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A Study on the Rate of Soil Infiltration in Karkala Municipal Area

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Abstract

Infiltration is the rate at which water can enter into a soil, in our project we have used double ring infiltrometer. It consists an inner and outer ring. The main purpose is to create a one-dimensional flow of water from the inner ring. If water is flowing in 1-D at steady condition and a unit gradient is present in the underlying soil, the infiltration rate is approximately equal to the saturated hydraulic conductivity of the soil. An inner ring is driven into the ground, and outer ring driven to help control the flow of water through the first ring. Water is supplied either with a constant or falling head condition, and the operator need to records how much water infiltrates from the inner ring into the soil over a given time period. Soil samples were collected from agricultural lands of Karkala region and Nitte, and tested for basic soil properties such as specific gravity, dry density, moisture content, coefficient of permeability and percentage of clay and silt of the soil.

To determine the presence of Nitrogen (N), Phosphorus (P) and Potassium (K) of soil optical transducers are used. Such transducer is useful to decide how much extra contents of these nutrients are added to the soil to increase fertility of the soil. This can improve the quality of soil and reduces the undesired use of fertilizers to be added. The N, P and K value of the sample are determined by absorption light of each nutrient.

***Keywords-:** Infiltration, Double ring infiltrometer, N P K, Optical transducer etc.*

INTRODUCTION

Infiltration refers to the entry downward movement of water in to soil surface. The infiltration rate is the velocity at which water enters into the soil strata. It is usually measured by the depth (in cm) of the water layer that can enter the soil in given time. To measure the rate of infiltration several methods are adopted, which gives information of surface hydraulic properties of soil. To measure the hydraulic properties of soil and rate of soil infiltration several methods are adopted to know the value of drain ability, Hydraulic conductivity and their relation with capillary pressure. Infiltration will be quantified using soil infiltrability and cumulative infiltration. Soil infiltrability is an indicator of ability of soil to allow water movement through the soil profile. Total amount of water that soil profiles are able to absorb from rainfall or irrigation in a given time is considered as a cumulative infiltration. The relation between these two are given as

$i = dI/dt$

where:

i - infiltration rate (cm/hr)

I – cumulative infiltration (cm)

t – time Soil infiltrability is determined by potential slope of surface (hr)

It is affected by time, structure and texture of soil, initial moisture content, soil type, soil surface cover, intensity of rain etc. The N, P, K (Nitrogen, Phosphorous, Potassium) are essential for plants and crops. Excessive use of fertilizer may result in failure or poor-quality output. Soil requires 16 kinds of essential elements for complete its life cycle. In those 16 elements N, P, K are most important because it is required plant development. Nitrogen is major requirement of chlorophyll. These elements are required at optimum level for proper plant growth. The value of N, P, K of soil is determined using available sensors such as optical sensors etc. The test is performed using solution of soil by light colours. The light is reflected from solution is received by optical fibre, then converted into electrical signals. This helps in finding the lack of nutrient in soil.

LEDs are used as light source for soil solution. The remaining lights are absorbed by photo diode. The optical transducer absorbs the N, P, K quantity and rate them as high, medium & low. Soil water mainly depends on groundwater and soil infiltration. Decayed or live root creates the path to flow. It is essential to know the information of effect of decayed root on

infiltration process and soil moisture. Rapid urbanization, industrialization and population growth demands more water in scale. India faced high scarcity of water from past few decades ground water comprises of 3 factors namely, inflow, outflow and change in storage of ground water. These 3 factors should be balanced properly. Infiltration is affected by soil characteristics and external factors.

The infiltration rate and soil moisture are developing due to interaction between them. The relationship is soil moisture is inversely proportional to the infiltration rate. The main objective of this study to analyse the infiltration rate of site to check the suitability of the soil for agriculture. Also, to determine the soil properties and to evaluate the percentage of NPK present in the soil.

In our study we have used double ring infiltrometer test which is more realistic method to determine the rate of infiltration of the site selected compared to the single ring infiltrometer. It avoids lateral flow of water and also give accurate value of infiltration of sites.

Site Selected

The region selected to conduct the project works are near Karkala i.e., at Nitte village, Joduras the and Hirgana near agriculture lands. The type of soil that is present in the region of study is Sandy Clay Loam. Following figure shows the soil map of study area. The purpose of selecting these sites because these areas are near to the Karkala city i.e., 5-10km from the centre of the city also its located near to the coastal region.

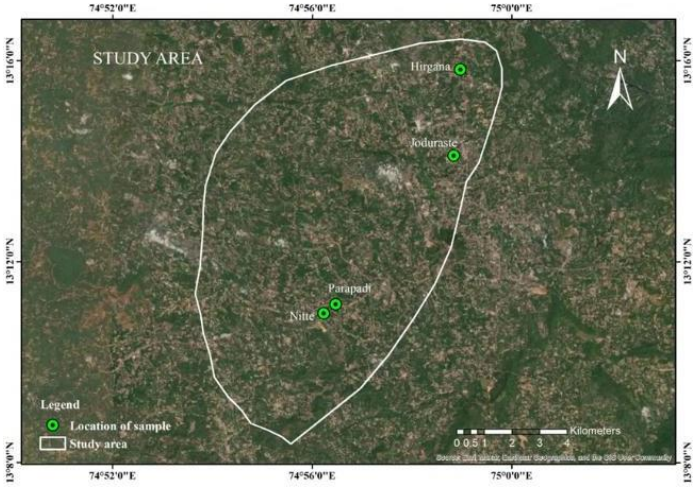

Fig 1.1 Study area

METHODOLOGY

At first, we need to carry field data and samples of soil of each location. Then at the same time for collected samples nitrogen, phosphorous and potassium content is calculated. After performing the basic soil properties test was done on selected location to determine Moisture content, Grain size, Bulk density, Clay& silt content of the soil and permeability of soil. The double ring infiltrometer test has been carried out on selected locations. This process is done for both pre monsoon and post monsoon seasons. After the results were found were compared and concluded.

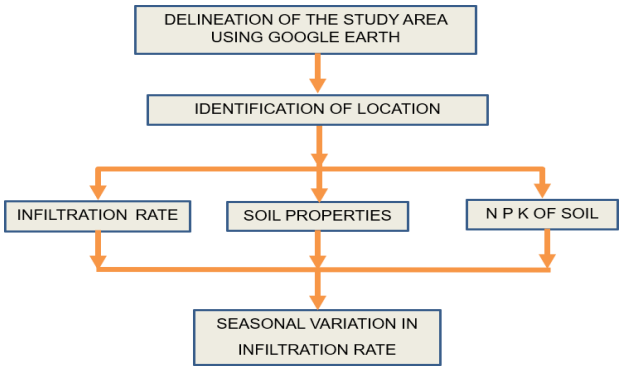

Fig 2.1 Methodology

Double Ring Infiltrometer Test:

Equipment

Two cylindrical rings one with 30cm and another with 45cm diameter, Metal hammer to drive the rings inside soil, measuring jar, bucket, stopwatch and measuring rod or scale.

Site Preparation

Prepare a level testing area at the bottom elevation of the proposed infiltration facility. Set outer ring in place and drive ring a minimum of 15cm into the soil. Set inner ring in centre of outer ring and drive ring a minimum of 15cm into the soil.

Testing Procedure

Hammer the 30 cm diameter ring at least 15 cm into the soil. Drive the measuring rod into the soil so that approximately 12 cm is left above the ground. Drive the 45 cm ring into the soil or construct an earth bund around the 30 cm ring to protect the soil surface when pouring in the water.Start the test by pouring water into the ring until the depth is 7-10 cm. The water in the two rings is to prevent a lateral spread of water from the infiltrometer. Record the time

when the test begins and note down water level on the measuring rod. Record the time when the test begins and note down water level on the measuring rod. After 5 minutes, record the drop in water level in the inner ring on the measuring rod in inner cylinder. Record the water level and maintain the water level similar on both rings. Continue the test until the water level is the same over the same time interval.

RESULTS

Result of infiltration rate:

Sample	F_0	F_C	Time (hours) T	$K= (F_0 – F_C)/T$
1	29.2	10.2	7	2.71
2	28.5	3.6	6	4.15
3	28.8	4.1	7	3.53
4	30	6.3	7	3.39

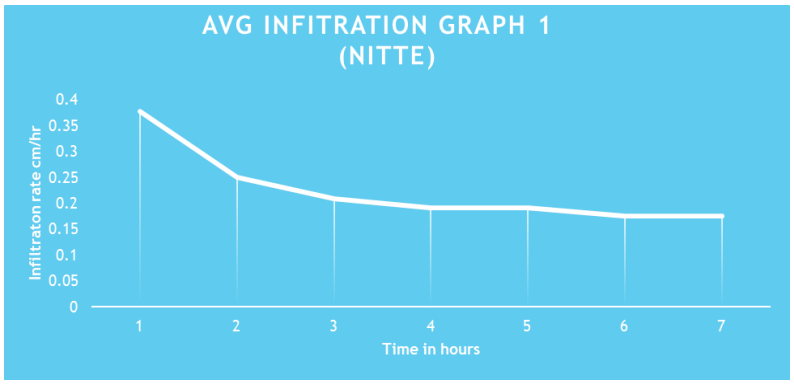

Fig. 3.1.1 Double Ring Infiltrometer Graph 1

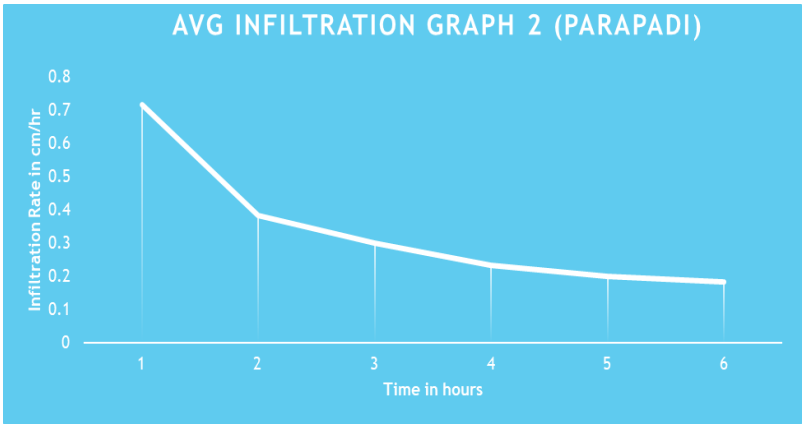

Fig.3.1.2 Double Ring Infiltrometer Graph 2

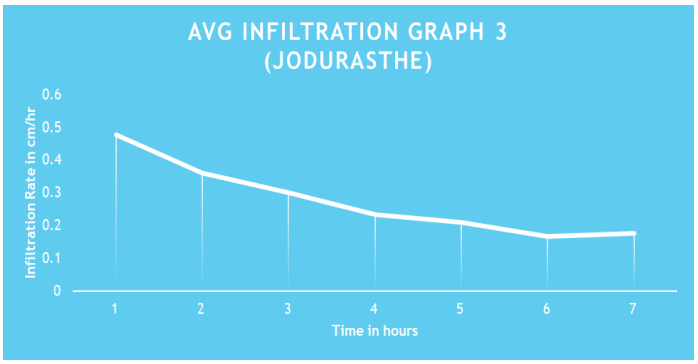

Fig..3.1.3 Double Ring Infiltrometer Graph 3

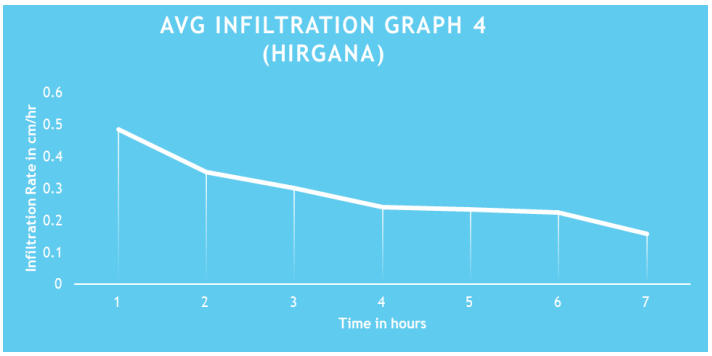

Fig.3.1.4 Double Ring Infiltrometer Graph 4

Results of NPK Test

Nitrogen Content

Sample	Longitude	Latitude	Test value in (kg/ha)	Rating
1	74.9371348	13.182808	573.64	High
2	74.9411534	13.1858534	593.53	High
3	74.9806025	13.2352137	433.3	Medium
4	74.9827938	13.263768	595.36	High

Phosphorus Content

Sample	Longitude	Latitude	Test value in (kg/ha)	Rating
1	74.9371348	13.182808	419.70	Medium
2	74.9411534	13.1858534	388.62	Medium
3	74.9806025	13.2352137	180.98	Low
4	74.9827938	13.263768	144.94	Low

Potassium Content

Sample	Longitude	Latitude	Test value in (kg/ha)	Rating
1	74.9371348	13.182808	130.32	Medium
2	74.9411534	13.1858534	136.84	Medium
3	74.9806025	13.2352137	52.13	Low
4	74.9827938	13.263768	131.63	Medium

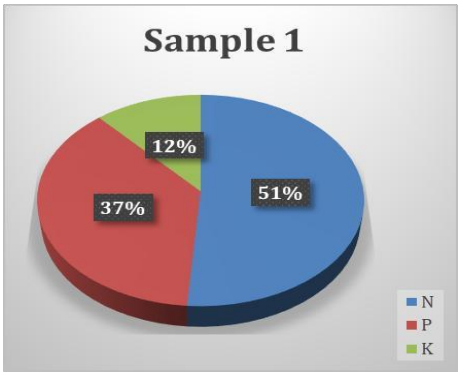

Fig. 3.2.1 NPK content of sample 1

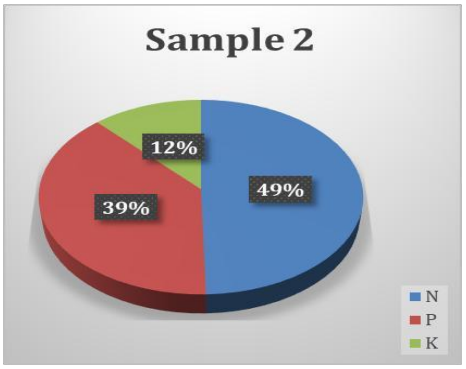

Fig. 3.2.2 NPK content of sample 2

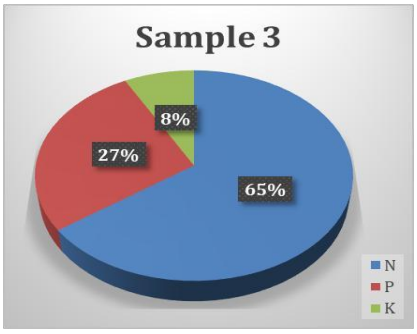

Fig. 3.2.3 NPK content of sample 3

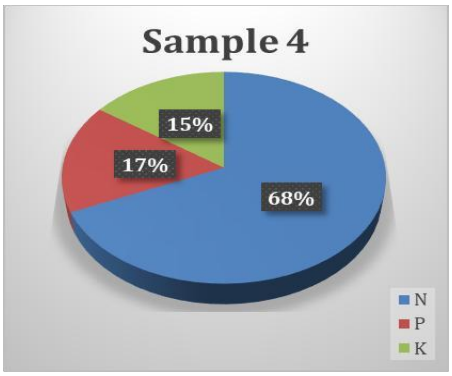

Fig. 3.2.4 NPK content of sample 4

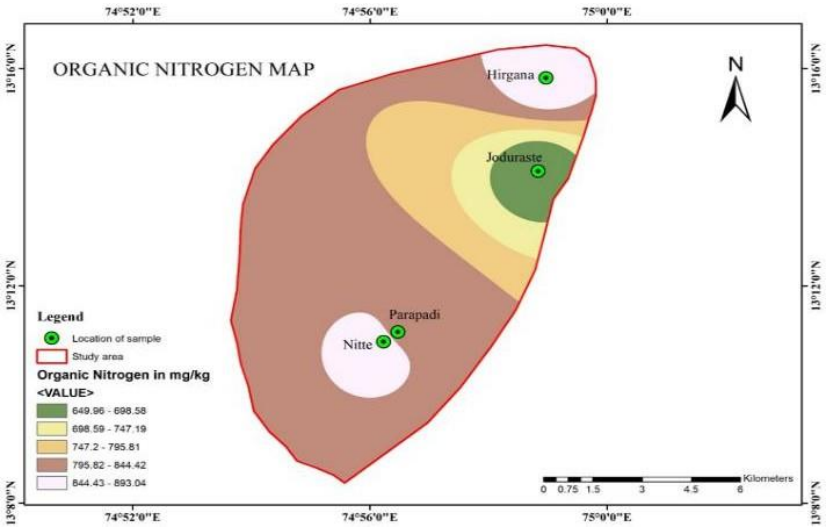

Fig.3.2.5 Nitrogen content

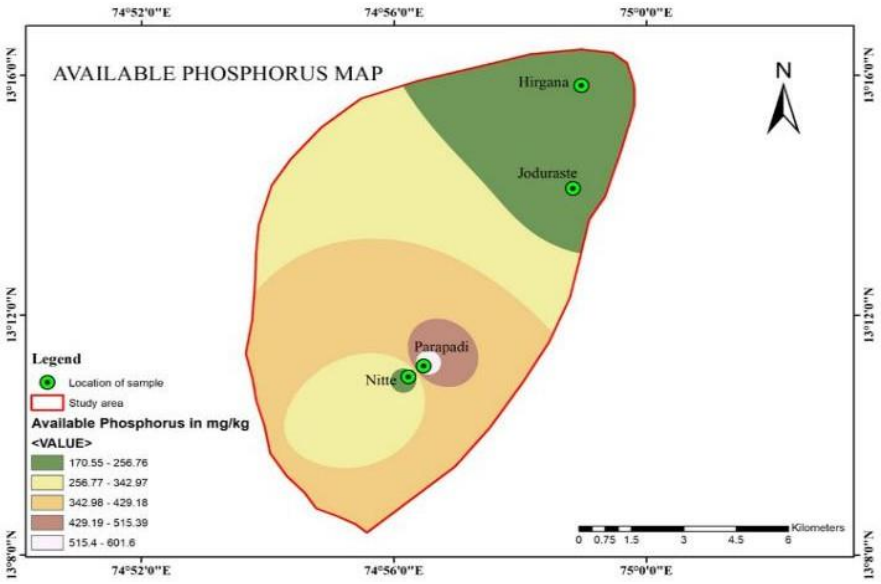

Fig.3.2.6 Phosphorus content

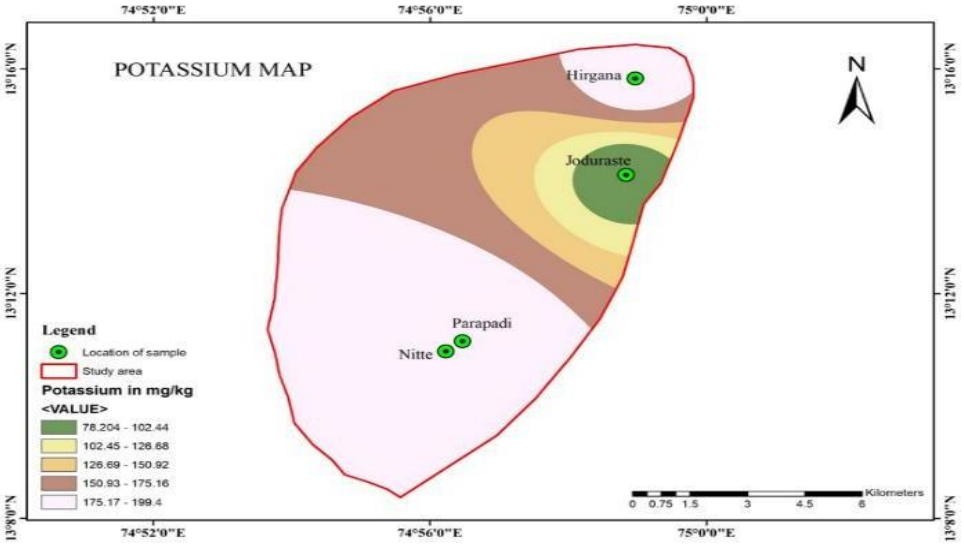

Fig.3.2.7 Potassium content

Result of other parameters:

Parameter tested	Sample 1	Sample 2	Sample 3	Sample 4
pH (20% solution)	5.2	4.18	6.02	4.51
Salinity (g/kg)	0.45	0.2	0.15	0.25
TDS (g/kg)	0.327	0.14	0.1	0.185
Electrical conductivity	151	64.8	46.3	85.3
Soil organic matter (%) (g/100g)	0.906	1.523	0.276	1.621
Soil carbon matters (%) (g/100g)	0.525	0.883	0.16	0.94
Total magnesium (mg/kg)	66.04 ± 0.4	65.66 ±0.52	595.06 ±0.72	927.77 ±1.2
Total calcium (mg/kg)	800 ± 0	1000 ± 0	1620 ± 0	860 ± 0
Iron (mg/kg)	3.08 ± 0.03	2.98 ± 0.01	16.98± 0.1	3.73 ± 0.05
Sulfate (mg/kg)	152.79 ± 0.4	76.39 ± 0.32	103.13 ± 0.38	114.59 ± 0.43

CONCLUSION

By this project we conclude that:

- On comparing hydrometer values, infiltration rate and results of the basic tests for all four locations we can say that the sites are suitable for agriculture.

- By these results of infiltrometer test we can conclude that all soils have good infiltration rate that is greater than 1.5cm/hr.
- NPK test was carried out to determine nutrient content in the soil according to the standard values and it was found that the nitrogen content for all the four samples is moderately high.
- From our study we suggest that all four soil samples are suitable for agriculture and will give good yield by treating the soil.

FUTURE SCOPE

- The project has achieved objectives of the pre-monsoon data of the four sites. The collection of samples and analysis of the samples are done in this project period.
- Post-monsoon data can be collected and compared to check the infiltration rate.
- Comparing both the pre-monsoon and post monsoon data analysis will completes the project.

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