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Ground Water Improvement Techniques for Burhanpur City

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Abstract- Water is the most precious natural resources on the earth, the principal constituent of all living things. It is a key factor in conditioning the earth for human existence and influencing the civilization process. Groundwater is an important source of freshwater all over the world through the history of human existence. At present, agriculture is the sector of largest drain on water, accounting for about 69% of all water use, while 23% water withdrawals is to meet the demands of industry and energy and just 8% is for domestic use. The emerging problem is declining groundwater table in many parts of the country as a result of over extraction for irrigation and other needs

Index Terms- water table, ground water, burhanpur city, counter

1. INTRODUCTION

Burhanpur district is located in the south western part of Madhya Pradesh, covering an area of about 2316 Sq. Km falling between North Latitudes 210 11' 00'' and 210 32' 00'' and East longitudes 750 59' 00'' and 760 46'00'' and falls under the Survey of India Topo Sheet No. 46 O & 55C. The district is bounded in the North by Khandwa district, in the East by Amaravati district of Maharashtra State, in the South by Buldana and Jalgoan districts of Maharashtra state and in the West by West Nimar district of Madhya Pradesh.

The normal annual rainfall of the district is 978.9 mm. About 89% of the annual rainfall takes place during the southwest monsoon. July is the wettest month of the year and about 28% of the annual rainfall takes place only during this month. During the southwest monsoon season, the relative humidity generally exceeds 84% (August month) and the rest of the year is drier. The driest part of the year is the summer season, when relative humidity is less than 41%. The wind velocity is higher during the pre-monsoon period as compared to postmonsoon period. The maximum wind velocity, 15.8 km/hr observed during the month of June and minimum, 4.3 km/hr during the month of November.

1.1 GEOMORPHOLOGY AND SOIL TYPES:-

The area of the district exhibits an undulating topography which includes highly dissected plateau, linear ridges, residual hills and low lying plains. It can be divided into two distinct physiographic units Viz., the northern and southern uplands and the Central low lands. A prominent hill range (Satpura Range) traverses the southern part of the district. The highest elevation in the district is 778 m amsl, seen on the Satpura Range in the Western part. The river Tapti carves out a narrow valley bifurcating this range into two parts. The northern area exhibits a low rising hill range and the area in the central part is generally plain dotted with isolated residual hills. The lowest elevation is around 249 m a msl, along Tapti River, southwest of Burhanpur town. Alluvium consisting of sand, clay and gravels occurs along Tapi river course. Black cotton soil is found as a thin surface soil cover mainly in a country mainly covered with Deccan Trap.

2. GROUND WATER SCENARIO

2.1 Hydrogeology

Deccan Trap, consisting of different lava flows whose thickness ranges between 15 to 20 m, occupies the major part of the district. There are mainly two types of sedimentary deposits in the area. The predominant deposits are formed due to deposition from the river sediments transported by the Tapi river and its tributaries and is defined as alluvium. The second predominant formation is due to deposition of material transported from the Satpura hill ranges by small streams through gravity. These talus and scree deposits are commonly known as bazada. Satpura Fault (Burhanpur lineament) is a major fault trending ENE-WSE across the entire northern part of the watershed area along the Satpura foot hills which is correspond to the Narmada lineament. The fault zone is distinct and evidence of faulting in the area the Nawanath temple along the Ambapani and Jhiri stream, is marked by crushing of basalt, presence of brecciaed basalt, fault escarpment, presence of spring, sharp contact of Basaltic lava flows with Bazada formation .The geomorphic location of fault zone favors arresting surface runoff and recharge to ground water

2.2 GROUND WATER RESOURCES

Dynamic Ground water resources of the district have been estimated for base year -2008/09, on block-wise basis. There are two number of assessment units (block) in the district which fall under non-command sub unit. Khaknar block of the district is categorized as safe blocks and Burhanpur as semi critical (same in 2003/04) with highest stage of ground water development is computed as 85 %. The net ground water availability in the district is 31,556 ham and ground water draft for all uses is 22,086 ham, making stage of ground water development 70% (70 % in 20003/04) as a whole for district. After making allocation for future domestic and industrial supply for next 25 years, balance available ground water for future irrigation would be 9,207 ham

2.3 PLANNING OF ARTIFICIAL RECHARGE PROJECTS

Identification Area

The artificial recharge projects are site specific and even the replication of the techniques from similar areas are to be based on the local hydro geological and hydrological environments. The first step in planning the project is to demarcate the area of recharge. The Project can be implemented systematically in case a hydrologic unit like watershed is taken for implementation. However, localised schemes are also taken to augment ground water reservoir. The artificial recharge of ground water is normally taken in following areas:

1. Areas where ground water levels are declining on regular basis.
2. Areas where substantial amount of aquifer has already been desaturated.
3. Areas where availability of ground water is inadequate in lean months.
4. Areas where salinity ingress is taking place.

2.4 Scientific Inputs

In order to plan the artificial recharge schemes following studies are needed.

2.4.1 Hydrometeorological Studies

These are undertaken to decipher the rainfall pattern, evaporation losses and climatological features. These can bring out the extent of evaporation losses in post monsoon period which would be helpful in designing the storages of particular capacity with a view to have minimum evaporation losses. In semi arid regions of India, evaporation losses are significant after January hence the stored water should percolate to ground water reservoir by this period. The data on rainfall intensity, number of rain-days, etc. help in deciding the capacity and design of the artificial recharge structures.

2.4.2 Hydrological Studies

Before undertaking any artificial recharge project, it is a basic prerequisite to ascertain the availability of source water for the purpose of recharging the ground water reservoir. For determining the source water availability for artificial recharge, hydrological investigations are required to be carried out in the Watershed/Sub-basin/basin where the artificial recharge schemes are envisaged. Four types of source water may be available for artificial recharge viz.

(i) Insitu precipitation on the watershed.
(ii) Surface (canal) supplies from large reservoirs located within basin
(iii) Surface supplies through trans basin water transfer.
(iv) Treated municipal and industrial wastewaters.

'In situ' precipitation will be available almost at every location but may or may not be adequate to cause artificial recharge but the runoff going unutilised outside the watershed/ basin can be stored/ transmitted through simple recharge structures at appropriate locations. In addition none, one or both of the other two sources may be available in any of the situations, the following information will be required:

a) The quantity that may be diverted for artificial recharge.
b) The time for which the source water will be available.
c) The quality of source water and the pretreatment required.
d) Conveyance system required to bring the water to the recharge site.

Hydrological studies are undertaken to work out surplus monsoon run off which can be harnessed as source water for artificial recharge.

2.4.3 Soil Infiltration Studies

In case of artificial recharge through water spreading methods, soil and Land use conditions which control the rate of infiltration and downward percolation of the water applied on the surface of the soil assume special importance. Infiltration in its most narrow and precise sense can be defined as "The process water entering into a soil through the soil surface". Although a distinction is made between infiltration and percolation (the movement of water within the soil) the two phenomena are closely related since infiltration cannot continue unimpeded unless percolation removes infiltrated water from the surface soil. The soil is permeated by noncapillary channel through which gravity water flows downward towards the ground water, following the path of least resistance. Capillary forces continuously divert gravity water into pore spaces, so that the quantity of gravity water passing successively lower horizons is steadily diminished. This leads to increasing resistance to gravity flow in the surface layer and a decreasing rate of infiltration as a storm progresses. The rate of infiltration in the early phases of a storm is less if the capillary pores are filed from a previous storm. There is maximum rate at which water can enter soil at a particular point under a given set of conditions, this rate is called the infiltration capacity. The actual infiltration rate equals the infiltration capacity only when the supply rate rainfall intensity less rate of retention) equals or exceeds.

2.4.4 Geophysical Studies

a) The main purpose of applying geophysical methods for the selection of appropriate site for artificial recharge studies is mostly to help and assess the unknown subsurface hydrogeological conditions economically, adequately and unambiguously.

Generally the prime task is to compliment the exploratory programme. Mostly it is employed to narrow down the target zone, pinpoint the probable site for artificial recharge structure and its proper design.

b) Nevertheless, the application of geophysical methods is to bring out a comparative picture of the sub-surface litho environment, surface manifestation of such structures, and correlate them with the hydrogeological setting.

c) Besides defining the sub-surface structure and lithology, it can identify the brackish/fresh ground water interface, contaminated zone (saline) and the area prone to seawater intrusion. Using certain common geophysical methods, it is possible to model the

i) Stratification of aquifer system and spatial variability of hydraulic conductivity of the characteristic zone, suitable for artificial recharge.

ii) Negative or non-productive zones of low hydraulic conductivity in unsaturated and saturated zones.

iii) Vertical hydraulic conductivity discontinuities, such as dyke and fault zone.

iv) Moisture movement and infiltration capacity of the unsaturated zone.

v) Direction of ground water flow under natural/artificial recharge processes.

vi) Salinity ingress, trend and short duration depth salinity changes in the aquifers due to varied abstraction or recharge. The application of proper techniques, plan of survey and suitable instruments will definitely yield better understandable results, but, of indirect nature.

3 METHODS OF ARTIFICIAL RECHARGE

3.1. Direct Methods

(a) Surface Spreading Techniques

This method of artificial recharge of groundwater employ different techniques of increasing the contact area and resident time of surface-water over the soil to enhance the infiltration and to augment the ground water storage in phreatic aquifers. The area should have gently sloping land without gullies or ridges and vadose zone should be permeable and free from clay lenses.

Flooding

The technique of flooding is very useful in selected areas where a favorable hydro-geological situation exists for recharging the unconfined aquifer by spreading the surplus surface-water from canals / streams over large area for sufficiently long period so that it recharges the groundwater body. This technique can be used for gently sloping land with slope around 1 to 3 percentage points without gullies and ridges.

Ditches and Furrows

In areas with irregular topography, shallow, flatbottomed and closely spaced ditches and furrows provide maximum water contact area for recharging water from the source stream or canal. This technique requires less soil preparation than the recharge basin technique and is less sensitive to silting.

Recharge Basins

Artificial recharge basins are either excavated or enclosed by dykes or levees. They are commonly built parallel to ephemeral or intermittent stream-channels. The water contact area in this method is quite high which typically ranges from 75 to 90 percentage points of the total recharge area. In this method, efficient use of space is made and the shape of basins can be adjusted to suite the terrain condition and the available space.

Run-off Conservation Structures

They are suitable in areas receiving low to moderate rainfall mostly during a single monsoon season and having little or no scope for transfer of water from other areas..

Bench Terracing helps in soil conservation and holding runoff water on the terraced area for longer durations, leading to increased infiltration and ground water recharge

Gully plugs are the smallest run-off conservation structures built across small gullies and streams rushing down the hill slopes carrying drainage of tiny catchments during rainy season. Usually, the barrier is constructed by using local stones, earth and weathered rock, brushwood, and other such local materials. ***Contour bunds*** involve a watershed management practice so as to build up soil moisture storages. This technique is generally adopted in areas receiving low rainfall.

Contour trenchesare rainwater harvesting structures, which can be constructed on hill slopes as well as on degraded and barren waste lands in both high- and low- rainfall areas

Percolation tanks is an artificially created surface water body submerging a highly permeable land area so that the surface runoff is made to percolate and recharge the ground water storage. Normally, a percolation tank should not retain water beyond February in the Indian context. It should be located downstream of a run-off zone.

Stream-channel Modification

These methods arecommonly applied in alluvial areas, but can also be gainfully used in hard rock areas where thin river alluvium overlies good phreatic aquifers or the rocks are extensively weathered or fractured in and around the stream channel. Artificial recharge through stream channel modifications could be made more effective if surface storage dams exist upstream of the

4. IDENTIFICATION OF AREAS FOR DIRECT METHOD

a. Hilly area behind kundi bhandara

The method can be used to improve ground water leve is Continuous contour trenching which is an experiment in the forest areas since 1993.2 CCT is the best suitable technique for low rainfall, hilly and undulating terrain areas. CCT are Excavating continuous trenches (60 cm wide x 30 cm. deep) on continuous contour lines which are mark, prepared with the help of contour marker. Trenching was started from top to bottom. Distance between two trenches is depend upon the slope as well as availability of time and resources.

Continue counter trenches

The major purposes of using CCT technique are…

1. To stop the soil loss
2. To reduce the rate of runoff, increase in percolation.
3. To increase the ground water level.
4. To increase the green cover over the area and soil quality.
5. To increase the availability of drinking water, agriculture development and employment.
6. To increase the soil moisture to vegetation and develop the degraded lands.

b. Mohana river

The method for Mohana river can be used is deepening and widening of river. Most river beds and nallahs in these areas were filled with silt due to which rain water would not accumulate in these areas. The widening and deepening of the riverbed/nallah in each area will be done for around 2 km to 3 km in length, across the entire span of the river bed or nallah and 2.5 to 3 meters deep.

c. Utawali river

On utawali river after every 1 km distance loose bolder structure can be constructed to accumulate water and also deepening of river can be done so that more water will store and percolate in ground.

d. Water water from treatment plant

As now in Burhanpur construction of sewage treatment plant is going on so the treated water may used in some areas for farming as well as by means of constructing soak pit this treated water can be used to improve ground water level and in this water may be discharge in areas of open land by constructing pond so that water may be percolated in ground by means of ponds

5. CONCLUSION

Deepening and widening of all the nearby tributary of Major River may be done and gabion and small earthen dam after every 1 to 2 km may be provided so that the rain water may be accumulate as well as percolate in ground.

The areas where sewers are not properly in working condition soak pits may be provided to utilize waste water.

Burhanpur is surrounded by hilly areas all around so deep counter trenches may be constructed so that the soil erosion as well as runoff may be utilize

REFERENCES

[1]. National Drinking Water Mission and Department of Rural
Development 1989. Rain Water Harvesting.Government of India, New Delhi.

[2]. Manual on Artificial Recharge of Ground Water 1994. Technical Series – M, No. 3, Central Ground Water Board, Faridabad, March 1994, 215 p.

[3]. Nayantara Nanda Kumar and NiranjanAiyagari 1997.
ArtificialRechargeofGroundwater.http://www.cee.vt.edu/programareas/environmental/teach/gwprimer/recharge/recharge.html

[4]. O'Hare, M.P., Fairchild, D.M., Hajali, P.A., Canter, L.W. 1986.
Artificial Recharge of Groundwater.Proceedings of the Second