Economic Analysis of Tube well driven Sprinkler irrigation and Furrow irrigation for Agriculture in Haryana, India

LUHACH, M.S.*, MALIK, D.P.** AND PURAN MAL

INTRODUCTION

Water is the most precious natural resources for sustained development of agriculture and in turns the prosperity of a country. The demand for irrigation water to the fast growing agriculture is always outstripped the supply potential created under limited and uncertain natural precipitation. This highlights the need for judicious use of vital natural resource water in conjunction with all other essential inputs to enhance and sustain agricultural production.

In Haryana, irrigation and power were given top priority in the development plans since its inception of state in 1966 so as to develop agriculture at faster rate. The southern part (Hisar, Bhiwani, Mohindergarh, Rewari, Gurgaon, part of Jhajjar districts), which falls in arid and semi arid regions of the state, had been in the grip of chain of droughts due to scanty and erratic rainfall. The soil of this region is sandy and undulating but the land is productive. Furthermore, the groundwater is brackish and unfit for irrigation in most part of region. Therefore, the method of irrigation is an important aspect of better management. The sprinkler irrigation, which is water efficient, has been introduced in canal-irrigated areas of Southern Haryana in late seventies. This system of irrigation saves water and can irrigate much more area than surface irrigation. It also eliminates channels and land leveling and more land is available for crop production. This method is particularly suited to the region because of sandy soils having high infiltration rate. In Haryana, about 85 thousand hectare area is irrigated under this system of irrigation during the year 2004-05.The sprinkler system of irrigation being costly and most of the cultivators have only limited capital. Thus it is essential to investigate cost and benefits of this method of irrigation. Therefore, the study was conducted with the following objectives i) to determine installation and operating costs of sprinkler set,ii) to determine the effect of sprinkler irrigation on farm income and iii) to examine economic feasibility of sprinkler irrigation.

** Planning Officer/ Research officer, Department of Economic and Statistical Organization, Govt. of Haryana, Chandigarh.

* Research Scientist, Department of Agricultural Economics, CCS Haryana Agricultural University, Hisar-125004, India.

*** Ph.D. Student Justus Liebig University Giessen , Germany, Contact detail : puran78@gmail.com

METHODOLOGY

The sample design consists of the multistage sampling technique. For the selection of districts, a list of all districts of Haryana state was prepared having sprinkler sets. Bhiwani, Mohindergarh, and Gurgaon districts were selected purposively on the basis of having maximum number of sprinkler sets. From each selected district, one block having maximum number of sprinkler sets was purposively selected. Further, from each selected block, a selection of cluster of three villages was made subject to constraint of time and money for data collection. Finally, ten cultivators were randomly selected from each village to make a total of 90 cultivators. All the selected cultivators were personally interviewed with the help of well structured and pre-tested schedule to collect relevant information regarding installation cost of pump and sprinkler sets, labour & maintenance costs, electricity charges, area irrigated, cropping pattern, yield of crops etc. for the present study for the year 2003-04.

Analytical Tools: Fixed cost reflects the amount of capital investment in well, pumping unit, sprinkler set and prices of variable inputs such as labour, electricity charges, expenses required for pumping & distributing water. Maintenance costs consist of expenses incurred on repair and lubricant etc. The annual fixed costs consisting of depreciation and interest on investment. The following procedure was used for computing the annual fixed cost on the individual items.

$$\text{Depreciation} = \frac{\text{Original value} - \text{junk value}}{\text{Year of useful life}}$$

The useful life of tubewell/wells was taken as 30 years, Motor (engine) and pipe 15 years and the sprinkler heads 10 years.

The criteria for investment decision used in this study, net present value (NPV), internal rate of return (IRR), benefit-cost ratio (BCR) and pay back period as discussed below:

Net Present Value: Future net returns were discounted to their net present value by using the following formula**:**

$$NPV = \frac{R_1}{(1+r)^1} + \frac{R_2}{(1+r)^2} + \text{- - - - - - - - -} + \frac{R_{n-1}}{(1+r)^{n-1}} + \frac{R_n}{(1+r)^n}$$

Where, R_1, R_2,---------- ,R_n are the net returns in period 1, 2, -------,n, respectively; n is the life in years, r is the discount rate and NPV is net present value of returns R_1, R_2 ,---------, R_n.

Internal rate of return: The internal rate of returns was calculated at the rate of discount until it satisfies the relationship B-C=O. Where B is the sum of discounted streams of positive values and C is taken as the sum of discounted streams of negative values.

Benefit-cost ratio: The benefit-cost ratio is the ratio between the sum of discounted net benefits of returns (R) and the sum of discounted cost (K) i.e. B=R/K..

Pay back period: It is the period within which the cost of the sprinkler sets is fully recovered from its own returns. In other words, it indicates the number of years by which the net return (R) equals

$$\sum_{i=1}^{n} Ri = K$$

to the establishment cost of sprinkler sets, (K). For this condition, the following relationship must be satisfied.

Where, Ri is net returns in i th year, K is cost of sprinkler sets.

RESULTS AND DISCUSSION

Installation cost

Establishment cost: To establish a sprinkler set for irrigation a cultivator required tubewell/pumping unit and sprinkler set. It is evident that even without sprinkler, cultivators who install a tubewell have to incur cost of well, cost of motor, pumps and boring in well. The average installation cost of a sprinkler set worked out to be Rs. 1, 30,700.00. The installation cost of a sprinkler set (included the cost of main and lateral pipeline, cost of sprinkler heads and other accessories) was 42.28 percent of the total investment for irrigation on farm. Cost of well, **(**motor, pumps & boring in well) was found to be about 36.95 and 20.77 per cent of total installation cost of sprinkler set, respectively.

Working cost: The details of annual cost of pumpset and sprinkler irrigation are discussed in this part. The variable cost accounted for 65.51 percent while fixed cost was 34.49 percent of total working cost for pumpset (tubewell). Labour charges were maximum among constituents of variable costs i.e. 42.95 percent followed by electricity charges (15.93 %) and repair & maintenance of irrigation system (6.26 %). Among fixed costs, interest charges constituted 25.03 percent followed by depreciation charges (9.46 %) for pumpset irrigation. The total average working cost calculated Rs. 36160.00 and Rs. 47229.00 on tubewell and sprinkler irrigation, respectively.

Labour cost: On sprinkler irrigated farm, average irrigated area of 90 cultivators was found to be 9.65 hectares and total numbers of irrigation per hectare applied were 4.7 . The per hectare labour requirement for irrigation was 161.45 hours. On the other hand, average irrigated area on pump set was calculated to be 3.58 hectares and total number of irrigations per hectare was 3.54. The labour requirement per hectare for irrigation was 542.21 hours. The average per hectare cost of sprinkler irrigation was Rs. 4894.00 and per irrigation cost was Rs. 1026.00. The average variable cost per

hectare, per irrigation and per hour to run the sprinkler set was, Rs. 2308.00, Rs.484.00 and Rs.14.29.00, respectively**.**

Under pumpset irrigation, the cultivators have to prepare small plots for irrigation and have to employ labour 153 hours for per hectare per irrigation. The use of human labour per hectare per irrigation due to adoption of sprinkler irrigation declined i.e. 78.00 per cent.

Farm income

Average cost and income from crops grown on pumpset and sprinkler irrigated farms are discussed in this part. With the acquisition of the sprinkler set, the cultivators were able to bring 6.07 hectares additional area under irrigation as well as under cultivation. Net return from one hectare of land from crops was worked out to be Rs.2770.00 and Rs. 3311.00 under pumpset and sprinkler irrigation, respectively. Hence, the cultivator earned additional net return from 6.07 hectare as Rs. 20098.00. Thus, on average net return per hectare from sprinkler irrigation were found to be 19.53 percent higher than pumpset irrigation. It is evident that increase in irrigated area is only possible through introduction of sprinkler irrigation.

Economic Feasibility

The returns from pumpset and total cost per hectare came out to be Rs. 9918.00 and Rs. 14737.00, respectively. Annual cost of pumpset is more than return, thus net returns were negative. Hence pumpset method of irrigation was found uneconomical in he study area.

In case of sprinkler irrigation, the installment of loan (principal + interest) in all the situations, viz., when 25 per cent subsidy is given, interest is 12 percent and recovery period is 6 years or no subsidy given at same interest rate and recover period is 10 years, can easily be paid. But when no subsidy is given at same rate of interest and recovery period is 6 years then it became difficult for cultivators to repay the installment. Hence, cultivators can repay the due installment easily when the sprinkler sets are subsidized. While in case of non-subsidized, the recovery period should be enhanced to 10 years. Thus, subsidy plays a vital role in timely recovery of loan provided that no pilferages in disbursement of subsidy amount.

The economical feasibility of sprinkler set was examined on the basis of the various indicators viz., Net Present Value, Interval Rate of Returns (IRR), Benefit-Cost Ratio (BCR) and Pay Back Period.

The net present worth of future returns which are determined by discounting both the costs as well as returns. It is evident that total cost during the first year was Rs. 65206.00 while from 2 nd year to 10 th year, it worked out to be Rs. 9956.00. Benefits from sprinkler irrigation assumed to be

remaining constant throughout the period. Net benefits were deflated for each year separately at a discount rate of 12 percent. The net present worth of benefit is Rs. 7970.00 for sprinkler set at the end of 10 year.

Benefit -cost ratio for sprinkler set was found out to be 1: 1.978 . Since the B-C ratio was greater than one indicated that the investment in sprinkler is considered to be economically viable. The net streams of deflated negative costs and positive (benefits) returns were equated in the seventh year of installation of sprinkler set. Thus, the pay back period for sprinkler set was calculated seven years**.**

Return or positive values for net cash flow were Rs. 91278.00 and cost or negative values were Rs. 45108.00. Reducing them to a lowest minimum or to make them zero, a coefficient 'r' was found out 17.00 percent indicating considerably a higher rate of return.

Thus, the investment on sprinkler sets from all the angles was found sound and economically viable. Therefore, cultivators are advised for installation of sprinkler sets. Financial institution should make available the credit requirement at right time and place for the purchase of sprinkler sets. Subsidy on purchase of sprinkler sets must be continuing particularly for small and medium cultivators.

CONCLUSIONS

The analysis concludes that the average installation cost of sprinkler set worked out to be Rs. 130700.00. The cost of sprinkler sets was about 42.27 percent of the total investment for irrigation on farm. Further the results indicate that by pump set (tubewell) only 3.58 hectares of area was irrigated, but after acquisition of sprinkler sets, the irrigated area increased to about three folds and decline in labour use per hectare by 78 per cent. The average net returns per hectare from sprinkler irrigation were found to be 19.53 percent higher than pump irrigation. The pump set method (furrow irrigation) of irrigation was found uneconomical due to negative returns. Sprinkler method of irrigation resulted into an additional returns of Rs. 20098.00 from additional irrigated area i.e. 6.07 hectares. The economic feasibility criterion of net present value, internal rate of return, benefit cost ratio and pay back period showed that the investment on sprinkler sets was found sound and economically viable.

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