ON-FARM INCREASED PRODUCTION, INCOME AND WATER-USE EFFICIENCY THROUGH MICRO-IRRIGATION IN INDIA

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ABSTRACT

On-farm production, income and water use efficiency for horticultural and other agronomical crops in terms of the benefit cost ratio micro-irrigation systems were calculated, and it is observed that B.C. ratio of drip irrigation was greater than conventional methods of irrigation. The water use efficiency was also higher than for conventional methods of irrigation. The monetary gains from micro-irrigation systems were larger than for conventional methods of irrigation for all crops. Information on water use efficiency, productivity and advantages of micro-irrigation compared to conventional irrigation methods is compiled and presented.

INTRODUCTION

Agriculture is the principal occupation of a major portion of the Indian population. Timely availability of an adequate and assured supply of irrigation water is crucial for the agricultural productivity. A large variation in the amount and distribution of rainfall in the recent past has resulted in inadequate availability of irrigation water and declines in the ground water table in most parts of the country. While the demand for water will continue to rise rapidly in agricultural, industrial and domestic sectors, the availability of water will be increasingly tightened because of the limited potential. It is also observed that presently agriculture alone utilized about 83 percent of the exploited water resources. In the future agriculture may receive a smaller share of water, because of the vital demand for drinking water and competition for industrial use. Therefore, agriculture will have to use less water. Simultaneously the high cost of development of water resources is making major irrigation projects economically unsustainable. The cost of irrigation per hectare has gone up from Rs. 1000/ha(US $24) in 1956 to nearly Rs. 65,000/ha (US $ 1475) in 1992, and still shows an increasing trend. Hence, it is clear that a major hurdle to increasing production and productivity, especially of high value commercial crops, may be inadequate water supplies. This hurdle can mainly be overcome through enhancing water use efficiency.

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Need for Study

Farmers are not yet fully convinced about the economics and advantages of micro-irrigation. Some farmers are convinced, as they are rich and can afford to install these systems. But they have not come forward to adopt these systems. Why? The simple and obvious answer is, what is the use of keeping one cow when milk is available freely? In light of this psychology, The authors have interviewed sixty two farmers in the region and on the basis of that efforts were able to calculate the on-farm increased production and income in horticultural crops in terms of the benefit- cost ratio through micro-irrigation systems on papaya, pomegranate, banana, grapes, strawberry as well as for tomato and roses. By going through the economics, The authors hope that a majority of the farmers shall be convinced to adopt micro-irrigation systems. Information as regards cereals, oilseeds, cash crops, and vegetables about water use efficiency, productivity and advantages as compared to conventional irrigation methods at the different places in country is compiled and presented in this paper.

RESULT AND DISCUSSION

Papaya

The cost of a drip irrigation system for papaya is about Rs. 40,000 per ha. The latex extracted and the yield of the fruit in drip fields is about 50% more from control fields. The payback period for installation of drip is less than one year. The B-C ratio of drip is about 4.0 compared to 3.0 in surface method. The extra income due to drip irrigation over conventional method is about Rs. 52,550 per ha. The economic details for drip irrigation for papaya are given in Table 1, results indicates that drip irrigation has good potential for papaya crops in coming years.

Pomegranate

The cost of a drip irrigation system for pomegranate is about Rs. 30,000 per ha. The economics for drip irrigation of pomegranate are given in Table 1.Extra income due to drip irrigation is about Rs.1,11,600 per ha. Hence pomegranate is very suitable for drip irrigation, and can be popularized in large scale in all parts of the country.

Banana

The variety of banana grown was Basarai which takes about 17-18 months to mature. After introducing drip irrigation, farmers are able to harvest two crops (main and one ratoon) in 24 months. The cost for drip irrigation is about Rs.

45,000 per ha. The amount of water applied by the farmer is usually about 16-20 liters/day/plant in the summer and 8 to 10 liters/day/plant in the winter. The yield of crop is about 75 Tons/ha compared to 50 Tons/ha in surface method of irrigation. The net per ha extra income due to drip irrigation over conventional irrigation is about to Rs.42,400 (Table 1). Micro-irrigation techniques have proved to be advantageous. The reason drip irrigation is not more popular is due to capital costs, and the farmers imagine that it is very cumbersome. It is difficult to get subsidies and bank loans, and the farmers believe in the traditional agricultural and irrigation methods.

Grape

The cost of the drip system is about Rs. 43,750 per ha. (average) for a spacing of 3 x 1.8 m. The amount of water applied by the farmer is about 20 liters/plant/day. The yield of grapes using micro-irrigation is 40 to 50 Tons/ha. Further it was reported that the quality of the fruit is uniformly good with berry elongation. Price of the fruits grown by drip is invariably Rs.1-2 more per kg than conventionally irrigated fruits. Further, it is possible to get the fruits 2 to 3 weeks earlier in the market, maximum extra yield and price for the fruits, under micro-irrigation system. The net extra income due to micro-irrigation comes to Rs. 1,90,250/ha (Table 2). The payback periods for drip come is less than one year and more than 60 percent of the area in Maharashtra has come under drip. Data indicate that there is an imperative need to bring the entire grape area under drip to get more yield, more income and more foreign exchange for the country apart from saving water especially in water scarcity areas. Further, more area should be brought under grapes, which will give more income to the farmers and bring us more foreign exchange as there is a large scope for exporting grapes from India to other foreign countries.

Strawberry

It has been reported that the yield is about 5 Tons/ha. Daily about 2 to 3 liters/plant water is applied. Drippers are provided every 30 cm on lateral tubes. The total population of plants per ha is about 100,000 when irrigated by drip since no bed is required for drip. The per ha cost of cultivation by drip is about Rs. 60,000, and fruits are obtained 15 days earlier than under conventional irrigation methods with average yield of 7.5 Tons/ha. The net per ha extra income due to drip irrigation over conventional methods is about Rs. 92,500 and the B-C ratio is 2.34. Micro-irrigation of strawberries gives more production and profit to the farmers

Tomato

Introducing a drip system into tomato production requires the spacing of the crop modified to reduce the cost. Normally the spacing is 90 x 60 cm. Some farmers

have changed to a pair row layout and use as spacing of 45 cm x 165 cm. LDPE
Lateral / Drip Tape can be used as a lateral to give water. One hole every 30 cm
is provided in the drip tape and about 50 m^3 / ha of water are given daily, i.e.,
about 5 mm/day. Yields with drip irrigation systems varies from 75 to 125
Tons/ha while 45 to 62.5 Tons/ha in conventional irrigation. Cultivation costs
and crop duration can be reduced by Rs. 10,000/ha and 20 days, respectively, in
drip as compared to conventional irrigation methods. Net extra income from
micro irrigation over conventional irrigation is about Rs. 71,600/ha. The payback
period for drip is one season for tomatoes. In view of increased yield, profit, and
high in B-C ratios, micro-irrigation technology such as drip irrigation, is
recommended for tomatoes.

Rose

The daily water requirement of well grown rose plants varies from 5 to 10
liters/day/plant. The initial cost of the system can be repaid in the first year since
the profit with drip irrigation is very high (Table 3). It is advised to grow the
rose crop on a large scale to meet the market demand.

For cereal crops, vegetables, relative performance of the crops grown in different
locations of the country with micro-irrigation systems were better than for
conventional irrigation. Performance was reflected in increased yield (Table 4).
The water use efficiency in cereals like wheat, bajra, sorghum, barley, gram and
maize were similar to those from groundnut, sunflower, cotton, sugarcane and
vegetables. As a result the area under drip irrigation has increased from, 1000 ha
in 1985 to 60,000 ha in 1993 and 2,54,000 ha in 1998. In another five years,
projected area is estimated to increase about one million hectares which is 1% of
the irrigated area, and about ten million hectares by 2020-2025 AD.

CONCLUSION

The net monetary returns, the benefit-cost ratio and other advantages have been
show to be superior for micro-irrigation techniques compared to conventional
irrigation. Farmer in the region should adopt micro-irrigation to increase on-farm
production, income and water use efficiency for horticultural as well as
agronomic crops.

Motivating farmers to adopt the technology will enhance water use efficiency, save
irrigation water and increase production and productivity. Efforts should be made to
bring down the costs of the system. Supply of standard material and equipment
conforming to BIS standards need to be made available. Prompt customer services for
maintenance and repair are essential. Farmers should develop conviction and confidence
in the systems.

REFERENCES

Anonymous (1998). Akola Cotton Demonstration Project (based on Israel Technology). Bulletin and reports published. by Commissioner of Agriculture. M.S. Pune and Dr. Panjabrao Deshmukh Agricultural University Akola 444 104 (M.S.) India.

Hugar, L.B. and Balappa Shivaraya.(1999). Problems and Prospects of Expansion of Micro-Irrigation Systems in India, Proceedings of National Seminar on Problems and Prospects of Expansion of Micro-irrigation Systems in India during Nov. 19-20, 1999, Bangalore, 169-172.

Mane, K.M. (1993). Economics of Grapes Cultivation Under Drip vs. Furrow Method of Irrigation in Maharashtra. Unpublished M.Sc. thesis submitted to UAS, Dharwad.

Padhya, A.H. (1990). Micro and Sprinkler Irrigation in India. Proceedings XI International Congress on the Use of Plastics in Agriculture. Feb. 26 – March 2, 1990. New Delhi. 50-55.

Sharma, B.R. (1991). Country Report India In Farm-level Irrigation Water Management, Asian Productivity Organization, Tokyo, 113-124.

Taley, S.M., Dalvi, V.B.; Patode, R.S. (1996) On-farm Increased Production and Income in Horticultural Crops Through Controlled Irrigation Techniques. Proceedings of the National Seminar on Role of Engineering Techniques in Increasing Agricultural Productivity, Dec. 5-6, 1996. Nagpur. 138-142.

Table 1.　Economics of Drip Irrigation for Papaya, Pomegranate, and Banana

Particulars	Papaya		Pomegranate		Banana	
	Drip	Surface	Drip	Surface	Drip	Surface
Spacing (Meter)	2.4x1.8	2.4x1.8	4.2x4.2	4.2x4.2	1.5x1.5	1.5x1.5
Cost of drip system (Rs/ha.)*	40,000	-	30,000	-	45,000	-
a) Life 5 yrs for lateral/ drippers and 10 yrs for main, submain and filter	-	-	-	-	-	-
b) Depreciation (Rs/ha)	6800	-	5100	-	7650	-
c) Interest 13%(Rs/ha)	2400	-	1800	-	2700	-
d) Repair and maintenance(Rs/ha)	2000	-	1500	-	2250	-
e) Total (Rs/ha)	11200	-	8400	-	12600	-
Cost of cultivation (Rs/ha)	30,000	37,500	40,000	50,000	37,500	42,500
Seasonal total cost (3+2 e)(Rs/ha)	41,200	37,500	48,400	50,000	50,100	42,500
Water used (L/day/plant)	15	25	10	17.5	10	25
Yield of produce a) Latex (Kg/ha) b) Fruits(Tons/ha)	1,375 150	1,250 100	- 23	- 17.5	- 75	- 50
Selling price a) Latex (Rs/kg) b) Fruits(Rs/ton)	50 500	50 500	10000	8000	2000	2000
Income from produce (6x7)(Rs/ha)	168750	112000	250000	140000	150000	100000
Net seasonal income (8-4)(Rs/ha)	127550	75000	201600	90000	99900	57500
Additional area cultivated due to saving of water (ha)	1	-	1	-	1	-
Additional expenditure due to additional area (4x10)(Rs/ha)	41200	-	48400	-	50100	-
Additional income due to additional area (8 x 10)(Rs/ha)	168750	-	250000	-	150000	-
Additional net income (12-11)(Rs/ha)	127550	-	201600	-	99900	-
Gross cost of production (4+11)/2 (Rs/ha)	41200	37500	48400	50000	50100	42500
Gross income (8+12)/2 (Rs/ha)	168750	112500	250000	140000	150000	100000
B.C. ratio (15/14)	4.09	3.00	5.17	2.80	3.00	2.35
Net extra income due to drip irrigation over conventional method Rs/ha [(13+9Drip)-9Surf]	52550 $1072	-	111600 $2277	-	42400 $865	-

* Approved by Government of Maharashtra State (India).

Table 2. Economics of Drip Irrigation for Grapes and Strawberry

Particulars	Grapes		Strawberry	
	Drip	Surface	Drip	Surface
Spacing(Meter)	3.0x 1.8	3.0x 1.8	3.6x2.7	2.4x1.5
Cost of drip system (Rs/ha.)	43,750	-	1,87,500	-
a) Life 5 yrs for lateral/ drippers and 10 yrs for main, sub-main and filter (Rs/ha.)	-	-	-	-
b) Depreciation(Rs/ha.)	7437.50	-	31875	-
c) Interest 13%(Rs/ha.)	2625	-	11250	-
d) Repair and maintenance(Rs/ha.)	2187.50	-	9375	-
e) Total(Rs/ha.)	12250	-	52500	-
Cost of cultivation(Rs/ha.)	125000	162500	60000	92500
Total Seasonal cost (Rs/ha.) (3+2 e)	137250	162500	112500	92500
Water used in (L/day/plant)	20	40	2	-
Yield of produce (Tons/ha)	45	30	7.5	5
Selling price (Rs/ton)	9000	8000	35000	30000
Income from produce (6x7) (Rs/ha.)	405000	240000	262500	150000
Net seasonal income (8-4) (Rs/ha.)	267750	77500	150000	57500
Additional area cultivated due to saving of water (ha)	1	-	0.5	-
Additional expenditure due to additional area (4x10) (Rs/ha.)	137250	-	112500	-
Additional income due to additional area (8 x 10) (Rs/ha.)	405000	-	262500	-
Additional net income (12-11) (Rs/ha.)	267750	-	150000	-
Gross cost of production (4+11)/2 (Rs/ha.)	137250	162500	112500	92500
Gross income (8+12)/2 (Rs/ha.)	405000	240000	262500	150000
B.C. ratio (15/14)	2.95	1.48	2.34	1.62
Net extra income due to drip irrigation over conventional method Rs/ha [(13+9Drip)-9Surf]	190250 $3883	-	92500 $1888	-

Table 3. Economics of Drip Irrigation for Tomato and Rose

Particulars	Tomato		Roses	
	Drip	Surface	Drip	Surface
Spacing(Meter)	1.65x0.45	0.9x0.6	0.9x0.6	0.9x0.6
Cost of drip system. (Rs/ha.)	30,000	-	25,000	-
a) Life 5 yrs for lateral/ drippers and 10 yrs for main, sub-main and filter	-	-	-	-
b) Depreciation(Rs/ha.)	5100	-	4250	-
c) Interest 13%(Rs/ha.)	1800	-	1500	-
d) Repair and maintenance(Rs/ha.)	1500	-	1250	-
e) Total(Rs/ha.)	8400	-	7000	-
Cost of cultivation(Rs/ha.)	70000	80000	175000	225000
Total seasonal cost (Rs/ha.) (3+2 e)	78400	80000	182000	225000
Water used in(L/day/plant)	5	10	5	10
Yield of produce (Tons/ha) (Dozens/ha)	75	50	76500	76000
Selling price (Rs/ton) (Rs/doz)	2000	2000	6.00	4.80
Income from produce (6x7) (Rs/ha.)	150000	100000	459000	362200
Net seasonal income (8-4) (Rs/ha.)	71600	20000	277000	137200
Additional area cultivated due to saving of water (ha)	1	-	0.5	-
Additional expenditure due to additional area (4x10) (Rs/ha.)	78400	-	182000	-
Additional income due to additional area (8 x 10) (Rs/ha.)	150000	-	459000	-
Additional net income (12-11) (Rs/ha.)	71600	-	277000	-
Gross cost of production (4+11) (Rs/ha.)	156800	80000	182000	225000
Gross income (8+12) (Rs/ha.)	300000	100000	459000	367200
B.C. ratio (15/14)	1.91	1.25	2.52	1.63
Net extra income due to drip irrigation over conventional method [(13+9Drip)-9Surf]	71600 $1461	-	277000 $5653	-

Table 4. Relative Performance of Crops Grown Under Micro-
Irrigation(Sprinkler) and Traditional Surface Irrigation Methods

Crop	Location	Yield (Q/ha)		Irrigation Water (cm)		Water Use Efficiency (Q/ha-cm)		Advantage of Sprinkler	
		Sur. Irri.	Spr Irri.	Sur. Irri.	Spr Irri.	Sur. Irri.	Spr Irri.	Water saving (cm)	Yield increase (Q/ha)
Cereals									
Wheat	Rahuri	32.41	36.39	35.0	20.25	0.93	1.79	14.75	3.98
	Udaipur	26.61	33.02	33.02	14.52	0.81	2.27	18.50	6.41
	Hissar	44.80	48.70	33.94	32.68	1.32	1.49	1.26	3.90
Bajra	Rahuri	6.97	8.33	17.78	7.82	0.39	1.07	9.96	1.36
Jowar	Rahuri	4.92	6.62	25.40	11.27	0.19	0.59	14.13	1.70
Barley	Bikaner	24.09	28.15	17.78	7.82	1.35	1.59	9.96	4.06
	Hissar	34.80	35.10	23.87	21.88	1.47	1.27	1.99	0.30
Gram	Hissar	6.55	9.91	17.78	7.82	0.37	1.27	9.96	3.36
Sorghum	Rahuri	44.12	54.97	18.00	12.00	2.45	4.58	6.00	10.85
Maize (Kharif)	Udaipur	15.62	18.10	12.80	9.00	1.22	2.01	3.80	2.48
Oil Seeds									
G.Nut (Summer)	Rahuri	23.24	28.98	90.00	62.00	0.26	0.47	28.00	5.74
	Junagarh	13.00	16.00	91.00	65.00	0.14	0.25	26.00	3.00
	Dharwad	33.96	39.86	76.30	63.60	0.45	0.63	12.70	5.90
	Punjab	5.50	11.90	68.60	50.20	0.08	0.24	18.40	6.40
	Navsari	30.00	31.00	56.00	44.00	0.55	0.68	12.00	1.00
(Kharif)	NCPA	8.33	9.34	60.00	30.00	0.14	0.31	30.00	1.01
	Rahuri	18.31	22.15	21.00	14.00	0.87	1.58	7.00	3.84
Sunflower (Rabi)	Rahuri	16.02	19.19	30.00	20.00	0.53	0.96	10.00	3.17
Cash Crops									
Cotton	Navsari	6.99	7.04	40.64	29.65	0.17	0.24	10.99	0.05
	Punjab	10.00	15.00	91.10	58.60	0.12	0.26	12.50	5.00
Sugarcane	Rahuri	792.1	866.3	245.0	188.0	3.23	4.61	57.00	74.20
	Dharwad	48.00	55.70	51.40	43.50	1.08	1.10	7.90	7.70
Vegetables									
Garlic	Rahuri	69.99	73.99	84.00	60.00	0.83	1.23	24.00	4.00
Chillies	Pune	17.41	21.52	36.00	24.00	0.48	0.89	12.00	4.11
(Kharif)	Rahuri	17.15	20.91	39.00	26.00	0.44	0.80	13.00	3.76
Onion (Summer)	Rahuri	334.9	412.7	78.00	52.00	4.29	7.94	26.00	77.80