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STUDY OF GROUND WATER OCCURRENCE AND FUTURE PLANNING IN URAD VILLAGE, WARUD TALUKA, AMRAVATI DISTRICT, MAHARASHTRA

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Abstract: Village **Urad** lies in **Warud** tahsil of Amravati district, Maharashtra and is located due North-East of Amravati city at a distance of about 104 km and falls in the watershed WR-1.This area covered under dark watershed zone declared by state ground water board. During this study 100% well inventory of the existing wells, in urad village has been carried out to delineate the unconfined aquifer on the basis of detailed and comprehensive hydrogeological survey. During this study basemap of 1: 10,000 is used for field survey. There are 363 wells existing in the village. Out of them 359 wells are irrigation dug wells and 4 dug wells and one bore well fitted with hand pump are used for drinking water supply purpose. In all 287 wells are fitted with electric pump. During the well inventory, summer and winter static water levels, lithology, aquifer and other related information has been collected. The wells are connected with respect to mean sea level by leveling. Reduced level(RL) values of pre monsoon and post monsoon water level were computed and water table contour maps of village area are prepared. Winter and summer water levels follow the topography. The movement of ground water is towards south west. The village area is covered dominantly by basaltic lava flows of varying thickness and sprodic alluvium. These flows show two units namely massive and vesicular basaltic lava flow unit. The massive basalt lava flow unit is basically hard and compact having no primary porosity and permeability. This flow unit acts as a impermeable formation. However primary cooling joints and secondary fractures and joints developed in massive basalt formations, convert it into a moderate ground water storage unit. In the village Urad groundwater occurs in weathered zone of vesicular, massive basalt and in jointed and fractured massive basalt. Rise and fall in water level represent the change in ground water storage within the aquifer zone. The average well density of this village is 26 wells / km^2 and due to the high density of wells and the higher water requirement for the perennial crops like orange, sweet lime, vegetables, imbalance in the ground water recharge and withdrawal conditions has been observed.

INTRODUCTION

The urad is included in warud tahsil of Amravati district has been previously called as ‘california’ of viderbha region. But due to excessive withdrawl of groundwater by deep bore wells and dug wells for orange cultivation, this area become dry and included in dark

watershed by state groundwater board.So there is a need to plan water conservation activities seriously.

Location

The village **Urad** lies in **Warud** tehsil of Amravati district and is located due north-east of Amravati head quarter at a distance of about 104 km and falls in the watershed WR-1.This area falls in dark watershed zone declared by state ground water board. The village falls in Survey of India, Toposheet No. 55 K/6 and 55k/7. The coordinates of the village are 78^{0}22'55" N: 21^{0}30' 04" E. It is located due north-east of Warud, tehsil head quarter, at a distance of about 18 km.(Figure 1).

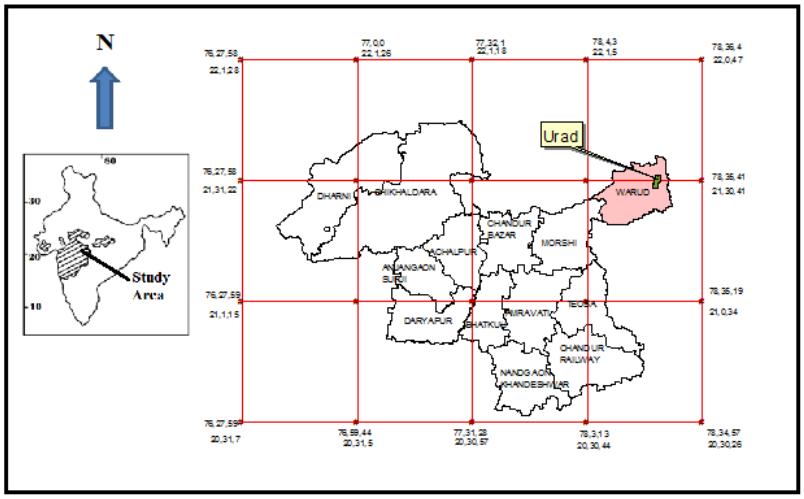

Figure 1: Location Map of Urad Village.

Methods of Study

During this study 100% well inventory of the existing wells, in Urad village has been carried out to delineate the unconfined aquifer on the basis of detailed and comprehensive hydrogeological survey with complete technical aspects about the aquifer, its characteristics, depth of wells, water level, annual fluctuation of water levels, well yields, cropping pattern water needs of villagers, availability of water and its useing pattern. During this study basemap of 1: 10,000 is used for field survey.Also refered the previous work and collected other relevant data like rainfall, temeperature, existing water conservation structures etc.

Socio-Economic Aspect

Village Urad is included in Pusla circle of Warud tahsil of Amravati district for administrative purpose.Village covers an area of about 13.84 sq.km.Population of the village is 554.Male population is 53% and female population is 47%.Population density is 40 per

sq.km.There are 136 households in the village.Basic facilities like electricity,primary education,drinking water source and road connectivity is available in the village.Total literacy is 58% out of which male literacy is 34% while female literacy is 24%.Main business of the people is agriculture.This area falls in dark watershed zone declared by state ground water board. Ground water is the only source for domastic as well as irrigation purpose.Once upon a time this area was covered by dense orange cultivation and still has been called california of vidarbha region.But most of the orange plants are now dried due to shortage of groundwater mainly due to excessive withdrawl of ground water. To overcome this problem watershed management techniques should be adapted and community involvement for long term watershed planning is very important(Sinha,C.P.,2000).

Table 1 : Information of urad village.

Sr.No.	Subject	Details
1	Village	Urad
2	Tehsil	Warud
3	District	Amravati
4	Population (2001)	554
5	Altitude range	400 to 480 m amsl
6	No. of irrigation wells	363
7	No. of wells electrified	287
8	No. of wells with oil engine	Nil
9	No. of disused wells	60
10	No. of drinking water wells	04
11	No. of drinking water bore wells	01
12	No. of irrigation water bore wells	04
13	Season	Crops
	Kharif	Cotton, Jowar Soyabean
	Rabbi	Wheat, Gram, Chilly, Vegetable
	Perennial	Orange, Sweet lime

Rainfall and Climate

The climate in the area is generally dry. The year may be divided into three seasons. The winter season is from November to February, summer season from March to May, and the monsoon season from June to October. The area receives the rainfall during monsoon season i.e. from June to October. This area receives an average annual rainfall of 961.34 mm. in last 10 years showing declining trend.The rainfall data for last10 years is shown below in Table 2.The data shows almost declining trend. [4]

Sr.No.	Year	Rainfall in mm.
1	2002	1684.46
2	2003	1482.00
3	2004	1308.68
4	2005	624.00
5	2006	715.01
6	2007	983.16
7	2008	553.58
8	2009	702.10
9	2010	796.70
10	2011	763.70
Total		9613.39
Average		961.34

Table 2 : Rainfall data of Amravati district for last 10 years.

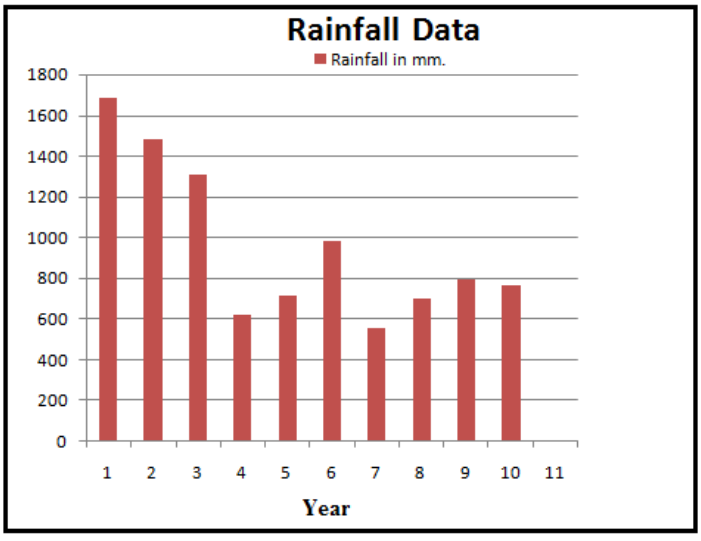

Figure 2: Rainfall for last 10 years.

Physiography and Drainage

Total geographical area of the village is 1384.19 hectare, Area under forest is 377 hectare and Cultivable area is 876.9 hectare.The topography of village is plain in general having gentle slope towards south west.. The North-eastern part of the village represents higher altitudes, and the altitude ranges from 400 to 480 m above msl. The morphometric characteristics of the watershed have been studied.(Horton,R.E.,1932,Horton, R.E.,1945,Strahler,A.N.,1957).The village area is mainly drained by 3rd order streams flowing through entire area. The 1st order drainage flows almost NE to SW and joins the 2nd order stream flowing in the same direction. The 1st and 2nd order further joins 3rd order which is also flowing in NE-SW direction , which later takes a bend and flows towards South East .After flowing for about 1.5 km it again bends and takes a straight course to southern part of Urad village. In general drainage pattern is dendritic and all streams are seasonal.

Geomorphology

Geomorphological characteristics of a watershed are commonly used for developing the regional hydrological models to solve the various hydrological problems of ungauged watershed(Sharma et.al.,2010).An accurate understanding of of the hydrological behavior of watershed is important for its effective management(Agarwal et.al.,2011). The western, southern and central part urad village is mostly included in storage zone which is characterised by thick soil cover and thick weathered zone. Rest of the northern and northeastern area is covered by arcuate, undulating belt of runoff zone (MDP-A)with exposed rock and thin soil cover. Runoff zone (HDP-A) with exposed rock ,negligible soil cover, plateau top and massive type residual hills is also present in extreme North East corner of urad village.

Agriculture

In the area kharif, rabi and perennial crops are grown. During field survey it has been observed that the Kharif crop requires watering only in long dry spell, while rabbi and perennial crops are based on groundwater irrigation. The crops grown in the area are given in Table 3.

Table 3 :Cropping Pattern of Urad Village.

Sr.No	Season	Crops	Area in hactare
1	Kharip	Cotton	297.22
		Jowar	97.21
		Soyabean	114.89

		Other crops	66.65
2	Rabbi	Wheat	1.60
		Gram	0.88
		Other crops vegetables, chilly	7.73
3	Perennial	Orange	133.14
		Sweat Lime	1.93

Irrigation Status

The traditional irrigation practice (flood irrigation) is widely used in the area. This results in lot of evaporation losses. The community though is aware of the modern irrigation practices but using them in less proportion, mainly drip irrigation systems. In the area 144.40 hectres of land is irrigated by 287 dug wells. The irrigation crop in the area are mainly orange, wheat, chilly, and vegetables.Due to the high density of wells and the high water requirements of the crops grown in the village, imbalance in the groundwater recharge and withdrawal conditions has been observed.

Geology

Study area is covered by basaltic lava flows of Deccan Traps. During traverses,flow units are mapped and altitudes of flow contacts are generated with the help of fly leveling.The surface exposures and study of well sections reveal lower part of basaltic lava flow is fine grained,grayish black in colour,compact and vertically jointed,while the upper part is made up of vesicular and amygdaloidal basalt.Individual flow is generally separated by fine grained material with tuffaceous or scoriaceous appearance ,redish broen incolour.These inter flow horizoans are known as redbole.When redbole is exposed to surface it becomes friable.

The various flows are mapped in the field and lithological section has been prepared.There are three lava flows exposed in this area(Table 4) .

Table 4 : Geological succession of Urad

Unit	Formations	Age	Thickness (m)	Altitude	Description
	Local Alluvium	Recent	2.00 to 8.00	-------	Consist of silt, sand,cobbels, pebbles and gravels

F 3	Massive Basalt	Lower Eocene to Upper Creataceo us	26	454 to 480	Greyish, fine grained, poorly jointed massive basalt
F 2	Vesicular Basalt		14	440 to 454	Greyish, fine grained , highly weathered, vesicular basalt
	Massive Basalt		14.00	426 and 440	Gryish, fine grained, poorly jointed and moderately weathered massive basalt.
F 1	Vesicular Basalt		9.00	417.00 to 426.00	Greyish, fine grained , highly weathered, vesicular basalt and vesicles are filled secondary calcite.
	Massive Basalt		-------	417 and below	Greyish, fine grained, poorly jointed compact massive basalt

Hydrogeology

The village area is covered by basaltic lava flows of varying thickness.These flows show two units namely massive basalt lava flow unit and vesicular basalt lava flow unit.The massive basalt lava flow unit is basically hard and compact having no primary porosity and permeability.This flow unit acts as a impermeable formation.However primary cooling joints and secondary fractures and joints developed in massive basalt formations , convert it into a moderate ground water storage unit.Rise and fall in water level represent the change in ground water storage within the aquifer zone.During the well inventory, summer and winter static water level data was collected.The wells are connected to mean sea level by fly leveling.Reduced level(RL) values of pre mansoon and post mansoon water level were computed and water table contour maps of village area are prepared.Winter and summer water levels follow the topography.The movement of ground water is towards south west.

Aquifer

The data collected through base line hydrogeological surveys were technically analyzed to identify the different aquifers and their boundary conditions in the village. There are 363 wells existing in the village. Out of them 359 wells are irrigation wells and 4 wells are used for drinking water supply purpose. In all 287 wells are fitted with electric pump. There is one bore well in urad village for drinking water purpose fitted with hand pump. In

the village area ground water occurs under water table condition i.e. unconfined aquifer system.The thickness of the lateral extension of the aquifer system are not uniform nature because of erratic behavior of the basaltic flow.The aquifer encountered in the village is composed of vesicular basalt and weathered massive basalt and jointed and fractured massive basalt.In aquifer the thickness of these three formations is variable from place to place. The vesicular basalt occurs between 417 and 426 meter above msl.During the field investigations in all 363 wells were examined for collecting information pertaining to hydrogeology of the aquifers, depth of wells, water level, annual fluctuation of water levels, well yields, cropping pattern and other relevant hydrogeological parameters required for assessing hydrogeological characteristics of the village area. On the basis of field survey the hydrogeological conditions were ascertained. In the village Urad groundwater occurs in weathered zone of vesicular , massive basalt and in jointed and fractured massive basalt. The average well density of this village is 26 wells / km^2.Now a day due to the high density of wells and the higher water requirement of the crops in the village ,imbalance in the ground water recharge and withdrawal conditions has been observed.

Deeper Aquifer

On the basis of reported data of irrigation bore wells which is collected by interviewing the cultivators, the deeper aquifer in the village is well developed. The data of the irrigation bore wells drilled in the agricultural land shows that there exists deeper aquifer up to a depth of 170 meter. Out of the four bore wells drilled for irrigation purpose all are found to be successful. The aquifer exists beyond the depth of 60 meter bgl. Initially, bore wells were drilled up to 80-90 meters yielding adequate quantity of water, but day by day there is race of constructing deeper bore wells due to which adverse effect is observed and the yields of the bore wells has been drastically reduced.

Depth to water level

The diameter of wells varies from 1.7 to 7.60 meter while the depth ranges from 3.10 to 29.The static water leval varies between 1.00 to 13.67 meter bgl during winter and 5.50 to 20.00 meter bgl during summer season(Figure 3).The average water level during winter is 4.37 and in summer is 9.41 meter.Nearly 50% of the wells are dry in summer season due to inadequate depth or absence of aquifer.The depth of aquifer ranges from 3 to 12 meter bgl.About 70% of rest of the wells sustaining in summer are having horizontal bores wells of 20 to 75 meter length.

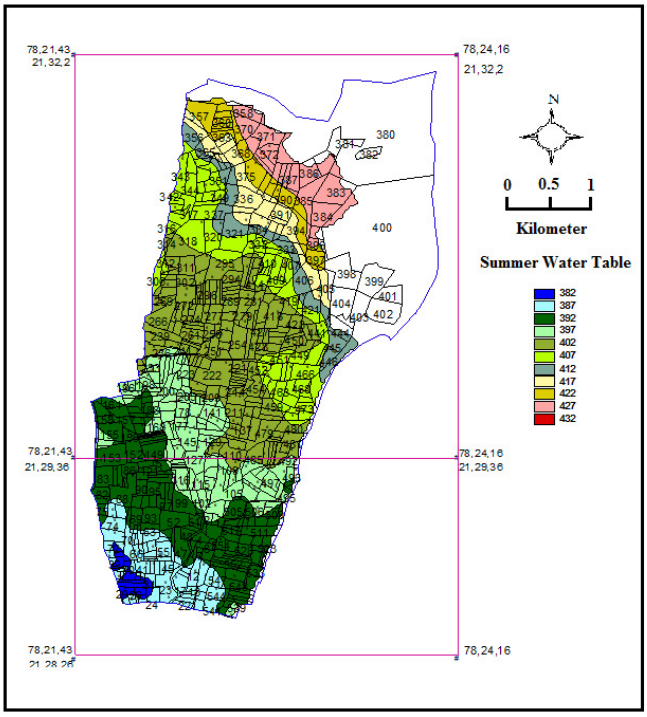

Figure 3: Summer Water Level

Water Level Fluctuation

To understand the short term behaviour of the water level from pre-monsoon to post-monsoon period , depth to water level map and water level fluctuation map is prepared. Based on the warer level fluctuation map , water level fluctuation between 1.5 to 13.50 meter is observed .From water level fluctuation map it can be seen that in the northern and central area of the village , the fluctuation is in the range of 0.456 to 5 meter indicating good areal extent and ground water potentially of the aquifer. While the wells located in the south part of the village are having 5 to 10 meter fluctuation showing moderate performance of the aquifer (Figure 4). The water level fluctuation between pre and post monsoon depends on local hydro geological situation.

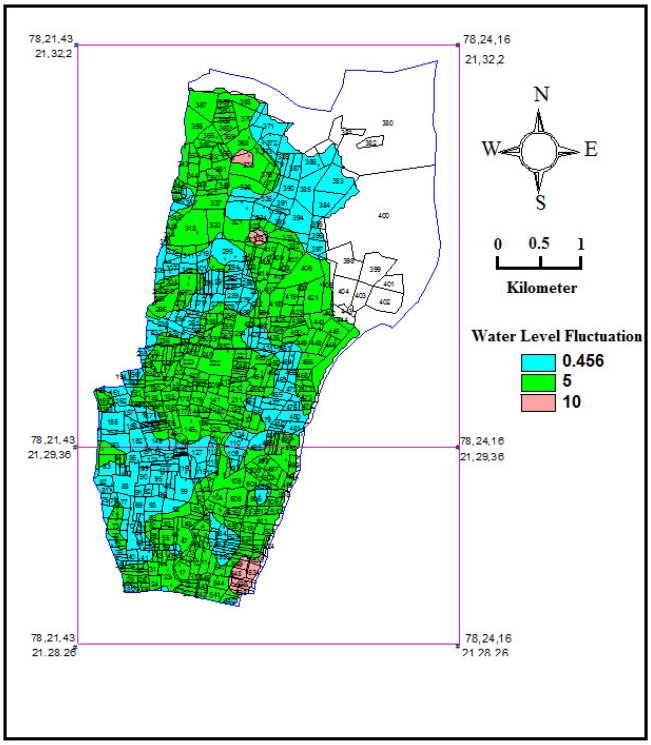

Figure 4: Water Level Fluctuation

Drinking Water Status:

There is one bore well fitted with handpump,two domestic wells and two public water supply wells are present in urad village to fulfil the drinking water requirement of the village. Water requirement of urad village every year is as follows-

Population 554 x 40 (lit./day) x 365 days

= 8088400 liters/year

= 0.81 ham./year

Water requirement for animals is as follows-

Animals 150 x 50 (lit./day) x 365 days

= 2737500 liters/year

= 0.27 ham./year

Total water requirement for human being and live stock is 1.08 ham per year.Four dug wells and one bore well fitted with hand pump are not having sufficient water to fulfil the need of population and live stock of the village.

Water conservation activity

Water Conservation Structures (WCS) have been constructed in the village to improve the recharge to groundwater in the village. Following water construction structures are existing in urad village area.

Table 5 : Various conservation structures present in urad village.

Sr.No.	Type of Structure	NO. of Structures.	Capacity (ham)
1	Cement Bandh	32	12
2	Mati nala bandh	04	10.70
3	Field Tank	07	0.61
4	Total	43	23.31

Field study of the location and condition of the water conservation structure indicates that all the 43 structures have been constructed at favorable sites from groundwater point of view. But the previous total capacity of all the existing structures is 23.31 ham. Is reduced due to silting and all the structures should be desilted to enhance recharge of groundwater.

Conclusions

Hydrogeological appraisal of village Urad was conducted. The basaltic lava flows are the main rock type in the area. The central portion all along the main stream the vesicular basalt unit is caped by local alluvium of some places. This together forms the main aquifer in the village. The direct precipitation received in the area is the main source of ground water recharge. Additional recharge takes place from water conservation structure constructed. The area is devoid of perennial streams. One major stream flows from N-S is seasonal in nature and turns dry during March. The groundwater occurs under water table condition in weathered vesicular trap in shallow depth zone. The aquifer is unconfined. A single aquifer system exists. The bore wells drilled in Deccan Traps indicates the presence of semiconfined condition in the fractured zone at deeper level below the zone of weathering. The depth of weathering is found to vary laterally from less than 4.00 meter bgl to more than 8.00 m in some places. Alluvium occurs in small areas along the stream, generally containing medium size gravel which is not productive as far as ground water prospectus is concern. The depth of water level in pre-monsoon varies from 5.50 to 20.00 meter bgl. Seasonal fluctuation varies from 1.5 m to more than 13.5 m bgl in the area. Aquifer was delineated and is composed of local alluvium, vessicular basalt, and fractured massive basalt. Also the density of irrigation wells is high, indicating high draft. However the number of wells in the north eastern portion is less due to nonworthy area.

Recommendations

In order to meet out the shortfall or to maintain groundwater level within the safe limit during hydrological cycle and for the sustainability for years together, involvement of the community may be sought both in supply side and demand side management. Some

suitable observation wells and rain gauge stations may be installed and data to be generated involving village youth for this purpose. Some technical options for water harvesting may be chosen considering community's traditional wisdom integrated with scientific techniques, so that options become adoptable, acceptable and manageable from maintenance and operation point of view. Secondly crops requiring less water, should be encouraged, use drip and sprinkler irrigation system, watering at morning 3 to 7 hrs to avoid evaporation losses, continuous contour trench should be undertaken in the high ground in the North and North East part of village, desilting of the existing water conservation structures, construction of new irrigation wells and bore wells should be totally banned with people's I.E.C.

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