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Artificial Recharging Borewells in Groundwater Over Exploited Zone of Karnataka - An Institutional Approach

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Abstract

In this study modest attempt to analyze the efforts of Village Panchayath in recharging drinking water borewells is undertaken. For the study, 30 village panchayaths were randomly selected from Bengaluru rural, Kolar and Chickballapur districts of EDZ of Karnataka. Results revealed that on an average 23 borewells were dugged in Village panchayaths for drinking water supply among them 43 per cent of wells failed in the past five years. About 75 per cent of failed borewells were recharged by the Village Panchayath under Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNAREGS) from the past five years. About 66 per cent of borewells which are recharged were successfully yielding water. In each Village Panchayaths on an average 7 drinking water borewells were recharged and cost incurred for construction of the recharge structure is of Rs.53000, unskilled and material payment in 50:50. In the recent past five years, about 1700 drinking water borewells were recharged under MGNAREGS of EDZ. The farmers and other groundwater users in dry agro-climatic zones need to take initiative in individual groundwater borewell recharge activities to a large extent for getting the benefit of recharge of borewells.

Keywords: Artificial borewell recharge, over exploited zone, MGNAREGS, village panchayath

In India 90 per cent of domestic water and 80 per cent of irrigation water is drawn from the groundwater source. Groundwater is the preferred source of drinking water as well as irrigation in India. India is the highest pumper of ground water (220-230 BCM), twice that of the USA and six times higher than the Western Europe. This shows the enormous dependency on groundwater for drinking and irrigation needs. About 65 per cent irrigated area of India constitutes hard rock area where recharge is 5 to 10 per cent of the rainfall. In addition, human efforts to recharge are grossly inadequate. In addition, users of groundwater either farmers or others do not appreciate that groundwater gets recharged by rejuvenating their borewells.

India is the largest pumper of groundwater due to which there has been large scale massive failure of irrigation wells. Lack of efforts to recharge them has exacerbated the well failure probability. Climate change is imposing severe thrust to groundwater on both demand and supply sides. The hydro-geological and socio-economic factors are both influenced by agro climatic factors in shaping groundwater for different uses and users.

Farmers are pumping twice that of groundwater recharged

The groundwater development in the parlance of hydrogeology usually refers to groundwater extraction. But in reality, groundwater development should include the component of recharge of groundwater also. The Eastern Dry agro-climatic Zone (EDZ) tops in the degree of groundwater development as the extraction as a per cent of recharge surpasses 195 per cent and entire region classified as "over exploited" (Anon., 2009). This implies that farmers and users of groundwater are pumping almost twice the natural recharge in the eastern dry agro climatic zone.

The Karnataka Ground Water (Regulation and Control of Development and Management) Act, 2011 envisages farmers in EDZ to implement the act in the notified area. The notified area is defined as the area critical for groundwater development. The details of the notified area in EDZ as on 2012 are listed (Table I). Accordingly, the major portion of the critical zones of groundwater extraction has been in the EDZ. Here no further extraction of groundwater is

TABLE I

List of notified areas for control and regulation of groundwater in EDZ of Karnataka

Districts	Taluks
Bangalore Urban	Anekal, Bangalore North, Bangalore South
Bangalore Rural	Devanahalli, Doddaballapura, Hoskote, Nelamangala
Chikkaballapur	Chikkaballapur, Chinthamani, Gouribidanur, Gudibanda
Kolar	Bagarpet, Malur, Mulbagilu
Tumkur	Koratagere, Madhugiri

permissible and accordingly the institutional finance is not provided for groundwater extraction in EDZ.

The EDZ also has to support drinking water needs in addition to food, fodder, fruits, vegetables, flowers and other needs of Bangalore metropolitan including industrial water. The drinking water needs of Kolar and Chikkaballapur, Bangalore Urban and Tumkur districts are growing due to rapid urbanization. EDZ also does not have perennial rivers. In addition, there has been large scale sand mining which is responsible for well failure of dug wells and borewells over time. EDZ has the entrepreneurial farmers who demonstrated successfully the use of micro-irrigation technology for narrow spaced crops such as green leafy vegetables, potato, tomato, cabbage, knol kohl and flower crops. Given this massive need for groundwater resource in over exploited EDZ, the options before the policy makers are as under:

1) Restriction of groundwater extraction with stringent enforcement of The Karnataka Ground Water (Regulation and Control of Development and Management) Act, 2011.

2) Support and facilitate groundwater recharge programme at micro level involving village panchayaths for drinking water borewells, Department of Agriculture for irrigation borewells

3) Undertake capacity building regarding groundwater development at village panchayath level.

Considering the three alternatives for policy makers, it is desirable to focus on second and third options. In this study a modest attempt is made to analyze the efforts of the Village panchayaths in EDZ in recharging drinking water borewells in villages.

METHODOLOGY

The study is conducted in EDZ of Karnataka. In this study, 30 gram panchayaths have been randomly selected in order to analyze the performance of drinking water borewells which have been recharged during the past five years. While CDZ pioneered in demonstrating success of recharging the irrigation wells, the success of recharging drinking water borewells has been ably demonstrated in EDZ by recharging approximately 1700 borewells by the village panchayaths. The descriptive statistics and regression analysis were used to express the result.

It is heartening to learn that 75 per cent of failed wells from the past five years have been recharged by panchayaths. In order to find the elasticity of successful recharge, the number of borewells recharged which are successfully yielding water have been regressed on the total number of borewells recharged since the past five years in each sampled panchayath. The fitted model is:

Natural Log of the number of recharged borewells which are successfully yielding groundwater =

- 0.457+ 1.04 (Natural log of Total number of borewells which are recharged)

n = Total number of observations 29, Adjusted R^2 is 0.83, F value is 137.68 and is significant.

RESULTS AND DISCUSSION

The total number of borewells drilled in Village panchayath for drinking water purpose ranged from 15 in Kallinayakanahalli, to 32 in Mastenahalli in Chikkaballapur district (Table II). The proportion of borewell failure ranges from 27 per cent in Kurudi to 51 per cent in Doddaganjur. The number of borewells recharged from past five years' ranges from 2 borewells in Pathapalya to 18 borewells in Kaivara in Chikkaballapur. The percentage of borewells functioning after recharge ranges from 16 per cent in

TABLE II

Drinking water borewell recharged and extent of recharge in village panchayaths of Chikkaballapur district.

Sl. No.	Name of the Village Panchayath	Taluk	Total No. of Borewells drilled in village panchayath	No. of Borewells failed in past Five Years	Percentage of Borewell failed	No. of Borewell recharged in past five years	No. of Re-charged Borewell yielding water	Percentage of Borewell yielding water
1	2	3	4	5	6 = (5/4)*100	7	8	9 = (8/7)*100
1	Pathapalya	Bagepalli	28	8	28.57	2	1	50.00
2	Thalagavara	Chintamani	21	7	33.33	5	5	100.00
3	Santhekallahalli	Chintamani	30	10	33.33	12	4	33.33
4	Mastenahalli	Chintamani	32	15	46.88	6	1	16.66
5	Kaivara	Chintamani	22	8	36.36	18	14	77.78
6	Permachanahalli	Chintamani	18	5	27.78	5	3	60.00
7	Chinnasandra	Chintamani	26	8	30.77	3	2	66.67
8	Doddaganjur	Chintamani	23	12	51.43	6	4	66.67
9	Irgampalli	Chintamani	25	14	44.44	12	10	83.33
10	Kadadanamari	Chintamani	20	8	40.00	3	3	100.00
11	Kadalaveni	Gouribidanuru	16	7	43.75	16	10	62.50
12	Kallinayakanahalli	Gouribidanuru	15	6	40.00	7	6	85.71
13	Kurudi	Gouribidanuru	18	5	27.78	3	2	66.67
14	Allipura	Gouribidanuru	23	10	43.48	4	2	50.00
		Average	22.64	8.79	37.71	7.29	4.71	64.48
		Total	317.00	123.00		102.00	66.00	

TABLE III

Drinking water borewell recharged and extent of recharge in village panchyaths of Kolar district.

Sl. No.	Name of the Village Panchayath	Taluk	Total No. of Borewells drilled in village panchayath	No. of Borewells failed in past five years	Percentage of Borewell failed	No. of Borewell recharged in past five years	No. of recharged Borewell yielding water	Percentage of Borewell yielding water
1	2	3	4	5	6=(5/4)*100	7	8	9=(8/7)*100
1	D N Doddi	Maluru	20	9	45.00	12	10	83.33
2	Lakkuru	Maluru	28	7	38.89	6	4	66.67
3	Rajenahalli	Maluru	26	11	27.78	9	9	100.00
4	Arabhikotthanuru	Kolar	27	10	37.04	13	9	69.23
5	Channasandra	Kolar	22	14	63.64	7	4	57.14
6	Manighatta	Kolar	25	12	47.06	6	3	50.00
7	Vemagal	Kolar	18	10	55.56	6	3	50.00
		Average	23.71	10.43	45.00	8.43	6.00	68.05
		Total	166.00	73.00		59.00	42.00	

TABLE IV

Drinking water borewell recharged and extent of recharge in village panchayaths of Bangalore Rural district

Sl. No.	Name of the Village Panchayath	Taluk	Total No. of Borewells drilled in village panchayath	No. of Wells failed in past five years	Percentage of Borewell failed	No. of Borewell recharged in past five years	No. of recharged Borewell yielding water	Percentage of Borewell yielding water
1	2	3	4	5	6 = (5/4)*100	7	8	9 = (8/7)*100
1	Melekote	Doddaballapura	24	8	33.33	10	7	70.00
2	Bashettihalli	Doddaballapura	27	12	46.88	10	6	60.00
3	Kundana	Devanahalli	22	8	36.36	4	3	75.00
4	Koira	Devanahalli	27	7	25.93	14	10	71.43
5	Avathi	Devanahalli	16	15	93.73	7	7	100.00
6	Bettakote	Devanahalli	24	14	58.33	3	2	66.67
7	Bidaluru	Devanahalli	18	8	44.44	4	2	50.00
8	Bijjavara	Devanahalli	19	10	52.63	4	3	75.00
9	Venkatagirikote	Devanahalli	26	12	46.15	9	5	55.56
		Average	**22.56**	**10.44**	**48.64**	**7.22**	**5.00**	**69.30**
		Total	203.00	94.00		65.00	45.00	

TABLE V

The elasticity of successful borewell recharge

Features	Co efficients	t Stat
Intercept	-0.46	-2.64
Natural log of total number of borewells recharged	1.04	11.73

TABLE VI

Cost for drinking bore well recharge structure (12 feet×12 feet×10 feet) construction in MGNAREG scheme by the Gram panchayaths

Items	Unit cost (in Rs)	Quantity	Total (in Rs)
20 MM Jelly (cum)	970.35	2.96	2874.17
40 MM Jelly(cum)	800.45	3.25	2604.92
Boulders (cum)	588.80	9.46	5572.21
Sand (cum)	1429.99	3.93	5619.01
Nylon mesh(mtr)	556.67	3.00	1670.01
cement (bags)	349.49	5.28	1843.88
size stone (cum)	192.03	9.90	1901.71
Name board	1136.67	1.00	1136.67
Skilled labour charge (Rs)	500.00	2.00	1000.00
Unskilled labour payment through NMR		142 labour days	28988.60
Total Payment			53211.17

Mastenahalli to 100 per cent in Thalagavara and Kadadanamari of Chikkaballapur district, on an average 64 per cent of recharged borewells are successfully yielding the water (Table II).

The average number of borewells drilled for drinking water in Village panchayath of Kolar district is 24 and among them 45 per cent (10 borewells) were failed during past five years. The number of borewells recharged from past five years' ranges from 6 to 13 borewells in Kolar and Malur Taluks, on an average 8 borewells per village panchayath were recharged in Kolar district. The percentage of borewells successfully yielding water ranges from 50 per cent in Manighatta and Vemagal to 100 per cent in Vemagal of Kolar district (Table III).

In Bangalore rural district, the total number of borewells drilled in Village panchayath for drinking water purpose ranged from 16 in Avathi, to 27 in Koira Village panchayath. The proportion of borewell failure ranges from 26 per cent in Koira to 93 per cent in Avathi. The number of borewells recharged from past five years' ranges from 3 borewells in Bettakote to 14 borewells in Koira. The percentage of borewells successfully yielding water ranges from 50 per cent in Bidaluru and 100 per cent in Avathi (Table IV).

The elasticity of 1.04 indicates that for every one per cent increase in the number of borewells recharged, there is one per cent increase in success in yielding water due to recharge, which implies 100 per cent success in recharge efforts of drinking water wells. This demonstrate that in the over exploited recharge, where the extraction exceeds recharge, groundwater recharge efforts have been successful (Table V).

About 60 per cent of village panchayaths face acute shortage of drinking water during the summer season (January to June) and as an immediate measure the panchayaths supply drinking water from private water tankers. The corresponding expenditure on drinking water supply ranges from Rs. 2.5 lakh to Rs. 16 lakhs and on an average Rs. 5.83 lakhs per village has been spent for supplying drinking water to people. In comparison the expenditure on groundwater recharge is comparatively low (being Rs. 3.71 lakh) and is also sustainable as the average number of borewells recharged per village panchayath is around seven, and the cost incurred to recharge per well is Rs. 53000/-.

The borewell recharge process includes digging a 12 feet x12 feet x10 feet pit around the bore well. At the bottom, in the casing, five feet of the bore well should be drilled around 100 to 200 holes and covered with nylon mesh, to make sure that silt should not enter the bore well. Then four feet should be filled with locally available stones or boulders around the casing, next 1.5 feet be filled with 40 mm jelly, next 1.5 feet with

20 mm jelly. A layer of charcoal powder has to be spread to absorb microorganisms. Then a nylon mesh has to be placed above the charcoal powder. Then two feet of sand layer needs to be spread on the top to enable silt free water to recharge the borewell. Next a one feet wall around the recharge structure with one inlet and outlet for rainwater from the catchment area needs to be constructed for the percolation pit to function.

In the MGNAREG scheme gram panchayaths of Kolar and Chikkaballapur districts have recharged on an average four to five drinking water borewells from past five years. The cost incurred to construct 12 feet × 12 feet × 10 feet recharge structure was of Rs. 53211. The structure construction generates on an average 142 man days for unskilled labour which accounts of Rs. 28988 (54 %) of the total cost and material component is of Rs. 24289 (46 %) which is paid to material supplier from the panchayath (Table VI).

The study indicates that 66 per cent of the drinking water borewells recharged successfully are yielding water in Eastern dry agro-climatic zone of Karnataka. This demonstrates that in the over exploited zone, the benefits due to recharge are certain and accordingly farmers and other groundwater users in EDZ needs to take initiative in individual groundwater borewell recharge activities to a large extent. The government should create awareness through capacity building programmes about the groundwater recharge for the farmers at village panchayath level with the help of the State Agricultural Universities and other concerned agencies.

References

Anonymous, 2009, Groundwater information booklet -Kolar District, Central Ground Water Board, Karnataka : p. 1 - 22

Chandrakanth, M. G., 2015, *Water resource economics*, Springer, London.

Kiran Kumar R. Patil, 2014, Economics of coping mechanism in ground water irrigation role of markets, technologies and institution. *Ph.D. Thesis* (Unpub.), Univ. of Agril. Sci., Bengaluru.

Kiran Kumar R. Patil, Chandrakanth, M. G. and Anitha, S., 2016, Bore well economics and sustainable groundwater management. *Jal Kranthi Abhiyan Groundwater Conference*, p. 77 - 87.

http://nrega.nic.in/netnrega/home.aspx

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