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A NEW CONCEPT OF DRAINAGE DEEPENING AND WIDENING FOR GROUNDWATER RECHARGE - A CASE STUDY

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Abstract: New concept of drainage deepening and widening for groundwater recharge is emerging today. This new concept has been applied to Gadegaon village, taluka Warud, district Amravati(M.S.) has been studied carefully. In Gadegaon drainage near the public water supply well behind cement bandhara has been deepened by 2 meter, width 20 meter and length 140 meters. During this process silt and clay has been removed for ground water recharge purpose. Lithologically this area is overlain by shallow alluvium up to 13 meter depth. Below 13 meter vesicular basalt is present. Both alluvium and vesicular basalt are acting as potential aquifer in this region. The village Gadegaon was facing acute shortage of drinking water since long time. After water budgeting, it is observed that the shortage of water reaches about 115.50 ham. After taking the structure of drainage deepening and widening adequate drinking water is available to public water supply well of Gadegaon village. This new concept of drainage deepening and widening can proved to be successful where weathered strata and clay over burden is present which restricts the groundwater percolation.

INTRODUCTION

The Gadegaon is included in Warud tahsil of Amravati district has been previously called as 'California' of Vidarbha region. But due to excessive withdrawal 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. 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).Some other new ideas are now adapted at many places for groundwater recharge which will be suitable for local conditions. At Gadegaon drinking water problem is solved by taking drainage deepening and widening structure.

Location

The village **Gadegaon** lies in **Warud** tahsil of Amravati district and is located due north-east of Amravati head quarter at a distance of about 118 km and North-East of Warud,

tahsil head quarter, at a distance of about 18 km, falls in the watershed WR-2.This area covered under dark watershed zone declared by state ground water board. The village falls in Survey of India, Toposheet No. 55k/7. (Figure 1).

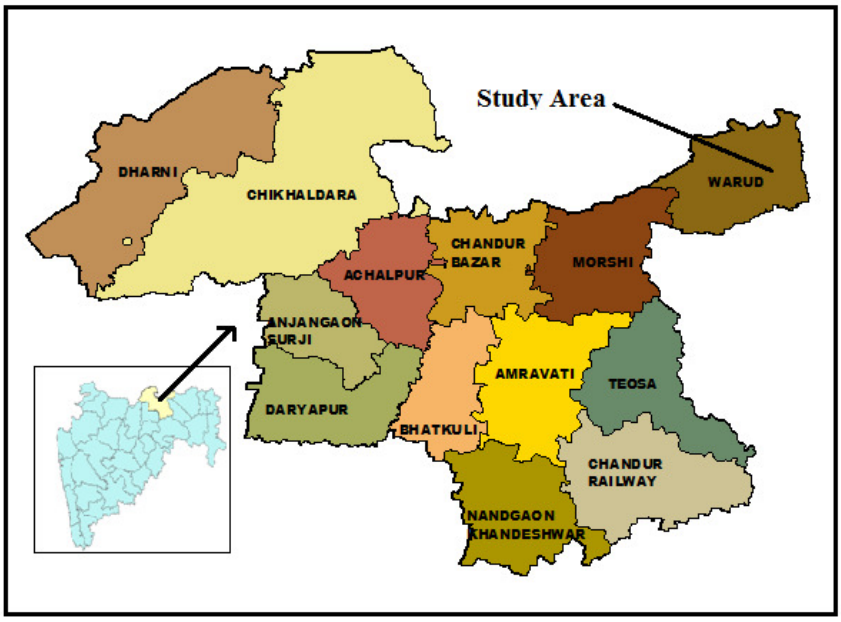

Figure 1: Map of Amravati district showing location of the study area.

Methods of Study

During this study well inventory of the existing public water supply well near the field of Ashok Dudkawre and adjoining irrigation wells has been carried out to understand the unconfined aquifer with complete technical aspects about the aquifer, depth of wells, water level, annual fluctuation of water level, well yield, water requirement of villagers, availability of water and its using pattern, cropping pattern. During this study complete information about existing water conservation structures has been gathered and rainfall data is collected from National Information Centre at district head quarters. Finally water budget of the village has been prepared.(Table3).

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.

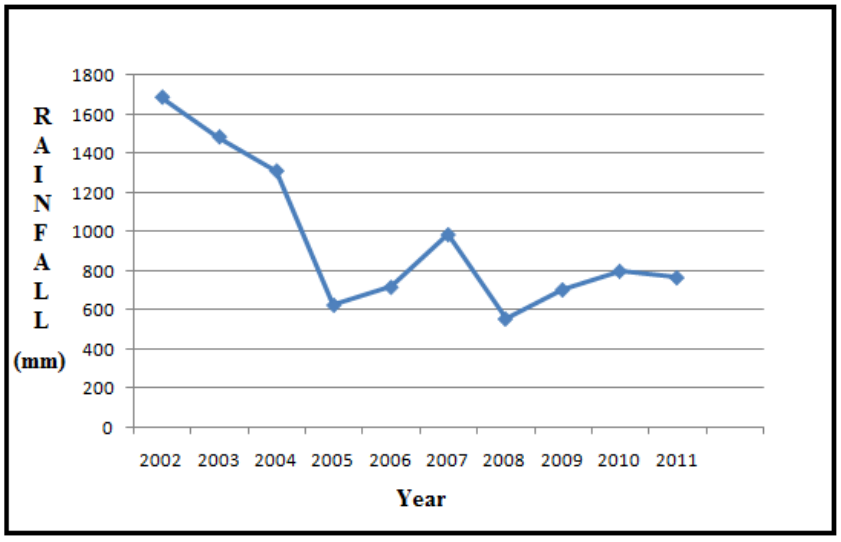

Figure 2:Rainfall data for last 10 years.

Physiography, Geomorphology and Drainage

The topography of village is plain in general having gentle slope towards South. The the altitude ranges from 384 to 380 m above msl. 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 morphometric charicteristics 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 adjoining the village. The 1st order drainage flows almost N to S 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 N-S direction, which later takes a bend and flows towards South East. In general drainage pattern is dendritic and all streams are seasonal.

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 adapted in less proportion. The total area of village is 445.53 hectares out of which 388 hectares of land is irrigated by 228 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 required crops grown in the village and declining trend of rainfall from last 10 years, imbalance in the groundwater recharge and withdrawal conditions has been observed.

Geology

Study area is covered by alluvium underlined by vesicular basalt. The surface exposures and study of well sections reveal that alluvium present upto 13 meter depth and below 13 meter vesicular basalt is present.(Fig,3)This alluvial layer was covered by silt and clay which resist the percolation of groundwater.

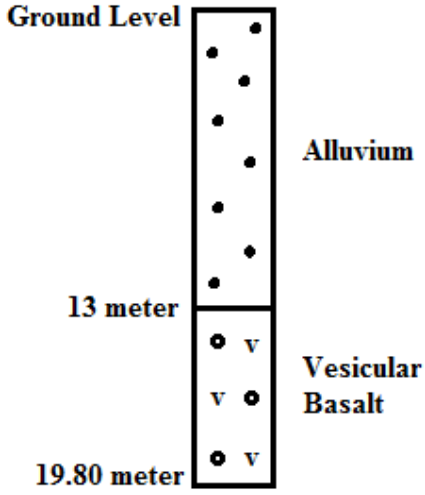

Figure 3: Litho section of public water supply well of Gadegaon village.

Aquifer

The data collected through hydrogeological surveys revels that alluvium is present up to 13.00 meters of depth and below alluvium, vesicular basalt is present. Here alluvium and vesicular basalt both are acting as potential aquifers. This alluvium is covered by soil and silt which has been removed during drainage deepening and widening activity. different aquifers and their boundary conditions in the village. There are 230 wells existing in the village out of them 228 wells are irrigation wells and 2 wells are used for drinking water supply purpose. In all 205 wells are fitted with electric pump. There are 4 bore well in gadegaon 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 depth of water level in pre-monsoon varies from 14.00 to 17.00 meter bgl. Where as depth of water level in post mansoon is 11.00 to 13.00 meter. Seasonal fluctuation varies from 3.00 meter to 7.00 meter bgl in the area. The thickness of the lateral extension of the aquifer system are not uniform nature because of erratic behavior of the basaltic flow and uneven thickness of alluvium. Now a days 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.

Drainage Deepening and Widening

New concept of drainage deepening and widening for groundwater recharge is emerging today. This new concept has been applied to Gadegaon village, taluka Warud, district Amravati. In Gadegaon drainage near the public water supply well behind cement bandhara has been deepened by 2 meter, width 20 meter and length 140 meters. During this process silt and clay has been removed for ground water recharge purpose. The clay cushion of 3.00 meter is left behind cement bandhara to reduce the direct pressure of stored water on bandhara walls(Plate 1 and 2). Lithologically this area is overlain by shallow alluvium up to 13 meter depth. Below 13 meter vesicular basalt is present. Both alluvium and vesicular basalt are acting as potential aquifer in this region. The village Gadegaon was facing acute shortage of drinking water since long time. After water budgeting, it is observed that the shortage of water reaches about 115.50 ham. After taking the structure of drainage deepening and widening 5600 cubic meter extra water is available resulted in almost equilibrium static water level condition in adjoining wells and in public water supply well of Gadegaon village.

Conclusions

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. The groundwater occurs under water table condition in alluvium and vesicular trap in shallow depth zone. The aquifer is unconfined. A single aquifer system exists. Drainage deepening and widening solved drinking water problem.

Table 1: Information of Gadegaon village.

Sr.No.	Subject	Details
1	Village	Gadegaon

2	Tehsil	Warud
3	District	Amravati
4	Population (2001)	1750
5	Census Number	00744500
6	Watershed Number	WR-2 (Wardha river basin)
7	Altitud e above mean sea level	380 meter
8	Number of Irrigation wells	230
9	No. of drinking water wells in use	02
10	No. of drinking water bore wells in use	04

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

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 3: Water budgeting of Gadegaon village for the year 2011-12

Water Budgeting of Gadegaon Village (2011-12)		
1	**Name of village**	**Gadegaon**

2	**Taluka**	**Warud**
3	**District**	**Amravati**
4	**Area of the village**	**445.53**
5	**Rainfall in mm.**	**763.7**
7	**Population**	**1750**
8	**No. of Animals**	**400**

Cropping pattern

Sr.No.	Crop season	Crops		Required water per hectare (TCM)	Total area of crop(hectare)	Total water consumption (TCM)
2	**Kharip**	**Jawar**		**0.25**	**42**	**10.50**
3	**Kharip**	**Pulse**		**0.25**	**56**	**14.00**
4	**Kharip**	**Cotton**		**0.25**	**22**	**5.50**
5	**Kharip**	**Soyabin**		**0.25**	**76**	**19.00**
9	**Rabbi**	**Gram**		**0.4**	**41**	**16.40**
10	**Summer**	**Orange**		**1.2**	**102**	**122.40**
11	**Summer**	**Vegetables**	**Other**	**0.6**	**22**	**13.20**
12	**Rabbi**	**Wheat**		**0.6**	**27**	**16.20**
Total					**388**	**217.20**

Existing water conservation structures

Sr.No.	Conservation Structure	Total	Capacity(Ham)	Ground water recharge(Ham)
1	**Percolation Tank**	**0**	**2.5**	**0**
2	**Cement Bandhara**	**4**	**2**	**4**
3	**Gabian Bandhara**	**0**	**0.5**	**0**
4	**Village Tank**	**0**	**1.5**	**0**
5	**Mati Nala Bund**	**0**	**0.5**	**0**
7	**Underground Bandhara**	**0**	**0.5**	**0**
9	**Kolhapuri Bandhara**	**1**	**1.5**	**0.75**
			Total	**4.8**

Table 3 : continue….

Total available water	
Available water=Village area(hect)xRainfall in meter	**340.25**
Surface Water	**17.01**

Groundwater Recharge	**34.03**
Soil Moisture	**51.04**
Groundwater Recharge due to Conservation Structures	**4.8**
(A)Total available water	**106.83**
Required Water	
Population x Required Water 50 per person x 365 days	**2.56**
Animals x Required Water 30 per animal x 365 days	**0.44**
Water for Irrigation	**217.20**
Water Required for Other purpose(2%)	**2.14**
(B)Total Required water	**222.33**
Total available water(A) - Total Required water(B)	**-115.50**
Shortfall of Water(Ham)	**-115.50**

Recommendations

In order to meet out the shortfall, involvement of the community is very important which can fulfill supply side and demand side management. Some technical options for water harvesting should be taken with community's traditional wisdom integrated with scientific techniques, so that options become adoptable, acceptable and manageable from maintenance and operation point of view. Secondly Low water requirement crops should be encouraged, use of drip and sprinkler irrigation system, watering at morning 3 to 7 hrs to avoid evaporation loss, continuous contour trench should be taken in the high ground, desilting of the existing water conservation structures, Irrigation bore wells should be banned with people's I.E.C.

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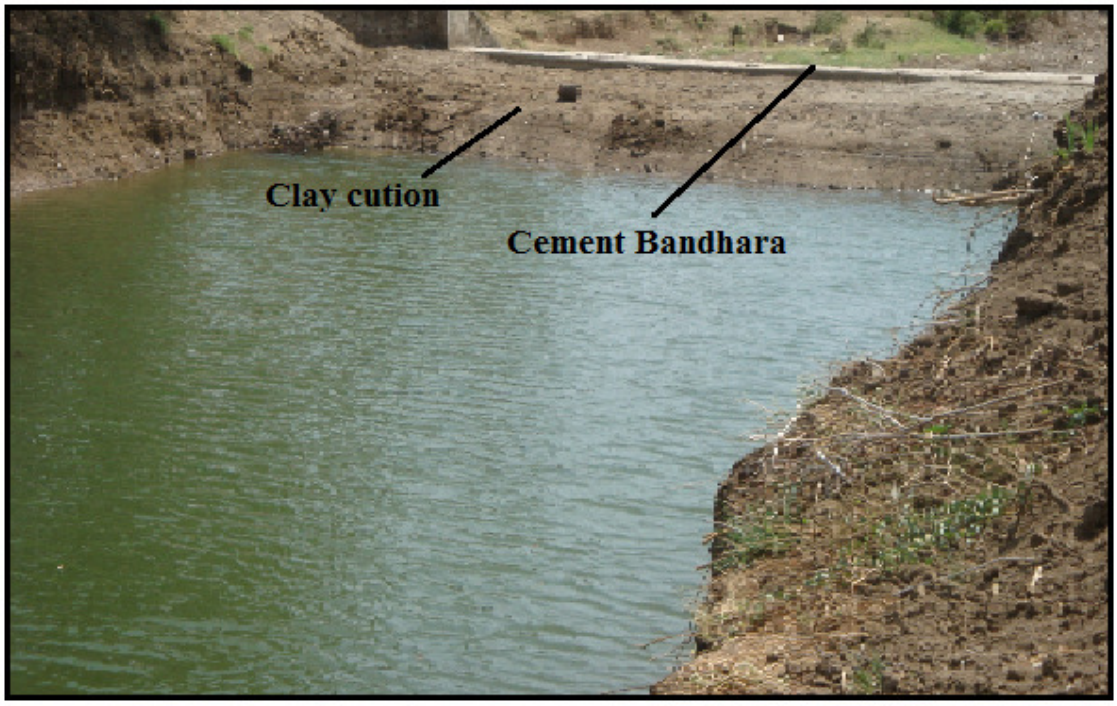

Plate 1:Stored water after nala deepening and widening

Plate 2: Stored water after nala deepening and widening