ORIGINAL RESEARCH PAPER

Earth Science

ARTIFICIAL RECHARGE STRUCTURES OF ERRAVANKAPALLI WATERSHED USING REMOTE SENSING AND GIS TECHNIQUES, NALLAMADA MANDAL, ANANTAPURAMU DISTRICT. A.P. INDIA

KEY WORDS: Artificial Recharge Structures, Watershed and Remote Sensing & GIS Techniques

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ABSTRACT

The groundwater storage and the recharge is the fundamental component of hydrological system. It is the result of water percolating through various layers of soil, Geology, Geomorphology, Land use / Land Cover and Slope of Erravankaplli watershed due to the atmospheric precipitation and snow. The amount of percolation varies from place to place and it depends on rainfall, characteristics of soils and characteristics of Lithology, nature of Land forms, temperature and humidity. Hence the, availability of sub-surface water will also vary from place to place. In Erravankapalli watershed Nallamada mandal of Anantapuramu Average 25 years annual is 549 mm rainfall, the availability of utilizable surface water is very low. People of the watershed area have to depend on groundwater for domestic and agriculture uses. Excessive pumping of groundwater in those areas has resulted in depletion of the groundwater levels. Open lands available for natural recharge is reduced due to large-scale urbanization. Identification various feasible location and suitable structures. In order to improve the groundwater availability, it is necessary to artificially recharge the depleted groundwater aquifers.

INTRODUCTION:

Groundwater recharge is the replenishment of an aquifer with water from the land surface. It is usually expressed as an average rate of 540 mm of water per year, similar to precipitation. In addition to precipitation, other sources of recharge to an aquifer are stream and seepage, irrigation return flow (from both canals and fields), inter-aquifer flows, and urban recharge. In contrast to natural recharge (which results from natural causes); artificial recharge is the use of water to replenish artificially the water supply in an aquifer. Of all the factors in the evaluation of groundwater resources, the rate of recharge is one of the most difficult to derive with confidence. Estimates of recharge are normally subject to large uncertainties and spatial and temporal variability.

The increasing demand for water has increased awareness towards the use of artificial recharge to augment ground water supplies. Stated simply, artificial recharge is a process by which excess surface-water is directed into the ground – either by spreading on the surface, by using recharge wells, or by altering natural conditions to increase infiltration – to replenish an aquifer. It refers to the movement of water through man-made systems from the surface of the earth to underground water-bearing strata where it may be stored for future use. Artificial recharge (sometimes called planned recharge) is a way to store water underground in times of water surplus to meet demand in times of shortage.

Some factors to consider for artificial recharge are (O'Hare et al., 1986)

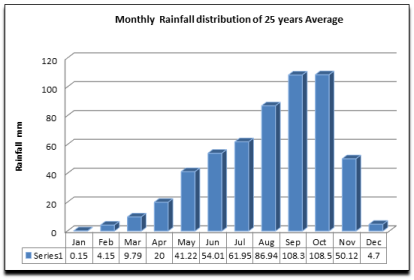
- Availability of waste water
- Quantity of source water available
- Quality of source water available
- Resultant water quality (after reactions with native water and aquifer materials)
- Clogging potential
- Underground storage space available
- Depth to underground storage space
- Transmission characteristics of the aquifer
- Applicable methods (injection or infiltration)
- Legal / institutional constraints Costs Cultural / social considerations.

STUDY AREA:

Erravankapalli watershed is nallamada mandal, Anantapur District, Andhra Pradesh state between lies longitude 77° 35 ' 00" to 77° 46 ' 00" latitude14 °30' 00" to 14 °35' 00" watershed area around 160 ^{2} km. one Mandal is covered namely Nallamada. The Study area is mostly Pediplain terrain land and eastern part is covered with residual hills, denudational hills and some pediments are there. Anantapur district area experiences semi-arid climate, the summer is very hot and the Mercury rises to + 420 Celsius. Winter is pleasant; night temperature is about 130 Celsius to 150 Celsius. Average rainfall per annum 550 mm

Rainfall & Climate

The average annual rainfall of the study area is 549 mm, which ranges from nil rainfall in February and March and 129 mm in September. September and October are the wettest months of the year. The mean seasonal rainfall distribution is 311 mm in south west monsoon (June-September), 146 mm in northeast monsoon (Oct-Dec), 1 mm rainfall in winter (Jan-Feb) and 72 mm in summer (March-May). The percentage distribution of rainfall season wise is 58.7% in southwest monsoon, 27.6% in northeast monsoon, 0.21 percentage in winter and 13.5% in summer (CGWB, 2013). The distribution of rainfall is shown in the form of Graphical (Fig.3). The other months are almost dry and March, April and May are warm months when the normal daily maximum temperature ranges between 31.7°C to 38.9°C. November, December and January are cooler months when the temperature falls about 14.5° C. (DES, 2016).



Physiography and Drainage:

The study area is located in Erravankapalli Watershed, Anantapur District, Andhra Pradesh state. The terrain consists of denudational hills and valleys, Corstone-Tor Composites with highest elevation of 554 m on the eastern side and undulating plains, shallow to moderately weathered

pediplains on the western part with an elevation of 840 m. On the eastern side of the area, a joint controlled second order stream, with rectangular drainage pattern is flowing along NNE-SSW direction, conforming to the major lineament trend. There are few first order drainages which feeds two reservoirs, located at the southern boundary of location. The lithology of the study area is pink (Orthoclase feldspar) and grey (Plagioclase feldspar) granite of Archaean age. The weathered zone thickness ranges between 10-30 m along East and central part of the campus.

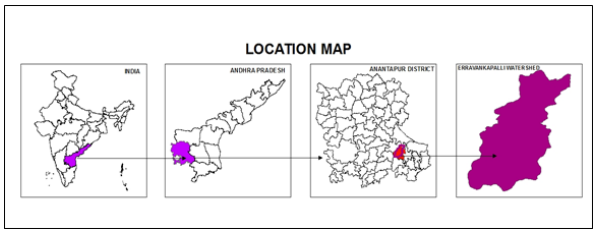


Fig:1. Location map of Erravankapalle watershed, Anantapur District.

Geology:

The Erravankapalle watershed area is underlain by variety of geological formations comprising from the oldest Pennisular Gnessic Complex (Achaeans) to Closepet Granite (Dharwar Super Group). Hydro geologically these formations are classified as consolidated (Hard); the consolidated formations include, crystallines (granitic gneisses) and Younger Granite,

Geomorphology:

Geo morphologically the watershed can be broadly divided into two land forms units, viz., Erosional , Structural land forms are covered in study area . The pediplain area is SW to NE i.e., Pediplain shallow to moderate major part of the watershed cover shallow weathered land .essentially in this area covered in Erosional Land form.

Soil:

The soil resource map is to be prepared on 1:50,000 scale. Mainly Loamy to gravelly clay deep Dark reddish brown soils is 96.29^{2}Km out of 160^{2}Km, Shallow gravely red soils 40.187^{2}Km, minor portion Clayey to gravely clayey moderately deep dark brown soils 23.07^{2}Km is covered.

The soil resource map is to be prepared on 1:50,000 scale. Soil mapping units will contain numerals as symbols to represent soil series association of soil series. Information on soil phases is essential for land management activities. In integrated study, phases like erosion, stoniness, slope etc. can be inferred from toposheets and other thematic maps. The soil legend with numerals, names of soil series and classification should be given on the map itself.

Slope:

Erravankapalli watershed Artificial recharge structures Slope layer crucial role area slope categorization is done according to the AIS & LUS guidelines. The categorization of slopes as per the guidelines is detailed below (Table: 1)

Sl.No	Slope Category	Slope area in(km)
1	Nearly Level	24.5346
2	Very Gently Sloping	19.7811
3	Gently Sloping	47.3512
4	Moderately Sloping	13.3217
5	Strongly Sloping	6.8605
6	Moderately Steep Sloping	24.020
7	Very Steeply Sloping	21.235
Grand Total		157.10

METHODOLOGY:

The methodology adopted in the present study involves integrated studies of Geomorphology map, soil map, Geology and land use and land cover map, on analysis of drainage network of the study area, aided by field checks. The area of recharge has been demarcated in the first step of planning a recharge scheme and also an assessment has been done in estimating the availability of adequate water for recharge. Because the "In situ" precipitation is available at every location but may or may not be adequate for the recharge purposes. In such cases water from other sources may be transmitted to the recharge site. The rainfall analysis has been done to determine the amount of water that would be available from a given catchment and the size of storages to be built.

Rainwater harvesting structures:

The groundwater is the only source of assured irrigation in drought prone areas with affordable investments and quick turnaround time without longer gestation periods unlike major irrigation projects. The major source of recharge to groundwater is rainfall, which constitutes about 25%. The rapid increase in groundwater exploitation has resulted in fall in water table level and drying up of shallow dug wells / bore wells rendering themselves useless and leading to unfold miseries to the farmers. Hence, there is an urgent need for the augmented rainwater harvesting to increase the recharge from 25% to at least to 40%.

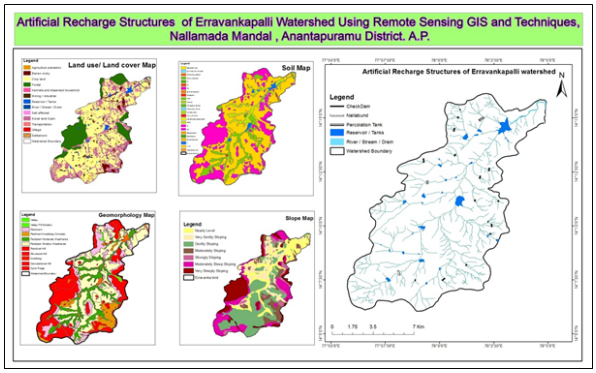


Fig: 2. Artificial Recharge Structures of Erravankapalle watershed, Anantapur District.

1. Check Dams:

Check dam is a small size masonry dam of about 0.5m.cft capacity draining about 25 ha. Constructed across the first order and second order streams. These are constructed in medium slope areas with an objective to provide recharge to the ground water and act as water points for cattle.

2. Mini Percolation Tanks:

The percolation tanks are small storage tanks of about 5-20 m.cft constructed by means of earthen bunds across the streams and minor valleys to recharge the irrigation wells downstream in order to have assured augmented water. However, to distribute the groundwater recharge over large area and to tackle the isolated narrow zones of groundwater irrigated areas, mini percolation tanks of about 1m.cft capacity are recommended.

3. Farm Ponds:
Farm ponds are storage ponds in the farmers land with small diameter and moderate depth. They will act as storage tanks during monsoon period mainly to the dry land agriculture. One farm pond is recommended for every 25 ha. of area.

CONCLUSION:

The detailed information provided by the composite maps(s) has been shown to be very useful in narrowing down the target points for selecting artificial recharge sites. This digital database, created for site selection purposes, will aid the planning, development and management of groundwater. It is true that satellite imagery alone cannot provide information regarding confined aquifers. Geophysical and drilling data have to be consulted to acquire sub-surface information. In some places construction of artificial recharge structures on sites recommended through the application of spatial technologies has proved useful.

Based on the integrated studies and field work, new artificial recharge structures are proposed. There are a total of 17 harvesting structures are proposed. In the proposed category, Check dams, percolation tanks and check walls are present. Four check dams are proposed on third order streams, five percolation tanks are proposed on third order streams and check walls are suggested on second order of streams in the study area.

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