SHIFT FROM SITE DEVELOPMENT TO SKILL DEVELOPMENT: A CASE STUDY OF WATER HARVESTING THROUGH MICRO CATCHMENTS

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ABSTRACT:- The present study was conducted to get insight about farmers' intention towards adoption of micro catchments as a useful tool for rainwater harvesting. The assessment of acceptability and compatibility of the intervention through farmers' perceptions, feed-back, practices and intentions regarding up-scaling the technology would develop the up-scaling and sustainability options for wider area. Under Watershed Rehabilitation and Irrigation Improvement Project besides other technologies, rainwater harvesting through micro catch-ments were demonstrated by Soil and Water Conservation Research Institute (SWCRI) in Pothwar area, Pakistan. The results highlight that the technology is not only suitable for in situ water conservation for fruit plants but also cost effective, water, labor and resource saving along with farmer friendly under rainfed condition with scare supplemental water availability. The cost of adoption of technology including labor charges for its preparation and maintenance was recovered from irrigation cost saved from single rainfall at the demonstration site. One of the important implications drawn in this regard was the need of a shift from site development to skill development. The same was derived as an important recommendation during assessment and evaluation of different demonstration and dissemination activities being conducted under Watershed Project. This shift could catalyze the technology adoption.

Key Words: Fruit Plants; On-farm Condition; Micro Catchment; Water Harvesting; Pakistan.

INTRODUCTION

The increasing population particularly in Asia has put a lot of pressure on the existing land resources to meet the food demands. Similarly the growing cities have also swallowed good agricultural lands available around them. With the increasing demand for non-agri-cultural uses along with little chances of expansion there is a need to exploit the potential available in arid and semi-arid regions to minimize the land scarcity (Hudson, 1987). However, precipitation is generally lower than potential evaporation. It is mostly non-uniform in distribution that results in frequent drought periods during the crop growing season. Usually the rains come in intense bursts resulting in surface run-off and uncontrolled rill and gully erosion (Oweis and Hachum, 2009). There-fore, there is a need of a more efficient

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capture and use of the scarce water resources in arid and semi-arid areas. An optimization of the rainfall management, through water harvesting in sustainable and integrated production systems can contribute for improving the small-scale farmers' livelihood by upgrading the rainfed agriculture production (Ibraimo and Munguambe, 2007).Water shortage is the major constraint in any area, which could aggravate due to seasonal patterns, variation and irregularity in rainfall that may influence water supply and periodic droughts in the area (Lone and Hassan, 2002). The Pothwar plateau has undulating sloping topography causing loss of soil and water (Ullah et al., 2009) and about 4.2 billion cubic meter of water is lost from this plateau as surface runoff annually (Bhutta, 1999) which if properly utilized could help to improve the crop productivity and improve resilience in the area. Small water harvesting technologies and other water related technologies and interventions have been useful in effective water use efficiency for improving livelihood in the area.

The concept of rain water harvesting is a process of collecting and concentrating precipitation from various forms of run-off for various beneficial uses (Oweis and Hachum, 2009; Critchley et al., 1991). The rainwater harvesting mechanism using different techniques covers a whole range of methods of collecting and concentrating various forms of run-off (Reij et al., 1988). It is a method of collecting surface runoff from a small catchment area and storing it in the root zone of an adjacent infiltration area (Cofie et al., 2004).

The present study was conducted to look at the short term effect and get insight about farmers' intention towards adoption of micro catchments as a useful tool for rainwater harvesting. The comparison of cost and benefits as realized from the on-farm demonstrations by the farmer-host- farmer would help to evaluate the economic viability of the technology. The assessment of acceptability and compatibility of the intervention through farmers' perceptions, feedback, practices and intentions regarding up-scaling the technology would further help to develop the up-scaling and sustainability options for wider areas.

MATERIALS AND METHOD

Under Watershed Rehabilitation and Irrigation Improvement Project besides other technologies, rainwater harvesting through micro catchments were demonstrated by Soil and Water Conservation Research Institute (SWCRI) in Pothwar area, Pakistan. Pell Farm was one of the demonstration sites for this technology. The site was selected as case study because the intervention was replicated and adopted by the farmer at large scale. The selected farm did not have any irrigation source and water for plants hauled from a distant source. Hence, irrigation expenses were comparatively higher. Farmer used to pay all the cost of pumping, transportation and then application to plants and had better information on cost of water before and after the intervention and hence could provide more accurate and reliable information. This was the second important reason for selecting this farm as case study. Case study is an ideal methodology when a holistic, in-depth investigation is needed (Feagin et al., 1991).

Therefore, for current work case study methodology was employed. A case study is expected to capture the complexity of a single case, and the methodology which enables this has developed within the social sciences (Johansson, 2003). The case study is defined by interest in individual cases, not by the methods of inquiry (Robert, 1998). The case may be a relatively bounded object or a process; it may be theoretical, empirical, or both (Ragin and Becker, 1992). As in all research, consideration must be given to construct internal and external validity, and reliability (Yin, 1989). Several discussions were conducted with the host farmer related to the development of the process right from site selection, initial dialogue with the farmer, demonstration and technical interaction between farmer and the technology providers (scientists). This process was performed to increase reliability and validity. Therefore, to develop abdicative reasoning from a few facts and for making appropriate comparisons from the known cases and applying to an actual problem situation both “evidential paradigm” (Ginzburg, 1989) and naturalistic generalisation (Stake, 1995) were considered. The results and discussion are based on the assessment, perception and memory recall, based on the experiences and practices of the farmer over the time of technology demonstration and adoption at the individual farm in real life situation. The actual costs paid/saved and benefits realized under farmer field conditions are used to generalize the results for similar conditions in the overall recommendation domain of rainfed Pothwar. The scope of paper is limited to the socioeconomic aspects only. Therefore, the technical part regarding design, shape and measurements for water requirement or command area requirement etc., are not discussed.

RESULTS AND DISCUSSION

The selected farm is located in Tehsil Kallar Kahar, District Chakwal on old road from Kallar Kahar to Chakwal. It is about 75 acres sub-hilly and sloppy land. The farmer has started to establish it since 7 years. There was no proper farming or plantation except naturally grown plantation at this area. Arable farming was not possible due to undulating topography of the farm area. Therefore the farmer planted different kinds of fruit plants at the farm. At present, more than 11,000 different fruit plants of olive, citrus, apple, fig, beri and pomegranate are grown at this farm.

At this site, three technologies namely; micro catchment, drip and bubbler irrigation for fruit plants were demonstrated in 2012 under the Watershed Project. Out of total plants drip irrigation was demonstrated for 350 plants while bubbler for 150 plants. Whereas, all other plants were irrigated through moveable pipe manually that needed lot of resources both in terms of cost of hauling water and labor. Before the intervention of project, farmers were spending a lot of energy, and manpower to irrigate these fruit plants and bear heavy cost for irrigation. The nearby water source was about 10 km away. Water was hauled through tanker driven by tractor and market rate for each tanker was Rs. 900. The farmer who had his own tanker and tractor, still had to pay Rs. 175 per tanker to get water (fill the tank from water source) and cost of diesel was about Rs. 450 per tanker. On average water hauling cost was about Rs 5.80 per plant. From this point forward to irrigate plants electric or diesel pump was used to lift water for pipe irrigation. The labour cost was about 1 rupee per plant per irrigation. On an average after every two weeks one irrigation is done. So during the peak summer season application of water to all the plants was quite difficult.

Watershed project team provided viable alternative solution and introduced the micro catchments technology in 2011 to conserve the rainwater for the fruit plants. The initial demonstration was done with 20 micro catchments. The project team besides developing demonstration site also disseminated the information to farmers. Proper guidance about the design and layout of micro catchments was provided to the farmer during demonstration site development. The host farmer was invited to participate in professional and agricultural service providers training programmes under the project. This demonstration and interaction changed the mindset of the farmer and after first rainfall 2500 micro catchments were added during the first monsoon season of 2013. The conditions of plants also improved and subsequent irrigation within micro catchments was easy and useful for water utilization. Now nearly 11,000 micro catchments had been developed. The average cost of preparing one micro catchment resulted in Rs. 6.36 as one laborer could prepare 50 micro catchments in one day. The repair and maintenance (R&M) was required after every three months and costs about Rs.4.77 per catchment per year. Total initial investment was 70,000 at the farm and additional 52500 against repair and maintenance per year for 11,000 plants.

According to farmer experiences and perceptions during monsoon season there was very little difference in water saving before and after the situation. However, normally there are additional 6-7 rains, during the year in addition to monsoon season. Therefore, comparative analysis was done for this time period and number of rains. Minimum saving was equal to the cost of one irrigation whereas the higher intensity rains might save upto the cost of two irrigations. Farmer was paying about Rs 9.11 plant^{-1} irrigation^{-1}. Farmer believe that not only this technology is cost saving, but also saves water, labour, energy and his own time. According to cost estimate net saving per plant was Rs. 43.53 per annum during the first year and almost Rs. 50 from second year (Table 1). The condition of plants also improved. Overall it is considered good for all types of plants but more beneficial for those plants whose water requirement was high like citrus, pomegranate and apple. The saved water and resources were diverted to growing vegetables (pumpkin) at the furrows/boundaries of the catchments which gave farmer additional income. The benefits of such water harvesting techniques have been reported from Balochistan (Rees et al., 1991) and there are also success stories from Egypt (Perrier, 1988), Tunisia (Ennabli, 1993; Ben Mechlia et al., 2009), Morocco, (Kutsch, 1983), China (Yuan et al.,

Table 1. Cost benefit analysis of micro catchments at the Watershed Project site

Indicator	Estimates
Total micro catchments (No.)	11000
Initial preparation cost (Rs. micro catchment^{-1})	6.36
Maintenance/annum cost (Rs. micro catchment^{-1})	4.77
Total cost during 1st year (Rs. micro catchment^{-1})	11.14
Irrigation cost (Rs. irrigation^{-1} plant^{-1})	9.11
Diesel (Rs.)	2.36
Water hauling cost (Rs.)	5.80
Labor cost (Rs)	0.95
No. of irrigation saved per year	6-7
Net saving (Rs. plant^{-1}* for 1st year)	43.53
Net saving (Rs. plant^{-1}* annum^{-1} for 2nd year onward)	49.89

** one micro catchment is prepared for each plant separately*

2003). In addition to direct benefits in terms of improved productivity and resource saving other indirect environment and conservational benefits are also reported in literature.

The target farmer, as manager of the farm, is also working as agriculture service provider. The technical knowledge improved through interaction with the project team from SAWCRI has also targeted the skill development beside the site demonstration. Spillover effects are also reported as some other farmers are now replicating this technology at their own expenses including Jalil Farm.

CONCLUSION AND RECOMMENDATIONS

The systematic demonstration, follow up and engaging farmer in different training and dissemination activities not only helped to improve his knowledge, trust, skills and interaction but also made farmer a change agent for extension and promotion of technology. The shift in focus from demonstration site development to skill development resulted in adoption and investment of resources by the farmer himself. The farmer has also started motivating other neighboring farmers having similar plantation and spillover effects are being observed in two years.

The results indicated that cost of input and initial investment along with the scale of business further catalyze investment in technology adoption subjected to systematic technology demonstration and dissemination strategy. It is therefore, recommended that:

- Site selection for demonstration should fulfill this requirement.
- Engagement of farmer and follow up to develop ownership based on skill development and imparting knowledge be targeted.
- A paradigm shift from site development to skill development is required for sustainable technology transfer.

- The linkages developed by engaging farmer in different dissemination activities would help to sustain such activities in a dynamic fashion and would make farmer able to modify the technology with technical backup from research system.
- For up scaling the technology at wider scale all stakeholders should be involved in planning, designing, implementation not only at demonstration site but also other knowledge sharing and training programmes for each technology.

ACKNOWLEDGEMENT

Financial support from USDA under Watershed Rehabilitation and Irrigation Improvement Project: Demonstration and Dissemination of Best Practices and Technologies to Help Rural Farmers and technical support by ICARDA for conducting this research and development activity are highly acknowledged.

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(Received April 2014 and Accepted September. 2014)