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Comparative Study of RBF Well Yield and River flow

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ABSTRACT
Safe drinking water is necessary for humans and other life formseven though it provides no calories or organic nutrients. Approach to safe drinking water has improved over the last decades in around every part of the world, but approximately one billion people still suffers hostage of safe water and over 2.5 billion lack accesses to adequate sanitation. Riverbank filtration is a natural water purification technology that involves with drawing water from rivers by production wells located on the river bank.The objective of present study is to compare the production well yield with a river flow. Pumping test was carried out for determining yield of a production well at a small village named somlapura on the bank of Tungabhadra River, Karnataka, India. The Yield of the River bank well is measured by water meter was compared with the river discharge obtained from Water Commission Board (Davangere). The results show that there is a constant well yield throughout the observation period, even though there is a fluctuation in river flow. Hence, it is concluded that, the RBF well yields the water at the rate of 330 liters/minute. Average Production of water from a well is 0.48 MLD (million liters per day). Therefore, with this production rate it can serve population of three thousand five hundred fifty five with 135 LPCD (liters per capita per day).

Keywords: River bank Filtration(RBF) , river discharge, water meter, yield test.

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I. INTRODUCTION

Good quality water sources are getting scarcer and pollution of the water sources is increasing due to over exploitation of water resources to meet the increasing water demand and insufficient sanitation services provision.On the other hand, water quality guidelines are getting more stringent due to the increasing number of emerging contaminantin water and consequently the cost of water treatment is increasing. In many developing countries,disinfection (very often chlorination) is the only treatment applied to public water supply.In this context, there is a need for a robust water treatment technology which is effective,low- cost and could be operated and maintained relatively easily in developing countries.

RBF is a well-suited low cost, sustainable approach for producing safe drinking water in developing countries such as India.Riverbank filtration (RBF) is a water treatment technology that consists of extracting water from rivers by pumping wells located in the adjacent alluvial aquifer. During the underground passage, a series of physical, chemical, and biological processes take place, improving the quality of the surface water, substituting or reducing conventional drinking water treatment. A schematic diagram of processes affecting water quality during bank filtration is presented in Figure 1.

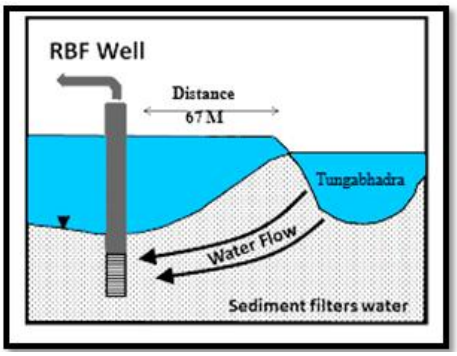

Fig 1: Riverbank Filtration (RBF) System

The performance of RBF with respect to water quality improvements depends on a number of variables;(i) hydro geologic conditions including characteristics and composition of alluvialaquifer materials, (ii) river/lake water quality, (iii) groundwaterdilution,iv) filtrationvelocityanddistance ofthe well(s) from river/lake, (v) temperature ofthe

water, (vii) pumpingrate, and (viii) soil/sediment characteristics atthe river/lake-aquiferinterface. The main objective of this paper is to check the Yield of the RBF well during all seasons and to correlate the relationship between river bank well yield and a river flow.

II. STUDYAREA AND METHODOLOGY

The study area is located in a rural area of the Karnataka, along the Tungabhadra River bank (fig2). The Tungabhadra meanders through the plains to a distance of 531 km (330 miles) and mingles with the Krishna at Gondimalla.Somlapur is a small Village/hamlet inRanebennurTaluk in Haveri District of Karnataka State, India. It comes under SomlapurPanchayath. Total population of the village is about one thousand six hundred as per 2011census (Source-somlapuraPanchayath). The average annual rainfall is found to be 792MM (CGWB).

It lies at an altitude of 583 meters above mean Sea level. It is located at a distance 48 KM towards East from District headquarter Haveri and 20 KM from TalukheadquaterRanebennur. Major part of the district is a gently undulating plain with hilly terrain on western most parts adjoining Uttara Kannada district, and moderately rugged terrain with series of ridges in southern part in Hirekerurtaluk. Major part of the area red sandy soil is occurring, followed by the medium soil and black soil. The red loamy soil and lateritic soil are seen in very small parts on the southern border of the district.

Fig 2: Location Map

III. HYDROGEOLOGICAL FEATURES

As per Central groundwater board Report shallow aquifers of alluvium along the stream courses and weathered zones of schist, metasedimentaries and meta-volcanic occurring between the depths of 3 to 20 mbgl. Deeper aquifers of fractured and jointed schist's, metasedimentaries and met volcanic, up to 200 mbgl. Pre monsoon Water levels during 2006 are 6.36 to 16.63 mbgl. Post monsoon Water levels during 2006 are 2.03 to 19.26 mbgl.

IV. METHODS

Pumping Test

In this method the water level in the well is depressed through large withdrawals of water till the working head is reached. At this stage the discharge from the pump is regulated so that the rate of withdrawal equals the rate of inflow in to the well; i.e. a constant water level is maintained in the well. Under this equilibrium condition, the volume of water pumped out in unit time gives the safe yield of the well. Volume of water pumped out can be measured using Water Meter (fig 4). The safe yield is usually expressedinm^3/sec.

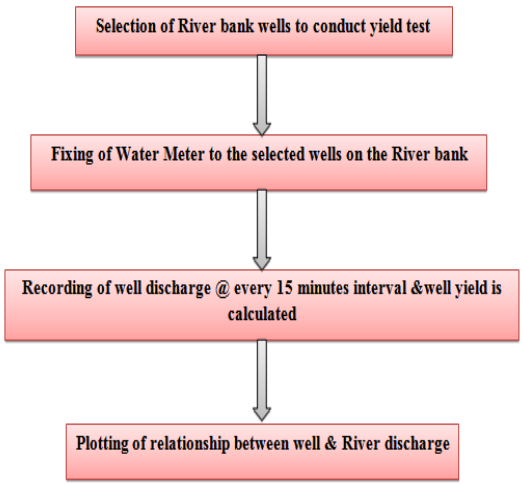

Fig 3: Work Flowof Yield Analysis

Pumping Test was conducted for a selected River bank well near Somlapura village .Test includes continuous pumping of about 3 hours todetermine the well yield (m^3/hr). Using the Water Meter fixed at the outlet of the pumping well (fig 4), the yield values are recorded at every 15minutes interval and the average yield is calculated. To understand the correlation between the yield of well and the River discharge, a graph is plotted using the recorded values.

Fig 4: Water Meter

River Discharge:

Surface-water bodies such as lakes and wetlands can receive groundwater inflow, recharge groundwater, or do both. The movement of water between groundwater and surface-water systems leads to the mixing of their water qualities. High quantities of nutrients or other dissolved chemicals in surface water can be transferred to the connected groundwater system.

Riverbank filtration can naturally occur or can be induced by pumping, whereby wells are placed adjacent to the river that creates a hydraulic potential gradient from the river towards the wells. These systems consist of well fields that draw water from an aquifer that is hydraulically connected to surface waters. Therefore to assess the performance of RBF well, it is essential to understand the river discharge.River discharge is the volume of water flowing through a river channel. This is the total volume of water flowing through a channel at any given point and is measured in m^3/sec (cumecs). The discharge from a drainage basin depends on precipitation, Evapotranspiration and storage factors.

The discharge of the river Tungabhadra is recorded on daily basis by the water commission board, Davangere. There are various gauge stations placed along the river stretch. The data required i.e. discharge of river was collected from the Haralahalli gauge station. (Table 1).

V. RESULTS AND DISCUSSION:

The pumping test is carried out for a during study periodfor a well located on the bank of Tungabhadra River. The purpose of test is to check the safe yield of a selected well, which will helps in deciding the quantity of water that can be safely extracted for supplying the public demand. Test includes continuous pumping for about 3hrs in a month during an observation period to determine the well yield (m^3/hr). The yield values are recorded at every 15minutes interval using water meter and the average yield is calculated. These average values were correlatedwith the River discharge, and a graph is plotted using the recorded values (fig 5).

Monthly average values of well yield are shown in Table 1. Average yield during observation period is recorded as 20m^3/hr.

Table 1: Results of Well Yieldand River discharge

SL.NO	MONTHS	YIELD OF WELL(m^3 /hr)	DISCHARGE OF RIVER(m^3/sec)
1	May	19.46	41.25
2	June	19.43	270.85
3	July	20.03	878.1
4	August	20.5	1272.2
5	September	20.8	180.57
6	October	19.57	112.65
7	November	19.51	38.56
8	December	19.76	13.68
9	January	19.46	10.56
10	February	19.51	0.00
11	March	19.54	0.00

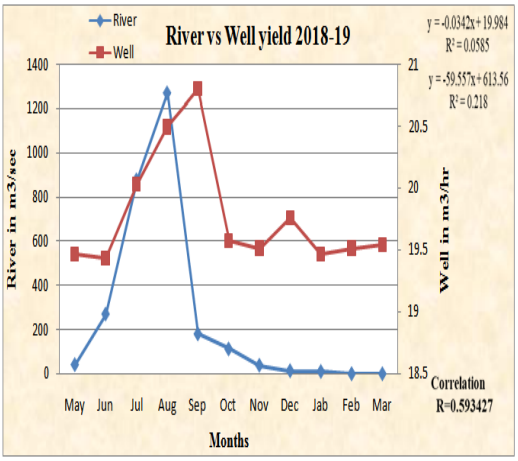

Fig5: River flowvs. Well yield

The graph (fig 5) indicates that there is a variation in River flow and the well yield is persistent throughout the year (2018-19)and the average discharge of the well yield is20m^3/hr.The above results show that there is a constant well yield throughout the observation period, even though there is a fluctuation in river flow. Hence, it is concluded that, the RBF well yields the water at the rate of 330 liters/hr. Average Production of water from a well is 0.48 MLD (million liters per day). Therefore, with this production rate it can serve three thousand five hundred fifty five persons per day with an approximation of 135 lpcd (liters per capita per day). Hence, it can be concluded that, it is sufficient for village like Somlapura whose population is about 1600 as per 2011 census report

with an average demand of water about 0.370 MLD.

During RBF, pumping pressure in the alluvial aquifer adjacent to the river will force the watertopercolatefromtheriverintotheaquifer.Inthispath,aseries of physical and biogeochemical processes take place, includingphysicalfiltration, adsorption,absorption, biodegradation,anddilution. Thus,riverbankfiltrateoftenshowsbetterqualitythanriverwater,makingitstreatmentforhumanconsumption aloteasierandless expensive.

The efficiency of RBF depends on local conditions including the hydrology and hydrogeology of the site. A special hydro geological investigation of the overall district studied by using different reports (CGWB).The Haveri district has 474.54 sq.km of forest, which constitutes 9.79% of the total Geographical area of the district.Major part of the area red sandy soil is occurring, followed by the medium soil and black soil. Metasedimentaries and meta-volcanic occurring between the depths of 3 to 20 mbgl. Deeper aquifers of fractured and jointed schist's, metasedimentaries and met volcanic, up to 200 mbgl.The average annual rainfall is found to be 792MM (CGWB).

Pumping Test was conducted for wells on the river bank. Test includes continuous pumping of about 3 hours to determine the well yield (m^3/hr). Continuous pumping of about 3hrs at selected well shows that there is gradual increase in discharge during monsoon (i e high in August and September), there after a slight decrease in discharge from October. Average discharge is recorded as 20m^3/hr.The Discharge was observed high in river during monsoon (i.e. July- September) and less flow occurred during summer .But that in RBF there is gradual increase in discharge during August and September (average 20.5 m^3/hr) and there after a slight decrease in discharge after October (average 19.56m^3/hr), the average discharge is recorded as 20 m^3/hr.

The RBF well yields the water at the rate of 330 liters/minute. Average Production of water from a well is 0.48 MLD (million liters per day). Therefore, with this production rate it can serve three thousand five hundred fifty five persons per day with an approximation of 135 lpcd (liters per capita per day). Hence, it can be concluded that, it is sufficient for village like Somlapura whose population is about 1600 as per 2011 census report with an average demand of water about 0.370 MLD.

VI. CONCLUSIONS:

The above results show that there is a constant well yield throughout the observation period, even though there is a fluctuation in river flow. Hence, it is concluded that, the RBF well yields the water at the rate of 370 liters/hr. Average Production of water from a well is 0.48 MLD (million liters per day). Therefore, with this production rate it can serve three thousand five hundred fifty five persons per day with an approximation of 135 lpcd (liters per capita per day). Hence, it can be concluded that, it is sufficient for village like Somlapura whose population is about 1600 as per 2011 census report with an average demand of water about 0.370MLD.

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