Vol. 7, Issue 5, Feb 2018 ISSN 2249-894X

REVIEW OF RESEARCH

An International Multidisciplinary Peer Reviewed & Refereed Journal

Impact Factor: 5.2331

UGC Approved Journal No. 48514

REVIEW OF RESEARCH
ISSN: 2249-894X
IMPACT FACTOR : 5.2331(UIF)
VOLUME - 7 | ISSUE - 5 | FEBRUARY - 2018

GROUND WATER SCENARIO AND WATER MANAGEMENT IN TEHRI DISTRICT

Dr. Guru Prasad Thapliyal[1] and Sajimon Philip[2]
[1] Assist. Prof. Deparment of Geography Gov. P. G Colleges Agrora Tehri Garhwal U. K.
[2]Res. Scho. Deparment of Geography. H. N. B. G.U Sringar Garhwal U. K .

ABSTRACT: -
No Matter who are where we are and what we do,we are all dependent on water . we need it every day, every where, every time and in many ways. We require it for agriculture, transportation medical facility, saritation, irrigation, industry etc. How ever, despite the importance of water resources in our lives According to the world health organization, less than 1% of the world's fresh water or 0.7% of all the water available one earth is readily available for human world for consumption & 2 billion people or almost 1 person out of five in the world are without access to safe drinking water. The rate of increase in population is higher than the rate of increase in water. This is the reason that in year 1991avallabllity of water for each person was 2209 cubic.m. which till the year 2011 has decreased to1545 cubic .m.according to a recent report passed by central water board the avallabllity of water per person in 2025 will get reduced to 1340 cubic.m. and in 2050 to 1339 cubic.m.According to F.O.in the comming10 years nearly 2 arb population of the world will reside in place with scarcity of water.

KEYWORDS: *agriculture, transportation medical facility, saritation, irrigation, industry .*

INTRODUCTION :

The study on water as a natural resource is inclusive of its hydrologic components and extraction demands imposed by human and animal population. A hydrologic analysis covering both the supply and demand factors is extremely important for planning and decision making for sustainable development of water resources in the hill regions. The utilization of available water depends upon the amount of infrastructure development in a region. In Tehri District the Ground water occurs locally within disconnected bodies under favorable geohydrological conditions such as in channel and alluvial terraces of river valleys, joints, fractures and fissures of crystalline and metasedimentary rocks, well vegetated and relatively plain areas of valley portions and in subterranean caverns of limestone rocks. The movement and occurrence of the ground water in the area also depends upon the fault degree of joint the slope of the terrain, the local and regional geomorphology. Ground water emerges as springs and seepage , locally called Naolas or sroths, under favorable physiographic conditions such as in gently sloping areas, broad valleys of rivers and along the lithological contacts. Gadheras are the group of springs coming from higher reaches of the mountainous tracts.

METHODOLOGY

The entire in formation and data required have been collected organinig frequent field trip, by using a questionnaire, schedule, interview. Primaray, secondary and observation techniques.

The study Area

Tehri Garhwal is one of the western most district of Uttaranchal State located on the outer ranges of the mid Himalayas. Total area of the district is 4421 km2. A major portion of the district is having hilly tract. The district lies between 30° 22' and 30° 46'N latitude and 78° 4' and 79° 29'E longitude. Uttarkashi from the north, Rudraprayag the from the east, Pauri Garhwal from the south and Dehra Dun District. from the west are the bounding districts. On the western front Yamuna river separates it from Jaunsar Pragana of Dehra Dun district while Bhagirathi rising from the north of Gangotri Galicer in district Uttarkashi Tehri Garhwal district, ground water flows out as springs and seepages where the water table intersects the ground surface. Study indicate that there are main types of aquifers viz. a) Local or Discontinuous Aquifers and b) Localised Aquifers. Ground water in the district occurs in fissured formations characterized by secondary porosity. A brief description of the main types of aquifers is given below:

LOCAL OR DISCONTINUOUS AQUIFERS:

These aquifers seen within the Lesser Himalayan Zone and are seen as two patches exposed in the south western/southern and east central/central parts of the district. Ground water in these areas occurs generally under unconfined to semi-confined situations in the sedimentary rocks (sandstone, shale and limestone), metasedimentary and low-grade metamorphic rocks like dolomite, slate, phyllite, quartzite etc. Calcareous rocks like limestone and dolomite host ground water in solution cavities and subsurface channels of limited areal extent. A study of the springs and naolas indicates that in general, the water is low and varies from 1 to 5 liter per second (LPS).

LOCALISED AQUIFERS:

Localised aquifers occur in both the Lesser and the Central Himalayan Zones. In the Lesser Himalayan Zone, these aquifers are exposed as a NW-SE trending patch occupying the western, central and south eastern parts of the district. In the Central Himalayan Zone north of the Main Central Thrust, these aquifers constitute the only source of potable water. Occurrence of ground water in localised aquifers is very restricted because of the nature of hard, crystalline rocks. Compact and massive crystalline igneous rocks and medium to high-grade metamorphic rocks contain very little ground water in the secondary porosity of fractures, joints and fissures of limited vertical and areal extent.

	Category	Captation
Groundwater in aquifers	confined unconfined shallow fossil	unconfined shallow fossil shallow well borehole deep well
Springs	gravity artesian	Artesian spring box open intake infiltration gallery traditional systems
Surface water	River streams lake pond	streams lake ponds Direct pumping dam, infiltration well riverbed filtration open intake, guhls(diverted channels)

STUDY ON SPRINGS:

A total of 48 cold water springs and 6 group of springs (gadheras) were inventoried in Tehri Garhwal district by Central Ground Water Board. Besides these, measurement of discharge and water temperature of two streams was also carried out during the systematic studies. A brief description of the springs and gadheras occurring in different rock types is given below:

(a) Phyllite: A total of 22 springs and gadheras were inventoried. The discharge data available revels that the maximum pre-monsoon discharge was 56 liter per minute (LPM) at Badkot (pre-monsoon, 2002) whereas the minimum discharge of 0.71 LPM was recorded at Malupani (pre-monsoon, 2010). The maximum discharge during the post-monsoon is 57.36 LPM was observed at Malupani while the minimum discharge of 1.32 LPM was observed at Nand Gaon (post-monsoon, 2010). The discharge of gadheras was comparatively higher than individual springs. The maximum discharge in gadheras was 700 LPM at Syansu followed by 150 LPM at Budgi Khala (pre-monsoon, 2002). The pre-monsoon water temperature ranges between 21°C and 24°C while during the post-monsoon period, water temperature ranges from 7.0°C to 27.0°C .

(b) Limestone and Dolomite: 9 cold water springs and gadheras were inventoried by Central Ground Water Board in this rock type. The minimum discharge during pre-monsoon is as low as negligible (<0.001 LPS) at Nagni followed by 1.39 LPM near Yamuna Bridge (pre-monsoon, 2010). During the post-monsoon, spring discharge varies from 4.92 LPM at Kauriyala to a maximum of 60 LPM near Chaudana (period: 2010). Very high discharge (both during pre-monsoon and post-monsoon) is recorded in the gadheras. The pre-monsoon discharge in gadheras is 800 LPM at Neergarh and 600 LPM near Dhaulagiri. Free flow (Artesian) conditions are also observed at Dhaudapani, where a discharge of 140 LPM has been recorded. Similar condition has been also observed around Nagni. The pre-monsoon water temperature of springs/gadheras varies from 19.0°C to 29.5°C while the post-monsoon water temperature varies from 7.5°C to 30.0°C at Neergarh.

(c) Quartzite: A total of 29 springs/gadheras were inventoried. The discharge of springs/gadheras in quartzite, which is a metamorphic rock of medium to high grade, is comparatively lower than the discharge in other rock types. The minimum pre-monsoon discharge of 0.19 LPM is seen at Muneth while the maximum discharge is 54.5 LPM at Silasu Bridge During post-monsoon the discharge varies from 0.41 LPM near Aindi to a maximum of 100 LPM near Phakot The water temperature during pre-monsoon period varies from 13.0°C to 35.5°C while during the post-monsoon, water temperature ranges from 2.5°C to 27.0°C .

STUDY ON HAND PUMPS:

Apart from the springs and gadheras, 71 India Mark-II hand pumps, installed by Uttarakhand Jal Sansthan, Garhwal Division were also inventoried during Ground Water Management Studies. The depth to water level, both during pre-monsoon and post monsoon, was also recorded during the Ground Water Management Studies in District Tehri Garhwal. The depth to water level data has indicated that water level

 VOLUME - 7 | ISSUE - 5 | FEBRUARY - 2018

ranges from 0.62 m bgl at Dhaudapani to a maximum of 70.07 m bgl at Arakot. During the post-monsoon monitoring, the minimum depth to water level is 0.90 m bgl at Dhaudapani while the deepest water level is 63.38 m bgl, again found at Arakot. Water level fluctuation (rise or fall) has been calculated from the pre-monsoon and post-monsoon depth to water level data of the hand pumps. Analysis of water level fluctuation indicates that minimum rise of 0.47 m is found at Chaudana whereas maximum rise of 38.75 m is observed near Motna, close to Tehri Reservoir. Decline in water level in hand pumps ranges from a minimum of 0.01 m at Durgapur to a maximum of 26.42 m near Jakhnidhar .Discharge in the hand pumps varies from a minimum of 14 LPM at Saurjaripan and Kunjapuri to a maximum of 24 LPM at New Tehri, the district headquarter (Source: Uttarakhand Jal Sansthan, New Tehri). During the drilling of a hand pump at Dhaudapani, about 3.5 km from Narendra Nagar, artesian flow was encountered in the bore well at a depth of 90.0 m bgl with a discharge of 140 LPM. Water temperature in hand pumps during pre-monsoon survey varies from 8.0°C to 37.0°C while during post-monsoon, water temperature ranges from 4.5°C to 32.0°.Hand pumps are commonly used by the local people for drinking and domestic works and are rapidly replacing traditional sources of water supply like springs and gadheras in the district. Almost all of them are installed along the motorable roads, thereby making them easily accessible. A total of 1766 villages were fully covered through water supply from all the India Mark-II hand pumps, thereby benefiting a total population of 543843.

GROUND WATER RESOURCES

Groundwater is often cheaper, more convenient and less vulnerable to pollution than surface water. Therefore, it is commonly used for public water supplies. Ground water is an important source of water supply in an area. However, due to hilly tracts, its utilization in a major part of Tehri Garhwal district is much less than the desired level. Besides, the complex hydrogeological set-up coupled with lack of hydrogeological database hampers precise estimation of ground water resource potential and its development in the district. Hence, no figure on estimation of annual ground water recharge as per the standard norms of Ground water Estimation Committee (GEC, 1997) is available for Tehri Garhwal district.


Under Ground water

Under Ground water

GROUND WATER QUALITY

To assess the chemical quality of ground water in Tehri Garhwal district, 37 water samples were collected from springs, gadheras and India Mark-II hand pumps. A perusal of hydrochemical data shows that ground water in Tehri Garhwal district is mildly alkaline having pH varying from 8.0 to 21. Concentration of chloride varies between 7.1 and 21 mg/L. Nitrate concentration in ground water of the district varies from 0.14 to 22 mg/L, which indicates that ground water is free from anthropogenic sources of pollution. Concentration of Sulphate varies from 4.8 to 557 mg/L, except at Kaddukhal Gadhera where a very high concentration of 1465 mg/L is observed. This is possibly due to higher mineralization of ground water in the area. Concentration of calcium in Tehri Garhwal district varies between 8 and 325 mg/L while concentration of magnesium varies from 4.9 to 212 mg/L. Sodium concentration in ground water varies from 1.6 to 44 mg/L whereas potassium concentration varies between 0.3 and 3.7 mg/L. The Total Hardness as CaCO3varies from 50 to 1681 mg/L. In general, the values of Total Hardness are low to moderately high thereby indicating that ground water is suitable for drinking and domestic uses. Hence, ground water is safe as far as fluoride concentration is concerned. Concentration of silica in ground water varies between 11 and 25 mg/L indicating the absence of highly acidic source rocks (aquifer material) in the area. From the concentrations of different inorganic constituents in ground water in Tehri Garhwal district, it is concluded that the quality of ground water is excellent and it is suitable for drinking, domestic and irrigational purposes.

GROUND WATER MANAGEMENT STRATEGY

Ground water development Taking into consideration the extremely rugged topography in major parts of the district, it is not feasible to go for a large-scale ground water development. However, small to medium scale development may be planned and materialised in a systematic manner.

In the northern part of the district, which is covered with snow almost throughout the year, the possibility of ground water development is nil. However, remaining areas of the district show moderate to good scope for ground water development. As most of the springs in the area are of gravitational type, they should be tapped at the higher reaches of mountains and subsequently collected in multi stage small tanks and used. The water thus tapped should be supplied by gravity flow through parallel pipe lines to different villages depending on the discharge. 22 Ground water development for irrigational use is almost nil in the district. However, surface lift schemes like Hydrums systems may become successful for irrigational purpose, especially in the lower reaches of mountains, near Nalas and small rivers/streams. Group of springs (Gadheras) having high discharge may be tapped at higher elevations of the hills by making Guls (surface flow schemes) and small canals for supply of water round the year. Hand pumps may be installed along roads by locating sites on prominent lineaments and

VOLUME - 7 | ISSUE - 5 | FEBRUARY - 2018

structurally weak zones as ground water in such terrain occurs in joints and fractures.

Hydrogeological investigations regarding feasibility for constructing tube wells in the district were carried out in Chauras area (for Uttarakhand Jal Sansthan) and at Kaudiyala (for Kotlibhel Hydroelectric Project of NHPC Limited). The studies revealed that drilling in these areas can be carried out by deploying a DTH rig (preferably with ODEX attachment) down to a depth range of 50-70 m and 203 mm (8 inch) diameter pipe assembly may be lowered for construction of tube wells. The depth to water levels is usually between 5 to 6 m bgl. Expected discharge of tube well in Chauras is around 800 to 1000 LPM whereas in Kaudiyala, tube wells having drilled depth of 40 to 50 m would yield around 250 to 300 LPM . Thickness of unconsolidated sediments, deposited by Alaknanda River in Chauras varies from 15-20 m. These sediments show good porosity and permeability and form potential aquifers. Apart from this, limestone and dolomite of Mussoorie Group may also become promising for construction of tube wells after proper hydrogeological surveys and ground water exploration in selected areas.

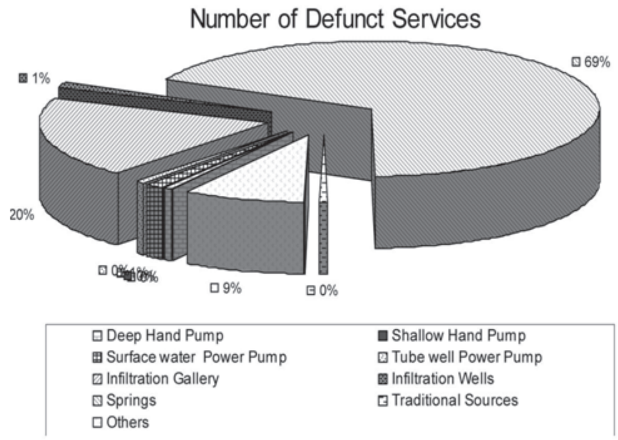
WATER CONSERVATION AND ARTIFICIAL RECHARGE

Due to the high Average Annual Rainfall in Tehri Garhwal district, there is good scope of water conservation through Roof Top Rainwater Harvesting. Due to high land slope in major part of the district, a significant amount of rainfall goes waste as immediate surface run off or overland flow, resulting in very less percolation to shallow aquifers. In such areas construction of suitable water conservation structures is required. Gully plugs and contour bunds are quite suitable for this purpose as they arrest surface run off, increase soil moisture, recharge the shallow aquifers, help in preventing soil erosion and increase the discharge of nearby springs and naolas. Construction of small check dams, nala bunds and continuous contour trenches depending on the local topographic and hydrologic conditions can be taken up in project mode. Continuous contour trenches would cover the entire slopes uniformly whereas nala bunds constructed in a series would cover the entire stretch of drainage in the hilly tracts. The local populace should be adequately trained through training and mass awareness programmes on artificial recharge and roof top rain water harvesting at feasible areas.

WATER INFRASTRUCTURE

Water sources available in the district can be generally divided into groundwater and surface water sources. Considering the various types of water sources, it is desirable to make a distinction between small and large sources useful for determining the nature of source-catchment linkages. Small and medium size systems include wells, boreholes with hand pumps, spring captation systems, small piped and pumped water supplies, and gravity water supplies. Such systems serve a variety of communities, including rural villages and townships, regional centers, as well as urban low-income areas and urban fringe settlements which are not connected to urban drinking water supply networks.

The captation system is a part of the water supply systems while source selection is a part of planning and design. Water source protection aims at not only ensuring the reliability of the source, but also contributes in its improvement by increasing the quality and quantity of the water, or diminishing fluctuations. This may render the source adequate for different uses and reduce the costs of the water supply system.



GROUND WATER RELATED ISSUES AND PROBLEMS

As far as the overall hydrogeological scenario of Tehri Garhwal district is concerned, there are no significant problems. However, some local problems encountered in the district and their possible remedies are listed below: Poor quality of ground water in some naolas.- This may be due to misuse and/or disuse of the structures. This problem may be tackled by development and renovation of the structures, cleaning of dirt and other garbage and periodic maintenance, either by the gram panchayat or by the state agencies and non-government organizations under self help programmes. Local people need to be trained by the district authorities and state/central government departments so that they can understand the importance of naola-based drinking water supply. Higher concentration of some inorganic constituents like calcium, magnesium, sulphate and the total hardness (as $CaCO3$) are observed, particularly in gadheras. There is scarcity of safe drinking water in some villages in the district. This is mainly due to unavailability of hand pumps and naolas/springs nearby. The problem can be solved either by installing hand pumps in the areas where accessibility is not a problem or by storing rainwater in storage tanks (surface or underground) and harnessing surplus monsoon runoff through small check dams and/or gully plugs in suitable areas. Rainwater harvesting in hilly areas has proved cost-effective and sustainable. Various attempts have been made and the people are concertized to collect the runoff water especially in the season of monsoon and this is the best and sustainable way of solving the water issues and decreases the dependency on ground water.

RECOMMENDATIONS

Some recommendations for sustainable ground water development and management in Tehri Garhwal district: Springs and gadheras should be used at higher elevations and water supply should be done by gravity flow through parallel pipe lines or canals so as to reach multiple villages down slope. Consideration of spring discharge is essential to arrive at the optimum number of water supply schemes for this purpose. Hydrums can be quite successful for catering to irrigational needs of the local people in the hilly tracts of the district. Guls, whose primary source of supply is ground water, need to be constructed in series for irrigational use. Springs and naolas should be properly renovated and maintained by the local people and/or gram panchayat in active collaboration with Non Government and Voluntary Organizations and state government departments. Hand Pumps should be constructed scientifically avoiding landslide prone areas. They should be properly maintained by the villagers to avoid any possible source of anthropogenic contamination. In areas having water scarcity, large diameter infiltration wells may be constructed after proper site selection studies, depending upon the local topographic conditions of the area. Villagers should be properly educated through mass awareness and water management training programmes for an effective water conservation practice. Rain harvesting system from the house roof is an effective method of harvesting water as the system of roof top rain water harvesting in hilly areas with high amount of monsoon rainfall has been found useful and cost-effective and the villagers should be

VOLUME - 7 | ISSUE - 5 | FEBRUARY - 2018

encouraged to tap roof top rain water. Unnecessary wastage of water should be stopped by putting valves or taps in the storage tanks (Hauj) and by periodic checking and repairing of pipe lines used for drinking water supply.

REFERENCES

1. Report of Ministry of water supply, government of India 2011, p. 19.21.22.
2. Source: District Statistical Diary, New Tehri: 2007.
3. G.K. Khadse, A.V. Talkhande, P.S. Kelkar and P.K. Labhasetwar, Conservation, Development and Management of Water Resources: An Experience in Himalayan Region, India: National Environmental Engineering Research Institute (CSIR), Nagpur, India, p.194.
4.Garia Jeevan Singh, 2008, Traditional Knoweldge based systems of water management in the western Himalaya of Uttarakha
5.Badola S.P and H.R Singh 1981 Hydrobology of The River Slknanda of The Garhwal Himalaya Gndia j Ecolog
6.Ashutosh Gautan 1990 Ecology and Pollutidm of mountain Water Ashish Pub House Panjahi Bagh Mew Delhi
7.Glock.W.S.1931.The Development of Drainage system. A Sonoptic View. Geographical Review- 21
8. Joshi.B.K.1996 Micro- Hydro Power and Electrification in Hill areas of U.P Himalaya Energy
9.9Singh Dhara 1996 –Hydraulic-rum and ils uses in Hill areas [Himalayan Energ Systems]
10.Sangita kumari – water management the Rohikhand geographical journal of india. Vol. –Xiii, Dec.2012.ISSN no- 0976.8556
11. V.P.gaikwad, C.T. pawar – water harvesting through percolation tank- A pancea for rural development a micro level analysis National geographer Vol.-VLIV,NO-1+2.2009
12.Dainik jagrn new paper 5january2018 dehradun