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RESEARCH ARTICLE

IMPACT ASSESSMENT OF WATER TABLE FLUCTUATIONS IN AND AROUND ARTIFICIAL RECHARGE STRUCTURES IN VANIYAR SUB BASIN OF THE PONNAIYAR RIVER, SOUTH INDIA

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ABSTRACT

Improvement in groundwater storage by artificial recharge structure constructed in the Vaniyar sub basin of the Ponnaiyar river in South India. Groundwater level was measured in and around the artificial recharge structures before and after its construction. After the construction of the artificial recharge structure, water level has measured. The groundwater table was generally at a depth of 14 m below ground level before the construction of artificial recharge structures. In this study area after the construction of artificial recharge structures, the groundwater level has increased by about 3.5 m at Vallymadurai dam constructed across Varatar stream. The temporal variation in groundwater level was compared with the water level fluctuation in and around the artificial recharge structures. The groundwater level in wells that are located closer to the check dam is considerably gaining. An area of about 300m, 500m and 1000m buffers is benefited by the rise in groundwater level around the check dam. The study indicates no reduction in recharge due to expected physical or organic clogging. Artificial Recharge Structures (ARS) constructed across the stream is ideal for augmenting groundwater storage in this sub basin.

INTRODUCTION

Groundwater is extracted for various purposes, which causes the rapid decline in groundwater table. Managed Aquifer Recharge methods (MAR) may be adopted in order to increase groundwater potential. Gale *et al*., (2006) describes MAR as intentional storage and behavior of water in aquifers. Selection of specific Managed aquifer recharge method depends very much on the hydrogeology to be recharged. Managed aquifer recharge will be helpful in enhancing groundwater level increase, improving groundwater quality, which increases urban land value (Gale *et al*., 2006). Check dam is one of the methods of MAR constructed across the non-perennial rivers and streams. Hydrological measurements will be helpful to evaluate the worth of check dam to understand the improvement on water level. Many research works have been carried to assess its impact by using hydrogeological measurements such as water level measurements, water quality parameters. Increase in groundwater level about 1.5m after construction of the check dam in north of Chennai; Parimala Renganayaki *et al*., (2013). Groundwater water level data are a good indicator to know the improvement on groundwater recharge. An improvement on groundwater recharge due to the construction of artificial recharge structures, especially check dam using water level measurement is carried out by Mudrakartha *et al* 2003; Gale *et al*., 2006; Muralidharan, 2007; Alderwish, 2010. An Improvement on groundwater quality around the check dam vicinity is assessed by water quality parameters and this is being assessed by Bhagavan & Raghu, 2005; Venkateswaran *et al*., 2012. The present study was carried out with the objective of an assessment of the impact of artificial recharge structure on groundwater level in the Vaniyar sub basin.

Study area

The Vaniyar sub basin is located in Dharmapuri and Salem districts of Tamilnadu. Annual average rainfall of this area is about 1491mm. The ephemeral stream Vaniyar originated on the northern slopes of Shervorayan hills and takes a course along the northeast in the valley and emerges out as the main artery of Dharmapuri district with northeast gradient and a small portion of catchment area falls in Salem district. The study area is agriculture based and water supply is met mainly by dug and bore wells. The study area map is given in Fig.1. Groundwater is extracted from the Vaniyar sub basin to supplement the drinking water needs of the urban population. Fast rate of reduction of groundwater level in population growth area is due to the continuous pumping of groundwater for water supply and extraction of groundwater by farmers for

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irrigation and drinking purposes. Hence, in order to maintain the yield of the aquifers and to supply assured water supply to the urban certain long-term water management measures such as the construction of an artificial recharge structure across the rivers. The location of existing artificial recharge structures and monitoring wells are shown in Fig2.

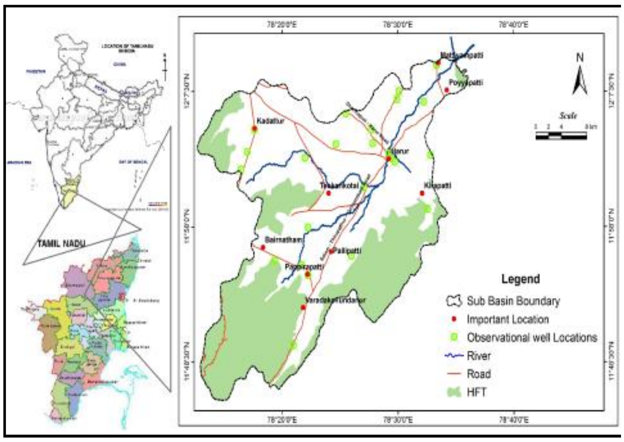


Fig. 1 Study area map of Vaniyar Sub basin

Water levels in Phreatic Aquifers

This sub basin mainly underlined by charnockite and followed by epidote-hornblende-gneiss. Groundwater occurs under phreatic conditions in the weathered mantle of crystalline rocks as well as in the shallow alluvial aquifers bordering in the major streams. Depth of water levels in large diameter wells in the area provides valuable information regarding the groundwater regime in the phreatic zone and is one of the guiding factors for selection of areas for recharge groundwater augmentation.

The water level data of 24 observation wells established and monitored in the study area during 2000–2014 have been used for the study and are shown in Table.1. Groundwater management studies were carried out by the Public Work Department, Water Resources Organization of Central Groundwater Board has also been included in their network. The location map of observation wells and ARS is given in Fig.2.

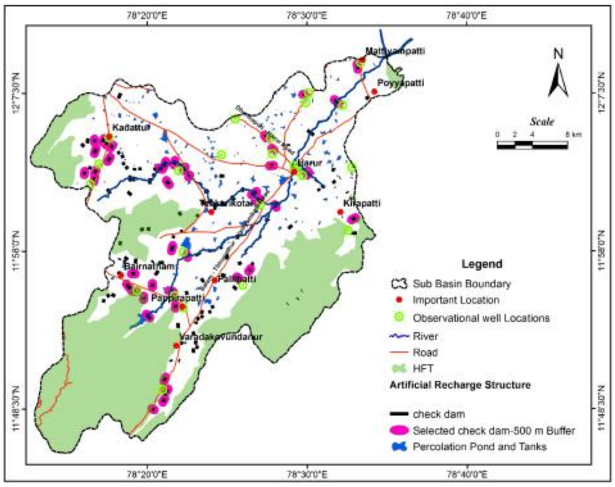


Fig.2. Location map of observation wells and ARS

Groundwater table Fluctuations

Fluctuations of the groundwater table in the phreatic aquifers are indicative of the status of the groundwater regime in the Vaniyar sub basin. Seasonal fluctuations of piezometric surface reflect the changes between the before and after construction during the period under consideration, whereas long-term fluctuations are indicative of the changes in groundwater storage in the aquifers in response to various recharge and discharge parameters over a period of time in the Vaniyar sub basin. Analysis of long-term fluctuations of ground water table gives an insight into the behavior of groundwater levels in the Vaniyar sub basin over a period of time in response to various recharge can provide valuable inputs for formulation of strategies for sustainable groundwater management.

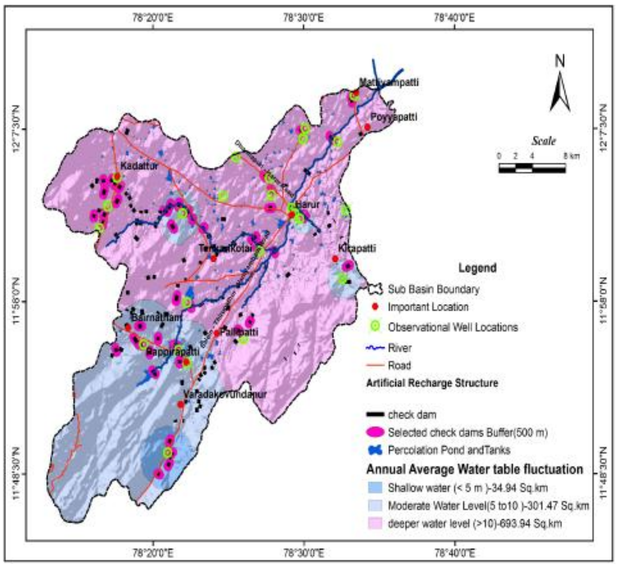


Fig.3. Average annual water table fluctuation map of vaniyar sub basin

The historical water level data of observation wells being monitored by the Central Ground Water Board (CGWB) and the Water Resources Organization of Public Works Department (PWD), Government of Tamil Nadu. Average annual water table fluctuation map of vaniyar sub basin is shown in Fig.3.

RESULTS AND DISCUSSIONS

The groundwater table was generally at a depth of 14 m below ground level before the construction of an artificial recharge structure. After the construction of an artificial recharge structure, the groundwater level has risen by about 3.5 m at Vallymadurai dam. The temporal variation in groundwater level was compared with the water level fluctuation in the artificial recharge structure.

In this study area based on the water level measurements estimated in and around artificial recharge structures. An area of 300m and 500m buffers is benefited by the rise in groundwater level around the structures. The study carried out after the construction of artificial recharge structures indicates no decrease in recharge due to expected physical or organic clogging. Groundwater table fluctuation before and after construction of ARS are shown in Fig.4.

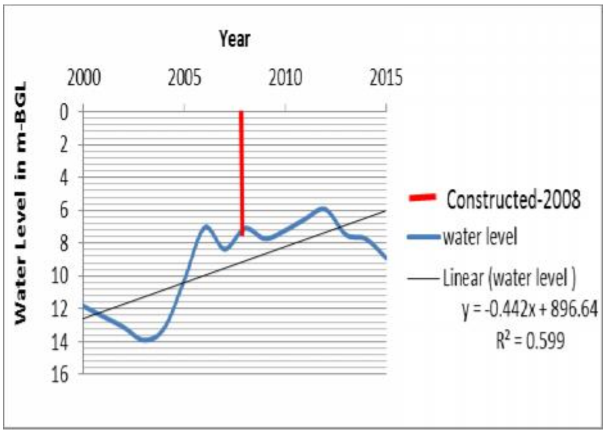


Fig 1 Vallymadurai-check dam

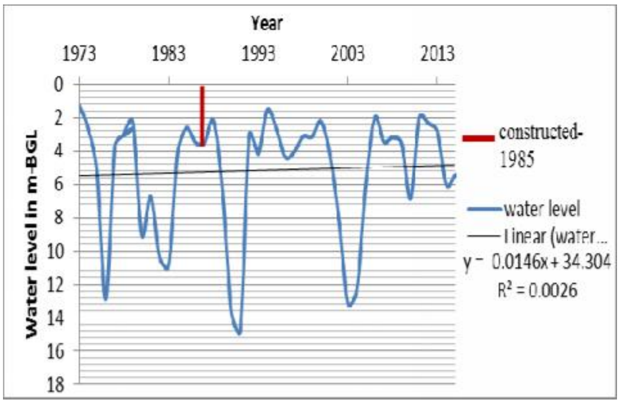


Fig .2 Pappiredipatty-check dam

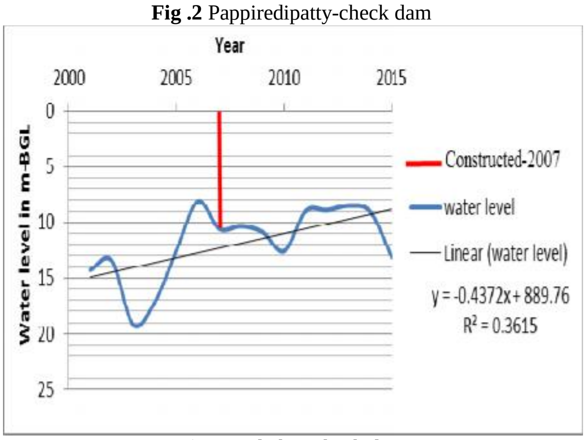


Fig 3 Kadathur-check dam

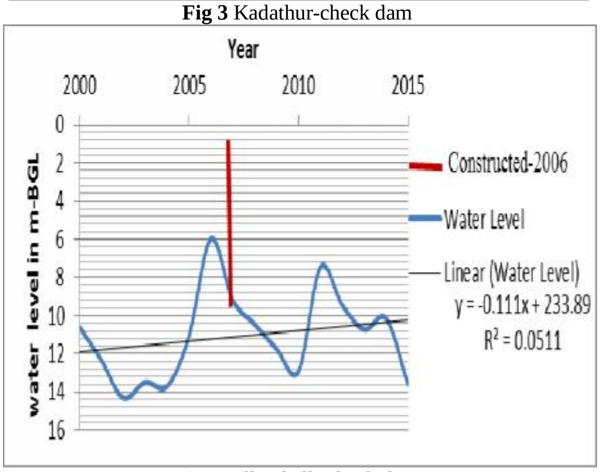


Fig 4 Sillarahalli-check dam

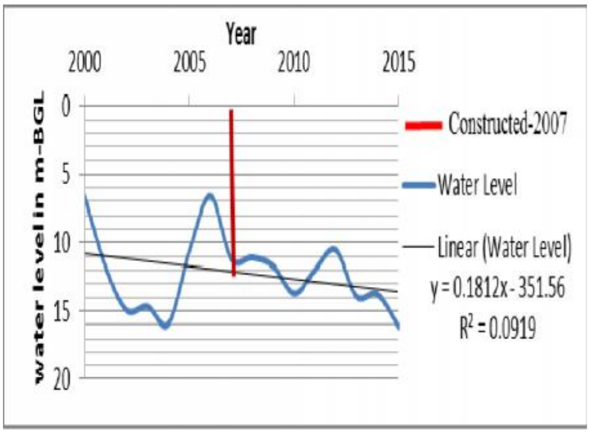


Fig 5 Menasi -percolation pond

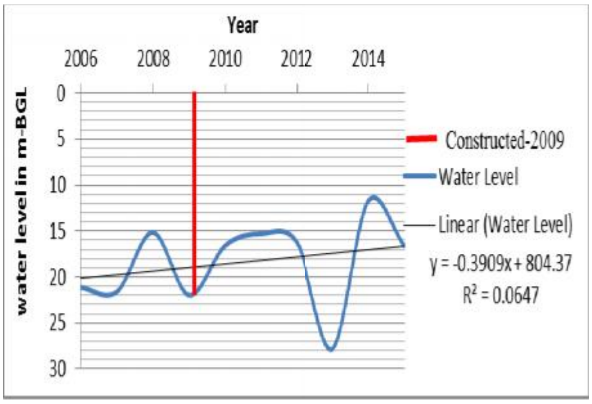


Fig 6 Mampatti-check dam

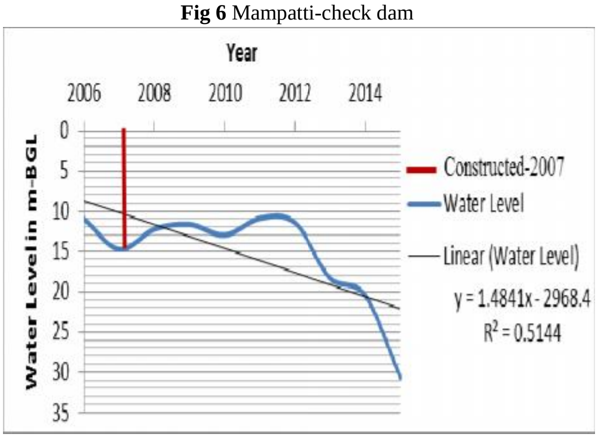


Fig 7 Jammanahalli-Percolation pond

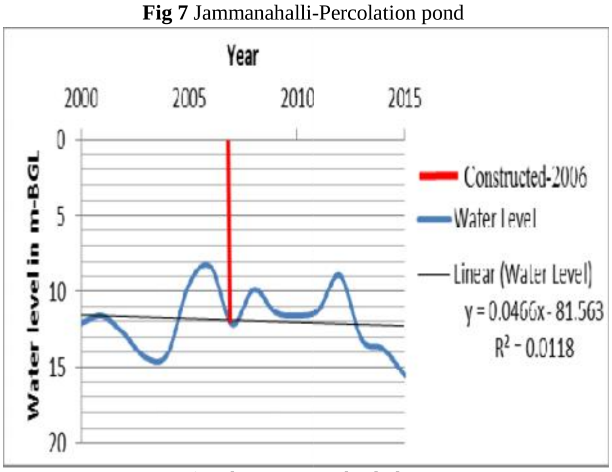


Fig 8 k.Vetripatti-check dam

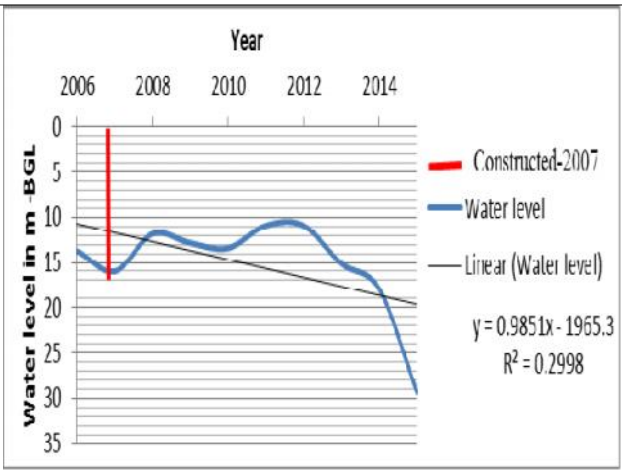


Fig 9 Kilanur-check dam

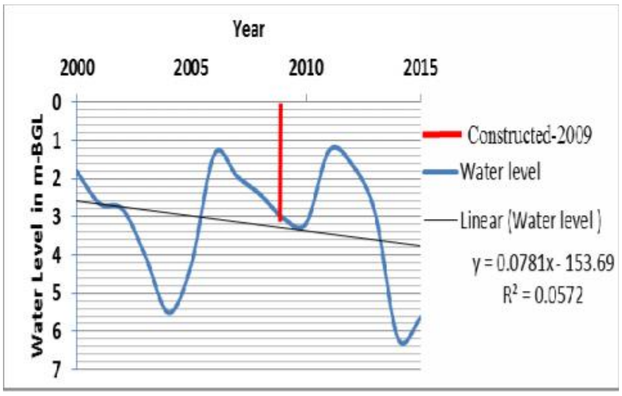


Fig 10 Kombur-Check dam

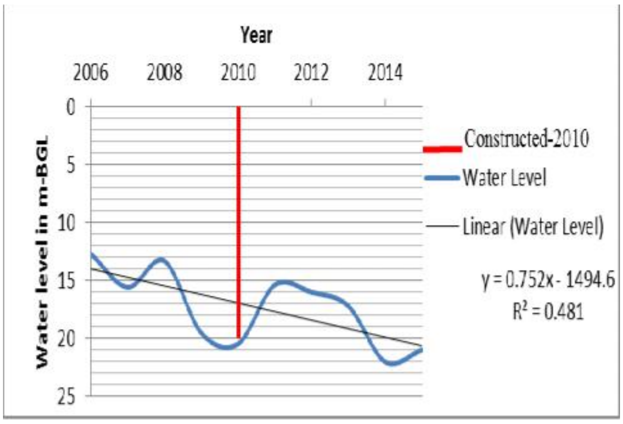
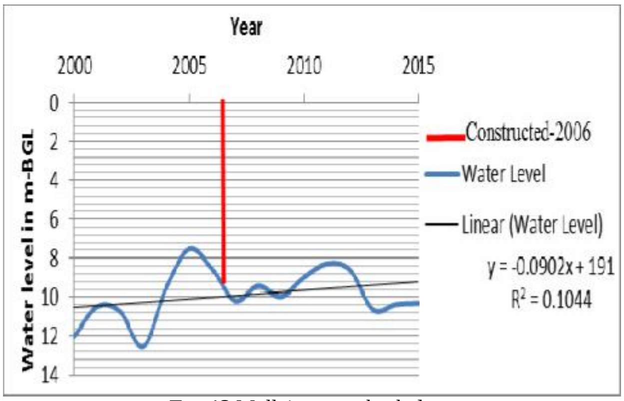


Fig 11 M.Velampatti-check dam



Fog 12 Mullaivanam-check dam

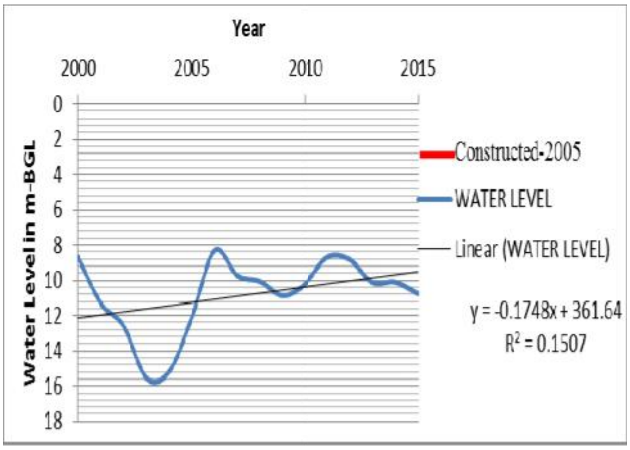


Fig 13 Harur old-check dam

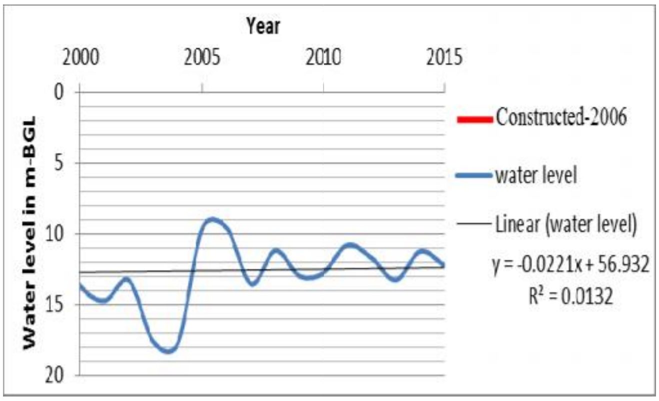


Fig 14 Peddur-check dam

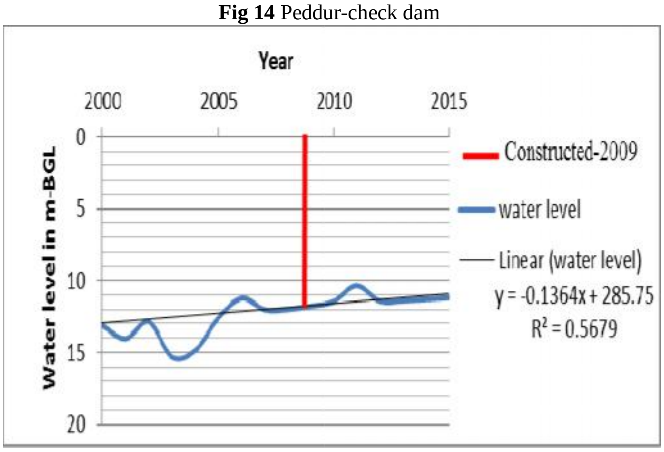


Fig 15 Harur P-check dam

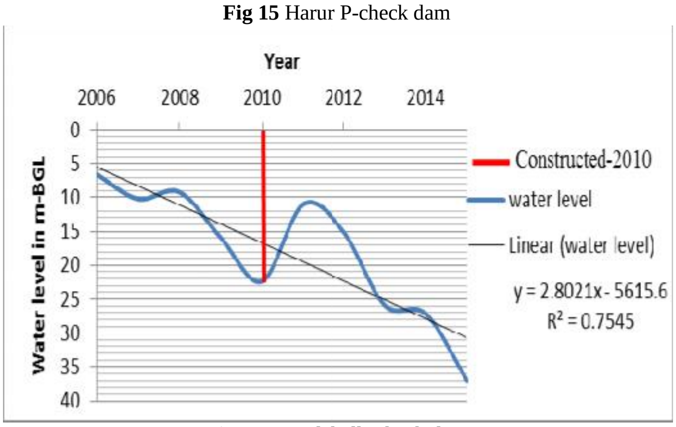


Fig 16 Regadahalli-check dam

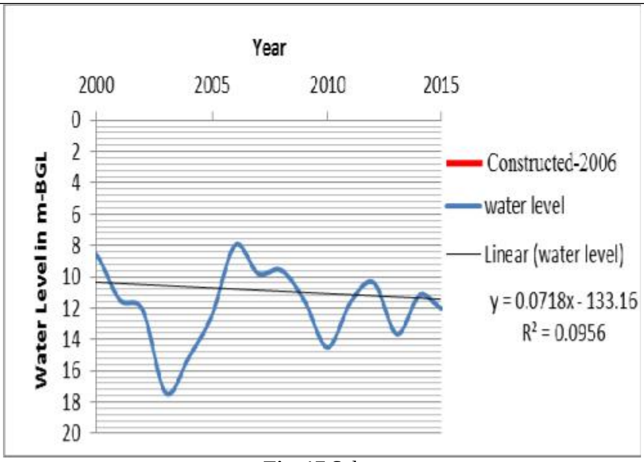


Fig 17 Salur

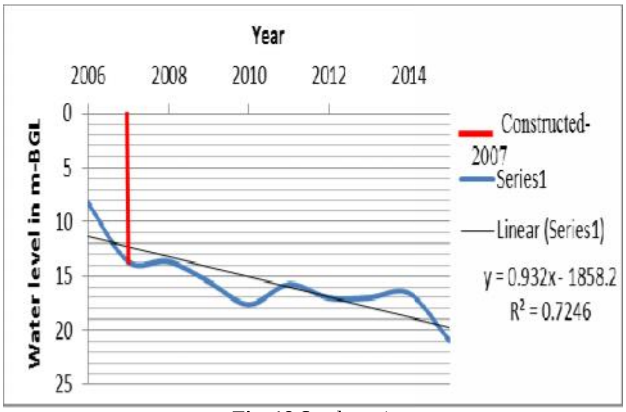


Fig 18 Sandapatti

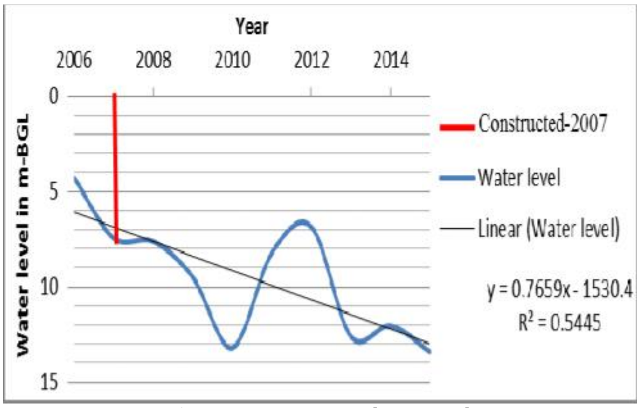


Fig 19 Ajjampatti-percolation pond

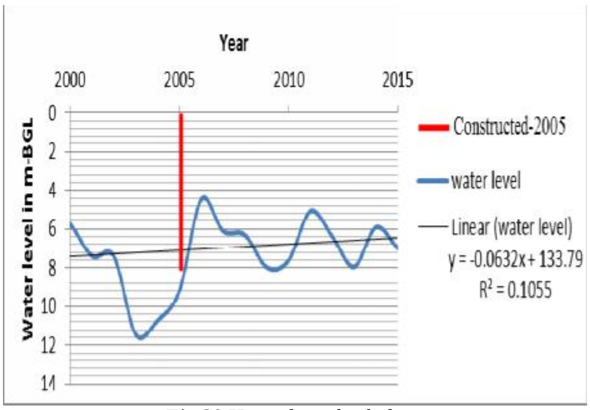


Fig 20 Harur dass-check dam

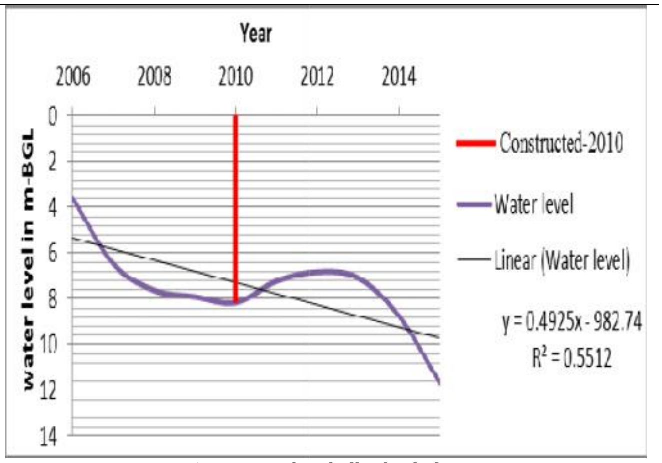


Fig 21 Gurubarahalli-check dam

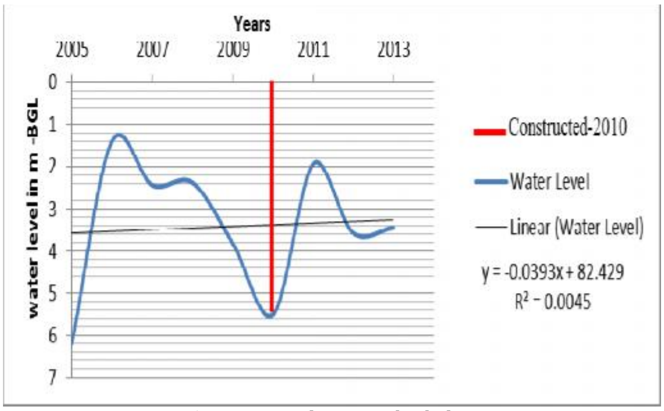


Fig 22 Pappirdipatty 1-check dam

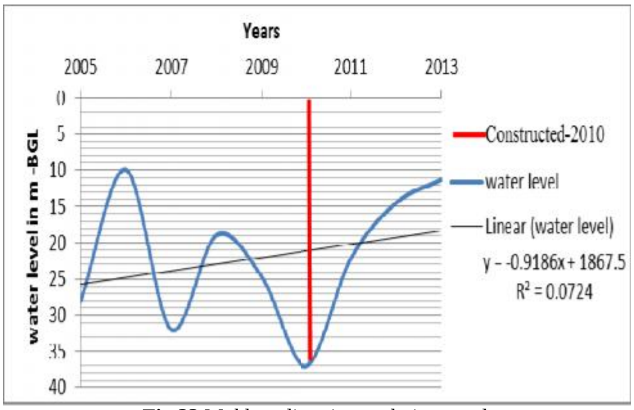


Fig 23 Mukkaredipatti-percolation pond

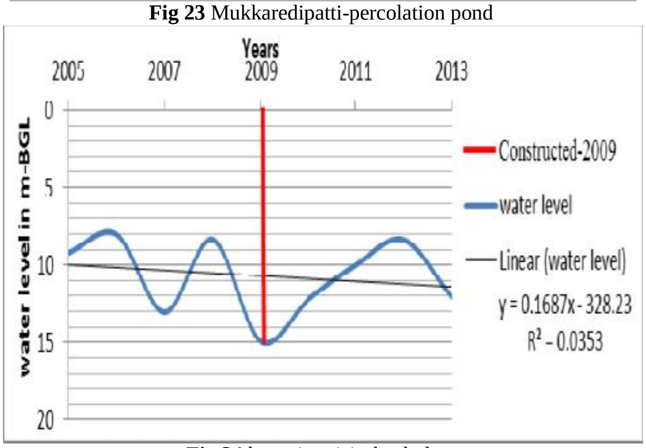


Fig 24 k.vetripatti 1-check dam

Fig. 4. Groundwater table fluctuation before and after construction of ARS

Table 1 Artificial Recharge Structures and groundwater table fluctuations in the observation wells

SI.No	Observation Well Locations	ARS Year	OW from ARS in m	Groundwater table			
				Before in m	After in m	Average in m	Rise in m
1	Vallimadurai	2008	200 m	10.81	7.36	9.2	3.5
2	Papppiredipatti	1985	430 m	6.57	5.12	5.1	1.4
3	Kadattur	2007	230 m	13.87	10.32	11.8	3.5
4	Sillarahalli	2007	350 m	11.33	10.81	11.1	0.5
5	Menasi	2009	380 m	11.59	12.86	12.1	0.5
6	Mampatti	2009	100 m	21.36	17.68	18.4	3.7
7	Jamanahalli	2007	806 m	10.95	15.93	15.4	-5
8	k.vetrapatti	2010	590 m	11.89	11.97	11.9	-0.7
9	Kilanur	2007	497 m	14.84	15.28	15.1	0.3
10	Kombur	2009	360 m	2.98	3.46	3.1	0.4
11	M.Velampatti	2010	697 m	16.31	18.32	17.3	-2
12	Mullaivanam	2006	455 m	10.19	9.64	9.8	0.5
13	Harur old	2005	187 m	12.57	9.77	10.8	2.8
14	Peddur	2006	288 m	15.42	11.72	12.8	3.7
15	Harur	2009	480 m	12.97	11.18	12.3	1.8
16	Regadahalli	2010	2000 m	12.84	23.21	18	-10
17	Sandapatti	2007	1600 m	10.96	16.76	15.5	-5.8
18	Ajjampatti	2007	1860 m	5.87	10.43	9.5	-4.6
19	Harur dass	2005	400 m	8.65	6.47	7.2	2.2
20	Gurubarahalli	2010	600 m	6.75	8.30	7.5	-1.55
21	Salur	2006	150 m	12.15	11.57	11.8	0.5
22	Papppiredipatti	2010	300 m	3.62	2.98	3.1	0.6
23	Mukkaredipatti	2010	230 m	15.98	17	16	1.02
24	K.Vetrapatti	2009	500 m	10.71	10.66	10.6	0.1

Note: ARS – Artificial Recharge Structures, OW – Observation Wells

In order to identify the impact of artificial recharge on strectures water table of twenty four observational wells, a comparison is made between of groundwater table before and after construction of the twenty one check dams and three percolation ponds located in the sub basin. The minimum and maximum water table observed before construction of the artificial recharge structure varies from 3.62m to 21m, after construction 2.98m to 23.28m. GPS Reading is used for locating surrounding wells and artificial recharge structures for finding out their distance.

CONCLUSION

Assessment of artificial recharge structures of groundwater table response was >3m groundwater level observed in some places such as Vallymadurai, Kadattur, Mampatti and Peddur. 2 to 3m groundwater table observed at Harur 1 and Harur 2. 1m to 2m groundwater table observed at Pappiredipatti ,Harur and Mukkaredipatti. 0 to 1m groundwater level observed at Sillarahalli, Menasi, Kilanur, Kombur, Mullaivanam, Salur, Pappiredipatti and K.Vetripatti. Whereas few observational wells located in K.Vetripatti, M.Velampatti, Jamanahalli, Sandapatti, Ajjampatti, Regadahalli and Gurubarahalli have shown no impact, it may be due to over exploitation of groundwater and insufficient rainfall.

Acknowledgement

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