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SOIL PHYSIO-CHEMICAL PROPERTIES OF BASANTAR CATCHMENT, J & K

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ABSTRACT

Basantar sub catchment, a small part of Chenab basin in Western Himalaya is selected for determining soil Physio - chemical properties which are useful to simulate any hydrological model for watershed management.

A total of ten sites distributed in the study area were selected based on elevation and access. Soil samples were collected from these sites which cover different land use (i.e. Agriculture, Barren, Grass and Forest). Collected samples were analyzed for Physical properties (i.e. Specific gravity, Bulk density, Permeability, Porosity, Moisture content and Moisture retention capacity) and chemical properties (i.e. Percent organic matter, carbon, potassium and sodium). Besides these properties infiltration test was also carried out at all the four different landuses.

The average percentage of various particle sizes in Basantar sub catchment is : Gravel-13.31, Sand-74.78 and Silt-11.83. Thus the soil in Basantar sub catchment is dominated by sand constituent. Average infiltration rate for Barren 6.44 cm/hr, Grass 3.30 cm/hr, Agriculture 12.40 cm/hr and Forest 11.70 cm/hr. Organic matter in different landuse conditions was 13 to 22% in forest, 9.32 to 21.89% in agriculture land, 3.64 to 17.83% in grass land and 7.7 to 18.64% in barren land. It is less than 25% in all the analysed soil samples. Potassium in the different landuse conditions was found 5.46 mg/g to 91 mg/g while sodium ranged between 4.90 mg/g to 36 mg/g.

1.0 INTRODUCTION

To understand hydrology of a particular area, all factors which affect hydrologic cycle should be studied. Soil characteristic is one of them. Soil studies of various basin is necessary in design of irrigation canals and agricultural planning. To run a hydrologic model in a micro watershed to model its hydrological behaviour, a complete input of soil properties is required. Keeping in view the importance of this study, Scientist of WHRC, Jammu had proposed a study " Physical and chemical properties of Basantar catchment, J&K." during 6 th RCC meeting held at Dehradun. The matter of this study was discussed and it was decided to carry out soil physio chemical properties of Basantar catchment in different landuse conditions. This study will be useful to hydrologist and engineers to apply any hydrological model/take up any irrigation project.

During field investigating programme, a total of ten sites distributed in Basantar basin were selected. Undisturbed and disturbed soil samples at these ten sites of different landuse were collected. For determining percentage of various size particles in the soil sample, mechanical sieve analysis method was adopted. Permeability and moisture retention capacity of soil samples were determined by using Constant permeability test and Pressure Plate Apparatus respectively. Porosity, moisture content in percentage and Bulk density of soil sample were determined at three different depths (0-15 cm, 15-30 cm, 30-45 cm) in all four land use. Besides soil sampling activity infiltration test were also carried out using double ring infiltrometre.

2.0 REVIEW

The soil physio- chemical properties are required for many hydrological studies and simulation of flow process. These properties are basic input for developing an integrated watershed management program or models. Though, many studies have been carried out in our country in different watersheds by different organizations. However, such type of studies are very few in J&K.

Singh, K. (1991), has prepared "Exploratory Soil Survey Report of Problematic Areas" for District Kathua, J & K. Main object of his studies are as, to identify and highlight the nature of soil problems in the area, to know the location and extent of the area and demarcate the same on the map and to study the probable cause of the occurrence of the problem. He also suggest the remedial measures. The soils of Jammu region show a great heterogeneity. According to the Soil Survey Organization, Department of Agriculture, Jammu the sub-surface soils around village Ramkot, tehsil Billawar which represents hilly and undulating area of Kathua district are predominant in sandy clay loam texture. The soils of R.S. Pura tehsil which represents plains of Jammu district was classified as Langotian (silty loam to silty clay loam), Bansultan (sandy loam to silt loam) and Kotli soil (silty clay loam to silty clay) series (Singh, K., 1986, 1991: Report Nos. 9, 15 & 16).
Omkar and Patwary (1992) have carried out infiltration studies in the Jammu region. The study has shown that the initial infiltration rates vary from 18 to 12 , 17 to 24, 12 to 36 and 18 to 72 cm/hr for different soils under bare, agriculture, grass and forest land uses respectively. The final infiltration rates for these soils and land uses vary from 0.3 to 2.4, 1.2 to 3.0, 0.3 to 6.3 and 0.6 to 1.2 cm/hr (Patwary et al., 1997).

3.0 STUDY AREA

3.1 Location and Topography:

Basantar catchment is a small tributary of Chenab basin in Western Himalaya and is contained in between 32° 30′ to 32° 45′ north latitude and 75° 00′ to 75° 25′ East longitude (fig 1). At its upper part the basin is narrow and elongated while it broadened down along lower part. The upper portion of the basin is characterized by rugged mountain topography whereas lower basin consist of low hills and aggregational plains. The slope of the sub catchment is from north-east to south-west. The river basin covers area of about 50800 hectare.

3.2 Geology:

The geology of the area consists of Shiwalik system and is mainly composed of sand stone, silt stone, red and purple & transported quartzite. The lower reaches including the foot hill plain consist of alluvial deposits brought down by seasonal rivulets. According to the geological map prepared by Mehrotra & Srivastava (1997) indicate that the geology of the study area is under the category of Recent/Sub recent, Shiwalik and upper part under Murree.

3.3 Climate:

The area falls under subtropical region, characterised by three well defined seasons, viz., winter, summer and monsoon. The Basantar river at its upper reaches is fed by melting of snow and in the lower catchment it is predominantly rainfed. India Meteorological Department has observed the normal annual rainfall about 1055 mm and 1177 mm at Jammu and Kathua stations respectively. The average temperature in the Jammu region varies from 4° to 40 ° Celsius.

3.4 Soil sampling

During field investigating program by NIH scientists and scientific staff, a total of ten sites distributed in the Chenab basin were selected based on approachability. Undisturbed and disturbed soil samples at these sites of different land use (i.e. Agriculture, Barren, Grass, Forest) were collected. Besides soil sampling activity, infiltration tests were also carried out. The undisturbed soil samples were taken by driving ring of 53*55 mm (contents 100 cc) for determining permeability of soil and disturbed soil samples were taken to determine bulk density, specific gravity, moisture contents, porosity and particle size distribution.

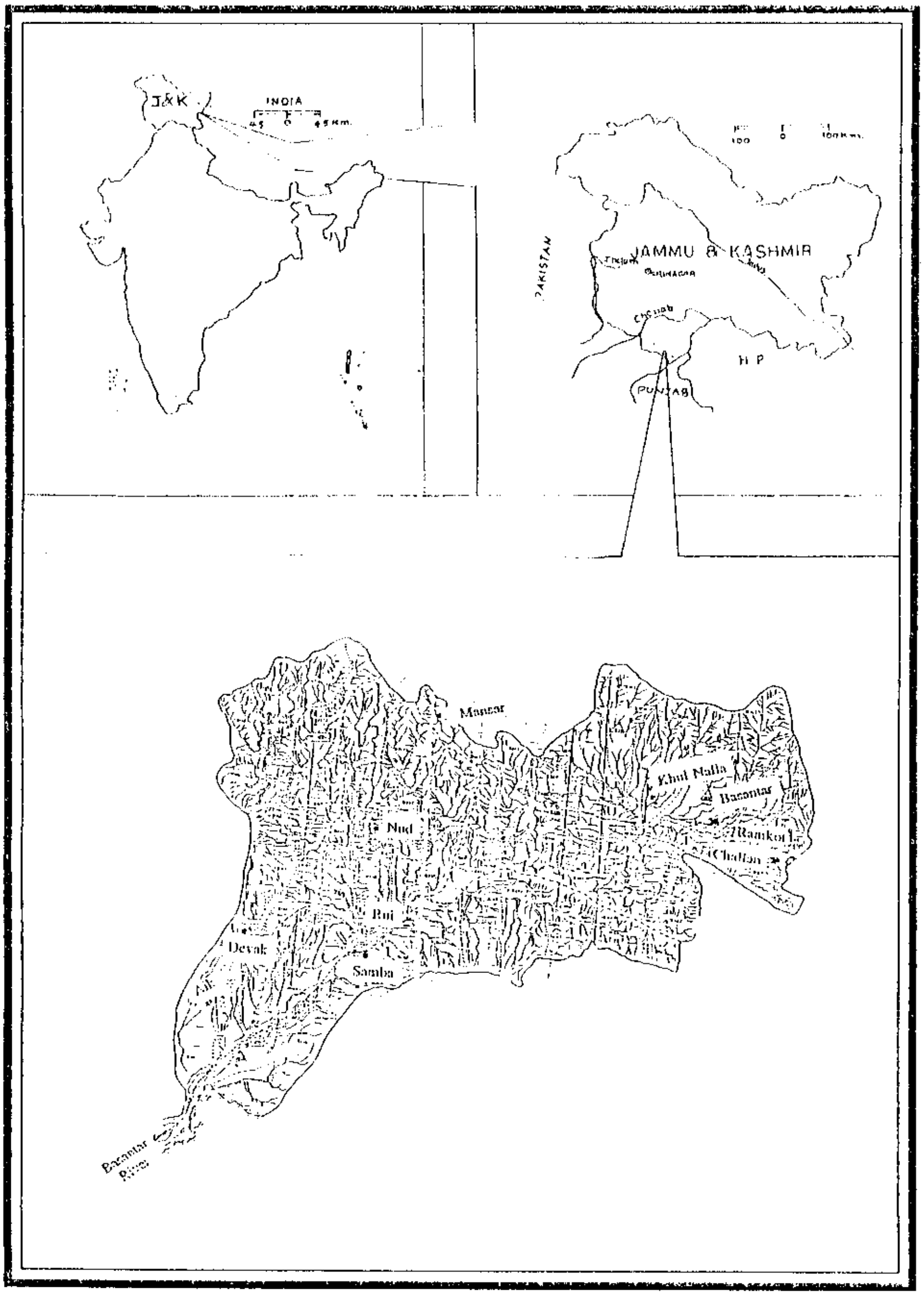


Fig.1 : STUDY AREA

4.0 PHYSICAL CHARACTERISTICS OF SOIL

4.1. Particle size distribution

For determining percentage of various size of particles in the soil samples collected from various locations in Basantar basin the facility of WHRC, NIH Jammu were utilized. The disturbed sample were oven dried and these oven dried samples of soil is separated into two fraction by sieving it through a 4.75 mm IS sieve. Sieving was performed on the soil sample passing through 4.75 mm IS sieve by arranging largest aperture sieve at the top and the smallest aperture sieve at the bottom. A receiver is kept at the bottom and a cover is kept at the top of the whole assembly. The proportion of the soil sample retained on each sieve was weighed and the percentage was calculated (Table 1) on the basis of total weight of dried soil sample taken.

The results of particle size analysis using fine sieve analysis were plotted to get a particle size distribution curve with the percent finer as the ordinate and the particle diameter as the abscissa with the diameter being plotted on a log arithmetic scale. Particle size distribution curves for the ten sample are shown in fig. 2 to 6. From the particle size distribution curves the percentage of silt, sand and gravel in the respective samples were determined based on M.I.T classification. The values of the three constituents for each of the samples determined by this analysis are shown in Table 2.

4.2 Specific Gravity and Bulk Density

The specific gravity of soil is the ratio of the weight in air of a given volume of soil particles to the weight in air of an equal volume of distilled water at a temperature of 4 °C. Although the specific gravity is employed in the identification of minerals, it is of limited value for identification or classification of soil because the specific gravity of the most soil falls with in a narrow range. The results are tabulated in Table. 3 and 4 respectively.

Methodology for calculating Specific gravity::

Thoroughly washed dry density bottle was weighted (M1 gr.) and 20 grams of oven dried soil sample was transferred into the bottle, both sample and bottle weigh (M gr.) was taken.10 ml of deaired distilled water was poured into the bottle, so that the soil is fully soaked and left the sample for 4 hr after that more water was added to make the bottle full. The weight of the bottle along with the water and sample was taken(M3 gr.).The weight of the bottle fully filled with the distilled water was taken as M4.The Specific gravity of soil sample was calculated as $G = (M - M1) / \{(M-M1)-(M3-M4)\}$

Table 1
Sieve Analysis for Basantar Catchment

Sieve Opening (mm)	Location of Sites Selected for sieve Analysis										
	Ramkot Busstand					Basantar				Khoon nala	
	Barren	Agri.	Forest	Grass	Hill Barren	Barren	Agri.	Forest	Grass	Agri.	Barren
2.000	86.50	85.33	82.81	76.79	94.10	98.61	65.46	81.71	97.08	98.47	86.47
1.000	68.27	68.27	64.99	50.52	87.20	93.03	42.04	62.21	90.04	92.76	71.48
0.600	63.25	63.25	61.38	45.68	82.90	91.64	36.64	57.31	88.32	90.68	66.54
0.425	50.29	50.29	53.25	35.21	75.00	85.91	28.67	49.55	80.61	90.27	55.63
0.300	41.83	41.83	48.56	29.11	71.20	80.64	27.95	43.78	74.90	84.98	48.38
0.212	26.67	26.67	43.10	20.70	64.50	65.14	23.79	37.27	59.61	60.53	40.99
0.150	22.79	22.79	39.22	16.11	62.00	52.28	19.63	33.18	47.25	66.19	33.28
0.075	2.95	2.95	22.59	0.00	16.30	6.08	8.28	15.31	6.96	35.14	13.93

Fig. 2

Grain size distribution for site Ramkot Busstand

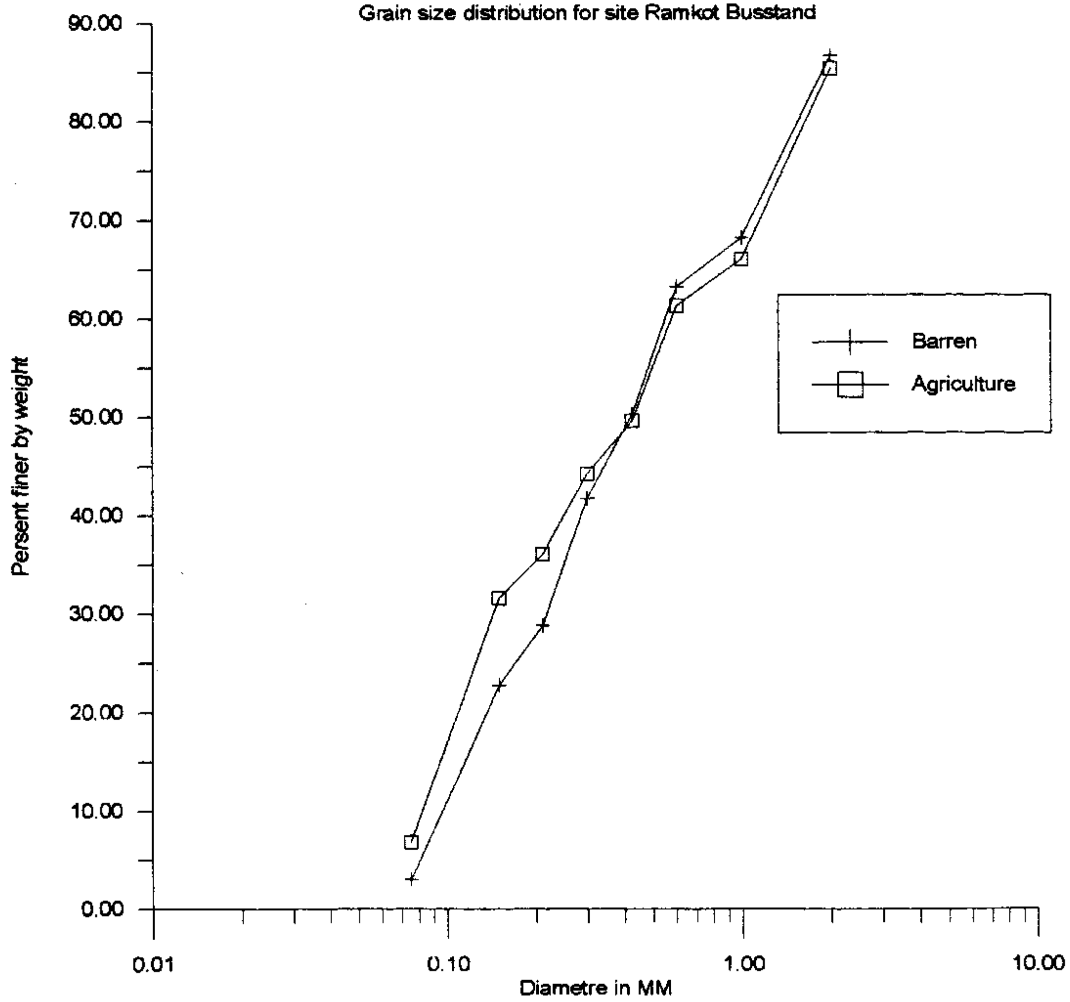


Fig. 3

Grain size distribution for site Ramkot Busstand

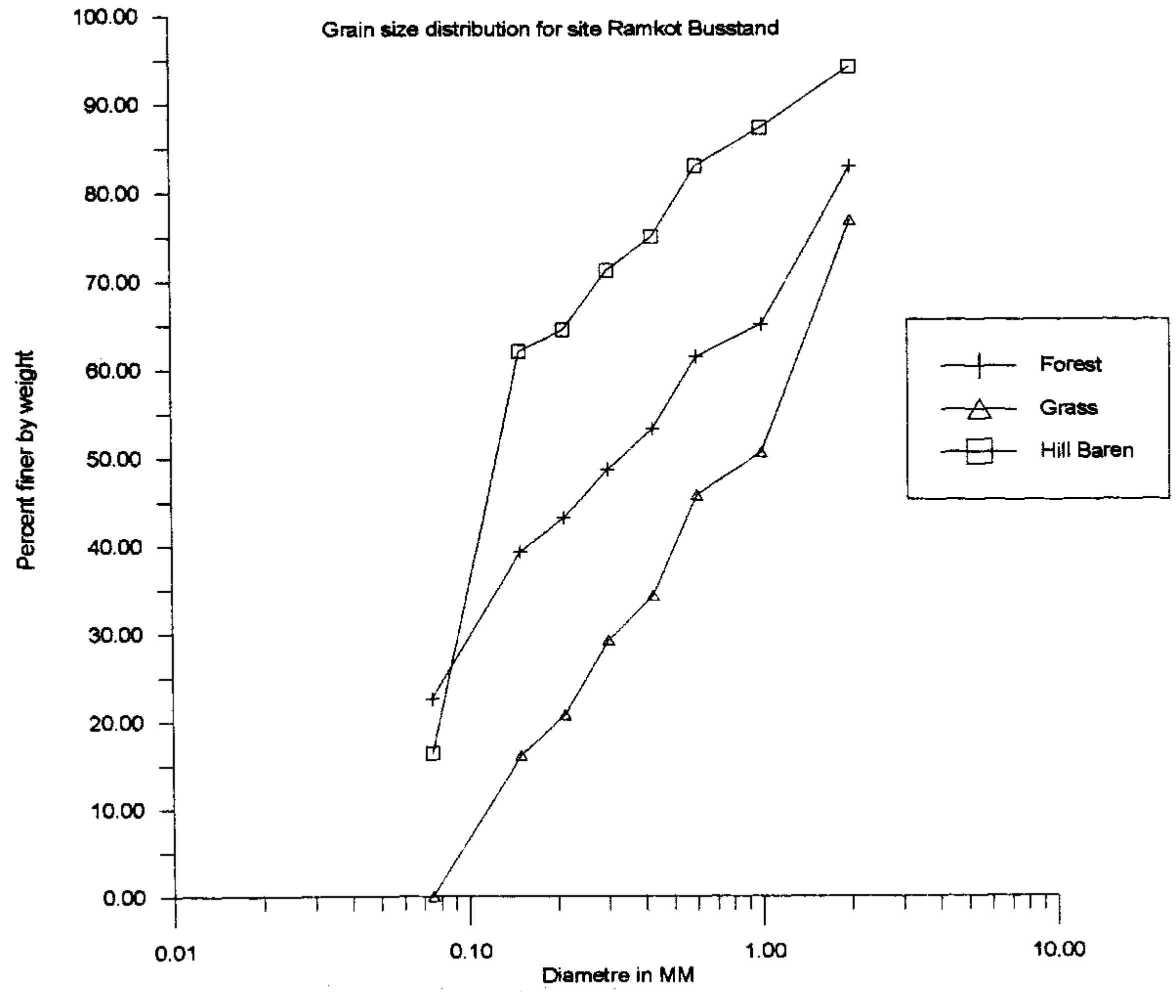


Fig. 4
Grain size distribution for site Basantar

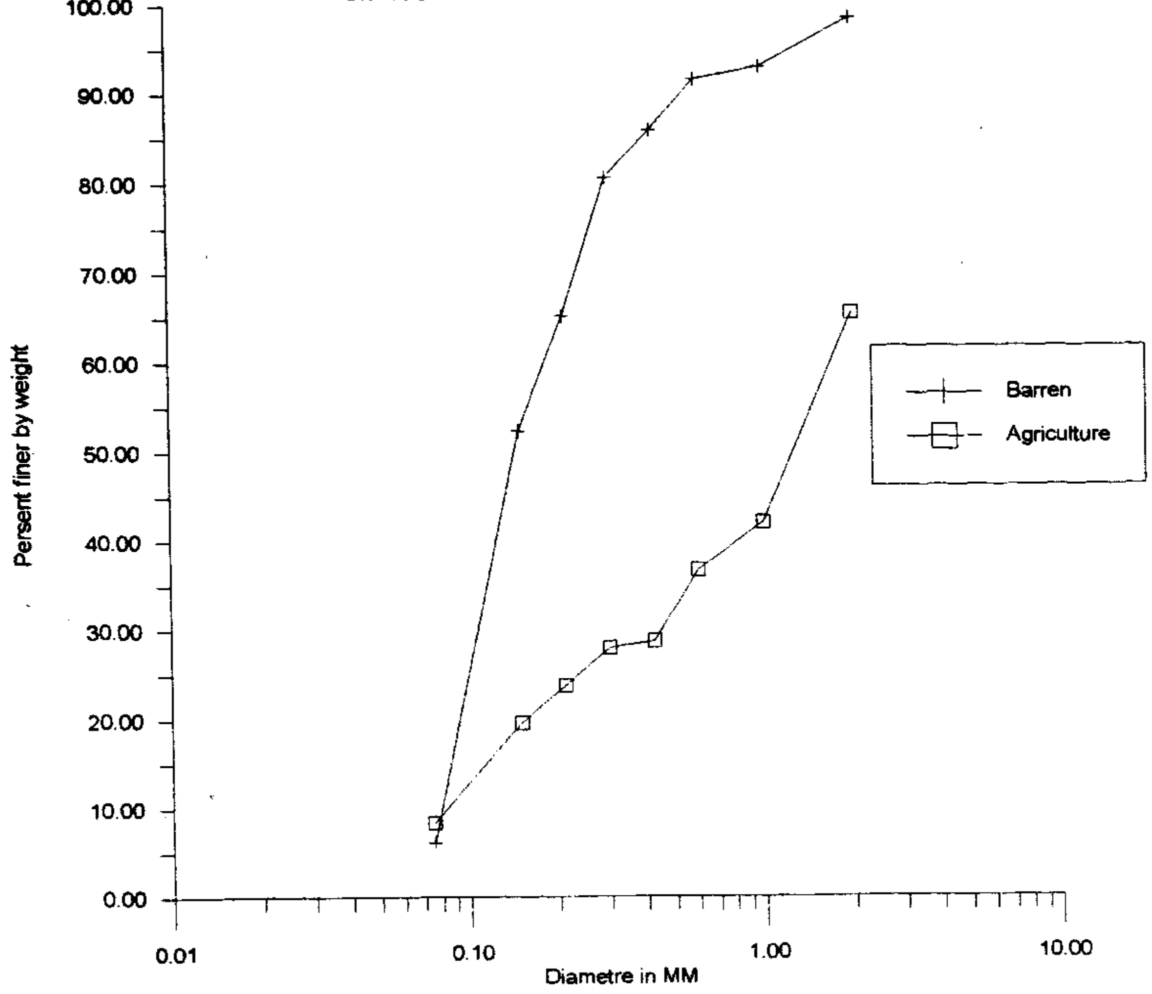


Fig. 5

Grain size distribution for site Basantar

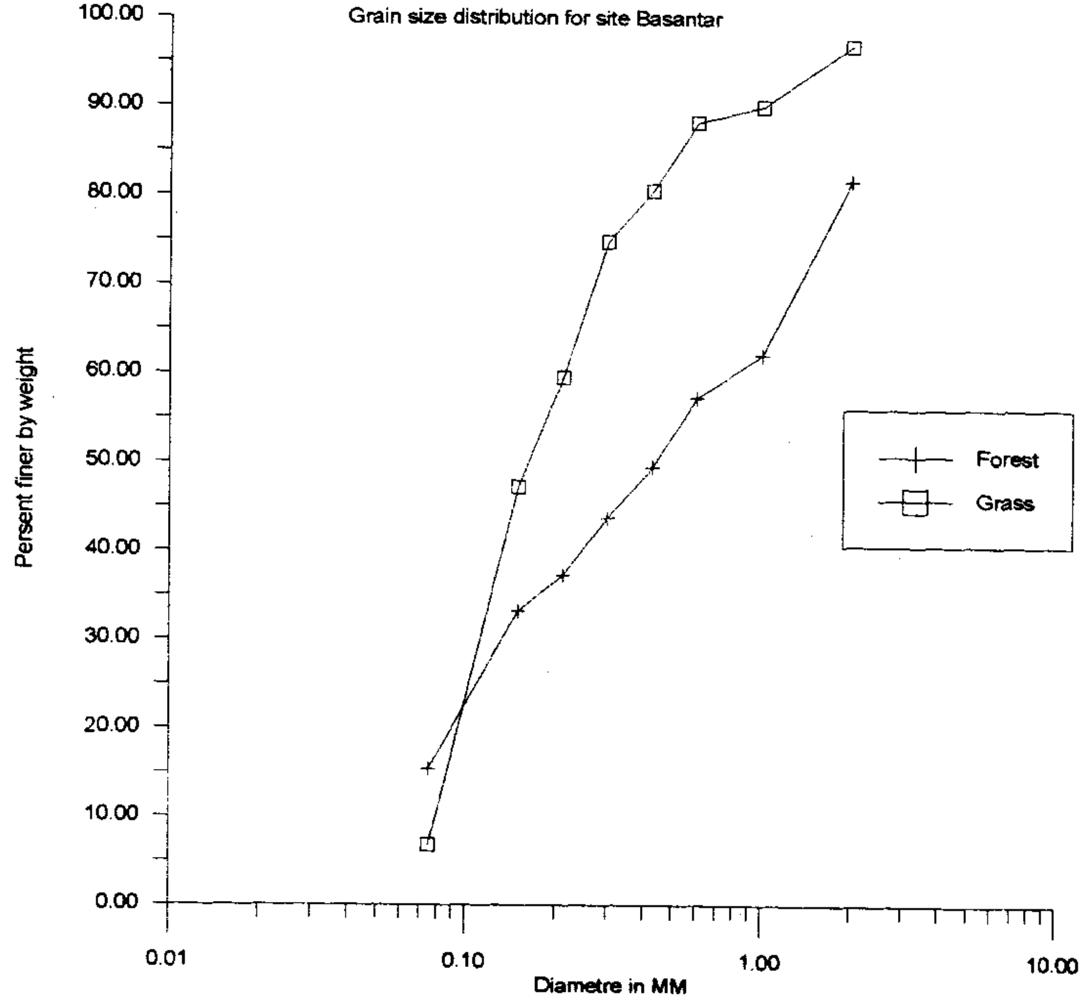


Fig.6
Grain size distribution for site Khul nalla

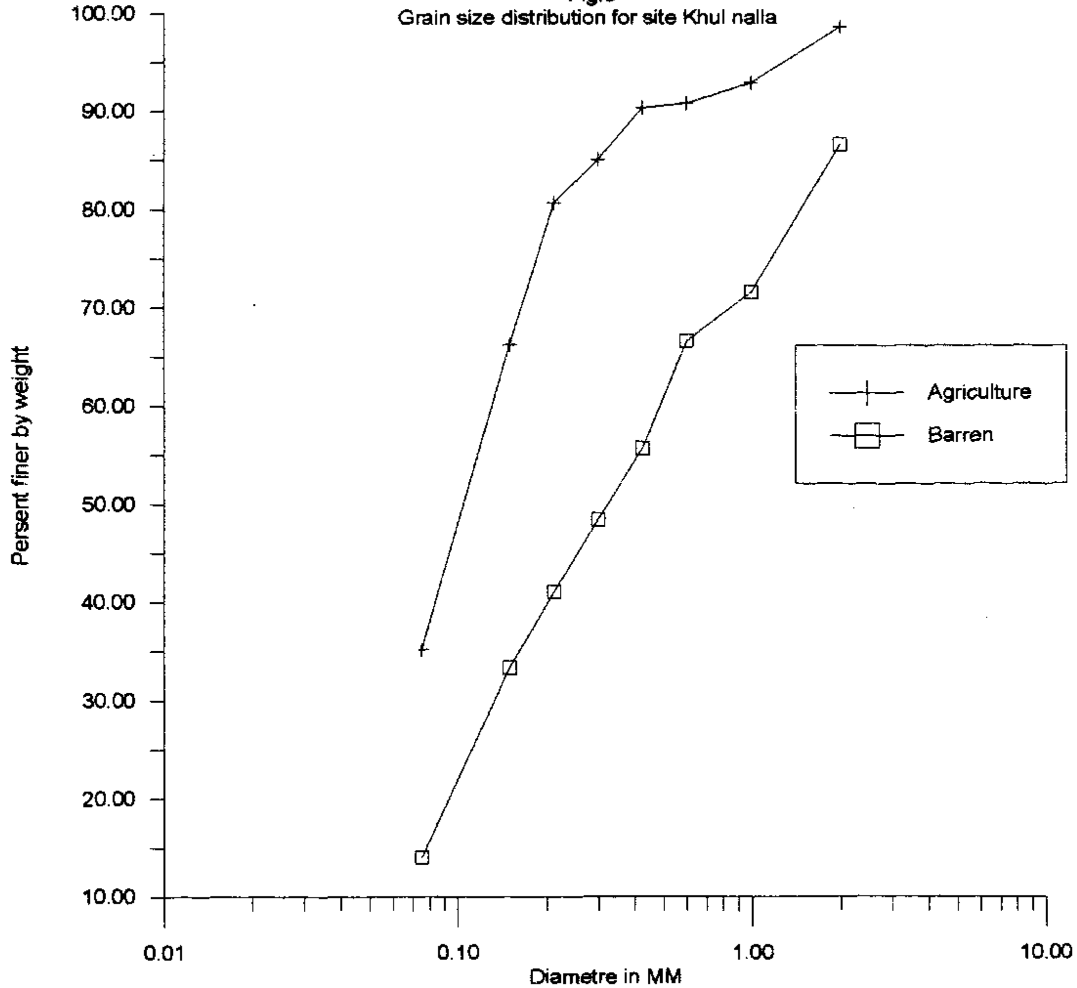


Table 2
Percentage of various type of soil in Basantar Catchment

Site location	Gravel	Sand	Silt
Ramkot Bustand Barren	13.35	83.07	3.58
Ramkot Bustand Agriculture	14.67	78.56	6.77
Ramkot Bustand Forest	17.19	60.22	22.59
Ramkot Bustand Grass	23.21	76.79	0
Ramkot Hill Barren	5.81	77.78	16.41
Bustand Barren	1.39	92.53	6.08
Bustand Agriculture	34.54	57.18	8.28
Bustand Forest	18.24	66.45	15.31
Bustand Grass	2.92	90.12	6.96
Khoon Nalla Agriculture	1.53	67.42	31.05
Khoon Nalla Barren	13.53	72.54	13.93

Table 3
Variation of Specific gravity under different landuse.

Location	Landuse			
	Barren	Forest	Grass	Agriculture
Basantar	3.066	2.900	3.171	3.475
Samba	1.660	2.670	2.000	2.660
Mansar	2.000	2.660	2.000	2.400
Rui	2.000	2.440	2.660	2.000
Aik	2.500	2.400	2.290	2.500
Nud	2.000	2.330	2.280	2.330
Devak	2.400	1.330	2.500	2.00.
Khoon nala	2.450	2.510	2.620	2.580
Ramkot	2.839	2.400	2.660	3.117
Challan	3.083	2.530	3.171	1.744

Table 4
Bulk density at different depths from surface of the Earth (Gr./CC)

Landuse	Depths	LOCATIONS									
		Basantar	Samba	Mansar	Rui	Aik	Nud	Devak	Khoon nala	Ramkot	Challen
Barren	0-15	1.1900	1.3700	1.7400	1.3200	1.6850	1.4350	1.4100	1.6800	1.7139	1.7955
	15-30	1.1500	1.7050	1.8500	1.4800	1.5300	1.5850	1.3100	1.6450	1.7366	1.9496
	30-45	1.4950	1.8450	2.0650	1.4400	1.6500	1.5500	1.3100	1.5900	1.6820	1.7770
Forest	0-15	1.5350	1.6200	1.8050	1.4800	1.3750	1.3650	1.3900	1.4400	1.4800	1.4918
	15-30	1.4950	1.7400	1.7500	1.4550	1.4500	1.5400	1.3900	1.5800	1.4550	1.2960
	30-45	1.1700	1.6200	1.7850	1.4400	1.3000	1.5650	1.2750	1.6200	1.4400	1.5510
Grass	0-15	1.7456	1.4000	1.7850	1.4050	1.635	1.4550	1.4650	1.2100	1.4050	1.1100
	15-30	1.7370	1.2600	1.9750	1.3150	1.5400	1.4900	1.3850	1.4300	1.3150	1.2100
	30-45	1.4280	1.4500	1.9800	1.3800	1.5050	1.4300	1.4100	1.6400	1.3800	1.2200
Agricultu re	0-15	1.6860	1.5750	2.0250	1.650	1.5700	1.6350	1.4200	1.5600	1.6550	1.6051
	15-30	1.5550	1.4900	1.8700	1.6300	1.4600	1.5500	1.3150	1.6200	1.6300	1.4640
	30-45	1.5600	1.7000	1.8200	1.5900	1.4700	1.3700	1.3800	1.5800	1.5900	1.5500

4.3 Porosity

Porosity is the percentage of the total soil volume that is not occupied by solid particles. Typically the pore space is occupied by water and air, the relative distribution of each a function of the time available for drainage of the water and the ability of the pores to drain dependent in turn, on their size, distribution and connectedness. If all soil particles are of the same size, shape and packing, then the pore space will be the same regardless of the particle size. Pore size is less in fine-textured soils, and is also reduced in size and total amount if some of the pores are filled with other, smaller soil particles.

In the soil pores, water is acted upon by forces of gravity and capillarity, often expressed as tension and reported in units of Pascal (atmospheres or bars) or as pF, the log within of the height of the water column, in centimeters. The later is the combined result of cohesion and adhesion. The tension at which water is held in the soil pores against the force of gravity depend upon the soil texture and soil structure. The former is concerned with the size and relative proportions of mineral particles, While the later is concerned how thick particles are arranged.

Soil texture affects percolation, the rate at which water moves down ward through soil, permeability, an expression of movement in any direction, and the hygroscopic constant, the water that is held at tension beyond 31 atmospheres, essentially physically and chemically bound to the soil particles.

The amount, nature and distribution of the particles and pores clearly determine the water relations of the soil and, as a consequence, stream behaviour. Some of the difference in hydrologic behaviours are shown in the table 5. The measure of pore space is called porosity, n, and ranges from about 0.25 to 0.70 in natural soils dependent upon packing, distribution, and uniformity of soil particles, and from 0.1 to 0.3 in rock (Dingman 1984)

Large quantities of water can readily infiltrate sandy soil as there are considerable large, interconnected pores. However, the tension at which much of water is held in sand is quite low, and water will permeate the profile rapidly and drain out. There is not sufficient tension to hold the water back against the force of gravity. In contrast, clays hold more water at very high tension more water may be drawn into a clay soil rapidly by capillarity, and a greater proportion of the water in the pore space will be held at higher tension than the sand. The result is that clays will not give up drainage water rapidly (if et all) since the force of gravity is too weak to remove the water from its high tension bond with the small clay particles. Water may be held at even higher tension and is response to chemical bonds, too, in colloidal suspension with in the soil. It is important to note, too, that " the rate of flow between two pores of different size is controlled by the pores of the smallest size" (Brutsaert 1963).

Porosity is an index of how much water can be stored in an aquifer but certainly it is not an index of its ability to yield water. The yield rate of an aquifer is a function of pores size and there interconnections. Fig.7 shows that with reducing particles size specific yield reduces while specific retention increases. When water is drained from a saturated material by gravity only a part of the volume stored is released. This portion of the stored water released is called specific yield. The portion of water which is not drained by gravity is called the specific retention, and the some of the specific yield and specific retention expressed as volume percentages is equal to the porosity.

Procedure

The computation of porosity involve the computation of void ratio. The two are unequally related by

$$n = \frac{e}{e+1}$$

The void ratio may be found from equation

$$e = \frac{G\gamma_w}{\gamma_d} - 1$$

In which G = specific gravity of soil solids

γ_w = the unit weight of water

γ_d = dry unit weight of soil solids

Procedure for getting the specific gravity was given in preceding section. Dry unit weight of soil grains was calculated by water displacement method; in which mass of the soil sample (M_1) was coated with melted wax of known specific gravity. The mass of the wax coated sample M_2 was calculated. Wax coated sample was slowly immersed into the container which was completely filled with water and the volume of the over flown water was measured. Wax coated sample was taken out after drying the sample wax was removed and the water content of the sample was calculated. Finally the dry unit weight of sample was calculated as below.

Mass of the specimen M_1 gr.
Mass of wax specimen M_2 gr.
Mass of wax coated $Mp = M_2 - M_1$ gr.
Density of paraffin wax = Gp (Gr./ml)
Vol. of wax coated Vp = Mp / Gp (ml)
Vol. Of water displaced Vw ml.
Vol. Of specimen V = Vw -Vp (ml.)
Bulk density $\rho = M_1/V$
Water content ratio w
Dry density of specimen $\rho_d = \rho/(1+w)$ gr./cm^3
Dry unit weight of specimen $\gamma_d = 9.81\ \rho_d$ (KN. / cm^3)
Specific gravity of soil sample = G
Unit weight of water γ_w (KN / cm^3)

$$\text{Void ratio } e = \frac{G\gamma_w}{\gamma_d} - 1$$

Samples collected from different site were analysed for porosity in WHRC, Jammu, Soil laboratory and results were tabulated in Table.6

Table.5
Textural Classes of Soils and Permeability

General texture	textural classes	permeability
Clayey(Heavy)	Clay Silty Clay Sandy Clay	very Slowly
Moderately Clayey	Silty Clay Loam Clay Loam	Slowly
Loamy(medium)	Sandy Clay Loam Silt Loam Loam Very Fine Sandy Loam	Moderately
Sandy Light	Find Sand Loam Sandy Loam Loamy Fine Sand	Rapidly
Very Sand	Loamy Sand Fine Sand Sand	Very Rapidly

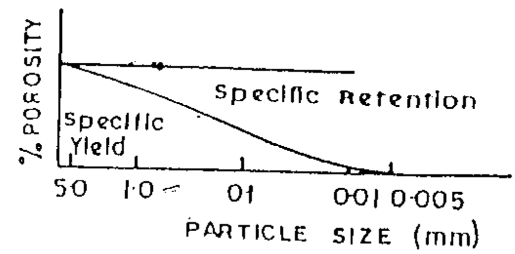


Fig.7
Reduction of specific yield with reducing particles size

Table.6
Porosity at different depths from surface of the Earth (in percentage)

Landuse	Depths from ground surface (cm)	LOCATIONS									
		Basantar	Samba	Mansar	Rui	Aik	Nud	Devak	Khoon nala	Ramkot	Challen
Barren	0-15	50.0	45.0	32.5	42.5	42.5	42.5	47.5	45.0	22.5	27.5
	15-30	45.0	35.0	31.0	42.0	47.5	37.5	50.0	50.0	25.0	35.0
	30-45	55.0	30.0	21.0	41.5	44.0	42.5	52.5	52.0	25.0	26.0
Forest	0-15	52.5	37.5	34.0	40.0	50.0	42.5	46.0	50.0	40.0	45.0
	15-30	55.0	40.0	32.5	42.5	45.0	45.0	52.5	45.0	42.5	42.5
	30-45	57.5	40.0	32.5	46.0	52.5	52.5	55.0	32.5	46.0	30.0
Grass	0-15	37.5	45.0	45.0	45.0	47.5	47.5	40.0	43.5	45.0	42.5
	15-30	52.5	52.5	52.5	47.5	42.5	42.5	50.0	40.0	47.5	41.0
	30-45	37.5	45.0	40.0	47.5	43.5	43.5	50.0	39.5	47.5	40.0
Agricultu re	0-15	32.5	45.0	45.0	37.5	45.0	45.0	50.0	35.0	37.5	35.0
	15-30	60.0	50.0	50.0	40.0	42.5	42.5	52.5	51.0	40.0	27.5
	30-45	35.0	32.5	32.5	32.5	50.0	50.0	50.0	52.0	32.5	32.5

4.4 Infiltration

The phenomena of infiltration deserves a special place in hydrologic studies as the understanding of the same enables us to estimate more effectively the amounts of runoff originating from precipitation and the results thereof can be applied more confidently to the design problems. The study of infiltration is very important to arrive at the estimate of rainfall excess from the given precipitation so as to have an idea of the resulting flood.

Infiltration is here defined as movement of water from the atmosphere to the soil across some definable but intangible interface. It is reported in units of depths per hour. Infiltration might best be regarded as concept because one cannot see or directly measure it without influencing its value. However, it may be approximated by variety of different methods, and the concept itself is useful in understanding this critical zone where precipitation or snowmelt first encounters the porous medium, the properties of which will determine how the water ultimately arrives at the stream.

The maximum rate that the air-soil interface will take is known as the infiltration capacity. This attribute of the soil, is expressed as a rate in centimeter per hour and is a function of soil surface condition (e.g., occurrence of litter) and surface horizon characteristics (texture and structure). It is further influenced by the rate at which the water is supplied to the soil and by the percolation rate, which in turns is dependent upon the amount of water in the soil at the start of the event and the time since the event began.

The rate at which infiltration actually occurs is always equal to or less than the infiltration capacity. Generally, both infiltration capacity and infiltration are influenced by the rate at which water is supplied to the soil surface, for instance, rainfall intensity. Infiltration and infiltration capacity are coincide if the rate at which water (precipitation, run-off, or snow melt) supplied to the soil surface exceeds the infiltration capacity.

Under naturally, undisturbed condition in the forest, infiltration capacity is almost always high enough to preclude natural overland flow (surface runoff, in general). Occasionally under particularly intense storms, on this saturated soils, surface runoff for short distance may be observed, but such condition are rare. If the soil surface is severely disturbed, infiltration rates may suffer drastic reductions, some times to as low as zero. With varying degree of disturbance and protection, infiltration may recover to pre disturbance rate especially with adequate protection and occurrence of frost which restores permeability.

Quantification of infiltration and infiltration capacity has been the subject of a large number of studies, with most of the successful measurement being made on disturbed, non forested lands, especially crop and range lands.

Methodology:

Commonly used methods for determining infiltration capacity are hydrography analysis and infiltrometre studies. Infiltrometres are usually classified as rainfall simulators or flooding devices. Flooding infiltrometers are usually rings or tubes inserted in the ground. Water is applied and maintained at a constant level and observation are made on the rate of the replenishment required. The present study has been conducted using a double ring cylinder infiltrometre discussed as follows:

Assembly:

In double ring cylinder infiltrometre, a small cylinder is placed concentrically inside another cylinder. Diameter were 30 cm for inner cylinder and 45 cm for outer cylinder. The height was 45 cm for both cylinders. The edge of the cylinder should be as large as practicable to get a true measure of the vertical infiltration.

Installation:

Cylinder infiltrometres should be installed with as little disturbance of the soil as possible. the soil surface should be in its natural condition and free from wood stems, rocks, or other items that may get caught under the cylinder edge on inserting the device. The depth of penetration of the cylinder should be as small as possible to minimize soil disturbance, but enough to prevent water from blowing out a hole under the cylinder wall. Penetration of about 5-10 cm is sufficient. If the soil surface is cracked, the cylinder should penetrate the soil at least as deep as the cracks, to prevent water from escaping laterally through cracks below the cylinder wall, the soil should be pushed or packed back against the cylinder.

Measurement of Infiltration

The water used in infiltrometre tests must be of the same quality and composition as the water in the real systems for which the infiltration rate is to be estimated. Also the water must be at about the same temperature as the soil. Equal water levels must be maintained in both cylinders (Bouwer, 1963) and the infiltration is measured on the inner cylinder only. The thought behind the double cylinder system was to let the outer annular space between the two rings absorb all the edge and divergence effects, so that the Infiltration from the inner ring would be a true measure of vertical infiltration rate of the soil.

Double ring cylinder infiltrometres could be effective only where there is a surface crust, an impeding layer on the surface, or other soil condition that makes it different to get a good bound between the undisturbed soil and the cylinder wall. Leakage along the cylinder wall can be minimized by placing another cylinder around the infiltrometre and maintaining the water level in there at exactly same height as in the inner cylinder.

Variation in Infiltration rates under different landuse conditions.

The field tests were conducted for barren lands, agriculture lands, grass lands and forest lands. Table.7 gives the initial and final infiltration capacities for different land use at various locations and result are described through correspondent infiltration curves (fig.8 to fig.11). It was found that the initial infiltration capacities for barren lands, grass land, agriculture land and forest lands varied from 3.6 to 14.5, 3 to 3.61, 9.6 to 18.08 and 9.8 to 13.81 cm/hr respectively. Where as , the final Infiltration capacities for same land uses were found to be varying from 0.14 to 1.36, 0.36 to 0.77, 0.8 to 2.59 and 1.2 to 1.31 cm/hr.

Fig 8

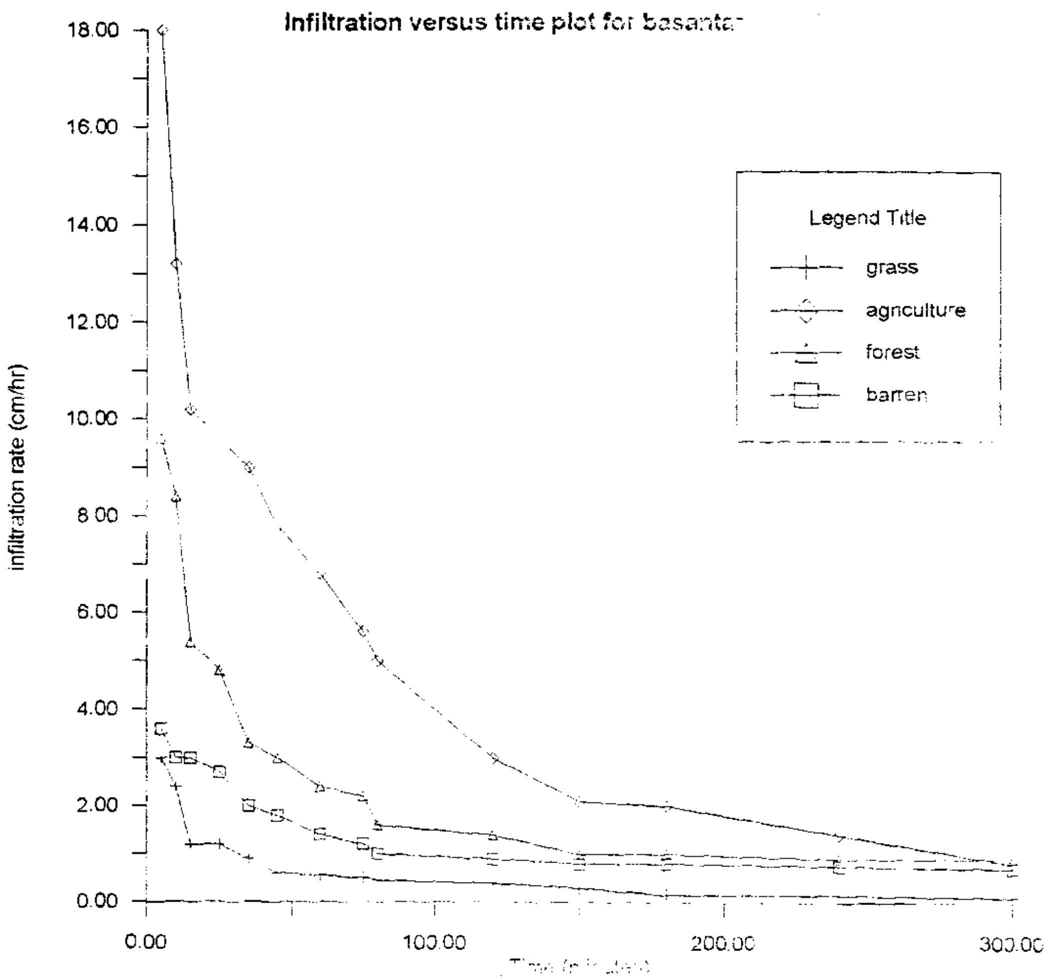

Infiltration versus time plot for basanta
infiltration rate (cm/hr)
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
100.00
200.00
300.00
Legend Title
grass
agriculture
forest
barren

Fig 9

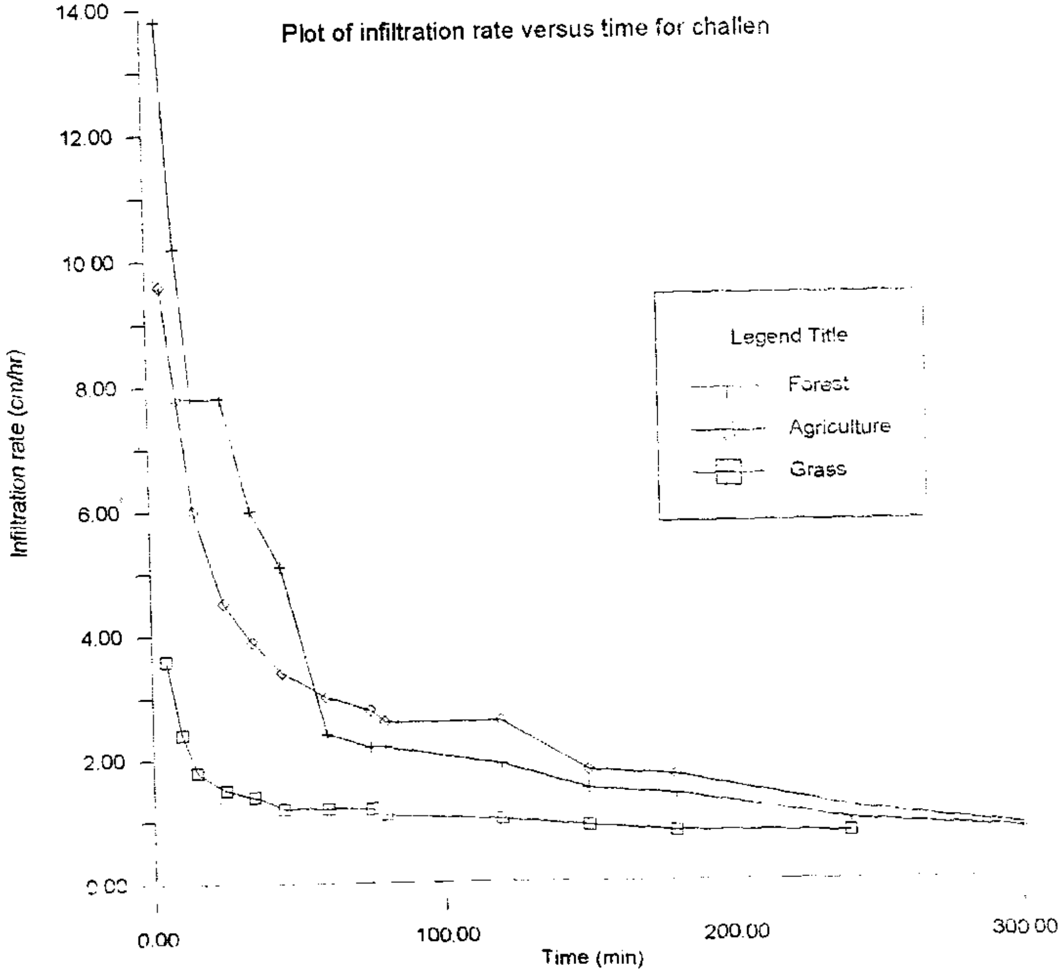
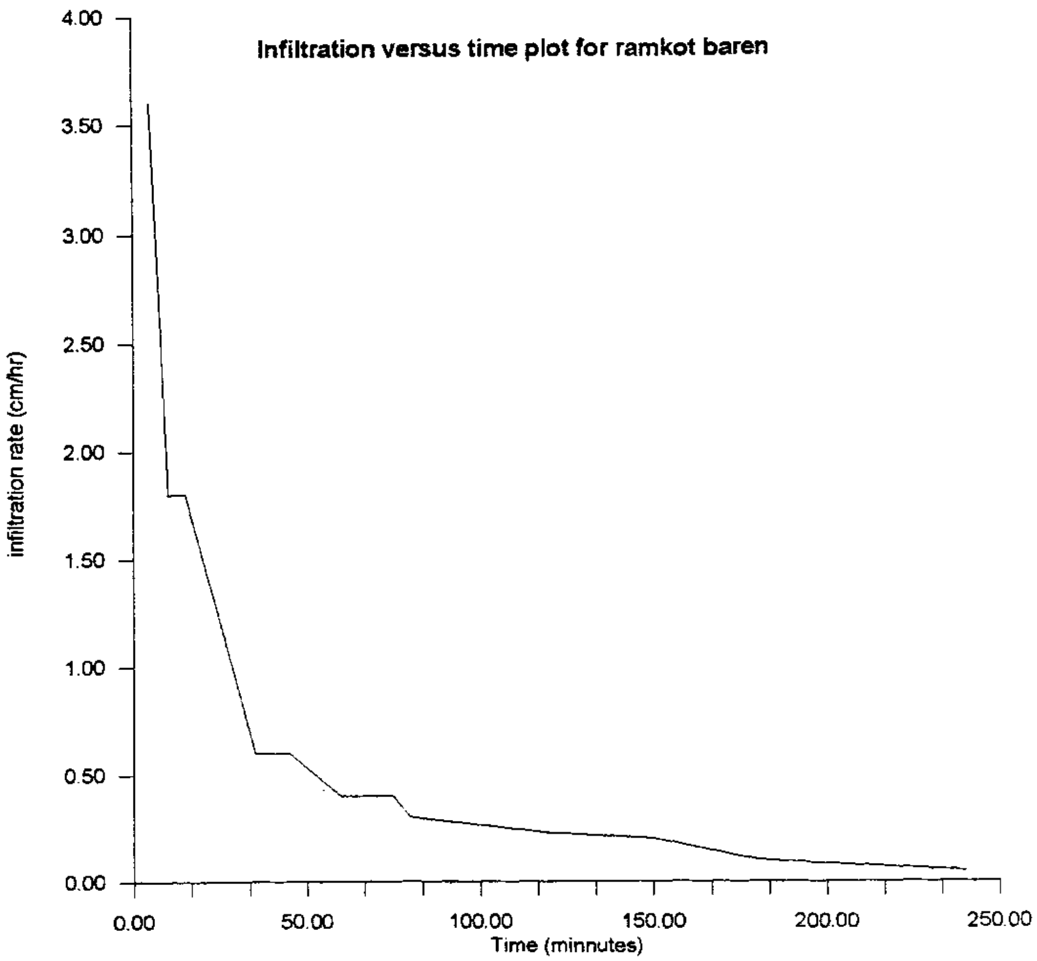

Plot of infiltration rate versus time for challen
Legend Title
Forest
Agriculture
Grass
Infiltration rate (cm/hr)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
100.00
200.00
300.00
Time (min)

Fig 10



Infiltration versus time plot for ramkot baren
infiltration rate (cm/hr)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Time (minnutes)

Fig 11

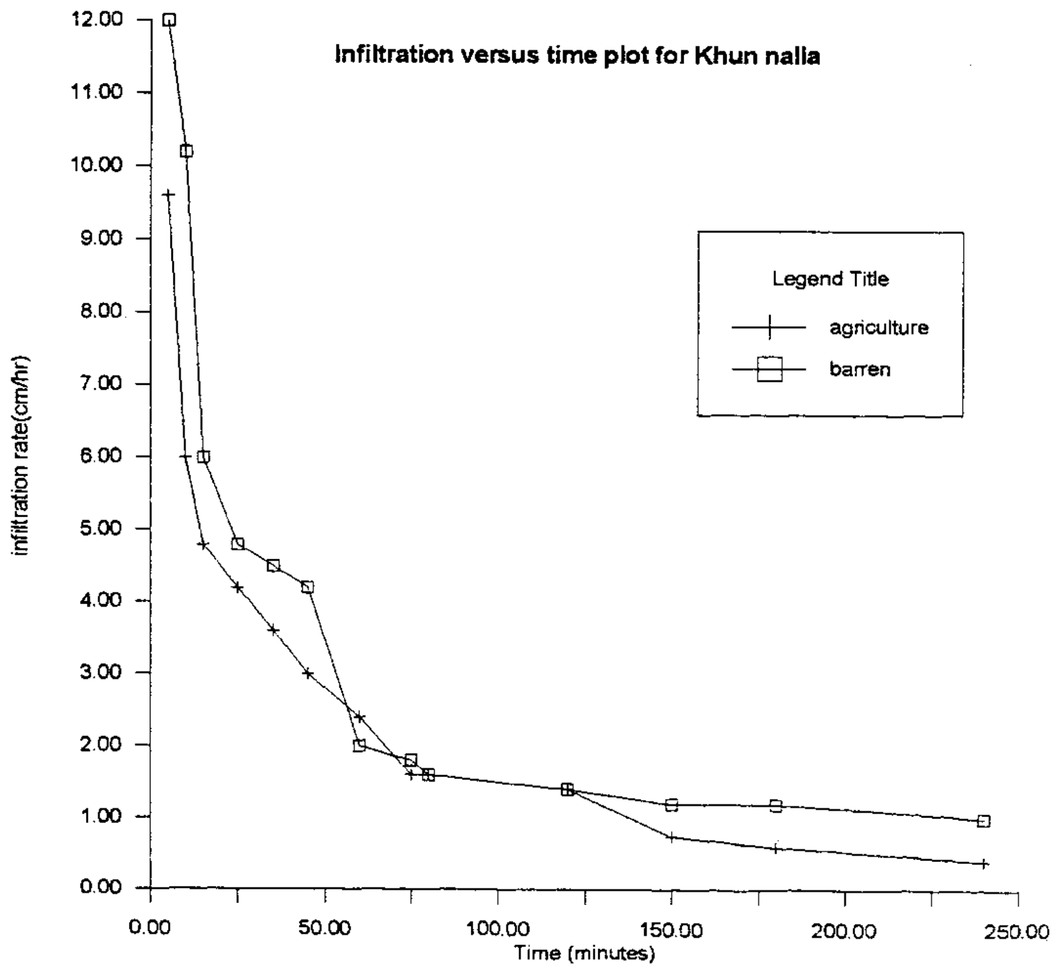

Infiltration versus time plot for Khun nalla
infiltration rate(cm/hr)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Time (minutes)
Legend Title
agriculture
barren

Table.7
Infiltration rates under different Landuse of Basantar catchment

Landuse	Tests	Infiltration Rates (cm/hr.) Initial	Average	Final	Location	Date of Sampling
Barren	1	3.60	6.40	0.05	Ramkot	22.7.96
	1.	12.00		1.00	Khoon nala	26.7.96
	3	3.60		0.70	Basantar	24.7.96
	4	105.00		0.85	Challan	25.7.96
Grasss	1	3.00	3.30	0.15	Basantar	23.7.96
	2	3.60		0.75	Challan	25.7.97
Agriculture	1	9.60	12.40	0.2	Khoon nala	26.7.96
	2	18.00		0.80	Basantar	23.7.97
	3	9.6		0.85	Challan	25.7.97
Forest	1	9.6	11.70	0.90	Basantar	23.7.96
	2	13.80		0.80	Challan	26.7.96

4.5Permeability

Permeability is defined as the porosity of a porous material which permits the passage or seepage of water (or other fluids) through its interconnecting voids. A material having continuous voids is called permeable. Gravel are highly permeable while stiff clay is the least permeable, and hence such a clay may be termed impermeable for all practical purposes.

Darcy (1856) showed experimentally that the rate of water q flowing through soil of cross - sectional area A was proportional to the imposed gradient i or

$$q/A \sim i \quad q = kiA$$

The coefficient of permeability has been called " Darcy's coefficient of permeability" or "coefficient of permeability" or permeability. The study of seepage of water through soils is important for the engineering problems involving flow of water through soils such as seepage under dams, the squeezing out of water from a soil by the application of load, and drainage of sub grades, dams, and back fills. The effective strength of the soil is often controlled by its permeability.

The various factors affecting permeability include grain size, properties of the pore fluid, void ratio of the soil structural arrangement of the soil particles, entrapped air, and foreign matters, adsorbed water in clay soils.

Methodology:

The coefficient of permeability can be determined by the following method:

(a) Laboratory methods

(1) Constant head permeability test.

(2) Falling head permeability test.

(b) Field methods

(1) Pumping-out tests.

(2) Pumping-in tests.

(c) Indirect methods

(1) Computation from grain size or specific surface.

(2) Horizontal capillarity test.

(3) Consolidation test data.

Permeability can be determined in the laboratory by direct measurement with the help of permeametres, by allowing water to flow through soil sample either under constant head or under variable head. Permeability can also be determined directly by field test. Permeability can also be computed by the consideration of grain size or from considerations of specific surface as given by Kozeny's formula or Loudon's formula. The present study has been conducted using ICW laboratory permeametre.

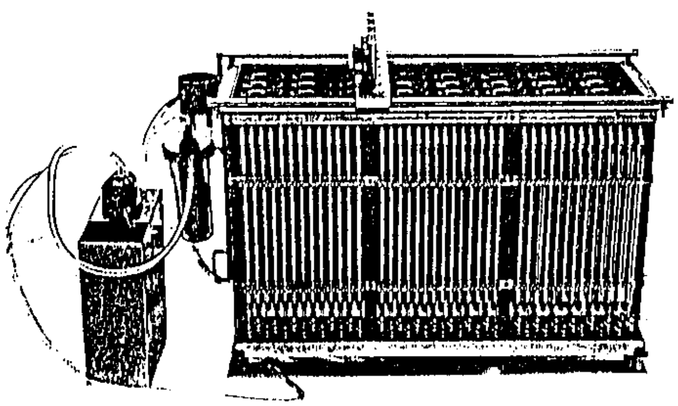


Fig. 12: ICW laboratory permeametre

Preparation of soil sample:
Undisturbed soil samples were collected from field by driving a stainless steel cylinder of size 53 X 55 mm (content 100 cc) and collected soil samples were brought to laboratory, top and bottom of the ring sample were checked to determine whether they have not been sealed up. Spot seals were removed by taking away tiny particles with the point of a knife, so that pores and root passage are reopened and it was kept in a water basin for two days, the water level in the basin must remain approx. 1 cm below the top of the sample ring.

Determining permeability with a constant head:
The siphons, previously filled with water, are placed when the water level inside the ring holders is about the same as outside. These keep the water above the samples up to a determined level, which can be adjusted by moving the nylon pipes and glass burettes in height. When measuring a constant level difference (h) should be maintained between in- and outside of the ring holder, which can vary between 2 mm (high permeable soils) and 20 mm (poor permeable soils). The k- factor can be best determined with the level difference as small as possible. The water is allowed evenly through the sample, and when quantity per unit of time (cm/min) has reached a constant reading, then essed with a formula,

$$K=144(Q.L)/(h.F_1)$$

where,

K, coefficient of permeability in m/day
Q, quantity of through-flowing water per unit time (cm3/min)
L, length of the sample (m)
h, level difference inside/outside the ring or ring holder (m)
F_1, area of cross section of the soil sample (cm2)

The results obtained by falling head method was tabulated in table No.3

Table 8

Variation of permeability (m/day) under different landuse

LOCATION	LANDUSE			
	Barren	Forest	Grass	Agriculture
Basantar	0.091	0.099	0.621	1.210
Samba	0.011	0.062	0.421	1.012
Mansar	0.022	0.122	0.322	1.001
Rui	0.032	0.103	0.323	1.021
Aik	0.021	0.098	0.721	1.410
Nud	0.042	0.097	0.788	1.630
Devak	0.082	0.122	0.821	1.712
Khoon nala	0.0981	0.108	0.822	1.721
Ramkot	0.062	0.107	0.799	1.620
Challan	0.004	0.066	0.421	1.009

4.6 Moisture content

Among most frequently determine soil characteristics is water content and is defined as the ratio of weight of water to weight of soil in a given mass of soil. The water content is generally expressed as a percentage and it may also be expressed as a fraction. In this study
the moisture content was determined using Oven drying method.

The undisturbed samples were collected and weighed, w, at site and brought to soil laboratory in plastic covers, collected soil were kept in a oven (105 -110 °C) for about 24 hours. So that it became perfectly dry. Its dry weight,w_d, is then measured and water content is calculated from below equation

$$W = [(w-w_d) / (w_d)] X 100$$

The results of tests are tabulated in Table.9

4.7 Soil Moisture Retention curves:

Preparation of soil sample and procedure

Collected samples from different landuse were fully saturated for 24 hours after drying, powdered and passing through a 2mm sieve. Saturated samples were kept in soil sample retaining rings, on the ceramic plate to receive the group of samples. Each ceramic plate cell will accommodate 12 sample when retained in the rings. Samples in ring were levelled and covered with square of waxed paper. Samples were allowed to stand for 16 hours with an excess of water on the plate. The excess water from the ceramic plate were removed with a pipette, mount the cells in the extractor and connect up the outflow tubes. All unused outlet parts were closed with the plug bolts. Pressure at 1/3 bar was built up in extractor with the help of compressor. Pressure was maintained at 1/3 bar and samples were removed when readings on the outflow Burette indicate flow has stopped and equilibrium obtained.

At the close of a run the external tubes running from the out flow tube assemblies should be removed to prevent possible back flow of water when the pressure in the extractor is released.

Immediately after the pressure regulator is shut off and the pressure exhausted from the extractor, the clamping bolts and lid are removed. Samples are transferred to moisture boxes as soon as possible after release of pressure in order to avoid changes in the moisture content. The above said procedure was repeated for determining moisture retention against 1,3,5 and 11 bars. Results obtained from the testing of the samples are given in table No.10

Table 9
Moisture content at different depths from surface of the Earth (in percent)

Landuse	Depths from ground surface (cm)	LOCATIONS									
		Basantar	Samba	Mansar	Rui	Aik	Nud	Devak	Khoon nala	Ramkot	Challen
Barren	0-15	10.697	16.590	18.367	7.3177	9.771	-na-	-na-	43.589	10.289	10.642
	15-30	30.603	16.380	17.440	6.859	9.677	-na-	-na-	44.933	17.280	16.525
	30-45	31.140	14.240	18.680	10.770	10.000	-na-	-na-	47.910	24.700	18.892
Forest	0-15	35.242	16.546	15.335	-na-	-na-	14.196	8.593	42.120	24.700	15.918
	15-30	35.910	15.610	12.900	-na-	-na-	12.41	12.100	43.320	34.960	11.367
	30-45	35.390	12.890	17.910	6.273	-na	17.191	14.860	46.890	39.280	13.620
Grass	0-15	10.452	13.360	17.434	10.916	9.364	-na-	-na-	43.840	20.734	12.920
	15-30	16.120	12.500	15.497	-na-	12.00	-na-	-na	44.880	18.196	14.880
	30-45	18.410	15.540	16.810	-na-	11.800	6.610	7.224	46.000	16.343	16.719
Agriculture	0-15	27.512	27.016	24.690	10.795	15.866	17.210	10.937	21.400	12.795	16.580
	15-30	18.270	27.900	24.670	14.84	18.148	16.013	19.370	18.04	14.390	14.940
	30-45	17.300	18.500	28.990	11.6	20.600	12.250	36.000	15.500	11.600	14.000

Derivation of Field capacity and Wilting Point

Soil moisture tension is not necessarily an indication of the moisture content of the soil nor the amount of the water available for plant use at any particular tension. These are dependent on the texture, structure and other characteristics of the soil and must be determined separately for each soil. A knowledge of the amount of water held by the soil at various tension is required, in order to understand the amount of water that is available to plants, the water that can be taken up by the soil before percolation starts, and the amount of water that must be used for irrigation.The field capacity of soil is the moisture content after drainage of gravitational water has become very slow and the moisture content has become relatively stable. this situation usually exists one to three days after soil has been thoroughly wetted by rain or irrigation. At field capacity, the large soil pores are filled with air, the micro pores are filled with water and any further drainage is slow. The field capacity is the upper limit of available moisture rang in soil moisture and plant relations. The soil moisture tension at field capacity varies from soil to soil, but it generally ranges from 1/10 to 1/3 atmospheres.

Field capacity is determined by ponding water on the soil surface in an area of about 2 to 5 sq. m. and permitting it drain to drain for one to three days, with surface evaporation prevented. Evaporation may be prevented by spreading a polythene sheet or a thick straw mulch on the ground surface. One to three days after the soil is thoroughly wetted, soil samples are collected with an auger from different soil depths at uniform intervals throughout the wetted zone. The moisture content is determined by gravimetric method.

Permanent wilting percentage, also known as permanent wilting point or wilting co-efficient, is the soil moisture content at which plats can no longer obtain enough moisture to meet transpiration requirements; and remain wilted unless water is added to the soil. At permanent wilting point the films of water around the soil particles are held so tightly that roots in contact with the soil cannot remove the water at sufficient rapid rate to prevent wilting of the plant leaves. It is a soil characteristics, as all plant whose root systems thoroughly permeats the soil will wilt at nearly the same soil moisture content when grown in a particular soil in a humid atmosphere.

The moisture tension of a soil at the permanent wilting point ranges from 7 to 32 atmospheres, depending on soil texture, on the kind and condition of the plants, on the amount of soluble salts in the soil solution, and to some extent on the climatic environment. Since this point is reached when a change in tension produces little change moisture content, there is little difference in moisture percentage regardless of the tension taken as the permanent wilting point. Therefore, 15 atmosphere is the pressure commonly used for this point.

The wilting Rae is the range in soil-moisture content through which plants undergo progressive degrees of permanent or irreversible wilting, from wilting of the oldest leaves to complete wilting of all leaves. At the permanent wilting point, which is the top of this range, plant growth cease. Small amounts of water can be removed from the soil by plants after growth ceases, but apparently the water is absorbed only slowly and is enough only to maintain life until more water is available. The moisture content at which the wilting is complete and the plant s die is called the ultimate wilting. Although the difference in the amount of water in the soil between the two points may be small, there may be big difference in tension. At the ultimate wilting point soil-moisture tension may be as high as 60 atmospheres.

Table 10
Percentage moisture content at various pressure

Landuse	Pressure	Location							
	In bars	Aik	Devak	Nud	Mansar	Ramkot	Khun nalla	Basantar	Samba
Barren	1/3	13.79	14.81	6.66	10.12	8.10	9.21	14.81	10.71
	1	10.17	12.10	4.0	9.21	5.26	8.22	10.71	8.33
	3	7.14	3.44	4.0	8.33	2.85	7.33	9.09	7.14
	5	3.44	3.44	3.84	5.26	2.82	5.26	3.44	4.0
	11	3.33	3.13	3.70	3.70	2.66	3.70	3.44	3.70
Fortest	1/3	7.14	17.39	13.0	14.22	7.69	1851	15.38	7.81
	1	5.55	5.88	9.09	8.76	6.89	10.70	14.11	1200
	3	5.55	5.55	8.69	4.16	3.70	8.33	9.09	7.69
	5	5.26	5.26	4.54	4.00	3.57	3.84	7.69	4.34
	11	2.00	4.00	4.16	4.16	3.44	3.70	6.14	3.84
Grass	1/3	13.04	10.71	12.5	9.10	16.66	8.10	17.92	9.09
	1	7.69	10.34	8.69	8.92	12.50	7.94	11.15	6.21
	3	4.34	8.33	5.00	8.69	9.52	6.62	4.54	4.18
	5	4.16	7.69	4.76	8.33	8.69	4.33	3.84	3.84
	11	4.16	3.70	4.54	4.16	4.39	4.16	3.70	2.12
Agriculture	1/3	14.2	14.28	14.81	9.52	15.00	17.88	17.92	14.28
	1	13.79	8.69	11.11	8.33	9.09	16.60	13.33	11.53
	3	3.57	5.88	8.33	8.33	8.00	4.34	13.79	5.84
	5	3.57	5.00	4.16	8.00	4.34	4.00	6.66	5.55
	11	3.44	5.00	4.00	4.00	2.85	3.84	4.22	5.26

The most common method of determining the permanent wilting percentage is to grow indicator plants in containers, usually in small cans, holding about 600 grams of soil. Sunflower plant is commonly used as the indicator plant. The plants are allowed to wilt and are then placed in chamber with an approximately saturated atmosphere to test them for permanent wilting. The residual soil moisture content in the container is then calculated which is the permanent wilting percentage. The determination of moisture content at 15 atmosphere tension which is the usually assumed value of permanent wilting point, can be done by the pressure membrane apparatus.

Fig. 13

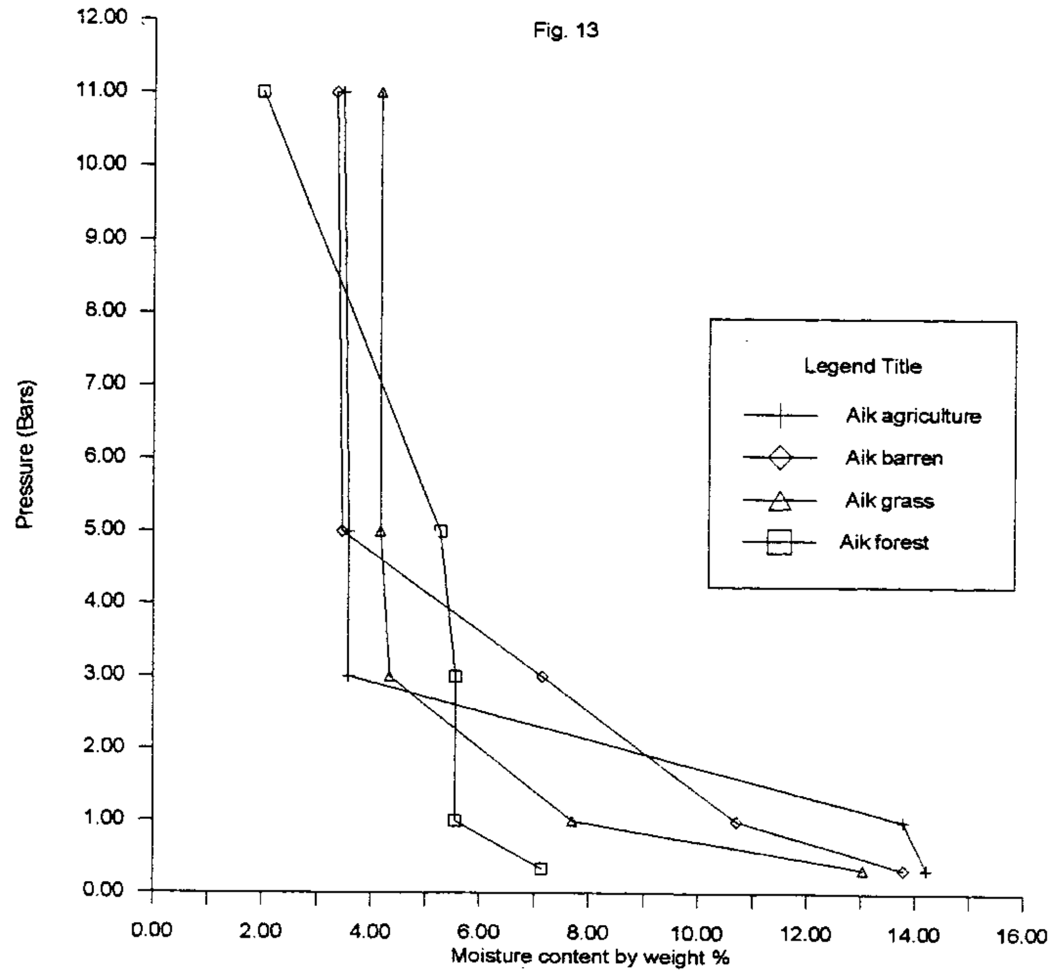
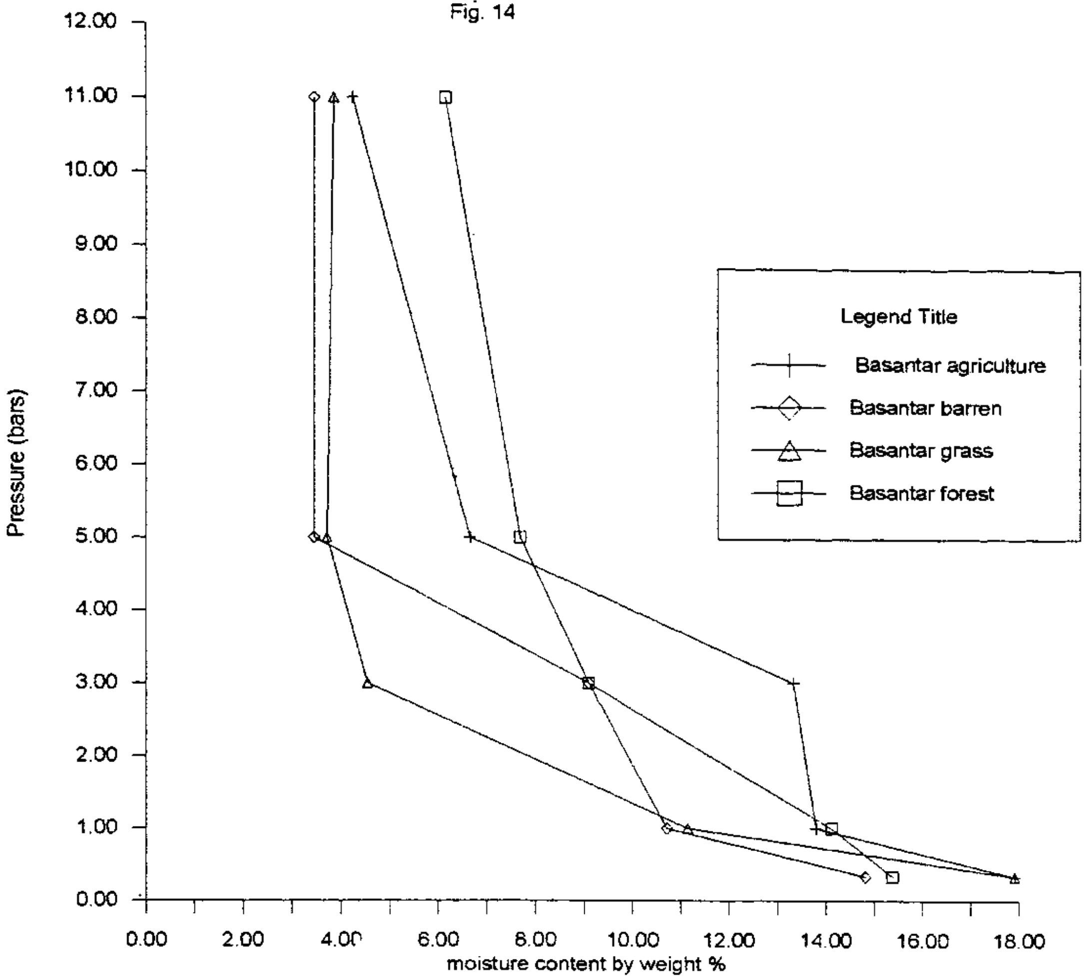
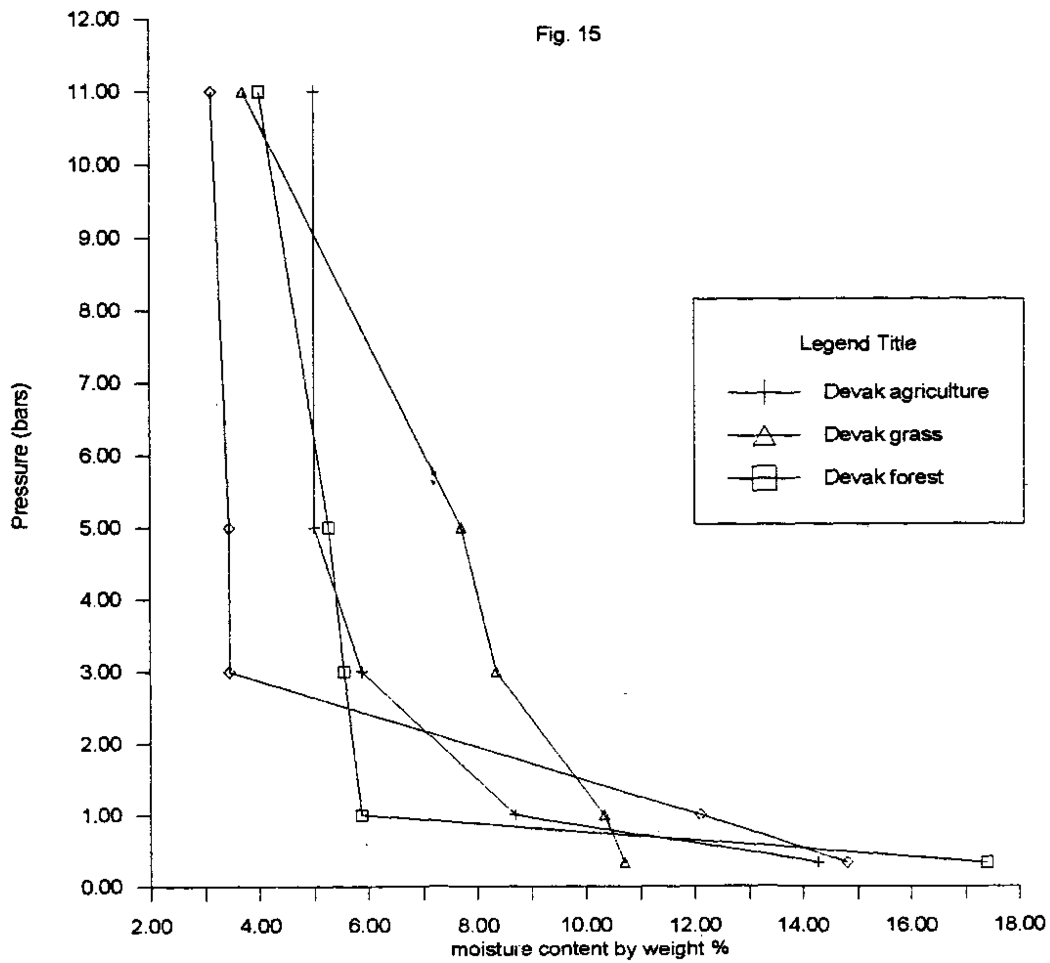

Legend Title
Aik agriculture
Aik barren
Aik grass
Aik forest
Pressure (Bars)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
Moisture content by weight %

Fig. 14



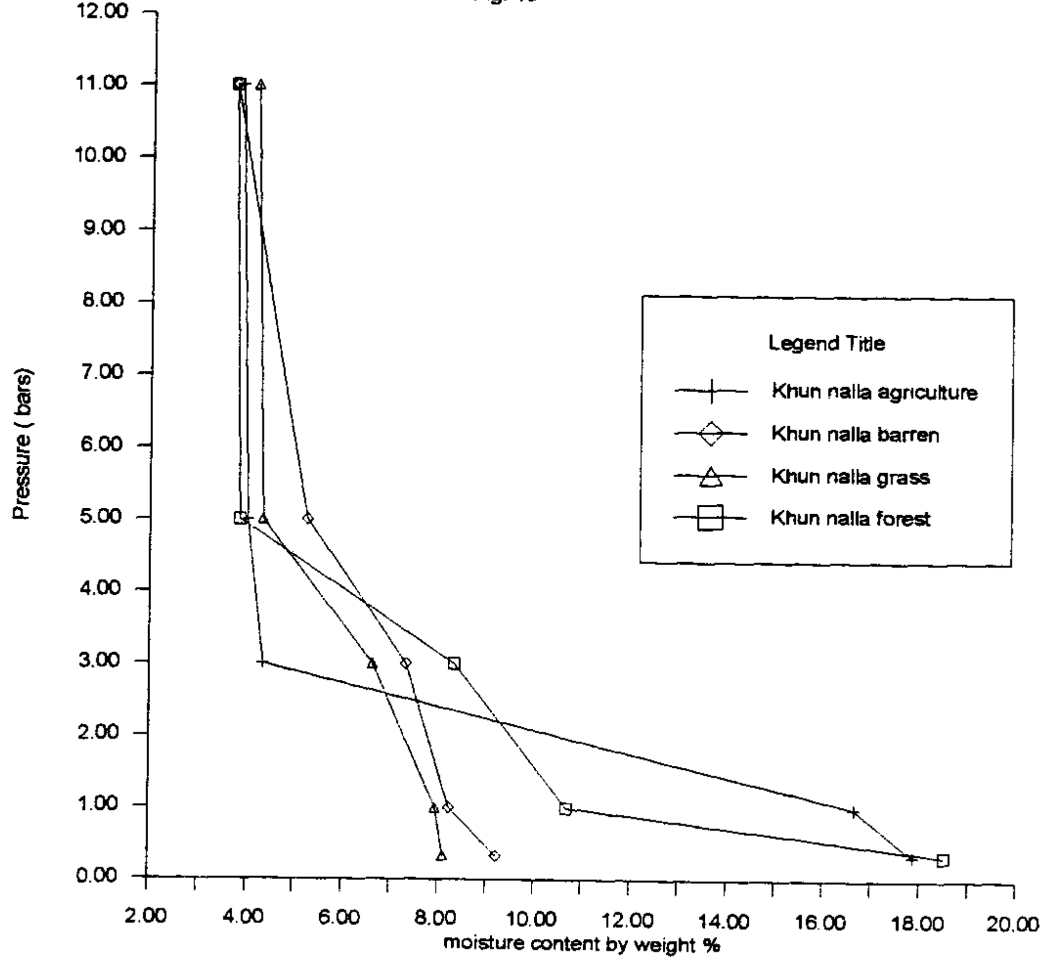
Pressure (bars)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
moisture content by weight %
Legend Title
Basantar agriculture
Basantar barren
Basantar grass
Basantar forest

Fig. 15



Legend Title
Devak agriculture
Devak grass
Devak forest
Pressure (bars)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
moisture content by weight %

Fig. 16



Pressure (bars)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
moisture content by weight %
Legend Title
Khun nalla agriculture
Khun nalla barren
Khun nalla grass
Khun nalla forest

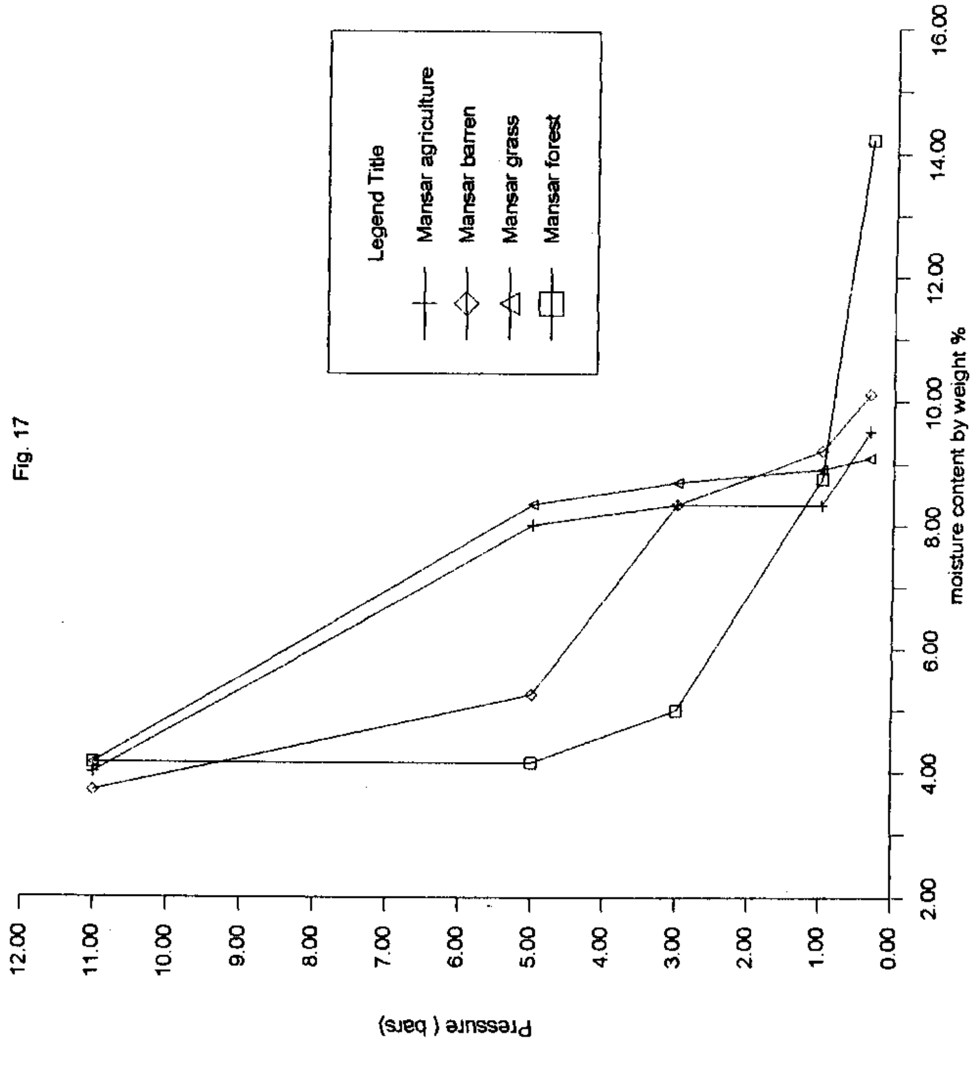

Legend Title
Mansar agriculture
Mansar barren
Mansar grass
Mansar forest
Pressure (bars)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
moisture content by weight %

Fig. 17

Fig. 18

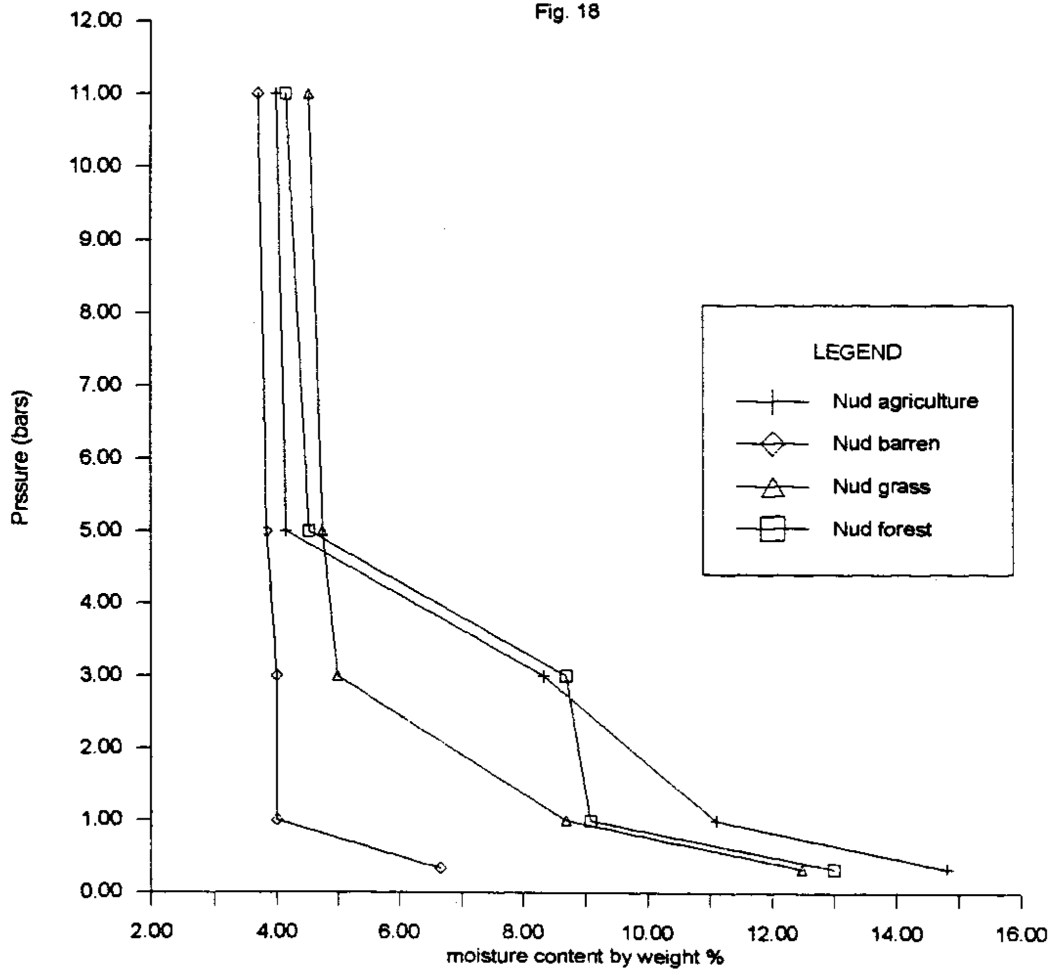
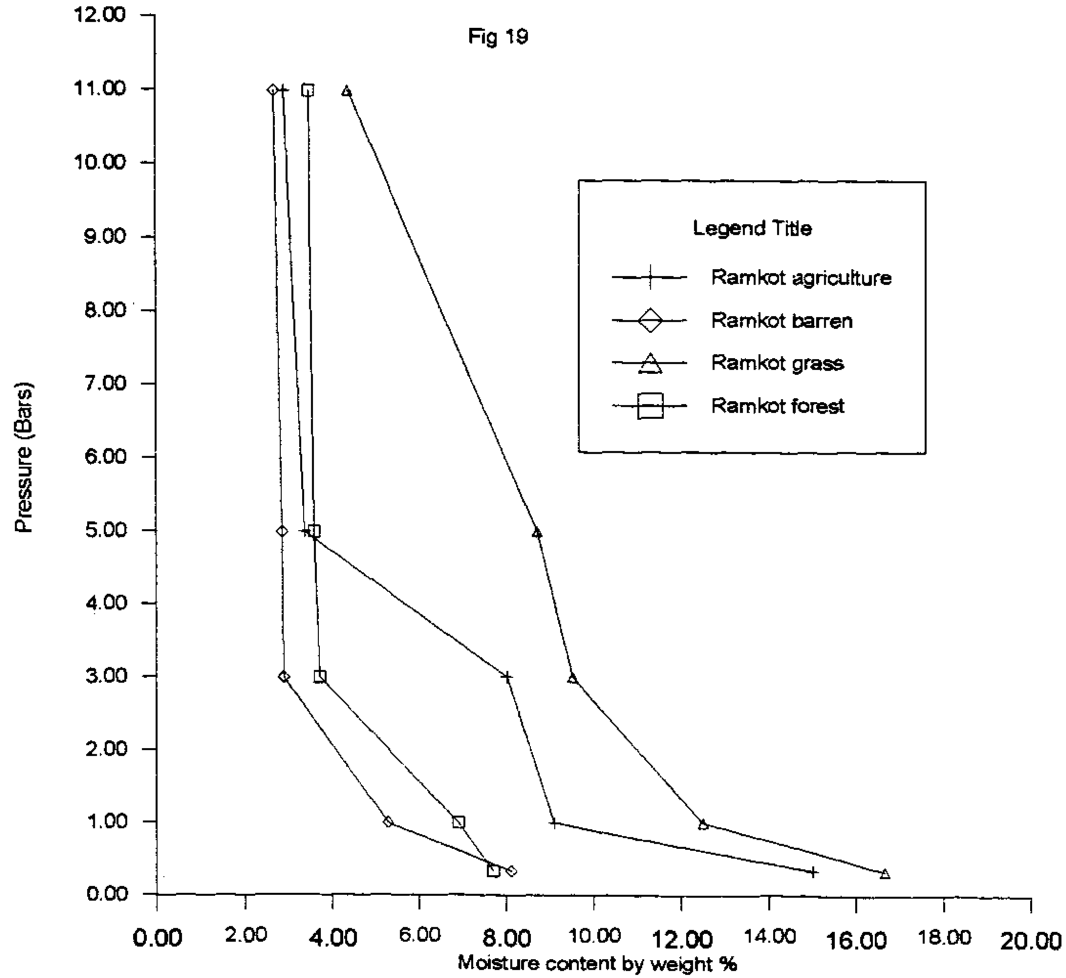
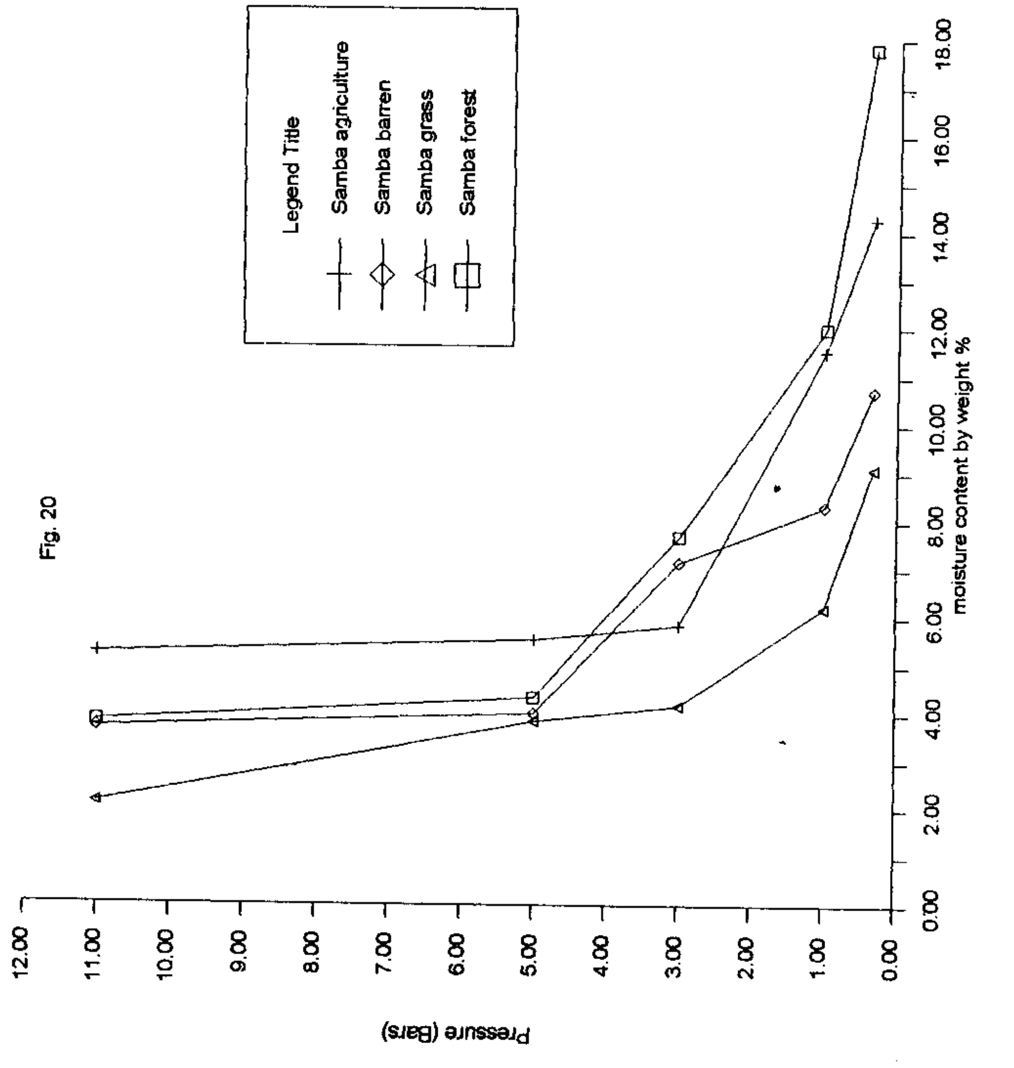

Prssure (bars)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
moisture content by weight %
LEGEND
Nud agriculture
Nud barren
Nud grass
Nud forest

Fig 19



Legend Title
Ramkot agriculture
Ramkot barren
Ramkot grass
Ramkot forest
Pressure (Bars)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00 18.00 20.00
Moisture content by weight %

Fig. 20


Legend Title
Samba agriculture
Samba barren
Samba grass
Samba forest
Pressure (Bars)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
moisture content by weight %

Soil type	Percent moisture, based on dry weight of soil		Depth of available water Per unit of soil
	Field capacity percentage	Permanent wilting	cm. per metro depth of soil
Fine sand	3 - 5	1 - 3	2 - 4
Sandy loam	5 - 15	3 - 8	4 - 11
Silt loam	12 - 18	6 - 10	6 - 13
Clay loam	15 - 30	7 - 16	10 -18
Clay	25 - 40	12 - 20	16 - 30

(Adapted from Booher, 1967)

5.0 CHEMICAL CHARACTERISTICS OF SOIL

Various soil physical parameters such as specific gravity, bulk density, moisture content, permeability, porosity, size analysis and moisture holding capacity have been carried out. In addition to these, an attempt has been made to study the soil chemical parameters. Soil is a mixture of various inorganic and organic chemicals. Inorganic soils are comparatively low in organic matter which generally ranges from 1 to 6%. In contrast, soils whose properties are dominated by organic materials are termed organic soils. (Brady, 1996). The major inorganic constituents are the compounds of Al, Si, Ca, mg, Fe, K, and Na and minor constituents are B, Mn, Cu, Zn, Mo, Co, I, and F. These salts occur in the form of weak solution. Carbonates, sulphate, nitrates and chlorides of Ca, Mg, k, and Na are usually found in abundance in such solution. Humus is the main organic constituent of soil and it may contain proteins, amino acids, purines, pyrimidines, sugars, fats, aromatic compounds, alcohols, waxes and resins etc. Growth of a plant is a function of nutrients available in the soil. Nitrogen and phosphorus, followed by potassium, calcium, sulphur, and magnesium are required in higher quantity and these are termed as macro-nutrients. Iron, manganese, copper, zinc, boron, silicon molybdenum, chlorine, vanadium, and cobalt though essential but are needed in very minute quantities by plant, so are called micro-nutrients.

5.1 Material and Methods

Sampling

Sampling is one of the most important and foremost step in collection of representative soil samples for physio-chemical analysis. Moreover the integrity of the sample must be maintained from the time of collection to the time of analysis.

In the present study soil samples have been collected from the soil surface (15 cm.) depth. All these samples have been collected from the different landuse conditions from the study area.

Methods of Analysis and Equipment Used

Physico-chemical analysis was conducted following standard methods as described by Saxena (1990). Organic matter (%) have been analysed by using titrimetric method. Organic Carbon (%) was computed by dividing the organic matter by 1.724 factor. Sodium and potassium were determined by flame emission method using Flame Photometer. The results of the parameters are discussed below.

5.2 Soil Organic Matter

soil organic matter comprises an accumulation of partially disintegrated and decomposed plant and animal residues and other organic compounds synthesized by the soil microbes as the decay occurs. Such material is continually being broken down and resynthesized by soil microorganisms. The organic matter content of a typically well drained mineral soil is small, varying from 1 to 6% by weight in the topsoil and even less in the subsoils. The presence organic matter greatly influence the soil properties and plant growth. Organic matter binds mineral particles into granules that are largely responsible for the loose, easily managed condition of productive soils and increases the amount of water a soil can hold. It is also a major soil source of phosphrous and sulphur and the primary source of the nitrogen (Brady, 1996). It is the main source of energy for soil organisms. Without it, biochemical activity would come to a near standstill.

After partial break down of the plant and animal residues, soil organic matter includes complex compound that are relatively resistant to decay. These complex material along with some materials, which are synthesized by the soil micro organisms, are collectively called humus. This material usually black or brown in colour, is very fine (colloidal) in nature. Small amount of humus thus increase remarkably the soil's capacity to promote plant growth.

In the present study, soil samples were collected from the different landuse conditions (i.e., forest, agriculture, grass, barren land) of Basantar catchment. The results are presented in the table .... In the forest land, organic matter varied from 13% to 22% but in Mansar it was only 4%. This lowest value of Mansar forest may be due the degraded forest condition. In agriculture land area, it varied between 9.32% to 21.89% except in Samba, it is 5.27%. 3.64% to 17.83% variation in organic matter was found in the Grass land samples. Barren land samples constitutes 7.7% to 18.64% organic matter. Organic matter value is less than 25% in each landuse conditions. It is showing poor nutrient conditions in the soil of the area. Results presented in the Table 12. is not showing definite trend in the different landuse conditions. The higher value of organic matter are recorded from the forest land or agricultural land area. Variation of organic matter in the different landuse conditions may be due to the several factor such as temperature, moisture, texture, drainage, cropping, tillage etc, which affects the organic matter amount in the soil.

5.3 Potassium and Sodium

After nitrogen and phosphorus potassium is third important nutrient required for the plant growth. Potassium plays many essential roles in plants. It is an activator of dozens of enzymes responsible for such plant processes as energy metabolism, starch synthesis, nitrate reduction, and sugar degradation. Potassium is extremely mobile within the plant and helps regulate the opening and closing of stomates in the leaves and the uptake of water by root cells.

Potassium increases crop resistance to certain diseases and encouraging strong root and stem systems. Sodium has been found partially to take the place of potassium in the nutrition of certain plants. Where there is a deficiency of potassium, native soil sodium or that added in such fertilizers as sodium nitrate may be useful (Brady, 1996).

The variation of potassium and sodium have been analysied for the samples of different landuse conditions and results are presented in the Table 13. In the forest land area potassium was found between 11.41 mg/g to 91 mg/g and sodium was 11.21 mg/g to 33.37 mg/g. In agriculture land area samples, K and Na were 8.60 mg/g to 33.85 mg/g and 4.90 mg/g to 24.41 mg/g, respectively. K and Na in th soil of the grass land area was found 6.67 mg/g to 86.92 mg/g and 12.4 mg/g to 36.00 mg/g, respectively. Barren land area soils are containing 5.61 mg/g to 53.16 mg/g potassium and 7.50 mg/g to 32.51 mg/g sodium. Variation of sodium and potassium amount in the different landuse conditions shows that landuse condition is not only the factor influencing the potassium and sodium value. In Ramkot Bus Stand samples potassium is less than the sodium while in other sites potassium is dominating. This variation may be due to the geological variation of the area

Table 11

Organic matter and carbon in the different landuse conditions

SITE/ PARAMETERS	LANDUSE			
	Forest	Agriculture	Grass	Barren
SAMBA				
% O. M.	18.64	5.27	--	11.35
% Carbon	10.81	3.05	--	6.57
RUI				
% O. M.	12.97	16.62	3.64	10.94
% Carbon	7.52	9.64	2.11	9.40
NUD				
% O. M.	14.19	14.59	5.67	7.70
% Carbon	8.23	8.46	3.29	4.46
RAMKOT HILL				
% O. M.	--	--	--	18.64
% Carbon	--	--	--	10.81
KHOON				
% O. M.	--	18.24	--	9.73
% Carbon	--	10.58	--	5.64
DEVAK				
% O. M.	15.40	21.89	7.29	15.00
% Carbon	8.93	12.69	4.23	8.70
RAMKOT BUS STAND				
% O. M.				
% Carbon	21.81	11.35	17.83	15.40
	12.65	6.58	10.34	8.93
MANSAR				
% O. M.	4.05	13.37	4.86	--
% Carbon	2.35	7.76	2.35	--
AIK				
% O. M.	19.46	13.37	7.70	12.97
% Carbon	11.28	7.76	4.46	7.52
BASANTAR				
% O. M.	14.59	9.32	13.37	16.62
% Carbon	8.46	5.40	7.76	9.64

Table 12

Variation of Potassium and Sodium (mg/g) in the soil of different landuse condition

PARAMETERS	LANDUSE			
	Forest	Agriculture	Grass	Barren
SAMBA Potassium Sodium	91 18	33.85 24.41	86.92 21	20.1 9.79
RUI Potassium Sodium	12.96 13.2	8.60 4.90	51.22 19.51	28.03 15.60
NUD Potassium Sodium	27.47 24.52	25.14 16.20	39.58 20.01	25.12 22.02
RAMKOT HILL Potassium Sodium	-na- -na-	-na- -na-	-na- -na-	-na- -na-
KHOON Potassium Sodium	-na- -na-	24.64 10.20	-na- -na-	81.29 -na-
DEVAK Potassium Sodium	33.37 21.21	26.58 16.20	29.00 16.60	5.61 7.50
RAMKOT BUS STAND Potassium Sodium	11.41 32.51	9.87 21.00	6.67 22.02	9.58 32.51
MANSAR Potassium Sodium	35.31 16.80	23.98 17.60	26.58 36.00	-na- -na-
AIK Potassium Sodium	55.10 11.21	26.58 9.39	13.15 12.40	53.16 17.80
BASANTAR Potassium Sodium	15.36 19.19	11.79 10.21	25.53 14.60	24.64 10.21

-na-, sample not available

6.0 Results

1. All physical and chemical properties of the soil were determined in the WHRC, Jammu laboratory. The particle size analysis of the soil samples were carried out in the soil laboratory of the institute. The grain size distribution of the soil particles is given in table No.2. It was observed from this table that Basantar catchment contains mainly sandy soil. Percentage of Gravel ranges from 1.39 to 34.54 , sand from 51.18 to 90.12 and silt from 0 to 31.05. The average percentage of constituents in this catchment : Silt-11.83, Sand-74.78 and Gravel-13.31.
2. The average value of specific gravity of soil sample in all four landuse was found to be: Barren-2.367, Forest-2.129, Grass-2.455 and Agriculture-2.403.
3. Bulk density, Moisture content and porosity was calculated at three different depths from ground surface in all four landuse.
4. Permeability of soil sample was also carried out in m/day using Constant head permeametre, average values for Barren-0.0458 , Forest-0.1005 , Grass-0,606 and for Agriculture-1.334 were found.
5. Infiltration test was also carried out at site using double ring infiltrometre, results were tabulated in table no.6, It was found that the initial infiltration capacities for barren lands, grass land, agriculture land and forest lands varied from 3.60 to 12.00, 3.00 to 3.60, 9.60 to 18.00 and 9.60 to 13.80 cm/hr respectively. Where as , the final Infiltration capacities for same land uses were found to be varying from 0.05 to 1.00, 0.15 to 0.75, 0.20 to 0.85 and 0.80. to 0.80 cm/hr.
6. Moisture retention capacity of the soil at different pressure (i.e.1/3, 1, 3, 5 & 11 bar) was also carried out using Pressure Plate Apparatus and results were tabulated in table 11, moisture content by weight verses pressure is also plotted for different landuse.(Fig.13 to 20).
7. Organic matter value is less than 25% in each landuse conditions. It is showing poor nutrient conditions in the soil of the different landuse conditions. The higher value of organic matter are recorded from the forest land or agricultural land area.
8. Potassium in the different landuse conditions was found 5.46 mg/g to 91 mg/g while sodium ranged between 4.90 mg/g to 36 mg/g. Results obtained of different landuse conditions are showing much variation. This may be due to different geological conditions.

7.0 Conclusion:

Soil Physio – Chemical properties are basic input for any hydrological modelling and also important for efficient management of irrigated agriculture. The most important soil properties influencing irrigation are its infiltration characteristics and water holding capacity. Other soil properties such as soil texture, soil structure, capillary conductivity, soil profile conditions, and depth of water table are also given consideration in the management of irrigation water.

From hydrology point of view i.e. rainfall – runoff, soil erosion, sedimentation, ground water quantity and quality modelling, these physio – chemical properties of soil are also important. In designing draining system particle size analysis of soil and soil moisture retention capacity plays most important role. In ground water modelling one should know the physical and chemical properties of soil i.e. permeability, porosity, infiltration, moisture content, soil organic matter, potassium, sodium etc. To determine the soil erodibility factor K in Universal Soil Loss Equation, percentage of silt and sand, soil structure and permeability of soil are the basic input.

Therefore, in the present study various physio – chemical properties such as; texture, porosity, infiltration, permeability, specific gravity, bulk density, moisture content, soil moisture retention curves, soil organic matter, potassium and sodium were determined in Basantar basin.

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