International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 1 Issue 2 ǁ 2013 ǁ PP. 50-54

Ground Water Development for Portable Water Supply

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Abstract
Groundwater hydrology is the science of the occurrence, distribution, and movement of water beneath the earth's surface. The only difference between geochydrology and hydrogeology is a greater emphasis on geology. Groundwater has been used since ancient times, but understanding the occurrence and movement of subsurface water as part of the hydrologic cycle has only recently emerged. Groundwater is an important source of fresh water on the planet. It is the one that assists in meeting the water requirements for various activities. This groundwater cannot be used for general purposes without first determining its quality. Water's physical, chemical, and biological properties should be within acceptable limits.
Keyword
Water, Water Supply, Groundwater, Surface Water , Portable water supply, Ground Water Resources,

I. Introduction

The main sources of water available to people in general are ground water, surface water (rivers, streams, and ponds), atmospheric water (rain, snow, and hail), and springs. The quality of these bodies of water varies greatly depending on their location and environmental factors. Precipitation infiltrates the ground and moves through the soil and pore spaces of rocks as the primary source of ground water. Water infiltration from lakes and streams, recharge ponds, and waste-water treatment systems are among the other sources. Many impurities, such as disease-causing microorganisms, are filtered out of ground water as it moves through soil, sediment, and rocks. [1] Many developing-country water resources are unsafe because they contain harmful physical, chemical, and biological agents. To maintain a good health however, water should be safe to drink and meet the local standards and international standards to taste, odour and appearance.

Understanding the origin, occurrence, and movement of groundwater came much later. Greek philosophers' writings on the origins of springs and groundwater contain theories ranging from fantasy to nearly correct accounts. As late as the seventeenth century, it was widely assumed that water from springs could not be derived from rainfall because the quantity was insufficient and the earth was too impervious to allow rain water to penetrate below the surface. As a result, early Greek philosophers like Homer, Thates, and Plato proposed that springs were formed by seawater. [2] Aristotle proposed that air enters cold dark caverns beneath the mountains, where it condenses into water and contributes to springs, via subterranean channels.

Ground Water Resources Availability:

In India, rainfall is the primary source of ground water recharge, which is supplemented by recharge from canals, irrigated fields, and surface water bodies. The upper unconfined aquifers, which are also active recharge zones and hold the replenishable ground water resource, account for the majority of ground water withdrawal. The replenishable ground water resource in the country's active recharge zone has been assessed by the Central Ground Water Board in collaboration with the relevant State Government authorities. [3] The assessment was carried out using Block/Mandal/Taluka/Watershed as the unit and in accordance with the Ground Water Estimation Committee (GEC)-1997 recommendations. According to the most recent assessment, the annual replenishable ground water resource in this zone is 432 billion cubic metres (bcm), of which 399 bcm is considered to be available for development for various uses after allowing 34 bcm for natural discharge during non-monsoon periods to maintain flows in springs, rivers, and streams (Central Ground Water Board, 2006). [4]

GROUND WATER BALANCE EQUATION

Considering the various inflow and outflow components,the terms of the ground water balance equation can be written as:

$$Ri + Rc + Rr + Rt + Si + Ig = Et + Tp + Se + Og + \Delta S$$

where,
Ri = recharge from rainfall;
Rc = recharge from canal seepage;
Rr = recharge from field irrigation;

Rt = recharge from tanks;
Si = influent seepage from rivers;
Ig = inflow from other basins;
Et = evapotranspiration;
Tp = draft from ground water;
Se = effluent seepage to rivers;
Og = outflow to other basins; and
ΔS = change in ground water storage.

This equation takes into account only one aquifer system and thus does not account for interflows between aquifers in a multi-aquifer system. However, if enough data on water table and piezometric head fluctuations, as well as the conductivity of intervening layers, is available, the additional terms for these interflows can be included in the governing equation[5].

II. Review of Literature

Despite the potential of groundwater and the critical role it plays in Nigeria's water supply security, its development and management do not appear to be receiving the attention they deserve. Its development and management are undertaken on a private rather than municipal basis. Groundwater is exploited in a haphazard and indiscriminate manner by the government, private institutions, and individuals, with no control, organisation, or management. This bleak scenario is the result of a deliberate and intensive failure to integrate regional groundwater exploration and exploitation programmes into the overall National Water Resources Development Program. The need for commensurate attention to groundwater development, led and managed by relevant professionals, has been critical. This need has arisen as a result of enormous groundwater development potential and obvious neglect of this sector of water Resources Development. [6]

G. Achuthan Nair et al. (2004) assessed ground water quality in North-East Libya using a water quality index. The suitability of groundwater for drinking was determined in six locations in north-east Libya, namely El-MarjAlbayda, Shahat, Susa, Ras al-Hilal, and Derna, from November 2003 to March 2004 by determining their physicochemical parameters (17 parameters) and water quality index (15 parameters). Libyans are aware of the importance of ground water quality and purity, and the current study will be invaluable in maintaining the desired levels. [7]

Aside from the resources available in the zone of water level fluctuation, extensive ground water resources have been demonstrated to exist in the country's deeper confined aquifers, the majority of which are in the Ganga-Brahmaputra alluvial plains (Romani, 2006). To a lesser extent, such resources are also available in deltaic and coastal aquifers. The recharge zones of these aquifers are located in the upper reaches of the basins. The resources in these deep-seated aquifers are termed 'In-storage ground water resources'. The quantity of these resources has been estimated to be 10,800 bcm. Although ground water resources in these aquifers are used to a limited extent in parts of Punjab, Haryana, and western Uttar Pradesh, detailed studies are to be taken up to fully understand the yield potentials and characteristics of these aquifers. [8]

During the 2011 pre- and post-monsoon seasons, Vikas Tomar et al. [9] collected water samples from 67 locations in Karnal district, Haryana. The samples were then tested for chemical properties. Sodium-calcium bicarbonate and magnesium bicarbonate were the most common types of water in the study area during the pre and post-monsoon seasons of 2011. The chemical changes caused by rain and natural recharge were investigated by categorising pre and post monsoon water samples using various standard irrigation criteria. It demonstrates that in 2011, Na-Ca-HCO3 water predominates during the pre-monsoon season and Mg-HCO3 water predominates during the post-monsoon season.

Chidanand Patil et al. [10] determined the extent of dumpsite pollution on groundwater quality by performing physical, chemical, and bacteriological analyses on water samples collected from seven bore wells near a landfill in Turmuri, Belgaum. During the study period, seven bore wells at 500, 750, and 1000m distances from the landfill were chosen. During the study period, the following parameters were tested using standard laboratory procedures: pH, Total Dissolved Solids (TDS), Total Hardness, Nitrate, Most Probable Number (MPN), and heavy metals such as Lead. In February and March, the pH ranged from 6.01 to 7.3, indicating an acidic nature, but in April and May, all wells were within the levels.

Shimaa M. Ghoraba et.al [11] collected 120 ground water samples from 29 Districts of Balochistan,Pakistan. The various parameters are selected for the testing of samples. All samples were analyzed for pH, Calcium, Carbonate, Magnesium, Sodium, Potassium, Chlorides, Sulphate and Nitrate, TDS and bicarbonate. The results revealed highly variable hydrochemistry. The chloride is found to be most predominating. The groundwater in Balochistan has high concentrations of fluoride, iron and nitrate in many districts. The pH part of the Durov diagram reveals that groundwater in study area is alkaline and electrical conductivity of most of samples lies in the range of drinking water standards adapted in Pakistan. From the SAR and conductivity plot it was found that most of groundwater cannot be used on soil without restricted drainage and special requirement of Management for salinity control.Comparision of data with WHO(2011) standards for drinking water indicate that the groundwater in the most of study area are suitable for drinking purpose except some few places. The groundwater recorded a wide range in TDS.

Objectives

- To study diseases transmitted through water
- To study ground water resources availability and status of its utilization in India
- To study list of substances found naturally in some ground waters
- To study physicochemical characteristics of Water in India

III. Research Methodology

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Typically, it encompasses concepts such as paradigm, theoretical model, phases and quantitative or qualitative techniques. The current study is descriptive in nature and is based on secondary data gathered from a variety of sources, including books , education, and development, journals, scholarly articles, government publications, and printed and online reference materials.

IV. Result and Discussion

In now days due to increase in population, industrialization, agricultural activities and urbanization, large quantities of sewage and industrial wastewater are discharged into water bodies has significantly contributed to the pollution of the surface and ground water.For the assessment of water pollution status of the water bodies, the following water quality parameters were analyzed: (1) pH (2) Conductivity (3) Temperature (4) Total dissolved solid (TDS) (6) Total Alkalinity (7) Hardness (8) Cations and Anions (9)Carbonates and Bicarbonates. (10) Sulphates.[12]

Table 1. Physicochemical Characteristics of Water in India

Sr. No.	*Parameter*	*BIS Specification*
1	pH	6.5 – 8.5
2	Conductivity	600 Ms/cm
3	Alkalinity	200 Mg/l
4	TDS	500 Mg/l
5	Hardness	300 Mg/l
6	Chlorides	250 Mg/l
7	Turbidity	5 NTU
8	Temprature	23^{0}C
9	Ca	75 Mg/l
10	Mg	30 Mg/l
11	Na	200 Mg/l
12	K	200 Mg/l
13	Carbonates and bicarbonates	-
14	Sulphate	150 mg/l

Table 2. List of substances found naturally in some ground waters which can cause problems in operating wells

Substance	Types of problems
Iron(Fe^{+2},Fe^{+3})	Encrustation, staining of laundry and toilet fixtures
Manganese (Mn^{-2})	Encrustation, staining of laundry and toilet fixtures
Silica (SiO_2)	Encrustation
Chloride (Cl^-)	Portability, Corrosiveness
Fluoride (F^-)	Fluorosis
Nitrate (NO_3^-)	Methemoglobenemia
Sulphate (So_4^{-2})	Portability
Dissolved Gases	Corrosiveness
Dissolved Oxygen	Corrosiveness
Hydrogen Sulphide (H_2S)	Corrosiveness
Carbon dioxide (CO_2)	Corrosiveness
Radio Nuclides	Portability
Miner Constituents	Portability, Health aspects
Calcium and Magnesium (Ca^{2+}, Mg^{2+})	Encrustation

From above table we can see the list of substances found naturally in some ground waters which can cause problems in operating wells. [13]

Table 3. Ground Water Resources Availability and Status of its Utilization in India

S. No	Regions	Annual Replenishable Ground Water Resource (bcm)	Natural Discharge during non-monsoon season (bcm)	Net Annual Ground Water Available (bcm)	Annual Ground Water Draft (bcm)	Stage of Ground Water Development (%)	Categorization of Assessment Units (Blocks / Mandals)		
							Total Assessment Units	Over Exploited, Nos / %	Critical Nos / %
1	2	3	4	5	6	7	8	9	10
1	Northern Himalayan states	5.4	0.48	4.92	1.84	37	30	2 / 6.67	0
2	North Eastern Hilly States	33.99	3.02	30.98	5.63	18	118	0/0	0
3	Eastern Plain States	111.63	9.03	102.5	43.97	43	1895	1/ .05	2/.11
4	North Western Plain States	80.78	6.92	73.85	72.17	98	277	201/72.56	28/10.11
5	Western arid Region	27.38	1.97	25.4	24.48	96	462	172/37.23	62/13.42
6	Central Plateau States	90.723	5.19	85.53	36.11	42	985	31/3.15	6/.61
7	Southern Peninsular States	82.78	7.14	75.65	46.4	61	1946	432/22.2	128/6.58
8	Islands	0.34	0.01	0.32	0.01	4	10	0	0
	Country Total	**433.02**	**33.77**	**399.26**	**230.63**	**58**	**5723**	**839**	**226**

Salient details of ground water resource availability, utilization, stage of development and categorization of assessment units for the above Regions of the country is given in Table.3[14]

V. Conclusion

Groundwater is one of the important source of fresh water for Humans. When the waste are dumped as such without any proper Engineered lining, it leads to the contamination of the groundwater due to the leaching process. The highly diversified hydrogeologic settings and variations in the availability of ground water resources from one part of the country to other call for a holistic approach in evolving suitable management strategies. The emphasis on management needs does not imply that ground water resources in India are fully developed. Effective management of available ground water resources requires an integrated approach, combining both supply side and demand side measures.A multitude of mechanisms have been developed or have emerged in these areas to enable farmers to benefit from ground water. Assured power supply is one of the key factors, the tariff, access and availability of which to a large extent determines the ground water use. Since the ground water development is mostly demand driven, it can be geared up through proper agricultural, credits, subsidy and energy support policies along with creation of suitable markets. In addition, the flood plains along the major river courses of the country offer good scope for groundwater development. Similarly, there are areas in the country with artesian condition, which can be mapped and suitable development plans formulated. In the alluvial areas, where multi-aquifer systems exist, there is a need to concretize methodologies for assessment of development potential of deeper aquifers. There is urgent an need for coordinated efforts from various Central and State Government agencies, non-Governmental and social service organizations, academic institutions and the stakeholders for evolving and implementing suitable ground water management strategies in the country.

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