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A Geospatial Approach to Potential Rooftop Harvesting of Rain Water in Pirwadi Village, Kolhapur District, Maharashtra (India)

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ABSTRACT: Despite the fact that water covers 71% of the land surface, water is a limited natural resource. Fresh water makes up approximately 2.5 percent of total water on the planet, and it is used for a variety of reasons including household, irrigation, and industrial. Due to haphazard population expansion, frequent droughts, and changing climate patterns, water shortage has become a major worldwide issue. In a developing country like India, which has a long history of rural culture, the need for household water is fast increasing. The practicality of roof rain water collection in a Pirwadi hamlet in Kolhapur district (MS), India, was investigated using geospatial tools. Using a Google picture of the research location, global mapper, and Arc Gis ver. nine point three software, the various types of roof areas of dwellings and buildings in the hamlet were discovered and computed. The Gould and Nissen formula and Rande's coefficient of runoff index for various types of roofs were used to determine the potential of roof rain water collecting (1999). The whole potential of roof rain water collection, according to the research, is estimated to be 11457490.78 Lt., which is more than enough to cover the village's full annual drinking and cooking demands. In rural areas, rainwater collection systems are particularly helpful in alleviating the problem of water scarcity.

KEYWORDS: Geospatial Techniques, Roof Rainwater Harvesting, Runoff Coefficient, Water Scarcity.

I. INTRODUCTION

Despite the fact that water covers 71% of the land surface, water is a limited natural resource. Fresh water makes up approximately 2.5 percent of total water on the planet, and it is used for a variety of reasons including household, irrigation, and industrial. Due to haphazard population expansion, frequent droughts, and changing climate patterns, water shortage has become a major worldwide issue. Domestic water demand is increasing dramatically in a growing nation as well as India, which have an extensive history of the rural culture [1].

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In India, the estimated yearly supply of new and fresh water per capita has reduced from 5177.00 cubic yards in 1951 to 1820.00 cubic meters in 2001, and it is expected to continue to decline to 1341 cubic meters in 2025 and 1140.00 cubic meters in the year 2050. According to the Water Resources Department, water shortage would reach its peak by 2050, posing a threat to the country's socioeconomic growth. Fresh water supply is unevenly dispersed across geography and time, while demand for it is constantly increasing[2], [3].

In this light, rainwater collection is a possible solution for tackling the significant problem of water sacristy. Rainfall harvesting is the collection of rainwater that falls directly on a roof or on the ground, bypassing the surface drainage stage on land. Although the term "rainwater harvesting" is now widely used, the idea of collecting water isn't new to India, as well as it has been practiced for millennia. Rainwater collecting is prevalent in semiarid areas where as rain fall is scarce, but it is also common in mountainous isolated locales and metropolitan areas where rainfall is plentiful but demands is high [4]–[6]. Rainwater is a pollutant-free, natural supply of water that may be collected using scientific rainwater collection methods [7].

The study area for this work is Pirwadi village in Kolhapur district (MS), India. This hamlet runs from 740 11' 01"E longitude to 160 39' 17"N latitude in Bhogawati river basin, particularly on the far eastern mountainous bank of the River Bhogawati. The hamlet enjoys a monsoon climate and is situated at an elevation of 1965 feet above mean sea level. With an average rainfall of 1025mm, the south west monsoon brings rain to the area [8].

The review's specific objectives are to investigate the reasonableness of rooftop downpour water gathering in Pirwadi town, Kolhapur region India, considering the abovementioned [9]. The current exploration depends on both essential and auxiliary information sources, as well as thorough field work in which an efficient timetable was used to accumulate information on day by day, month, as well as yearly water needs and shortage, as well as find out with regards to the review region's available water assets. Populace, families, environment, precipitation, and temperature information were accumulated from a few divisions [10]. Evaluating the catchments accessible for rooftop top water collecting, where the rooftop tops are the catchments, is a tedious activity. In light of that, a GIS approach was used to

ascertain the area of different kinds of rooftops in the review district. Various kinds of rooftop catchments and expressways were digitized utilizing a Google satellite photograph. The necessary organizers were saved as kml documents, which were then sent out to Global Mapper application and went to shape records[11]–[13].

The shape documents were sent out in Arc GIs 9.3 and the region of each kind of rooftop accessible in the exploration district was assessed to lay out the review region's absolute downpour water gathering capacity. The spillover coefficient is the component that records for the way that catchments can't gather all of the downpour that falls on them the amount of water gathered relies upon the size and unpleasantness of the rooftop. For estimating the coefficient of spillover, Rande's gathering effectiveness approach for different sorts of rooftops has been utilized. For the review region, the Gould and Nissen equation was utilized to decide the capability of rooftop downpour water assortment. The financial worth of the water that would be collected has additionally been evaluated [14].

Roof Top Area Calculated for Each Roof Type

Ancillary Data for Spatial Data

Rainfall Statistics - Climate

Water Scarcity Level – Population – Household Water Requirement

Rande's Collection Efficiency Index is a measure of how well a company collects money.

Estimated Yearly Rainfall in m is equal to Roof Rain Water Harvesting Potential (Cu. m). Sq. m. Catchment Area Coefficient of Runoff

Roofs make up the catchment, which is an important part of the RRWH systems, as well as composed water from the roofs of residences or buildings may be used for daily needs or artificial groundwater replenishing. This procedure is less expensive and extremely effective, and if appropriately performed, it may aid enhance the area's ground water level. The following important components make up an outstanding roof rainwater collection and conservation system [15].

Gutters and Downspouts: A system of transport channels that connects the catchment surfaces to the storage area.

Contamination and debris removal technologies include leaf screens and roof washers.

Cisterns or Storage Tanks: Where rainwater is collected and stored.

Conveying: The method of transporting treated rainwater, whether by gravity or by pump?

Filters, equipment, and additives for settling, filtering, and disinfecting water are used in water treatment.

Filters and storage tanks are essential components of the RRWH system, since they guarantee the availability and purity of collected water [16]–[18].

Rooftop water gathering limit is the capacity of a rooftop to accumulate all of the water that falls on it throughout the span of a year, including every single blustery day. The yearly water creation, which is generally estimated in liters, is the aftereffect of the rooftop type and the yearly normal precipitation in the district [19][20]. The quantity of rainfall collected is determined by the catchment area's size and texture. A smoother, cleaner, better impenetrable roofing material assists with further developing water quality and amount [21]. The coefficient of spillover for various kinds of house rooftops was resolved utilizing Rande's coefficient effectiveness record. The Roof characterizations of Pirwadi Village are displayed in Figure 1.

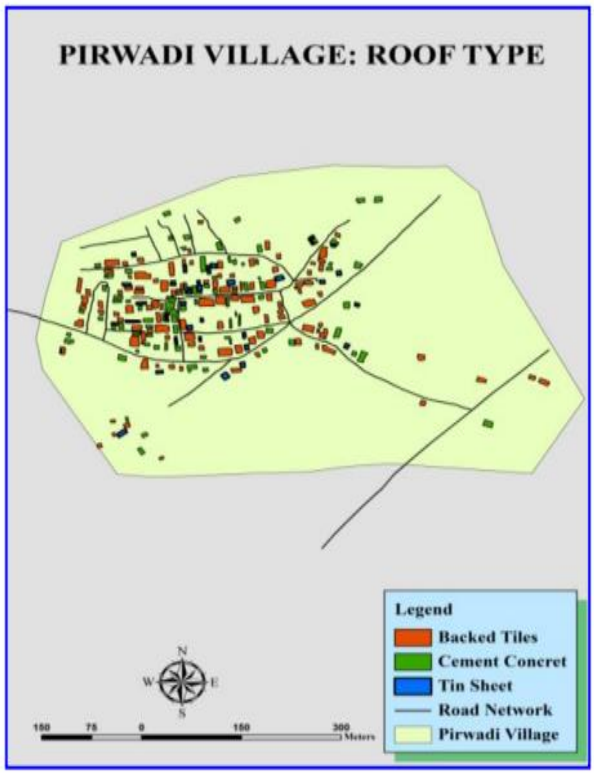

Fig 1: Roof classes of Pirwadi Village [22].

II. DISCUSSION

Pirwadi town covers 279 hectares and has a complete populace of 1893 individuals residing in 378 houses. Homegrown water is given in this village for the most part by wealth of cylinder wells. Since the village is near Kolhapur, the gauge depends on the city's normal yearly precipitation of 1025mm. The valuable information of rooftop region show that upheld tiles represent most of rooftops, with an area of 9629.987 square meters, trailed by concrete cement (5010.858 square meters) and tin sheets (1519.987 square meters) correspondingly. Water assortment effectiveness fluctuates by rooftop type; albeit a concrete substantial rooftop has the most noteworthy assortment productivity, inhabitants in this space decide to construct rooftops with upheld tiles. Subsequently, upheld tiles (5916.29 cu. m.) have the most noteworthy water yield, trailed by concrete substantial rooftop (4365.71 cu. m.) and tin sheets correspondingly. This present town's complete water gathering potential from housetops is 11457.49 cu. m[23]–[26].

It is assessed that 20 liters of water for every individuals each day is required in helpless countries, particularly in provincial districts, to give fundamental family prerequisites like tidiness and wellbeing (UNO, 1990). On the off chance that we apply the UNO's insignificant standard for private water utilization, the aggregate yearly interest for water in Pirwadi village for the entire populace would be 13818900.00 liters. Assuming we gauge that of the 20 liters of water for every capita each day, 10 liters for every capita each day is expected for cooking and drinking, the absolute yearly water utilization locally would be 6909450 liters [27]. This suggests that roughly 60% of the RRWH's whole

potential might be expected to satisfactorily meet the town's fundamental requirements for drinking and cooking.

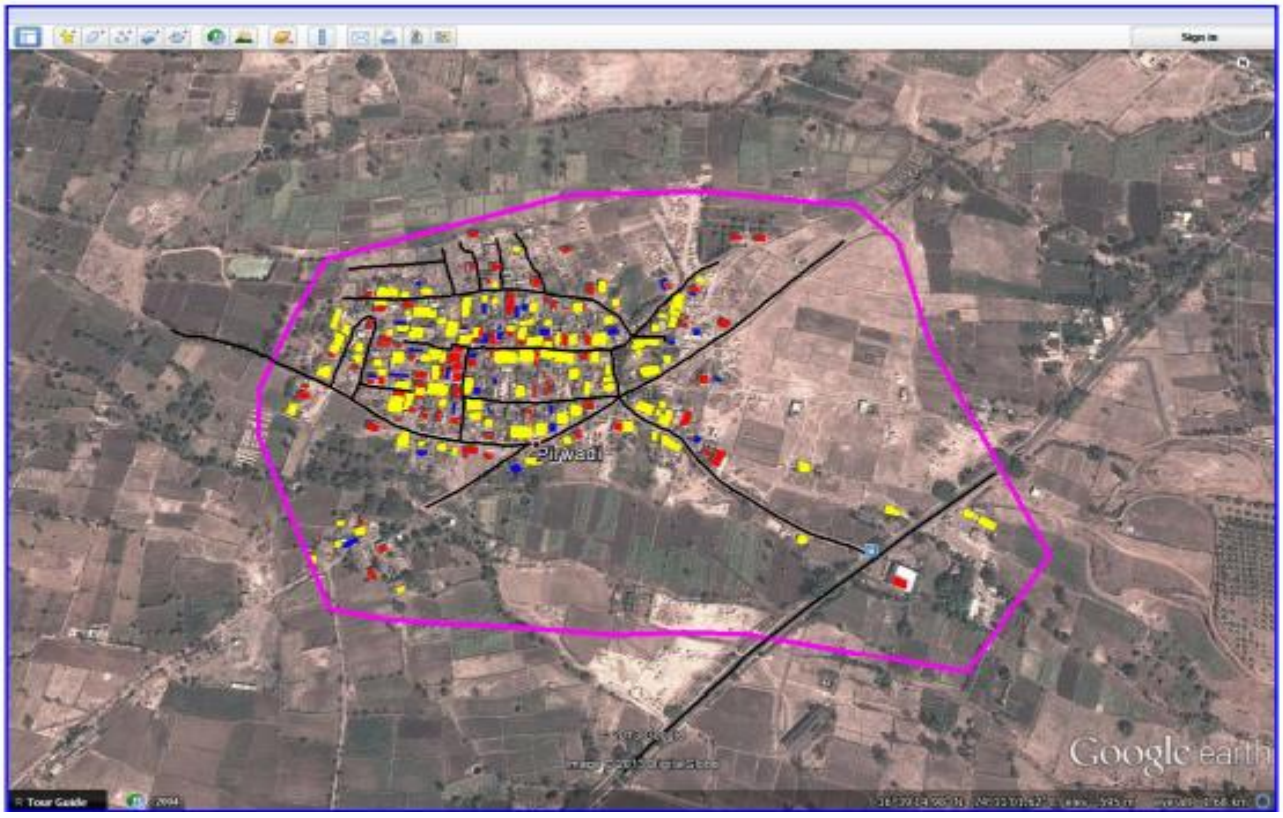

Fig: 2 Illustrates the Google picture & Digitization work of Pirwadi Village

Table No: 1. Coefficient of Runoff

Roof type	Estimated collection Efficiency (as % Precipitation)
Cement Concrete	85
Tin Sheets	75
Backed Tiles	60

Source: Rande (2002)

Table No.2 Potential of RRWH in Pirwadi Village

Roof Type	Area in Sq. m.	Potential of Water Harvesting in Liters	Potential of Water Harvesting in cu. m.
Backed Tiles	9629.987	5916292.00	5916.29
Tin Sheets	1519.753	1175488.75	1175.49
Cement Concrete	5010.858	4365710.03	4365.71
Cumulative Potential of water harvesting		11457490.78	11457.49

(Source: Compiled and computed by researcher)

Table No.3 in Pirwadi Village

Total Population (2001)	No. of Households (2001)	Total Annual RRWH Potential (in Liters)	Total LPCPD Annual Demand of Water (@ 20 Liters)	Total LPCPD Annual Demand of Water (@ 10 Liters)
1893	378	11457490.78	13818900	6909450

(Source: District Census Hand Book, 2001 & computations made by researcher)

Rather to permitting water to stream off, water gathering is the assortment and limit of downpour. Water is gathered from a housetop like surface and coordinated to a tank, stockpiling, profound pit (taking everything into account, shaft, or borehole), spring, or penetrable storehouse, where it leaks down and recharges the groundwater table. Dew and cloudiness may likewise be gathered utilizing nets or other hardware. The overflow is collected from roofs rather than rivulets, canals, roadways, or other land surfaces, which distinguishes it from stormwater reaping: 10 Watering gardens, domesticated animals, water systems, homegrown usage with proper treatment, and homegrown heating are just a few of its applications. The collected water might also be utilized for long-term storage or groundwater recharge. Water collection is one of the most simple and well-established methods for self-supply of water for households, as well as private and family-scale initiatives, which are often sponsored by the customer. Larger structures for schools, emergency clinics, and other offices, on the other hand, might build up expenditures that are simply ready to be covered by owners, organizations, and administrative entities.

Water collection is the process of collecting run-off from a building or other impervious surface in order to preserve water for later use. Typically, this entails collecting rainwater from a rooftop. The rain will collect in drains, which will transport the water through downspouts, and then into a capacity vessel. Water collection frameworks may be as simple as collecting rainwater in a rain bucket or as complex as collecting water into massive reservoirs to feed your whole family with interest. For the most part, the prospect of collecting water conjures up images of an ancient farm reservoir or

thoughts of non-industrial civilizations. Actually, water collection is becoming a viable solution for delivering water to our families and organizations. It's no longer only for the homestead! Water collection is a common practice in several countries, including Germany and Australia. Water collecting frameworks will become more well-known in Amerika as a result of the green structure development.

III. CONCLUSION

By utilizing rooftop downpour water gathering strategies in Pirwadi town, the local area's water deficiency condition during the hot season might be changed into a water-adequate position. The whole capability of rooftop downpour water gathering has been determined to be 11457490.78 Lt, which is all that anyone could need to meet the town's entire yearly drinking and cooking needs. Water collection methods are effectively beneficial in alleviating the problem of water deficit in provincial districts, according to the prior discussion. The many types of water are called by many different names all across the globe. It advances from water assortment to water assortment to water assortment to water assortment to water assortment to water assortment to water assortment to water assortment to water assortment to water assortment to water Furthermore, phrasing like rooftop water assortment or rooftop water assortment are additionally utilized in different nations. In a metropolitan circumstance, we concur that water assortment is an authentic development. To take utilization of this asset, you should simply catch the free water that falls on your rooftop and send it to a water stockpiling tank. You might assume responsibility for your water supply and substitute all or a significant piece of your water prerequisites thusly. Water assortment constructions might be set up to serve your total home as well as your scene requests.

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