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Groundwater fluctuation in the Pondhra Watershed Basin of Karmala Tahsil, Solapur (MS)

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Abstract:

Depletion of groundwater has become a problem in the rural sector. It has bearing on converging the source by technological intervention which has led to deprivation of poor section of the society. The present study has attempted to understand the causes and effect of well water depletion by selecting a small watershed viz. Pondhra basin in the Karmala tahsil of Solpur District, Maharashtra. The paper concludes that the fluctuation of well water is maximum near the water divide and hence there is need for the watershed development programmes in the basin. The average fluctuation in the basin is found to be 4.53 m. The water level fluctuation is highest in the village Morwad i.e 5.68 and lowest in the village Vit and Undergaon i.e 2 m. The average rainfall in the basin is 567 mm with high spatial variation (Standard Deviation 28.66 mm).The study further concludes that such programmes should be planned taking into account the site factors.

Keywords: Groundwater fluctuation, watershed management, well water depletion.

1.0 Introduction:

Water is a vital resource for agriculture in low-latitude regions with a markedly seasonal climatic regime (Bell and Roberts, 1991). It is an important media in various Bio-chemical cycles of the tropics. Biological life and in turn, the human life is based on availability of water resources in an ecosystem. As far as the agricultural activities are concerned, water is an indispensable input and more so in case of drought-prone areas. Raghunath (2007) has opined that increased water requirement for agriculture, municipal and industrial need is far more than the annual recharge. This may lead to depletion of ground water.

Together with the soil medium, the water resources determine the agro-ecosystem. Evaluation of water resources is the primary concern of not only planners but also of agriculture scientists, agro-climatologist, hydrologists and others. Rao (1979) has emphasized that appraisal of water resources is mainly based on geomorphological studies, especially in geology, geomorphology including river-morphology, sedimentation and fluvial processes, geophysics, geohydrology and engineering geology. The problems related to water resource availability in drought-prone areas of Peninsular India have been discussed by Misra (1984).

Groundwater resources, although renewable and inexhaustible, in the present context should be treated as an exhaustible and depletable resource. The comment of Turk (1985) is very relevant in case of the study area. He is of the view that groundwater should be considered as fossil resource as the recharging of deep aquifers is a long-term process over hundreds to thousands of years.

Compared to surface water bodies, groundwater is relatively protected from contamination by overlying soils and sediments. The Central Groundwater Board has identified that increasing population; deficient monsoons, unregulated wells, and dependency on loans for costly agricultural inputs have created stress on ground water (CGWB, 2006). As groundwater levels are depleted the source is converged and rich peasantry slowly dominate and poor population suffer from deprivation. Postel (1999) has observed this kind of stress and urged the need of technological intervention. Walden (2004) and (DTE 2004) has opined that water stress has close association with an epidemic of farmer suicides in Andhra Pradesh.

In early watershed project, the benefits of rehabilitating landscapes were assured to be natural with respect to different types of land uses & levels

of affluence & poverty (World Bank 1990). Agriculture has been identified as the major contributor of NPS of water resource (Humenic et al 1987). Watershed development in India date back several decades to an assortment of soil and water conservation efforts (Pangare & Gondhalekar 1998). Soils in agricultural fields function as the crop growing medium and in the context of runoff agriculture as the receiver and retainer of water and nutrient inputs for crops (Jonathan et al 2007).

As with the green revolution (Leaf 1983) rising income would then trigger other economic activity and transform entire village economies. This scenario has in fact played out in several famous watershed villages including Sukhomajr in Haryana &Ralegaon-siddhi,Hivarebajar& implegaonwagha in Maharashtra (Chopra et al, 1990, famngton & Lobo, 1997, Kerr et al, 2002). John Kerr (2002) opined that rain fed agriculture is unproductive & watershed project focused on harnessing water resource for maximum agricultural productivity. Watershed level agro-ecosystem studies are essential to relate land management and to enhance our agricultural nutrient cycle (Richard Lawrence, 1985). Watershed management requires integrity, scientific knowledge of ecological relationship within a complex framework of cultural values and traditions (Kohm, and Franklin, 1997).). Runoff plays an essential role in moistening dry soil, which activates microbial decomposition of organic matter, thereby producing and releasing plant available nutrient (Norton et al, 2003).

Earlier, the use of groundwater was insignificant in the State. Maharashtra is one of the most well favoured states in the country in respect of rainfall, but it may soon become a state where large parts of it face perennial water shortage. El-Hames (2005) has pointed out that for the specific locations with high ground water potential and determining a maximum pumping rates that can maintain the depth of groundwater table at a sustainable level are very important factor in groundwater management. Therefore, it is necessary that institutional, policy and technological initiatives should be taken to address both the quantity and the quality issues of groundwater.

The drought-prone area of Maharashtra is facing both economic and Environmental problems. At the same time environmental problems like degradation of land, biomass, and watershed have become serious problems. These problems have posed the question mark on rural development. Therefore it is interesting to find out solution to such problems. The studies in environmental science may formulate proper strategy to enhance the resource base for agricultural development. The present paper attempts to understand these issues by selecting a small watershed in the drought prone zone of Maharashtra state.

2.0 The Study Area:

Pondhra watershed basin in Karmala tahsil has been selected for the study. The absolute location of study area can be expressed as from 18^0 15′ to 18^0 25′ N latitude and from 75^0 00′ to 75^0 10′E Longitude. It covers the area of Survey Of India (S.O.I) Toposheet No. 47N/03. The basin covers an area of 181.08 km^2 within the Karmala tahsil. The study area lies in the rain shadow zone of western ghat in the middle Bhima basin. The study area receives rainfall during South-West monsoon from June to September. The micro level distribution of rainfall shows variation. The southern part of area of the basin in village Sogaon receives 520 mm while northern part of the basin receives 600 mm rainfall.

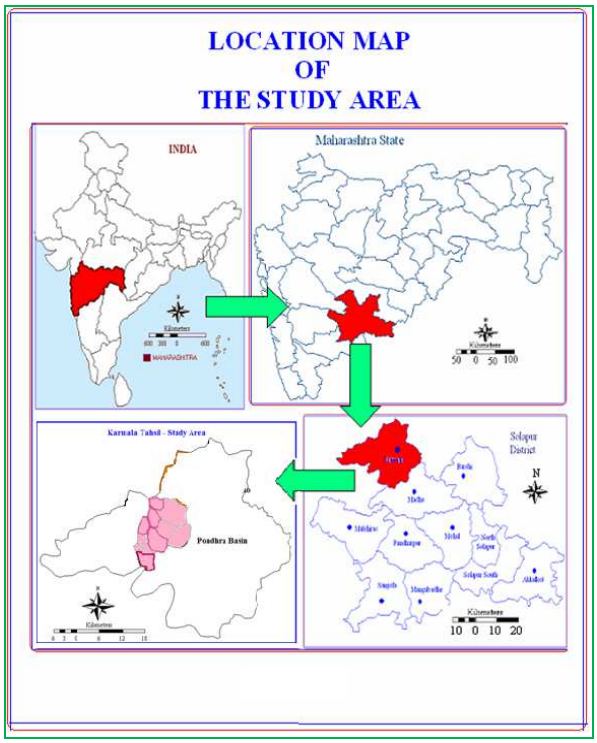

Fig. 1: Location Map: Study Area- Pondhra Basin

Pondhra River originates near the village Mohalkarvadi and flows in southeast direction and meets to veet talab at village veet . A researve forest area and veet Pajhar talab (percolation Tank) are situated Northeast side of the village. River pondhra meets Bhima near the near the village Sogaon East. There are 11 villages in the basin viz Sogaon, morwad, Vit, Vihal, Pondhvadi, manjargaon, Undergaon, Ritevadi, Anjandoh, Umrad, Jhare.

3.0 Environmental Setting:

The study area, as a part of Maharashtra plateau, is covered by Deccan Trap i.e basic lava flow. Uniformity of lava flows continued by differential weathering and erosional processes leading to undulating surface. The study area exhibits such kind of undulation from the source region to the confluence. The climate and structure favours formation of medium to thick cotton soil along the streams which thin cover of sandy to pebbly soils along the plateaus and flat toped hills. The soil consists of layers of calcareous material. The kankar deposits are visible in the field study. This may be attributed to basic lava and dry climate.

It can be easily been understood that soil coverage in both the basins is dominated by thin soils with low productivity. Further, the field study has revealed that field soil moisture is present only upto last week of the January or first week of February in dry farming areas. Thus for the study of climatic parameters observes that the basins have scarcity of water normally. It becomes severe problem in the year of drought probability of which is quite high. This has put forth the need to use groundwater conjunctively. The groundwater resource may be improved using watershed management techniques. The fertility status is good in the narrow belts along the streams. Furthermore, the aquifers are limited and shallow. The ground water is confined to cracks and crevices of compact basalt. Water table in this area varies from 6 to10 meter below ground level (mbgl).

3.1 Methodology for Ground Water Study:

To study the ground water of the region, water levels in different wells located in the basin have been observed for pre and post monsoon period for this 11 wells have been selected. These pre and post monsoon water levels are plotted and are compared with the overall fluctuation of average rainfall. Total 11 villages come under the watershed basin of Pondhra Basin. Out of which the village Umrad and Anjandoh are situated at the central part of the Pondhra Basin. The village Sogaon is in south side while Morvad is in the North side of the basin. The basin boundary marked on the map (Fig : 02). The Table which includes the 11 well locations serially shown in the Table : 1. Similarly graph for the same has been shown in Fig : 03.

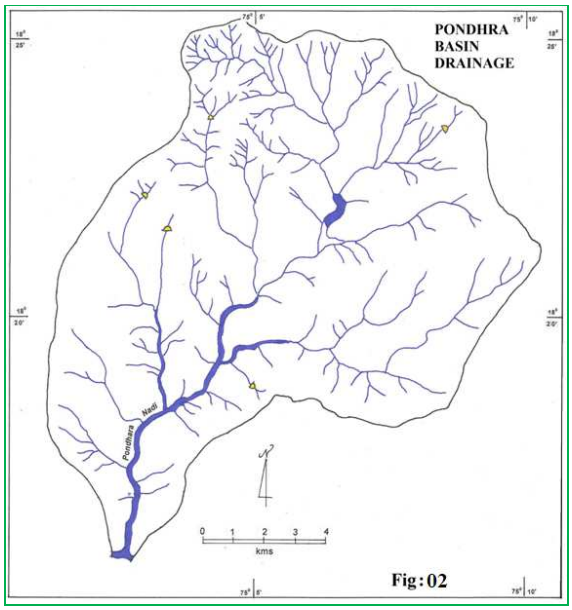

Fig. 02: Drainage Map of Pondhra Basin

4.0 Results and Discussion:

The out-put of all study is summarized in terms of graph. These graph include the Water levels measured with respect to ground at pre and post monsoon period and average Rainfall (Fig. 3). In general the depth to water level in the village Sogaon ranges from 1.5 m to 6.2 mbgl (Meter Below Ground Level).

The average post monsoon water level in the village Sogaon and village Vit are 1.5 and 2.0 mbgl respectively. This is mainly because of the village Sogaon is very close to the Ujjani river backwater area and the Vit Pajhar Talab (Percolation tank) exists at village Vit. Because of this water percolation is more and water levels are at higher sides (meter below ground level). In contrary to that village Morwad is situated near to the water divide and the water level fluctuation is more i.e 9.7 mbgl (pre monsoon) and 4.02 (post monsoon). The Rainwater falling at the divide is separated by the divide and

flows to the adjacent basin. This may lead to the less recharge of rainwater. Hence, groundwater levels fall down.

However, the average pre-monsoon water level in the Pondhra basin is 7.82 mbgl and the average post-monsoon groundwater level in the basin is 3.82 mbgl. Also the average fluctuation in the basin is found to be 4.53 mbgl. It is seen that generally the depth of water levels follows the surface topography and the drainage pattern in the Pondhra Basin. The wells situated near water divide show high fluctuation while those near the stream show low fluctuation in well water depth. This means that groundwater storage in the upper part of the basin easily transgressed to lower parts (Patil and Saptarshi 2013).

This can be checked by constructing continuous contour trenching (CCT), gulley plugging and restoration of flora. The site suitability for the different watershed management programmes may useful in this regard. The CCT helps to increase the water levels in the surrounding wells which increase the yield of farms due to changes in cropping pattern. This will also avoid loss of soil due to erosion; increase the grass coverage which will helpful for soil stabilization.

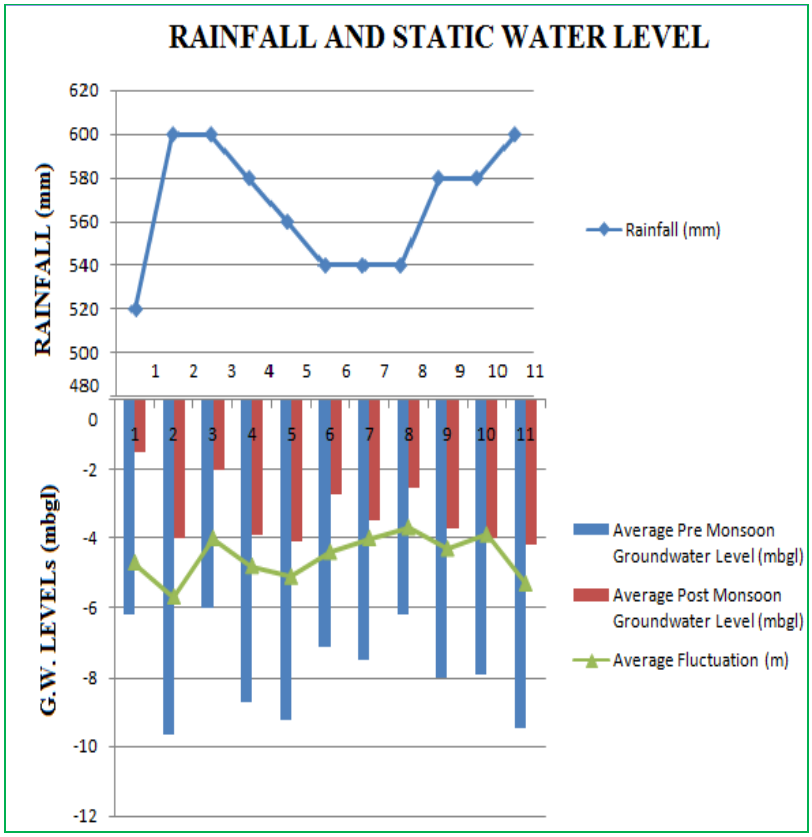

Fig. 3: Rainfall And Static Water Level.

Table 1: Average Pre and Post Monsoon Groundwater Levels, Average Rainfall and Average Fluctuation in the Ground Water Level

Sr. No.	Name of village	Average Pre Monsoon Groundwater Level (mbgl)	Average Post Monsoon Groundwater Level (mbgl)	Rainfall mm	Average Fluctuation (m)
1	Soagaon	6.2	1.5	520	4.7
2	Morvad	9.7	4.02	600	5.68
3	Vit	6	2	600	4
4	Vihal	8.7	3.9	580	4.8
5	Pondhvadi	9.2	4.1	560	5.1
6	Manjargaon	7.1	2.7	540	4.4
7	Undergaon	7.5	3.5	540	4
8	Ritevadi	6.2	2.5	540	3.7
9	Anjandoh	8	3.7	580	4.3
10	Umrad	7.9	4	580	3.9
11	Jhare	9.5	4.2	600	5.3
		86	36.12	6240	49.88
	Average	7.82	3.28	567 (STD 28.6)	4.53

5.0 Conclusions:

The average pre- monsoon groundwater level in the Pondhra basin is found to be 6.2 mbgl to 9.7 mbgl and the average post- monsoon groundwater level ranging from 1.5 mbgl to 4.2 mbgl. However, the average fluctuation in the basin is found to be 4.53 m. The average rainfall in the basin is 567 mm with high spatial variation (Standard Deviation 28.66 mm). Rainfall from the basin directly converts to overland flow due to lack of tree cover, water harvesting structures and flows out of the basin. The study urges to plan for site specific watershed management programmes in the basin.

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