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Impact Of Watershed Treatment On Groundwater Recharge In Southern India- An Analysis

M. Shivamurthy, G. Eswarappa and N.N. Swaroop
University of Agricultural Sciences, Bangalore, India
Murthy_sandhya@yahoo.com

Abstract

The study was conducted in Eastern Dry Agro-climatic zone of Karnataka, India. The Participatory Rural Appraisal (PRA) mapping of watershed to incorporate the water harvesting structures and different type of irrigation wells is developed to choose sample farmers. Field measurement of the 36 bore-wells of sample farmers within and outside the watershed area was estimated during the field work. The results of the study reveals that after Watershed Development Programme(WDP) the net irrigated area increased by 26 percent from 4.94 to 6.24 acres. Outside WDP area, the net irrigated area decreased marginally by 4 percent. In the WDP area, the proportion of working wells increased from 71 percent to 85 percent as the proportion of the failed wells declined from 29 percent to 15 percent. In the WDP area, yield of dug well increased by 70 percent from 264 gallon per hour to 446 gallon per hour due to the recharge effect from water harvesting structures. The ground water extraction by the farmers in the up stream was 25 acre inches before the programme implementation and increased by 216 percent to 79 acre inches. In the down stream the extraction increased by 72 percent from 71 to 122 acre inches. The gross area devoted to water intensive crops like paddy and sugarcane increased from 33 acres to 114 acres in WDP area, while it declined from 30 to 26 acres by 13 percent outside WDP area. There is inequity to the access for the ground water as 15 percent of the farmers have access to 25 percent of the ground water, incurring 17 percent of the irrigation cost and realizing 24 percent of the net returns. Within WDP area, the top 12.5 percent have access to 11 percent of the ground water, incurring 14 percent of irrigation cost and realizing 7 percent of the net returns. The irrigation intensity and cropping intensity of the WDP area increased by 8 and 19 percent respectively after programme implementation because of recharge effect of water harvest structures

Introduction

Groundwater resource for irrigation is nature's benediction to agriculture in the Hard Rock Areas (HRA) of southern India where the hydro-geo-morphological features are not as favorable as in the alluvial plains of Gangetic basin, for recharge. HRAs in the India constitute at least 60 per cent of the total geographical area. Many tend to think of groundwater as underground lakes or streams or as fossil water, which are extremely rare. Groundwater is simply water filling spaces between rock grains or in cracks and crevices in rocks. The rock layer that yields sufficient groundwater is called an aquifer. Groundwater is not present all the way to the core of the earth. At some depth beneath the water bearing rocks, the rocks are watertight. Obviously the volume of water held depends upon the ratio of open space to total volume (porosity), Chndrakanth and Arun, 1997.

Irrigation is critical input in agriculture from the point of view of food security in India. The advantage of groundwater use in terms of quality and volume has encouraged farmers to enhance area under cultivation of groundwater intensive crops. With the inherent economic, institutional, agronomic and environmental disadvantages associated with surface irrigation, groundwater is emerging as an indispensable resource for irrigation. In this regard, it is in order to note that the volume and quality of groundwater for irrigation is highly location specific as it depends on the hydro-geological topographic, economic and agro-climatic factors. The occurrence of groundwater in the hard rock areas is uncertain and it is some thing like gambling. One of the apparent truth is that the surface water bodies in the vicinity largely influence the volume of groundwater. All these factors regarding scarcity as well as indispensability of water resources, calls for a need for its conservation through watershed management.

In areas where access to surface water is limited and where access to ground water is significantly a function of recharge, watershed development programs provide rich opportunities of augmenting groundwater resources. As groundwater has been the only source of irrigation in the hard rock areas devoid of surface irrigation sources, farmers in these areas are extracting and exploiting groundwater. This is leading to well interference and further on to premature and initial well failure. In this situation, the role of watershed development to offset the cumulative interference is crucial.

Methodology

Basavapura micro watershed situated in the Eastern Dry Zone of Karnataka in southern part of India was purposefully selected to assess the dynamics of access to water resource for irrigation in the context of watershed development. Untimely, uncertain and uneven distributed rainfall has compelled the farming community to develop and manage groundwater resources. Augment the groundwater recharge through rainwater harvesting programs is being taken up under State and Central Government Schemes.

The Participatory Rural Appraisal (PRA) mapping of watershed to incorporating water harvesting structures and different types of irrigation wells was developed to choose 40 sample farmers spread over in three villages. In order to measure the effect of watershed activities in augmenting groundwater recharge in the adjacent parts of outside watershed, 20 farmers were chosen, who are located two kilometers away from the boundary of the watershed as a control.

The life and age of the irrigation wells were estimated by using the 'life tables' as in statistical theory. Life of irrigation well refers to the number of years a well has already functioned. Measurement of output of water from twelve sampled bore wells in each village considering different pipe sizes and water yield pressures were made to measure water yield increase due to watershed effect after the program implementation. The historic cost of well including cost of divining/lining/casing at the time of construction or sinking is compounded, from

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the year of construction to the year 2004 for functional and non-functional wells. This was done to estimate the total investment made by farmers in irrigation at 2004 prices. Water used in each crop was calculated in acre-inches.

Results and Discussion

Changing in holding size and bore-well command within and outside Watershed Development Program (WDP).

The average holding size in the watershed prior to the initiation of watershed development program was 7.79 acres, of which 4.94 acres (63%) was irrigated, 1.98 acres (26%) was rainfed and the remaining 11 per cent was cultivable waste. As a result of WDP, the average holding size increased marginally to 8.1 acres. A total of 9.5 acres have been newly purchased after program implementation due to the prospect of access to water resource. Out of 8.1 acres, 6.24 acres (77%) was irrigated by wells, 0.97 acre (12%) was rainfed and the rest 0.89 acre (11%) was cultivable waste. However, farmers in outside the watershed, the average holding size of 6.35 acres remain the same before and after the WDP.

After the WDP, the percentage increment of net area irrigated for large and small farmers was 23 and 36 per cent, respectively, and the net area irrigated increased by 26 per cent from 4.94 to 6.24 acres.

Yield of wells within and outside WDP

Among the nine dug wells, which were completely dried up before the program, four wells got recharged. The average yield of bore well was 1150 Gallons Per Hour (GPH) before the implementation of WDP and it increased to 1426 GPH by 24 per cent. The average yield of dug wells before WDP was 264 GPH and increase to 446 GPH. Where as out side the WDP area the average yield of bore wells was 1470 GPH before WDP and decreased to 1242 GPH (15%).

Cropping pattern within and outside WDP

Shifting of cropping pattern towards light or relatively low water intensive crops is the most fundamental coping mechanism available to farmers as the first best solution to cope with scarce water resource for irrigation. Cropping patterns are compared before and after the WDP, within and outside watershed areas. Considering both within and outside WDP areas, the gross area devoted to water intensive crops like paddy and sugarcane increased from 33 to 114 acres (245%) in WDP area, The reverse trend was observed in outside WDP area due to groundwater depletion, while it declined from 30 to 26.5 acres (12%) outside WDP area. Farmers outside WDP are coping with groundwater scarcity by shifting from paddy to relatively low water user crops like maize.

Irrigation Intensity and Cropping Intensity.

Irrigation intensity and cropping intensity with in watershed increased by 8 and 19 per cent before and after program implementation because of the recharge effect of wager harvesting structures. The irrigation intensity and cropping intensity of small farmers was 225 per cent and 216 per cent, respectively, and this is higher by 30 per cent and 35 per cent compared with the irrigation intensity and cropping intensity of small farmers outside WDP area. This shows that, access to water resource for irrigation is enhanced by the influence of recharge through water harvesting structures in the watershed.

Conclusions

Contribution of watershed treatments to groundwater recharge dampens the negative economic externality, due to well interference. The watershed development with an emphasis on ground water recharge can be recommended. There was considerable improvement in average increase in land holding, access to irrigation water, cultivation of water intensive crops and irrigation and cropping intensity among the farmers in the watershed. Hence, there is a need to implement this approach in all the dry tracts of the country. Also, the watershed treatments contribute to the groundwater recharge, considering the sustainability of watershed, farmers should be educated to maintain the water harvesting structures like, chekdams, ravine reclamation structures, rubble field checks etc,.

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