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AN ASSESSMENT OF GROUNDWATER RESOURCES IN THE VILLAGES OF GOLLAPALLE AND NAMPALLE, CHITTOOR DISTRICT ANDHRA PRADESH

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ABSTRACT An attempt is made in the present paper to assess the groundwater resources available in the villages of Gollapalle and Nampalle, Chittoor District, A.P. The water table levels are measured from the wells located in the two villages for both wet and dry seasons in order to find out the fluctuations in the water table levels and aquifer characteristics. It is observed that there is high degree of fluctuations in the water table levels in the two villages during the two seasons.

The groundwater resources are assessed in the two villages and the quantity of groundwater available is computed based on the recharge from rainfall and recharge from irrigated fields. The total quantity of groundwater resources of Gollapalle village is 1526 ha.m. and Nampalle village is 1428 ha.m. The groundwater resources extracted every year is only 28.7 per cent and 51.7 per cent of the groundwater resources available in the Gollapalle and Nampalle villages respectively. The net groundwater balance can be exploited to increase the irrigation potential in the two villages.

INTRODUCTION

In order to assess the groundwater resources at microlevel, the two villages namely Gollapalle and Nampalle are selected in Chittoor District, Andhra Pradesh. The village Gollapalle is located in Bangarupalem mandal and Nampalle in Irala mandal.

The Gollapalle villages has a total geographical area of 1713 hectares with a total population of 7800 persons as per the 1991 cenus. There are eleven hamlets under this revenue villages. The geographical area of Nampalle village is 1575 hectares with a total population of 4559 persons according to 1991 census. There are ten hamlets under this revenue village.

The climate of the two villages are generally semi-arid in nature. The Gollapalle village receives an annual average rainfall of 926 mm where as Nampalle receives 775 mm. More than 85 percent of the annual rainfall is received during the south-west and north-east monsoon seasons in the two villages.

The two villages has undulating topography with barren rock outcrops. The hills and the outcrops present in the two villages are composed of granitic rocks. There are no perennial streams in the two villages. A few streams present in the two villages flows for a shorter period during the rainy seasons. There are 3 tanks in the Gollapalle village and 18 small and medium tanks in Nampalle village which remain dry during most of the period in a year.

Well irrigation is predominant in the two villages accounting for 70 percent followed by tank irrigation. There are 192 wells out of which 160 are dug-cum-borewells, 20 open wells and 12 surface borewells in the Gollapalle village. Out of 333 wells present in the Nampalle

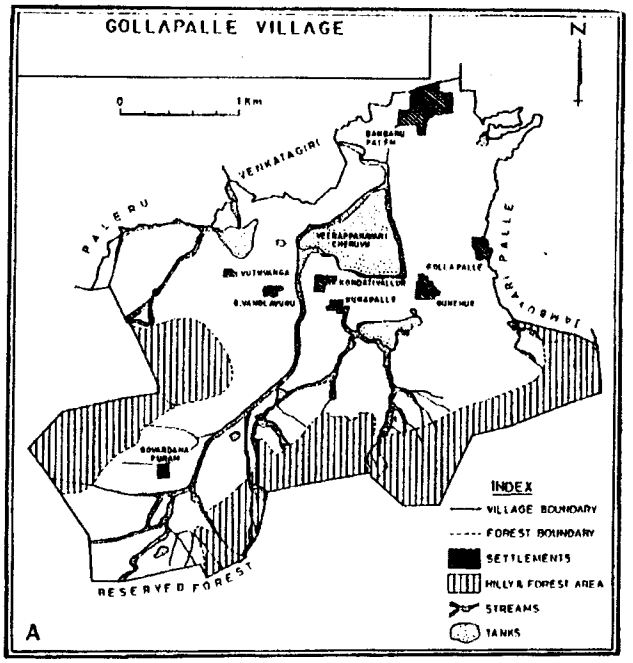

Fig. 1 (A) : Gollapalle Village

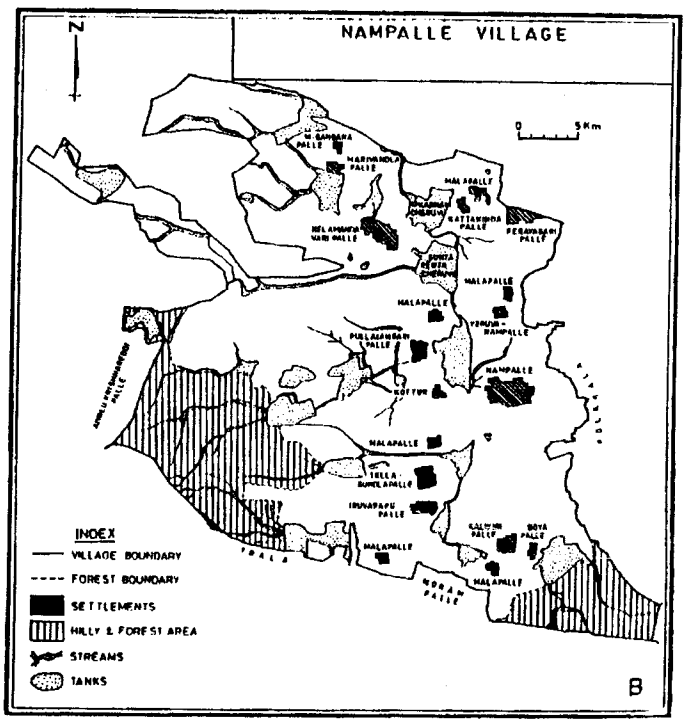

Fig. 1 (B) : Nampalle Village

village, 236 are open wells, 40 surface borewell and 57 dug-cum-borewells.

GROUNDWATER OCCURRENCE

The distinct rock types present in the two villages are granites and gneisses of Archaean era. Granites and gneisses in unweathered condition is non-porous and cannot hold water. These rocks are fractured due to weathering processes providing interconnected fissures which permits the percolation of water into the underground. This percolation brings about further disintegration by which rock material becomes coarse granular and is able to store considerable quantities of groundwater. Depending upon the areal extent and depth of weathering these layers constitute potential aquifers in regions of crystalline granitic and gneissic rocks. Underlying this weathered layer there lies semi-weathered layer which will retain the original crystalline structure of granites is highly fractured. In some of the wells of the two villages, the semi-weathered layer is totally absent or in certain cases contains considerable amount of water if it is present. Generally, large diameter wells alone are successful in the granitic terrain but the recent survey reveals that it is feasible to drill deep borewells in favourable areas to get copious supply of groundwater in the two villages.

In general the rise of water table level starts in the month of July and continues upto December depending on the amount of precipitation, while the water level starts declining from the month of January and continues upto the end of may-June.

An inventory of existing wells in the two villages is made in both dry and wet seasons. The depth water table is recorded in all the wells from the ground level. While collecting the data, sufficient care has been taken to aviod perched aquifers or its superficial influence on the wells. Water table maps of the two villages are prepared for both the seasons.

WATER TABLE CHARACTERISTICS OF GOLLAPALLE VILLAGE

Most of the wells in the Gollapalle villages are dug-cum-borewells and open wells. The depth of the dugwells are ranging from 7 m to 16 m. There are very few number of borewells distributed on all the sides of the village area. In most of the open wells bores are also drilled upto an average depth of 30 m from bottom of the well because of the declining water table levels.

The wells are mostly concentrated on the north and northeastern parts of the Gollapalle village. There is high declining water table levels during summer season. Most of the open wells are becoming dry during summer, as a result of which farmers are inevitably going for dug-cum-borewells to meet their demands for agricultural activities.

From the water table level contour map prepared for the mansoon (rainfall) season reveals that the water table levels are at shallow depth ranging from 3 m to 12 m from the surface. It also reveals that the depth to water table is at a higher level in the east and north eastern parts of the villages. The shallow depth of water table level may be due to the storage of water in the tanks during the short period of the monsoon season. These storage tanks are acting as recharges sources for the increase of water tables levels in the wells located in the surrounding areas. It is also noticed that the water table levels are at lower depths in the wells located aways from the tanks. On the southern and western parts of the village the lowering of water table is due to the granitic outcrops and as well as due to the absence of recharge sources like rivers and tanks. As the depth of the open wells are ranging from 7 m

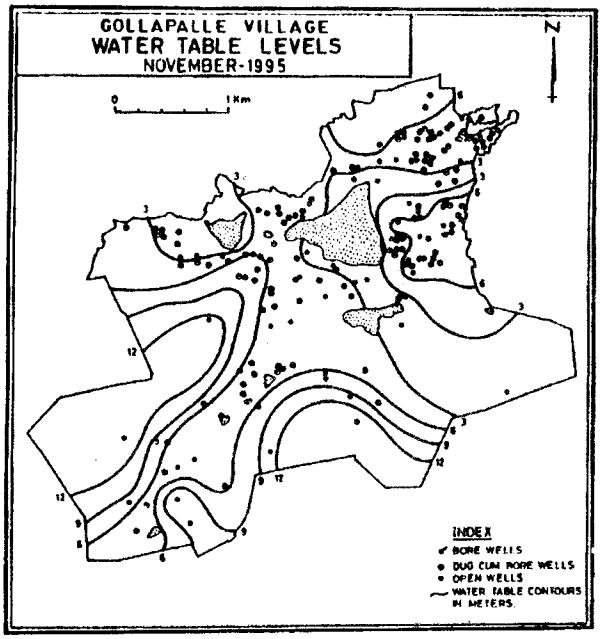

Fig. 2 (A) : Gollapalle Village - Water Table Levels, November - 1995

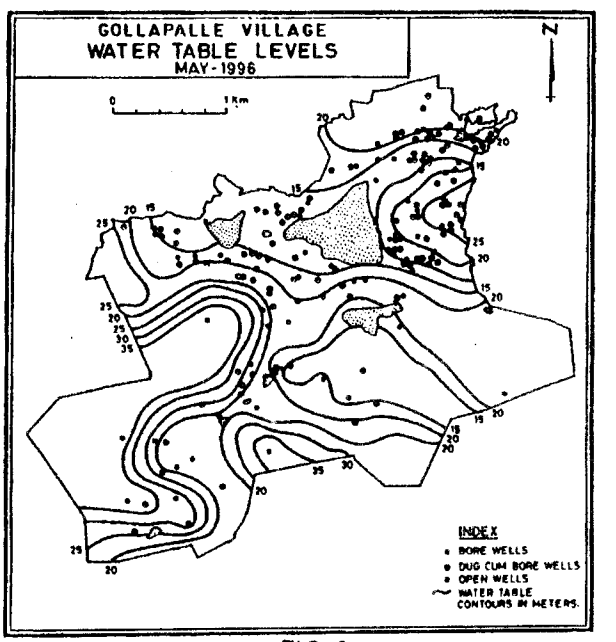

FIG. 2

Fig. 2 (A) : Gollapalle Village - Water Table Levels, May - 1996

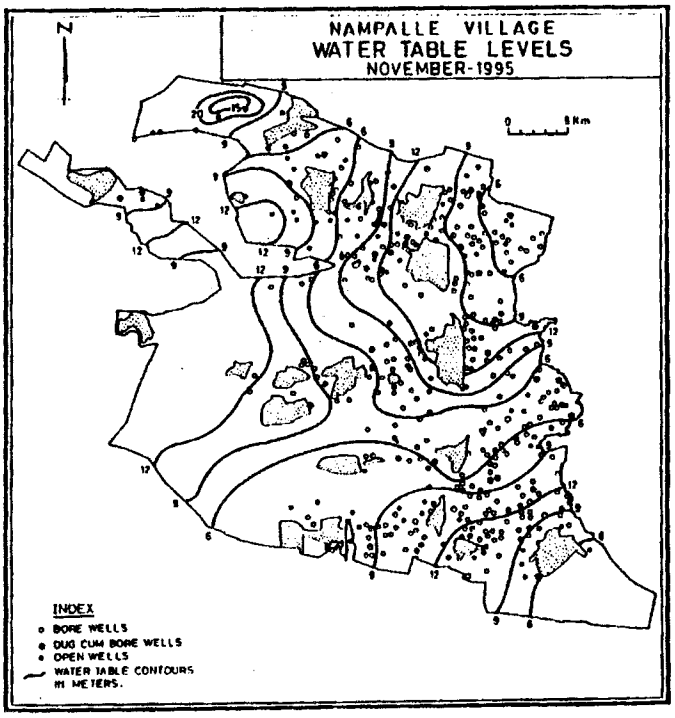

Fig. 3 (A) : Nampalle Village - Water Table Levels, November - 1995

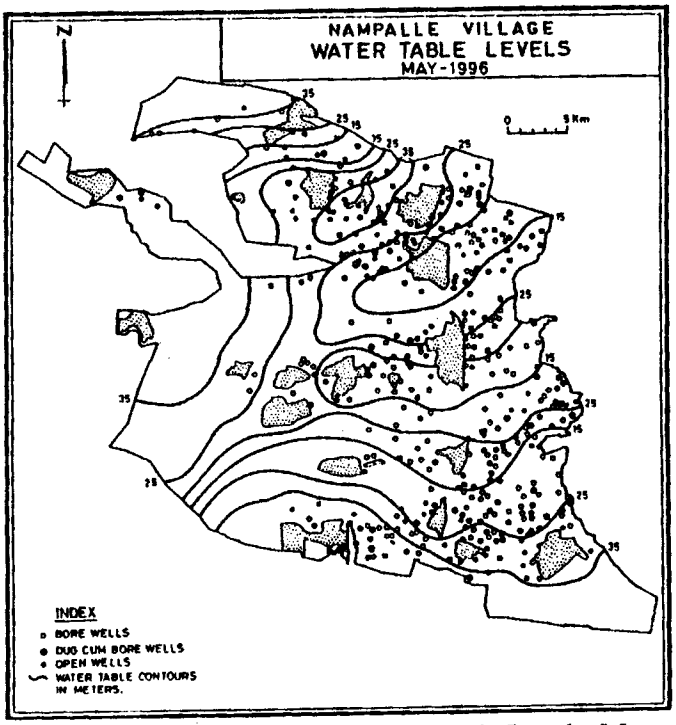

Fig. 3 (B) : Nampalle Village - Water Table Levels, May - 1996

to 16 m; the water stored in these are used irrigation for a short period in a year.

From the water table contour map prepared for the dry seasons reveals that there is high declining in the water table levels. It varies from 15 m to 35 m during the summer months. In the wells located adjacent to the tanks, the water is at shallow depth ranging from 15 m to 25 m from the ground surface. Because of the low rainfall conditions most of the open wells are getting dried up during the summer season. The water table levels on the southern and western parts of the village are at a lower level ranging from 20 m to 35 m depth. Only a few borewells which were drilled upto more than 40 m depth are yielding groundwater for agriculture purposes.

The high fluctuations of water table levels in the Gollapalle villages is due to the presence of unconfined aquifers in the area. This also depends upon the low intensity of rainfall, undulating topography, presence of granitic outcrops, lack of storage reservoirs and non-perepnnial nature of the rivers or streams presents in the village.

WATER TABLE CHARACTERISTICS OF NAMPALLE VILLAGE

The wells present in the Nampalle village are mostly open wells with a depth ranging from 5 mt to 12 mt. Apart from the open wells there are a few bowerwells and as well as dug-cum-borewells which are drilled upto a depth varying from 25 mt to 60 mt. Most of the wells are highly concentrated on the eastern part of the village.

The interpolation of water table contour map reveals that the water table is at shallow depth varying from 6 mt to 12 mt from the ground surface. There are number of tanks of varying sizes present in the villages, which are acting as recharge sources for the wells locating in the adjacent areas. Apart from the tanks there are some streams with seasonal flow for a short period of the year. Because of the seasonal streams and tanks, the water table levels in the village are at shallow depth during the November and December months.

The water table contour map prepared for the dry (summer) season reveals that the depth of water table levels varies from 15 mt to 35 mt from the surface. Eventhough there are number of tanks in the village area, only a little quantity of water is stored during the short period of the rainfall season. Most of the open wells are getting dried up due to declining water table levels during the dry seasons. The ground water for irrigation is extracted only from the dug-cum-borewells and very few number of borewells present in the village. The depth of the borewells and dug-cum-borewells present in the village area are ranging from 30 to 60 mt from the surface. The depth to water table is more on the western part of the village when compared to the eastern side. Only a few borewells and dum-cum-borewells present in the village are supplying groundwater for agricultural purposes for the second crop.

The aquifers present in the Nampalle village area are mostly of unconfining nature. There are some bore wells an dug-cum-borewells touching the confining aquifers which are yielding quantities of groundwater during the summer months also. The village is having a low groundwater potential due to the low rainfall conditions, the granitic outcrops and low infiltration capacity of the soils.

ASSESSMENT OF GROUNDWATER RESOURCES :

Groundwater resources are the quantities of water that can be withdrawn from the groundwater storage. The available groundwater resources can be used for irrigation

to improve the agricultural potentiality of the region. The groundwater resources are assessed in the two villages with the aquifer geometry of differential lithological units and the hydraulic constants of the aquifers evaluated. In a systematic survey, water levels observed from the wells are recorded and the water level fluctuations are worked out.

For the estimation of groundwater resources, it is very essential to ascertain the specific yield of the substrata. The well log data and the thickness of various classes of materials and their percentages are assigned to find out the specific yield values. The strata logs are collected only in the unscreened open wells located in the granitic and gneissic terrains of the two villages. The specific yield percentages determined from the strata logs are 9.0 for the aquifers of granitic and gneissic terrains of the two villages.

Groundwater recharge in the study area is computed mainly from rainfall and irrigated fields. The parameters such as mean water table rise in different types of aquifers and the specific yield percentages of various classes of materials are used to assess the groundwater in resources in the two villages.

The total quantity of groundwater available in thr region is computed on the basis of 1) Recharge from rainfall and 2) Recharge from irrigation fields.

1. **Recharge from Rainfall :** It has been computed by considerating the area of different types of aquifers and their corresponding mean water table rise and the specific yield percentages.

   Ground water Recharge = Areas of the aquifers x mean water table rise x specific yield.

   The different types of aquifers present in the two villages are Granites and gneisses.

   The mean water table rise in the wells located in the granitic terrains of the Gollapalle village is 13.4 mts. The area of the aquifers present in the Gollapalle villages is 1265 hactares. Hence the annual ground water storage in the Gollapalle village is found to be 1526 ha. mt.

   The mean water table rise in the wells located in the Granites and gneissic formations present in Nampalle village is 11.6 mts. The area of the aquifers in the village is 1368 hactares. The annual groundwater storage in the Nampalle village is found to be 1426 ha. m.

2. **Recharge from irrigated fields :** By considering the various hydrological and hydrogeological conditions prevailing in the two villages, the recharge from the irrigated fields is computed. It is assumed that the infiltration capacity of soils from the irrigated fields as 10 per cent and the total depth of irrigation water as 0.50 mts. The total recharge from the irrigated fields of various sources can be computed from the following equation.

   Recharge from the irrigated fields=Total area irrigated x percentage of infiltration x depth of irrigation water.

   The total area under irrigation accounts for 237.65 hectares in the Gollapalle village. The recharge from the irrigated fields of Gollapalle village is 12 ha. m.

   The total area under various irrigation sources of the Nampalle village is 429.15 hectares. The recharge from the irrigated fields of Nampalle village accounts for 22 ha. mt.

   The annual quantity of groundwater resources available through the entire thickness of the aquifer zone is 1298 ha mt. in the Gollapalle village.

The groundwater resources or the annual quanity of groundwater passing through the entire thickness of aquifers of the Nampalle is 1054 ha. mt.

GROUNDWATER EXPLOITED / DRAFT

The groundwater exploited for irrigation purposes is the average of the draft based on number of pumping wells and the extent of the area irrigated. The exploitation for domestic consumption and as well as Livestock is also taken into consideration to estimate the groundwater draft in the two villages (Table 1). The average rate of pumping from each well is recorded as 15 cu.m/hour. The primary data collected from the farmers of the villages, it is estimated that the average pumping of water per day is 8 hours and the number of pumping days in a year is 180 days.

The total groundwater exploited is estimated as 437 ha. m. in the Gollapalle village accounting for 28.7 per cent of the available groundwater resources. The groundwater draft is 732 ha.m. in the Nampalle village accounting for 51.3 per cent of the total groundwater resources available in the region. The annual groundwater balance left unused in the Gollapalle is 71.3 per cent of the available groundwater resources whereas it is 48.7 per cent in the Nampalle village. Hence there is every possibility to extract the groundwater resources from the aquifers of the two villages to meet the requirements for the cultivation of crops in both the reasons.

Table 1

Groundwater Exploited / Draft

		Gollapalle	Nampalle
A. Draft due to the pumping wells			
1.	Number of wells present (open wells + dug-cum-borewells + borewells)	192	333
2.	Rate of pumping from each well	15m^3/hour	15m^3/hour
3.	Total pumping of water from each well in a day (8 hours per day as pumping rate)	120m^3/day	120m^3/day
4.	Total withdrawal of groundwater from the wells (assuming 180 days as pumping days)	415 ha.m	719 ha.m
B. Draft due to population and Livestock			
1.	Population of the area	7800	4559
2.	Draft due to population (2.55 ha.m/1000)	20 ha.m.	12 ha.m.
3.	Draft due to livestock (10% of the above)	2.0 ha.m.	1.2 ha.m.
	Total groundwater exploited / draft (A+B)	**437 ha.m.**	**732 ha.m.**
	Groundwater recharge	**1526 ha.m.**	**1428 ha.m.**
	Net Groundwater balance	**1089 ha.m.**	**696 ha.m.**

CONCLUSIONS

From the water-table contour maps drawn both for wet and dry resons, it is observed that there is high degree of fluctuations in both the villages. Most of the dug wells present in the two villages are getting dry during summer months due to declining water table levels.

The total quantity of groundwater resources passing through the entire thickness of aquifer zones of Gollapalle village is 1526 ha. m. and Nampalle is 1428 ha. m. The annual quantity of groundwater extracted is 437 ha.m. accounting for 28.7 per cent of the available groundwater resources of the Gollapalle village. The annual groundwater draft is 723 ha. m. accounting for 51.7 per cent of the groundwater resources of the Nampalle village.

The remaining quantity of groundwater can be withdrawn by increasing the number of wells. The open wells already present in these villages can be further deepened or bores can be drilled to explore the groundwater resources to the possible extent.

There is considerable for extending agriculture to pastures and grazing lands by extracting the groundwater balance available in the two villages.

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