CS(AR)-32/98-99

REPRESENTATIVE BASIN STUDIES: HYDROLOGICAL SOIL CLASSIFICATION OF SUDDAGEDDA BASIN, ANDHRA PRADESH

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INDIA
1998-99

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ABSTRACT

Hydrological soil classification at Suddagedda basin of Andhra Pradesh has been made based on field and laboratory experiments on the soil samples. Hydraulic conductivity of the soil in the basin has been determined using Guelph permeameter at two depths at various sites (17 sites). The contour map of the field saturated hydraulic conductivity is presented in the report. To facilitate inter-comparison, the reported values of infiltration at the corresponding sites in the basin are also presented. Soil properties together with other information have been presented and the basin soil has been grouped into different hydrological soil groups. The findings of the study can be used as a reference for hydrological studies that may be done in future. The study was conducted as a part of the representative basin studies of the Deltaic Regional Centre, Kakinada of National Institute of Hydrology.

Chapter 1

Introduction

People are dependent on soil, and conversely, good soils are dependant on people and the use they make of the land. Soils are the natural bodies in which plants grow. They provide the strategic point for successful agriculture. Most great civilizations have depended on good soils. The ancient dynasties of the 'Nile' were made by food-productivity capacity of the fertile soils of the river valley and its irrigation systems. Likewise, fertile valley soils of the Tigris and Euphrates rivers in Mesopotamia and of the Indus etc. were sites flourishing civilizations.

Soil productivity helps to determine how much food and fiber can be provided for the world's ever-increasing human population. Some soils are naturally productive, while some are not. Some respond to wise cultural management and can be made more productive. Some will not respond so and could best be left in their native state with natural grass or forest vegetation. In many cases, however, without some knowledge of the nature and properties of soils, it is not possible to predict soil quality in a given area or to know how soils should be managed and conserved.

Physical properties of soils such as texture, structure, capacity to retain and transmit water are some of the properties, which are important from a hydrologist's point of view, apart from its chemical properties. The soil, located at atmosphere-lithosphere interface, plays an important role in determining the amount of precipitation that runs off the land and the amount that enters the soil for storage and for future use. Soils play a key role in water retention and storage. Water movement in soils occurs as a liquid flow in saturated soils, and as a liquid and vapor flow in unsaturated soils.

In this report, an attempt has been made to present the properties of soil, with emphasis on systematic determination of the hydrologic soil properties of Suddagedda Basin, Andhra Pradesh, India (a representative basin adopted by National Institute of

Hydrology, Deltaic Regional Centre, Kakinada). The properties, such as saturated hydraulic conductivity and infiltration, were determined and soil classification through grain size distribution analysis was carried out. Based on the hydrological properties, the soil in the basin has been classified into hydrological soil groups.

Chapter 2

Study area

The Deltaic Regional Centre of National Institute of Hydrology, Kakinada has selected Suddagedda basin in Andhra Pradesh to conduct various hydrological studies and the basin has been identified as representative of medium size basins in the hydrological region. The centre is conducting intensive hydrological investigations since adoption of the basin. The basin lies between latitudes 17^0 14' 00" and 17^0 36' 10"N and longitudes 82^0 08'30" and 82^0 18'15"E. The study area is demarcated by the 700m and 20m contours, sloping towards south-southeast. The total catchment area is 658.3 sq.km up to river mouth. The location of the basin (index map) is shown in Fig.1.

2.1 Drainage

The stream origins at Vatangi reserved forest area in Rajavommangi mandal of East Godavari Dist., Andhra Pradesh at an elevation 700m and flows southward and is joined many rivulets on its way near Gokavaram where a reservoir called Subbareddy Sagar is formed. Further, traveling southwards it is joined on its left bank by Konda Kalva near Tatiparthi village and is called 'Suddagedda River'. The drainage pattern in the basin is denditric in the upstream of the basin. However, the drainage pattern is not clear in the downstream side. Being plain terrain (coastal zone) the exact demarcation of catchment boundary is very difficult. The drainage network map of the basin upto Gollaprolu is shown in Figure 2. But with limited field verifications the catchment area up to Gollaprolu is measured as 337 Sq.km.

2.2 Hydrogeology

Khondalites, Granites and Charnokites underlie a major portion of the basin. The central and western parts of the basin is underlain by alluvium. The southern part of the basin is underlain by Khondalite schite for rocks, basaltic formation of Tirupathi sandstones. Groundwater in the crystalline rock is restricted to weathered and fractured zones and is being exploited mostly by dugwells, dug-cum borewells (SGWD,1993).

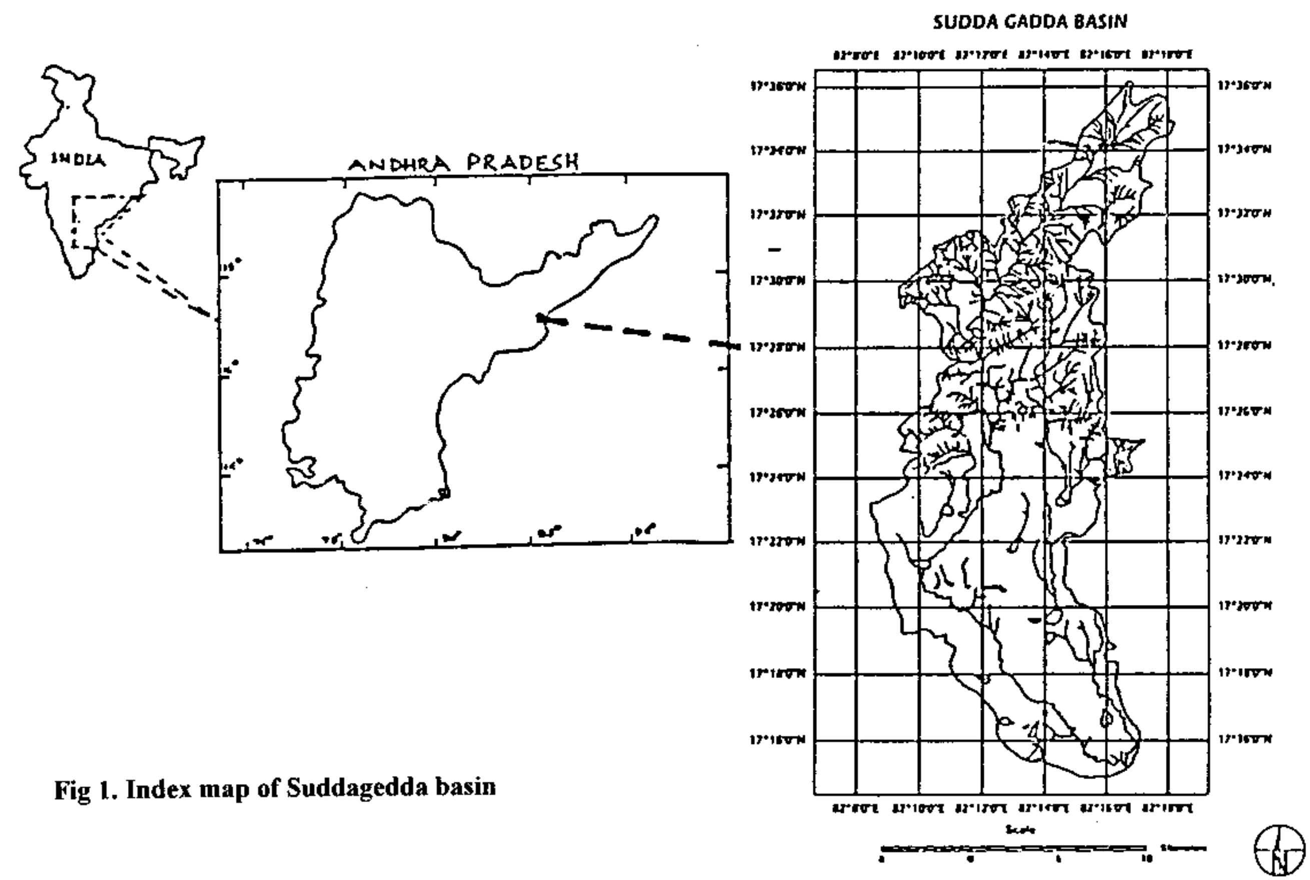

Fig 1. Index map of Suddagedda basin

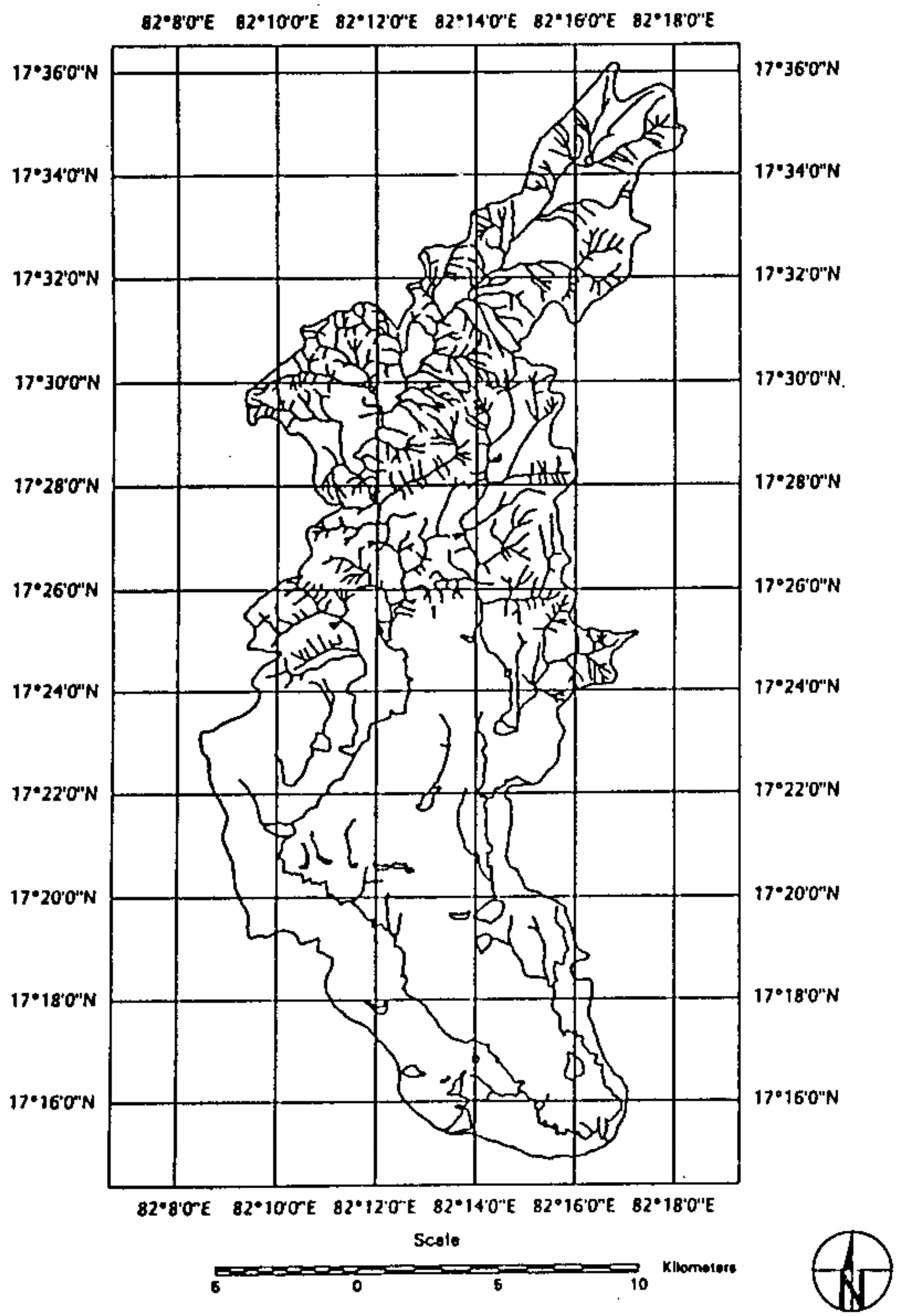

Fig 2. The drainage network map of Suddagedda basin upto Gollaprolu

2.3 Soil and Land use

The predominant soils in the basin are black clay, red and light brown red soils. Towards the northern part of the basin, red soils are predominant in the hilly tracts and valley portions wherein the middle part of the basin light brown soils and towards southern part black soils are predominant. The main crops are paddy, banana, sugarcane, chilies and cotton. The total area irrigated under surface water sources is 6981 hectares, out of which an extent of 1758 hectares is under minor irrigation tanks (SGWD,1993). The upstream of the basin mainly consists of forest cover.

2.4 Climate

The basin area comes under tropical climate with hot summers and light winters. The major portion, about 80%, of the rainfall is received during monsoon season (June to November). The region experiences four distinct seasons of climate viz. winter (December-February), hot weather or summer season (March-May), southwest monsoon seasons (June-September) and northeast monsoon seasons (October-November). May is the hottest month with maximum daily temperature touching about 40^0C. The minimum temperature to the tune of 15^0C is observed in the month of December.

Chapter 3

Field and Laboratory Investigations

To determine various soil parameters for hydrological soil properties, field and laboratory investigations were carried out. The testing points for field investigations were selected based on the soil map and topographical maps. The soil samples were collected from these points for later analysis in the laboratory.

3.1 Hydraulic Conductivity Studies

Hydraulic conductivity is the measure of the ability of a soil to conduct water under a unit hydraulic gradient. Field saturated hydraulic conductivity (Kfs) refers to the saturated hydraulic conductivity of soil containing entrapped air. Field saturated hydraulic conductivity is more appropriate than the truly saturated hydraulic conductivity for unsaturated zone investigations because by definition, positive pressure heads do not persist in unsaturated conditions long enough for entrapped air to dissolve. In the presence of the water table, the auger hole method is a simple and reliable technique for measuring hydraulic conductivity in relatively uniform soils. However this method cannot be used if the water table is not present in the region of interest. The methods for measuring hydraulic conductivity in the absence of the water table are more complicated. The shallow well permeameter method, also known as the dry auger hole method and the bore hole permeameter method are the techniques for measuring hydraulic conductivity. Hydraulic conductivity decreased as the soil water suction increases. This relationship is called the conductivity pressure head relationship. The Guelph permeameter is used to determine Kfs for a particular soil. Once the soil water suction is measured, the hydraulic conductivity (K) at that soil water suction (φ) can be readily estimated by relationship.

$$K = Kfs(e\alpha * \varphi)$$

where

α = Alpha is a parameter indicating slope of the curve relating natural log of K to φ

φ = Soil water suction in cm of water

e = 2.71828 (base of natural logarithm)

Kfs = saturated hydraulic conductivity of the soil

Guelph permeameter can measure matrix flux potential (ϕm) which is the measure of a soil's ability to pull water by capillary force through a unit cross sectional area in a unit time. The matrix flux potential (ϕm) in sq.cm /sec is given by following relationship.

$$\phi_m = 0.0572 * X * R1 - 0.0237 * X * R2$$

Alpha parameter (α) is the slope of the curve relating the natural log of hydraulic conductivity (K) to soil water suction in per cm expressed by following relationship.

$$\alpha = Kf_s / \phi_m$$

3.1.1 Guelph permeameter apparatus

The Guelph permeameter is essentially an "in hole" Mariotte bottle constructed of concentric transparent plastic tubes. The apparatus comprises the following sections. The two models of Guelph permeameter can be referred in Shukla and Soni (1993). The sketch of the apparatus is depicted in Fig 3.

(i) Tripod Assembly
(ii) Support Tubes and lower air tube fittings
(iii) Reservoir Assembly
(iv) Well head Scale and upper air tube fittings
(v) Auxiliary tools

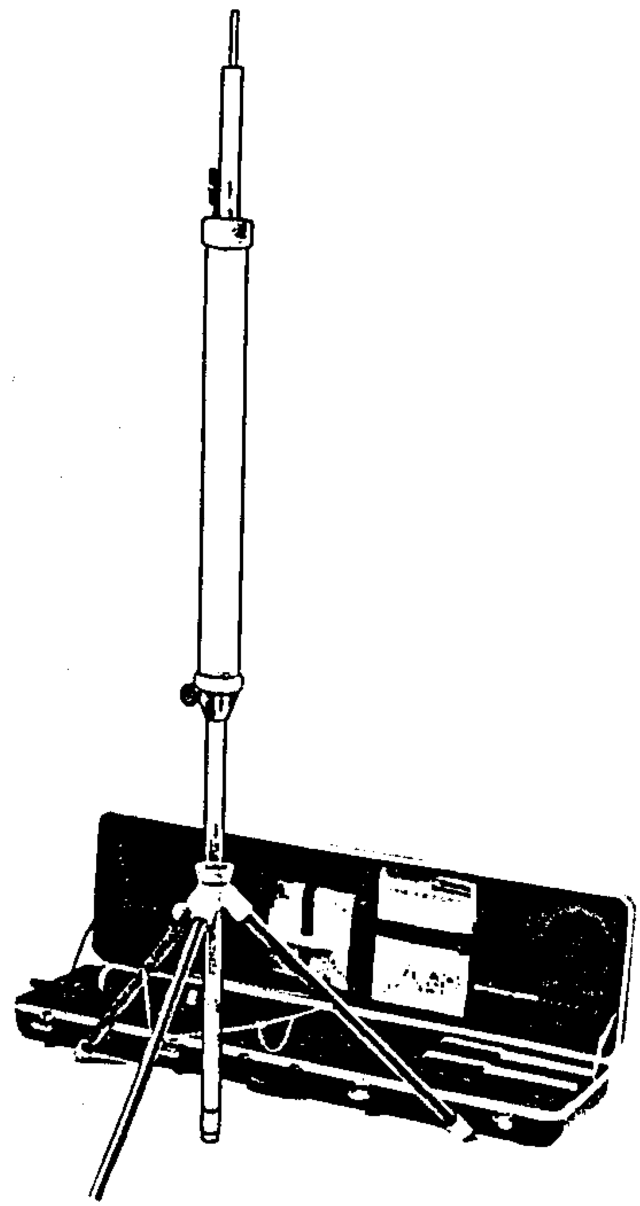

Fig 3. The sketch of the Guelph permeameter apparatus

3.1.1.1 Tripod assembly

The tripod assembly consists of a tripod based with movable tripod rushing and three detachable tripod legs complete with end tips. The flexible tripod base has three leg sockets into which the tripod legs are inserted. Tripod chain is used for firm placement and support of tripod legs.

3.1.1.2 Support tube and lower air tube fittings

These are the fittings, which conduct water from the reservoir assembly into the well hole and provide the means for establishing and maintaining a constant head in the well hole. The support tube supports the reservoir assembly, over the well hole and transports water from the reservoir to the water outlet. The water outlet tip serves as a base for the permeameter and disperses the energy of the out flowing water through the ribbed vents at the bottom to the tip to minimise erosion of the soil in the well hole. The air tip-seating washer rests on the inside step of the water outlet tip and is the seat for the air inlet tip. When the inlet is fully seated against the air tip-seating washer, air cannot move up through the support tube and there is no flow of water out of the reservoir. The air inlet tip is connected to the bottom of the lower air tube and is used to regulate the wellhead height. The air restriction washer is located inside the air inlet tip and regulates air flow to provide a constant, non fluctuating head in the well.

3.1.1.3 Reservoir assembly

The reservoir assembly provides a means of storing water and measuring the outflow rate while the Guelph permeameter is in use. It consists of inner reservoir tube, outer reservoir tube, reservoir valve base and reservoir cap. For studies in very low permeability soils, for example clay soil, use of the inner reservoir alone is required to provide adequate outflow rate. When working in moderate to high permeable solid, for example sands and loamy solid, the reservoir combination is used. The inner reservoir tube is graduated in centimeters for measuring the rate of fall of water out of the reservoir in both situations. The Guelph permeameter shows the closed or sealed state with air inlet tip sealed against air tip sealing washer. When air tube is uplifted, with accompanying air inlet tip and well height indicator, water flows from the reservoir down the inside of the support tube through the water outlet tip and into the well. The water height in the well is established by the height of the air inlet tip. This water height in the well can be set and read using well height indicator in conjunction with the well head scale.

The reservoir base includes the reservoir valve. The base connects and seats the inner and outer reservoir tubes to the support tube. Water flow is controlled by the position of the reservoir valve. When the valve position is up, both reservoirs supply water to the well hole. When it is pointing straight down, only the inner reservoir supplies water to the well hole. The reservoir cap provides an airtight cover for the top of the reservoir, the seal of the air tube and supports the well head scale. The middle air tube is located inside the inner reservoir tube. Two ports are located in the reservoir cap namely Fill port and Fill plug. The vacuum port consists of a Access tube, Neoprene tube and clamping ring. The vacuum port facilitates pulling a vacuum when the reservoirs are not initially completely filled.

3.1.1.4 Well head scale and upper air fittings

The upper air tube is connected to be Middle air tube with air tube couplings. It serves as an extension to facilitate the setting of the well head after the well head scale is put in place.

3.1.1.5 Auxiliary tools

The Guelph permeameter kit includes a soil auger for excavating a well, a sizing auger, a well peep brush, a vacuum hand pump for filling a vacuum in the reservoir and collapsible water container for carrying water to the field. The well peep brush meant for removing any smear layer that exists in the augured well hole that may create a barrier to the natural flow of water out of the well into surrounding wall.

3.1.2 Experiment procedure

The Guelph permeameter method (Reynold et. al., 1985) measures steady state liquid recharge necessary to maintain a constant depth of liquid in an uncaged cylindrical well finished above the water table. Constant head level in the well hole is established and maintained by regulating the level of the bottom of the air tube which is located in the centre of the permeameter. As the water level in the reservoir falls, a vacuum is created in the air space above water. When the permeameter is operating, equilibrium is established. The reduced pressure in the air above the water in the reservoir together with the pressure of the water column extending from the surface of the well to the surface of the water in the reservoir, is always equal to the atmospheric pressure.

When a constant well height of water is established in a cored hole in a soil, a bulb of saturated soil with specific dimension is rather quickly established. The bulb is very stable and its shape depends on the type of soil, the radius of the well and the head of water in the well. The shape of the bulb is numerically described by the C factor used in the calculations. Once the bulb shape is established, the outflow of water from the well reaches a steady state flow rate, which can be measured. The rate of this constant outflow of water, together with the diameter of the well and height of water in the well can be used to determine the field saturated hydraulic conductivity of the soil.

The Richard analysis of steady state discharge from a cylindrical well in unsaturated soil, as measured by the Guelph permeameter technique accounts for all the forces that contribute to three dimensional flow of water into soils, the hydraulic push of water into soils, the hydraulic push of water into soil, the gravitational pull of liquid out through bottom of the well and the capillary pump of water out of the well into the surrounding soil. The Richard analysis is the basis for the calculation of field saturated hydraulic conductivity. The C factor is a numerically derived shape factor that is dependent on the well radius and head of water in the well (Shukla and Soni, 1993)

3.1.3 Procedures for field use

Before making a measurement with the Guelph permeameter in the field, it is necessary to perform a site and soil evaluation, prepare a well hole, assemble the permeameter, fill the reservoirs, and place the permeameter in the well hole.

3.1.3.1 Well preparation

The instruments needed for excavating and preparing a well borehole are soil auger and sizing auger. The soil auger and sizing augur. The soil auger is used to remove bulk amounts of soil and rock. The sizing auger is used as a finishing tool to produce a proper sized well hole of uniform geometry and to clean debris off the bottom of the well hole. The sizing auger is designed to produce a hole that is uniformly 6 cm in diameter with a flat bottom. Generally, the procedure is to use the soil auger to excavated using the sizing auger to produce a debris free well hole of uniform geometry.

In the moist solid or in medium to fine textured soils, the process of angering a hole may create a smear layer which can block the natural flow of water out of the well into the surrounding soil. In order to obtain reliable and representative results using the Guelph permeameter, the smear layer must be removed. The well peep brush is designed to use in the standard 6 cm diameter well hole.

3.1.3.2 Permeameter placement

Tripod is centered over the well hole and slowly the permeameter is lowered so that the support tube enters into the well hole. The tripod is used to support the permeameter in well down to approximately 38 cm in depth. For use in wells deeper than 38cm, the tripod rushing alone provides the functions of centering and stabilizing the permeameter. After the permeameter is placed, it can be easily filled with water. The following standard procedure should be followed for making measurements.

i Verify that both the reservoirs are connected. The reservoirs are connected when the notch on the reservoir valve is pointing up.

ii Establish a 5 cm well head height (H1). Slowly raise the air inlet tip to establish the 5 cm well head height. Raising the air tube too quickly can cause turbulence and erosion in the well.

iii Observe the rate of fall of the water level in the reservoir. It is too slow, then turn the reservoir valve so that the notch is pointing down. Water will then be supplied, only from the small diameter inner reservoir, which will result in a much greater drop in water level between readings.

iv Measure permeameter outflow. This is indicated by the rate of fall of water in the reservoir. Readings should be made at regular time intervals, usually 2 minute intervals are used. The difference of readings at consecutive interval divided by the time interval equals the rate of fall of water, R1, in the reservoir. Continue monitoring the rate of fall of water in the reservoir until the rate of fall does not significantly change in three consecutive time intervals. This rate is called R1 and is defined as the "steady state rate of fall" of water in the reservoir at height H1 which is the first well height established and is always 5 cm in the standardized procedure.

v Establish 10-cm Well head height (H2). Slowly raise the air inlet tip to establish the second well head height of 10 cm. Monitor the rate of fall of water, R2, in the reservoir until a stable value of R2 is measured.

vi The field saturated hydraulic conductivity, Ks can be calculated using he following equation:

$$Ks = 0.0041 * X * r2 - 0.0054 * X * r1$$

where,

X = Reservoir constant, equal to 35.19 where reservoir combination is used and 2.16 when only inner reservoir is used.

R2 = Steady rate of fall of water in the reservoir for a head of 10 cm.

R1 = Steady rate of fall of water in the reservoir for a well head of 5 cm.

3.2 Infiltration Studies

Infiltration tests were carried out at each site using Double ring infiltrometer, with inner ring of diameter 22.5 cm and the outer ring of diameter 37.5 cm. Constant head principle was used to determine the infiltration characteristics of the soil. The procedure of the experiment is described by Rao et. al. (1996). The results of the infiltration tests are presented in Table 2.

3.3 Particle size Distribution Analysis

The soil samples collected from the field were analyzed in the Soil Laboratory, Deltaic Regional Centre, National Institute of Hydrology, Kakinada for particle size distribution. The details of the procedure adopted are presented below.

The complete sieve analysis can be divided into two parts - the coarse and fine analysis. An oven -dried sample of soil is separated into two fractions by sieving it through 4.75 mm IS sieve. The portion retained on it (+4.75 mm size) is termed as the gravel fraction and is kept for coarse analysis, while the portion passing through (-4.75 mm size) is subjected to fine sieve analysis. The test covers only coarse sieve analysis (for gravel fraction) as well as fine sieve analysis (for sand fraction). The sieves used for fine sieve analysis are 2.0 mm, 1.18 mm, 800, 600, 300, 150, 75 micron IS sieve.

3.3.1 Test procedure

1. Using a riffler, take a representative sample of soil collected from the field and dry it in the oven.
2. Weigh the required quantity of dried soil, keep it in a tray and soak it with water. Depending on the maximum size of material present in substantial quantities in the soil the mass of soil sample taken for analysis may be according to IS : 2720 (part IV).
3. Puddle the sample thoroughly in water and transfer the slurry to the 4.75 mm sieve which divides the gravel fraction from the sand fraction. Wash the slurry with jet of water. Collect the materials retained on 4.75 mm sieve and the material passing through it in separate containers. Keep the material retained on 4.75 mm sieve in the oven
4. Wash the material passing through the 4.75 mm sieve through a 7.5 micron sieve so that silt and clay particles are separated from the sand fraction.
5. Sieve the dried material, retained on 75 micron sieve (step 4), through the following set of sieves: 2mm, 1.18 mm, 800 micron, 600 micron, 300 micron, 150 micron and 75 micron size. The set of sieves should be arranged one above

the other and fitted to a mechanical sieve shaker such that the 2 mm sieve is at the top and the 75 micron sieve is at the bottom. A cover should be placed on the top of the 2mm sieve, and a receiver should be placed below the 75 micron sieve. A minimum of 10 minutes sieving should be used. The soil fraction retained on each sieve should be carefully collected in containers and the mass of each fraction determined and recorded.

6. Alternatively, the material retained on 75 micron sieve (step 4), may not be dried, but be washed through a nest of sieves specified in step 6, nested in order of their fineness with the finest (75 micron) at the bottom. Washing should be continued until the water passing through each sieve is substantially clean. The fraction retained on each sieve should be emptied carefully without loss of material in separate container and oven dried. The oven-dried fraction should be weighed separate and their mass should be recorded.

3.4 Hydrologic Soil Classification

Hydrologic soil classification is essential for the evaluation of runoff. The main parameters used commonly in hydrologic soil classification are:

i Effective depth of soil

ii Soil texture/average clay content in the surface and subsurface layers

iii Soil structure in the surface and subsurface layers

iv Infiltration rate

v Soil permeability

3.4.1 Effective depth of soil

The depth of soil that can be effectively exploited by the plant roots is an important criterion in selecting land for irrigation. Effective depths include the solum thickness plus adjusted or corrected thickness of the disintegrated and weathered permeable rock material where the soil rests on such a material. In the case of soils with hard pan, the effective depth is the thickness of soil overlaying such a layer. When the soils are lying over disintegrated and weathered sub stratum, the adjusted and correlated thickness can be calculated by multiplying the thickness of this layer with the percent soil material contained in it.

3.4.2 Soil texture

Soil texture refers to relative proportion of various soil seperates in a soil material and is related to soil-water inter relationship. On the basis of relative proportion of sand, silt and clay, various textural groups are recognized. Clay, being the most active and reactive fraction, is used as a single factor index in deciding the hydrologic group of a series. Clay content of the surface layer and the average clay content of the whole profile is considered for this purpose.

3.4.3 Soil structure

Soil structure refers to the arrangement of the soil particles in the soil profile. Soil structure governs the moisture and air regimes of the soil. Soil structure and texture affect the movement of water in the soil and its transmission.

3.4.4 Infiltration rate

The infiltration characteristic of a soil is an important parameter required for many hydrological studies and simulation of flow processes. Quantitatively, infiltration rate is defines as the volume of water passing into soil per unit area per unit time and has the dimension of velocity. The maximum rate at which soil can absorb water through the soil surface is termed as infiltration capacity. This is a function of soil moisture condition. This plays an important role in classification soil into various hydrological groups.

3.4.5 Soil permeability

Soil permeability refers to the ease with which water can move in the soil profile. It is a measure of drainability of the soil. Soil properties such as texture, structure, management practices, landcover, landuse, etc. control the total water intake a soil profile at a given time. This parameter too plays a major role for soil classification.

3.4.6 Hydrologic soil groups

The United States Department of Agriculture has classified the soil into four hydrological groups, namely A, B, C and D, respectively in the increasing order of runoff potential. The criteria for each soil group as defined by USDA are presented in Table 1. The description of the classification is given below.

Table 1. USDA criteria for hydrological soil classification (SCS method)

Soil Characteristic	Hydrological Soil Group			
	A	B	C	D
Effective depth (cm)	>100	51-100	26-50	<25
Texture	Sand, Loamy Sand	Sandy . Loam, Silty Loam, Loam	Silt, Sandy clay Loam, Clay Loam, Silty Clay Loam	Silty Clay, Silty Clay, Clay
Clay (%)	0-8	9-25	26-40	>40
Structure	Single grained, granular crumb	Granular crumb, Sub angular blocky	Sub angular blocky, columnar prismatic	Platy, Massive
Infiltration rate (cm/hr)	>8.0	5.1-8.0	1.6-5.0	<1.6
Permeability (cm/hr)	>13	2-13	0.5-2	<0.5

Group A Soils having high infiltration rate even when thoroughly wetted and consisting chiefly of deep to very deep, well to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B Soils having moderate infiltration rate when thoroughly wetted and consisting of moderately deep to deep, moderately well drained soils with fine to moderately coarse structures. These soils have a moderate rate of water transmission.

Group C Soils having slow infiltration rate when thoroughly wetted and consisting of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine structures. These soils have a slow rate of water transmission.

Group D Soils having very slow infiltration rate when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

Chapter 4

Results and Discussions

The hydrologic soil properties of an area are essential to accurately estimate the runoff generated due to a storm in that area. The main soil parameters generally considered for analysis are soil texture, soil structure, infiltration rate, hydraulic conductivity etc. In the present study, saturated hydraulic conductivity determination and particle size distribution analysis were carried out. The results of infiltration studies by Rao et. al. (1996) are also presented.

The hydraulic conductivity of the soil in Suddagedda basin was determined for two depths (15 cm and 30 cm). The hydraulic conductivity values determined using Guelph permeameter are tabulated in Table 2. It can be observed from the table that the hydraulic conductivity of the soil is very low. These low values agree with the general observation that the soil type of the basin is mainly clay. The Table 2 contains the values of infiltration in the same site (as reported by Rao, et. al., 1996). These values are presented to have a comparison of both the parameters. The values of hydraulic conductivity were used to plot a contour map of the hydraulic conductivity in the basin and the map is presented in Fig 4 and 5. The contour map clearly indicates the variation of hydraulic conductivity across the basin (coastal to hilly terrain). High values are observed near the coastal region and it increases towards upstream. The upper reaches of the basin are covered with thick forest and any of these field investigations could not have been carried out.

The Table 3 depicts the particle size distribution of soil in the Suddagedda basin. The results of the analysis indicate that the soil in the basin falls in the fine sand to medium sand class. This may be due to the handicap that no distribution analysis was carried out below 0.75 micron. The particle size distribution curves for each site is shown in Fig 7-21.

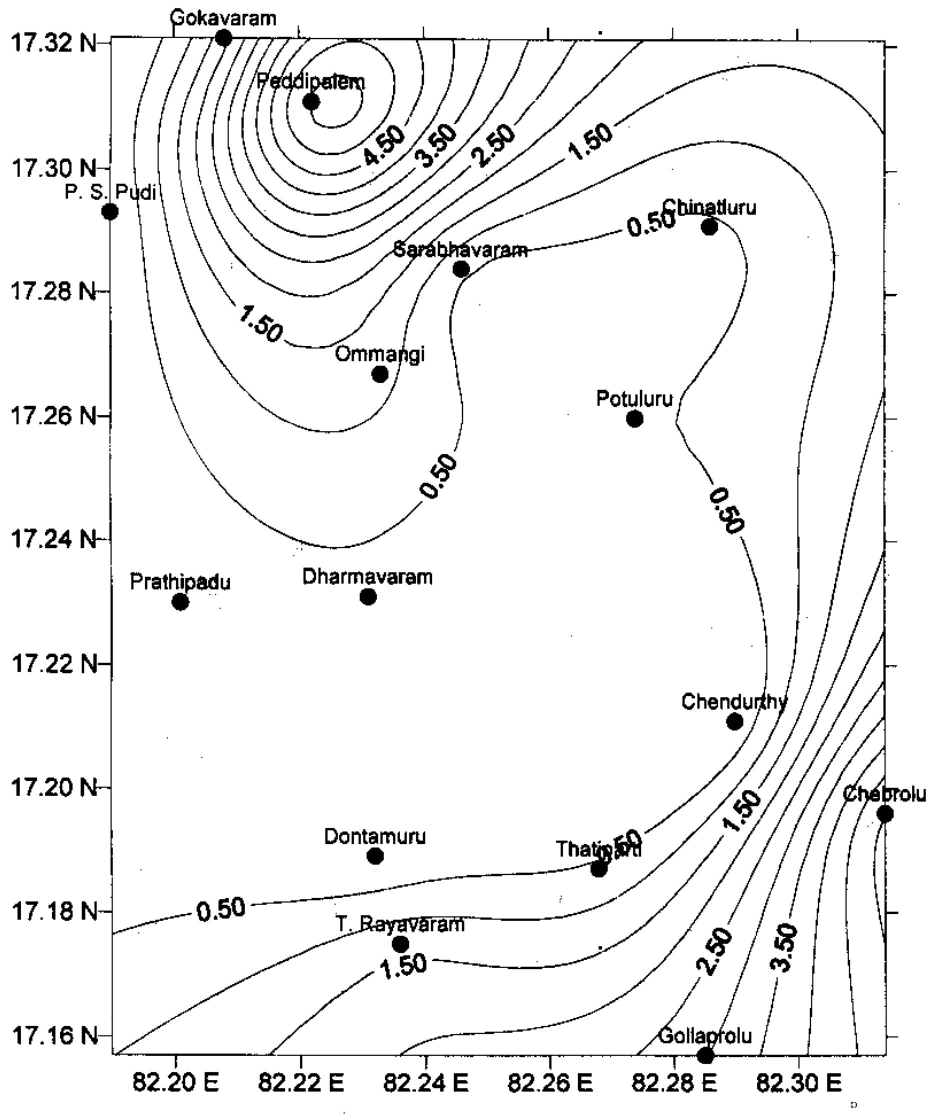

Fig 4 Hydraulic cunductivity contour at 15 cm depth

X

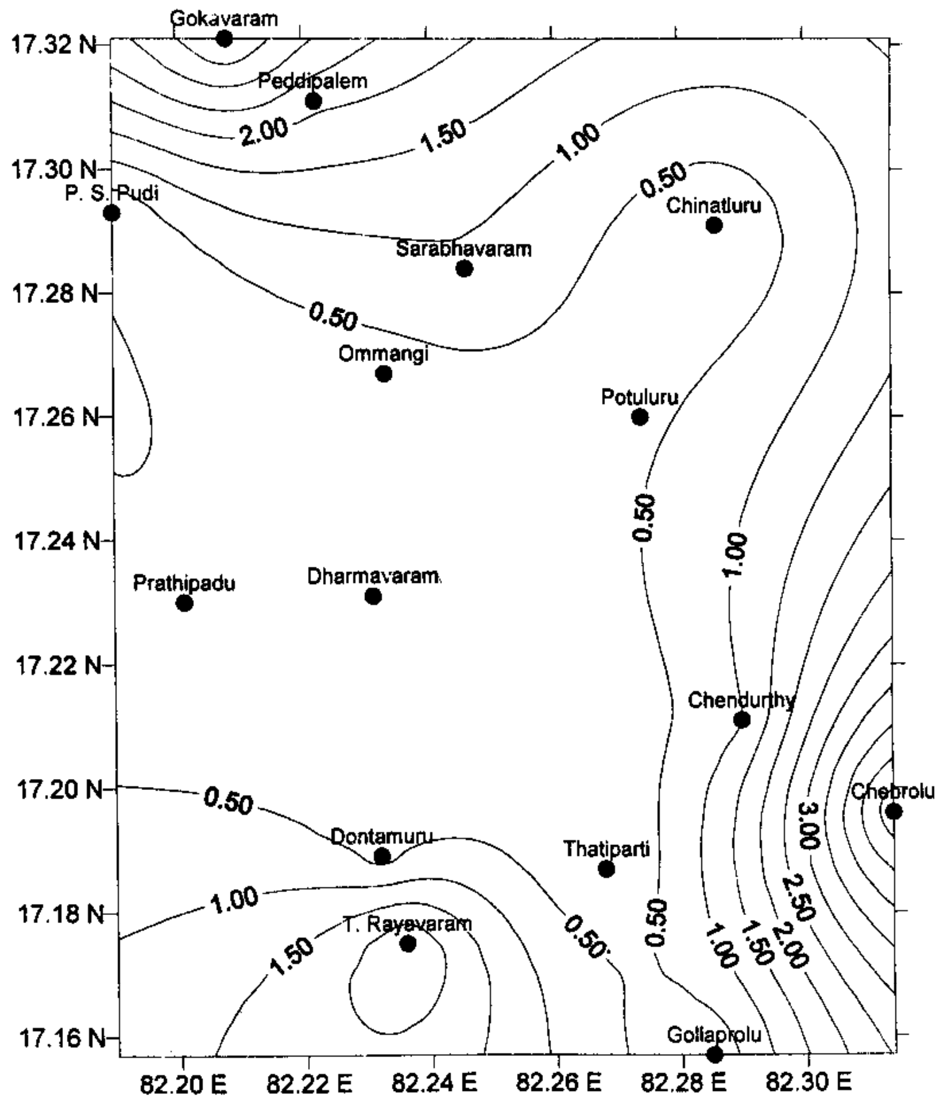

Fig 5 Hydraulic conductivity contour at 30 cm depth

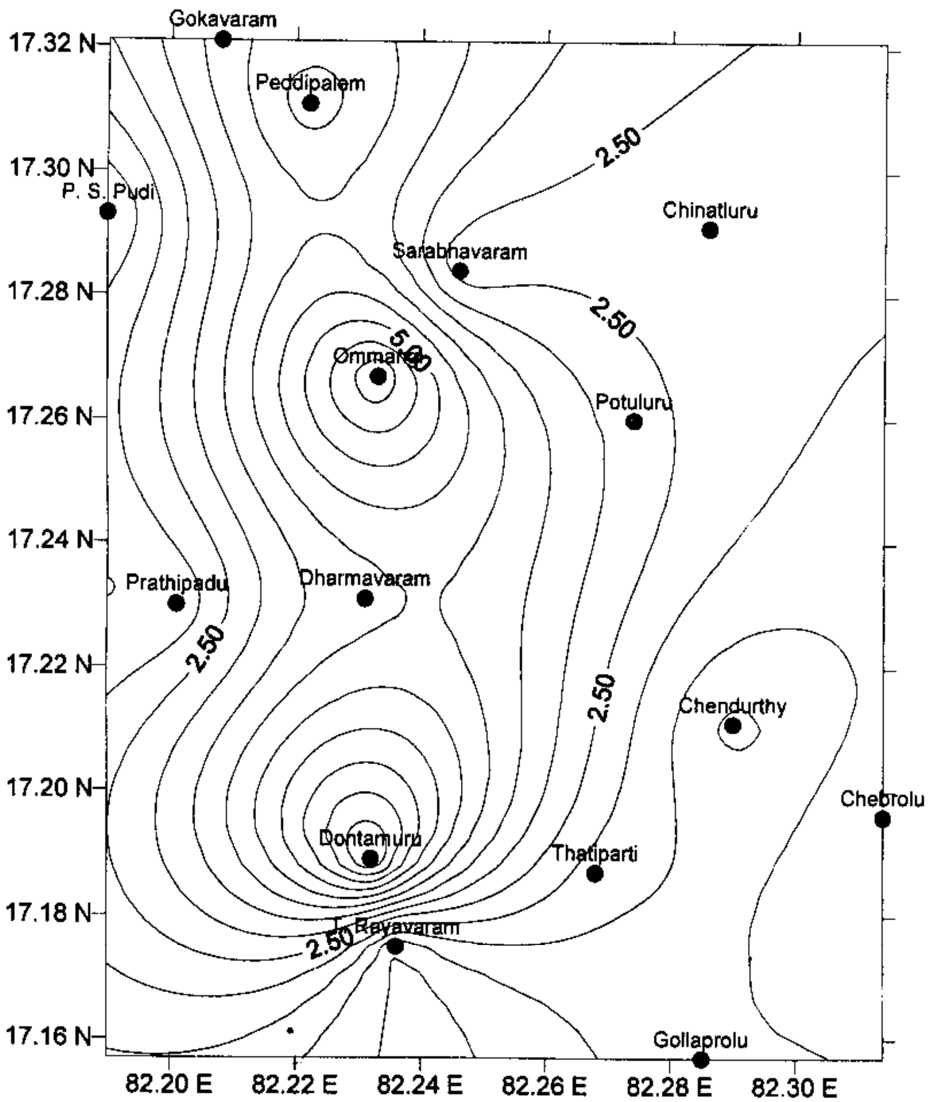

Fig 6 Infiltration rate contour of Suddagedda basin

Table 2. Hydrological soil properties in Suddagedda basin.

Village	Hydraulic Conductivity at 15 cm depth (cm/hr)	Hydraulic Conductivity at 30 cm depth (cm/hr)	Infiltration rate (cm/hr)	Hydrologic Soil Grouping	
				Based on Hydraulic Conductivity	Based on Infiltration
T. Rayavaram	1.317	2.517	0.44	C	D
Gollaprolu	2.973	0.123	1.44	B	D
Chebrolu	4.990	5.436	2	B	C
Chintaluru	0.446	0.043	2.18	D	C
Sarabhavaram	0.637	0.913	2.13	C	C
Ommangi	1.132	0.307	6.51	C	B
Uttarakanchi	0.374		13.42	D	A
Gokavaram	1.798	4.119	3.73	C	C
Peddipalem	5.542	2.102	4.8	B	B
Pedda Sankara Pudi	0.026	0.062	0.89	D	D
Thatiparthi	0.595	0.051	1.76	C	C
Chendurthy	0.109	0.930	0.83	D	D
Prathipadu	0.089	0.055	1.55	D	D
Dontamuru	0.052	0.302	7.22	D	B
Dharmavaram	0.300	0.429	3.79	D	C
Potuluru	0.429	0.420	2.74	D	C

Table 3. Particle size distribution in the Suddagedda basin soil

Name of Village	Depth of sampling (cm)	Gravel (%)	Sand (%)	Silt & Clay (%)	Texture
Chebrolu	10-35	27.4	65.6	07.0	Sandy
Chintaluru	10-35	14.0	76.8	09.2	Sandy
Sabhavaram	10-35	12.2	77.2	10.6	Sandy
Uttarkanchi	10-35	17.4	72.2	10.4	Sandy
Gokavaram	10-35	18.0	77.0	05.0	Sandy
Peddipalem	10-35	05.0	81.0	14.0	Sandy
P. S. Pudi	10-35	21.6	73.0	05.4	Sandy
Dontamuru	10-35	14.8	79.8	05.4	Sandy
Dharmavaram	10-35	26.2	67.2	06.6	Sandy
Potaluru	10-35	05.6	83.2	11.2	Sandy

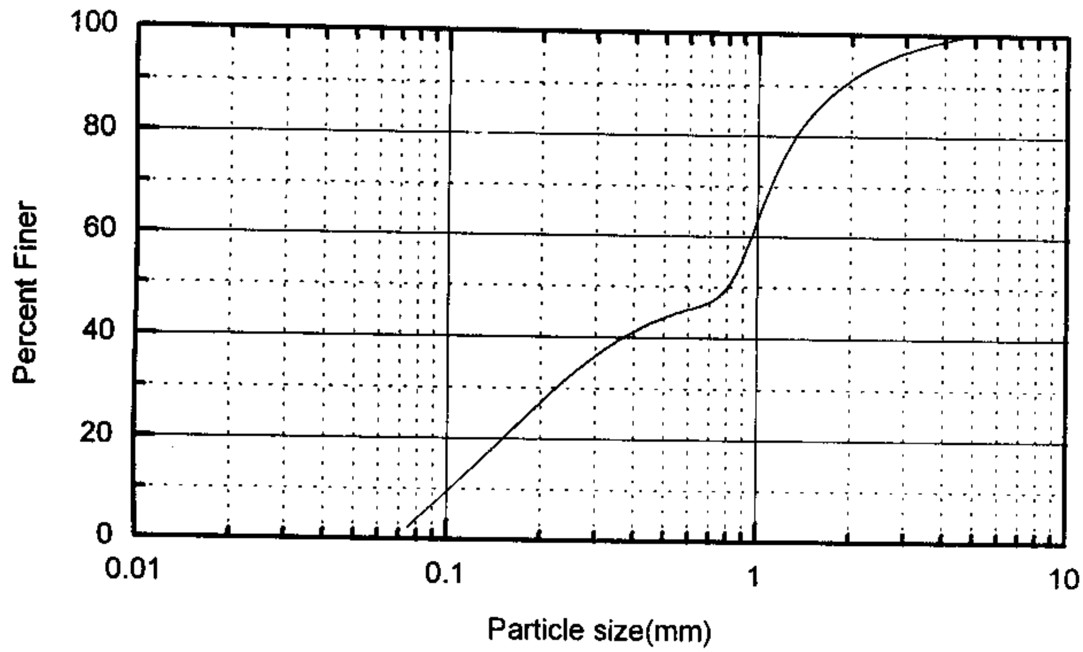

Fig 7 Grainsize distribution curve (Uttarkanchi village)

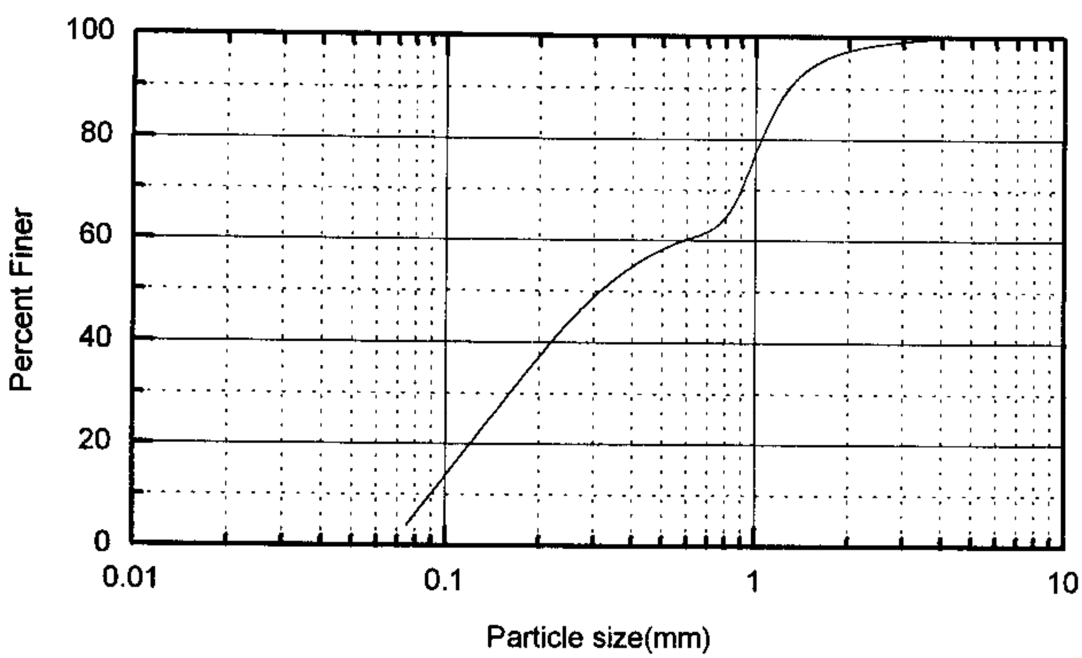

Fig 8 Grainsize distribution curve (Potuluru village)

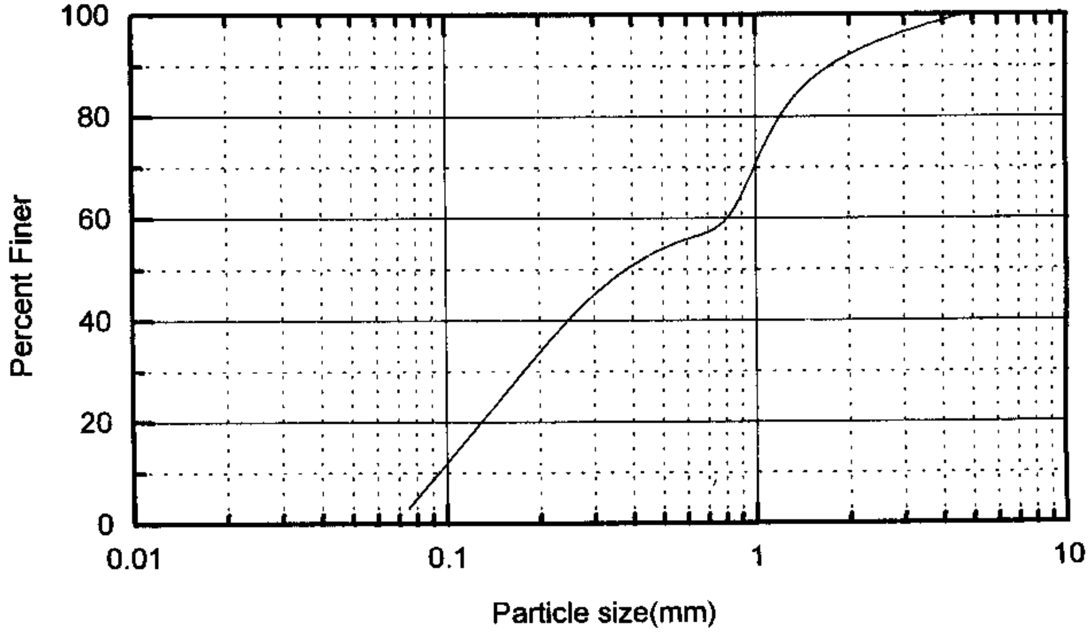

Fig 9 Grainsize distribution curve (Chintaluru village)

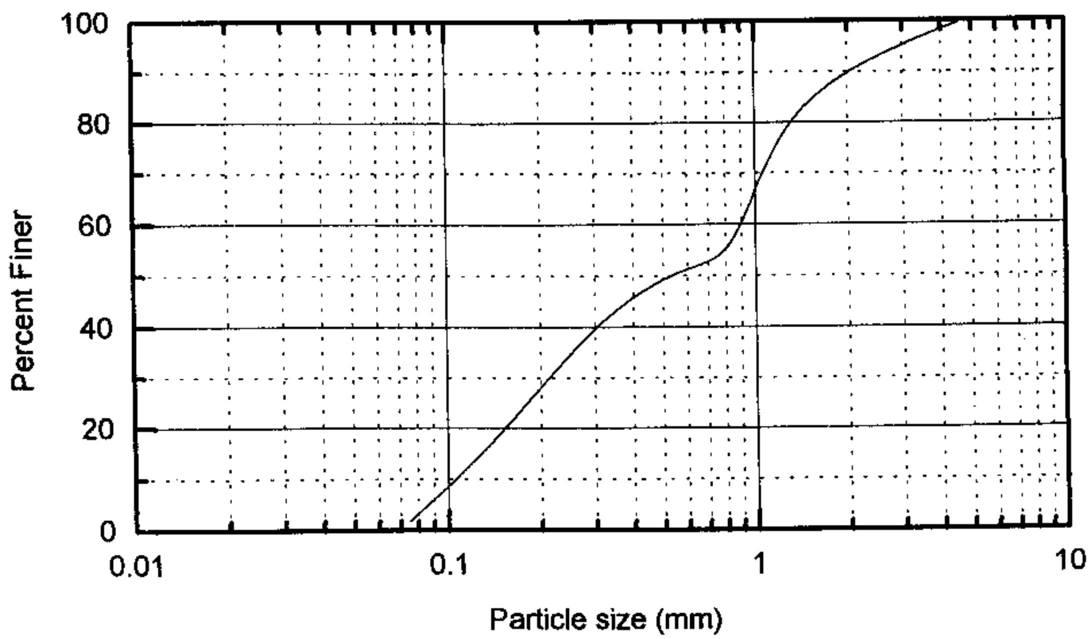

Fig 10 Grainsize distribution curve (Gokavaram village)

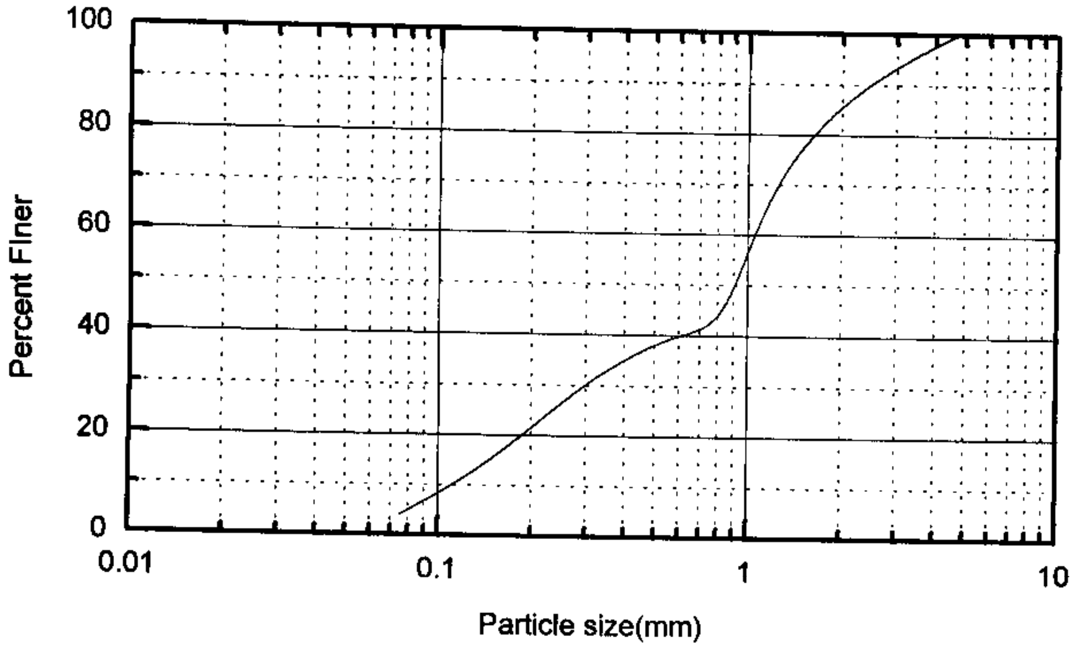

Fig 11 Grainsize distribution curve (Dharmavaram village)

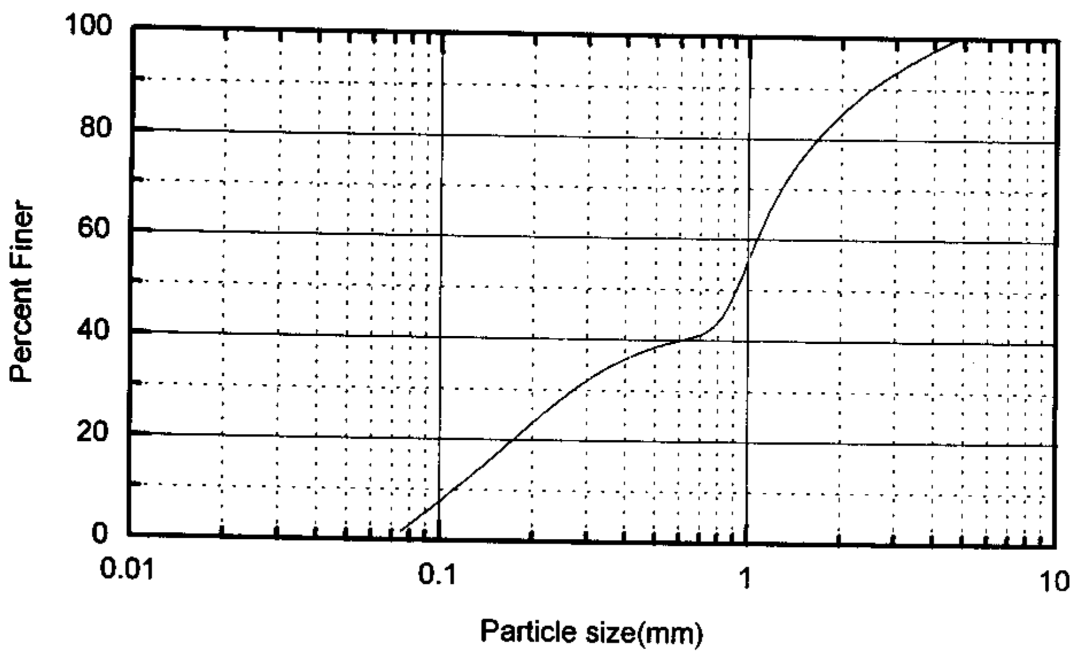

Fig 12 Grainsize distribution curve (Chebrolu village)

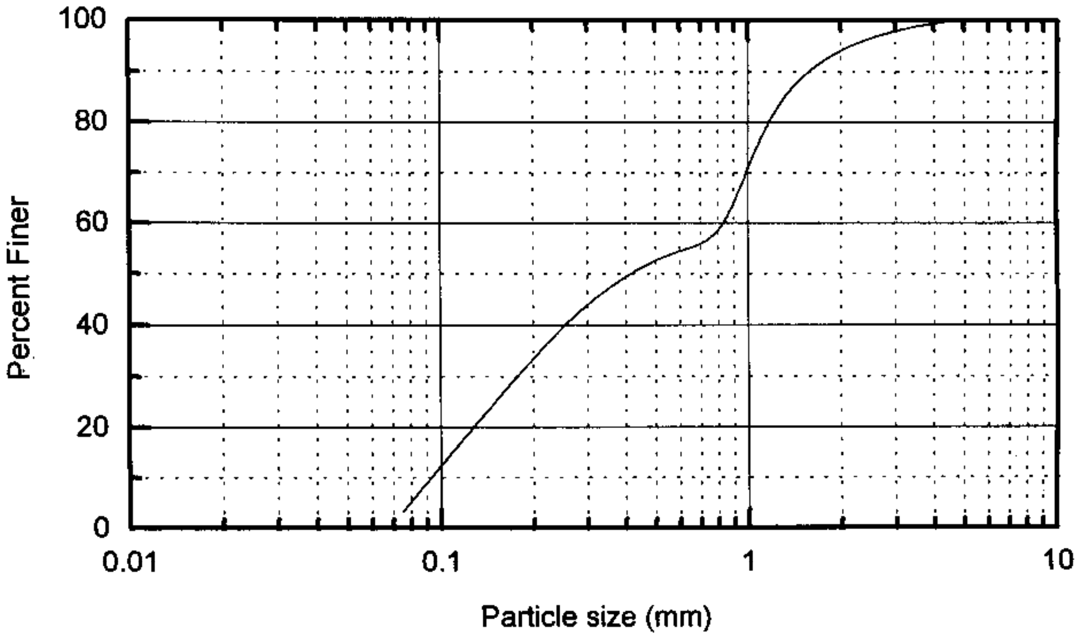

Fig 13 Grainsize distribution curve (Sarabhavaram village)

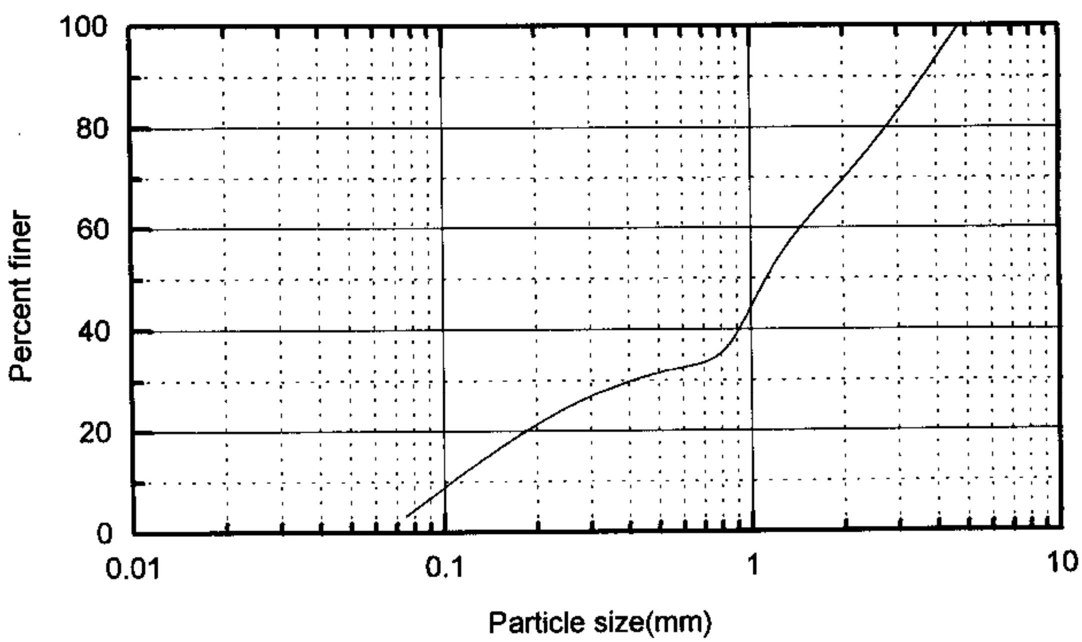

Fig 14 Grainsize distribution curve (Gollaprolu village)

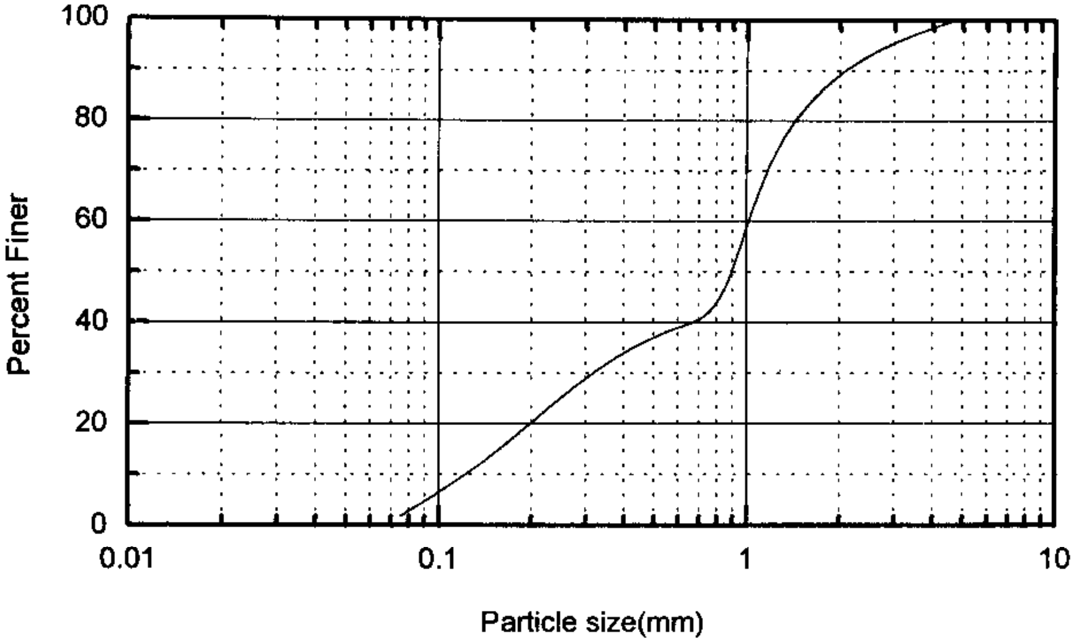

Fig 15 Grainsize distribution curve (Pedda sankaripudi village)

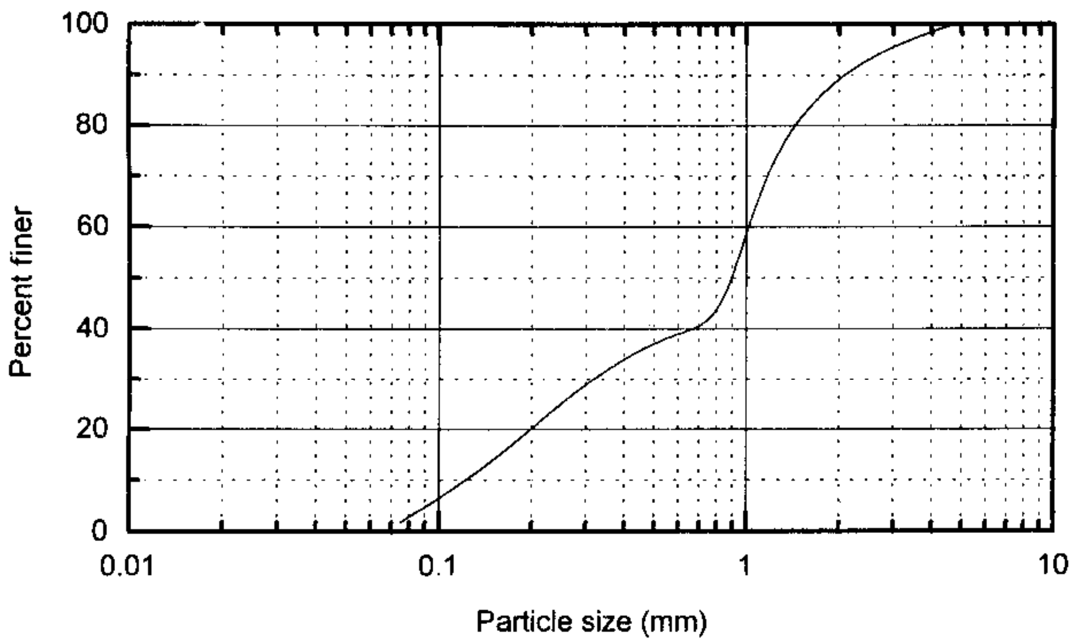

Fig 16 Grainsize distribution curve (Prathipadu village)

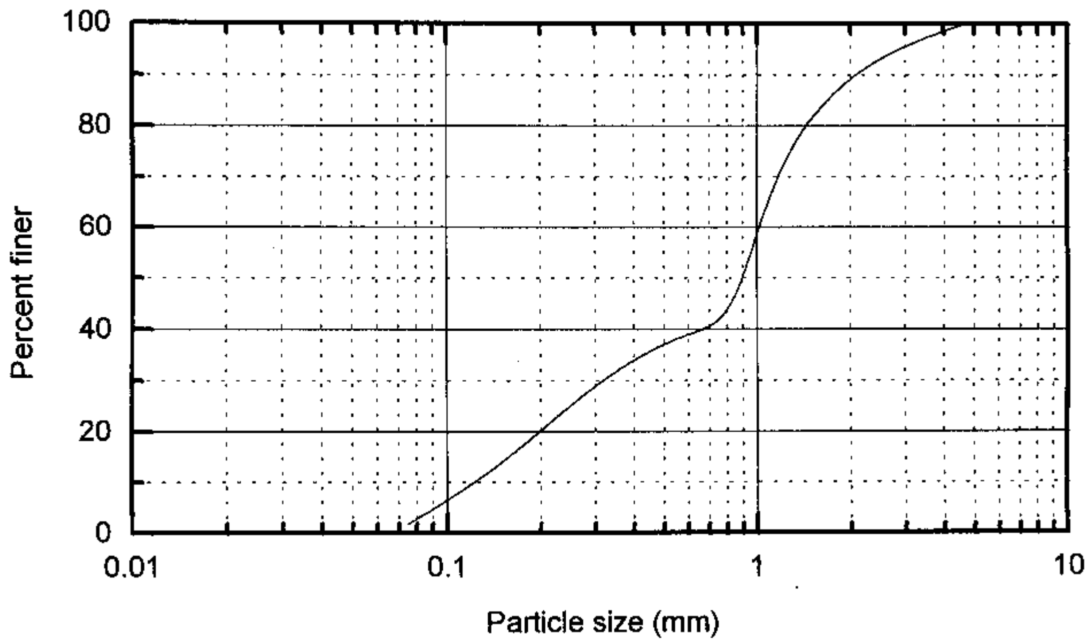

Fig 17 Grainsize distribution curve (Tatiparthi village)

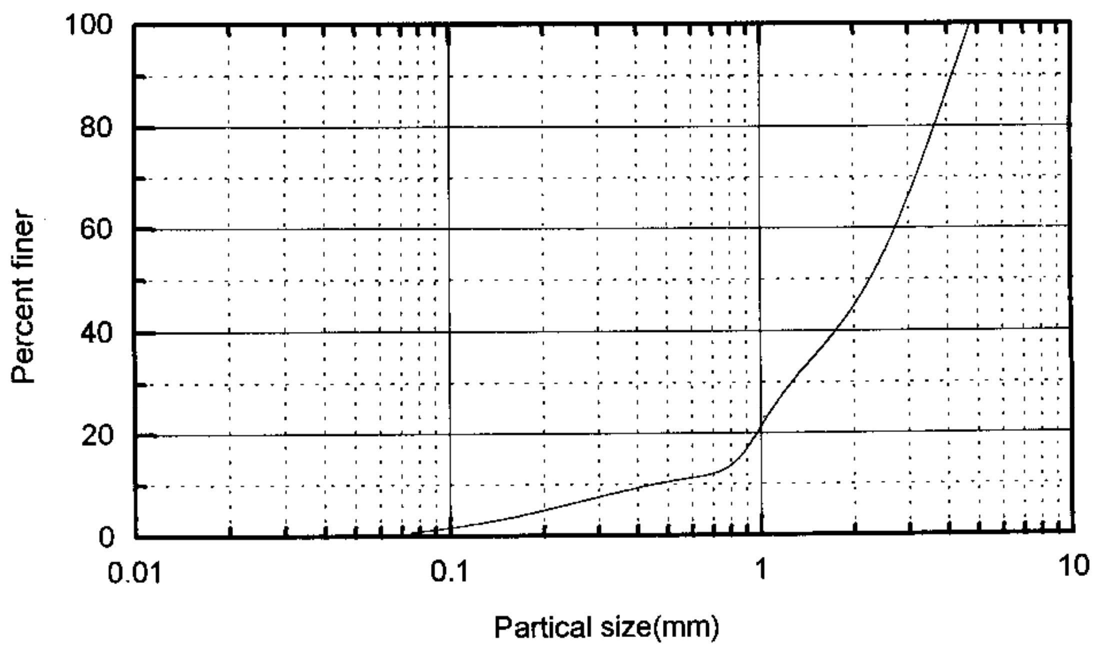

Fig 18 Grainsize distribution curve (Chendurthi village)

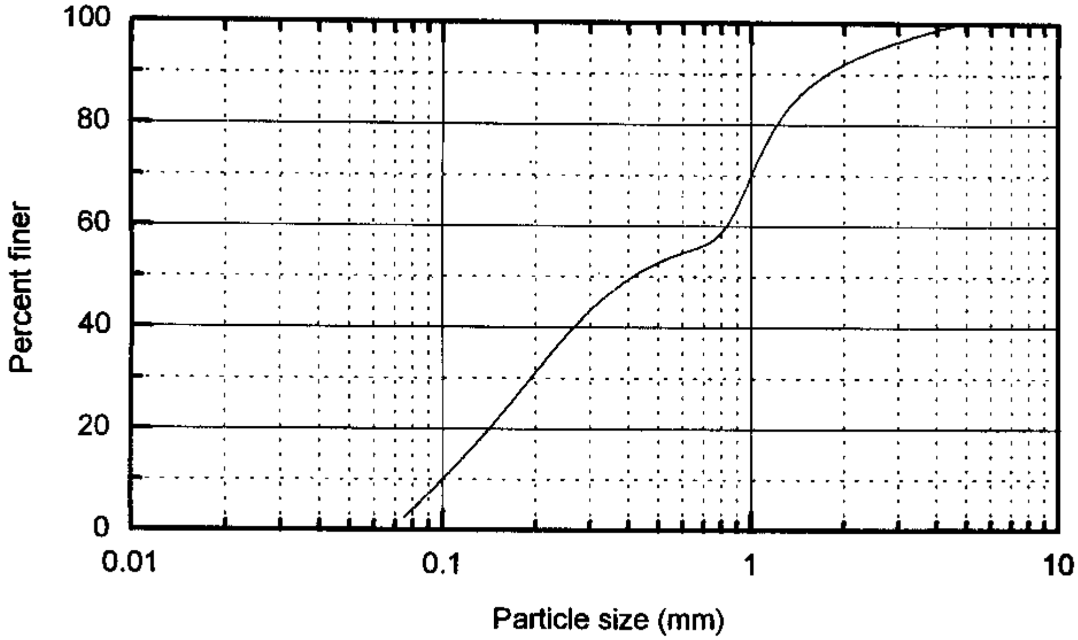

Fig 19 Grainsize distribution curve (Dontamuru village)

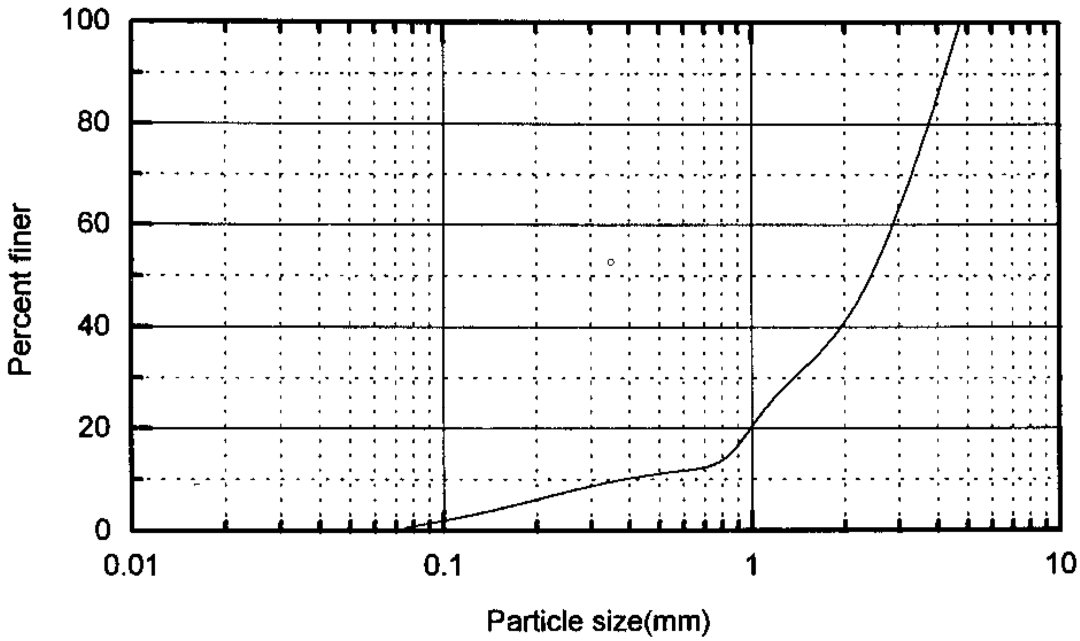

Fig 20 Grainsize distribution curve (T Rayavaram village)

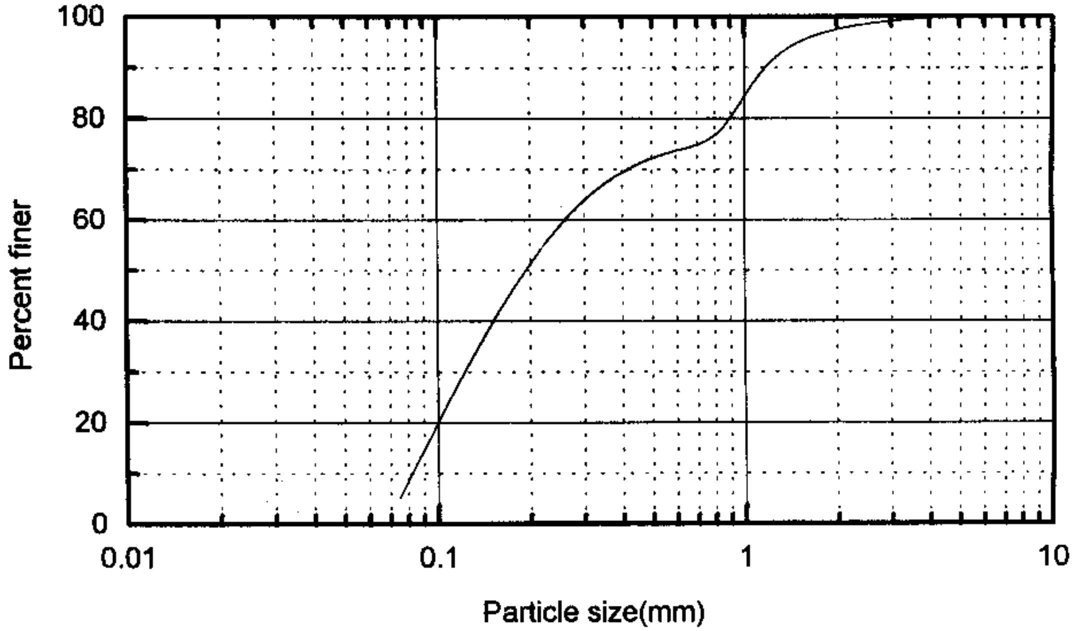

Fig 21 Grainsize distribution curve (Peddipalem village)

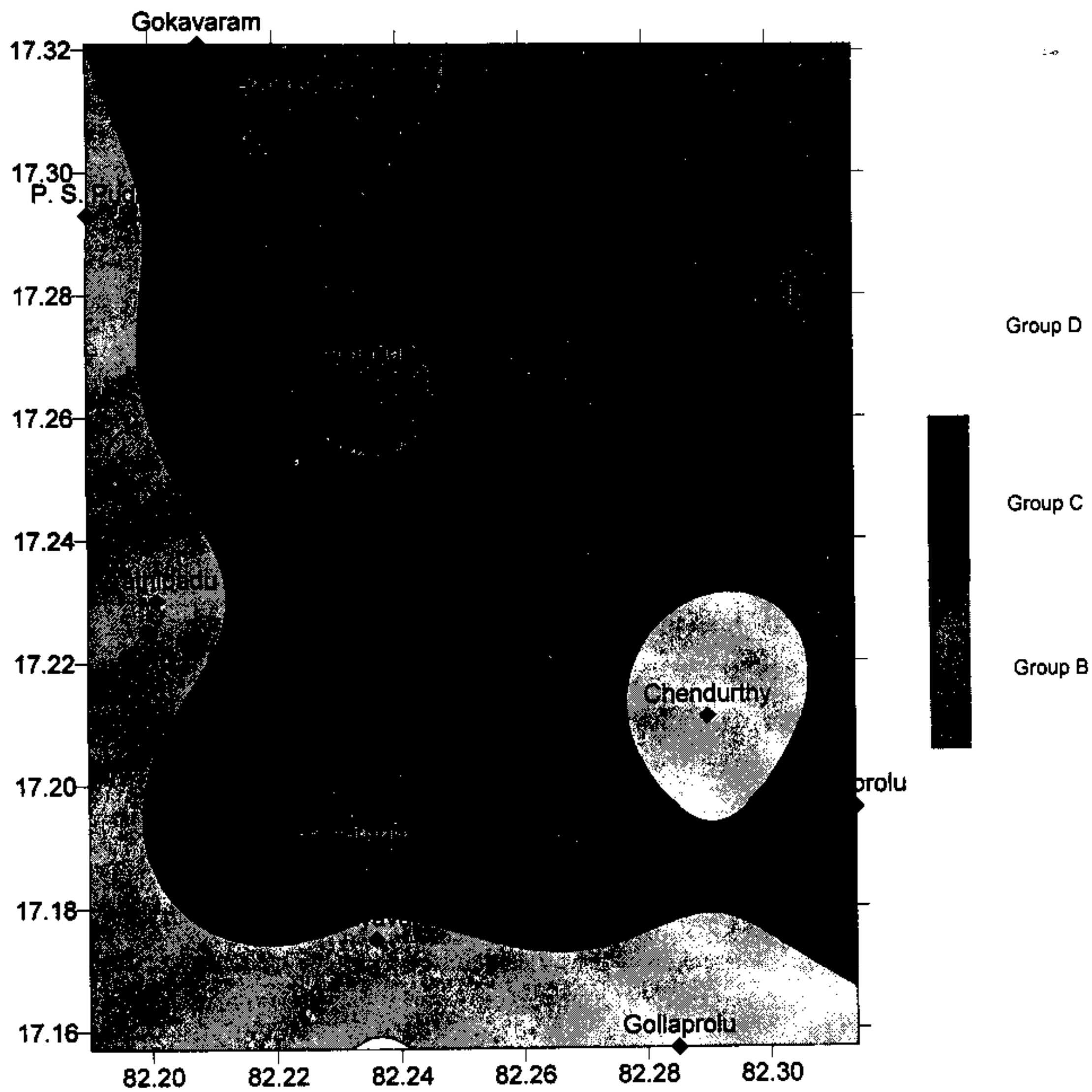

Fig 22 Map showing hydrological soil group of the basin

Table 4. Hydrological soil classes of the Suddagedda Basin

Village Name	Hydrological Soil Group
T. Rayavaram	D
Gollaprolu	D
Chebrolu	C
Chintaluru	C
Sarabhavaram	C
Ommangi	B
Uttarakanchi	A
Gokavaram	C
Peddipalem	B
Pedda Sankara Pudi	D
Thatiparthi	C
Chendurthy	D
Prathipadu	D
Dontamuru	B
Dharmavaram	C
Potuluru	C

The hydrological groups in which each area falls are presented in Table 4. A map showing the areas falling under each soil group is also presented (Fig 22). The hydraulic conductivity and infiltration are function of soil texture and clay content. Hydraulic conductivity and infiltration capacity, are mostly close to each other. But, as can be seen from Table 2, large variations in values of infiltration capacity and saturated hydraulic conductivity are observed. This may be due to the presence of cracks and rat-holes in the soils. Moreover, during preparation of saturated hydraulic conductivity by Guelph permeameter, the soil gets disturbed and a smooth layer is formed around inner wall of the hole that reduces the hydraulic conductivity. Therefore in the present study, infiltration rate has been taken as the criteria for the hydrological classification groupings of the basin.

Chapter 5

Summary and conclusions

Suddagedda basin. Andhra Pradesh has been selected as a representative basin by the Deltaic Regional Centre of National Institute of Hydrology, Kakinada to conduct various hydrological investigations in the field level. As a part of the representative basin studies, an attempt has been made to classify the basin into hydrological soil groups based on field experiments and is presented in the report. The soil hydraulic conductivity at two depths (15cm and 30 cm) has been determined using Guelph Permeameter Apparatus at 17 selected locations in the basin. The contour map of the hydraulic conductivity is presented in the report. It is expected that content of the report and the results presented would be of much use in undertaking various hydrological studies on this basin.

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Acknowledgements

We express our deep sense of gratitude to Dr. S. M. Seth, Director, National Institute of Hydrology, Roorkee for providing us with the infrastructure and support for conduct of this study as a part of the annual work program of Deltaic Regional Centre, Kakinada.

We are grateful to Dr. K. S. Ramasastri, Scientist 'F' and Coordinator, National Institute of Hydrology, Roorkee for he was instrumental in the formulation and execution of the study. We express our sincere thanks to Mr. S. V. N. Rao, Scientist 'E', Deltaic Regional Centre, Kakinada for his creative criticism during the course of the study.

Thanks are also due to the Scientists and staff members of the Deltaic Regional Centre, Kakinada for providing support in various means throughout the duration of the study.

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