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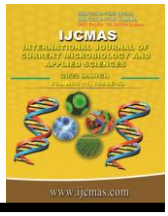

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Injection Bore Wells are used in the Chittoor Watershed Project to Save Water in an innovative way

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A B S T R A C T

Several developmental paradigms experimented during the India's post-independence era have indicated that for development to be sustainable it needs to be community based with central focus on inclusiveness, gender equity and in consonance with nature's laws. This has led to the concept of watershed as a unit for development and philosophy of area development through integrated approach by covering all developmental programmes under different departments into a comprehensive programme for resource conservation and their optimum utilization considering resources on one hand and the demands of all socio-economic classes of people on the other. Injection bore wells are used in the Chittoor Watershed project to save water in an innovative way has been become excellent example in the watershed programme.

Introduction

The Chittoor district lies in the southern part of the state of Andhra Pradesh between Northern Latitudes of $12^0$37" and $14^0$8" and between the Eastern Longitudes $78^0$33" and $79^0$55" at an average altitude of about 190 m from sea level.

The total geographical area of the district is 15,151sq.kms. There are about 1,540 revenue villages grouped into 66 mandals. The normal annual rainfall of the district is 933.9 mm with maximum temperature varying through the year between 29.9°C & 40.3°C. Agricultural lands occupy 51.96% (single crop-91.2% and double crop-8.8%) of the total area, while land under non-agricultural use is 8.03%, barren and uncultivable land occupies about 7.2% of total geographical area. Forest area is about 19.3%; water bodies such as rivers, tanks etc. is 3.1% and city/town/village area is about 1.7% (Shah, *et al*., 2007; Bhattacharya, *et al*., 2010).

Thus, forest and agriculture are the predominant land uses in the district. Paddy, bajra, ragi, horsegram, redgram, groundnut, sugarcane and mango are the major crops grown in the district.

Introduction of Watershed Programme in Chittoor District

Development of rain-fed/ dry land areas in order to maintain the momentum of agricultural growth.

Prevention of land degradation to augment productivity.

Restoration of traditional water saving initiatives to meet the increasing demands and prevent excessive exploitation of ground water

Activities carried out under IWMP

The state has essentially played the role of a facilitator through a network of local level institutions in the implementation of IWMP leaving the responsibility of programme implementation to the communities (Sakthivadivel, *et al*., 2007; Narula, *et al*., 2014). As per the guide lines the capacities of the communities have been built by organizing various trainings and other programmes for effective implementation through appointed Project Implementing Agency (PIA) by providing required guidance and supervision as required. The main objective behind such implementation strategy is to ensure that the development process will be continuous and sustainable in the long run even after the government support is withdrawn. The programme included several other activities to enable poor and landless to earn additional income through agricultural and non-agricultural livelihood activities. Watershed development involves structural and non-structural activities so as to bring changes in ecological variables such as land use, vegetative cover, soil moisture, augmenting groundwater and overall economics. The major activities undertaken as part of IWMP implementation are as given below.

Specific Objectives of the Study

The broad objectives of this thematic study is to understand the usage of injection wells in Chittoor district and how it is helped to recharge of water in the drought prone area of Chittoor district farmers.

Materials and Methods

Collected case studies

Collected secondary data from the DWMA and SLNA website

Study Area

The study conducted in Chittoor watershed projects of Batch-III & IV, which covered 13 projects from 4 watershed computer centers i.e., Tirupati, Sodam, Palamaner and Piler.

Overall Watershed Projects in Chittoor

The total number of watershed projects in Chittoor district from the period 2009-10 to 2012-13 along with other details is furnished in Table-1 from Batch I to IV. Total implemented projects were 62 projects in 39 mandals of the district and covering 250966 Ha of land for various watershed works in 352 micro watersheds.

Under the watershed development various works were taken up in all the projects especially Natural Resource Management works like Soil & Moisture works i,e staggered contour trenches, Water absorption trenches, sunken pits, loose boulder structures, rock fill dams, Water Harvesting works mini percolation tanks, percolation tanks, check dams, check walls, farm ponds, dugout ponds, injection wells played a key role for enhancing the water and soil conservation.

The present thematic study is more focused on injection wells in the district, about importance, features, technical aspects and its impact on conservation and protection of water and benefits derived to the farmers.

Introduction of Injection Wells

As the injection wells definition emphasizes to protect groundwater resource in planting fluid underground into porous geologic formations, importance of ground water also needs to be

considered since aquifers are contained water where sufficient quantity of groundwater to supply public consumption and other purposes. It has to use more in a sustained manner and there have been various regulations in place to avoid overuse or manipulation of the resource. And also placed in setting minimum requirements for injection wells such as general and specific permits to ensure injected fluids stay within the well in the intended zone so that to avoid adverse effects on public health. There have been different methods identified for artificial recharge of groundwater by communities used such as surface spreading methods and aquifers through shafts, pits, and injection wells.

The physical, chemical and biological quality of recharge water also affects the selection of recharge methods. Suspended solids in recharge water causes clogging. It is also important that the recharge water be chemically compatible with the aquifer material through which it flows and the naturally occurring groundwater to avoid chemical reactions that would reduce the aquifer porosity and recharge capacity.

Similarly, biological agents such as algae and bacteria can cause clogging of infiltration surfaces and wells, limiting the recharge capacity. So, the design of recharge structure requires careful consideration to ensure correct sizing of the pond to provide sufficient recharge into groundwater.

Periodic maintenance of artificial recharge structures is essential because infiltration capacity is rapidly reduced as a result of silting, chemical precipitation, and accumulation of organic matter. In case of spreading structures, annual maintenance consists of scraping the infiltration surfaces to remove accumulated silt and organic matter.

While in injection wells and connector wells, periodic maintenance of the system consists of pumping and/or flushing with a mildly acidic solution to remove encrusting chemical precipitates and bacterial growths on the tube well slots. By converting injection or connector wells into injection cum pumping wells, the interval between periodic cleanings can be extended; in the case of spreading structures except subsurface dikes constructed with an overflow outlet, annual desilting is a must.

In order to replenish an aquifer, which is under stress, surface storage structures (percolation tanks) are being constructed in some regions where the groundwater is the principal source of irrigation or irrigation tanks are converted to percolation tanks by closing the outlet sluices and allowing the stored tank water to recharge the aquifers.

Percolation tanks (or ponds) are water harvesting structures constructed across or near streams to impound rainwater and to retain it for a longer time to increase the opportunity time for infiltration. The water storage is expected to induce percolation and replenish the aquifer, which is being exploited through wells located down the gradient.

Check dams, generally constructed for soil conservation can be considered as mini or micro-percolation tanks where water is not directly drawn for irrigation from check dams but is allowed to percolate into subsurface strata, thus augmenting the groundwater. In this view, in watershed programme followed 2 types of injection wells with different features and specification.

Importance of injection bore wells are explained in Type I and Type II which includes the details of watershed works done in relation to injection wells, project site and area, work details, inputs incorporated, abstract estimation of works and detailed estimation works.

Dugout Pond for Type-I Injection Well

The main purposes of the Dugout pond for injection wells are to harvest the runoff so as to facilitate recharge the Bore wells. Injection well is also helpful to harvest the runoff from rain water drain for recharging drinking water sources.

Expected Outcome of Type-I Injection Well

To bring the over exploited villages in to safe villages

To reduce the Ground water table from > 15mts to 3 to 8mts. range

Construction of Type-I Injection Wells

Avoid toilet water into silt trap.

Provide 2 + type bolts and nuts in the casing pipe to avoid unwanted incidents

Based on the Geologist recommendation give inputs, the depth of drilling and depth of casing pipe.

Provide fencing around the structure for protection.

Level the ground with excavated earth around the structure to prevent water logging.

Type-II Injection Wells

Injection well to harvest the runoff from field catchment in Water Bodies (in New Dugout Ponds) Type II: The purpose of the Type-II injection wells is to to bring the over exploited villages in to safe villages, to bring the Ground water table from > 15mts to 3 to 8mts. range and to reduce the dependency of water transportation for drinking water.

Status of Injection Wells in Chittoor Watershed Project

In the selected district, it was accepted by the watershed committee and local community to have the injection wells in their area and approached the officers of the concern and obtained approval according to the feasibility and technical aspects of the Type I and Type II injection wells. The injection wells were mainly sanctioned to Tirupati, Pileru, Palamaner and Sodam projects of III and IV of the batches in the district.

The present scenario of injection wells in Tirupati were for the year 2020 denotes the details of the pre-project estimation, sanctioned amount and completed works undertaken by the project implementing agencies such as WCC and Project. This has been implemented in 5 projects where the total number of physical works estimated in pre-project was 33 with a financial outlay of Rs. 55.41 (lakhs). The entire amount was for all physical and currently the amount spent for works was Rs. 34.76 (lakhs) and the remaining has to be incurred shortly.

Similarly the current status of injection wells in Sodam WCC for the year 2020 indicates the details of the pre-project estimation, sanctioned amount and completed status of works undertaken by the project implementing agencies for 2 projects. The total number of physical works estimated in pre-project was 4 and the total estimated amount was Rs. 7.08 (lakhs). The total amount was sanctioned and so far physical works completed were 3 and the amount spent was Rs. 2.68 (lakhs) and the remaining is under progress.

Further, injection wells status in Palamaner reveals the pre-project estimation, sanctioned amount, and completed status of works undertaken by the project implementing agencies Table-11 for 4 projects. The number of physical works estimated in pre-project was 13 with a total cost of Rs. 21.78 (lakhs). At present the total physical works are in progress the total amount spent is Rs. 14.69 (lakhs) and the balance is left to be utilized.

Injection wells status during the year 2020 in Piler WCC table-12 shows the details of the pre-project estimation, sanctioned amount, and completed status of works undertaken by the project implementing agencies such as WCC and Project for 2 projects.

The total numbers of physical works estimated in pre-project were 10 and the total estimated amount was Rs. 16.42 (lakhs). The entire amount was sanctioned to take up the works but the total amount spent was Rs. 10.93 (lakhs) and the works are under progress (in terms of composing a research report)

Total injection wells sanctioned for Chittoor district were 60 and the majority of works have been completed. The allocation of water for recharge through specific type of artificial recharge structures should be done considering these aspects. In case of deeper aquifers, injection wells are recommended on the basis of thickness of aquifer and status of ground water withdrawal and the feasibility of gravity injection at safe rate obtained.

Results and Discussion

The study concluded that the success of an artificial recharge depends upon the local hydro geological situation and is primarily governed by the specific capacity of a recharge well or the transmissivity of the shallow aquifer. However, once an artificial recharge scheme is under operation then its efficiency is decided by the quality of the water used for recharge and also by the level of periodic maintenance practiced.

Injection well status in Chittoor reveals some of the best practices to improve the groundwater supply. The total number of projects undertaken in the district are 62 covering an area of 2,50,966 ha. This system not only denotes the action plans planned, but it also sets out the actions required in the form of providing inputs and adding value. More significantly, technical support for appropriate action in the programme which has helped to ensure the timely project plan will not prolong administrative and technological sanctions from the officials and technical staff concerned.

Table.1 Overall Watershed Projects in Chittoor District

Sl. No.	Details	Number
1	Mandals	**39**
2	Projects	**62**
3	Micro-watersheds	**352**
4	Gram Panchayats	**358**
5	Habitations	**3656**
6	Watershed User Groups	**6885**
7	WCCs-GO-PIA	**4**
8	WCCs-NGO-PIA	**4**
9	**Project area (in Ha.)**	**250966**

Table.2 Injection Wells in Tirupati WCC

Sl. No.	Project	Estimates Prepared		Admin Sanctioned		Completed	
		Physical	Financial (Lakhs)	Physical	Financial (Lakhs)	Physical	Financial (Lakhs)
1	Chinthapenta	1	1.83	1	1.83	1	**0.33**
2	Jakkadona	15	24.56	15	24.56	15	**18.75**
3	Netthikuppam	4	7.51	4	7.51	4	**1.43**
4	Pulikallu	11	18.2	11	18.2	11	**12.12**
5	Pulluru	2	3.3	2	3.3	2	**2.13**
Grand Total		**33**	**55.41**	**33**	**55.41**	**33**	**34.76**

Table.3 Injection Wells in Sodam WCC

Sl. No.	Project	Estimates Prepared		Admin Sanctioned		In Progress		Completed	
		Physical	Financial (Lakhs)	Physical	Financial (Lakhs)	Physical	Financial (Lakhs)	Physical	Financial (Lakhs)
1	Ayyavandlapalle	2	3.73	2	3.73	1	0.3	1	**1.84**
2	Yerrathivaripalli	2	3.35	2	3.35	0	0	2	**0.84**
Grand Total		**4**	**7.08**	**4**	**7.08**	**1**	**0.3**	**3**	**2.68**

Table.4 Injection Wells in Palamaner WCC

Sl. No.	Project	Estimates Prepared		Admin Sanctioned		Completed	
		Physical	Financial (Lakhs)	Physical	Financial (Lakhs)	Physical	Financial (Lakhs)
1	Chokkandlapalle	5	8.34	5	8.34	5	**6.35**
2	Dandapalli	5	8.85	5	8.85	5	**4.16**
3	Gudipalle	2	2.89	2	2.89	2	**2.74**
4	Rallabuduguru	1	1.7	1	1.7	1	**1.44**
Grand Total		**13**	**21.78**	**13**	**21.78**	**13**	**14.69**

Table.5 Injection Wells in Piler WCC

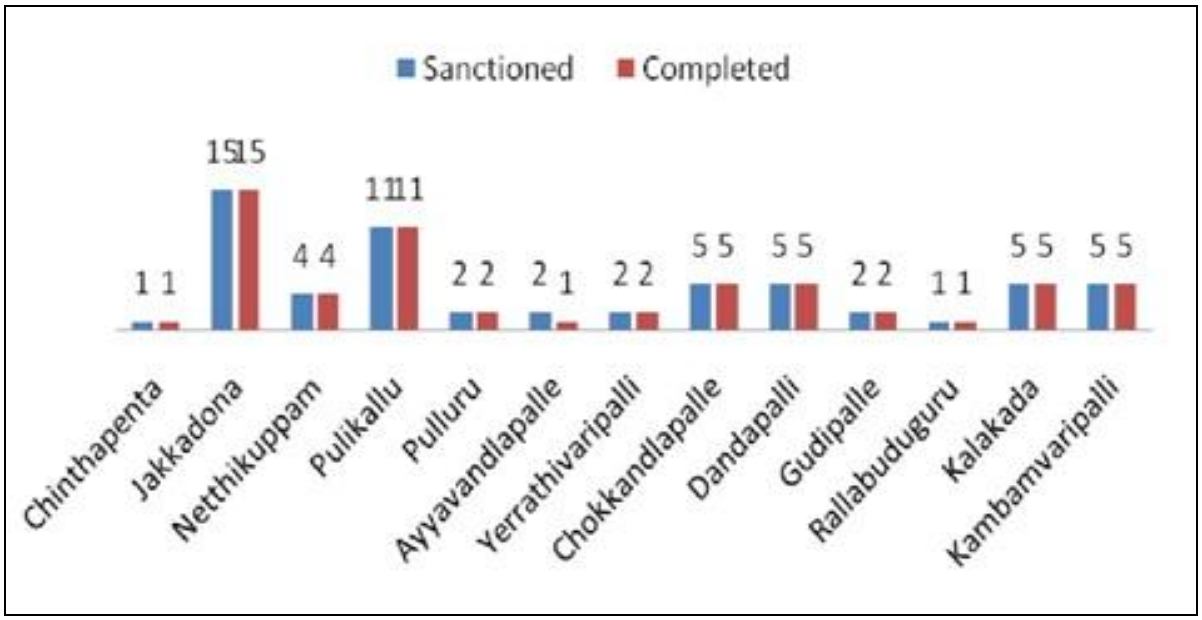
Sl. No.	Project	Estimates Prepared		Admin Sanctioned		Completed	
		Physical	Financial (Lakhs)	Physical	Financial (Lakhs)	Physical	Financial (Lakhs)
1	Kalakada	5	8.18	5	8.18	5	**5.4**
2	Kambamvaripalli	5	8.24	5	8.24	5	**5.53**
Grand Total		**10**	**16.42**	**10**	**16.42**	**10**	**10.93**

Table.6 Overall Abstract of Injection wells in 13 projects of Chittoor district

Sl. No.	Name of the project	Sanctioned	Completed
1	Chinthapenta	1	**1**
2	Jakkadona	15	**15**
3	Netthikuppam	4	**4**
4	Pulikallu	11	**11**
5	Pulluru	2	**2**
6	Ayyavandlapalle	2	**1**
7	Yerrathivaripalli	2	**2**
8	Chokkandlapalle	5	**5**
9	Dandapalli	5	**5**
10	Gudipalle	2	**2**
11	Rallabuduguru	1	**1**
12	Kalakada	5	**5**
13	Kambamvaripalli	5	**5**
Total		**60**	**59**

Fig.1 Construction of Type-I Injection Wells

Graph.1 Abstract of Injection Wells in Chittoor District



Injection well status in Chittoor district means to assess the project site planned, approved and completed works so far in Tirupati, Sodem, Palamaner, Piler WCC areas as per the works proposed. It is noticed that the project results demonstrates a full use of approved works by not only taking up but also completing them as per the time schedule. So, regarding the individual WCC projects, Tirupati approved works were 33 and implemented 33, Sodem approved works are 4 and finished works 3, In Palamaner, 13 approved works and finished all the works while in Piler, approved works were 10 and completed all. The total number of injection well projects completed in the district. This indicates successful implementation of works in several areas resulting increase in the recharge of groundwater in the sanctioned areas. This also suggests the importance of having injection wells in order to avoid depletion of ground water and introduce best practices to increase the groundwater table.

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