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Abstract:-

The study was conducted to assess effect of water harvesting structures like minar irrigation tank on ground water recharge and water quality at Agricultural Research Station, Mugad, Karnataka, India. The minor irrigation tank water spread area was 12.16 ha with a storage capacity (0.89 M. m3) was selected to assess the effect on ground water recharge and water quality. Rainfall, water storage depth and water level of bore wells were measured every fortnight. Results showed that water harvesting structure (minor irrigation tank) resulted in mean rise of water level of bore wells by 10.41, 9.67 and 9.00 m for the year 2010-11, 2011-12 and 2012-13, respectively. The ground water quality analysis revealed that the pH was neutral (6.93-8.14) during both pre and post monsoon seasons. The ground water EC was lower and ranged between 0.5 and 0.65 dSm-1. The SAR and RSC values of the ground water were also lower and would not cause sodicity hazard on soils with prolonged irrigation.

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IMPACT OF RAIN WATER HARVESTING STRUCTURE ON AUGMENTATION OF GROUNDWATER RECHARGE

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Keywords:

listening skill, strategy training, engineering students.

INTRODUCTION :-

The over exploitation of groundwater due to increase in cropping intensity as well as growing of high water consuming crop such as rice has led to rapid decline groundwater table. Day by day open wells/tube wells yield is decreasing and groundwater quality get deteriorated in almost all regions. Annual withdrawal of groundwater for irrigation is far more than annual natural recharge. The total annual ground water withdrawal in India (251 billion cm3) is the highest for any nation (Adhikari et al., 2013). An effective way of bridging the gap between ground water withdrawal and natural recharge is augmentation of ground water by artificial recharge techniques. Runoff water management is one of the major component of watershed management for augmentation of groundwater by artificial recharge. This could be achieved by gully plugging, nala bunding, construction of farm pond, percolation tank and minor irrigation tank.

Assessment of ground water recharge is important in determining the sustainable yield of wells. Groundwater recharge is the downword percolation of water leading to recharging the water table. This results in an addition to the ground water reservoir (CGWB 2009). In the semi arid regions of Karnataka about 33 mm (6 %) of groundwater was recharged from an annual rainfall (Shivanna et al., 2004).

An earlier study is semi arid tract of south India revealed that integrated soil and water conservation measures on watershed basis had improved the ground water regime. Reduction in surface run-off from 27.4 % to 57.4 % induced higher infiltration due to enhanced opportunity time. This led to increased water level in the well by 0.5 to 1 m, thereby increasing the area irrigated by the well by 172 % compared to the pre project period, which intern improved the crop yield by 70 % (Rao et.al., 1996).

Groundwater resource is the key to the economic development of the farmers. This study was undertaken to know the recharge rate of the wells from the existing minor irrigation tank for efficient and suitable groundwater management.

MATERIALS AND METHODS:

The study was carried out for 3 years during 2010-13 at Agricultural Research Station, Mugad, UAS, Dharwad. The station is located at an altitude of 697 meters above the mean sea level and at 15o -15' North latitude and 74o -40' East longitude. This station comes under Mugad minor irrigation tank command area. The mean annual rainfall is 1040 mm. The water spread area of tank is 12.16 ha and command area is 251.50 ha. Eleven bore wells from 500 to 2000 m distance on downstream side of the tank were selected. The measuring pole was installed in the tank to measure the water level of the tank. Every fortnight, observations were made on water level of the tank and bore wells and rainfall data were also collected for analysis. The rain fall occurred between the two successive readings were recorded. The ground water samples were collected during pre and post monsoon seasons and analyzed for chemical properties like pH, EC, water soluble cations such as Na, K, Ca and Mg and anions such as Cl, SO4, HCO3 and CO3. The SAR (Sodium Adsorption Ratio) and RSC (Residual Sodium carbonate) values were calculated.

RESULT AND DISCUSSION:

Ground water recharge: Recharge of ground water table due to the minor irrigation tank as observed through the wells situated in the lower reaches of the tank is presented in Table 1. There was a rise in water table of tank and almost all wells located below the tank for the most of the period of the year.

The mean maximum water table depth in the well was 19.67 to 20.69 m bgl (below ground level) during the months of May and June and the mean minimum water table depth of wells was 10 to 10.28 m bgl during the months of October and November during the year 2010-11 and 2011-12. It was observed that for the year 2012-13, the mean maximum water table depth of well was 28.95 meters for the month of May and the mean minimum of 19.95 meters during the month of August. It is also revealed from Table 1 that the average depth of water table was 16.24, 14.35 and 24.44 m for the year 2010-11, 2011-12 and 2012-13, respectively.

It could also be inferred that as rainfall occurred the water level in the wells as well as in the tank rose. Correlation co-efficient values (Table 2) between well water level and the tank water level indicated that there was strong relation (“r” values ranged between -0.87 and -0.88). During 2012-13, tank water level remained within the dead storage level (due to low rainfall) , therefore correlation co-efficient values were not estimated. The tank water level started rising from end of the July. From June onward the water level in the well rose mainly due to the rainfall. From Table 1, it could be observed that August onwards there was raise of water level in the tank which rose to 2.50 and 2.55 m for the month of October and November in the year 2010-11 and 2011-12, respectively. There was drastic reflection by rise of water table of wells up to 10.28, 10.00 and 19.95 m bgl in the year 2010-11, 2011-12 and 2012-13, respectively. This is proved that there was a clear-cut increase in water level in the wells due to tank. The rise of water level in well was 10.41 and 9.67 m for the year 2010-11 and 2011-12, respectively. The water was stored in the tank for 8 months period and it was sufficient period for groundwater recharge in the command area and the other downstream fields. The water stood for longer period of time in the tank with more water spread area which created opportunity for enhanced groundwater recharge up to month of February. From November and December onwards the farmers started utilizing tank water and well water for irrigation so the both water levels depleted. From December onwards the water level declined in the tank therefore, recharge was reduced and as a result there was not much increase in the water table of the wells situated below the tank. This indicated that tank had a positive effect on the recharge of underground water (Adhikari et al., 2013 and Mallikarjunappa Gouda et al., 1992). In the year 2012-13 overall rainfall was less and water level was within the dead storage level in the tank so the groundwater level rose up to the month of October only due to rainfall. This indicated that recharge efficiency of tank was very high. Throughout the year 2012-13 the water level in the well was more than 19.95 m bgl. From Figure 1, it was seen that, maximum groundwater recharge was observed in the month of October, November and December in both years 2010-11 and 2011-12. In the month of May the water level of wells were 20.69, 18.94 and 28.95 m bgl in the year 10-11, 11-12 and 12-13, respectively.

Ground water quality: Mean ground water pH ranged between 6.93 and 8.14 during different seasons and years (Table 3). The water pH remained slightly higher during pre-monsoon compared to post monsoon season. The pH was neutral and suitable for irrigation during both pre and post monsoon seasons. Similarly, electrical conductivity was also within the permissible limit during both pre and post monsoon seasons and suitable for irrigation. However, the EC was slightly higher during pre-monsoon season. The EC ranged between 0.65 and 0.5 dS/m. Similar results were obtained by Adhikari et al., 2013. The water SAR varied between 3.3 and 5.03 me/l. The value was well within the critical value of 10 me/l, therefore the water do not cause sodicity hazard on soils with long term usage as irrigation water. The RSC ranged between 1.56 and 5.45 me/l during different seasons and years. The value being less than the critical limit of 2.5 me/l, might not cause sodicity in soil with prolonged irrigation.

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Table: 1. Mean ground water level of eleven borewells in the downstream of miner irrigation tank, rainfall and water level in the tank

Date	01/06/10	16/06/10	01/07/10	16/07/10	01/08/10	16/08/10	01/09/10	16/09/10	01/10/10	16/10/10	01/11/10	16/11/10
Mean water table below ground level (m)	20.26	20.17	19.98	19.42	18.54	18.15	16.90	16.66	14.54	11.74	10.40	10.28
Rainfall (mm)	12.4	60.6	63.6	49.6	216	41.2	183.4	50.4	101.2	91	97.4	0
Water level in tank (mts)	0	0	0	0	0.38	0.61	1.43	1.91	2.34	2.48	2.5	2.43
2011-12												
Date	01/06/11	16/06/11	01/07/11	16/07/11	01/08/11	16/08/11	01/09/11	16/09/11	01/10/11	16/10/11	01/11/11	16/11/11
Mean water table below ground level (m)	19.67	19.14	15.48	13.37	11.19	10.83	10.34	10.30	10.12	10.00	10.07	10.21
Rainfall (mm)	31.2	86	145.9	98.8	134.8	107.6	123.4	43.2	84.6	95	41.2	0
Water level in tank (mts)	0.00	0.00	0.00	0.88	0.98	1.40	1.76	1.98	2.42	2.55	2.49	2.25
2012-13												
Date	01/06/12	16/06/12	01/07/12	16/07/12	01/08/12	16/08/12	01/09/12	16/09/12	01/10/12	16/10/12	01/11/12	16/11/12
Mean water table below ground level (m)	20.55	20.50	21.98	21.48	20.41	19.95	19.95	19.96	19.95	19.97	20.84	23.20
Rainfall (mm)	0	44	31.8	57	110	123.2	24.6	44.8	77.2	25	0	0
Water level in tank (m)	0	0	0	0	0	0	0	0	0	0	0	0

Date	01/12/10	16/12/10	01/01/11	16/01/11	01/02/11	16/02/10	01/03/10	16/03/11	01/04/11	16/04/11	01/05/11	16/05/11	Average
Mean water table below ground level (m)	10.29	10.34	11.84	12.99	13.67	14.69	16.44	19.61	20.69	20.68	20.69	20.69	16.24
Rainfall (mm)	18	3.4	0	0	0	0	2.2	0	0	65.4	0	53	1086.80
Water level in tank (mts)	2.13	1.83	1.52	1.46	1.31	1.22	1.22	0.99	0.76	0	0	0	
2011-12													
Date	01/12/11	16/12/11	01/01/12	16/01/12	01/02/12	16/02/12	01/03/12	16/03/12	01/04/12	16/04/12	01/05/12	16/05/12	Average
Mean water table below ground level (m)	10.18	10.53	12.14	14.05	16.20	17.59	18.01	18.83	19.14	19.13	18.94	18.94	14.35
Rainfall (mm)	21.6	0	0	0	0	0	0	0	0	41.2	28.2	21	1105.70
Water level in tank (mts)	2.13	2.07	1.80	1.58	1.46	1.22	1.16	0.55	0.24	0.00	0.00	0.00	
2012-13													
Date	01/12/12	16/12/12	01/01/13	16/01/13	01/02/13	16/02/13	01/03/13	16/03/13	01/04/13	16/04/13	01/05/13	16/05/13	Average
Mean water table below ground level (m)	26.02	27.57	27.50	27.42	27.68	28.03	28.92	28.92	28.92	28.94	28.94	28.95	24.44
Rainfall (mm)	0	0	30.8	0	0	0	0	8.8	6.6	0	23.2	26.2	633.20
Water level in tank (m)	0	0	0	0	0	0	0	0	0	0	0	0	

Table 2. Correlation co-efficient between water mean ground water table and rainfall and tank water level during different years

Parameters	Correlation co-efficient values		
	2010-11	**2011-12**	**2012-13**
Mean water table below ground v/s rainfall	0.13	-0.32	-0.57
Mean water table below ground v/s tank water level	-0.88	-0.87	-

Table 3. Season wise ground water quality in the Mugad minor irrigation tank command area

Parameters	2010-11		2011-12		2012-13	
	Pre-monsoon	Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon	Post-monsoon
pH	6.93	7.70	7.88	7.50	8.14	7.40
EC (dS/m)	0.58	0.56	0.57	0.50	0.65	0.60
SAR (meq/l)	3.47	3.30	4.27	4.15	5.03	4.70
RSC (meq/l)	-2.94	-2.70	-5.45	-5.00	-1.72	-1.56