Feasibility Assessment of On Farm Water Harvesting Structures forLivelihood Security of Small and Marginal Farmers

ABSTRACT

The present study was taken up inthe black clay soil zone of Manthani mandal of Peddapalli district Telangana state in which series of on farm water harvesting structures were taken up by small and marginal farmers. The sizes of water harvesting structures, season wise cropping pattern, crop yields, cost of cultivation and net margins were collected from randomly selected farmers. Thereafter, techno economic feasibility of taking up water harvesting structures was assessed. The field study revealed that these structures are technically feasible and financially viable for effective rainwater harvesting, providing critical irrigation to crops, enhancing crop yields and cropping intensity,resulting in resilience to adverse effects of climate change and consequent improvement in livelihood security of farmers.

Key words: Techno Economic Feasibility, Water Harvesting Structure and Livelihood security

1. INTRODUCTION

India is the most vulnerable country to climate change in view of the fact that half of the population is depending on Agriculture and allied sectors (which are highly sensitive to climate change) for livelihood. In addition, rainfed area constitutes about 50% cultivated area of the country and contribute to about 40% of food production. The rainfed areas are plagued by severe land degradation, lack of access to irrigation, plummeting groundwater table, and poor state of soil organic carbon, moisture holding capacity and productivity, etc. Further, the adverse effects of climate change are compounding the persistent problems in rainfed areas, threatening the livelihood security of people.

To address the complex problems of rainfed farming, Government of India has been supporting soil and water conservation works as a part of watershed development and Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) in a big way. Among the different soil and water conservation works, water harvesting structures hold the promise of harvesting excess rainwater during monsoon period, facilitating protective irrigation to crops during the critical stage of crop growth especially during dry spells of Kharif season, paving the way for stabilizing the crop production and income of farmers in rainfed areas. In addition, financing by banks for water harvesting structures is an eligible activity as a part of water resource development under priority sector lending.

Improving the productivity, profitability and stability in rainfed agriculture is critical to achieving the goals of inclusive growth and enhancing farmers' incomes given the demographic and geographic importance of rainfed agriculture. Rainwater management through dug out farm ponds is an important part of strategy for enhancing productivity of rainfed agriculture [11]. Witha view to address the issues in rainfed farming and build resilience to climate change, farm ponds/water harvesting structures were supported in a cluster of rainfed villages in Manthani mandal of Peddapalli (erstwhile Karimnagar) district of Telangana state of India. The investment of scarce financial resources is justified if the water harvesting structures are economically viable [10]. Several researchers carried out economic viability exercise of water harvesting structures at different locations [2, 5, 7, 8, 9, 10, 11, 12 and 13]. Most common criterion adopted by researchers was generation of cash flows and evaluation of Benefit Cost Ratio (BCR), Net Present Worth (NPW) and Internal Rate of Return (IRR), etc., among others. In the present study, the same criterion was followedfor evaluation of economic viability of the investment on water harvesting structures.

2. MATERIALS AND METHODS

The water harvesting structures selected for study were in the fields of marginal farmers in Manthani mandal of Peddapalli district, Telangana state. Though the average annual rainfall in the study area is about 970 mm, but its uneven distribution and dry spells during crop growth period have been affecting crop yields and net returns of the farmers.In addition, severe soil loss due to high runoff resulting from intense storms during monsoon period(influenced by climate change)is also a major problem in the study area. The predominant soil type is clay soil in the study area.

The main crop grown in the region is rainfed Cotton (as mono crop). Most of the farmers in the study area are small and marginal and they belong to socially backward classes with poor economic condition. The change in the climate particularly intense rainfall and dry spells during monsoon as also lack of access to irrigation are severely aggravating the crop yields and net margins of farmers in the region. Looking at the nature of soil and requirement of farmers, chain of water harvesting structures along with other soil and water conservation works were supported as a part of watershed development programme for harvesting precious rain water for giving critical and supplementary irrigation to crops. A view of a water harvesting structure taken up in the study area is shown in Plate 1.

The sizes of water harvesting structures and cropping pattern(season wise) of eight randomly selected marginal farmers with similar landholding size were obtained. The crop yield, cost of cultivation and sale price of produce were obtained through interaction with farmers. Looking at the loose embankments and nature of soil, the economic life of structure was assumed to be six years. Also, for simplicity of calculations it was assumed that the cash inflows and outflows took place at the end of the year. Further, the incremental cost due to structure, additional labour cost for irrigation and maintenance of structure were considered for assessing the financial viability of investment on water harvesting structure. Though the silt trap is provided in the design of water harvesting structure, the cost of silt removal at the rate of 10% of cost of water harvesting structure was considered from the second year of operation of farm pond.

Plate 1 A view of a water harvesting structure

The net incremental returns due to the introduction of farm pond were worked out based on the collected field data. Thereafter, year-wise incremental cost and returns (i.e.cash flows) were generated and financial parameters namely BCR, NPW and IRR were determined by using library functions available in MS-Excel.

3. RESULTS AND DISCUSSSION

The season-wise crops grown, area under each crop, yield, cost of cultivation, and income in pre and post-development of water harvesting structuresare given in Table 1. These are the average values of eightselected farmers. In addition, the net incremental income because of water harvesting structure is presented in Table 1. The sizes of structures varied from 10x10x3 m to 25x25x3 m.As the soil is predominantly clay, it was observed that there was ample runoff available for rainwater harvesting, proving the technical feasibility of the investment.

In the pre-developmental stage (i.e. beforethe excavation of water harvesting structure) the farmers grew Cotton as rainfed *Kharif* Crop. In the post-development stage (i.e. after the excavation of water harvesting structure) the farmers followed the cropping pattern of Cotton (Kharif) and Chickpea (rabi). The water harvesting structures were found to be filled to its full capacity by the middle of August month. The farmers gave critical irrigation to Kharif Cotton cropduring dry spells, if any. On an average the yield improvement is by 35% in the post-structure scenario. The farmers were found to grow chickpea as second crop. The farmers gave irrigation at pre-and at flowering (45 days after sowing) stage of chickpea crop.

It was observed that with the excavation of water harvesting structure,on an average an area of 2 % of land holding size was lost for the pond (including berm and embankments), but the farmers could grow Chickpea as rabi crop. The cost of irrigation was also taken into account in the cost of cultivation of crop in the post developmental stage, while assessing the financial viability. With the increase in cropping intensity to 148% after excavation of water harvesting structure, the profit to the farmer was found to increase from Rs. 39000/- to Rs. 79680/-, leading to net incremental return of Rs. 40680/year (Table 1 and Fig. 1). Change in cropping pattern and cropping intensity as also increase in productivity and profitability of farmers, who took up farm ponds/water harvesting structures were reported by several researchers [1, 3, 4, 6 and 13] across different parts India. The present study also corroborated the similar findings as presented in Table 1 and Fig. 1.

Table 1 Details of cost, income, and incremental income (pre and post-development stage)

Amount in Rs.

Stage/season /crop	**Area (ha)**	**Yield (q/ha)**	**Total yield (q)**	**Cost of cultivation (Rs./ha)**	**Sale price (Rs./q)**	**Total income (Rs.)**	**Total cost of cultivation (Rs.)**	**Profit (Rs.)**
Pre-development								
Kharif								
Cotton	1.2	15	18	80000	7500	135000	96000	39000
Rabi								
No crop	0	0	0	0	0	0	0	0
Sub-Total (A)								**39000**
Post-development								
Kharif								
Cotton	1.176	19	22.344	87500	7500	167580	102900	64680
Rabi								

Chickpea	0.6	10	6	15000	4000	24000	9000	15000
Sub-Total (B)								**79680**
Net incremental income (B-A)								**40680**

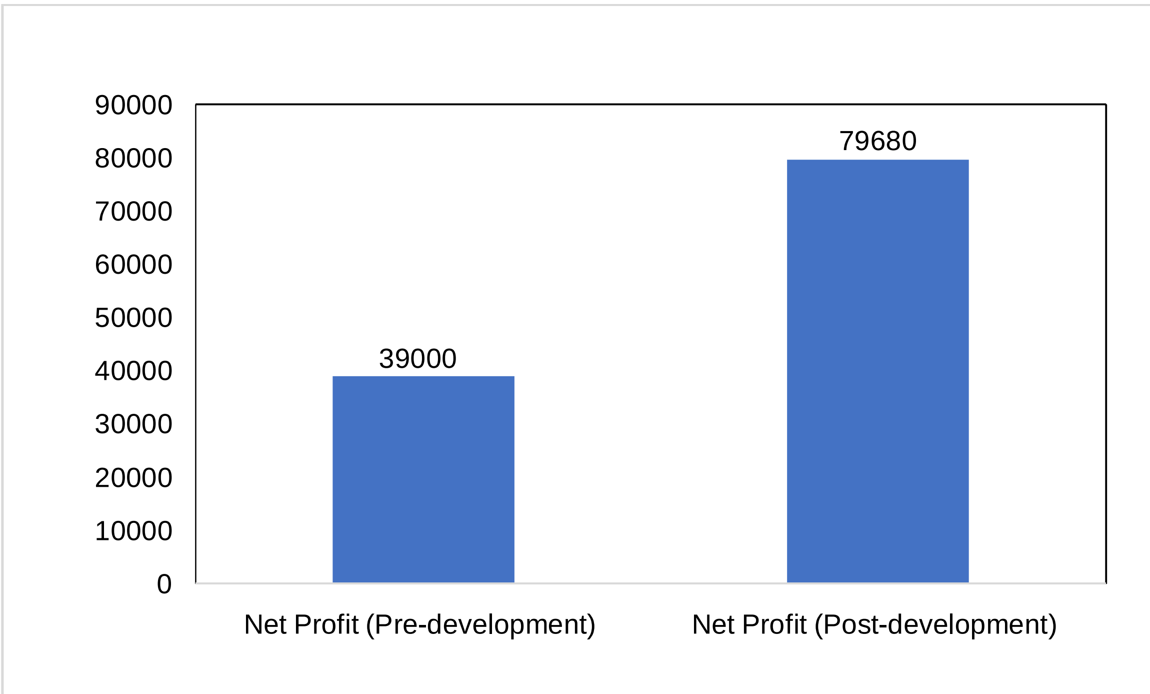

Fig. 1 Net Profit (in Rs.) during Pre and Post Stages

The year wise cash flows (i.e. incremental cost and returns) assuming the economic life of water harvesting structure as 6 years are presented in Table 2. The evaluated financial parameters, NPW, BCR and IRR are also furnished in Table 2.

Table 2 Financial parameters

Years	**1**	**2**	**3**	**4**	**5**	**6**
Cost (Rs.)	55000	5500	5500	5500	5500	5500
Benefit (Rs.)	40680	40680	40680	40680	40680	40680
Net benefit (Rs.)	-14320	35180	35180	35180	35180	35180
Present worth of cost (Rs.)	47826.1	4158.8	3616.3	3144.6	2734.5	2377.8
Present worth of benefit (Rs.)	35373.9	30759.9	26747.8	23258.9	20225.1	17587.1
Net Present Worth (NPW) at 15%DF	90094.6					
Benefit Cost Ratio (BCR)	2.41					
Internal Rate of Return (IRR)	>50%					

It can be observed from Table 2 that the BCR is greater than 1, the NPW is positive at 15% discounting factor and IRR is more than 50%, justifying the financial viability of the investment on water harvesting structure, thus ensuring livelihood security of farmers duly contributing to improved resilience to climate change. The results are also in conformity with those reported by researchers [7&11] for the adjoining Adilabad district(with deep black soils) of Telangana state. The income gains and consequent high financial viability of investment have resulted from the improved crop yields, change in cropping pattern, and increase in the cropping intensity. Further, the study also revealed that there is an imminent need for regular de-siltation and maintenance of water harvesting structures for getting the benefits over a long period of time.

4. CONCLUSION

The adverse effects of climate change are posing serious threat to water resource availability especially in the rainfed areas of the country. Based on the field based feasibility study, it is concluded that water harvesting structures are technically and financially a viable solution for enhancing the crop production and yields, cropping intensity and profitability of farming in the rainfed areas. Further, the present study clearly established that there is enormous potential for rainwater harvesting in black clay soil zone of Manthani mandal of Peddapalli district Telangana state for promoting climate resilient and sustainable agriculture, thus ensuring livelihood security of small and marginal farmers in the area in the face increasing evidence of adverse climatic conditions.

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