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SUSTAINABLE ENVIRONMENTAL SANITATION AND WATER SERVICES

Over exploitation – a critical groundwater problem

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WATER DEMAND IS progressively increasing due to its use for agriculture, industries and domestic requirements. Wherever surface water storage or canal irrigation is absent or limited, there is a greater activity of groundwater extraction. In recent years the utilization of groundwater by digging wells has increased manifold due to availability of financial assistance from NABARD and other banking institutions. The density of irrigation wells has grown very critically in same watershed causing serious problems of water scarcity and other environmental conditions. The groundwater related problems of overexploitation have assumed an alarming position so as to require immediate remedial measures to address the situation.

Effects of Overexploitation on Groundwater Regime

The over extraction of groundwater i.e. excessive withdrawal beyond the normal recharge in any given area creates many harmful effects which could be identified as:

- Continuous lowering of water levels. (Both pre-monsoon and post- monsoon)
- Lowering of pump sets, causing low efficiency, higher cost of operation
- Reduction of yields of wells, well interference due to close spacing of wells, severe drinking water scarcity in summer months.
- Deepening of wells, mining of groundwater from deeper aquifers
- Increase in cost of groundwater extraction, cost benefit affected
- Damage to aquifers due to compaction, risk of ground subsidence due to inter-relationship between withdrawal and downward trend in water levels due to overdraft conditions.
- Total collapse of operation & management system of groundwater resource of the basin or watershed and disturbed planned and sustained development and regulatory system in the area.
- The intensive high water requirements from crops such as sugarcane, bananas, onions, grapes and oranges puts high demand on groundwater requirements, which do not match with natural recharge conditions.

Studies in Maharashtra

The groundwater resources in the Maharashtra State due to its specific hydrogeological conditions and physiographic configurations have assumed a greater importance. Therefore groundwater resources are required to be scientifically assessed and planned for sustained development. In order to achieve this objective a systematic approach in groundwater assessment has been adopted. The entire area of the State has been demarcated into 16 river basins and each basin is further divided into 1505 watersheds. Periodic assessment of groundwater for all these watersheds has been undertaken since 1973.

Water Level Studies

It may be stated that, like the pulse in a human body, the behavior of water levels forms a valuable diagnostic tool in the hands of the Hydrogeologist to understand the health of the groundwater reservoir. This requires the establishment of an adequate network to monitor the groundwater levels both on the regional and the micro (watershed) scale, with a density of observation stations as per the scale of investigation. Maps are essential and required to be adequately maintained. For a more rigorous analysis of the water level data and its relation to various causative factors, statistical techniques should be increasingly used to replace the single qualitative methods. Analysis of water level changes affords the estimation of hydraulic parameters and analysis of the water level trend forms important parameter in the planning of water resources.

Assessment of Groundwater Recharge Withdrawal

Periodic studies are carried out for groundwater recharge and withdrawal for each watershed on the basis of field data on water levels and pumping tests (transmissivity and storativity values). A network of observation wells is set up in all the watersheds and the measurement of water levels pre-monsoon (summer) and post-monsoon (winter) are taken every year. Total annual recharge is calculated on the basis of fluctuation, storage capacity and specific yield of aquifer for each watershed.

Similarly total annual withdrawals for each watershed is calculated by total number of wells and their average annual draft. Well inventory surveys are carried out to determine the pumping hours and draft of the wells. Such scientific studies are useful in assessing the groundwater regime and status of development so as to provide planned and sustainable development. These assessment studies have shown a rapid growth in the groundwater resource development.As seen in fig. 1, there are a total of 7 dark watersheds in the Nashik district having more that 85% of

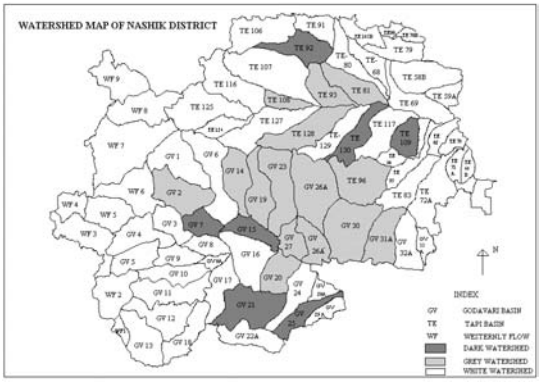

Figure 1. Watershed map of Nashik District

development as shown in the table 1. All these watersheds harvest cash crops like Onion, Sugarcane, and Groundnut, etc. requiring high water. 30 – 33% of water is drawn from groundwater sources (well draft) for non-paddy and paddy respectively during Kharif only. The number of wells in these watersheds has gone so high that its density, as seen from table 2, again contributes to the overdraft.

As indicated in fig 2, the wells have gone deeper to tap the water reaching the depth of about 10m or higher. There is a decline of water level reaching almost to the depth of well and the water level study of last 10 years shows the falling trend.

Remedial Measures in Overexploited Areas

In such critical overexploited areas, remedial measures are required immediately to be undertaken to solve the problem in stages and restore normalcy. The remedial measures would be of two types:

1. **Restrictive regulatory measures** – It is very necessary for the planned development of resources to provide laws and regulations through enactment. The groundwater law should be enforced, restricting new wells, capacity of pump sets, restriction on pumping hours, limitation of perennial crops, spacing of wells, registration of wells, etc. These restrictive regulatory measures may be partly useful and requires effective law implementation machinery. It may involve litigation problem, but needs to be pushed through for bringing discipline in groundwater resource utilization.

2. Artificial recharge project works – The other creative and more useful remedial measures is artificial re charge, which is considered to be the ultimate solution in groundwater development after direct excessive ab straction from the aquifer. The objective is to recoup the excessive withdrawal of the groundwater, which would help in reversal of declining of water level trend, and achieve the normalcy of groundwater storage and its utilization. The artificial recharge is an established practice as a process of replenishment of the water in the groundwater storages through various works provided for that purpose. Both conventional and unconven tional project works like construction of Percolation Tanks, Nala Bunds, Check Dams, Contour bunds, Pitting and Trenches, Water Spreading, Bore Blast Technique, Jacket well etc have to be implemented to reduce the surface run off and to compensate overdraft of watershed.

In addition to above remedial measures, the adoption of modern techniques of sprinkler and drip irrigation would help in limiting the indiscriminate use of water applied for irrigating the crops.

Conclusion

The author has attempted to throw light on the overexploitation of groundwater and need for undertaking the projects of artificial recharge and water conservation in the overdeveloped watersheds by taking case history of dark watersheds of Nashik district in Maharashtra. The

Water-shed No.	Net Recharge (Hectare metre)	Net Draft (Hectare metre)	No. Of wells	Development Stage (%)	Cropping Pattern
GV 7	3354.52	3139.49	4540	93.59	Grapes
GV 15	1204.90	1253.70	1794	104.05	Sugarcane, Grapes
GV 21	2957.32	2726.53	4598	92.20	Onion, Grapes
GV 25	2388.68	2135.71	3642	89.41	Onion, Groundnut
TE 92	2147.18	2843.92	3443	132.45	Sugarcane, Jawar
TE 109	1193.94	1072.05	2146	89.79	Onion, Wheat
TE 130	3522.68	3223.61	5017	91.51	Onion, Cotton

Figure 2. 5th Groundwater Assessment based on 1998 Draft Data of Dark Watersheds in Nashik District

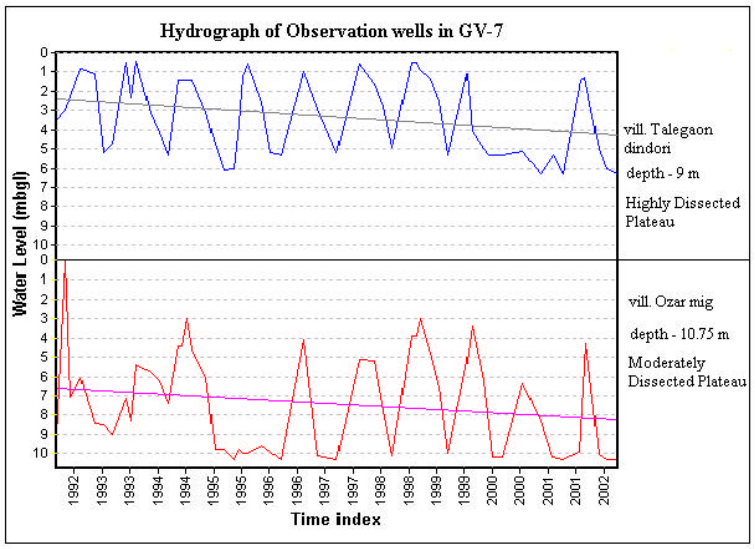

Figure 2. Hydrograph showing water level and the trend of the last 10 years

Sr. No.	Village	Watershed No.	Geographical Area (sq. km.)	Total No. Of wells	Density per sq. km.
1	Dixi	GV 7	3.36	241	72
2	Thergaon	GV 7	1.39	150	107
3	Sundarpur	GV 15	2.70	139	51
4	Atakwade	GV 21	1.73	61	35
5	Bhaygaon	TE 109	4.67	182	39
6	Patharde	TE 109	3.04	74	24

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causative effects, field observations and the remedial measures have been discussed in this paper. The assessment of groundwater carried out by GSDA has been presented to support the severity of the overexploitation and the emphasis is given on the artificial recharge and adoption of modern techniques of irrigation.

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