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Water Level Fluctuation in the Narangi Watershed of Vaijapur Tahsil, District Aurangabad, INDIA

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Abstract:
Declining water level trends and yields of wells and drying up of shallow wells are common in many parts of India. The present study has attempted to understand the behavior of water level fluctuation by selecting a small watershed viz. Narangi watershed in the Vaijapur tahsil of Aurangabad District, Maharashtra. The average pre- monsoon groundwater level in the Narangi watershed is 9.30 mbgl to 18.80 mbgl and the average post-monsoon groundwater level ranging from 4.90 mbgl to 18.20 mbgl. The average rainfall in the area is 517.45 mm with high spatial variation. Rainfall from the basin directly converts to overland flow due to lack of tree cover, water harvesting structures and flows out of the basin. For the effective water conservation plans in the Narangi watershed area, the water conservation treatment structures like gully plugs, continuous contour trenches (CCT), earthen check dams, percolation tanks are recommended. The implementations of such structures will definitely help to combat over the scarcity situation in the area.

Keywords: Pre and post-monsoon water level, Water level fluctuation, Narangi watershed.

1. Introduction:
Development of groundwater resources are directly linked to prosperity of mankind. The areas having more development of groundwater resources have flourished more as compared to others. The agriculture development has been thriving due to utilization of groundwater. The rural population almost solely depends on the groundwater to meet their drinking and domestic needs. However due to lack of regulatory measures, it has pumped indiscriminately to meet the ever increasing demand of water. As a result, groundwaters levels are declining wells are drying up both in hard rock and alluvial areas in the country. The groundwater is interlinked to the topography, geology, climate, rainfall pattern, land use and landholding pattern, socio-economics and human interferences. The groundwater resources being dynamic in nature is subjected to changes with time and seasons and such needs to be developed judiciously (CGWB, 2001). 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, agroclimatologist, hydrologists and others (Raghunath,2007;Patil & Saptarshi,2012) Groundwater is one of the major sources of supply for domestic, industrial and agricultural purposes. In some areas groundwater is the only dependable source of supply, while in some other regions it is chosen because of its ready availability. The shallow water table depths have significant impacts on crop growth, vegetation development and contaminant

transport. Furthermore, depletion of groundwater supplies, conflicts between groundwater users and surface water users, potential for ground water contamination are concerns that will become increasingly significant as further aquifer development takes place in any basin. The consequences of aquifer depletion can show the way to local groundwater rationing, excessive reductions in yields, wells going dry or producing erratic groundwater quality changes, changes in flow patterns of ground water (Nayak, et al, 2006). Rainfall is the principal supply of recharge, though in some areas, canal seepage and return flow from irrigation also contribute significantly to the groundwater recharge. Groundwater resource comprises of two parts – dynamic resource in the zone of water-table fluctuation which reflects seasonal recharge and discharge of aquifers and static resource below this zone, which remains perennially saturated (Das, 2006; Chatterjee and Purohit, 2009).The crisis about water resources development and management thus arises because most of the water is not available for use and secondly it is characterized by its highly uneven spatial distribution (Wani et al., 2002, Khadri and Suple, 2015). Declining water level is mainly attributed to the recurrence of drought years, over exploitation of groundwater, increase in the number of groundwater structures and explosion of population (Raju et al., 2006).

In Maharashtra around 82% of rural population is dependent on agriculture & around 85% of rural and to some extent urban population too dependent on groundwater. Earlier, the use of groundwater was insignificant in the State. Subsequent to 1972, occurrence of frequent droughts, development of cheap drilling devices and availability of relatively low cost institutional finance, and energization led to proliferation in irrigation wells within the State. Maharashtra is one of the most well endowed states in the country in respect of rainfall, but it may soon become a state where large parts of it face perennial water shortage, if urgent institutional, policy and technological initiatives are not taken to address both the quantity and the quality issues of groundwater (Zende and Nagarajan, 2012). Analysis of water table fluctuations (WTF) is a useful tool for determining the magnitude of both short-term and long-term changes in groundwater recharge and has been widely applied under varying climatic conditions (Gerhart, 1986; Hall and Risser, 1993; Healy and Cook, 2002; Sharda et al,2006). The attempt has been made to understand water level fluctuations (WLF) in Narangi watershed in the drought prone area of Marathwada.

2.0 Study Area:

Vaijapur tehsil of Aurangabad district is the gateway of Marathwada region, and is situated in the western parts of the district and mostly covered under the Godavari drainage basin. The total area of Vaijapur tehsil is 1510.5 km^2. The Narangi watershed (GV-33) covering an area of 339.25km^2 of Vaijapur Tehsils of Aurangabad district falls between the latitudes 19°45′00′′-20°05′00′ ′N and longitudes 74°36′00′′-74°50′15′′ E This area is covered under Survey of India Toposheet Nos. 46 L/12, 47I/13 and 47I/9, under the watershed GV-33 (GSDA and CGWB, 2005). The area is drained by a Narangi river, tributary of Godavari River (Fig.1). Watershed has its maximum RL 624 m (Head) and and minimum 471 m single outlet point at end of the basin i.e. the fall is 153m. The Narangi river rises on the southern slopes of the water divide to the south of the Maniyad river a little above Narala village and flows past Vaijapur. A little below the latter, it is joined by the Deo nala, flowing from Nasik district. It has a fairly long south southwesterly course before its point of entry into the Godavari is carried a little down the latter. It is joined by the Chor nala from the west and Kurla nala from the east. Actually the Narangi continues the trend of the Kurla river after the latter's confluence. There are 9 mini waterhsed covering 38 villages in the basin. The average annual rainfall in Vaijapur taluka is 517.45 mm. Rainfall data of 64 years have been collected and analyzed from 1952 to 2015, Average, minimum and maximum rainfall in the tehsil is 517.45mm, 150mm and 918mm. yearly rainfall trend of the tehsil is shown in fig.1. From About 83% of annual rainfall is received during June to September. The variation in rainfall from year to year is large and study area falls in drought prone area hence is characterized by the erratic behavior of the rainfall (Deshpande & Aher,2012). In view of irregular behavior in the annual rainfall pattern its behavior on groundwater system of the study area is expected.

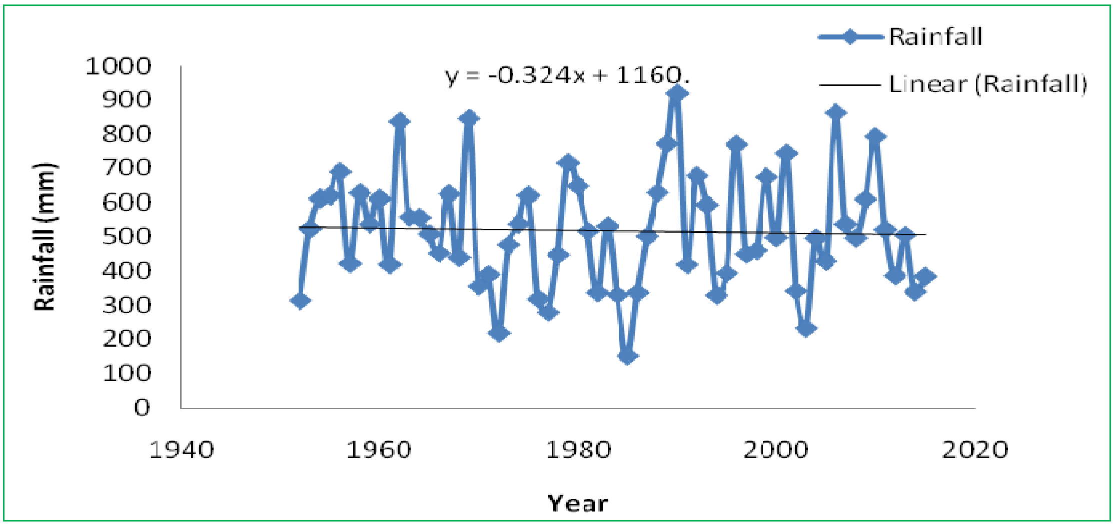

Fig.1: Year wise rainfall trend of Vaijapur as per IMD data

2.1 Geology and Hydrogeology:

The whole area is monotonously covered by the basaltic lava flows called Deccan Trap. The lava flows are called trap because of the step like or terraced appearance of their out-crops. The lava flows are indicative of a great volcanic activity. The close of cretaceous period in the Indian Sub-continent was marked by an outburst of great volcanic activity through a series of gigantic fissures. The traps are overlain by thin alluvial deposits along the rivers. The lava flows are horizontal and each flow has distinct two units. The upper layers consist of vesicular and amygdule zeolitic basalt whiles the bottom layer consists of massive basalt. Quaternary alluvium occupies the Godavari valley and well exposed south of Vaijapur and comprises gravel beds, sands, silts, and clay. The formations are acting as aquifer, are vesicular basalt and fractured and jointed massive basalt. Alluvium also acting as a aquifer. The thickness depends upon the intensity and duration of weathering. The soils are mostly formed from igneous rocks and are black, medium black, shallow and calcareous types.

3.0 Result and Discussion:

To study the ground water of the region, water levels in different wells located in the watershed have been observed for pre and post monsoon period for this three wells have been selected. These pre and post monsoon water levels are plotted and are compared with the overall fluctuation of average rainfall. Total three well come under the watershed showing runoff zone, recharge zone and storage zone of watershed. 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 (Fig.3,4,5).

3.1 Movement of Groundwater:

Precipitation forms the principal source of recharge of groundwater in trappean flows and in the alluvial sediments. Seepage from the surface water bodies also augments the recharge to the groundwater in these formations. The elevation of water table shows that it generally follows the topography. The movement of groundwater in general is towards the Godavari river. Though there is hydraulic continuity between the different trappean units but there are wide variations in the water due to the heterogeneous nature of the aquifer materials. The ground water movement is generally sluggish in alluvial area due to high sand and clay ratio.

3.2 Depth to Water Level (DTW):

Depth to water level varies within the area depending upon the hydro geological framework, level of groundwater development and topography of the area etc. it also varies with time. The general phenomenon of rise during monsoon and decline after monsoon till the next monsoon is witnessed in the region. The data of 3 hydrograph monitoring network stations (Dugwells) established by Groundwater Survey and Development Agency has been analyzed to depict the ground water level during pre monsoon and post monsoon seasons (GSDA, 2015).

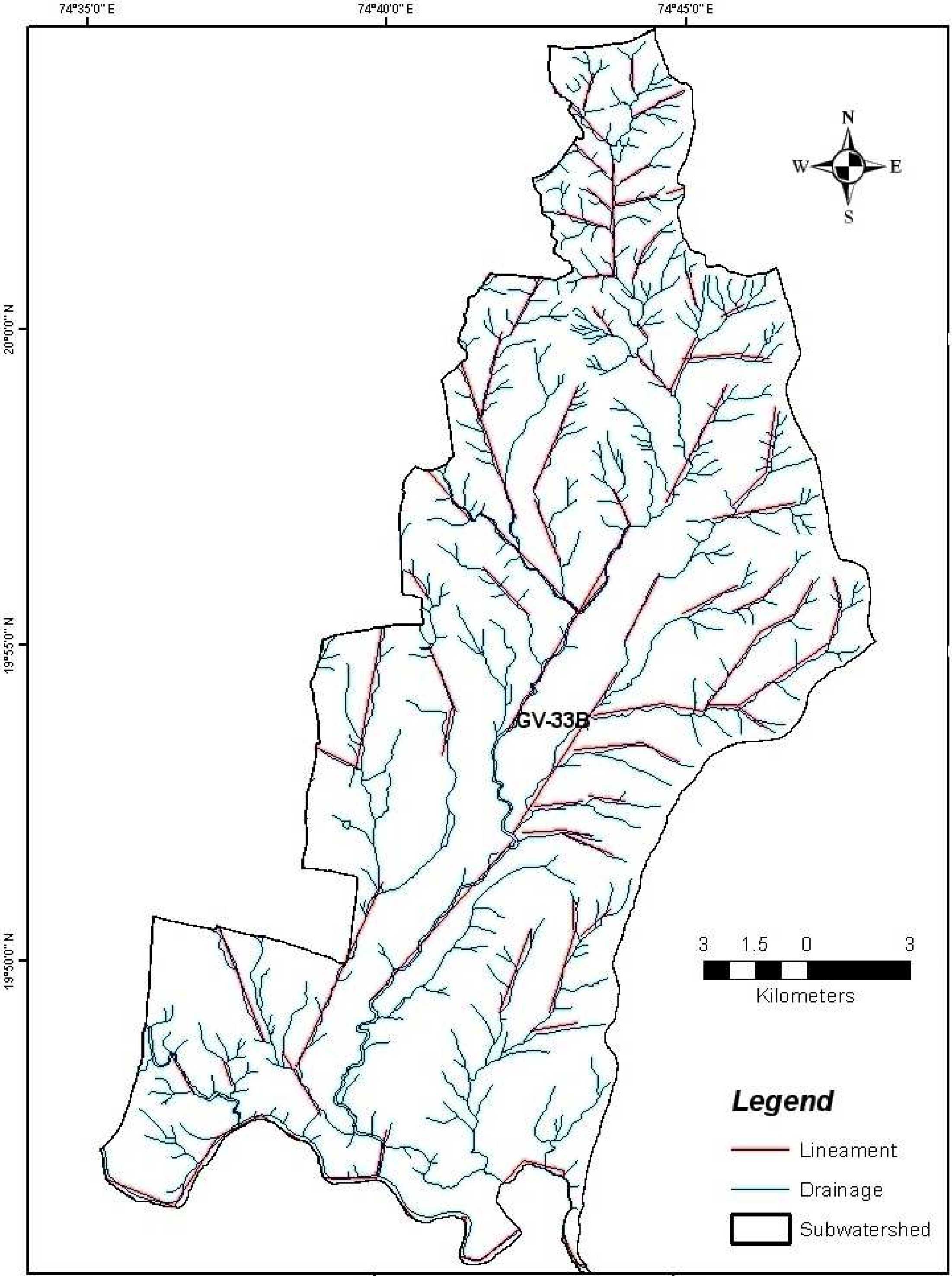

Fig.2: Location Map of Narangi Watershsed

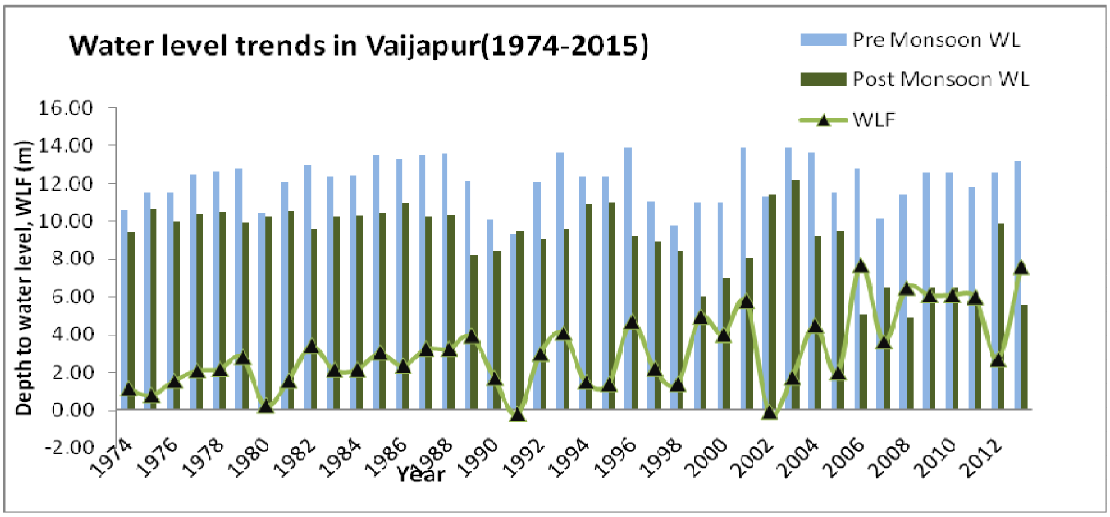

Fig. 3: Water Level Trends in Observation Well of Vaijapur Area

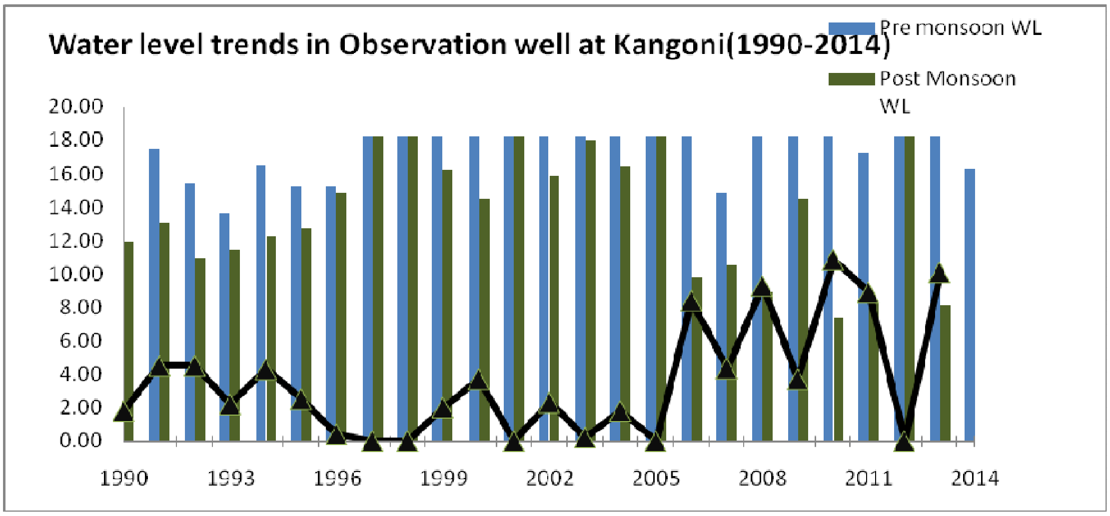

Fig. 4: Water Level Trends in Observation Well of Kangoni Area

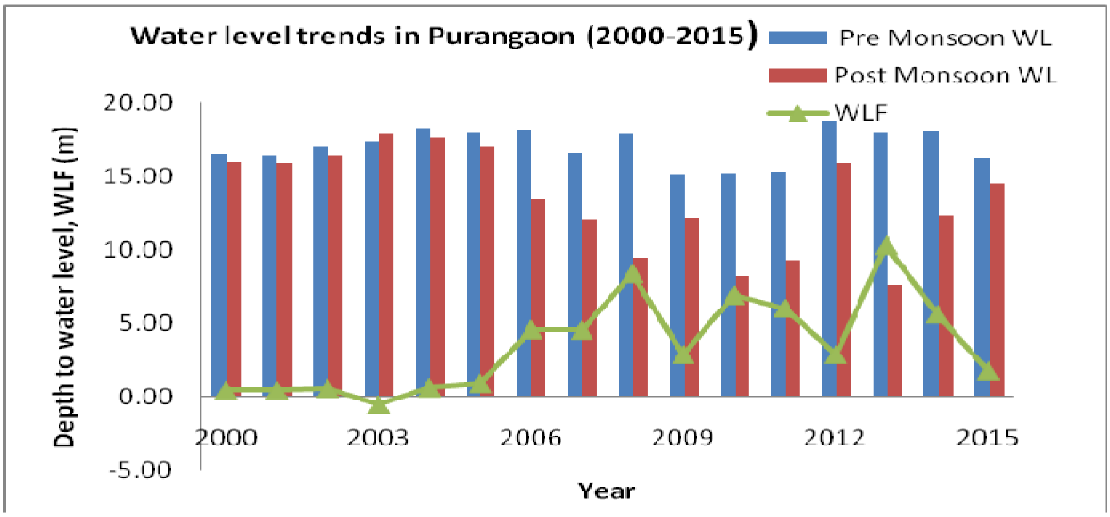

Fig. 5: Water Level Trends in Observation Well of Purangaon Area

3.3 Pre and Post-monsoon Scenario:

Depth to water level during pre-monsoon varies between 9.30 and 18.80m bgl. Most of the dugwells were having little water column. The area was having depth to water level more than 10m bgl except 1991 in Vaijapur. The deeper range of depth to water level occurred around Kangoni and Purangaon area. Depth to water level during post-monsoon varies between 4.90-18.20m bgl and overall water level was deeper. The deeper water level beyond 10m bgl range occurred in most of the year in Kangoni and Purangaon area.

3.4 Seasonal Fluctuation of Water Table:

The difference between pre-monsoon and post-monsoon water level is taken as seasonal fluctuations, which assumes significance for groundwater recharge estimations. Seasonal fluctuations between pre and post monsoon were calculated and shown in fig. (Fig.3,4,5). It is observed that groundwater table was recharged during the monsoon as it rose upto 0.2-10.85m in case of Vaijapur and Purangaon fluctuation was negative by 0.70 and 0.51 respectively. In wells of Vaijapur fluctuation was in the range of -0.2 to 7.7m, in well Kangoni fluctuation was in the range of 0 to 10.85m, in Purangaon area fluctuation was in the range of -0.51 to 10.35m (Fig.3, 4, 5).

4.0 Conclusion:

The average pre- monsoon groundwater level in the Narangi watershed is 9.30 mbgl to 18.80 mbgl and the average post- monsoon groundwater level ranging from 4.90 mbgl to 18.20 mbgl. However, the average fluctuation in the watershed is found to be 3.35 m. The average rainfall in the area is 517.45 mm with high spatial variation. Rainfall from the basin directly converts to overland flow due to lack of tree cover, water harvesting structures and flows out of the basin. For the effective water conservation plans in the Narangi watershed area, the water conservation treatment structures like gully plugs, continuous contour trenches (CCT), earthen check dams, percolation tanks are recommended. The implementations of such structures will definitely help to combat over the scarcity situation in the area.

5.0 Acknowledgement:

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