Water management study with reference to Geology and well inventory data in Hassnabad area

PRAMOD B. PATHRIKAR
Head Dept. of Geology
Rajarshi Shahu Arts, Commerce & Science collage
Pathri Tq. Phulmbri Dist. Aurangabad

ASHOK V. TEJANKAR
Pro Vice-Chancellor of
Dr. Babasaheb Ambekdar Marathwada.
University,Aurangabad

ABSTRACT

The village Hassnabad come under watershed GP-14B which come under toposheet No 46 P/12-56 P/12 and having maximum elevation is 606 m. and minimum is 575 m. The hydrology of the watershed is depends on the rock formation generally they consist of basalt rock formation and weathered and fractured massive basalt vesicular basalt type of aquifer and the sub saturated zone and average rain fall is 600 m. There is very less scope for the rain water in hilly area to percolate in to the ground because of the rapid runoff and irrigation through groundwater is hampered. Hence the people of these areas face scarcity of water in summer as well as in winter for irrigation and in some villages for drinking also.

The area falls in the terrain of Deccan Trap basalt consisting of two major types of basaltic flows viz. compact basalt and amygdaloidal basalt, compact basalt is a thick and extensive flow. It may be aphanitic or porphyritic in nature. Jointing pattern in the compact basalt plays important role in the percolation of water. But jointing pattern shows variation even within short distances. Joints may be inconsistent, broadly spaced or closely spaced. Top of the compact basalt is almost always hydrothermally altered and becomes amygdaloidal.

The main objective behind the present study is to locate favorable sites for percolation of water. Effective percolation could be achieved through water conservation by resorting to certain water conservation measures for sustainability of ground water reserve.

The hydrology of the watershade is depends on the rock formation generally they consist of basalt rock formation and weathered and fractured massive basalt vesicular basalt type of aquifer runoff zone and recharge zone and the sub saturated zone and average rain fall is 600 m. Well selected for observation for collection of groundwater data in study area. The observation well selected at different village.

Keyword:- Watershed, Groundwater, Effective Percolation,.

Introduction:

The Hassnabad village area will facing a huge water scarcity problem in summer sessions in every year this problem affect economical as well plants and animal in the area hence this work can help to geologically to overcome the problem. The available surface water resources are inadequate to the entire water requirements for all purposes. The resource can be optimally used and sustained only when quantity and quality of groundwater is assessed. It has been observed that lack of standardization of methodology in estimating the groundwater and proper tools for handling the same, leads to miscalculation of estimation of groundwater. It is essential to maintain a proper balance between the groundwater quantity and its exploitation. Otherwise it leads to large scale decline of groundwater levels, which ultimately cause a serious problem for sustainable agricultural production. A possible solution for such problems is micro level planning, and use of standard methodology for assessing the groundwater. In recent years micro level planning has gained acceptance, since it can be locally applied and readily managed by self-sufficient rural governance. Groundwater resources are dynamic in nature as they grow with the expansion of irrigation activities, industrialization, urbanization etc. As it is the largest available source of fresh water lying beneath the ground it has become crucial not only for targeting of groundwater potential zones, but also monitoring and conserving this important resource. The expenditure and labor incurred in developing surface water is much more compared to groundwater, hence more emphasis is placed on the utilization of groundwater which can be developed within a short time. Besides targeting groundwater potential zones it is also important to identify suitable sites for artificial recharge usage cycle. When the recharge rate cannot meet the demand for water, the balance is disturbed and hence calls for artificial recharge on a country

wise basis with the increasing use of groundwater for agricultural, municipal and industrial needs; the annual extraction of groundwater is far in excess of net average recharge from natural resources. Consequently, groundwater is being withdrawn from storage and water levels are declining resulting in crop failures. Vagaries of monsoon and indiscriminate development of groundwater often result in declining trend of groundwater levels.

There is an urgent need for artificial recharge of groundwater by augmenting the natural infiltration of precipitation into subsurface formation by some suitable method of recharge. Artificial recharge is one method of modifying the hydrological cycle and thereby providing groundwater in excess of that available by process. Advent of Satellite remote sensing and Geographical Information System has opened new vistas for groundwater studies. This is due to the fact that earth observing devices, both on space craft as well as on aircraft provide most up-to-date, accurate, unbiased and detailed spectral, spatial and temporal information on conditions of natural resources. This paper addresses the strategies for an integrated approach of remote sensing and GIS for groundwater targeting, management and conservation of groundwater resources that ensures optimum and judicious use of groundwater in study area and in identification of artificial recharge sites.

STUDY AREA

The Hassnabad area fall Longitude 75^0 10' to 75^0 48' Latitude 20^0 5' to 20^0 9' in Maharashtra Aurangabad district and Phulmbri taluka, is come under the toposheet No 46 P/12 and having maximum elevation of 610 m. and minimum of 580 m.

Rainfall and climate:-

The area under study fall in tropical and semi-arid region of Maharashtra and receives an average rainfall of 750 mm. Due to Eastward slope most of the rainwater run off to Girja river. The climate of the region is characterized by three distinct seasons viz. summer, monsoon, and winter. The temperature ranges from maximum of 42^0c in summer to minimum of 12^0c during winter.

Soils:-

The area is covered by the black cotton to brownish black colored soil which is having thickness ranges between 0.30 m to 1.50 m below ground water level. The thickness of black cotton soil is more in the central and northern part of the watershed, whereas the terrain is moderately to gently sloping. This soil is very fertile and good for growing both Kharif and Rabi crops. The main cropping seasons in this area are kharif and Rabi, Cotton Jawar and Maze are the main crops grown in kharif whereas wheat, pulses and vegetables are the principal crops of Rabi.

Geology of Hassnabad Area:

Total area covered by this watershed is 9764 Ha. It has minimum elevation of 525 m. msl. Near Jodwalsa village at the confluence of Purna and Girja rivers and its maximum elevation 573 m.msl. This is comparatively low lying area of the basin. The flows scaling the watershed are follows.

Flow No. 1:

This is compact aphanitic basalt, occurring in the well section of the low-lying area of Hasnabad. The flow is observed from 573m to 576m. The lower part of the flow shows closely spaced jointing and highly permeable. The top portion of the flow is hydrothermally altered and has becomes amygdaloidal basalt by filling the vesicles having thickness of 2.00m to 2.5m which show limited percolation due to less jointing developed.

Flow No. 2:

This is jointed compact porphyritic basalt is occurring in the well section from 560m to 575m having a thickness of 15m. The flow shows change in the jointing pattern in the middle part is closely jointed and in the lower part, it shows broadly spaced jointing and top portion is thick hydrothermally altered which clearly seen in dugwell.

Flow No. 3:

This is thin band of red Tachylytic basalt having 1 to 1.5m thickness**.** It is seen at limited places in the well section of Northwest part of Latifpur and Northern part of Pimpri village area. This play role as a better for downward percolation of ground water. Thickness of red Tachylytic basalt is not uniform at some places it is zero. Which is suitable area for downward percolation.

Flow No.4:

It is compact porphyritic basalt with small to medium sized plagioclase phenocryst which are white in colour. The lower and middle parts of the flow from 568m to 582m show favorable conditions for the percolation. The top portion of this flow has become hydrothermally altered and amygdaloidal which is watertight.

Flow No.5:

This flow starts appearing along the road level. It is compact porphyritic basalt with small plagioclase phenocryst which are crowded in the flow. On weathering due to removal of these phenocryst, the flow has acquired very rough and rugged appearance. It show broadly spaced jointing and has developed spheroidal weathering. The top portion of this flow has become purple and vesicular amygdaloidal with large amygdales filled with silica and zeolites. From there are no outcrops of the flow as it is canceled under soil cover. The road rises above this flow

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Geohydrology Of Hassnabad Area:

The hydrology of the watershed is depends on the rock formation generally they consist of basalt rock formation and weathered and fractured massive basalt vesicular basalt type of aquifer and the sub saturated zone and average rain fall is 600 m. Well selected for observation for collection of groundwater data in study area.

The zone is the saturated zone in study area. Here the spaces between soil particles contain only water. The water table is the uppermost edge of this saturated zone. Aquifers refer to places within the sub saturated zone where the water between soil particles or in fractures in bedrock is readily available and can be obtained by wells. Some of the precipitation that falls becomes surface water. The geology and topography of the land determine how surface water flows.

The fifteen observation well selected at Gosegaon, Hasnabad, Wazerkhed, Kota and Javkheda Bk. village Seven year Pre-monsoon and Post monsoon water table level is taken in well inventory survey and comparative Graph is prepared. In this watershed at Village Hasnabad, Wazerkheda and Kota (Pre-monsoon) show deepest water table upto 26 m. and at Village Gosegaon Hasnabad, Wazerkhed, Kota and Javkheda Bk dugwell show very shallow water table only 1 to 4 m. depth. Average water table depth in study area in between 1 to 21 m. depth in winter and Feb. to May water scarcity for drinking purpose also.

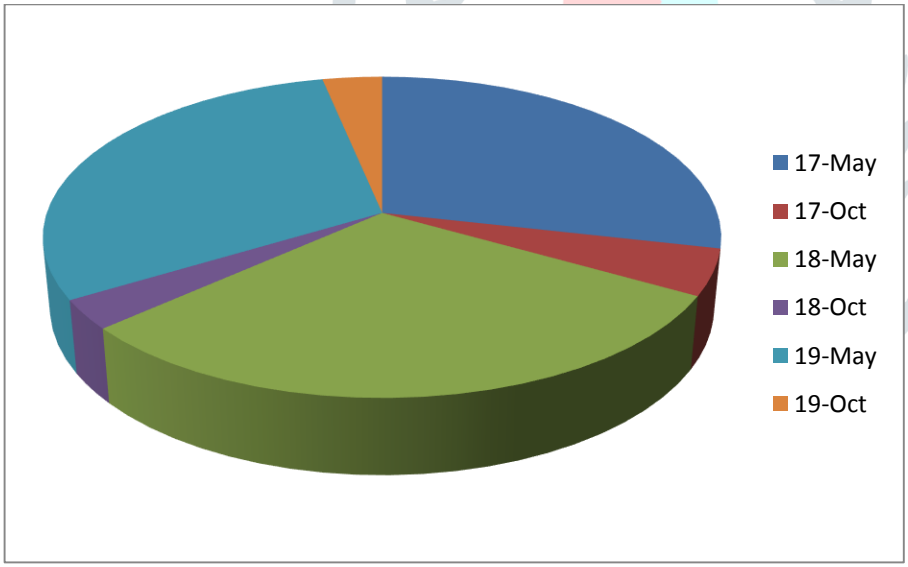
In this watershed the deepest water table has been observed at Hasnabad in pre-monsoon period and considerable increase in the water level in the month of October after the post-monsoon period. In pre-monsoon period

Gosegaon and Kota are the two villages where there is availability of groundwater consistently from 2017 to 2019. But there is lowering of water table in the year 2018 in case of Wazerkheda. Javkheda, as it is situated on the hilly area the water table. However there is large variation in the water table level in pre and post-monsoon period. It shows that the geological conditions are favorable for the recharging in that area.

In post-monsoon period water table becomes quite shallow at Hasnabad it has recorded 1.00m in oct 2017. However there is lowering of watertable consistently in 2019 onwards till 2019. Similar is the case with Gosegaon. Both these locations are at the lower elevations and adjacent to the river beds. In all villages there is increase in the level in Oct 2017, but after that there is lowering of level in 20187. Again there was a little rise in 2019 and there was a fall in 2018. This area is predominantly composed of Amygdaloidal basalt. On the higher elevation there is presence of Compact basalt. Well located in Gosegaon shows Amygdaloidal basalt up to the depth of 516m and hydrothermally altered Amygdaloidal basalt up to the depth of 485m. Sheet jointing has been developed prominently in the rock. As the well is near to the Girja river there is lateral percolation of water through the sheet jointing specially during post-monsoon period. In summer the river becomes totally dry.

Well Inventory Data Of Study Area

Well No.	Village Name	Latitude	Longitude	Water Table Depth in different villages of pre & Post Monsoon					
				May-17	Oct-17	May-18	Oct-18	May-19	Oct-19
1	Gosegaon	20⁰ 06'42"	75⁰`37'19"	17.8	2.9	18.9	1.85	18.9	2.05
				20.5	10	19.32	17.55	22	19.17
				19.7	8.5	10	2.45	12.8	1.77
2	Hassnabad	20⁰ 06'12"	75⁰`38'20"	10.8	4	6.95	3.6	8.02	0.85
				6.4	3.1	12.1	4.2	12.4	2.1
				5.2	2.3	9.85	2.9	11.3	1.88
3	Wazerkhed	20⁰ 09'28"	75⁰`15'42"	11.2	3.55	6.95	9.2	11.95	4.6
				10.8	4	6.95	3.6	8.02	0.85
				11.2	7.6	11.9	4.2	11.65	2.78
4	Kota	20⁰ 12'53"	75⁰`22'22"	6.4	0.3	10.4	2.6	7.6	0.6
				0.9	3.9	1.8	7.7	1.7	7.7
				1.85	3.95	2.8	4.8	2.3	5.9
5	Javkheda. Bk	20⁰ 02'45"	75⁰`31'00"	9	3.55	11	5.2	11	3.8
				7.4	3.8	8.3	6	10.15	5.2
				7.7	1.2	9	1.6	11	1.7



Graph showing Water Table Depth in different villages of pre & Post Monsoon

The wells located in middle and lower part of compact basalt: The middle and lower parts of the compact basalt flow are jointed in nature. The middle jointed portion of the flow is exposed at the surface, it provides avenue for percolation of water. However, Joints in compact basalt observed at the surface are opened up and gradually close towards bottom they become watertight at the deeper level. Therefore in this case the rainwater percolates up to the shallow depths. Therefore, water bearing capacity of compact basalt depends upon spacing of the joints, pattern of jointing and degree of jointing.

The wells located on amygdaloidal basalt: The quantity of water and the rate of withdrawal depends on thickness of aquifer and lateral extent of sheet jointed weathered zone. If the thickness of weathered zone is more than in such case well yields higher volume of water for a long period of time. But the thickness is up to 1 to 1.5 m then in

such case the water diminish after the rainy season. The thickness of overlying weathered amygdaloidal basalt is less, then water enters in to the joints present in the underlying compact basalt.

The wells located in the top portion of compact basalt: Top portion of the compact basalt flow is always hydrothermally altered and amygdaloidal in nature. Therefore upper part of this flow is unjointed in nature and acts as homogeneous, watertight mass. Only on intermediate stage of weathering, secondary porosity is developed in the form of sheet jointing and this rock becomes permeable. The groundwater occurrence depends on the condition of amygdaloidal portion of top compact basalt flow.

Conclusion

- Development of groundwater by means of dug wells is to be considered in safe watershed areas.
- There are moderately dissected plateau in most of the part of study area e.g. Gosegaon, Wazerkhed. This area must be considered for the groundwater development by means of dug wells, bore wells.
- In low-lying areas due to good precipitation in monsoon there is availability of surface water. But, this surface water cannot percolate through the thin compact basalt flow having inconsistent jointing. But, there is availability of permeable rock below it. Such conditions are prevalent in the GP-14B watershed.
- Construction of new dug wells may be taken up according to the balance of groundwater available for future groundwater development prefer in safe watersheds.
- In case of small and marginal farmers the community wells are recommended according to the geological formations, instead of individual wells.

Suggestions/ Recommendations

- For perennial crops canal water and groundwater be applied alternatively and well water should be given for skipped rotation.
- Three alternatives are available for conjunctive use:
  a) Use of surface and groundwater in the same area at different times.
  b) Irrigation through surface water and groundwater in different areas, and
  c) Use surface water in one rotation and groundwater in the subsequent.
- Identify the critical areas of water logging, salinity and areas of very shallow ground water levels.
- Construction of different groundwater extraction structures (e.g. dug well, bore well,) for optimal utilization be initiated and evolve suitable strategies for controlling rising water levels. It is advisable to a cultivator to construct such structures for this purpose.
- Groundwater withdrawal in command should be optimum when depth to water level is 1.5 m to 2.5 m below ground level.
- To provide late watering by groundwater when surface water is not available during Kharif and summer season.
- Estimate additional recharge that takes place due to canal command.399
- There is a need for involving experienced hydro-geologist for understanding nature of aquifers and estimating improvement in groundwater potential, required for implementation of conjunctive use in canal command areas.
- Intensify efforts to retain soil moisture to minimize evaporation losses.
- Excessive withdrawal of groundwater by bore wells/ irrigation wells should be controlled. It should not exceed the 'Safe yield' condition. This is necessary to aintain integrity of the aquifer system with respect to quantity and quality of groundwater in space and time.
- It is suggested that in the vicinity of project and canals where water table remains Quite shallow, groundwater should be utilized on priority. This practice minimizes the possibility of water logging.
- Surface water should be used on priority in the area where groundwater potential is poor.
- Institutional disciplines are also necessary. It should be ensured that the tail end

areas get water on equitable basis.

- Large number of farmers should adopt drip irrigation, sprinkler irrigation systems that require less quantity of water for irrigation.
- There is a need to raise awareness level of the community and the water users regarding importance and use of this most important resource. Participation of water user groups and community is expected. Economy in use of water needs to be imbibed in the mindset of the water users.

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