Research Paper Engineering

Study Of Infiltration Capacity At Anjar, Kutch

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ABSTRACT

Infiltration is a hydrological phenomena occurring in nature. It is nonlinear and complicated process. The present study is an attempt to analyses the infiltration capacity of soil in study area in ANJAR KUTCH. This report discuss the infiltration process, factors affecting it, various method used for calculating infiltration rate by carrying out the experimental work at 18 sites in ANJAR KUTCH using the Double Ring infiltrometer.

The infiltration capacity can be calculated by various methods like General hydrologic budget, Green-Ampt, Kostiakov equation, Horton's equation, Darcy's law. The infiltration capacity at various sites has been calculated using Horton's method calculating the constant value k which helps in finding out infiltration capacity at various sites. The result and analysis it has been observed that the Infiltration rate is been affected due to change in soil types.

The value of k ranges from 0.3544 to 0.6576 and most of values are between 0.4 to 0.7 at various sites in ANJAR KUTCH depending on soil characteristics. By using the value of k contour maps is made which helps in finding the value of k directly on particular sites and thus helps in finding infiltration capacity of soil.

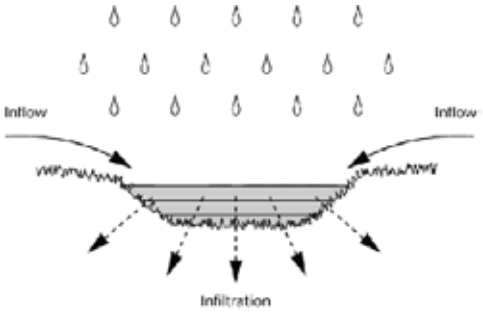
Keywords :

I. Introduction

Infiltration is the process by which water on the ground surface enters the soil. Infiltration rate in soil science is a measure of the rate at which soil is able to absorb rainfall or irrigation. It is measured in inches per hour or millimeters per hour. The rate decreases as the soil becomes saturated. If the precipitation rate exceeds the infiltration rate, runoff will usually occur unless there is some physical barrier. It is related to the saturated hydraulic conductivity of the near-surface soil. The rate of infiltration can be measured using an infiltrometer. Infiltration is governed by two forces: gravity and capillary action. While smaller pores offer greater resistance to gravity, very small pores pull water through capillary action in addition to and even against the force of gravity.

The rate of infiltration is affected by soil characteristics including ease of entry, storage capacity, and transmission rate through the soil. The soil texture and structure, vegetation types and cover, water content of the soil, soil temperature, and rainfall intensity all play a role in controlling infiltration rate and capacity. For example, coarse-grained sandy soils have large spaces between each grain and allow water to infiltrate quickly. Vegetation creates more porous soils by both protecting the soil from pounding rainfall, which can close natural gaps between soil particles, and loosening soil through root action. This is why forested areas have the highest infiltration rates of any vegetative types. The top layer of leaf litter that is not decomposed protects the soil from the pounding action of rain, without this the soil can become far less permeable. In some vegetated areas, the hydrophobic soils in the succulent leaves can be spread over the soil surface with fire, creating large areas of hydrophobic soil. Other conditions that can lower infiltration rates or block them include dry plant litter that resists re-wetting, or frost. If soil is saturated at the time of an intense freezing period, the soil can become a concrete frost on which almost no infiltration would occur. Over an entire watershed, there are likely to be gaps in the concrete frost or hydrophobic soil where water can infiltrate.

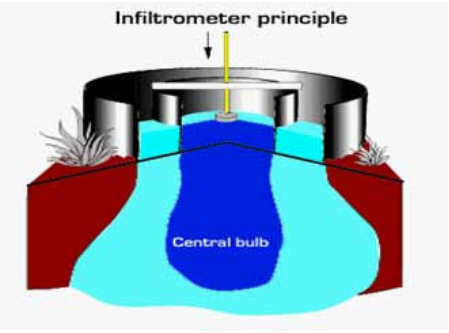
Once water has infiltrated the soil it remains in the soil, percolates down to the ground water table, or becomes part of the subsurface runoff process.



The process of infiltration can continue only if there is room available for additional water at the soil surface. The available volume for additional water in the soil depends on the porosity of the soil and the rate at which previously infiltrated water can move away from the surface through the soil. The maximum rate that water can enter a soil in a given condition is the infiltration capacity. If the arrival of the water at the soil surface is less than the infiltration capacity, all of the water will infiltrate. If rainfall intensity at the soil surface occurs at a rate that exceeds the infiltration capacity, ponding begins and is followed by runoff over the ground surface, once depression storage is filled. This runoff is called Horton overland flow. The entire hydrologic system of a watershed is sometimes analyzed using hydrology transport models, mathematical models that consider infiltration, runoff and channel flow to predict river flow rates and stream water quality. Infiltrometer The double ring infiltrometer is a way of measuring saturated hydraulic conductivity of the surface layer, and consists of an inner and outer ring inserted into the ground. Each ring is supplied with a constant head of water either manually or from mariotte bottles. Hydraulic conductivity can be estimated for the soil when the water flow rate in the inner ring is at a steady state.

It works by directing water onto a known surface area due to the parameters of the inner ring. The rate of infiltration is determined by the amount of water that infiltrates into the soils per surface area, per unit of time. Infiltration can be measured

by either a single or double ring infiltrometer, with preference usually lying with the double ring because the outer ring helps in reducing the error that may result from lateral flow in the soil. The outer ring virtually turns a 3D single ringed system of looking at infiltration into a one dimensional model by allowing water in the centre ring to flow nearly exclusively straight down. This allows much easier calculation by taking out the need to account for lateral flow.



NEED OF THE PRESENT STUDY

The rate of infiltration is affected by soil characteristics including entry, storage capacity and the transmission through the soil. The Soil texture and structure, vegetation types and cover, water content of soil, soil temperature and rainfall intensity all play a role in detecting infiltration rate and capacity. For example, coarse-grained sandy soils have large space between each grain and allow water to infiltrate quickly. Vegetation creates more porous soils by both protecting the soil from ponding rainfall, which can close natural gaps between soil particles, and loosening soil through root action. That is why the urban area have low infiltration rate is less due to less vegetation. .

OBJECTIVES OF THE STUDY

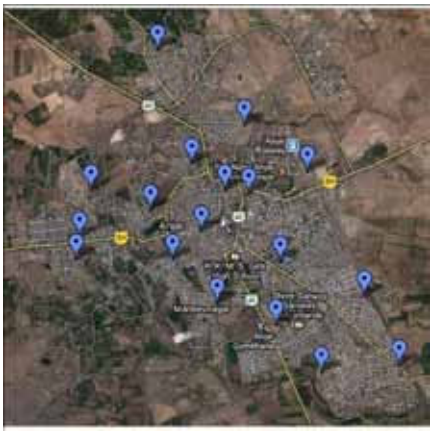
The objectives of this study are as below:

1. To evaluate the rate of infiltration by using Double Ring Infiltrometer.
2. To evaluate value of constant k in Horton's equation.

SCOPE OF THE STUDY

Infiltration rates were estimated at 20 sites in the Anjar kutch. Contour maps and graph of the distance versus Horton's constant k were generated for all the sites. Horton's equation was used in estimating the rate of infiltration at various sites having different soil characteristics. An average value of constant k in Horton's method gives the infiltration capacity at various sites in west zone of Anjar,kutch.

3 STUDY AREA



Varies location of Anjar city like Near khodiyar temple,Railway colony,busstation,Anjar library,Anjar nagar seva sadan,Vijay nagar.

DATA COLLECTION

soil data

METHOD:

Horton's equation : Horton's equation is another viable option when measuring ground infiltration rates or volumes. It is an empirical formula that says that infiltration starts at a constant rate, f0, and is decreasing exponentially with time, t. After some time when the soil saturation level reaches a certain value, the rate of infiltration will level off to the rate fc.

$$f_t = f_c + (f_0 - f_c)e^{-kt} \quad \text{.....(3.5)}$$

Where

- ft is the infiltration rate at time t;
- f0 is the initial infiltration rate or maximum infiltration rate;
- fc is the constant or equilibrium infiltration rate after the soil has been saturated or minimum infiltration rate;
- k is the decay constant specific to the soil.

Conclusion

The rate of infiltration is affected by soil characteristics including entry, storage capacity and the transmission through the soil. There are various methods used for finding the infiltration capacity of the soil like General hydrologic budget, Green-Ampt, Kostiakov equation, Horton's equation, Darcy's law. From various method mentioned above Horton's method we can easily calculate the infiltration capacity of the soil by doing field experimental method at 18 sites in the Anjar kutch. In Anjar kutch, most of sites have black cotton soil. Therefore, rate of the infiltration is not constant at all sites. but rate of infiltration is not affected as there is no continues change in soil types.

The Present study can be useful in rainfall-runoff modelling, design of storm water drainage system, flood analysis and other hydrological processes.

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