International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 16s, 2025
https://www.theaspd.com/ijes.php

Study Of Rainwater Harvesting In Puttur Taluk, Dakshina Kannada District, Karnataka.

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Abstract
Approximately 83% of India's water resources are allocated to agriculture. Therefore, it is crucial to preserve and hold onto the water that is left over after the rainy season. The trend of rainfall in Puttur has been shown to decline, as indicated by the three-year moving average curve for the period from 1990 to 2017. We need to put in a rainwater gathering system here. A check dam is a makeshift structure made from easily accessible mud and loose stones. They are generally constructed across minor streams and rivers. These check dams store a lot of water during the dry months and limit the flow of water. The water level in nearby wells and water sources rises as the collected water gradually seeps into the ground. In coastal regions, they also lessen the quantity of freshwater that enters the ocean. In rural areas, check dams are a popular, inexpensive, and simple method. Check dams are therefore highly helpful in managing water resources. Making artificial ponds, which are subsequently utilized for everyday activities like watering plants in the dry season, is another way to ensure fresh water is available during the rainy season. At high elevations, it is mostly constructed using impermeable materials such as geomembrane and geosynthetics. Large volumes of water can be held by gravity or pumped from man-made ponds when needed. Soil property studied like bulk density, wet sieve analysis, water content and infiltration revealed that rainwater harvesting promotion will decrease dependency on groundwater in dry periods up to 40%.

Several factors have contributed to the recent depletion of groundwater. The goal of this research paper is to improve Puttur's groundwater recharge and efficient use of stored water. The primary factor influencing groundwater recharge is the soil's ability to infiltrate. The flow of water from the surface into the soil is known as infiltration. Infiltration tests were conducted at eight sites in the Puttur areas of the Dakshina Kannada District in the state of Karnataka. The double ring infiltrometer method was used to measure the infiltration rates. The results showed that the infiltration rate is influenced by temperature, bulk density, porosity, soil type, and antecedent moisture content. The in-situ density of soil is determined using the core cutter method. Evapotranspiration is not synonymous with evaporation. It is the confluence of two transpiration and evaporation processes. Transpiration explains how water moves inside a plant and how stomata in its leaves cause the following loss of water as vapor. An element (like a tree) that helps evapotranspiration is known as an evapotranspiration. From surfaces, including soil (soil evaporation), and from vegetation, evapotranspiration (ET) is the word used to define the movement of water into the atmosphere. Good number of rational and empirical formula are available to compute evapotranspiration (12). But many are specific to regions due to large number climatic parameters. As farmer understand about rainfall only, simple tools are needed to compute crop water requirements using from minimum climatic data.

Keywords- *Check dam, Rainwater harvesting, Groundwater Recharge, Infiltration rate, Evapotranspiration, Crops, Artificial ponds.*

I. INTRODUCTION

One of the earliest and most basic ways for families to collect and store rainwater instead of letting it runoff is through rainwater harvesting, or RWH. The process of collecting and storing rainwater for future use when necessary is known as rainwater harvesting. Water is directed to an appropriate gathering site as it rains (9).
Small obstacles known as "check dams" are constructed to obstruct the flow of water in shallow rivers and streams in order to collect water. During monsoon rains, the small dams store surplus water flow in a small catchment area behind the building. The impounded water is forced deeper into the ground by the pressure that is created in the catchment area (1). Restocking the wells and groundwater reserves in the area is one of the main

environmental benefits. Although it can also be utilized for domestic needs and livestock, the water held by the dam—both surface and subsurface—is mostly used for irrigation during the monsoon and later in the dry season. Check dams are built in a range of sizes using a variety of materials, including clay stone and cement. Earthen check dams, or embankments, can easily be constructed by the farmers themselves. Masonry and reinforced cement concrete (RCC) structures, on the other hand, require some degree of advanced construction experience and money monetary inputs. Earthen dams do not allow for overflow of water, in contrast to masonry and RCC structures which allow excess water to flow over the spillway.

II. GLOBAL WATER SCENARIO

There are major issues when national data on renewable water supplies in 149 nations are compared with present and anticipated population projections. It is estimated that by 2025, 46 to 52 countries—up from 28 in 1990—will experience water stress or scarcity based on per capita water availability in 1990. This expansion puts human health and marine ecosystems at risk, especially in light of the rise in international disputes over water resources (9). A safe future depends on water conservation and sustainable use. Preserving the Authenticity of the Guidelines.

III. PUTTUR WATER SCENARIO

Puttur experiences acute water scarcity, particularly during the summer, like many other parts of India. The situation is made worse by elements including erratic rainfall, excessive groundwater use, and inadequate water management. Damage to the ecosystem and land subsidence are caused by groundwater depletion. Surface water bodies are harmed by pollution from sewage, agricultural runoff, and industrial discharge, endangering aquatic life and human health. Puttur lacks infrastructure and efficient water saving techniques. Strategies such as watershed management, effective irrigation, and rainwater collection can be beneficial. With shifting rainfall patterns and increasing temperatures brought on by climate change, water stress will probably get worse.

IV. OTHER METHODS OF RAINWATER HARVESTING

Surface Water Collection Systems: Surface water is simply water that accumulates on the ground's surface. When rainwater falls on the surface of the earth, it usually flows down slopes as it moves towards a point of depression where the moving water can collect (4).

Rooftop system: These can also be used to harvest rainwater. They can be used to direct rainwater that falls on the roof of a building into containers or tanks. These tanks are usually elevated so that when the tap is opened, water flows at a high pressure. (14)

Dams: These are barriers that are designed to trap water. Rainwater can accumulate directly in them or drainage systems can be created to direct water into them. Water collected in dams is mostly used for irrigation purposes or treated and then distributed for domestic use (2).

Underground Tanks: These are also ideal for collecting rainwater. They are constructed by digging into the ground and creating a space which is then cemented to reduce water infiltration. The top is also sealed and water is obtained through pipes directed into the tank (5).

Rain saucer: Sometimes one can decide to collect rainwater directly as it falls from the sky by using a rain-saucer. These look like upside down umbrellas or big funnels. Some are usually attached to a pipe so that the collected water is directed elsewhere.

Water Collection Reservoirs: Water collected through this method is not really clean and may be contaminated. However, it can still be used for crop irrigation. Such rainwater is harvested from roads and pavements.

Barrage: A barrage is a dam that has several openings which can be closed or opened to control the quantity of water that passes through it. It is usually large and can be used to collect a lot of water.

Slopes: Rainwater tends to collect at the bottom of slopes when it flows on the ground. When it rains heavily, water levels can rise to the hill top. This is a simple and natural way to harvest rainwater.

Trenches: This is another great way to harvest rainwater for irrigation. When it rains, the water is directed to the farm using trenches. It is one of the traditional methods of rainwater harvesting that is still very much in use today (10).

Rain Barrels: These are also used for rainwater harvesting. They are specifically designed for this purpose and can be purchased from retail stores. Rain barrels are used for harvesting rainwater that falls on rooftops (10).

V. NEED FOR STUDY

I. Ground water, which is in aquifers below the surface of the Earth, is one of Nation's most important natural resources. Ground water is the source of about 33% of the water that country and city water departments supply to households and businesses (public supply).

II. In the past the ground water table was located about 10 to 30 feet below the earth surface, but due to urbanization, there is lack of ground water table goes on depletion day by day. So, it is observed that the ground water recharge and usage of rain water in dry season after storing is necessary to reduce the exploitation of ground water.

III. Puttur is a developing town which is located in Dakshina Kannada District, gets 4300mm of annual rain fall and still facing a major problem of water scarcity. And also, it is observed that ground water table is about 300ft to 450ft below the ground level.

IV. Recharge of ground by check dams is one of the easier and economical methods of ground water recharge and practiced by village from long ago.

V. So the study on water requirement and usage in Puttur taluk is very essential to tackle the problem of scarcity of water in this region by implementing effective methods such as Artificial ponding and Check dams.

VI.METHODOLOGY

To utilize this information as a methodology for assessing check dams, we can outline it as follows:

1. Plotting the rainfall at a location across a number of years as a bar graph will not reveal any trends or cyclic patterns because the years that follow each other vary greatly. The average of three or five consecutive years is determined gradually by shifting the group averaged, one year at a time, in order to show a broad trend in the rainfall pattern. The location's 27-year rainfall record is displayed. The average of the first three years of data is presented at the graph's midpoint. By leaving out the first and averaging the records from the first two to four years, the next point is calculated, once more placing the average at the middle of this group. As a result, a three-year moving mean curve is produced, smoothing out the significant variance in the years that follow (13). A moving mean curve that spans three or five years might be helpful in determining long-term trends or patterns in a location's rainfall. The Puttur region's yearly rainfall during a 27-year span, from 1990 to 2017, is shown with three-year moving mean curves.

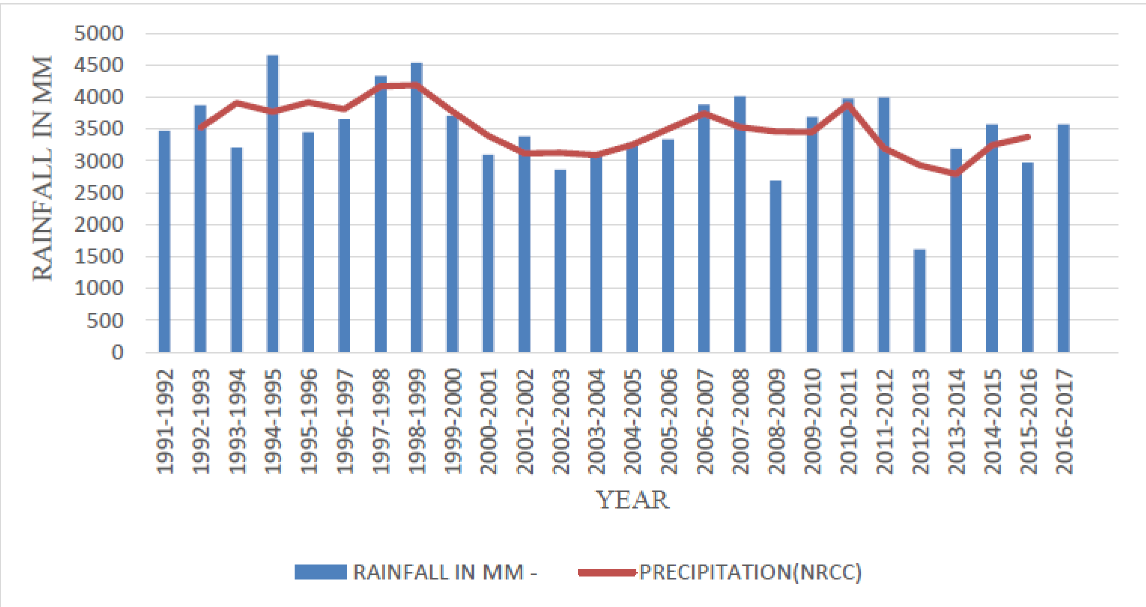

Fig-1: Trend analysis of rainfall in Puttur

2. The efficacy of check dams can be evaluated based on their impact on the process of infiltration, which is crucial for groundwater recharge and erosion prevention. Infiltration refers to the downward movement of water from the ground surface into the soil, with its rate measured in centimetres per hour. Runoff occurs when rainfall surpasses the infiltration rate, highlighting the significance of managing water flow. This rate is influenced by

factors such as the saturated hydraulic conductivity of the near-surface soil, which affects how easily water moves through it. Measurement of infiltration rate can be conducted using an infiltrometer, distinguishing it from percolation, which refers to water movement within the soil mass.

3. The effectiveness of check dams in promoting infiltration can be attributed to their ability to harness gravitational and capillary forces. Gravitational water moves downward through larger soil pores, while capillary action draws water into smaller surface pores. Check dams help slow down surface water flow, allowing water to infiltrate the soil more effectively. However, factors such as soil composition and surface conditions can influence infiltration rate, with clay particles swelling when wet, reducing pore size. Additionally, areas lacking forest litter protection may experience soil particle detachment by raindrops, hindering infiltration.

4. Evaluation and suitability impervious farm ponds. Utilizing the stored water for agricultural purposes at dry seasons.

VII.TESTS CONDUCTED

Methodology is given in a flow chart (Fig-2)

FLOW CHART

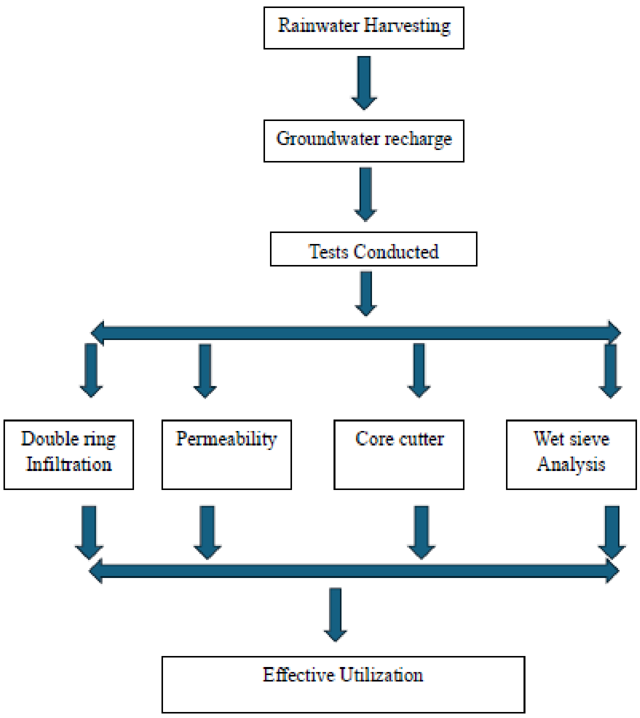

Fig-2: Flow chart of methodology

1. Core cutter method: It is used to for finding field density of cohesive/clayey soils placed as fill. It is rapid method conducted on field. It cannot be applied to coarse grained soil as penetration of core cutter becomes difficult due to increased resistance at the tip of core cutter leading to damage to core cutter.

2. Wet sieve analysis: The procedure is conducted as per code recommendation. The sieve analysis determines the gradation (the distribution of aggregate particles, by size, within a given sample) in order to determine compliance with design, production control requirements, and verification specifications. The results of a sieve analysis canbe used to help classify a soil. Soils can be divided into two broad classes: coarse- grained soils and fine-grained soils. Coarse-grained soils have particles with a diameter larger than 0.075 mm.

3. Permeability test: Permeability testing measures the ability of a material to allow fluids (usually liquids) to pass through it. It's crucial in various fields like geotechnical engineering, hydrology, and material science for understanding drainage, filtration, and fluid flow characteristics.

4. Double ring infiltrometer: Double ring Infiltrometer method was used for measurement of infiltration rates at all the sites. In these two concentric rings were used. The diameter of the inner ring is 300mm + 10mm and the outer ring diameter is 600mm + 10mm. The slight variation in diameter allowed nesting of the rings during transport. Rings are 250 mm deep and were made from 6 mm thick steel plate with sharpened bottom edge. The rings were driven at about 15cm deep in soil by using falling weight type hammer striking on a wooden plank placed on top of ring uniformly without or undue disturbance to soil surface (14). The observations for infiltration rate were carried out on inner ring with field type point gauge and stop watch etc. The rate of fall of water level was measured in the inner ring while a pool of water was maintained at approximately the same level in the outer ring to reduce the amount of lateral flow from the inner ring. Generally, the water level was kept at 50 mm depth; the difference in height between the inner and outer rings was kept to a minimum (3). Other equipments used were water container, a measuring flask, wooden plank, hammer, stop watch, hook gauge and scale. The rate of fall of the water level in the inner cylinder water was measured at every 5-minute intervals. The process was stopped once a steady infiltration rate had been found.

5. **BLANEY CRIDDLE METHOD:** Disregarding many influencing factors, consumptive use varies with the temperature, length of day, and available moisture regardless of its source (precipitation, irrigation water, or natural ground water). Multiplying the mean monthly temperature (t) by the possible monthly percentage of daytime hours of the year (p) gives a monthly consumptive-use factor (f). It is assumed that crop consumptive use varies directly with this factor when an ample water supply is available [6].

Following equation is recommended for calculating Consumptive use

Cu = k×f (in mm) (1)

Where, k= monthly crop co efficient. f= monthly consumptive use factor f = P/40(1.8T+32)

T= Mean daily temperature in °C over the month considered,

P= Mean daily percentage of total annual day time hours of a given month.

Table- 1: ET_0 values by Blaney Criddle method

	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Jan	5.78	5.98	3.70	3.81	5.63
Feb	5.63	5.81	5.85	5.26	5.71
Mar	4.42	4.70	4.95	5.58	5.66
Apr	4.21	4.40	4.73	4.66	5.89
May	3.96	3.37	3.20	4.36	4.77
Jun	1.17	1.37	3.21	4.50	1.11
Jul	1.51	1.73	0.77	1.36	0.89
Aug	1.39	1.44	0.90	2.23	1.70
Sep	2.11	2.64	2.40	2.49	2.04
Oct	3.23	3.73	2.92	4.24	4.05
Nov	4.39	4.49	4.26	3.53	4.68
Dec	4.47	5.24	3.10	5.17	5.03

The maximum monthly ET_0 appeared in April or May each year, and the minimum monthly ET_0 occurred in December. ET_0 declined significantly in April and May in recent 50 years; in other months, there is no significant increase or decline trend. The most important factor affecting ET_0 from January to May and December is the average wind speed, and from June to September, ET_0 is affected the most by the sunshine hours and in October and November by humidity [8].

Analysing the ET_0 from 2001- 2016, shows that ET_0 rate is low in June, July and August and generally increases September to May and then again decreases. Hence ET_0 rate was obviously affected by Sunshine, Temperature, and Relative Humidity [6] [11]. Therefore weightage is given to these three parameters and the other parameters that affects are taken together as Constant K, Thus, equation is used and K value is computed in Table-2 using climatic data of 2001-2015 and using equation (2) for Puttur using ET_0 values already computed by Blaney Criddle method for different months. Average of K values for all years is taken month wise (by leaving any two years 2008 & 2013 for calibration purpose). This is from the analysis of 27 years rainfall from 1990-2017 (Fig-1).

$$[\mathbf{0.243}(\boldsymbol{T}) + \mathbf{0.27}(\boldsymbol{R.H}) + \mathbf{0.05}\,(P)]K = ET_0 \qquad (2)$$

Where, T = Mean Temperature , R. H = Relative Humidity , P= Sunshine in hours

Table-2: Calculated K values

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2001	0.17	0.18	0.17	0.16	0.14	0.01	0.02	0.05	0.09	0.11	0.15	0.16
2002	0.17	0.18	0.16	0.17	0.11	0.05	0.05	0.06	0.12	0.09	0.18	0.17
2003	0.18	0.19	0.15	0.16	0.17	0.05	0.01	0.01	0.09	0.11	0.17	0.20
2004	0.15	0.19	0.17	0.15	0.06	0.05	0.02	0.06	0.06	0.11	0.13	0.18
2005	0.15	0.15	0.13	0.16	0.18	0.04	0.01	0.03	0.04	0.06	0.11	0.12
2006	0.12	0.08	0.13	0.13	0.10	0.07	0.01	0.01	0.04	0.05	0.05	0.12
2007	0.24	0.21	0.15	0.15	0.15	0.04	0.01	0.05	0.06	0.10	0.21	0.19
2009	0.19	0.21	0.17	0.14	0.13	0.07	0.03	0.05	0.05	0.14	0.13	0.18
2010	0.19	0.20	0.17	0.17	0.13	0.06	0.03	0.03	0.05	0.10	0.11	0.15
2011	0.21	0.21	0.18	0.14	0.05	0.05	0.02	0.02	0.02	0.08	0.12	0.15
2012	0.20	0.19	0.15	0.13	0.13	0.04	0.05	0.04	0.07	0.10	0.14	0.15
2014	0.15	0.22	0.16	0.18	0.11	0.10	0.03	0.03	0.08	0.11	0.17	0.12
2015	0.14	0.19	0.20	0.17	0.14	0.16	0.04	0.07	0.08	0.15	0.13	0.19
2016	0.20	0.21	0.19	0.23	0.17	0.04	0.03	0.06	0.07	0.14	0.17	0.18
Avg	**0.174**	**0.184**	**0.161**	**0.156**	**0.123**	**0.060**	**0.025**	**0.039**	**0.066**	**0.100**	**0.139**	**0.159**

Table-3: Values of Actual ET_0 by Blaney Criddle (B) and ET_0 calibrated

Month	Actual ET_0 value of 2008 (B)	2008 calibrated	Actual ET_0 value of 2013 (B)	2013 calibrated
JAN	7.79	5.94	5.98	5.34
FEB	7.57	6.30	5.81	5.57
MARCH	6.03	5.44	4.7	4.96
APRIL	6.16	5.36	4.4	5.07
MAY	5.64	4.23	3.37	3.92
JUNE	1.10	1.99	1.37	1.84
JULY	1.45	0.84	1.73	0.80
AUGUST	2.08	1.35	1.44	1.26
SEPT	2.93	2.20	2.64	2.08
OCT	4.65	3.40	3.73	3.20
NOV	6.00	4.56	4.49	4.34
DEC	6.88	5.19	5.24	4.78

Table- 3 and Fig-3 shows actual ET_0 (Blaney Criddle) and calibrated ET_0 (using (2)). Hence equation (2) can be used for quick computation of ET_0 for Puttur region with minimum climatic variables like T, RH and P only.

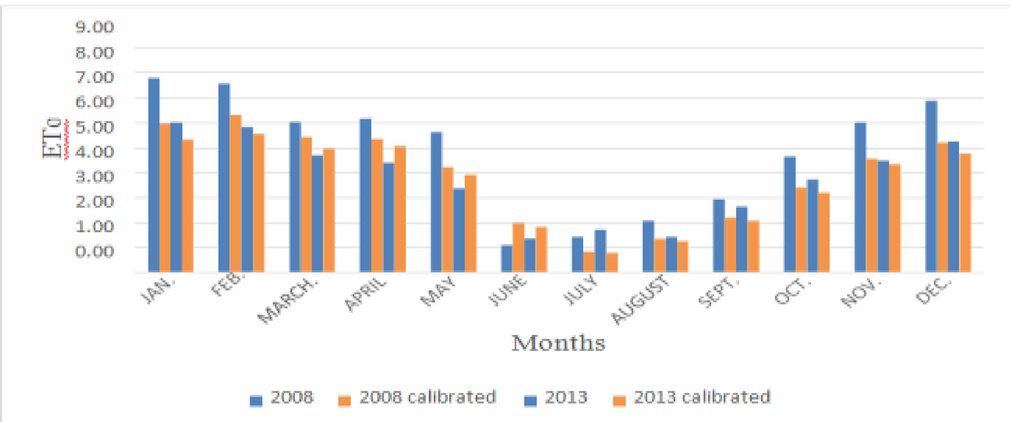

Fig-3: Values of Actual ET_0 and calibrated ET_0

VIII. SITE SELECTED

Fig-4 shows the locations of the five sites selected for check dams and four locations were identified for artificial ponds.

Fig-4: Locations of the sites

A. **CHECK DAMS**

Collected the soil sample near thecheck dams, details are shown below.

1.Siddhamoole (C1)

Located near Perlampady, Sullia built across the stream (12°64'94.36" N,75°31'79.81" E)

- Built using concrete with two layers of geomembrane
- Water is used for crops such as arecanut, banana, pepper, rubber and coconut.
- 5 HP pump is used to draw water.
- 63mm (2.5 inch) suction pipe with 50mm (2 inch) main distribution is used.
- The watering for farms is done about 2.5hr in a single shift around 50 to 60 liters/plant using jet spray.
- About 5 acres of land is watered from this check dam.
- Storage of water improved the vegetation of about 47.5 acres around this check dam.

2. Ekkadka (C2)

- Located near Perlampady (12°63'80.36" N,75°32'50.58" E), Sullia built across the stream
- Built using concrete with two layers of geomembrane and sand packing is done.
- The width of the check dam is about1.2m and length is about 12m with overall depth of 11ft.
- The water from the check dam is filled to nearby pond of 30ft width, 55ft length and 3.35 depth.
- Water is used for crops such as areca nut, banana, pepper, rubber, cocoa and coconut.
- 5 HP pump is used to draw water.
- 63mm suction pipe with 50mm main distribution is used.
- The watering for farms is done about 2 to 2.5hr in single shift around 50 to 60 liters/plant using jet spray.
- Storage of water improved the vegetation of about 42 acres around this check dam.

3. Balipaguli (C3)

- Located near Vitla (12°77'41.94" N,75°06'88.62" E) built across a river.
- Built using concrete along with shutters and no sand packing is done.
- The width of the check dam is about 1.2 and length is about 36.5m with overall depth of 3m.
- Water is used for crops such as arecanuts, banana, pepper, rubber and coconut.
- 5 HP pump is used to draw water.
- 63mm suction pipe with 50mm main distribution is used.
- The watering for farms is done about 2.5hr in single shift around 50 to 60liters/plant using jet spray and about 15liters/plant using drip irrigation.
- About 10 acres of land is watered from this check dam.
- Storage of water improved the vegetation of about 59.5 acres around this check dam.

4. **Kodangai** (C4)
- Located near Vitla (12°77'06.64" N,75°06'86.55" E) built across a river.
- Built using concrete along with steel shutters and no sand packing is done.
- The width of check dam is about 1.2m and length is about 36.5m with overall depth of 3.6m.
- Water is used for crops such as paddy, areca nut, banana, pepper, rubber and coconut.
- 5 HP pump is used to draw water.
- 76mm suction pipe with 50mm main distribution is used.
- The watering for farms is done about 2.5hr in single shift around 50 to 60 liters/plant using jet spray and about 15liters/plant using drip irrigation.
- About 8 acres of land is watered from this check dam.
- Storage of water improved the vegetation of about 116.5 acres around this check dam.

5.Kedila (C5)
- Located near Mura (a natural pond) (12°79'22.37" N,75°16'93.75" E).
- Water is used only for infiltration.
- Have the capacity of storing over a crore of liters.
- Storage of water improved the vegetation of about 210 acres around this check dam.

B. ARTIFICIAL PONDS

The following are the places that were selected for the ponds in Puttur taluk for soil sample collection and analysis.

1.Kodippady (A1)
- Located near Kabaka (12°76'08.31" N,75°16'55.35" E) , the pond is shown in Fig 4.
- Built at hilltop to get certain pressure head using geomembrane and geosynthetics.
- The width of this pond is about 25m, and its length is about 47.5m with overall depth of 7.92m with water holding capacity of 58 lakh liters.
- Water is used for crops such as arecanut, banana and coconut.
- Siphon method is used to draw the water.
- 76mm suction pipe with 50mm main and then distribution pipe of 19mm is used.
- The watering for farms is done about 2.5hr in single shift around 50 to 60liters/plant using jet spray and about 15liters/plant using drip irrigation.
- About 10 acres of land is watered from this pond and almost 55 lakh liters are used in dry season.
- About 50mm to 10mm is evaporated (10% of total volume).
- The pond is mainly used in dry season (March to June).

2.Thingalady (A2)
- Located near Kumbra, (12°72'06.45" N,75°25'93.45" E) the pond is shown in Fig 5.
- Built at hilltop to get certain pressure head using geomembrane and geosynthetics.
- The width of this pond is about 21.3m and length is about 44mwith overall depth of 7.62m with water holding capacity of 50 lakh liters.
- Water is used for crops such as arecanut, pepper, banana and coconut.
- A 5HP pump of 20000liters discharge is used to draw the water.
- 76mm suction pipe with 50mm main and then distribution pipe of 19mm is used.
- The watering for farms is done about 2.5hr in single shift around 50 to 60liters/plant using jet spray and about 15liters/plant using drip irrigation.
- About 13 acres of land is watered from this pond most of the water in the pond is used for watering in dry season for greater requirement another tank is built nearby.
- About 50mm to 10mm is evaporated (10% of total volume).
- The pond is mainly used in dry season (March to June).

3.Ekkadka (A3)

- Located near Perlampady (12°63'74.09" N,75°32'57.44" E), Puttur, Fig-6.
- Built at hilltop to get certain pressure head using geomembrane, geosynthetics and 200 grade polythene sheets of 3 layers.
- Width of this pond is about 21.3m and length is about 27.4m with overall depth of 3.65m with water holding capacity of 32lakh liters.
- Roof top water and borewell water are filled to the pond.
- Water is used for crops such as areca nut, pepper banana and coconut.
- Siphon method is used to draw the water.
- 162mm suction pipe with 50mm main and then distribution pipe of 19mm is used.
- The watering for farms is done about 2.5hr in a single shift about 15liters/plant using drip irrigation.
- About 6 acres of land is watered from this pond and almost 30 lakh liters are used in dry season for watering.
- About 50mm to 10mm is evaporated (10% of total volume).
- The pond is mainly used in dry season (March to June).

4.Bettampady (A4)

- Located near Puttur, (12°66'51.14" N,75°20'76.22" E) Fig 7.
- Built at hilltop to get certain pressure head using geomembrane and geosynthetics.
- The width of this pond is about 24.8m and its length is about 54.86m with overall depth of 5.25m with water holding capacity of 60 lakh liters.
- Water is used for crops such as areca nuts, bananas and coconut.
- Rainwater and nearby spring water fill the pond.
- Siphon method is used to draw the water.
- 76mm suction pipe with 50mm main and then distribution pipe of 19mm is used.
- The watering for farms is done about 2.5hr in a single shift with a 4mm diameter pipe about 15ltrs/plant using drip irrigation.
- About 12 acres of land is watered from this pond and about 55 lakh liters are used in dry season for watering.
- About 50mm to 10mm is evaporated (12% of total volume).
- The pond is mainly used in dry season (March to June).

Fig 5: Kodippadi artificial pond

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 16s, 2025
https://www.theaspd.com/ijes.php

Fig 6: Thingalady artificial pond

Fig 7: Ekkadka artificial pond

Fig 8: Bettampady artificial pond

IX. RESULTS AND DISSCUSIONS

After identifying required sites tests were conducted at check dams and artificial ponds analysis the results are shown below.

a) *Result of Core Cutter*

Table 4 Soil properties near check dams and artificial ponds

Check dams	**Water content (%)**	**Bulk density (gm/cc)**	**Dry density(gm/cc)**	**Permeability (cm/sec)**
Siddhamoole	10.81	1.77	1.5	$6.04*10^{-3}$
Ekkadka	18.63	1.79	1.52	$2.19*10^{-3}$
Kodangai	14.51	1.93	1.68	$6.32*10^{-3}$
Balippaguli	9.38	1.87	1.7	$3.44*10^{-3}$
Kedila	7.78	1.92	1.78	$2.74*10^{-3}$
Artificial ponds				
Kodippady	10.21	1.45	1.44	$2.36*10^{-3}$
Thingalady	13.00	1.94	1.712	$2.13*10^{-3}$
Ekkadka	14.51	1.89	1.65	$2.19*10^{-3}$
Bettampady	15.23	1.68	1.48	$2.40*10^{-3}$

From Table-4 we observed that dry density high in Kedila and Balippaguli has 1.78g/cc and 1.7g/cc respectively and low in Siddhamoole has 1.5g/cc. From this above table we observed that dry density high in Thingalady and Ekkadka has 1.712g/cc and 1.65g/cc respectively and low in Kodippady 1.44g/cc. From this result we observe that bulk density isan indicator of low soil porosity and soil compaction. Dry density depends upon the moisture content, beyond the optimum moisture content dry density value reduces. Siddamoole and Kodangai soil are more permeable compared to other sites.

Table-5 Results of wet sieve analysis near check dams and artificial ponds

Check dams	**% of gravel**	**% of sand**	**% of silt and clay**
Siddhamoole	14.65	76.62	8.73
Ekkadka	14.35	76.79	8.9
Kodangai	6.76	87.66	5.58
Balippaguli	18.59	72.49	8.92
Kedila	18.38	72.03	9.59
Artificial ponds			
Kodippady	6.72	87.45	5.83
Thingalady	14.35	76.79	8.9
Ekkadka	6.76	87.66	5.58
Bettampady	18.59	72.49	8.92

We observed that (Table-5), that Puttur Taluk has sandy soil and is considered poorly graded soil.

Infiltration values at check dams and artificial ponds were computed using Horton's equation.

Table- 6 Infiltration values near check dams and artificial ponds

Check dams	**Infiltration rate (cm/hr)**	
	Minimum	**Maximum**
Siddhamoole	38.18cm/hr	24.01cm/hr
Ekkadka	13.21cm/hr	6.01cm/hr
Kodangai	21.61cm/hr	9.61cm/hr
Balippaguli	25.21cm/hr	8.41cm/hr
Kedila	38.41cm/hr	14.41cm/hr
Artificial ponds		
Kodippady	15.61cm/hr	9.61cm/hr
Thingalady	25.21cm/hr	13.21cm/hr
Ekkadka	13.21cm/hr	6.01cm/hr
Bettampady	61.22cm/hr	40.82cm/hr

From Table-6 infiltration rates are higher in Bettampady, Kedila and Siddamoole.

X. CONCLUSIONS

Trend analysis of rainfall (Fig-1) revealed the ground water level in Puttur has decreased drastically from few years. As a result, water level in the well and the borewell have gone down.

- Puttur taluk has many streams where the water flows up to the month of Januaryto February. Constructing the check dams to these streams is one of the best traditional methods to recharge ground water. In other areas where streams of water are not available, the construction of an artificial pond is an artificial solution.
- Five potential sites where the check dams are already constructed were selected to study the effect of ground water recharge. From the soil test analysis and interaction with nearby people we can conclude that the variation of after level inthe bund will also increase the level of ground water in nearby wells and bore wells. As the groundwater level decrease infiltration value increases.
- Infiltration rate depends upon the saturation condition of the soil, and from wet sieve analysis it is observed that in Puttur Taluk Percentage of silt is more.
- Four sites with artificial ponds were selected to study the effect of storage of water on level of ground water table.

- The study reveals that the promotion of rainwater harvesting will decrease the dependency of people on ground water up to 40%. Overall investigation, experimental studies and analysis reveal that the promotion of check dams' help to slow down surface water flow and enhance infiltration capacity.

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