Journal of Advanced Zoology

*ISSN: 0253-7214*
*Volume 44 Special Issue-1 Year 2023 Page 1078:1090*

# Scientific and sustainable planning to harvest and conserve rainwater to meet the basic needs of the community in Anakapalle district, North Coastal Andhra Pradesh, India.

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**Article History**
**Received : 11 Nov 2022, Reviewed: 26 dec 2022, Accepted: 09Jan 2023**

**Abstract:**
Adequate/minimum supply of water to each household is one of the aims of the Jal Jeevan Mission (JJM), Ministry of Jal Shakthi, Govt. of India. Anakapalli is devoid of any major/ minor irrigation projects to supply drinking water in the district. The district is predominantly rain fed. Fortunately, the average rainfall in the district is fairly good. The rainfall per annum is 1175mm. It is very interesting to note that 0.72% of rainfall harvested is good enough to meet the daily LPCD water requirement of the people in the entire district per annum. In this context roof top rain water harvesting in the sump in each household is an alternative to traditional water supply systems, providing water harvesting sump to each household is envisaged to address the supply of 55 lpcd water in Anakapalli District.
**Keywords:** rainwater, Anakapalli, harvesting

## Introduction:

"*The third world war is at our gate, it will be about water*" said by *Mr. Rajendra Singh*, who is also known as the Waterman of India. One much quoted statement was made by the then Vice President of the World Bank *Dr Ismail Serageldin* who said "*Many of the wars of the 20th century were about oil but wars of the 21st century will be about water unless we change the way in which we manage it*". Water is essential for all life and used in many different ways, It is also a part of the larger ecosystem in which the reproduction of the biodiversity depends. Fresh water scarcity is not limited to the arid climate regions only, but in areas with good supply the access of safe water is becoming critical problem. Lack of water is caused by low water storage capacity, low infiltration, larger inter annual and annual fluctuations of precipitation (due to monsoonic rains) and high evaporation demand (Sivanappan, 2006). In this context, it is pertinent to note that, there is an immense need to harvest and conserve rain water in all/ various possible ways. Rainwater Harvesting (RWH) is probably the most ancient practice in use in the world to cope with water supply needs. In recent decades, as a result of new technological possibilities, many countries are supporting updated implementation of such practice to address the increase in water demand pressures associated with climatic, environmental and societal changes (Amos *et al.,* 2016). RWH does not, however, constitute a new technology. People who rely completely on rainwater for their survival have over the centuries developed indigenous techniques to harvest rainwater. Small dams and runoff control means for agricultural purposes can be traced back to early history (Mbilinyi *et al.*, 2005). The first water harvesting techniques are believed to have originated in Iraq over 5000 years ago (Falkenmark *et al.,* 2001). Ghaffarian Hoseini *et al.* (2016) suggest these uses can globally account for 80-90% of overall household water consumption, and highlight the significant water conservation benefits associated with RWH implementation. Consequently, installation of RWH systems increases water self-sufficiency of cities and can help delay the need to construct new centralized water infrastructures (Steffen *et al.*, 2012). The implications of RWH for energy consumption are currently contested.

**Benefits of rainwater harvesting**

Rainwater harvesting is a simple and primary technique of collecting water from natural rainfall. At the time of a water crisis, it would be the most easily adaptable method of mitigating water scarcity. The system is applicable for both critical and normal situations. It is an environmentally friendly technique that includes efficient collection and storage that greatly helps local people. According to Rahman *et al.* (2014), these are the associated advantages of rainwater harvesting is that it can curtail the burden on the public water supply, which is the main source of city water and it can be used in case of an emergency (i.e., fire);

RHW solely is a cost-effective as installation cost is low, and it can reduce the expense that one has to pay for water bills. It extends soil moisture levels for the development of vegetation and groundwater level is highly recharged during rainfall.

Water availability per person is dependent on population of the country and for India, per capita water availability in the country is reducing due to increase in population. The average annual per capita water needs for the years 2021 and 2031 is estimated to be around 1486 cubic meters and 1367 cubic meters tentatively. The annual per-capita water availability of less than 1700 cubic meters is considered to be a water scare condition. It has been estimated that by 2050, at least one in four people will probably reside in a nation with a freshwater crisis due to water shortages and poor water quality. As a result, the United Nations Sustainable Development Goals, Transforming Our World: the 2030 Agenda for Sustainable Development, include guaranteeing the availability and sustainable management of water. Goonetilleke *et.al 2016*, Carroll, S *et.al 2013*, McDonald, R.I. *et. al. 2014*. This paper attempts to explore possible ways to give an alternative strategy to address much needed per capita water availability to the inhabitants of Anakapalle district. The geographical area of Anakapalle district is 4291sq.km which accounts for 2.6% of the area of Andhra Pradesh State. The district has a total population of 17.27 Lakhs with 4.53 Lakhs households.

Fortunately, in Anakapalle district, the average annual rainfall has been reasonably good over the years and is approximately 1175.4mm.

**Background:**

Addressing the need to harvest rainwater, the Jal Shakti Abhiyan: Catch the Rain (JSA: CTR) campaign was launched by the Hon'ble Prime Minister of India on World Water Day, 22nd March 2021. The theme of this Abhiyan is "Catch the Rain – where it falls – when it falls". Districts need to prepare household level water conservation plans

**Present condition:**

GoI has initiated a Programme called Jal Jeevan Mission (JJM), the aim of which is to provide all households with tap connections connecting every rural household by the end of the year 2024 with a stand of *providing a minimum 55 litre per capita per day.*

For that the district administration is dependent on overhead tanks/GSLR, sourcing ground water through bore wells. Of Late the government is giving tap connections to every household under Jal Jeevan Mission (Govt. of India). But in Anakapalli District there is no assured water supply and is solely dependent on borewells dug near water bodies (River beds, tank beds etc.

In this connection, it is to note that water availability at source point is directly related to rainfall in the district. In many of the sources, ground water depletes/ falls down during summer season, forcing the district administration to supply water to the villagers through the water tankers.

Many at times, the district administration is planning to construct soak pits near water sources to see that groundwater is recharged. But these efforts are neither on a saturation basis nor on a systematically/ scientifically planned basis. In this context, the real time success stories of the retired scientists, is very apt to look into.

Mr. Murali Sharma, a water activist from the city of Hyderabad, Telangana is actively involved in water harvesting techniques and adapted scientific solutions since last two decades and is still counting. He boldly says that he has never felt the need to have a groundwater bore set up or even had a dire need to dig a well for water utilization. Mr. Sharma served for ICRISAT, Hyderabad and showcased his professional experience in water management techniques in many national and international conferences and gave many scientific presentations to his expertise.

To his academic and scientific vigor on utilization of rain water he has strategically designed his house to effectively harvest rain water which falls on the roof tops to underground water tank storage systems. He has scientifically calculated that the rainwater from the rooftops gives an average of nearly 1.25 lakh liters of water in a span of a year, considering it to be an average amount of water. He designed his living space in such a way that the rain water from the rooftop is diverted to a PVC pipe-based system which is therefore channelized to a filtration section/ system gets filtered for dust particles and then flows down to the final underground tank storage systems which is of the capacity of holding nearly 1 lakh liters as a whole.

Murli Sharma’s family effectively uses the stored water for their daily needs like drinking, cooking and to water their kitchen gardens.

Sourabha - Bengaluru in the state of Karnataka is proud to have its first of its kind eco-friendly water house located in Vijayanagar is a very well-known iconic spot for the past few years. Eco-friendly enthusiasts, those who are planning to construct a new house are visiting this place called Sourabha to know its scientific planning and eco-friendly management practices in that home. As we have noticed in the case of Mr. Murali Sharma’s place, almost similar practices with a diversified implementation method gives an edge above it.

Design aspects of Home - Sourabha

The rain water collected from the rooftop to the surface plot area is being channelized into three diversified applications.

1. Roof top rainwater harvesting techniques
2. Roof top rainwater channelized to recharge ground-based water.
3. Percolation techniques in the open garden area to recharge ground water

A major portion of rainwater almost nearly 80 - 85 % is channelized to the northern part of the house which will flow into the northern part of the house which will flow into the with a capacity of 4500 liters nearly. A PoP based filtration system with the support of a tank. When the northern tank is full and the excess is allowed to pass down a piping system to a underground to pass down through a piping systems to a underground sump tank with a capacity of 25000 liters, when these two storage tanks are full with their capacities, the rain water which is in excess will be routed to tanks with perculation systems to thereby recharge the water which is present in the ground levels. The leftover water from the rooftop accumulated to be around 10 to 15 % is allowed to random through rainwater piping systems with a Pop-up filter installed at ground levels.

After the filtration process, the water which is free from the particulate matter and impurities flows down to the secondary sump which can withhold a capacity of 10,000 liters, scientifically constructed underneath the car garage systems.

Altogether both the primary and secondary sumps can withstand a capacity of 35,000 liters in the non-rainy season. The amount of rainwater which falls on the open area to that of the ground areas. Hence by following the above practices, we can effectively utilize even a single drop of rainwater for our good sustenance.

**Alternative development Strategy/futurology:**

It is important to note that, the Anakapalli District receives 1175mm of rainfall which amounts to 50,43,301ML (Mega Liters) of rainwater, out of which a meager 0.72% of rain water is sufficient to meet the household water needs in the district. Here it is relevant to note that, the Govt. of AP has planned to supply drinking water from the Polavaram project under the name of Uttarandra Srujala Sravanthi, which involves huge funds. By adopting this alternative model, there will be huge savings on the economic side and also harnessing the rainwater is a sustainable idea.

To substantiate that, the micro level plan will be of greater relevance, the following statistics will suffice to explain:

In the Table 1, Mandal wise statistics of Anakapalli District on the amount of water required per annum by all the households of each mandal is presented.

**Table 1: Amount of water required by the total households of each Mandal per annum in Anakapalle District.**

| Sl No | Name of the Mandal | No.of House holds | Population As Per 2011 Census | Number of persons per household | Water requirement of a HH @ 55 lpcd per person per annum (in *Liters*)(55*365*4) | Water requirement of total HH of a Mandal per annum (in *Mega Liters*) |
|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 1 | Anakapalli | 48903 | 186937 | 4 | 80300 | 3927 |
| 2 | Atchuthapuram | 17121 | 66577 | 4 | 80300 | 1375 |
| 3 | Butchayyapeta | 16936 | 66214 | 4 | 80300 | 1360 |
| 4 | Cheedikada | 11850 | 46643 | 4 | 80300 | 952 |
| 5 | Chodavaram | 23574 | 88493 | 4 | 80300 | 1893 |
| 6 | Devarapalli | 14980 | 58312 | 4 | 80300 | 1203 |
| 7 | Elamanchili | 19114 | 70553 | 4 | 80300 | 1535 |
| 8 | Golugonda | 14298 | 52852 | 4 | 80300 | 1148 |
| 9 | K.kotapadu | 15757 | 60498 | 4 | 80300 | 1265 |
| 10 | Kasimkota | 17438 | 67262 | 4 | 80300 | 1400 |
| 11 | Kotauratla | 14978 | 54510 | 4 | 80300 | 1203 |
| 12 | Madugula | 19553 | 72006 | 4 | 80300 | 1570 |
| 13 | Makavarapalem | 15869 | 57568 | 4 | 80300 | 1274 |
| 14 | Munagapaka | 14794 | 55520 | 4 | 80300 | 1188 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 15 | Nakkapalli | 20540 | 81079 | 4 | 80300 | 1649 |
| 16 | Narsipatnam | 24729 | 91612 | 4 | 80300 | 1986 |
| 17 | Nathavaram | 17571 | 64607 | 4 | 80300 | 1411 |
| 18 | Paravada | 19684 | 78165 | 4 | 80300 | 1581 |
| 19 | Payakaraopeta | 23883 | 93093 | 4 | 80300 | 1918 |
| 20 | Rambilli | 13979 | 53913 | 4 | 80300 | 1123 |
| 21 | Ravikamatham | 18389 | 70761 | 4 | 80300 | 1477 |
| 22 | Rolugunta | 13061 | 48388 | 4 | 80300 | 1049 |
| 23 | S.rayavaram | 19956 | 74101 | 4 | 80300 | 1602 |
| 24 | Sabbavaram | 16221 | 67334 | 4 | 80300 | 1303 |
| **TOTAL** | | **453178** | **1726998** | **4** | **80300** | **36390** |

For a total household of 453178 and population of 1726998 in Anakapalli District the number of persons per household is calculated to be 4 and water requirement for each household @55lpcd per annum being 80300L. It can also be seen that the total water requirement of all households in the district is 36390ML (Mega Liters).

**Table 2: Total rainwater received per annum by each Mandal in Anakapalle District.**

| Sl No | Name of the Mandal | Mandal wise Average Rainfall in mm | Geographical Area of the Mandal in Sq. Kms | Total rainfall receives per annum in terms of Mega Liters |
|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** |
| 1 | Anakapalli | 1181 | 183.6 | 216832 |
| 2 | Atchuthapuram | 1076.8 | 151.01 | 162608 |
| 3 | Butchayyapeta | 1097.7 | 192.78 | 211615 |
| 4 | Cheedikada | 1157.6 | 117.99 | 136585 |
| 5 | Chodavaram | 1162.7 | 156.99 | 182532 |

| | | | | |
|---|---|---|---|---|
| 6 | Devarapalli | 1187.5 | 175.11 | 207943 |
| 7 | Elamanchili | 1113.6 | 117.07 | 130369 |
| 8 | Golugonda | 1159.3 | 326.73 | 378778 |
| 9 | K.kotapadu | 1197.9 | 157.5 | 188669 |
| 10 | Kasimkota | 1130 | 196.95 | 222554 |
| 11 | Kotauratla | 1077.4 | 209.41 | 225618 |
| 12 | Madugula | 1359.4 | 201.71 | 274205 |
| 13 | Makavarapalem | 1174.4 | 154.71 | 181691 |
| 14 | Munagapaka | 1105.7 | 92.92 | 102742 |
| 15 | Nakkapalli | 1349.1 | 254.68 | 343589 |
| 16 | Narsipatnam | 1246.9 | 128.81 | 160613 |
| 17 | Nathavaram | 1296 | 288.64 | 374077 |
| 18 | Paravada | 1130.5 | 150.9 | 170592 |
| 19 | Payakaraopeta | 1309.1 | 129.84 | 169974 |
| 20 | Rambilli | 986.6 | 147.11 | 145139 |
| 21 | Ravikamatham | 1189.5 | 246.18 | 292831 |
| 22 | Rolugunta | 1227.8 | 150.76 | 185103 |
| 23 | S.rayavaram | 1112.2 | 165.84 | 184447 |
| 24 | Sabbavaram | 1181.9 | 193.47 | 228662 |
| **TOTAL** | | **1175.4** | **4290.71** | **5043301** |

Mandal wise rainwater received per annum in Anakapalli District statistics is shown in Table 2. Considering the mandal average rainfall in mm and geographical area in Sq.Kms, the total rainfall received in the mandal is calculated. It can be seen that, as Anakapalli District receives Average rainfall of 1175.4mm within its geographical area 4290.71 Sq.Km the total average rainwater received per annum is 5043301ML.

**Table 3: Percentage of rain water harvest sufficient to meet the needs of households per annum in each Mandal in Anakapalle District.**

| Sl No | Name of the Mandal | Water requirement of total HH of Mandal in terms of Mega Liters | Total rainfall received per annum in terms of Mega Liters | % of rainfall Sufficient to meet @ 55 lpcd per annum |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 1 | Anakapalli | 3927 | 216832 | 1.81 |
| 2 | Atchuthapuram | 1375 | 162608 | 0.85 |
| 3 | Butchayyapeta | 1360 | 211615 | 0.64 |
| 4 | Cheedikada | 952 | 136585 | 0.7 |
| 5 | Chodavaram | 1893 | 182532 | 1.04 |
| 6 | Devarapalli | 1203 | 207943 | 0.58 |
| 7 | Elamanchili | 1535 | 130369 | 1.18 |
| 8 | Golugonda | 1148 | 378778 | 0.3 |
| 9 | K.kotapadu | 1265 | 188669 | 0.67 |
| 10 | Kasimkota | 1400 | 222554 | 0.63 |
| 11 | Kotauratla | 1203 | 225618 | 0.53 |
| 12 | Madugula | 1570 | 274205 | 0.57 |
| 13 | Makavarapalem | 1274 | 181691 | 0.7 |
| 14 | Munagapaka | 1188 | 102742 | 1.16 |
| 15 | Nakkapalli | 1649 | 343589 | 0.48 |
| 16 | Narsipatnam | 1986 | 160613 | 1.24 |
| 17 | Nathavaram | 1411 | 374077 | 0.38 |
| 18 | Paravada | 1581 | 170592 | 0.93 |

| | | | | |
|---|---|---|---|---|
| 19 | Payakaraopeta | 1918 | 169974 | 1.13 |
| 20 | Rambilli | 1123 | 145139 | 0.77 |
| 21 | Ravikamatham | 1477 | 292831 | 0.5 |
| 22 | Rolugunta | 1049 | 185103 | 0.57 |
| 23 | S.rayavaram | 1602 | 184447 | 0.87 |
| 24 | Sabbavaram | 1303 | 228662 | 0.57 |
| **TOTAL** | | **36390** | **5043301** | **0.72** |

Mandal wise percentage of rain water to be harvested to meet the needs of households per annum is presented in Table 3. It is clearly evident that the district can meet the water needs of all the households if only 0.72% of rainwater can be harvested.

As per the above data presentation, it is proved beyond doubt that rain water harvesting is definitely one of the better solutions to meet water requirements of a household.

As an average a household of 4 members with 220 lpcd requires 80300L of water per annum and also Since 1 cubic meter stores 1000L of water, to store 80300L of water the pit size should be 80m3 i.e 4.3m*4.3m*4.3m.

Based on the space constraint among the houses, the following 3 types of models can be explored.

They are:

Type A: A sump capacity of 40,000L

(Households having sufficient space)

Pit Size: 3.42m*3.42m*3.42m

Type B: A sump capacity of 25,000L

(Households having space constraint)

Pit Size: 2.92m*2.92m*2.92m

Type C: Households with no space

Community lands like grama kantam, Govt. Lands, common lands in Layouts can be explored to use as rain harvesting structures.

The pits so constructed can further be incorporated with simple water filtering techniques that are in use and can also be provided with outlets from the sump pits so that the excess water can be used for recharging ground water.

This idea can be replicated in entire India by saving scarce economic resources

**Expected outcome:**

- Rain water is made available to all households (4,53,178HH) through individual sump pits /community sump pits in the district.
- Sustainable alternative model of making water available.
- Less economic cost.
- Power saving
- Reduces groundwater depletion

**Conclusion:**

Even after tremendous progress made in many areas of science and technology, food grain self-sufficiency, providing required water for each household in the country is a distant dream. With the above simple idea and incorporating rainwater harvesting structure i.e., sump in the building plan a mandatory in near future either with the public funds or individual funds will definitely be an alternative approach to development in terms of supplying water to each household with less economic cost and sustainability.

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