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# Impact of Watershed Management on the Groundwater and Irrigation Potential: A Case Study

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***Abstract*— Explosion in population, has led to increase in demand of various natural resources, including that of the most precious resource-water, especially for irrigation and agricultural purposes. Over exploitation of water resources affects the ecology of the region and affects the sustainability. Thus, a judicious use of water resources, especially in semi-arid and rural areas of India calls for good watershed management practices and implementing it in a watershed/micro-watershed. This paper highlights the impact of watershed management on the ground water and irrigation potential of micro watershed of K.Puthukottai, in Dindigul District, Tamilnadu state of India. Different types of watershed treatment activities such as soil and moisture conservation measures (e.g. water absorption trench, continuous contour trench, field bunding) were undertaken in private agricultural lands. All the above measures have contributed to an increase in area under irrigation and crop diversification. The survey carried out revealed that water levels in open wells in the area had risen in the range of 0.6 to 7.4 meters (average being 3.9 meters). Further, the studies have shown that the duration of water availability in wells has increased from four months to nine months after the introduction of water harvesting structures. All these indicate that there a positive impact of watershed management practices on the groundwater and irrigation potential of the area. It is anticipated that continued implementation over prolonged periods of time, may led to sustainability of the watershed.***

***Keywords:*** **Watershed Management, Groundwater Potential, Irrigation Potential, People's Participation.**

## I. INTRODUCTION

A 'watershed' which is an independent hydrological unit can be defined as the drainage basin or catchment area of a particular stream or river. Simply stated it refers to the area from where the water to a particular drainage system like river or stream comes from. It can be defined at various levels, at a macro-level (district or regional levels), at village level (hundreds or thousands of hectares), at farm level or even within the farm. The micro-watershed concept (i.e. watershed area less than 1500 ha, according to NABARD (National Bank for Agriculture and Rural Development) watershed development fund guidelines, 2006), aims to establish an enabling environment for the integrated use, regulation and treatment of water and land resources of a watershed based ecosystem to accomplish the objectives of resource conservation and biomass production (John Kerr, 2007). One of the definitions of watershed management is 'the process of creating and implementing plans, programs, and projects to sustain and enhance watershed functions that affect the plant, animal, and human communities within a watershed boundary'. In spite of sufficient rainfall in several part of India, people have to depend on tankers for their domestic water supply during summer. This is mainly due to large improper management of not only water resources of watershed, but that of a region (Swami et.al, 2011). The Indo-German watershed development programme (IGWMP) is an integrated programme for rehabilitation of watersheds and for the regeneration of natural resources. The programme is implemented by the village watershed committees (VWC- a body nominated by villagers), in association with Non-Governmental Organizations (NGOs). IGWMP which was operationalised in December 1992 under 'bilateral aid agreement' between the Germen and Indian Governments, was visualized and initiated in 1989, by Fr.Hermann Bacher of Social Centre, Ahmednagar, who is regarded as the guiding spirit behind the above programme. (The Indo-German Watershed Development Program, Maharashtra, 2009). The key to the success of any watershed project and its sustainability depends on people's participation. For achieving the desired participation of people, the roles of community organizations, groups and other stakeholders are crucial. Local people must play an active role starting from the project design, and then on to implementation and maintenance. In this context, a participatory watershed management approach is considered as ideal for achieving food security and sustainability (Budumuru Yoganand et.al, 2006). Government of India (GOI) has accorded a very high priority to the holistic and sustainable development of rain fed areas. Specific thrust is given for rain fed areas in all major schemes of Ministry of Agriculture, GOI. Rainfed Area Development Programme (RADP) introduced in the year 2011-12 as a sub-scheme under Rashtriya Krishi Vikas Yojana (RKVY), is being implemented in 10 States with an outlay of about Rs.250 crore for productivity enhancement and augmenting family income through alternate production systems. Besides, watershed development programmes are being implemented for the development of rain fed and degraded areas based on concept of natural resource conservation. The National Rain fed Area Authority (NRAA) was set up as an expert body in November, 2006, to provide knowledge inputs regarding systematic up-gradation and management of country's dry land and rainfed agriculture. NRAA is assisting the various States of India, in the preparation of States-specific perspective plans for the development of rainfed areas. The net sown area in India is about 141.36 million hectare (Mha)

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(2008-09), of which 78.17 Mha (about 55%) is rained. Water resources management is an essential component of sustainable development as economic development is traditionally accompanied by increase in water-use. Proper watershed management entails triple benefits to human beings, namely (i) maintains the productive capacity of natural resources in the watershed area; (ii) arrests the degrading processes: (iii) more cost-effective than rehabilitation of degraded watersheds. Watershed development programmes mainly aim to generate such activities, which would have *in situ* conservation of as much precipitation as possible in the soil profile, and collection, storage and reuse of such harvested water according to land capabilities. The ultimate purpose of development of a watershed is to increase the economic and social well being of the participants of the basin in particular, and that of the nation as a whole (Jesy Thomas, 2009). Rainfed agriculture in India is characterized by low productivity, degraded natural resources and widespread poverty which made the development planners to implement productive, environmentally sustainable, socially equitable, land and water management (Joshi et al. 2008). It is in this context, the concept of watershed development has been introduced in India. Watershed development has been conceived basically as a strategy for protecting the livelihoods of the people inhabiting the fragile ecosystems which have been experiencing stress on the moisture held in the soil. The aim has been to ensure the availability of drinking water, fuel wood and fodder and raise income and employment for farmers and landless laborers through improvement in agricultural production and productivity (Wani et al.2008). In view of the above importance, it is imperative that 'watershed management' practices are the implemented at various levels starting from micro-level and their impact assessed scientifically. India has to go a long way in the above respect. Considering the above importance a micro watershed was chosen as a case study with respect with the following objectives: To assess the impact of the watershed management activities on**:**

(i) The ground resources, especially on the water levels in the open wells.

(ii) Impact on the Irrigation and agricultural productivity.

## II. DETAILS OF CASE STUDY

### *A. Study Area*

K.Puthukottai watershed is situated in Reddiarchatram block of Dindigul District, Tamil Nadu, and India. It covers an area of about 1218.50 ha .The study area lies between 77'55'15'' latitude and 77'47'5'' longitude. The inhabitants of K.Puthukottai watershed depend on agriculture for their livelihood. Devar hills are the ridge point of the watershed. There are many gullies flowing from Devar hills towards the valley. Athimadai odai, Palam puthu odai and Kolipannai odai are the important gullies in the watershed.

### *B. Methodology*

The study was conducted during 2012 in K.Puthukottai village of Reddiyarchatram block of Dindigul district. From the village, a list of beneficiaries having land under watershed area was prepared, by collecting data, namely:

**(i) Observation and discussion from local farmers**: An informal discussion/interview was held with the local farmers to collect data which included the questions like: (1) Do you have any idea about watershed management? (2) What type of watershed treatment structures are provided in your land? (3) Do you observe any change in your land after the watershed treatments? (4) Do you have any benefits from watershed management? (5) What is the present land use pattern? (6) What is the present cropping pattern? (7) How much is the yield from the present agricultural activities? (8) What is your present income? From the answers to such questions the generated benefits, if any, by watershed treatments was assessed.

(ii) **Well inventory survey**: Totally 25 wells are selected for the well inventory survey. Based on the survey the details like total depth well, water level in the well and operating hours of the well were collected.

(iii) **Land use survey:** The present land use pattern and changes in land use pattern due to watershed treatments activities, were collected from land records and field survey.

(iv) **Cropping pattern survey:** The present cropping pattern and changes in yield due to watershed treatments activities were also collected from field survey. Data thus collected was then analysed to draw critical observations and salient conclusions.

## III. RESULTS AND DISCUSSION

### *A. Benefits of Watershed Treatments*

Watershed treatments were mainly targeted towards soil and water conservation. The study also discussed the impacts of these treatments on land and water related benefits to farmers. Out of 50 irrigated farmers, 30 farmers reported that their uncultivable small land have been converted into cultivable land due to project treatments. Farmers owning land from both irrigated and non irrigated category reported a remarkable increase in soil moisture after the farm-based treatments. Most of the farmers who own irrigated lands reported increase in area under irrigation, water for irrigation and groundwater level. As the availability of irrigation facility is the major factor in cultivation, most benefits of increased water availability in the village are captured by farmers who own irrigation sources. On the other land, increase in soil moisture is the only major benefit of the watershed treatments reported by farmers owning non-irrigated lands.

### *B. Changes in Availability of Irrigation Water*

Watershed development appears to benefit farmers in the study area in terms of groundwater recharge, preventing soil and water erosion and so on. The impact of watershed treatment measures such as percolation pond, farm pond, field bunds, continuous contour trench, water absorption trench and check dams on groundwater recharge is quite

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visible. Based on discussion/interviews held with farmers, it was observed that there was increase in water table, increase in perennial availability of water in the wells and in pumping hours. All of this appears to have contributed to an increase in the area under irrigation and crop diversification. The field data on changes in availability of irrigation water from the wells selected from the area is given in Table 1.

**Table 1: Changes in Availability of Irrigation Water From Well**

| Sl. No | Well identification | Depth of well (in 'm') | Before the project | | After the project | |
|---|---|---|---|---|---|---|
| | | | Depth of water (in 'm') | Operating hours | Depth of water (in 'm') | Operating hours |
| 1 | K-12 | 9 | 1.8 | 3 | 6.5 | 6 |
| 2 | K-8 | 11 | 4 | 2 | 8.4 | 6 |
| 3 | G-176 | 7 | 2 | 2 | 4 | 6 |
| 4 | KI-4 | 10 | 3.4 | 2 | 8 | 4 |
| 5 | K-57 | 11 | 1.5 | 3 | 7.3 | 7 |
| 6 | K-48 | 10 | 4 | 2 | 7 | 5 |
| 7 | K-65 | 11 | 3.7 | 3 | 6.6 | 6 |
| 8 | K-5 | 12 | 5 | 3 | 9.2 | 6 |
| 9 | G-183 | 7 | 2.4 | 4 | 4.8 | 7 |
| 10 | K-40 | 12 | 2.9 | 4 | 5.6 | 8 |
| 11 | K-109 | 9 | 2.3 | 2 | 7.8 | 5 |
| 12 | KI-293 | 11 | 4.7 | 2 | 7.6 | 6 |
| 13 | K-238 | 12 | 6.4 | 2 | 9.5 | 3 |
| 14 | K-153 | 11 | 7.2 | 2 | 7.8 | 5 |
| 15 | K-163 | 13 | 6 | 4 | 8.6 | 9 |
| 16 | K-190 | 11 | 5 | 4 | 10 | 9 |
| 17 | K-261 | 11 | 4 | 4 | 5.9 | 5 |
| 18 | G-240 | 10 | 3 | 4 | 8.1 | 7 |
| 19 | K-170 | 9 | 3.5 | 3 | 5.4 | 5 |
| 20 | K-254 | 12 | 4 | 4 | 7.9 | 4 |
| 21 | K-295 | 10 | 5.3 | 2 | 6.5 | 6 |
| 22 | K-292 | 9 | 2.5 | 2 | 4.9 | 6 |
| 23 | k-283 | 12 | 2.6 | 2 | 8.4 | 4 |
| 24 | k-284 | 10 | 2.3 | 3 | 4.3 | 5 |
| 25 | k-322 | 12 | 1.5 | 3 | 8.9 | 7 |

**Note: K-Kothapully Panchayat, G-Gurunathanayaganur Panchayat; number indicates the well identification number assigned to it.**

### *C. Changes in Land Use Pattern*

There have been changes in the 'land use' pattern as a result of the implementation of the area as seen from the results given in Table 2.The cropped area increased due to continuous availability of water in the well. So that perennially irrigated area increased. Income for the land holders also increased due to watershed project.

**Table 2: Changes in Land Use Pattern**

| Sl. No. | Particulars | Before the project(ha) | After the project(ha) |
|---|---|---|---|
| 1 | Public land | 428 | 428 |
| 2 | Land Privately owned | 790 | 790 |
| 3 | Cropped Area in ha: | 131 | 155 |
| | Seasonally Irrigated | 70 | 45 |
| | Perennially Irrigated | 61 | 76 |
| 4 | Rain fed Area in ha: | 533 | 560 |
| | Fallow Area (Cultivable waste) | 126 | 126 |
| 5 | Uncultivable Waste area | 126 | 99 |

### *D. Changes in Cropping Pattern and Productivity*

Both the cropping pattern and productivity have undergone changes due to the implementation of the project as there is continuous availability water in the wells (Table 3). The increase in the yield of crops will definitely enhance the income levels of the people of the region.

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Table 3: Changes in cropping pattern and productivity

| Sl. No. | Particulars | Yield before project (qtls per Ha) | Yield after the project (qtls per Ha) |
|---|---|---|---|
| 1 | Bajra | 17 | 189 |
| 2 | Sorgham | 13 | 157 |
| 3 | Tomato | 260 | 120 |
| 4 | Small Onion | 60 | 70 |
| 5 | Rice | 65 | - |
| 6 | Grounut | 100 | 250 |
| 7 | Gingili | - | 50 |
| 8 | Red gram | - | 35 |
| 9 | Cowpea | - | 59 |
| 10 | Black gram | - | 42 |

## IV. CONCLUSION

The watershed management practices implemented in the study have been fairly successful and have achieved a lot in terms of water and soil conservation benefits. There has been a significant increase in the water availability for irrigation and livestock, land productivity, and rehabilitation of degraded and extension of arable land. The cropped area of implementation of the project has increased due to continuous availability of water in the wells, which in turn is expected to continue to increase in the land holders of the region. There is a change in the cropping pattern in and an increase in the yield of the crops cultivated in the region after the implementation of the project. The results from the study are encouraging. It is recommended that such studies be made a part of the implementation procedure of the project and the results obtained may be made public for the benefit of the all stakeholders and to others in general.

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