

Original Research Article

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Assessment of Water Resources in Nagarjuna Sagar Right Canal (Jawahar) Command of Andhra Pradesh

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ABSTRACT

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The Nagarjuna Sagar Project is one of the prestigious projects in India and it irrigates nearly 9 lakhs ha area. The canal is divided into 9 branch canals spread across Guntur and Prakasam districts. The month wise and branch wise discharge data and hydraulic particulars of main and branch canal was collected from Water Resources Department, Lingamgunta circle and Ongole circle. The daily rainfall data from 1997 to 2018 (22 years) obtained from the Directorate of Economics and Statistics (DES) was used for calculating annual availability of rainfall distribution over the command area. The total availability of the surface water of 11 years was 2,229 MCM. Average annual rainfall of Guntur and Prakasam Districts under command area was noticed as 780 mm and 749 and overall command area was recorded as 765 mm. The average groundwater availability of the command area was estimated as 1385 MCM. Finally, conjunctive use of water in command area is 3,614 MCM (128 TMC).

Introduction

The Nagarjuna Sagar Project is built across river Krishna at Nandikonda village of Nalgonda District. The main objective of this Nagarjuna Sagar project is to bring the 9 lakhs hectare of land under cultivation. The right canal was designed with carrying capacity of 11,000 Cusecs. The area irrigated by Nagarjuna Sagar Jawahar Canal is about

4.75 lakhs ha in Guntur and Prakasam districts (Anonymous, 1999).

The Canal is divided into 9 branch canals spread across Guntur and Prakasam districts. The Right main canal having Guntur, Zulakallu, Bellarnkonda, Peddanandipadu, Addanki, Eddanapudi, Darsi, Pamidipadu and Ongole branch canals.

Study area

Nagarjuna Sagar Project Right Canal (Jawahar) Command

The command area lies between the latitudes of 15° 20' 00" to 16° 41' 24" N and the longitudes of 79° 18'44" to 80° 25' 56" E, encompassing Guntur and Prakasam districts in the state of Andhra Pradesh. The geographical command area consists from block 1 to 22 (GA) as shown in Figure 1 and Table 1.

Nagarjuna Sagar Right (Jawahar) Canal Command area spreads over 37 mandals in Guntur and 23 mandals in Prakasam districts.

Materials and Methods

Surface water availability

Nagarjuna Sagar Right (Jawahar) Canal water releases data i.e. month wise and branch wise discharge data and hydraulic particulars of main and branch canal was collected from Water resources department, Lingamguntla circle and Ongole circle for a period from 2008 to 2018. Mean annual availability of water at different stages was computed. The daily rainfall data from 1997 to 2018 (22 years) was obtained from the Directorate of Economics and Statistics (DES) and used for calculating annual availability of rainfall contribution over the command area by Usman *et al.*, (2016).

Groundwater monitoring

Groundwater monitoring is being carried-out continuously by monitoring of 300 observation wells in Nagarjuna Sagar Right Canal command area comprising I to XXII blocks with 188 Observation wells in Guntur and 112 Observation wells in Prakasam established the State Groundwater Department. Usman et al (2016) studied variations in conjunctive water management practices, groundwater productivity and crop

profitability in Chuharkana irrigation sub-division.

Assessment of ground water resources using water table fluctuation method

Water Table Fluctuation (WTF) method is based on the premise that rise in groundwater levels in unconfined aquifers are due to recharge water arriving at the water table. It is the most widely used method for estimating recharge (Healy and Cook, 2002).

Recharge is calculated as

$$R = S_y dh/dt$$

Where

R recharge, S_y the specific yield, h is water-table height, and t is time

Static ground water reserve = thickness of aquifer below the zone of water level fluctuation down to exploitable limit Average DTW X areal extent of the aquifer X specific yield of the aquifer

Water Table Fluctuations represent spatially averaged recharge. Determining representative values of S_y is a major difficulty in applying this method. Another difficulty lies in ensuring that the fluctuations in water levels are due to recharge and are not the result of changes in atmospheric pressure, the presence of entrapped air or other phenomena such as pumping.

Results and Discussion

The surface water availability estimated from different sources namely water releases data obtained by Water Resources Department, Lingamguntla and Ongole Circles of Nagarjuna Sagar Right Canal (Jawahar) Command Area, Andhra Pradesh is presented in Figure 2.

Table.1 Line diagram of Nagarjuna Sagar Right Main Canal

Milage		Name of the Branch Canal/ Major	Length	Designed discharge in C/S	Block No
M-F-Ft			M-F-Ft		
0-0-000	NAGARJUNA SAGAR RIGHT MAIN CANAL	Right Canal Head Regulator		11,000	
4-6-000		Pasuvemula Major	1-0-207	5.24	1
7-0-000		Tallapalli Major – I	0-4-365	4.48	2
8-4-000		Tallapalli Major – II	0-4-300	10.13	2
12-1-558		Mallavaram Major	7-7-572	126.18	3
13-6-000		Khambampadu Major	1-6-290	18.53	3
15-7-000		Paluvai Major	5-0-110	64.09	3
20-7-076		Buggavagu O T Regulator		11000	
21-7-00		Rentachintala Major	9-5-655	42.64	4
24-0-110		Daida Major	12-6-360	266.40	4
24-6-440		Charlagudipadu Major	3-4-150	24.16	4
27-3-550		Miryala Major	2-5-495	17.20	5
30-2-220		Ramapuram Major	18-3-018	253.80	5
33-4-000		Pedakodamagundla Major	2-4-402	22.30	5
34-2-655		Cross regulator cum surplus escape		10100	
38-0-330		Kesanupalli Major	6-6-613	68.80	6
40-4-280		Zulakallu Branch Canal	1-3-299	564.29	6
42-0-560		Janapadu Major	4-4-000	34.40	6
46-3-000		Guttikonda Major	2-4-535	15.20	7
47-3-550		Kotanemalipuri Major	7-2-330	31.40	7
49-5-570		Bellamkonda Branch Canal	11-3-027	645	8&9
52-5-165		Guntur Branch Canal	32-1-000	2920	10
52-7-400		O.T. of 1 AR Kothapalli Major(shifted from GBC)		8.64	10
57-0-475		Addanki Brach Canal	37-3-272	2469	11
57-2-250		Cross regulator		3947.00	
58-6-543		Inumella D.P		1.07 / 0.25	11A
59-5-300		Inumella Major	8-0-080	23.20	11A
64-2-330		Ipur D.P		1.80	12
66-0-610		Angaluru Major	8-0-440	52.02	12
69-6-049		Perumallapalli Major	20-5-372	192.60	13
74-0-470		Perurupadu Major	3-1-110	28.97	13
78-3-196		Dondapadu Major	6-2-220	48.97	14
81-5-474	Cheekateegalapalem Major	14-1-550	140.14	14	
83-2-402	Palakuru Major	0-6-250	5.57	14	
85-3-150	Cross regulator cum escape		3346		

Table.2 Annual average rainfall data of NSP right canal command from 1997-2018

Year	Average Guntur rainfall, mm	Average Prakasam rainfall, mm	Average command area rainfall, mm
1997	812.79	995.02	903.91
1998	897.25	881.50	889.38
1999	590.66	526.55	558.61
2000	914.58	865.98	890.28
2001	809.20	737.07	773.14
2002	533.01	500.20	516.61
2003	862.92	684.30	773.61
2004	739.67	578.63	659.15
2005	896.35	789.69	843.02
2006	724.28	827.79	776.04
2007	915.52	848.51	882.02
2008	911.43	921.96	916.70
2009	395.00	542.70	468.85
2010	1344.15	1458.24	1401.20
2011	625.26	524.70	574.98
2012	960.14	957.30	958.72
2013	1111.02	1085.85	1098.44
2014	603.13	452.79	527.96
2015	606.63	674.85	640.74
2016	796.93	590.23	693.58
2017	650.56	651.55	651.06
2018	464.34	389.95	427.15
Average	780.22	749.33	764.78

Table.3 Annual average groundwater availability in NSRC command area

Year	Static Available Ground water resources (ha-m)	Static Available Ground water resources (MCM)	Static Available Ground water resources (TMC)
2008-09	306220.56	3062.21	108.14
2009-10	231930.37	2319.30	81.91
2010-11	241896.13	2418.96	85.43
2011-12	231477.38	2314.77	81.75
2012-13	204298.04	2042.98	72.15
2013-14	231477.38	2314.77	81.75
2014-15	211998.85	2119.99	74.87
2015-16	182554.57	1825.55	64.47
2016-17	199768.15	1997.68	70.55
2017-18	231024.39	2310.24	81.59
2018-19	224229.56	2242.30	79.19
Average static ground water volume	226988.67	2269.89	80.16

Fig.1 Location map of the study area

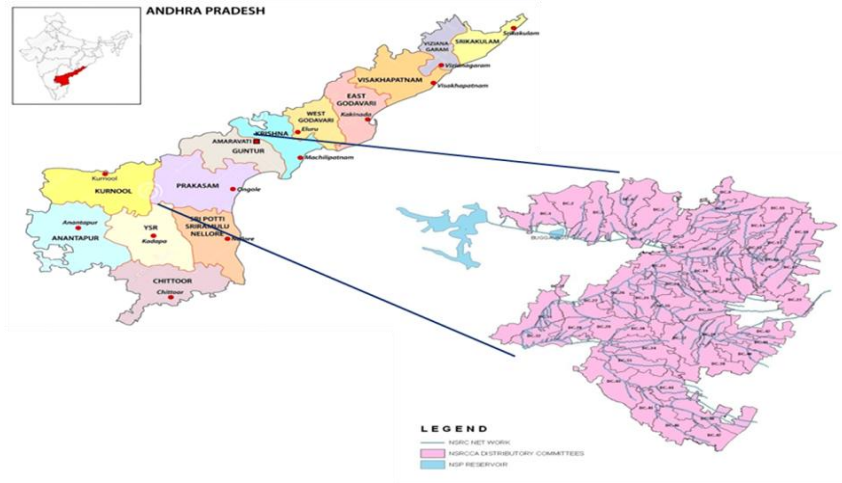


Fig.2 Off-take wise water withdrawals of NSP right canal command area at different levels (TMC)

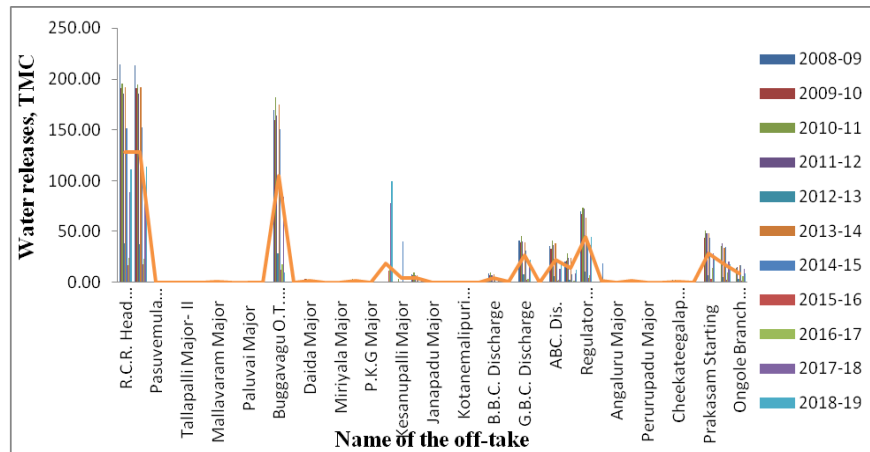


Fig.3 Average annual rainfall of the command area from 2008-2018

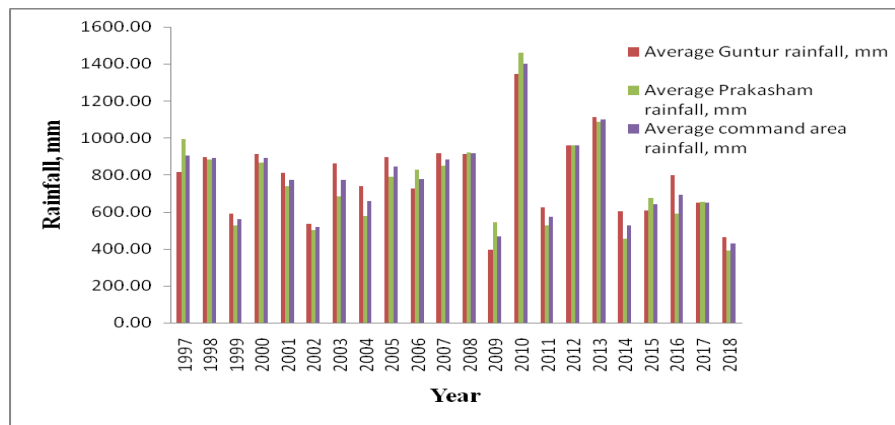


Fig.4 Network of Observation wells in Nagarjuna Sagar Right (Jawahar) canal command area

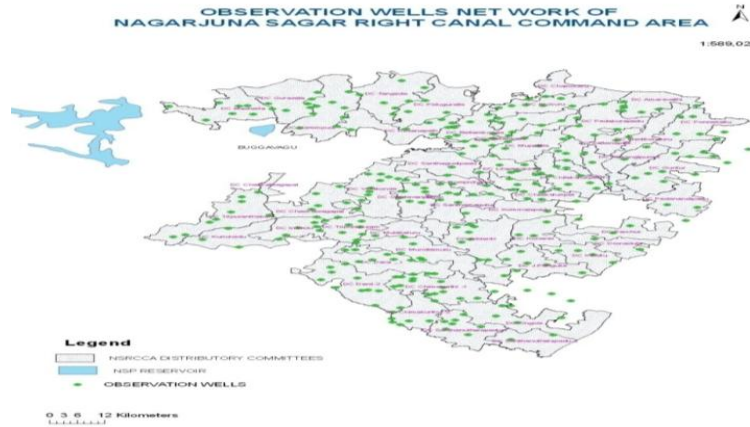


Fig.5 Average station wise depth to water level of observation wells BGL in Nagarjuna Sagar right canal command area from 2000 to 2018

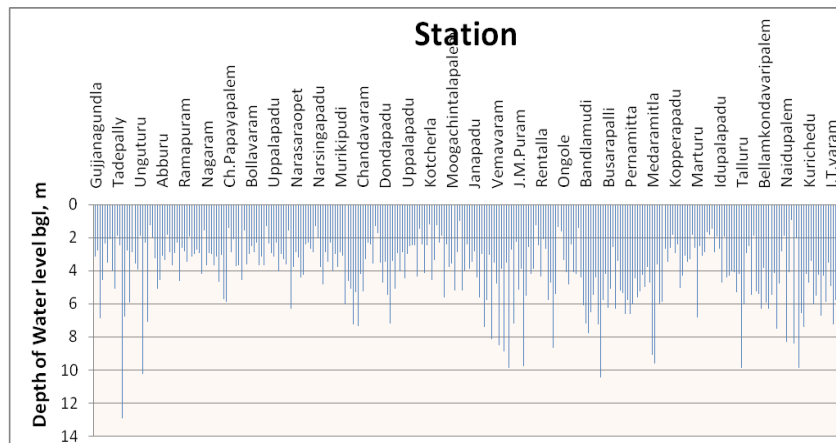


Fig.6 Average Station wise depth to water levels of Piezometers BGL in Nagarjuna Sagar right canal command area from 2016 to 2018

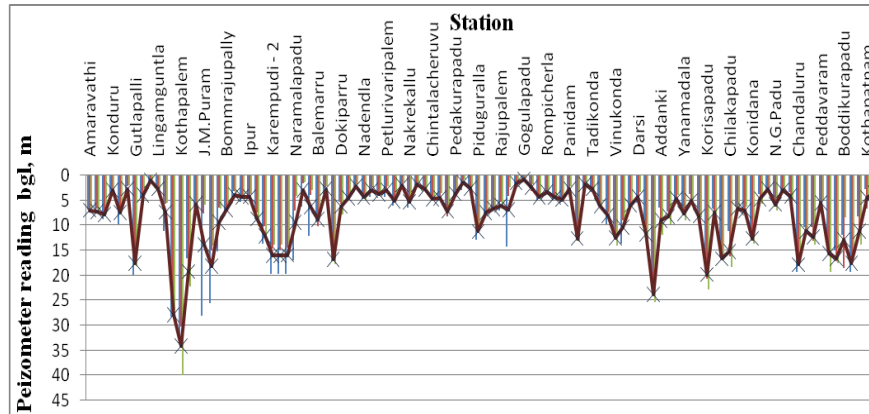
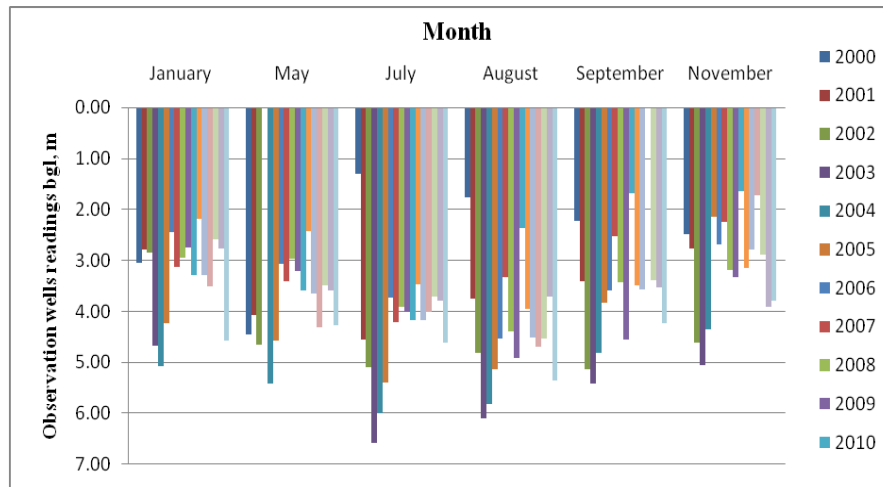


Fig.7 Mean monthly 300 observation wells readings from 2000 to 2018



From the above data, off-take wise water withdrawals of the entire command from the year 2008-09 to 2018-19 were computed. The mean withdrawal of water releases off-take wise was computed and maximum obtained at Buggavagu O.T. with 104.92 TMC and minimum value was obtained at Pasuvemula Major and Tallapalli Major- I with 0.03 TMC. The mean water releases at head section of 11 years of data was computed as 128.13 TMC (3,627.71 MCM).

The evaporation losses take place from the exposed water surface area, which would vary with the temperature, humidity, wind velocity etc. In hot and dry weather months (summer) these losses are maximum but they seldom exceed 1-2% of the total water entering into the canal. The average evaporation varies between 4 mm to 10 mm per day. The conveyance losses now evaluated in the canals selected are inclusive of evaporation losses and no separate studies could be possible.

The overall conveyance efficiency of the Nagarjuna Right Bank Canal (including evaporation losses and seepage losses etc.,) as 61.45% recommended by the CWC, Government of India and then total

availability of the surface water is 2,229 MCM.

Rainfall

Mean annual rainfall entire command area comprises of two districts namely Guntur and Prakasam as shown in Table 2 and Figure 3.

From the above data average annual rainfall of Guntur and Prakasam Districts under command area was noticed as 780 mm and 749 mm and overall command area was recorded as 765 mm.

Groundwater availability

Groundwater monitoring is being carried out in both districts of Andhra Pradesh by the State Groundwater Department. The observation wells network in Nagarjuna Sagar Right (Jawahar) Canal Command Area was shown in Fig. 4.

The location wise 300 mean observation wells from year 2000 to 2018 reading was shown in Figure 5. From the data maximum value was observed as 12.96 m below ground level at Mothadaka village and minimum value obtained was 0.934 m below ground level at

Brundavanam village. Mothadaka village in Tadikonda Mandal in Guntur District was more groundwater table as compared to the Brundavanam village in Sattenapally Guntur District (Table 3).

Piezometer

AP State Groundwater Department was installed 104 piezometers in the command area the reading was presented Figure 6. From the above data, the maximum reading was obtained as 23.75 m DTW at Tallur and minimum value obtained as 0.87 m DTW at Gogulapadu Village, Gurazala mandal, Guntur district. The data revealed that the groundwater depletion was more at Tallur compared to Gogulapadu Village, Gurazala mandal, Guntur district.

From the above data highest value 6.59 m in the month of July, 2003 and minimum value occurred in the month of September, 2013 due highest rainfall and canal release during the above period.

Groundwater volume data was collected from the State Groundwater Department, Guntur and presented in the Table 3.

From the data, it was clear that, the maximum value was observed as 3062.21 MCM in the year 2008-09 and minimum value in the year 2015-16 as 1825.55 MCM. i.e. due to poor rainfall and overdraft of ground water. Average groundwater availability was 2270 MCM (80.16 TMC). Finally the groundwater availability is 61% of 2270 MCM and total availability of the surface water is 2,229 MCM. The available water resources for conjunctive use in the command area are 3,614 MCM (128 TMC) (Fig. 7).

In conclusions the Nagarjuna Sagar Right Canal Command area of the total availability of the surface water of 11 years of data was is

2,229 MCM. Average annual rainfall of Guntur and Prakasam Districts under command area was obtained as 780 mm and 749 and overall command area was recorded as 765 mm. The average groundwater availability in the command area is 1385 MCM. Finally, the total water available by conjunctive use in the command area is 3,614 MCM (128 TMC).

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