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Investigation of Rainwater Harvesting System for NIT, Arunachal Pradesh

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Abstract: Water is one of the most important resources required for the survival of human beings. Similarly, for the proper and smooth functioning of any educational institute, proper water management measures should be taken. The permanent campus of NIT ARUNACHAL PRADESH is situated in a remote and hilly area, so water sources should be managed efficiently to meet the demand. Arunachal Pradesh is a region of high rainfall and if proper and efficient rain water harvesting is done then large amount of rain water could be collected and brought into proper use. The harvesting of rainwater is basically the collection and storage of rainfall through different techniques and using the collected water to meet the demand of human consumption. In this regard, we attempted to study the impact of rainwater harvesting in meeting the day to day requirements in NIT Jote campus. This project deals with the various scenarios of rainwater harvesting and its usefulness in meeting the water demands of the institute. The analysis shows that 80 litres and 30 litres of water could be supplied to 1150 individuals throughout the year with a storage of 18000 m³ and 4500 m³ respectively for Zone I (hostel and staff quarters). Similarly Zone II (academic blocks, administrative block and central library) requirements also analysed and required size of the tank was proposed. This would result in the reduction of load from the main supply (7 km away) and moving a step towards sustainable development.

Keywords: Rain water harvesting, rainfall intensity, Annual Demand.

I. INTRODUCTION

Water is one of the most important natural resources available to human being. Among all the earth's renewable resources, water has a unique place. It is essential for the survival of all forms of life, food production, economic development and for general well-being of the society. Water is also one of the most manageable of the natural resources as it is capable of transport, diversion, storage and recycling. All these properties of water explains its great utility for mankind. Over the years, the need for preserving and maintaining water resources has been made at various scientific events. Water is an important source for every living organism, human and plant needs water for survival. Water is a nature's gift given to the people living on the earth. However, the shortage of water supply had become a global issue. The increasing population of the worldwide had lead to increase the water's demand. In addition, develop country try to keep pace with the rapid growth of the country's economy and discharge chemical, solid, rubbish to the river, squatter, land development, slaughter houses, improperly dispose waste from animal husbandries and firms had caused the water pollution problem. The addition of chemical such as chlorine for water treatment process will kill all the bacteria and micro-organisms include the useful micro-organisms contain the water. To solve the problem of shortage of water supply, water collected by a rainwater collection system is the best solution and alternation for the region. Zelenakova et.al described comprehensive rainwater management approaches and an overview of the source control techniques as well as practical examples of rainwater use for non-potable purposes The provision of such a scheme shall ensure a constant and a reliable water supply to that section of the people for which it has been designed. Taipodia et.al did investigation of water supply in NERIST campus. The proposal for rain water harvesting with the suitable estimation of demand and supply was done and the required storage volume was proposed Rainwater harvesting is an important simple low-cost technique that requires minimum specific expertise or knowledge and offers many benefits. Matos et.al did case study to revert the non-sustainable tendency of increasing surface and groundwater extraction to satisfy the rising demand of water, a more sustainable use of this essential resource Rainwater harvesting is a technology used to collect, convey and store rain for later usage. Zhen et.al.[5] did analysis of plans for rainwater reuse in a residential area in Jiangsu, china. To make full use of rainwater resources, and to reduce the environmental stress brought about by rainwater drainage, rainwater sampled in a residential area in Yancheng City . Villarreal and Dixon [8] did Analysis of a rainwater collection system for domestic water supply in Ringdansen, Norrko ping, Sweden.

The possibilities for implementing a rainwater collection system in Ringdansen, a residential area in Norrko ping, Sweden, have been explored by analyzing four scenarios for using rainwater in a dual water supply system to supplement drinking water. It involves direct collection and storage of the run-off rainwater for direct use in future. The different usage of harvested rainwater can be for domestic purposes like cooking, washing and bathing and agriculture purposes like watering land, feeding cattle etc. It also can be artificially recharged into the ground which is the natural aquifer. Rainwater Harvesting is the way to support Eco-system and Human well-being. One typical roof-top rainwater harvesting system consists of three basic components Catchments or roof surface to collect rainwater, delivery system to transport the water from the roof to the storage reservoir (gutters and drainpipes) and storage reservoir or tank to store the water until it is used. The storage reservoir has an extraction device that- depending on the location of the tank- may be a tap, rope and bucket, or a pump. The rainwater harvesting system comprises of a number of components for transporting rainwater through pipes or drains, filtration and tanks for storage of harvested water which is shown in fig 1.1. The common components of a rainwater harvesting system are catchment, coarse mesh, gutter, conduits, first-flushing, filter, storage facility, recharge structures etc.

II. NEED FOR RAINWATER HARVESTING IN JOTE CAMPUS

As discussed earlier in the section of introduction – importance of rainwater harvesting at NIT AP Jote campus, we clearly came to know the all the advantages which we can draw out by implementing this small but highly efficient technique in the campus. Thus to increase the potential, benefits of this system and draw maximum advantages from it, we need to have large rooftop areas which will be going to act as catchment areas. More the catchment areas more will be the surface runoff and thus more will be the amount of harvested water. Rainwater harvesting is the one of the important alternative valuable water resources to overcome the growing water shortage due to increasing population, agricultural practices and industries. The proper system of water supply is not only enough for the consumers, but the water supply should meet the demand. Though NIT campus has its own water supply source, but it seems to be inadequate in terms of quantity and scarcity of water in future. So, this study aims to study the prevailing circumstances, particularly in terms of quantity and solution for sustainable water supply. It was found that the adoption of rain water harvesting is the easy and cheapest source of water supply in this location which can be adopted very easily. The water can be stored above the ground or under the ground by capturing the rainwater at the time of rainstorm and consuming it later for various purposes. Arunachal Pradesh is one of the heavy rainfall regions among the north-east region of India and the mean annual rainfall varies from 3000 to 5000 mm.

The new campus of National Institute of Technology, Arunachal Pradesh situated at Jote, PapumPare District will be demanding large volume of water essentially for laboratories of various departments and residents staying in hostels and quarters. It is further identified that PapumPare District has a very good precipitation with the mean of annual rainfall 3200 mm. Moreover transporting necessary water from remote place to the institute may be more expensive and challenging. Hence, rainwater harvesting may be a good option to implement at the campus for partial fulfilment of the water requirement. This study focuses on the design of sustainable rainwater harvesting system at NIT AP Jote campus. In this regard, the future demand and existing water supply system would be analysed critically. Then, a detailed field survey would be conducted to estimate the possible roof water collection, conveyance and collection system for the implementation of the rainwater harvesting.

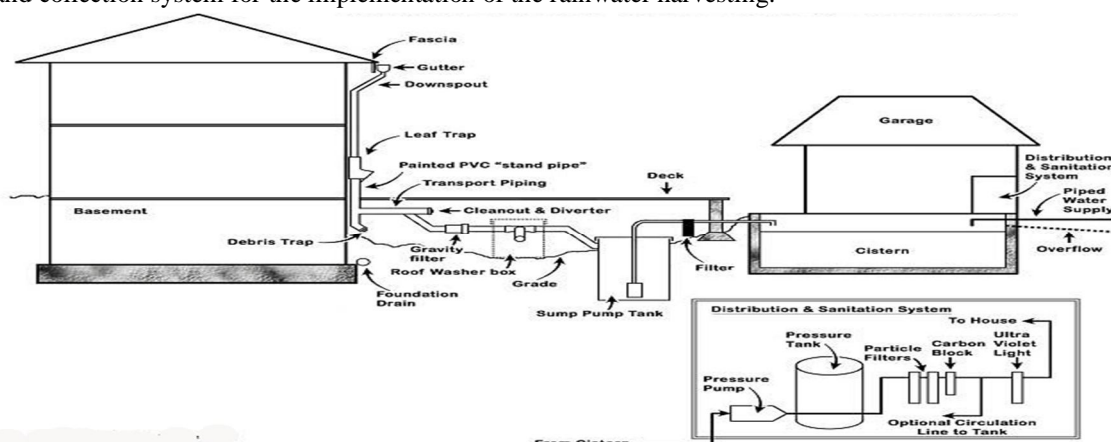


Fig 1.1 Schematic diagram for typical Rainwater Harvesting System

III. STUDY AREA

NIT, AP (JOTE CAMPUS) is located at 93.61E longitude and 27.14 N latitude in Papumpare district of Arunachal Pradesh at an elevation of about 250 meters above mean sea level. This study included and considers all the major buildings having large rooftop areas. Hence, study areas includes all the halls of residence, staff quarters, all the departmental building (Computer science, Electronic, Mechanical, Chemical, Civil, Electrical, Bio-tech), conference hall, main institution building including (central library, computer centre, and various laboratory). Fig 4.1, showing majority of the buildings considered for rainwater harvesting system at NIT AP Jote campus. The entire campus is divided into two zones. Zone I contains “Hostels and staff quarter”, and Zone II contains “Academic block, Central library, Conference hall and all departmental building.

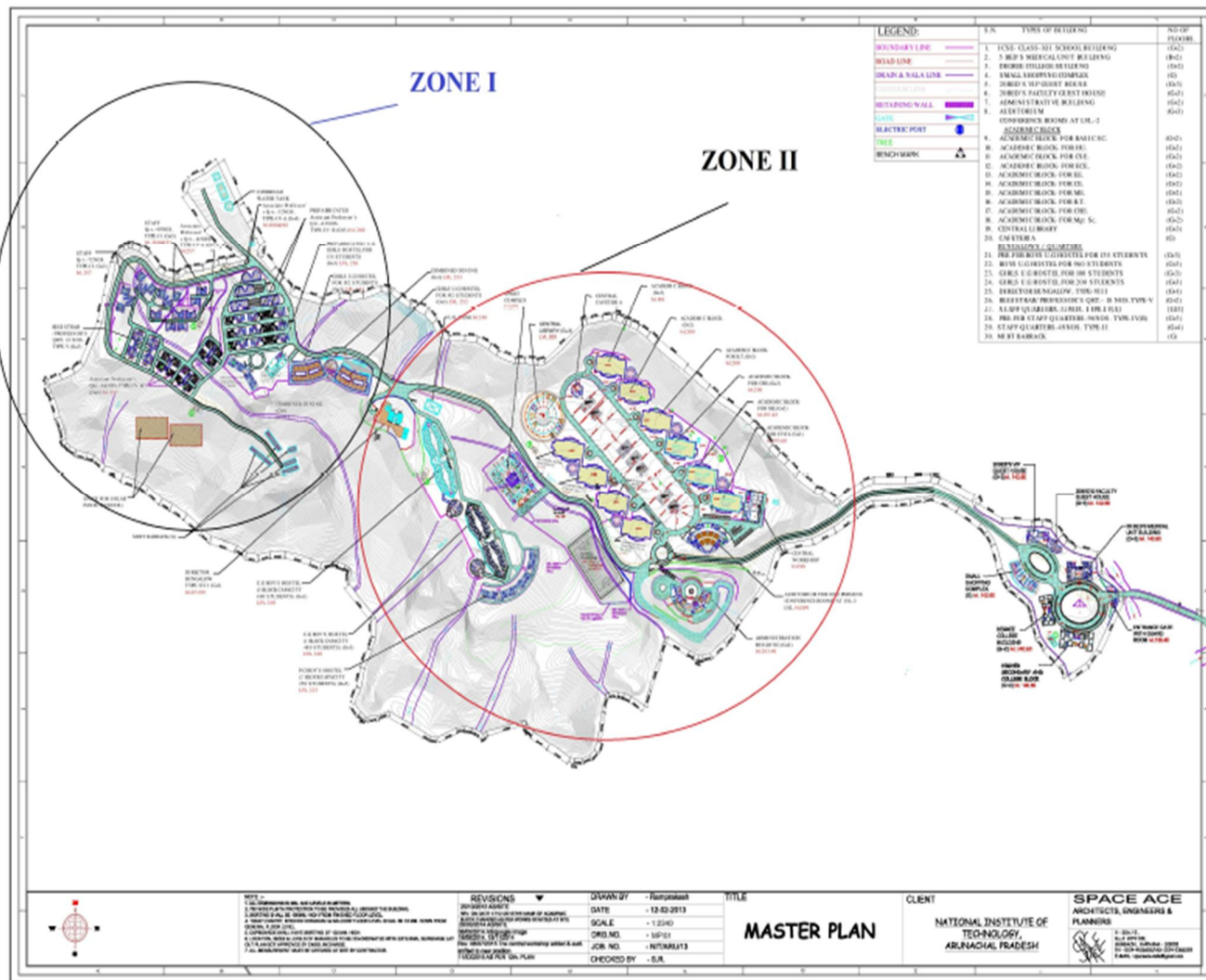


Figure 4.1 NIT AP jote map

Jote has a tropical climate and receives high rainfall during Southwest monsoon (June-September) and retreating Northeast monsoon (December-January). Average annual rainfall ranges between 300cm to 500cm. The rainfall data for papumpare district for the 11 years (2006-2016) are being taken from the Arunachal Pradesh meteorological department, Itanagar which is assumed to be same for the station of NIT AP (Jote campus) have been tabulated and average monthly rainfall data has been calculated in Table 4.1. The proposal aims at the effective implementation of rainwater harvesting at the NIT, AP (Jote campus), for which certain parameters have to be quantified. The roof areas were found out in order to calculate the exact quantity of harvestable water available. The monthly harvestable water and demand were also calculated.

TABLE 4.1: Rainfall Data (mm) 2006-2016 for Itanagar (APMD)

| MONTH/YEAR | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------|
| JANUARY | 38.4 | 7.2 | 73.4 | 35.8 | NA | 9.4 | 32.8 | 2.5 | 6.5 | NA | 34.2 |
| FEBRUARY | 200.6 | 93.4 | 21.2 | 9.4 | NA | 23 | 6.6 | 9.3 | 65.7 | 30.0 | 9.60 |
| MARCH | 38.8 | 98.8 | 156.8 | 41.2 | 310 | 113.6 | 36 | 116.8 | 29.5 | 60.2 | 101.1 |
| APRIL | 168.8 | 417.2 | 199.2 | 197.8 | 439.9 | 186 | 336 | 79 | 13 | 100.9 | 409 |
| MAY | 417.8 | 500.8 | 605.4 | 485.2 | 393 | 337.6 | 289 | 557.9 | 563.6 | 115.7 | 482 |
| JUNE | 930.4 | 900 | 987.4 | 494.4 | 713.8 | 413.4 | 819 | 471.7 | 779.6 | 1158.9 | 398 |
| JULY | 365 | 691.4 | 750.2 | 483.6 | 416.8 | 936 | 779.2 | 551.5 | 546 | 319.2 | 660.6 |
| AUGUST | 171 | 367.6 | 824.9 | 516.2 | 366.9 | 518.2 | 494 | 405.6 | 741.6 | 483.5 | 193 |
| SEPTEMBER | 244 | 533.6 | 363.2 | 123 | 674.8 | 274.8 | 537.8 | 333.4 | 570 | 221.4 | 486.7 |
| OCTORBER | 105.4 | 112.8 | 157.4 | 240.4 | 45.8 | 37.2 | 215.6 | 167.4 | 51.2 | 87.5 | 225.3 |
| NOVEMBER | 30.8 | 12.8 | NA | 26.4 | 83.8 | 17.4 | 3 | 24 | 20 | NA | NA |
| DECEMBER | 10.8 | 3.4 | 6.4 | 12.6 | 19.1 | 12.9 | 5 | 2.8 | 20 | 16.2 | NA |

The rooftop surface area is nothing but the catchment area which receives rainfall. Catchment area of the different hostels and Institutional departments are obtained by “detailed project report”(DPR) which is provided by Engineering Cell NITAP. The estimated number of employees and visitors for the new campus building was given by the building management team.

TABLE 4.2: Rooftop Area Of Zone I

| Types Of Building | Area (m ²) | Population |
|--|------------------------|-----------------------------|
| UG BOYS HOSTEL(I&II) | 2630*2=5260 | 960 |
| UG GIRLS HOSTEL(I&II) | 952.75*2=1905.5 | 384 |
| STAFF QUARTER TYPE II | 70*14=980 | 49(quarters) *4=196 |
| PRE- FABRICATED UG GIRLS HOSTEL | 580 | 135 |
| STAFF QUARTER TYPE IV A | 135*8=1080 | 46 (quarters) *4 =184 |
| PRE-FABRICATED STAFF QUARTER TYPE IV B | 128*18=2304 | 99 (quarters) *4=396 |
| TOTAL | 12109.5 | 2255 |

TABLE 4.3: Rooftop Area Of Zone II

| Types Of Building | Area (m ²) |
|---|------------------------|
| ADMINISTRATION BUILDING | 1068 |
| ACADEMIC BLOCK FOR CSE, CIVIL, BIO-TECH, CHEMICAL, MECHANICAL, ECE,EE, HU ,MANAGEMENT, BASIC. SC, | (2381 * 10) =23810 |
| CENTRAL LIBRARY | 3047 |
| AUDITORIUM | 1180 |
| TOTAL | 29105 |

The determination of average monthly rainfall are calculated by following Formula:

$$\text{Average monthly rainfall} = \frac{\text{Total monthly rainfall}}{\text{Total number of years}}$$

TABLE 4.4: Average Monthly Rainfall Data

| Month | Total Monthly Rainfall(mm) | Average Monthly Rainfall(mm) |
|-----------|----------------------------|------------------------------|
| JANUARY | 240.2 | 26.69 |
| FEBRUARY | 468.8 | 46.88 |
| MARCH | 1102.8 | 100.2545 |
| APRIL | 2546.8 | 231.5273 |
| MAY | 4748 | 431.6364 |
| JUNE | 8066.6 | 733.3273 |
| JULY | 6499.52 | 590.8655 |
| AUGUST | 5082.5 | 462.0455 |
| SEPTEMBER | 4362.7 | 396.6091 |
| OCTOBER | 1446 | 131.4545 |
| NOVEMBER | 218.2 | 27.275 |
| DECEMBER | 109.2 | 10.92 |
| TOTAL | | 3189.48 |

TABLE 4.5: Mean Number of Rainy Days

| Month | Mean No. Of Days |
|-----------|------------------|
| JANUARY | 2.57 |
| FEBRUARY | 6.42 |
| MARCH | 10.28 |
| APRIL | 19 |
| MAY | 17.71 |
| JUNE | 21.28 |
| JULY | 23.71 |
| AUGUST | 18.14 |
| SEPTEMBER | 15.42 |
| OCTOBER | 8.85 |
| NOVEMBER | 3.71 |
| DECEMBER | 2 |

The mean number of rainy days in a month is an important consideration in the estimation of the monthly harvestable water. In this regard data obtained from the Arunachal Pradesh meteorological department has been given in table 4.5.

The rainfall intensity for NIT JOTE campus is given in table 4.6 calculated below formula:

$$\text{Rainfall intensity per day} = \frac{\text{average monthly rainfall}}{\text{No. of rainy days}}$$

The Rainfall available after losses assuming water loss for all type of sources to be 0.1 inch and this loss is considered after each event of rainfall. Hence, 2.54 mm/day of rainfall loss after every rain event. Hence, Rainfall available after losses = (rainfall intensity per day) – 2.54 mm per day that is tabulated in Table 4.7. This total available monthly rainfall takes into account the rainfall, which is available after losses .

Total available monthly rainfall = (rainfall available after losses) x (mean no. of rainy days)

Table 4.6: Rainfall intensity per day (mm/day)

| | |
|-----------|-------|
| JANUARY | 10.38 |
| FEBRUARY | 7.30 |
| MARCH | 9.75 |
| APRIL | 12.19 |
| MAY | 24.37 |
| JUNE | 34.46 |
| JULY | 24.92 |
| AUGUST | 25.47 |
| SEPTEMBER | 25.72 |
| OCTOBER | 14.85 |
| NOVEMBER | 7.35 |
| DECEMBER | 5.46 |

Table 4.7: Rainfall Available After Losses (mm/day)

| | |
|-----------|-------|
| JANUARY | 7.84 |
| FEBRUARY | 4.76 |
| MARCH | 7.21 |
| APRIL | 9.65 |
| MAY | 21.83 |
| JUNE | 31.92 |
| JULY | 22.38 |
| AUGUST | 22.93 |
| SEPTEMBER | 23.18 |
| OCTOBER | 12.31 |
| NOVEMBER | 4.81 |
| DECEMBER | 2.92 |

Table 4.8 Total available monthly rainfall (mm)

| | |
|-----------|---------|
| JANUARY | 20.16 |
| FEBRUARY | 30.57 |
| MARCH | 74.14 |
| APRIL | 183.27 |
| MAY | 386.65 |
| JUNE | 679.28 |
| JULY | 530.64 |
| AUGUST | 415.97 |
| SEPTEMBER | 357.44 |
| OCTOBER | 108.98 |
| NOVEMBER | 17.85 |
| DECEMBER | 5.84 |
| TOTAL | 2810.10 |

IV. RESULT AND DISCUSSION

The total amount of water that is received from rainfall over an area is called the rainwater legacy of that area and the amount that can be effectively harvested is called the water harvesting potential. The calculation is divided into two parts zone I and zone II. Zone I :Upper part (hostel, staff quarters) and Zone II: Lower part (academic blocks, central library and administrative block). The formula for calculation for harvesting potential or volume of water received or runoff produced or harvesting capacity is given as:-

$$\text{Volume of water received (m}^3\text{)} = \text{area of catchment (m}^2\text{)} \times \text{amount of rainfall (m)}$$

We have calculated the volume of required water in two zone :

$$\text{Total roof area of zone I} = 12109.5\text{m}^2 \text{ (Hostel area)}$$

$$\text{Total roof area of zone II} = 29105 \text{ m}^2 \text{ (Academic area)}$$

The rainfall volume can be calculated as shown below:

$$\text{Rainfall volume Zone I} = (\text{Total roof area Zone I}) \times (\text{Average rainfall})$$

$$\text{Rainfall volume Zone II} = (\text{Total roof area Zone II}) \times (\text{Average rainfall})$$

The detailed rainfall volume calculation is shown in table 5.1

TABLE 5.1: Rainfall for Zone I and Zone II

| Month | Average Rainfall(mm) | Rainfall Volume Zone I (m ³) | Rainfall Volume Zone II (m ³) |
|-----------|----------------------|--|---|
| JANUARY | 20.16 | 244.14 | 586.79 |
| FEBRUARY | 30.57 | 370.23 | 889.83 |
| MARCH | 74.14 | 897.84 | 2157.94 |
| APRIL | 183.27 | 2219.28 | 5333.99 |
| MAY | 386.65 | 4682.17 | 11253.53 |
| JUNE | 679.28 | 8225.69 | 19770.33 |
| JULY | 530.64 | 6425.81 | 15444.34 |
| AUGUST | 415.97 | 5037.19 | 12106.80 |
| SEPTEMBER | 357.44 | 4328.45 | 10403.36 |
| OCTOBER | 108.98 | 1319.64 | 3171.73 |
| NOVEMBER | 17.85 | 216.17 | 519.57 |
| DECEMBER | 5.84 | 70.72 | 169.97 |
| TOTAL | 2810.10 | 34037.33 | 81297.53 |

A. Annual Demand For Zone I (Hostel Area)

Calculation for UG and PG hostel: (SCENERIO I)

Scenario I: This scenario basically includes the calculation which deals with meeting the water demand of 1150 students with a fixed supply of 80 litres per individual throughout the year.Total population is 1150,Assuming supply of 80 lit/capita/day and total volume of water required per day =1150*80 =92000 lit/day so Volume of water to be supplied for 1 month =92000*30 =2760000 lit/month=2760 m³/month.

Assuming monthly demand to be approximately 2800 m³/month

Scenario II: This scenario basically includes the calculation which deals with meeting the water demand of 1150 students with a fixed supply of 30 litres per individual throughout the year.

Total population =1150.Assuming supply of 30 l/capita/day.

Total volume of water required per day =1150*30 =34500 l/day.

Volume of water to be supplied for 1 month =34500*30 =1035000 l/month =1035 m³/month.

So monthly demand is 1035 m³/month.

In scenario I the harvested rain water would be providing 80 lpcd of water to 1150 individual, to meet the demand of 2800 m³ of water per month, water is needed to be stored in the months of excess rainfall. From table 5.2 total amount of water deficiency is 14261.98m³~ 15000m³ which is needed to be stored in the months of May to September, for fulfilling the continuous demand in the month of October to April. In addition to this a volume of 2800m³ ~3000m³ is needed to be combined with the fixed storage. Thus a storage of 18000m³ of water would be provided to serve the 1150 students.

TABLE 5.2: ANNUAL DEMAND ZONE I(SCENERIO I)

| Month | Demand (m ³) (A) | Rainfall (m ³) (B) | Extra Water needed to meet the demand(m ³) (A-B) | Excess water after meeting the demand(m ³) (B-A) |
|-----------|------------------------------|--------------------------------|--|--|
| January | 2800 | 244.14 | 2555.85 | - |
| February | 2800 | 370.22 | 2429.77 | - |
| March | 2800 | 897.83 | 1902.16 | - |
| April | 2800 | 2219.3 | 580.73 | - |
| May | 2800 | 4682.2 | - | 1882.17 |
| June | 2800 | 8225.7 | - | 5425.69 |
| July | 2800 | 6425.8 | - | 3625.81 |
| August | 2800 | 5037.2 | - | 2237.18 |
| September | 2800 | 4328.4 | - | 1528.45 |
| October | 2800 | 1319.6 | 1480.36 | - |
| November | 2800 | 216.17 | 2583.83 | - |
| December | 2800 | 70.72 | 2729.28 | - |
| Total | | | 14261.9866 | 14699.31 |

TABLE 5.3: ANNUAL DEMAND ZONE I(SCENERIO II)

| Month | Demand (m ³) (A) | Rainfall (m ³) (B) | Extra Water needed (m ³) (A-B) | Available Water (m ³) (B-A) |
|-----------|------------------------------|--------------------------------|--|---|
| January | 1035 | 244.14 | 790.86 | - |
| February | 1035 | 370.22 | 664.77 | - |
| March | 1035 | 897.83 | 137.161 | - |
| April | 1035 | 2219.27 | - | 1184.21 |
| May | 1035 | 4682.17 | - | 3647.17 |
| June | 1035 | 8225.69 | - | 7190.69 |
| July | 1035 | 6425.80 | - | 5390.81 |
| August | 1035 | 5037.19 | - | 4002.19 |
| September | 1035 | 4328.44 | - | 3293.45 |
| October | 1035 | 1319.64 | - | 284.64 |
| November | 1035 | 216.17 | 818.83 | - |
| December | 1035 | 70.72 | 964.28 | - |
| Total | | | 3375.90 | 24993.18 |

In scenario II, the harvested rain water would be providing 30 litre of water to 1150 individual, to meet the demand of 1035 m³ of water per month, water is needed to be stored in the months of excess rainfall. From table 5.3 total amount of water deficiency is 3375.90m³, which is needed to be stored in the months of April to October, for fulfilling the continuous demand in the month of November to March .In addition to this a volume of 1035 m³ is needed to be combined with the fixed storage, so total storage required is 4410.9 Thus a storage of 4410.9~4500 m³ of water would be sufficient to serve the 1150 students.

B. Annual demand for zone ii (academic area)

C. Toilet flushing demand & laboratories demand

The amount of water required for the flushing of toilet is depend upon total number of building which is 11 and total number of bathroom in each building is 6 so total number of bathroom is 66 and the number of toilets in each bathroom is 5 ,So total no of toilets is 330 and number of flushing per day is 10 .Assuming 10 litre of water is required for one flushing. Total volume of water required is 33000 litres/day.Amount of water consumed per month will be 990m³/month

No. of laboratories in college buildings are 5. Assuming 100 litre of water is required for laboratories per dayAmount of water required per month is 15 m³/month.Total water consumed for toilets and laboratories purpose is 1005 m³/month

Table 5.4: ANNUAL DEMAND ZONE II

| | Demand (m3) | Rainfall (m3) | Extra Water needed (m3) | AvailableWater (m3) |
|-----------|-------------|---------------|-------------------------|---------------------|
| Month | (A) | (B) | (A-B) | (B-A) |
| January | 1005 | 586.79 | 418.21 | - |
| February | 1005 | 889.83 | 115.17 | - |
| March | 1005 | 2157.94 | - | 1152.94 |
| April | 1005 | 5333.99 | - | 4328.99 |
| May | 1005 | 11253.53 | - | 10248.53 |
| June | 1005 | 19770.33 | - | 18765.33 |
| July | 1005 | 15444.34 | - | 14439.34 |
| August | 1005 | 12106.8 | - | 11101.8 |
| September | 1005 | 10403.36 | - | 9398.36 |
| October | 1005 | 3171.73 | - | 2166.73 |
| November | 1005 | 519.57 | 485.43 | - |
| December | 1005 | 169.97 | 835.03 | - |
| Total | | | 1853.84 | 71602.02 |

The monthly demand for zone II is 1005m³. Water is needed to be stored in the months of March to October which is required to fulfil the demand which is 1853.84 m³ in the deficient months (November to February), thus leading to total storage of 2858.84m³~3000m³.

Hence a volume of approximately 3000m³ should be stored by approximate tank to fulfil the demand of zone II.

V. CONCLUSION

Water is one of the most important resources required for the survival of human beings. Thus for the proper and smooth functioning of an institute proper measures should be taken. The permanent campus of NIT ARUNACHAL PRADESH is situated in a remote and hilly area, so alternate water sources should be managed to meet the demand. Arunachal Pradesh is a region of high rainfall and if proper and efficient rain water harvesting is done then large amount of rain water could be collected and brought into proper use. The harvesting of rainwater is basically the collection and storage of rainfall through different techniques and using the collected water to meet the demand of human consumption. In this regard, we attempted to study the impact of rainwater harvesting in meeting the day to day requirements in NIT Jote campus.

Analysis of rainfall, demand and the amount of water to be harvested has been done. The analysis has been done by dividing the area into two zones, zone I(hostel, staff quarters) and zone II(academic block, administrative block and central library).Zone I analysis has been performed for two scenarios in which demand is taken as 80 lit/capita/day and 30 lit/capita/day. After the analysis it is found that for 80 and 30 litres demand a storage of 18000 m³ and 4500 m³ respectively are required for fulfilling the demand of 1150 individuals throughout the year.

The analysis done for Zone II shows that a storage of 3000 m³ is required to meet the demands of academic blocks (laboratories and bathrooms), central library and the administrative block.



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