



An Impact Study on Implementation of Micro Irrigation System: Need, Potential and Current Scenario

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ABSTRACT

Multi stage sampling techniques were adopted for the selection of sampling unit. Total one hundred sixty farmers were selected for the study. It was clearly observed that in Modasa taluka the area under Micro Irrigation System (MIS) was 35.55 per cent and hence, remaining 64.45 per cent area can be considered as the market potential area that can be covered under MIS. Similarly, in Dhansura taluka the area under MIS was 35.80 per cent and remaining 64.20 per cent area can be considered as potential area for MIS which can be covered under MIS. Considering Sabarkantha district as a whole, the area under MIS was 35.69 per cent and hence the potential of MIS can here be 64.31 per cent *i.e.* the remaining area which has not been covered under MIS. The gross seasonal income among various farmers' group was found highest in case of large farmers *i.e.* 7,11,000 Rs. followed by medium farmers (3,94,489.09 Rs.), small farmers (1,99,292.31 Rs.) and marginal farmers *i.e.* 91,600.00 Rupees, respectively from their respective area under cotton cultivation covered under drip irrigation system. In case of sprinkler irrigation gross seasonal income among various farmers' group was found highest in case of large farmers *i.e.* 4,43,233.30 Rs. followed by medium farmers *i.e.* 2,27,734.00 Rs., small farmers *i.e.* 1,46,309.45 Rs and marginal farmers *i.e.* 1,22,470.00 Rupees, respectively. Problems faced by after installation of MIS include after sales service, unavailability of MIS parts and high cost of installation.

Key words *Multi stage sampling, sampling unit, MIS*

Water is one of the most crucial and precious natural resource. Vitaly important for agricultural development and our daily needs. It is an indispensable resource that permeates every aspect of human society and affects every man, woman and child. Intensified agriculture and outgrowing population are depleting the already scarce resource, "the water". Although water is manageable resource yet it is often used in crop production quite which initially enters the lands at the head works finally

becomes available for crop use in fields. The solution to the water related problems is to evaluate the existing irrigation system so as to reduce the losses of this precious commodity and thereby increase its efficient use. This is a challenging situation and the need of the hour is to conserve water and its efficient use. According to a recent estimate, thirty four countries in the world will be facing water scarcity by 2025 AD indicating that per capita availability of fresh water supplies will be less than 100 m³ person per year. A country with renewable water availability on an annual per capita basis exceeding about 1700 m³ will suffer only occasional or local water problems. Below this threshold, countries begin to experience periodic or regular water stress. India (1400 m³) and China (1700 m³) will 'come first into this category in the year 2025 AD, while USA will have more than 7000 m³ person-1 year-1 and will not face any scarcity. Rising demand for urban and industrial water supplies in the world pose a serious threat to irrigated agriculture. The allocation of water for agriculture will come down to 50% from the present level of 70%. However, to achieve required food and fibre production with increasing population, India has to enhance the current irrigation potential of 91 Mha to 160 Mha. Major objectives of the study were to find out the potential and current state of micro-irrigation in Sabarkantha district, to assess the adoption of micro-irrigation by various farm categories, to assess the economics of micro-irrigation in different farm group and constraints faced by farmers in using MIS.

Need for micro-irrigation:

To achieve required food production with increasing population, India has to enhance the current irrigation potential of 91 Mhm to 160 Mhm. But, the total water resources estimated are 230 Mhm will have to cater the need to the non-agricultural uses also. The country is likely to be water stressed in the coming years. Therefore hand in hand with technologies for water harvesting and

storage, technologies for precision water application methods need to be adopted. Micro-irrigation with fertigation will enhance production per unit input in these nutrient poor, shallow and sloppy soils. Micro irrigation is a co-ordinated and controlled water management system where water is made to flow under pressure through a net work of pipes of varying diameters, the main-line, the sub-main lines and the lateral lines with appropriately placed emitters along the length of the latter through which water is discharged to the root zone.

MATERIALS AND METHODS

This section deals with the methodology adopted for evaluation of the objectives under the present study, which is described under following heading.

Location and general description of the study area: The Sabarkantha district was selected purposively. The reason for selection of this district is the possibility of increase in selling of drip and sprinkler irrigation. Total area under irrigation in Sabarkantha is 35,900 hectares. Major crops of the region are cotton, potato, chilli, wheat, and castor.

Sampling technique: Multi stage sampling techniques were adopted for the selection of sampling unit. The study was confined to Sabarkantha district. Two talukas from the district were selected purposively at the first stage. At the second stage four villages from each taluka and 20 Micro Irrigation System (MIS) user farmers were selected randomly.

Adoption of micro-irrigation by various farm categories: It was studied by calculating distribution of the respondent according to their extent of adoption of sprinkler irrigation system, awareness about adoption of MIS through fellow farmer, dealer, television advertisement, through posters, awareness about GGRC (Gujarat Green Revolution Company) schemes/subsidy and credit taken from other credit institution.

Constraints faced by farmers in using MIS: Garret's ranking technique was used to analyze the constraints faced by the farmers in using MIS. The respondents were asked to rank the given problems. The order of merit thus given by the respondents was converted into ranks using the following formula.

$$\text{Per cent position} = \frac{100 (R_{ij} - 0.5)}{N_j}$$

Where,

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

N_j = Number of factors ranked by the j^{th} individual

The percent position of each rank thus obtained was converted into scores by referring to the table given by Garret and Woodworth (1969). Then for each factor, the scores of individual respondents were added together and divided by the total number of respondents for whom scores were added. These mean scores for all factors were arranged in descending order, ranks were given and the most limiting factor was identified.

Economics of micro-irrigation in different farm group: Economics of MIS was calculated through cropping pattern of the study area, yield, cost of installation and other cost of installation. viz average area under cultivation, calculation of cultivation per season is given in result and discussion.

RESULTS AND DISCUSSION

The Results obtained from the research work in the order to fulfill the various objectives of study are discussed here:

Potential and current state of micro-irrigation in Sabarkantha district: The taluka wise current status and market potential of Micro Irrigation System (MIS) in Sabarkantha district of Gujarat is presented in Table 4.1.1. It was observed that the highest area covered under MIS was found in Vadalitaluka i.e. 13.03 per cent, followed by Dhansurataluka (12.96 per cent), Modasataluka (12.24 per cent), Talodtaluka (10.56 per cent) and other talukas viz; Idar, Khedbrahma, Meghraj, Vijaynagar, Bayad, Bhiloda, Himmatnagar Prantij and Malpur respectively, in area under MIS installation. Considering the Sabarkantha district as a whole, the per cent share of MIS was found 8.10 per cent. The highest market potential of MIS was noticed in Malpur Taluka i.e. 96.96 per cent, followed by Prantijtaluka (95.73 per cent), Himmatnagar (95.54 per cent), Bhiloda (94.21 per cent), Bayad (94.20 per cent) and Vijaynagar (91.38 per cent). Market potential of MIS in other talukas in descending order include Meghraj, Idar, Khedbrahma, Talod,

Table 1. Taluka wise current status and market potential of Micro Irrigation System (MIS) in Sabarkantha district

No.	Taluka	Total Irrigated Area (ha)	Area under Micro Irrigation System (ha)	Per cent share of MIS	Market potential of MIS (Per cent)
1	Bayad	19318.87	1120.47	5.80	94.20
2	Bhiloda	21321.32	1234.12	5.79	94.21
3	Dhansura	10402.25	1347.65	12.96	87.04
4	Himmatnagar	36790.06	1639.87	4.46	95.54
5	Idar	36838.44	3583.52	9.73	90.27
6	Khedbrahma	13087.15	1315.21	10.05	89.95
7	Malpur	7729.57	234.87	3.04	96.96
8	Meghraj	17957.38	1637.92	9.12	90.88
9	Modasa	17995.14	2203.44	12.24	87.76
10	Prantij	16675.65	712.59	4.27	95.73
11	Talod	12428.28	1312.86	10.56	89.44
12	Vadali	14054.54	1831.36	13.03	86.97
13	Vijaynagar	5776.97	497.79	8.62	91.38
Total		230375.62	18671.67	8.10	91.90

Modasa, Dhansura and Vadali, respectively. The market potential of Micro Irrigation System(MIS) in Sabarkantha district was 91.90 per cent.

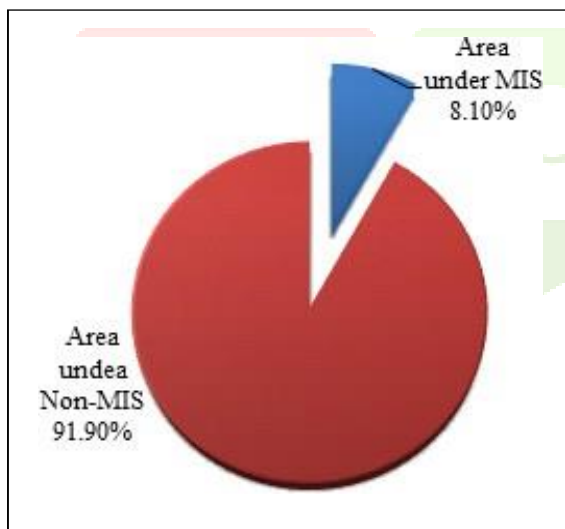


Fig 1. The per cent share of area under MIS and non-MIS in Sabarkantha district is presented here. It is clearly visible in the figure that 8 per cent land out of total irrigated land is covered under MIS while remaining 91.10 per cent land is not covered under MIS.

Figure 2 shows the market share of different companies that provide the MIS installation for the farmers. It was observed that Netafim occupied the highest share in the study area which was near about 35 per cent, followed by 29 per cent share of Jain irrigation, 15 per cent share of Paragaon, 10 per cent share of the John deer, 9 per cent share of Plasson and 4.37 per cent share of Om irrigation.

Distribution of farmers according to land holding: This figure 3 shows the distribution of farmers according to land holding in Sabarkantha district. It can be observed that near about 41.88 per cent farmers in the study area were medium farmers (2 to 4 ha land holding), 27.50 per cent were small farmers (up to 2 ha land holding), 24.38 per cent farmers were large (more than 4 ha land holding) and only 6.25 per cent farmers were marginal farmers (up to 1 ha land holding). So there is lots of potential for installation of MIS in study area.

Sources of irrigation for the farmers: The Figure 4 shows the different sources of irrigation adopted by the Sample farmers. Result shows that near about 37 per cent farmers have adopted the open wells as the source of irrigation, followed by 31 per cent through tube well, 17 Per cent through canal and 15 per cent through the water tank.

Table 2. Current status and market potential of Micro Irrigation System (MIS) in Sabarkantha district

Sr. No	Taluka	Village	Total Land (Viche)	Area under Micro Irrigation System (MIS)	Per cent share of MIS	Market potential of MIS (Per cent)
1	Modasa	Kesarpura	189	65	34.39	65.61
		Mahadepura	215	86	40.00	60.00
		Pahadpur	179	64	35.75	64.25
		Madapur	258	84	32.56	67.44
		Total	841	299	35.55	64.45
2	Dhansura	Adulpur	246	82	33.33	57.14
		Dhansura	226	82	36.28	63.72
		Lalpur	288	92	31.94	68.06
		Dolpur	268	112	41.79	58.21
TOTAL (Modasa and Dhansuratalukas)			1869	667	35.69	64.31

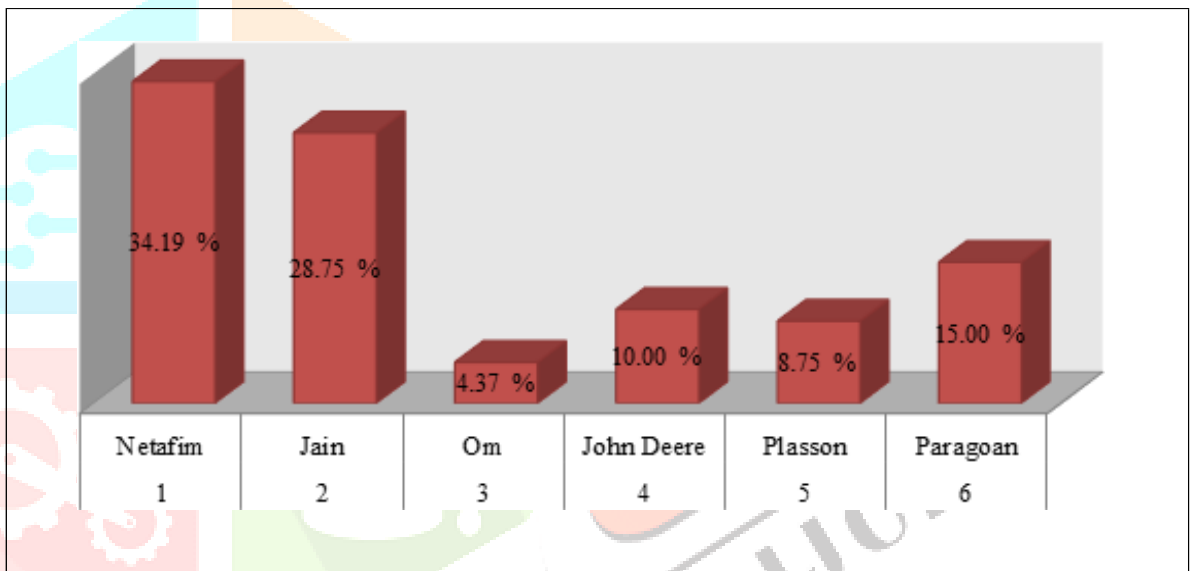


Fig 2. Market share of different Companies that provide the MIS Installation for the farmers

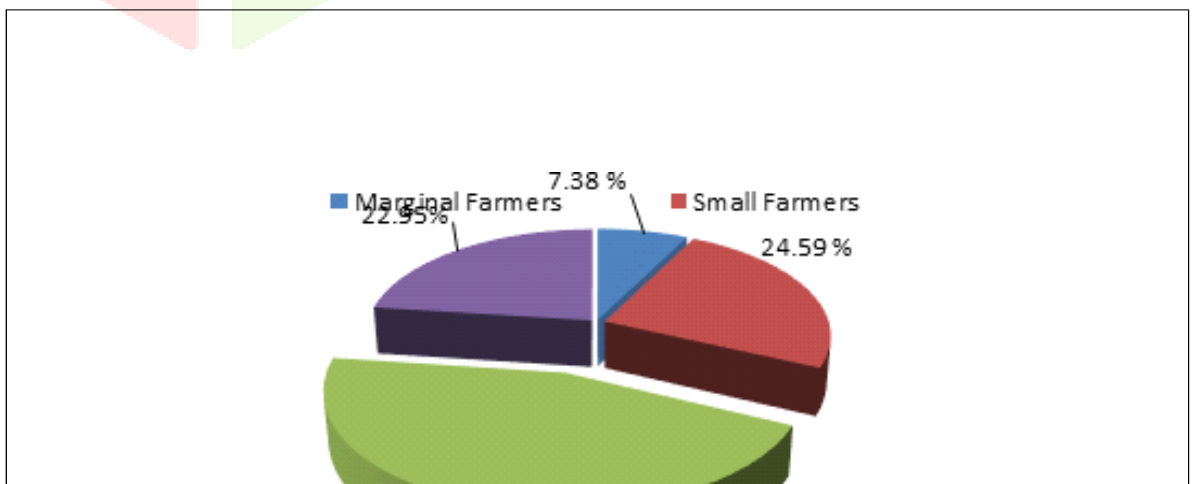


Fig 3. Distribution of farmers according to land holding

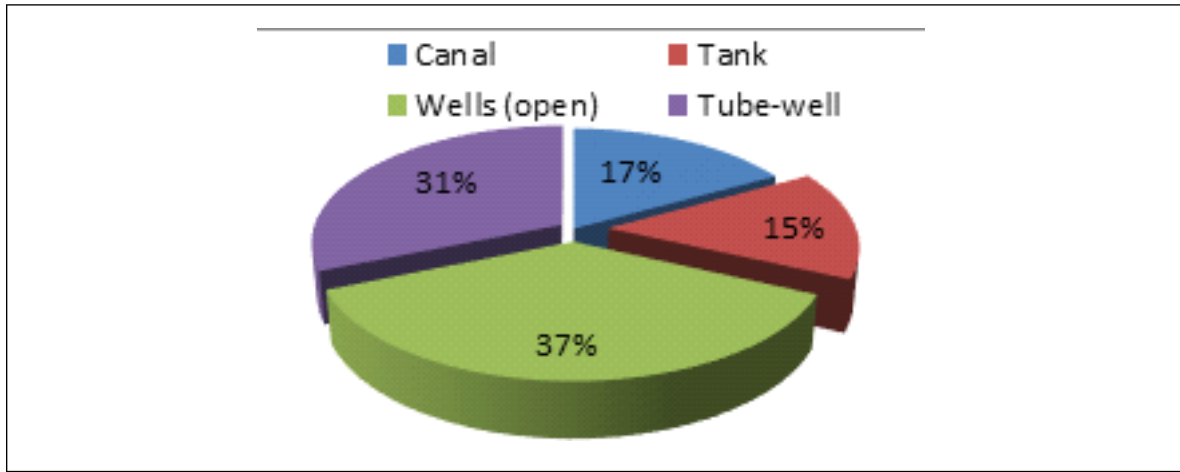


Fig. 4: Sources of irrigation for the farmers

Distribution of the farmers according to their extent of adoption of sprinkler irrigation system:

The Figure 5 shows the distribution of the farmer according to the level of adoption of sprinkler irrigation system. Out of 160 sample farmers, 38 farmers adopted sprinkler irrigation system and all these farmers who adopted sprinkler irrigation system were groundnut growers. The per cent share of adoption of sprinkler irrigation system by different categories of farmers was calculated with respect to total number of farmers who have adopted the sprinkler irrigation system and here it is 38 farmers. The result shows that out of all the sprinkler irrigation system adopter farmers, 31.58 per cent farmers were small farmers, followed by 28.95 per cent medium farmers and large farmers each. The per cent share of marginal farmers in adoption of sprinkler irrigation system was only 10.53 per cent.

Distribution of the farmers to their extent of adoption of Drip irrigation system:

The Figure 6 shows the distribution of the farmer according to the level of adoption of drip irrigation system. Out of 160 sample farmers, 122 farmers adopted drip irrigation system and all these farmers who adopted drip irrigation system were cotton growers. The per cent share of adoption of drip irrigation system by different categories of farmers was calculated with respect to total number of farmers who have adopted the drip irrigation system and here it is 122 farmers. The result shows that out of all the drip irrigation system adopter farmers, 45.08 per cent farmers were medium farmers, followed by 24.59 per cent small farmers, 22.95 per cent large farmers and 7.38 per cent marginal farmers.

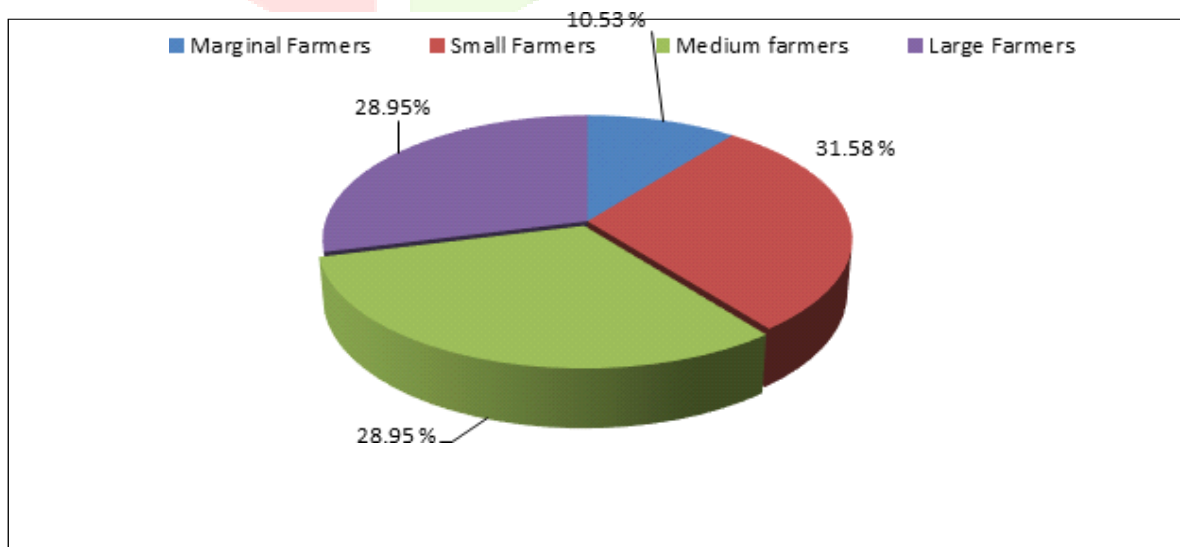


Fig 5. Distribution of the farmers according to their extent of adoption of sprinkler irrigation system

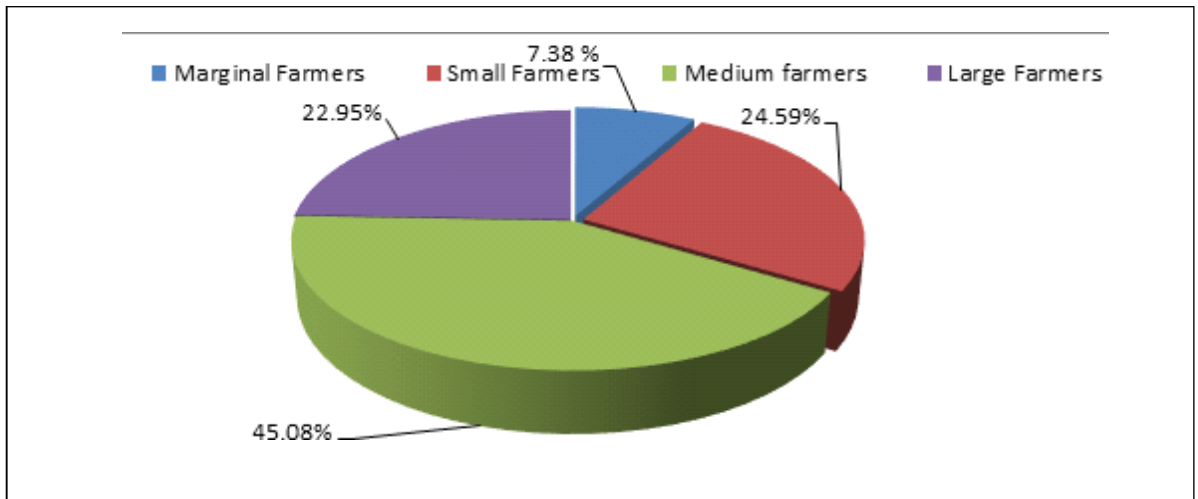


Fig 6. Distribution of the farmers according to their extent of adoption of Drip irrigation system in Sabarkantha district

Distribution of the farmers according to their extent of adoption of Micro irrigation system (MIS):

The Figure 7 shows the distribution of the farmer according to the level of adoption of Micro Irrigation System (MIS). Out of 160 sample farmers, 67 farmers who have adopted MIS were medium farmers and their per cent share in MIS adoption was 41.88 per cent, followed by 41 small farmers in adoption of MIS with per cent share of 25.63 per cent, 39 large farmers with per cent share of 24.38 per cent in MIS adoption and 13 marginal farmers with per cent share of 8.13 per cent in the study area.

Sources of credit institution for the farmers for installation of MIS: The Figure 8 shows the credit institutions available for farmers for the installation of MIS. The result shows that 38 per

cent farmers installed MIS through the cooperative society, followed by 30 percent through the bank, 19 percent through the money lender and 13 per cent farmers installed MIS through the credit help of relative.

Cost of installation of drip irrigation system for the small, medium and large farmers

Out of 160 sample farmers, 122 farmers were using drip irrigation system. Out of 122 farmers, 55 farmers were medium, followed by 30 small farmers, 28 large farmers and 9 marginal farmers. The average area under cotton crop covered by drip irrigation system of large farmers was 5.93 ha, followed by medium, small and marginal farmers *i.e.* 3.01 and 1.54 and 0.71 hectares, respectively.

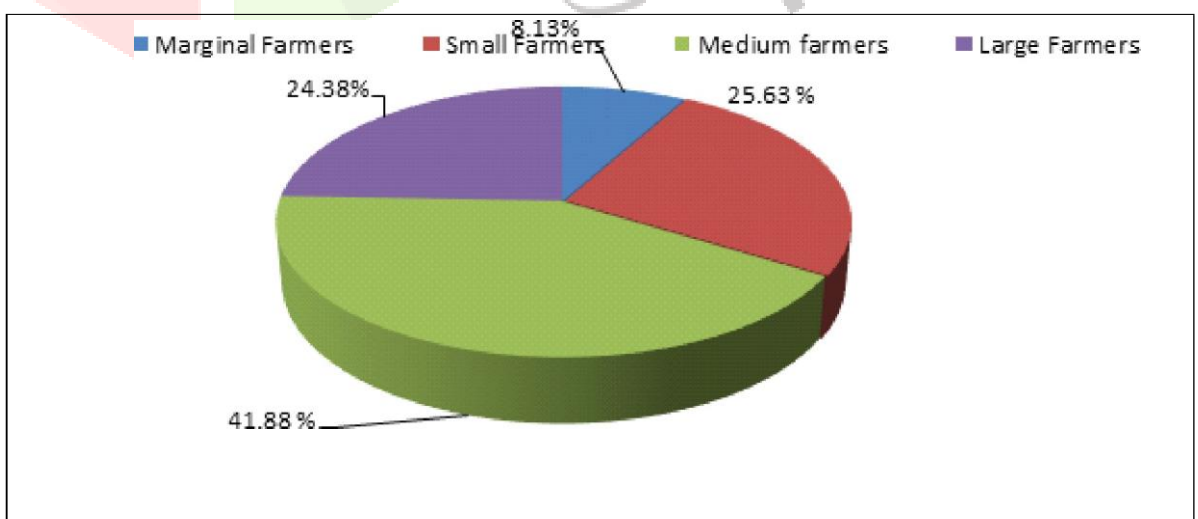


Fig. 7. Distribution of the farmers according to their extent of adoption of Micro Irrigation System (MIS) in Sabarkantha district.

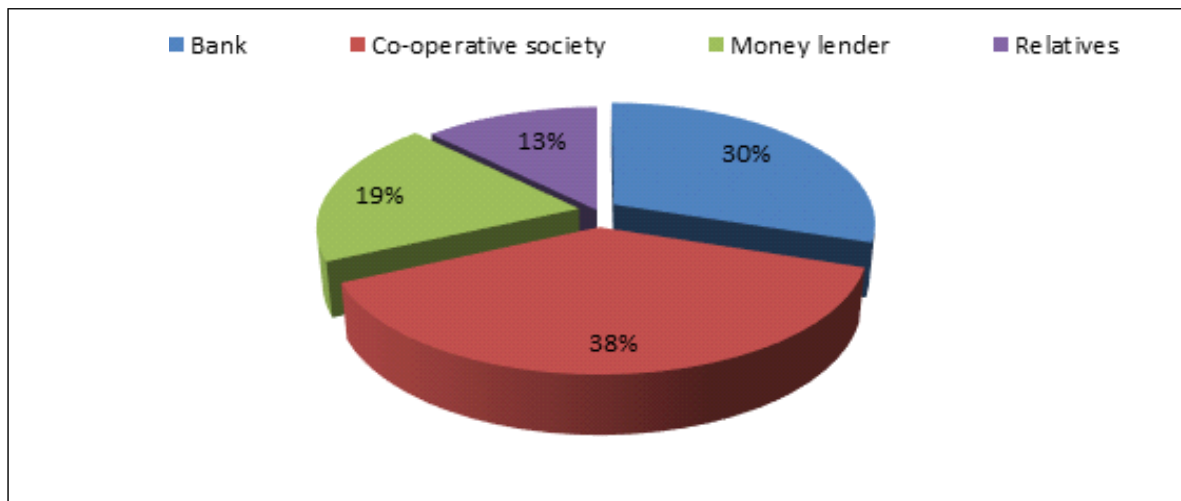


Fig. 8. Sources of credit institution for the farmers for installation of MIS

The average fixed cost of drip irrigation system was found highest in case of large farmers *i.e.* Rs. 8,54,059.37 followed by medium farmers (4,28,880.02 Rs.), small farmers (1,34,694.05 Rs.) and marginal farmers (1,38,172.59 Rs.) for their respective area under cotton covered under drip irrigation system. The depreciation on drip irrigation system was calculated at 10 per cent on fixed cost of drip irrigation system and interest was calculated

at 9 per cent on fixed cost of drip irrigation system. The cost of cultivation of cotton crop under drip irrigation system was observed highest in large farmers *i.e.* 1,94,642.18 Rs. per average area under cotton covered under drip irrigation system, followed by medium farmers (98,762.05 Rs.), small farmers *i.e.* (50,426.29 Rs.) and marginal farmers *i.e.* 23,360.71 Rs. per average area under cotton cultivation covered under drip irrigation system.

Table 3. Economics of drip irrigation system in cotton for different categories of farmers in Sabarkantha district.

Sr. No.	Particular	Marginal farmers	Small farmers	Medium farmers	Large farmers
	Average area under cotton crop	0.71	1.54	3.01	5.93
1	Fixed cost of drip system	138172.59	134694.05	428880.02	854059.37
	A) Depreciation (Rs.)	13817.26	13469.41	42888.00	58405.94
	B) Interest @ 9 percent (Rs.)	12435.53	12122.46	38599.20	76865.34
	C) Repairs and maintenance rs.	1066.67	2302.50	4509.55	8887.50
	D) Sub total (Rs.) (A+B+C)	27319.46	27894.37	85996.75	171158.78
2	Cost of cultivation per season (Rs.)	23360.71	50426.29	98762.05	194642.18
3	Gross seasonal (D+3) (Rs.)	50680.17	78320.65	184758.80	365800.96
4	Seasonal water use (mm)	265.89	271.03	250.00	250.00
5	Yield of produce, (kg.)	4266.67	9210.00	18038.18	35550.00
6	Selling price, (Rs./kg.)	21.44	21.93	21.85	20.00
7	Gross seasonal income (5*6), (Rs.)	91600.00	202120.00	394489.09	711000.00
8	Net seasonal income (7-3) (Rs.)	40919.83	123799.35	209730.29	345199.04
9	Net income per mm of water use (8/4), (Rs.)	161.25	463.05	838.92	1380.80
10	Water use efficiency (5/4), kg/mm of water use	16.42	34.33	72.15	142.20
11	Benefit cost ratio (7/3)	1.83	2.60	2.20	2.02
12	Pay-back period, (1/8) season	3.58	1.09	2.07	2.51
13	Cost per hectare (Rs.)	193645.79	86550.21	137810.7	137889.0

The seasonal water use by different farmers' groups according to their respective area under cotton cultivation. covered under drip irrigation system was 271.03 mm in case of small farmers, followed by 265.89 mm (marginal farmers) and 250.00 mm by medium and large farmers each. The gross seasonal income among various farmers' group was found highest in case of large farmers *i.e.* 7,11,000 Rs. followed by medium farmers (3,94,489.09 Rs.), small farmers (1,99,292.31 Rs.) and marginal farmers *i.e.* 91,600.00 Rupees, respectively from their respective area under cotton cultivation covered under drip irrigation system. Similar trend was observed in case of net seasonal income among various farmers' categories. Net income per mm of water use fetched was 1380.80 Rs. by large farmers followed by, 838.92 Rs. by medium farmers, 463.05 Rs. by small farmers and 161.25 Rs. by marginal farmers, respectively. The water use efficiency was calculated by taking ratio of yield of produce in kg. to seasonal water used for producing that particular produce, which is cotton here. The highest water use efficiency was observed in case of large farmers *i.e.* 142.20, followed by medium farmers (72.15), small farmers

(34.33) and marginal farmers *i.e.* 16.42. The highest benefit cost ratio was noticed in case of small farmers (2.60), followed by medium farmers (2.20), large farmers (2.02) and marginal farmers *i.e.* 1.83. the highest cost of installation of drip irrigation system per hectare was recorded in marginal farmers *i.e.* 1,93,645.79 Rs., followed by large farmers (1,37,889.04 Rs.), medium farmers (1,37,810.78 Rs.) and small farmers (86,550.21 Rs.).

The Table 4 shows the cost of installation of sprinkler irrigation system for the different categories of farmers in the study area. Out of 160 sample farmers, 38 farmers were using sprinkler irrigation system. Out of those 38 farmers, 15 farmers were small, followed by 12 medium farmers, 11 large farmers and 4 marginal farmers. The average area under groundnut crop covered by sprinkler irrigation system of large farmers was 5.39 ha, followed by medium farmers (3.03 ha.), small farmers (1.82 ha.) and marginal farmers *i.e.*, 0.71 hectares. The depreciation on sprinkler irrigation system was calculated at 10 per cent on fixed cost of sprinkler irrigation system and interest was calculated at 9 per cent on fixed

Table 4. Economics of sprinkler irrigation system in groundnut for different categories of farmers in Sabarkantha district.

Sr. No.	Particular	Marginal farmer	Small farmer	Medium farmer	Large farmer
	Average land holding	0.71	1.82	3.03	5.39
1	Fixed cost of drip system	23644.04	28851.01	48383.38	88407.03
	A) Depreciation (Rs.)	2364.40	2885.10	4838.34	8840.70
	B) Interest @ 9 percent (Rs.)	2127.96	2596.59	4354.50	7956.70
	C) Repairs and maintenance (Rs.)	1068.75	2734.09	4543.75	8086.36
	D) Sub total (Rs.) (A+B+C)	5561.12	8215.78	13736.59	24883.70
2	Cost of cultivation per season (Rs.)	10687.50	27340.91	45437.50	80863.64
3	Gross seasonal (A+3) (Rs.)	16248.62	35556.69	59174.09	105747.33
4	Seasonal water use (mm)	289.75	355.55	574.83	1062.22
5	Yield of produce, (kg)	4375.00	5224.18	8252.33	15934.09
6	Selling price, (Rs./kg.)	28.00	27.91	27.58	27.82
7	Gross seasonal income (5*6), (Rs.)	122470.00	146309.45	227734.00	443233.30
8	Net seasonal income (7-3) (Rs.)	106221.38	110752.76	168559.91	337485.96
9	Net income per mm of water use (8/4), (Rs.)	366.77	314.16	293.38	318.16
10	Water use efficiency (5/4), kg/mm of water use	15.10	14.82	14.35	15.00
11	Benefit cost ratio (7/3)	7.71	4.17	3.88	4.24
12	Pay-back period, (1/8) season	0.22	0.26	0.29	0.26
13	Cost per hectare	34205.87	16083.18	16062.37	16593.98

Table 5. Constraints faced by farmers after installation of MIS

Sr. No.	Particulars	Per cent position	Mean score	Rank
1	High cost of installation	49.61	50	III
2	Cost of maintenance	50.47	49	IV
3	Side effect of poor quality water	55.31	47	V
4	Unavailability MIS parts	25.31	63	II
5	After sales service	14.92	71	I
6	Rodents	56.95	46	VI
7	Training of MIS operation	81.25	32	VIII
8	Insurance	71.09	39	VII

cost of sprinkler irrigation system. The cost of cultivation of groundnut crop under sprinkler irrigation system was observed highest in large farmers *i.e.* 80, 863.64 Rs. per average area under cotton crop covered under sprinkler irrigation system, followed by medium farmers (45, 437.50 Rs. per average area under groundnut under sprinkler irrigation system), small farmers (27, 340.91 Rs. per average area under groundnut under sprinkler irrigation system) and marginal farmers *i.e.* 10, 687.50 Rs. per average area under groundnut cultivation covered under sprinkler irrigation system. The seasonal water use by different farmers' groups according to their respective area under groundnut cultivation covered under sprinkler irrigation system was 1062.22 mm in case of large farmers, followed by 574.83 mm (medium farmers), 355.55 mm (small farmers) and 289.75.00 mm by marginal farmers.

The gross seasonal income among various farmers' group was found highest in case of large farmers *i.e.* Rs. 4,43,233.30 followed by medium farmers *i.e.* Rs. 2,27,734.00 small farmers *i.e.* Rs 1,46,309.45 and marginal farmers *i.e.* 1,22,470.00 Rupees, respectively from their respective area under groundnut cultivation covered under sprinkler irrigation system. Similar trend was observed in case of net seasonal income among various farmers' categories. Net income per mm of water use fetched was 366.77 Rs. by marginal farmer

followed by, large farmers *i.e.* 318.16 Rs. small farmers *i.e.* 314.16 Rs. and medium farmers *i.e.* 293.38 Rs., respectively. The water use efficiency was calculated by taking ratio of yield of produce in kg. to seasonal water used for producing that particular produce, which is groundnut here. The highest water use efficiency was observed in case of marginal farmers *i.e.* 15.10, followed by large farmers (15.00), small farmers *i.e.* 14.82 and medium farmers *i.e.* 14.35. The highest benefit-cost ratio was noticed in case of marginal farmers (7.71), followed by large farmers (4.24), small farmers (4.17) and medium farmers *i.e.* 3.88. The highest cost of installation of sprinkler irrigation system per hectare was recorded in marginal farmers *i.e.* 34, 205.87Rs., followed by large farmers (16, 593.98 Rs.), small farmers (16, 083.18 Rs.) and medium farmers *i.e.* 16,062.37 Rs.

Constraints faced by farmers in using MIS: Problems faced by after installation of MIS are shown in Table 4.4.1. After sales service and unavailability MIS parts occupied first and second place with a mean score of 71 and 63, respectively, followed by high cost of installation with a mean score of 50, cost of maintenance with a mean score of 49 and side effect of poor quality water with a mean score of 47. Rodents, insurance and training of MIS operation were the least prevailing constraints in their order.