Agricultural Economics Research Review
Vol. 17 (Conference No.) 2004 pp 107-113

Economic Analysis of Sprinkler and Drip Irrigation Technology in Haryana*

M.S. Luhach, R.K. Khatkar, V.K. Singh and R.S. Khatry

Abstract

The paper examines the water-use efficiency and economic worth of investment in sprinkler, drip and surface irrigation systems in Haryana using the primary data. The results have indicated considerable savings in water from sprinkler and drip irrigation methods. The sprinkler irrigation method has also been found to reduce operational costs as well as labour requirements. Using different project evaluation criteria, it has been suggested that it is worth to invest in the sprinkler and drip irrigation systems.

Introduction

The surface irrigation system has many drawbacks such as wastage of water in delivery, difficulty in maintaining uniformity of irrigation, soil erosion and limitation of irrigating undulated lands. To overcome these problems specifically to reduce wastage of water, sprinkler and drip irrigation methods have been suggested.

The sprinkler irrigation was first propagated in India during 1950s, but could not become popular due to availability of water in large quantity. In recent years, however, realization about the need for effective utilization of water, sprinkler irrigation has started gaining ground. The total area under sprinkler irrigation has been estimated to be about 0.68 per cent or 6.58 million hectares of the total irrigated area of 77.80 million hectares. In Haryana, sprinkler irrigation is practised on about 85 thousand hectares of land. Sprinkler irrigation, which is water-efficient, has been introduced in the canal irrigated areas of southern Haryana. Sprinkler system of irrigation saves water and can irrigate much more area than surface irrigation. It also eliminates the needs for channels and land leveling. This method is

*Paper is based on the Ph.D. thesis of the first author.

Department of Agricultural Economics, CCS Haryana Agricultural University, Hisar-125 004

particularly suited on sandy soils that have a high infiltration rate. Small streams of irrigation water can be used efficiently and sprinkler distributes water uniformly.

Drip irrigation* was introduced during the early 1970s in India. From a mere 1500 hectares in 1985, the area under drip irrigation grew to 2,59,500 hectares in 2000-01. In Haryana, area under drip irrigation is about 2135 hectares at present.

Irrigation is essential for increasing the efficiency of input-use, adoption of high-yielding varieties, and improving cropping intensity and crop yields. The water requirement is bound to increase with the expansion and intensification of agriculture in addition to the increased demand from the industrial and domestic sectors. There is still a wide gap between the created irrigation potential and utilization. Since water is a scarce resource, it is important to conserve and manage it efficiently. The over-exploitation of water has cropped up the problem of depletion and rise in water table which has resulted in creation of salinity and waterlogging problems. The question of economic efficiency in water-use has remained largely unattended. Keeping in view the importance of efficient irrigation methods to increase the productivity of per unit irrigation water, a study has been conducted to assess the economic impact of sprinkler and drip irrigation in Haryana.

Methodology

Four districts of the Haryana state having sprinkler and drip irrigation systems were selected for this study. These were: Bhiwani, Mahendergarh, Hisar and Gurgaon. One block having the maximum sprinkler and drip sets from each selected district was identified purposively. Then a cluster of three villages from each selected block was selected randomly. From each selected village, at least five farmers were selected each for sprinkler, surface irrigation (fruits and crops) and drip irrigation methods. Thus, 60 farmers each for sprinkler, surface and drip adopter were selected, making a total sample size of 240.

The primary data for the year 1999-2000 pertaining to the investments on sprinkler and drip irrigation system, cropping pattern, input use and output produced, input and output prices and other operational costs were collected from the selected respondents in a pre-tested schedule. Budgeting

* Drip irrigation involves application of water only at the roots of the plant where it is required and thereby saves lot of water. Crop yields improve and the costs on fertilizers, pesticides, etc. get reduced. Its efficacy and applicability is more in plantation crops like fruits and forest trees.

technique was used to analyze the data. The economic worth of these systems was estimated using the following evaluation criteria.

Net Present Value (NPV)

$$\Sigma [(B_t - C_t) / (1 + r)^t]$$

Internal Rate of Return (IRR)

$$\Sigma [(B_t - C_t) / (1 + IRR)^t] = 0$$

Benefit-Cost Ratio (BCR)

$$\Sigma [(B_t / (1 + r)^t] / \Sigma [(C_t) / (1 + r)^t]$$

where, B_t denotes the benefits in the year t, C_t is the cost in year t and t is the time period, and r is the discount rate (rate of interest).

Results and Discussion

The average irrigated area on the sprinkler irrigated farms was 9.65 hectares and the number of irrigation per ha applied was 4.77 (Table 1). Labour requirement for irrigation was 161.45 hours/ha, resulting in 34 labour hours/irrigation/ha. On the other hand, average irrigated area under pump-set through surface irrigation was 3.58 hectares and number of irrigation per ha was 3.54. Per ha labour requirement for irrigation was 542.21 hours. Labour requirement per ha per irrigation was 153 hours.

The average cost of sprinkler irrigation was Rs 4,890/ha with per irrigation cost as Rs 1,026. The average variable costs per ha, per irrigation, and per hour to run the sprinkler set were Rs 2,308, Rs 484 and Rs 14.29, respectively. While the average per hectare total cost of flood irrigation was Rs 10,100 (36,160/3.58) and per irrigation cost was Rs 2,853. The average variable costs per ha, per irrigation and per hour to run pump set (surface irrigation) were Rs 6,616, Rs 1,868 and Rs 12.20, respectively. Thus, sprinkler irrigation reduced the costs on running and labour. The use of human labour per hectare per irrigation after acquisition of sprinkler set was declined by 78 per cent. These findings were in consistent with those of Yamauchi and Bui (1990), Wilson *et al.* (1984) and Sankhayan and Singh (1985).

The average net income of a farmer from crops was Rs 2770/ha under pumpset irrigation and Rs 3311/ha under sprinkler irrigation, as depicted in Table 2 . With the acquisition of the sprinkler set, the farmers were able to bring 6.07 hectares additional area under irrigation as well as cultivation.

Table 1. Comparative efficiency of sprinkler and pump set irrigations

Crop	Sprinkler irrigation			Pump set irrigation		
	Area (ha)	No. of irrigations/ha	Labour required to irrigate crop/ha (hours)	Area (ha)	No. of irrigations/ha	Labour required to irrigate crop/ha (hours)
			(A) Kharif			
Bajra	1.55	3	100.50	0.66	2	296.0
Cotton	1.04	5	167.50	-	-	-
Jowar	0.55	4	134.00	0.28	3	232.57
Guar	0.68	3	100.50	0.22	2	565.09
Moong-moth	0.29	2	67.00	-	-	-
			(B) Rabi			
Wheat	2.88	8	268.00	1.75	5	718.86
Gram	1.50	3	100.50	0.30	2	629.33
Mustard	0.75	3	100.45	0.23	2	296.00
Barley	0.41	5	167.51	0.14	2	296.00
Total	9.65	4.77	161.45	3.58	3.54	542.21
Total operating costs/annum	22271			23686		
Total costs /annum	47229			36160		

Table 2. A comparative economics of pumpset and sprinkler irrigated farms

Crops	Area (ha)	Cost (Rs /ha)	Average yield (kg/ha)	Gross return (Rs/ha)	Net return (Rs /ha)
			Pump set Irrigation		
Bajra	0.66	11080	1330	7485	-395
Guar	0.22	8630	810	9540	910
Jowar	0.28	13034	316	12640	-394
Wheat	1.75	18640	3970	24641	6001
Gram	0.30	9290	990	10360	1070
Mustard	0.23	13470	1840	18930	5460
Barley	0.14	15780	2880	16246	526
Total	3.58	25118.44*		27888.83*	2770.39*
			Sprinkler irrigation		
Bajra	1.55	9654	1285	6485	-3169
Cotton	1.04	16865	1236	23818	6953
Jowar	0.55	12228	456	13680	1452
Guar	0.68	7755	890	12108	4353
Moong-moth	0.29	6036	528	7740	1704
Wheat	2.88	14056	3686	20098	6042
Gram	1.50	9175	1286	10582	1387
Mustard	0.75	11462	1885	19560	8098
Barley	0.41	10860	2560	15961	5101
Total	9.65	10163.94*		13474.81*	3310.88*

*indicates average per hectare

Table 3. Economic viability of sprinkler set

Particular	Value
Net present worth/ Net present value (NPV) in Rs/ha	7970
Internal rate of return (IRR) in per cent	17
Pay back period (Years)	7
Benefit-cost ratio	1:1.97

Hence , the cultivator earned additional net return worth Rs 20098 from 6.07 ha. Thus, the net returns from sprinkler irrigation were Rs 1953 per cent higher than from the pumpset irrigation.

The values of NPV, IRR and B:C ratios are depicted in Table 3. It is evident that investment in sprinkler irrigation was more remunerative. The higher benefit:cost ratio (1:1.97), NPV(Rs 7970) and IRR (17%) indicated that it was worth to invest in sprinkler irrigation. The initial investment could be recovered in a period of seven years..

Economic Viability of Fruit Crops under Surface Irrigated and Drip Irrigated Farms

Net Present Value (NPV)

The net present value of future returns was discounted using the prevailing rate of interest. The discounted returns from one hectare of grapes, ber and citrus (kinnow) were Rs 31520 (Rs.179040–147520) Rs 37050 (Rs. 6787—30820) and Rs 86300 (Rs.140500–54200), respectively, under furrow irrigated system. The NPV of drip irrigated grapes, ber and citrus (kinnow) orchard was Rs 98040 (Rs 225630–128490), Rs 60910 (Rs 98040–29030) and Rs 133840 (Rs.183380–49540), respectively. Higher NPV values on drip irrigated farms depicted its superiority over surface irrigation technology in the case of orchards.

Internal Rate of Return (IRR)

To find out the discount rate (IRR), the values were discounted till the difference between the discounted streams of returns and cost was reduced to either zero or minimum. The IRR values for grapes, ber and citrus under furrow method were 14, 22, and 24 per cent, respectively. Likewise the IRR values under drip irrigated for grapes, ber and citrus (kinnow) orchard were as high by 17, 28.5 and 29.0 per cent, respectively.

Benefit Cost Ratio (BCR)

At the assumed discount rate of 12 per cent, the benefit-cost ratios were found as 1:1.21 for grapes, 1:2.29 for ber and 1:2.59 for citrus under the surface irrigation system. The values of BCR for drip-irrigated orchards of grapes, ber and kinnow were 1:1.76, 1:3.73 and 1:3.70, respectively. The ratios were greater than unity on both surface- and drip-irrigated orchards for all the three crops; it showed that investment in orchards was economically viable. But higher ratios in drip irrigation indicated that more investment on drip irrigation should be encouraged.

Pay-back Period

The costs were fully recovered after the seventh year of orchard, indicating that the pay back period was seven years for all the selected crops under both the methods of irrigation.

Hence, based on these criteria, drip-irrigation technique was found economically more viable and cost-effective in comparison to the surface irrigated orchards. These findings are in consistent with those of Inamdar *et al.* (1996).

Table 4. A comparative status of NPV, IRR, BCR and pay-back period of fruit crops grown under furrow and drip method of irrigation

Particulars	Furrow irrigation method			Drip irrigation method		
	Grapes	Ber	Citrus (Kinnow)	Grapes	Ber	Citrus (Kinnow)
Net present value (NPV)	31522	37048	86310	98044	69013	133839
Net benefit cost ratio (BCR)	1:1.21	1:2.20	1:2.59	1:1.76	1:3.77	1:3.70
Internal rate of return (IRR)	14	22	24	17	28.5	29
Pay-back period, years	7	7	7	7	7	7

Conclusions

The sprinkler and drip irrigation techniques are water-saving, cost-effective and efficient in comparison to surface irrigation through flooding or furrow system. The higher values of NPV, IRR, and BC ratio indicate better economic viability of sprinkler and drip irrigation Thus, these techniques should be encouraged to make use of already scarce water resource most efficiently.

References

Inamdar, P.P., J.R. Pawar and D.L. Sale, (1996). Economic analysis of biwali drip irrigation unit for irrigated sugarcane crop in Maharashtra. *Bharatiya Sugar,* **22(4)**: 13-20.

Sankhayan, P.L. and I.P. Singh, (1985). Impact of surface and lift irrigation systems on the cropping pattern. *Economic Affairs, India,* **30(3)**: 201-209.

Wilson, P., H. Ayer and G. Snider, (1984). *Drip Irrigation for Cotton: Implication for Farm Profits*. Agricultural Economics Report Vol. 10, US Department of Agriculture. Washington D.C. 29 p.

Yamauchi, J. and W. Bui, (1990). *Drip Irrigation and Survival of Sugarcane Industry*. Research Extension Series. Hawaii Institute of Tropical Agriculture and Human Resource. No. 113, p8.