	26.67	13	21.67
5	Poultry birds	21	35.00	18	30.00

Note: Percentage figure indicates percentage to total respondents

#### 4.1.6 Farm assets of sugarcane cultivating farmers

As shown in the Table 4.6, among drip irrigated sugarcane growers, 41.67 per cent had farm building. 38.34 per cent farmers had tractors, 5.00 per cent farmers had power tiller. 30 per cent farmers had bullock cart. 21.67 per cent farmers had plough (Bullock Drawn+ Machine Drawn), 26.27 per cent farmers had trolley, 83.34% farmers had own bore well, all had electric motor and 8.33% farmers had weeding tools.

In case of surface irrigated sugarcane growers, 41.67 per cent farmers had farm building, 3.34 per cent farmers had power tiller, 36.60 per cent farmers have bullock cart, 25.00 per cent farmers had the plough (Bullock Drawn+ Machine Drawn), 15 per cent had trolley, equal per cent of farmers having owned bore well and tractor (20.00 %), 18.34 per cent had electric motor and 16.67 per cent had weeding tools.

The proportion of tractor, bore power tiller, trolley, bore well, electric motor owned by the drip irrigated sugarcane growers was more compared to surface irrigated growers. The more number of bore wells and electric motor were found in drip irrigated sugarcane growers because of sole dependency on bore well for irrigation.

**Table 4.6: Farm assets of sugarcane farmers in the study area**

Sl. No.	Particulars	Drip (n=60)		Surface (n=60)	
		No.	Percentage	No.	Percentage
1	Farm building	25	41.67	25	41.67
2	Tractor (H.P.)	23	38.34	12	20.00
3	Power tiller	03	05.00	02	03.34
4	Plough ( Bullock Drawn+ Machine Drawn)	13	21.67	15	25.00
5	Bullock cart	18	30.00	22	36.67

5	Trolley	16	26.67	09	15.00
6	Bore-well	50	83.34	12	20.00
7	Electric motor	60	100	11	18.34
8	Weeding tools	05	08.33	10	16.67

Note: Percentage figure indicates percentage to total respondents

## 4.2 Costs and returns of sugarcane cultivation

### 4.2.1 Cost of cultivation

The costs of cultivation of sugarcane on per acre basis is presented in Table 4.7

#### Variable cost

##### Material cost

On an average drip irrigation sugarcane cultivation farmers used 2.66 ton seed sets per acre for which they incurred the cost of Rs.5,852 and it accounted 8.24 per cent of total cost, where in surface irrigation sugarcane cultivation farmers, the average seed sets used was 2.54 ton per acre for which they incurred the cost of Rs.5,588 it accounted 8.24 per cent of total cost. The difference in seed cost was due to wider spacing followed in drip irrigated sugarcane growers.

The farm yard manure used by the drip irrigation sugarcane cultivation farmers was 4.06 ton for which the cost incurred was Rs.6,090 (8.57 % of total cost). The surface irrigation sugarcane cultivation farmers used less farm yard manure *i.e.*, 4.71 ton for which the cost incurred was Rs. 7065(10.40 % of total cost) per acre.

Fertilizer cost is one of the major costs in sugarcane cultivation. In drip irrigation sugarcane cultivation farmers used 81.12 kg of nitrogen, 48.29 kg of phosphorus, 48.25 kg of potassium, 5 kg of zinc, 5 kg boron, and 10.33 kg of sulphur for which they incurred Rs. 519, Rs. 1,207, Rs. 965, Rs. 480, Rs. 600 and Rs. 910, respectively. The total cost of fertilizer in drip irrigation sugarcane cultivation farmers was Rs. 4,681(6.59 % of total cost). In surface irrigation sugarcane cultivation farmers the fertilizer used was more than drip irrigation sugarcane cultivation farmers which was 127.53 kg of nitrogen, 82.66 kg of phosphorus, 81.86 kg of potash and 5 kg of zinc, 5 kg boron, and 14.31 kg of sulphur for which the cost incurred was Rs. 816, Rs. 2,071, Rs. 1,637, Rs. 480, Rs. 600 and Rs. 1,073, respectively and the total cost incurred was Rs.6,677 and it accounted 9.83 per cent of total cost (Table 4.7). The difference in cost can be attributed to more proportion of fertilizer used in drip irrigated sugarcane growers due to flood irrigation followed which may leach out some amount of fertilizer applied.

For plant protection chemicals, both drip irrigation sugarcane cultivation farmers

and surface irrigation sugarcane cultivation farmers incurred the cost of 3,000 per acre, it accounted 4.22 per cent, and 4.42 per cent of total cost in drip and surface irrigation sugarcane grower respectively. The cost of plant protection chemicals was very less, this is because of lack of awareness and technical guidance regarding various pests and diseases and their ill effects on cane yields. Even in this matter also very few growers approached Agricultural Department for technical guidance. Majority of sugarcane growers have neglected the incidence of pests and diseases.

The cost incurred on irrigation by surface irrigation sugarcane cultivation farmers was very less which was Rs. 400 (0.64 % of total cost) per acre paid to Irrigation Department but the irrigation cost for drip irrigation sugarcane cultivation farmers was very high with Rs. 8,633(16.69 % of total cost) which included amortized cost of investment on bore well and IP sets.

### **Labour cost**

Labour cost is another important cost in sugarcane cultivation, which is shown in Table 4.7. For land preparation, drip irrigation sugarcane cultivation farmers and surface irrigation sugarcane cultivation farmers incurred the cost of Rs. 3,540 per acre. For farm yard manure application both the sugarcane growers incurred the cost of Rs. 1,655 and for planting of sugarcane sets also both the sugarcane cultivation farmers incurred the same cost of Rs. 3,850.

Irrigation cost included labour cost for scheduling irrigation and making channels for irrigation purpose. In drip irrigation sugarcane cultivation farmers the labour charge incurred for irrigation purpose was Rs. 2,400 where as it was Rs. 3,000 in surface irrigation sugarcane cultivation farmers.

Chemical fertilizer application required human labour for mixing the fertilizer, application and bullock labour for transportation. In drip irrigation sugarcane cultivation farmers the farmers incurred the cost of Rs. 770 and in surface irrigation sugarcane cultivation farmers it was Rs. 1,540.

Inter cultivation in sugarcane requires all three types of labours for effective weed management and other types of cultural operations. In drip irrigation sugarcane cultivation farmers, the labour charge for inter cultivation was Rs. 4,950 whereas, it was Rs. 9,000 in surface irrigation sugarcane cultivation (Table 4.7).

Only human labour is required for application of plant protection chemicals. In both



drip irrigation sugarcane cultivation farmers and surface irrigation sugarcane cultivation farmers the labour charge for application of plant protection chemicals was Rs. 385

Harvesting and transportation are the two important operations which require large quantity of labour. In drip irrigation sugarcane cultivation farmers the cost incurred on labour for harvesting and transportation was Rs. 3,850 whereas, it was Rs. 2,310 in surface irrigation sugarcane cultivation farmers. The difference was due to less human labour used for harvest the crop by farmers as their yield levels were low surface irrigated sugarcane growers.

Total machine labour cost as it accounted for 2.81 per cent (Rs.2,000) of total cost in drip irrigated sugarcane cultivation and 3.68 per cent (Rs.2,500) in surface irrigated sugarcane cultivation. Bullock labour cost accounted for 4.22 per cent (Rs.3,000) in drip irrigated sugarcane cultivation and 5.89 per cent (Rs.4,000) in surface irrigated sugarcane cultivation. Human labour cost accounted for 28.74 per cent (Rs.20,405) in drip irrigated sugarcane cultivation and 32.90 per cent (Rs.22,330) in surface irrigated sugarcane cultivation.

Interest on working capital was worked out at seven per cent on variable costs and it worked out to be Rs. 3,893 in drip irrigation sugarcane cultivation and Rs.3,720 in surface irrigation sugarcane cultivation (Table 4.7).

The total variable cost in case of drip irrigation sugarcane cultivation formed 83.05 per cent (Rs.58,967) of total cost, and it was 78.56 per cent ( Rs.55,350) in surface irrigation sugarcane cultivation. The difference found between drip and surface irrigation sugarcane cultivation was due to the difference in cost incurred on human labour, fertilizer and irrigation.

### **Fixed cost**

The average land rent in drip irrigation sugarcane cultivation was Rs.10,000 and Rs. 12,000 in surface irrigation sugarcane cultivation .

The average depreciation of all the assets per year per acre of sugarcane was found to be Rs.720 in drip irrigation sugarcane cultivation and Rs.534 in surface irrigation sugarcane cultivation.

Land revenue was found to be Rs.20 in both drip irrigation sugarcane cultivation and surface irrigation sugarcane cultivation.

Interest on fixed cost at 12 per cent was worked out to be Rs.1289 in drip irrigation

sugarcane cultivation and Rs.1506 in surface irrigation sugarcane cultivation (Table 4.7).

Total fixed cost was Rs.12,029 (16.94 % of total cost) in drip irrigation sugarcane cultivation and Rs. 12,550 (18.49% of total cost) in surface irrigation sugarcane cultivation. In fixed cost there was not much difference between the sample farmers except the small difference found in depreciation cost which was more in drip irrigated farmers due to more machinery owned by the famers in this region compared to surface irrigated farmers.

Total cost of cultivation worked out to be Rs.70,996 in drip irrigation sugarcane cultivation and Rs.67,870 in surface irrigation sugarcane cultivation.

**Table 4.7: Cost of cultivation of Sugarcane in rupees.**

Sl. No.	Particulars	Per acre			
		Drip (n=60)		Surface(n=60)	
		Quantity	Value (Rs)	Quantity	Value (Rs)
<b>1</b>	<b>Variable costs</b>				
<b>a)</b>	<b>Material Input</b>				
1.	Seed sets (tons)	2.66	5,852 (8.24)	2.54	5,588 (8.23)
2.	Farm yard manure (ton)	4.06	6,090 (8.57)	4.71	7,065 (10.40)
3.	Fertilizer				
	Nitrogen (kg)	81.12	519.16	127.53	816.19
	Phosphorus (kg)	48.29	1,207	82.66	2,071
	Potassium (kg)	48.25	965	81.86	1,637
	Zink (kg)	5.00	480	5.00	480
	Boron (kg)	5.00	600	5.00	600
	Sulphur (kg)	10.33	910	14.31	1,073
	Total	198	4,681 (6.59)	253.57	6,677 (9.83)
4.	Plant protection (litre)	2.70	3,000 (4.22)	2.81	3,000 (4.42)

5	Irrigation cost (cm )	156	11,856 (16.69)	220	440 (0.64)
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<b>b)</b>	<b>Labour</b>				
<b>1</b>	<b>Land preparation</b>				
	Human labour (man days)	4	1,540	4	1,540
	Bullock labour (pair days)	1	1,000	1	1,000
	Machine labour (hours)	2	1,000	2	1,000
<b>2</b>	<b>FYM application</b>				
	Human labour(man days)	3	1,155	3	1,155
	Machine labour (hours)	1	500	1	500
<b>3</b>	<b>Planting</b>				
	Human labour (man days)	10	3,850	10	3,850
<b>4</b>	<b>Irrigation</b>				
	Human labour(man days)	16	6,160	21	8,085
<b>5</b>	<b>Chemical Fertilizer application</b>				
	Human labour (man days)	2	770	4	1,540

<b>6</b>	<b>Inter cultivation</b>				
	Human labour (man days)	7	2,450	13	5,000
	Bullock labour (pair days)	2	2,000	3	3,000

	Machine labour (hours)	1	500	2	1,000
<b>7</b>	<b>Plant protection chemical application</b>				
	Human labour (man days)	1	385	1	385
<b>8</b>	<b>Harvesting and transportation</b>				
	Human labour (man days)	10	3,850	6	2310
<b>9</b>	<b>Total labour</b>				
	Human labour (man days)	53	20,405 (28.74)	58	22,330 (32.90)
	Bullock labour (pair days)	3	3,000 (4.22)	4	4,000 (5.89)
	Machine labour (Hours)	4	2,000 (2.81)	5	2,500 (3.68)
9.	<b>Interest on operational cost @ 7%</b>		3,893		3,720
	<b>Total variable cost</b>		58,967 (83.05)		55,320 (78.56)
<b>II</b>	<b>Fixed costs</b>				
1	Land rent		10,000		12,000
2.	Depreciation		720		534
3.	Land revenue		20		20
4.	Interest on fixed cost @ 12%		1289		1506
	<b>Total fixed cost</b>		12,029 (16.94)		12,550 (18.49)
<b>III.</b>	<b>Total cost of cultivation</b>		70,996		67,870

Note: Figures in the parentheses represent percentage to the total cost of cultivation.

#### 4.2.2 Returns from Sugarcane cultivation.

The return from sugarcane cultivation is presented in Table.4.9. There was a difference in the yield between two regions, in drip irrigation sugarcane cultivation the yield was 68 ton per acre where as in surface irrigation sugarcane cultivation it was 55 ton per acre. In drip irrigation sugarcane cultivation the gross return worked out to Rs.1,52,320. And in surface irrigation sugarcane cultivation the gross return worked out to Rs.1,23,200. The cost of cultivation was Rs.70,996 in drip irrigation sugarcane cultivation and Rs.67,870 in surface irrigation sugarcane cultivation. So the net return worked out to Rs.81, 324 in drip irrigation sugarcane cultivation and Rs.55,330 in surface irrigation sugarcane cultivation. Net return per rupee of variable cost was 1.37 in drip irrigation sugarcane cultivation and 1.01 in surface irrigation sugarcane cultivation. Net return per rupee of total cost was 1.15 in drip irrigation sugarcane cultivation and 0.81 in surface irrigation sugarcane cultivation. Cost of production was Rs.1044 in drip irrigation sugarcane cultivation and Rs.1234 in surface irrigation sugarcane cultivation and net return per ton was Rs.1196 in drip irrigation sugarcane cultivation and Rs.1006 in surface irrigation sugarcane cultivation.

**Table 4.8: Returns from Sugarcane cultivation.**

Sl. No	Particulars	Drip	Surface
1	Yield (tons)	68	55
2	Price (Rs/tons)	2,240	2,240
3	Gross return (Rs)	1,52,320	1,23,200
4	Cost of cultivation (Rs)	70,996	67,870
5	Net return (Rs)	81,324	55,330
6	Net returns per rupee of variable cost (Rs)	1.37	1.01
7	Net returns per rupee of total cost (Rs)	1.15	0.81
8	Cost of production per ton (Rs)	1044	1234

9	Net return per ton	1196	1006
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The difference in the yield was due to intensive cultivation practices carried out in surface irrigated and also availability of water. The price per ton of sugarcane was found to be same in two regimes which was Rs.2440. There was considerable difference in the gross income realised because of difference in the yield. The difference in the net income between two regimes was due to differences in cost of cultivation and gross income.

#### **4.2.3 Comparative profitability of sugarcane production**

Per acre profitability of sugarcane production of drip and surface sugarcane farm was calculated and presented in Table 4.8. The improved method drip gives more yield as compared to surface that's why gross return was highest in drip as compared to surface sugarcane farm. The results revealed that, gross return was higher i.e. Rs.1,52,320 on drip sugarcane farms and Rs.1,23,200 on surface sugarcane farms. It inferred that drip sugarcane production was more profitable than surface sugarcane production, because of the improved irrigation system and use of improved packages of practices. It was clear that; output-input ratio was higher as 1.15 on drip sugarcane farms than that of 0.81 on surface sugarcane farms, because production was greater on drip irrigation farm as compared to surface irrigation farm. It implied that, when 1 rupee spent on drip and surface sugarcane production, it would lead to give the returns of Rs.1.12 and Rs.0.77 from sugarcane production, respectively. Per ton cost of sugarcane production was higher Rs.1262 on surface sugarcane farms, while that was Rs.1052 in drip sugarcane farms. This was due to total cost of production.

#### **4.3 Resource use efficiency of sugarcane cultivation under drip and surface irrigation method.**

Resource use efficiency of sugarcane cultivation under drip and surface sugarcane grower a e presented in Table.4.10

In the present study Cobb-Douglas type of production function was used to estimate the resource productivity and returns to scale in sugarcane production for drip and surface irrigated farmers. In order to determine whether the factors of production were used optimally or not, the efficiency of the allocation of resources was studied by comparing the marginal value of product with opportunity cost of each of the factors of production.

The estimates of elasticity of production presented in Table 4.7 revealed that, all the variables considered have positive relationship with yield in drip irrigated farmers

Further the variables setts, water and micro nutrients which had coefficients of 0.1523, 0.1783 and 0.1929 respectively were positive and significant at one per cent, five per cent and ten per cent level. One per cent increase in the following variables like setts, water and micro nutrients would increase the output by 0.15, 0.17 and 0.19 respectively. The elasticity coefficients of human labour, area, and fertilizer were positive but non-significant.

The coefficient of multiple determination ( $R^2$ ) was 0.86 for drip irrigation farmers. This indicated that the function explained 86 per cent of variation in the gross income of sugarcane. The sum of elasticities was 1.0905 indicating constant return to scale.

The elasticity coefficients (Table 4.10) of all inputs were positive in surface sugarcane grower. The coefficients for the variables area (0.1601), setts (0.2202) and fertilizer (0.168). This indicates that one per cent increase in area, setts and fertilizer, would increase the output by 0.16, 0.22 and 0.16 per cent respectively. The coefficients of human labour, micro nutrient, and water were positive but non-significant.

The coefficients of multiple determination ( $R^2$ ) was 0.86 indicates that the variables included in the function explained 86 per cent of the variation in the gross income. The sum of elasticities was 1.1053 which was very close to unity indicating that surface irrigation sugarcane farmers were operating under constant returns to scale.

In case of both the drip and surface irrigation sugarcane growers the sum of regression coefficients was close to unity indicating that returns to scale was constant.

This implies that if the uses of all the factors (independent variables) are increased by one per cent the gross return would increase by one per cent.

Table 4.9 Resource use efficiency in sugarcane cultivation under drip and surface irrigation.  
(Dependent variable: Per farm output)

Sl. No	Variables	Drip	Surface
1	Sample size	60	60
2	Intercept	1.7981	1.7333
3	Human labor(man days)	0.0152 (1.4361)	0.1164 (1.1229)
4	Fertilizer(Kg)	0.0111 (0.0675)	0.168*** (2.8439)
5	Micro nutrients(Kg)	0.4425*** (2.7471)	0.1792 (1.5489)

6	Setts(tonn)	0.1523*** (3.0813)	0.2202** (2.4153)
8	Area(acre)	0.0038 (0.118)	0.1601* (1.9193)
9	Water	0.37** (2.2981)	0.1729 (0.5863)
10	R <sup>2</sup>	0.8700	0.8638
11	Adjusted R <sup>2</sup>	0. 8659	0. 8534
12	Σ bi	0.9827	0.6675

Note: \*\*\* significant at 1 % \*\* significant at 5 % \* significant at 10 %

- Figures in the parenthesis represent t value

#### 4.4 Decomposition Contribution of drip and surface irrigation technology on output growth in sugarcane cultivation.

The decomposition analysis for Sugarcane is presented in Table 4.10. The total yield difference between drip and surface irrigation was estimated to be 24.63 per cent. The differences in drip irrigation technology (17.12) contributed more than the input use gaps (7.51) to the yield difference. Among all the inputs, differences water contributed more to the yield difference to the extent of 7.51 per cent. And other inputs like micro nutrients, seed setts and area showed marginal contributions to the existing yield deference where as human labour and fertilizer shown a negative contribution.

**Table: 4.11 Decomposition Contribution of drip and surface irrigation technology on output growth in sugarcane cultivation.**

Sl. No	Sources of difference	Farmers fields
I	Total difference in output due to drip and surface irrigation (Yield in ton)	24.63
II	Sources of contribution	
1.	Drip irrigation technology	17.12
3	Input use gaps	
	a. Human labour	-0.66
	b. Fertilizer	-0.34
	c. Micro nutrient	0.85
	d. Seed setts	0.92
	e. Area	0.82
	f. Water	5.92
	Due to all inputs	7.51



III	Total estimated yield difference	24.63
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## 4.5 CONSTRAINTS OF SUGARCANE GROWERS

### 4.5.1 Constraints faced by drip sugarcane growers

Constraints faced by drip sugarcane growers were calculated in frequency and percentages are presented in Table 4.11. The results revealed that, the regular load shading of electricity was serious problem, expressed by 92.75 per cent sugarcane growers. Higher initial cost for installation of drip irrigation was expressed by 82.35 per cent of sugarcane growers. Cracking and clogging of emitters, was expressed by 70.67 per cent of drip sugarcane growers. High cost of water soluble fertilizer and chemicals was expressed by 68.75 per cent of sugarcane growers. Drip irrigation unit material damage due to rats/rodents which was expressed by 76.31 per cent in sugarcane growers. Followed by high cost of spare parts (73.00 %), high rate wages of labour (62.80), unavailability of improved varieties of sugarcane setts (50.00 %), lack of training programme about improved cultivation (36.50 %) and lack of credit facilities which was expressed by 81.25 per cent of sugarcane growers.

**Table 4.11: Constraints of drip Sugarcane growers**

Sl. No.	Constraints	Per cent
1	Regular load shading of electricity	92.75
2	Higher initial cost for installation of drip irrigation	82.35
3	Cracking and clogging of emitters	70.67
4	High cost of water soluble fertilizer and Chemicals	68.75
5	Drip irrigation unit material damage due to rats/rodents	76.31
6	High cost of spare parts	73.00
7	High rate wages of labour	62.80
8	Unavailability of improved varieties of Sugarcane setts	50.00
9	Lack of training programme about improved cultivation	36.50
10	Lack of credit facilities	81.25

### 4.5.2 Constraints faced by surface sugarcane growers

Constraints faced by surface irrigated sugarcane growers were calculated in frequency and percentage is presented in Table 4.12. The result revealed that, regular load shading of electricity was expressed by 90.32 per cent in surface sugarcane growers. Non-availability of labour on time was expressed by 86.50 per cent of sugarcane growers. Non-availability of irrigation facilities (76.31 %), lack of timely supply of water through canals (61.50 %) and lack of credit facilities, lack of fertilizer on time, high wages of labour and unavailability of improved varieties of sugarcane setts was expressed by 78.13 per cent, 74.00 per cent, 68.71 per cent, and 55.25 per cent of respondents, respectively. Lack of training programme about improved cultivation was expressed by 46.37 per cent in sugarcane growers. Low prices of sugarcane at the time of harvesting was also severe problem followed by which was expressed by 84.37 per cent sugarcane growers.

**Table 4.12: Constraints of surface Sugarcane growers**

<b>Sl. No.</b>	<b>Constraints</b>	<b>Per cent</b>
1	Regular load shading of electricity	90.32
2	Non-availability of labour on time	86.50
3	Non-availability of irrigation facilities	76.31
4	Lack of timely supply of water through canals	61.50
5	Lack of credit facilities	78.13
6	Lack of fertilizer on time	74.00
7	High wages of labour	68.71
8	Unavailability of improved varieties of sugarcane setts	55.25
9	Lack of training programme about improved cultivation	46.37
10	Low price of sugarcane	83.37



**Economics of groundwater irrigation per farm under drip irrigation farmers (n=60)**

<b>Sl. No</b>	<b>Particulars</b>	<b>DIF</b>
1	Total number of borewells	60
2	Number of functioning borewells	46
3	Number of farmers	60
4	Total area irrigated (acres)	180
5	Number of failed borewells	14
6	Age of functioning borewells (years)	7
7	Depth of wells (feet)	75
8	Yield of borewell (GPH)	1967
9	Amortised cost per functioning well	14000
10	Pump (HP)	7
11	Number of hours pump put on in a year	432
12	Annual repairs and maintenance	3000
13	Annual Cost	30715

**Table 4.10: Partial budgeting in drip Sugarcane production**

SI No	Debit	Amount	Credit	Amount
1	a) Added cost due to drip(Apportioned cost of drip)		Reduction in cost due to drip: 1.Reduction in labour cost on irrigation and weeding	
	b) Increased cost of harvesting(Due to improved yield on account of drip)			
2	Decrease in returns	Nil	1.Increase in returns due to drip: (ie.increase in productivity of____qtls/ac at ----/qtls )	
			2.Additionsl income from increased area under cultivation due to savings in water:	
Total: A			B	
Net Change B-A=-----				
Increased benefit ratio				

Sl. No	Variables	Drip	Surface
1	Sample size	60	60
2	Intercept	19.51(13.50)	4.44(0.26)**
3	Setts	4.62(12.76)	-0.07(0.09)
4	Fertilizer	-4.27(-11.91)	0.006(0.012)
5	Labour	0.27(0.29)	-0.16(0.07)
6	Ppc	-0.001(-0.01)	0.32(0.16)
8	R <sup>2</sup>	0.9638	0.9953
9	Adjusted R <sup>2</sup>	0.9621	0.9948
10	$\sum b_i$		

Sl. No	Variables	Drip	Surface
1	Sample size	60	60
2	Intercept	1.73(0.68)**	4.44(0.26)**
3	Setts	0.24(0.17)	-0.07(0.09)
4	Fertilizer	0.14(0.93)	0.006(0.012)
5	Labour	0.27(0.29)	-0.16(0.07)
6	ppc	-0.29(0.15)	0.32(0.16)
8	R <sup>2</sup>	0.8714	0.9953
9	Adjusted R <sup>2</sup>	0.8595	0.9948
10	$\sum b_i$		

**Table 4.7: Per acre physical input or output in drip and surface Sugarcane cultivation**

Sl. No.	Particulars	Unit	Sugarcane growers		t test
			Drip	Surface	

	<b>a. Input</b>				
1	Human labour	man day	49	62	
2	Bullock labour	pair day	03	04	
3	Machine power	hours	04	05	
4	Sugarcane setts	ton	2.66	2.54	
5	Manure	ton	4.06	4.71	
6	Nitrogen	kg	81.12	127.53	
7	Phosphorous	kg	48.29	82.66	
8	Potassium	kg	48.25	81.86	
9	Plant protection	litter	2.70	2.81	
10	Irrigation	cm	4,841.77	2722.37	
	<b>b. Output</b>				
11	Main produce	tons	68	55	

#### 4.2.1 Physical inputs and outputs used in sugarcane production

Per acre physical inputs in sugarcane production under drip and surface irrigation systems were estimated and presented in Table 4.7. Use of hired human labour was higher on surface sugarcane farms (62 man days) compared to drip irrigated sugarcane farms (49 man days). Use of bullock labour was three pair days on drip sugarcane farm and four pair days on surface sugarcane farms. Use of machine power was four hours on drip sugarcane farms and five hours on surface sugarcane farms. The use of sugarcane setts was higher in case of drip sugarcane farm (2.66 ton) compared to surface sugarcane farm (2.54 ton). Use of manures was highest *i.e.*, 4.71 ton, on flood irrigated farm compared to drip farm *i.e.*, 2.66 ton. Use of nitrogen, phosphorous and potash was 127.53 kg, 82 kg and 81.76 kg on surface sugarcane farms, respectively. While use of nitrogen, phosphorous and potash was 81.12 kg, 58.29 kg and 58.25kg, respectively on drip sugarcane farms. The use of plant protection for surface sugarcane farm was found more (2.81 litre/acre), while in case of drip sugarcane farms, it was 2.70 litre/ha. Use of irrigation was higher as 4,841.77 cubic meters in surface sugarcane farm while that was 2722.37 cubic meters in drip sugarcane farm. It was inferred that, there was water saving in drip sugarcane farm.

It was also observed that main produce of sugarcane was higher (68 tonne per acre) on drip sugarcane farms compared to 55 tonne per acre on surface sugarcane farms.