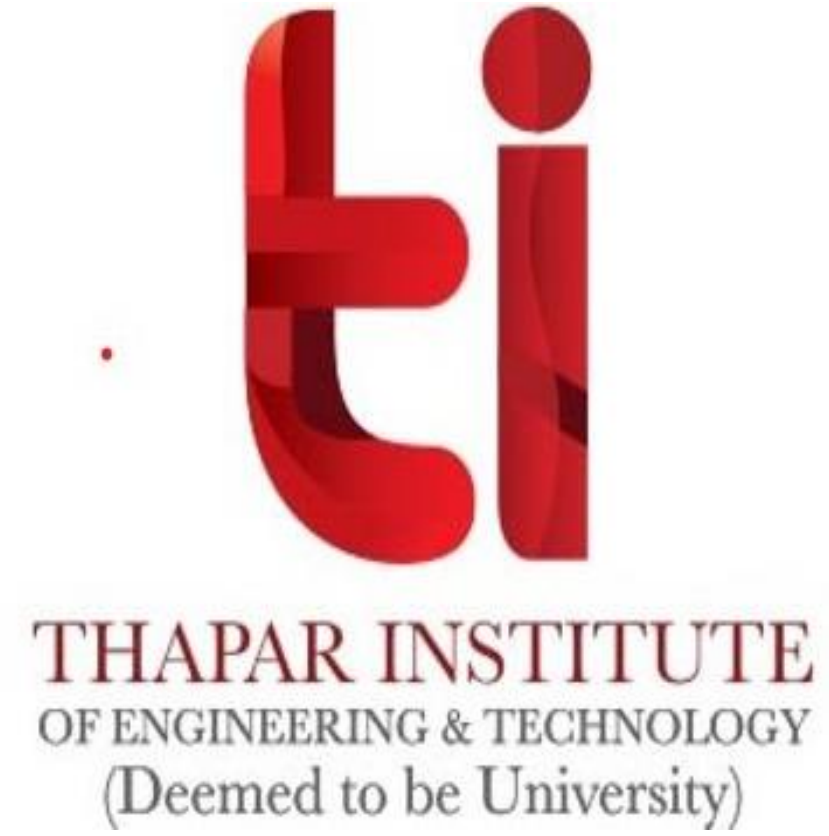
A Practical Activity Report-2
For
Technologies
For
Sustainable Development-UEN004
3rd Year



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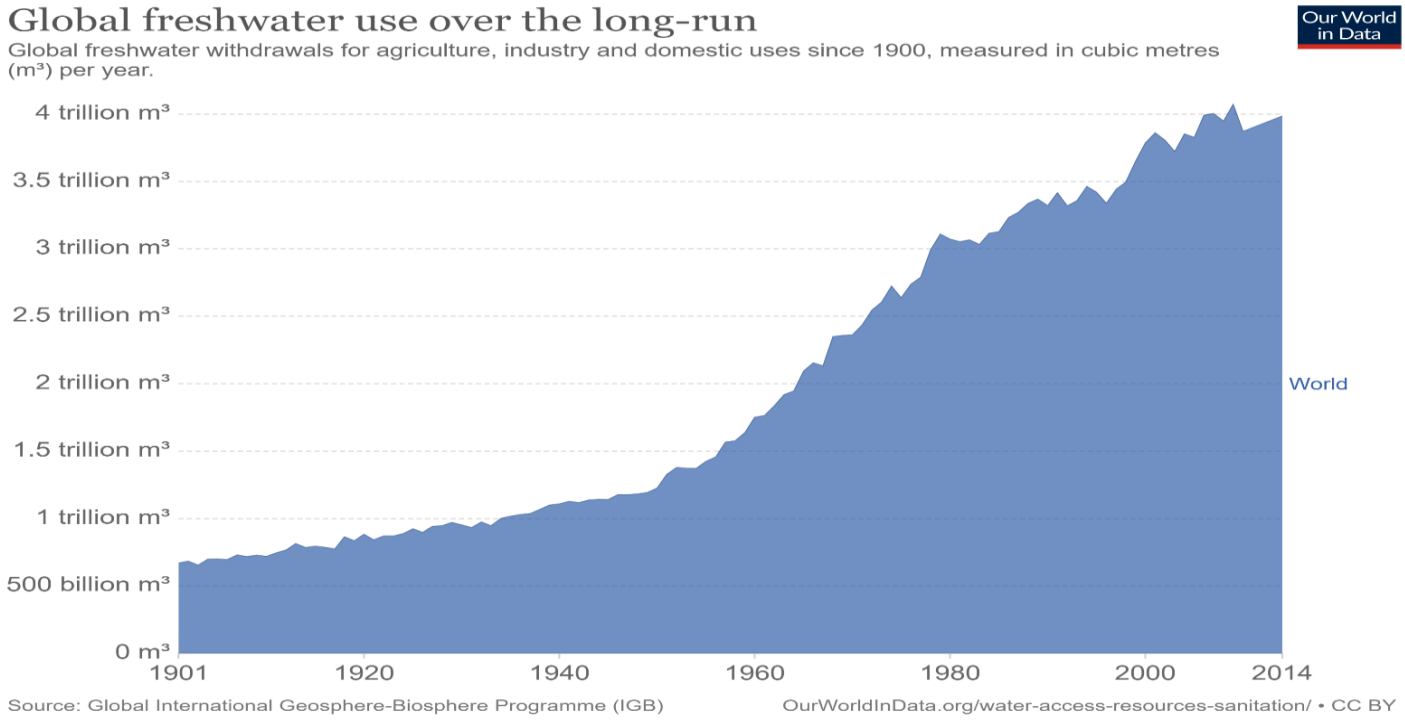
Introduction:

“Thousands have lived without love, not one without water.”

Water is our necessity to live. It’s impossible to sustain life without water. It is used in every activity of day whether from waking up with a glass of water to getting ready for office, from making breakfast to making dinner, from agriculture to industrial almost in every field.

In 2010, According to the European Food Safety Authority (EFSA) water makes up on average 60% of an adult’s body weight from 31%bones to 83% in lungs. This Opinion has also paved the way for the issuing of national guidelines for the daily intake of water.



Source: ourworldindata.org

The population explosion and shift towards more resource intensive consumption economically means global freshwater use i.e. using fresh water for agriculture industry and municipal uses and it has increased rapidly as shown in graph from 1900

Sustainable development as coined by the Brundtland Commission in the document "Our Common Future" state as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (UN, 1987).Water is at the core of sustainable development. The 2015 UN-Water Annual International Zaragoza Conference state 6 goals to ensure availability and sustainable management of water and sanitation for all out of which one was “ by 2030, expand international cooperation and capacity-building support to developing countries in water and sanitation related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.”

India has just 4% of the world's fresh water but 16% of the global population. Across India women spend 150 million work days every year. But India also experience average precipitation of 1,170 millimetres (46 in) per year, or about 4,000 cubic kilometres (960 cu mi) of rains annually. According to Times of India on an average 1.65 lakh litres every year has been recharged due to the water collected from roof but this paper is about conserving water using rain water harvesting technique in a unique way

Literature Review:

- The Rain Water Harvesting System

Rainwater harvesting is a technology used for collecting and storing rainwater from rooftops, the land surface or rock catchments using simple techniques such as jars and pots as well as more complex techniques such as underground check dams. The techniques usually found in Asia and Africa arise from practices employed by ancient civilizations within these regions and still serve as a major source of drinking water supply in rural areas. Commonly used systems are constructed of three principal components; namely, the catchment area, the collection device, the conveyance system.

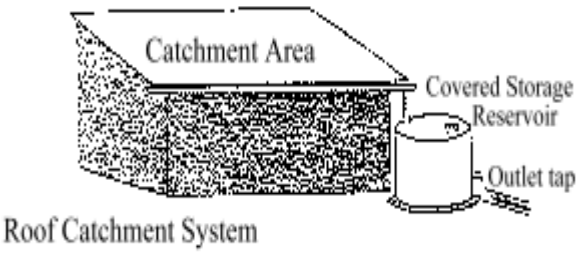


Figure 1: Rooftop Catchment System.

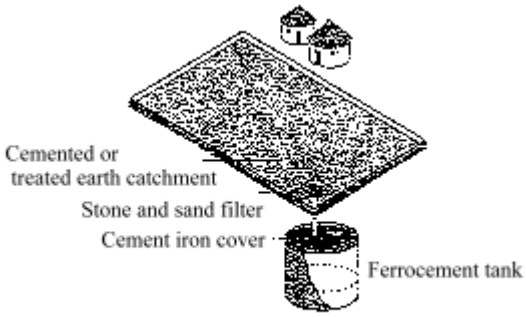


Figure 2: Ground Catchment System

Source:gdrc.org

Rainwater harvesting technologies are simple to install and can be operated by Local people Running costs, also, are almost negligible. Water collected from roof catchments usually is of acceptable quality for domestic purposes. It can be modify to local climatic conditions, rainwater can be a continuous source of water supply for both the rural and poor. Depending upon household capacity and needs, both the water collection and storage capacity may be increased as needed within the available catchment area. But on negative side water supply is limited due to uncertainty of rainfall.

The idea of rain water harvesting is implemented In India from a small scale to large scale

Examples

Nashik Grape Farmer Saves 2 Crore Litres of Water Despite Droughts. Here's How!

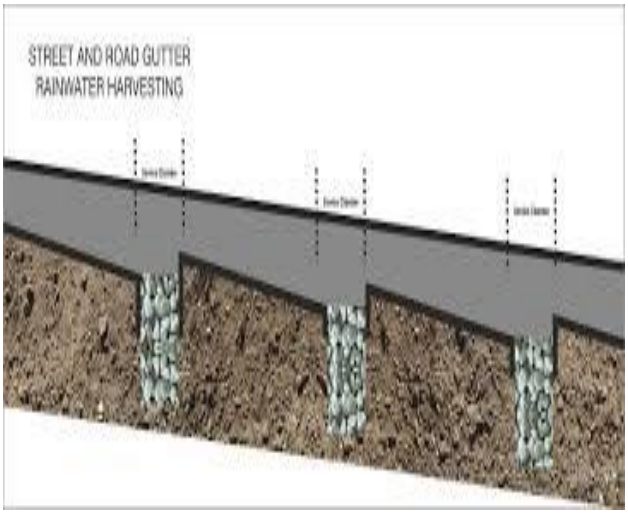
Harvest Rain or Pay Higher Water Bill: DIY App by Bengaluru's Rainman Can Help!

- Rainwater harvesting over national highways by ministry of roads and transport highway

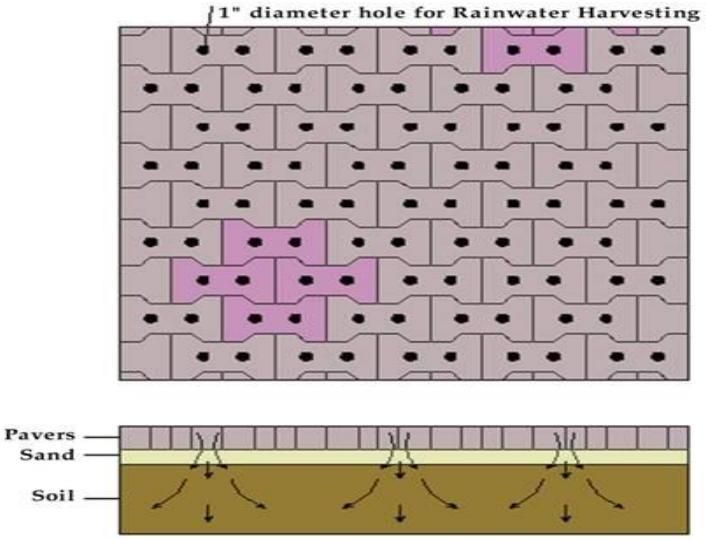
Highway Authority is improving the water table is to capture the rain water and utilize it for recharging of ground aquifers.

Rain Water Harvesting and Artificial recharging shall be provided on all the building and structures such as Toll Plaza building, wayside amenities, grade separated structures etc. which are to be developed as a part of the project corridor. Periodic cleaning and maintenance of such structures/ arrangements to ensure its proper functionality shall also be the part of the maintenance contract.

The surface run-off from roads is huge in quantity this run-off needs to be properly managed so that it does not go waste. Considering that the average annual rainfall in India is about 1100 mm, the total annual volume of run-off from a 1 km long National-Highway, taking run-off efficiency as 80%, is: 1000 m x 7 m x 80 x 1100 mm = 6160 cubic metres = 61,60,OOOlitres. Filter system shall also be ensured. Where no guidelines are available, as a thumb rule, all Road projects may have one recharge shaft of 0.5 m dia for 10 to 15 m depth one on each side of the carriageway along the side drain at the lowest point where water stagnates.



Source steetrainwaterharvesting.blogspot.com



Source: kscst.org.in

Problem Statement:

Today we live in world were natural resources are depleting on an exponential scale. One of this life providing resource is fresh water. As per the Central Water Commission, 85.3% of the total water consumed was for agriculture in the year 2000. And prediction is of 83.3% by 2025. India does not spend any money in conserving water consumed in agriculture. As mentioned above India receive average precipitation of 1,170 millimetres (46 in) per year, or about 4,000 cubic kilometres (960 cu mi) of rains annually. Out of which 1.65 Lakh Litre water is harvested but can we harvest more. At present scenario there are water van patrolling on roads to irrigate roadside vegetation that cost diesel labour and more than required water. According to Times of India 468 billion litres of rainwater is wasted due to lack of any harvesting techniques on road network. So how we can implement rain water harvesting on roads?

Source: dreamstime.com

Solution:

"The fall of dropping water wears away the Stone."

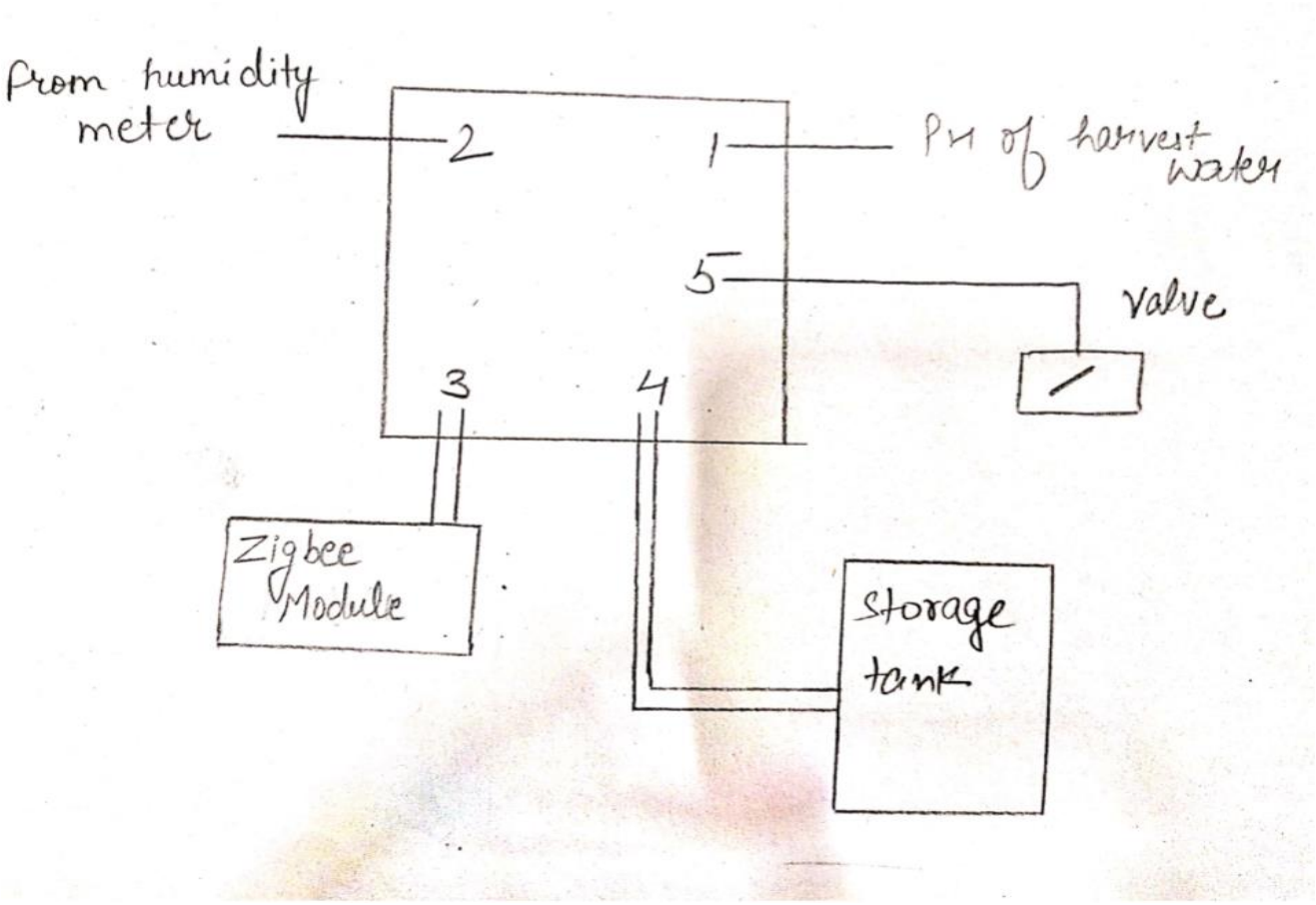
Above quote beautifully describe the constant effort no matter how small they are can make a change. We already know how a light pole on a roads looks like there are two light lamps on both side and void between them. Actually a road light lamp consist of two poles one hollow that support the whole pole light and second on outer circumference that hold the two lamps and their wiring. We will use this hollow void area of inside to collect rain water which will be connected to draining system setup below the road which will bifurcate into two drains one will be used for irrigating the roadside trees and plants and second would go for municipal water supply. Our main focus is to conserve water that is being used for irrigation. Every plant have its requirement of water and irrigating more than that is of no use so there will be a device that will control amount of water being supplied for irrigation by checking requirement of trees and plants.to conserve more water we will use drip irrigation rather than just draining out the direct supply.

Present Scenario:

The roadside vegetation is look after by NHAI authority. They give tender to local companies. The patrolling van are set up for the job which runs on highway to water the roadside vegetation. A particular company is given tender of let say 70km and that particular company is responsible of watering that 70km stretch. They use high pressure pipes whose flow rate is much higher thus much water is used rather than actual requirement. Moreover diesel to run these van is also a costly affair as petroleum diesel are non-renewable resources. So just to water the roadside vegetation it cost both our valuable resources. But using our solution the above losses can be eliminated.The apparatus information is given below.

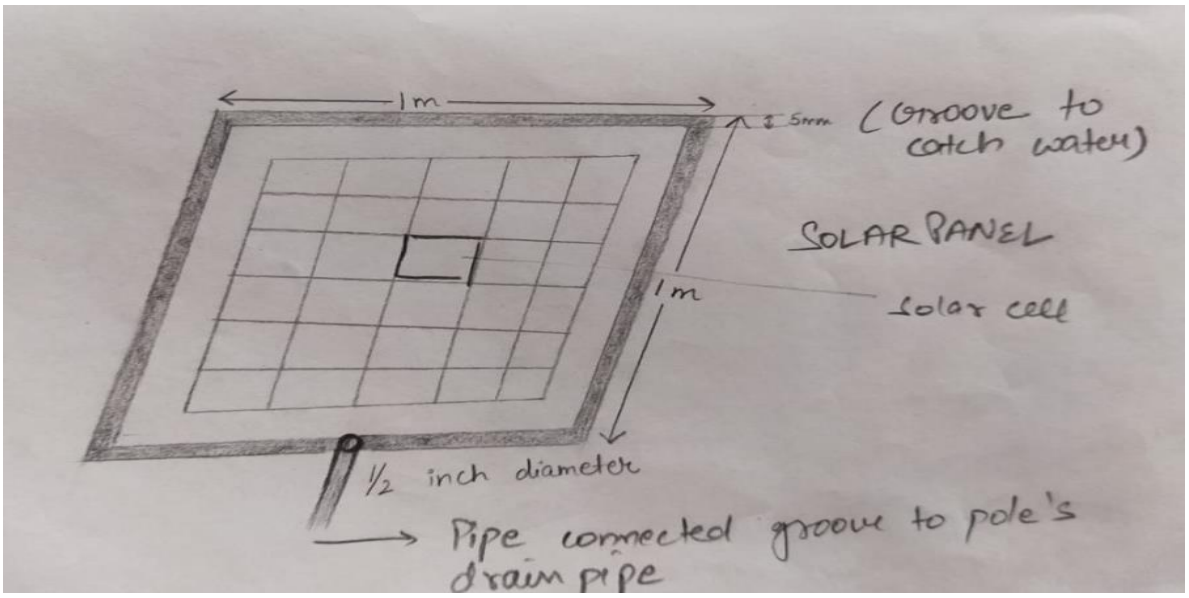
Apparatus:

- **Controller**



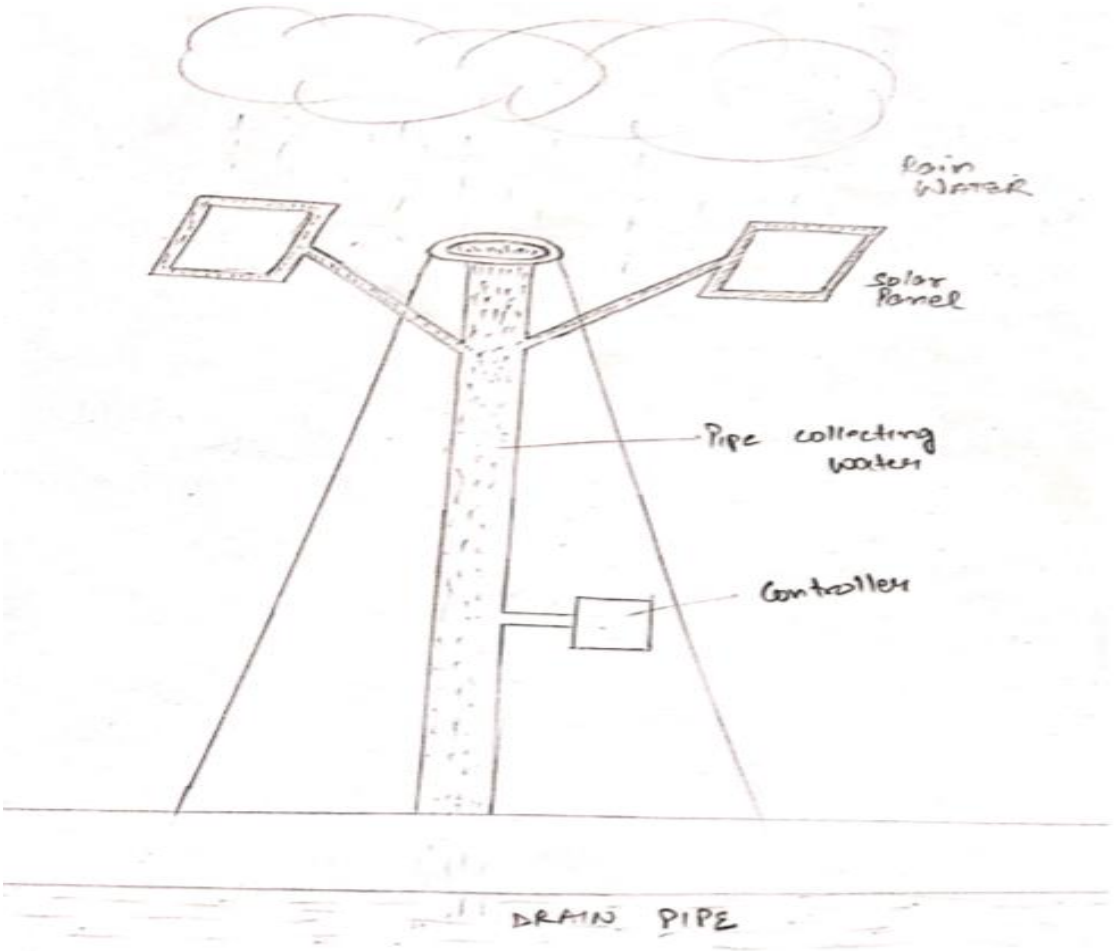
- Terminal 1 is connected with ph sensor that will read ph level of rain water
- Terminal 2 is connected with humidity meter that will read humidity level of soil
- Terminal 3 is connected to a zigbee module that will setup a wireless connection
- Terminal 4 is connected with storage tank where harvested water will be stored
- Terminal 5 is connected with valve that will control the flow

❖ **Solar panel**



➢ Solar panel is modified to catch the rain water by making a groove in its boundary that will collect the rain water and through a drain pipe of 0.5 inch diameter water will be transferred to pole from where it will drain out to plants and storage tank

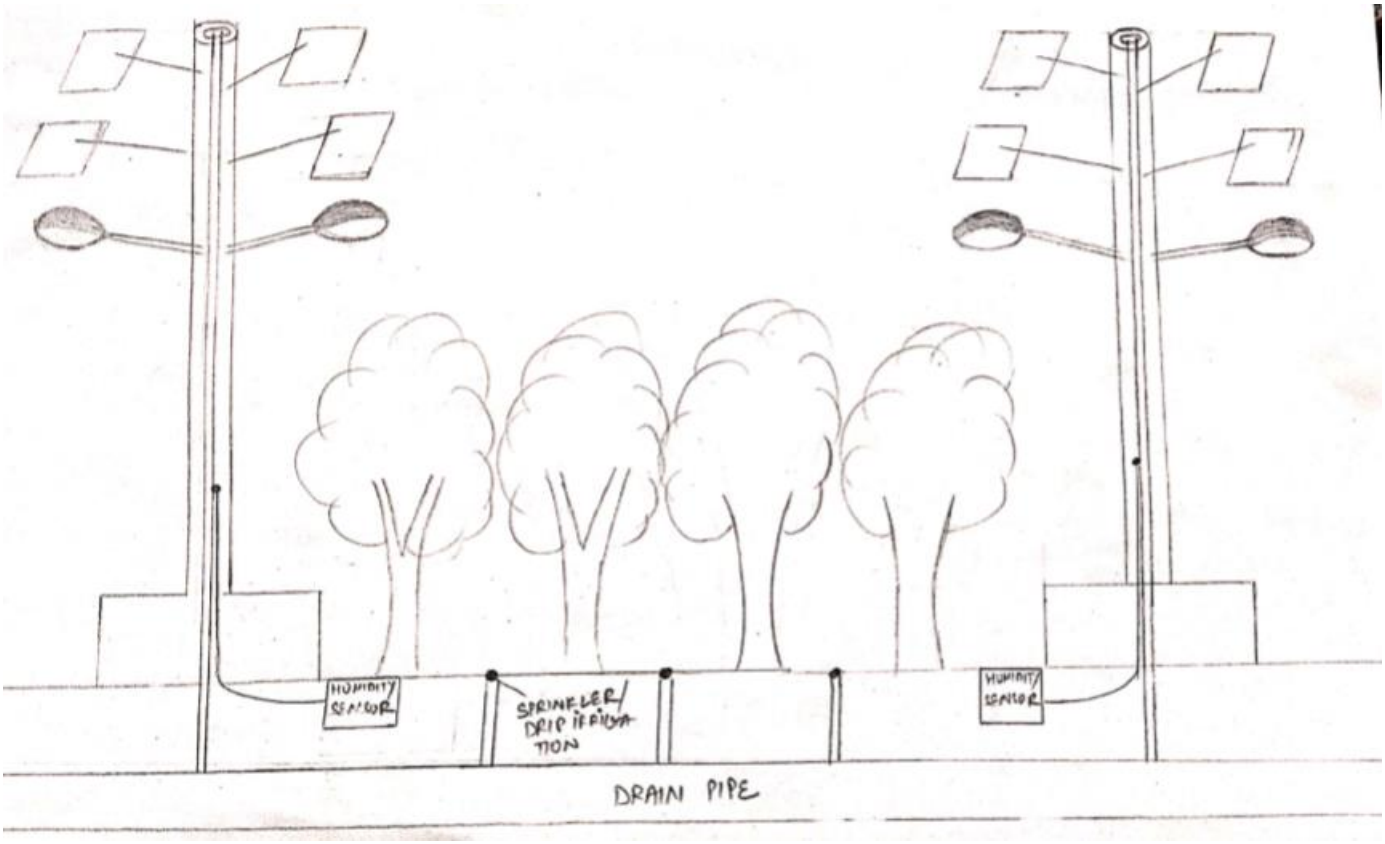
❖ **Light Pole**



➢ Light pole will have a circular opening that will collect rain water

- As discussed above solar panels and pole opening will collectively make $7m^2$ of harvesting area
- A tunnel shaped pipe connect all areas to drain pipe
- A controller discussed above is present inside the pole that will perform all the task

❖ **Arrangement:**



- A humidity sensor if connected with every pole that will measure moisture in soil
- Tunnels from drain pipe are connected to ground between trees to provide water supply for Drip irrigation or sprinkler irrigation

Working:

First rain water will be collected from panels and pole opening then it will pass through the tunnel and then controller will check the ph level of water if it is acidic in nature signal will be given to controller to close the valves and water will be blocked from getting into drain pipe. Then via ZigBee module a signal will be send to NHAI authority informing them water is acidic in nature so the irrigation system is halted. If water is of normal ph. then signal is send to humidity sensor to check amount of moisture in soil as it will give information about amount of water required and if soil is already moist then water will not be allowed to enter in drain pipe and will be collected in storage tank but if soil is having less moisture then signal will be sent to controller to open the drain valve thus letting water enter in drain from where it will be used for irrigation of whole vegetation. If in case of no rainfall storage tank is empty then ZigBee will send signal to authority.

Algorithm of Control unit:

```
Declare
        Input Tankful;                    //signal control unit when to turn process off
        Input tank empty;
         Input humid:
        Input xbee;          // to transmit signal to authority
        input ph;             //check for water acidic level and respond accordingly
        output valve;         //connecting pole with drain pipe
        output valve2:      // setup to fill storage tank


Algo
        If(ph=0&& humid=0)
                {
                        Set valve=1;
                }
         else
            {
              Set xbee=1;
            }
         If(tank_empty)
            {
            Set valve2=1;
            }
```

Calculation

An average annual rainfall over this whole road is about 650mm i.e 0.65m

Total area of pole void, solar panels boundary total area of rain water harvesting =7m^2

Total rain water harvested annually (ideally) =7*0.65 =4.55m^3

=4550L 1m^3=1000L

According to Times of India report we can extract 87% of water from rain water excluding acidic water. Thus using our device amount of water can be separated is 4550-550=4000L

Considering standard distance of 50m between each pole:

Total no of trees between this area=6

A normal bush used for fancy fencing can expand to 3 metre thus = 50/3=17

Calculation of water requirement between two poles per day:

A weeping fig tree (which is planted on NH1) requires an 2L water per day when irrigated via drip irrigation and a bush require amount of 1.5L water daily to survive

So total requirement of water per day= (no of trees*required water) + (no of bushes*required water)

= (6*2.5) + (1.5*17) = 40.5L per day

Total Number of days for which water required for irrigation= total harvested water/required water

= 4000/40.5

= 100 days

Considering the famous SHER SHAH SURI MARG the NH1 highway between AMRITSAR to DELHI which cover a stretch of 488kms

Stretch of vegetation over this road=350km

Total No of poles where rain water harvesting required = (350*1000)/50 =7000 poles

Present Scenario without our solution:

Daily water consumption by using basin irrigation:

Number of trees=7000*6 =42000, Water per tree =5L

Total water =42000*5 =210000L

Number of bushes = 7000*17 = 119000

Water per bush =1.5L

Total water = 119000*1.5

=178500L

Total water used per day=210000L+178500L = 388500L

Price of water being used for commercial use=₹3.2 per 1000L

Total cost of water per day = (388500*3.2)/1000 =₹1243.2

To water them in present scenario patrolling cars are used whose tender is given by NHAI authority to local company and many van cover their local stretch by watering them

So charge of commercial vehicle =₹3000

Total cost of water per day=3000+1243.2

= ₹4243

Out of 365 days watering trees is mandatory for 200 days (excluding rainy season and watering can be done in winter on alternate days)

So total cost per year=₹848600

On including labour charges (assuming 3 person are required taking 360 wage per day)

=3*360*200

So total cost = 848600+216000 = ₹1064600

Calculation of our solution apparatus:

The solar panel and pole will be modified to collect as much as water they can

So modification will cost near about ₹2000

Drip irrigation system for 50m=₹1000

Cost of humidity sensor and PH sensor =₹100

Cost of dedicated microcontroller=₹200

ZigBee module (per 10 poles) =₹800

ZigBee module (per pole) =₹80

Thus total cost of modification per pole required=₹3380

Electricity worth ₹20 will be sufficient for device for operating for 5 years (1 hour working daily)

Thus total cost per pole =₹3400

Total cost for 7000 poles=₹2380000

Due to unevenness in rainfall

The harvested water can serve near about 100 days only (half only)

Thus saving water of total cost = 1064600/2

= ₹640300

Calculation of breakeven point =Total cost with our solution/total cost without our solution

=2380000/640300

= 3.7years

In a period of 10 years this modification can save:

= (640300*10)-2380000

=₹4023000

Hence this solution lead to profit of ₹4023000

Total water conserved=4000*7000*10

=280000000L of water

Approximately makes amount of 28 crore of irrigation water

Outcome & Benefits:

- ₹1064600 is just cost of watering the roadside vegetation using patrolling vans for a year
- ₹640300 can be saved just adopting our solution
- The total profit in 10 years is ₹4023000
- Total water conserved is 280000000L of water in 10 years

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