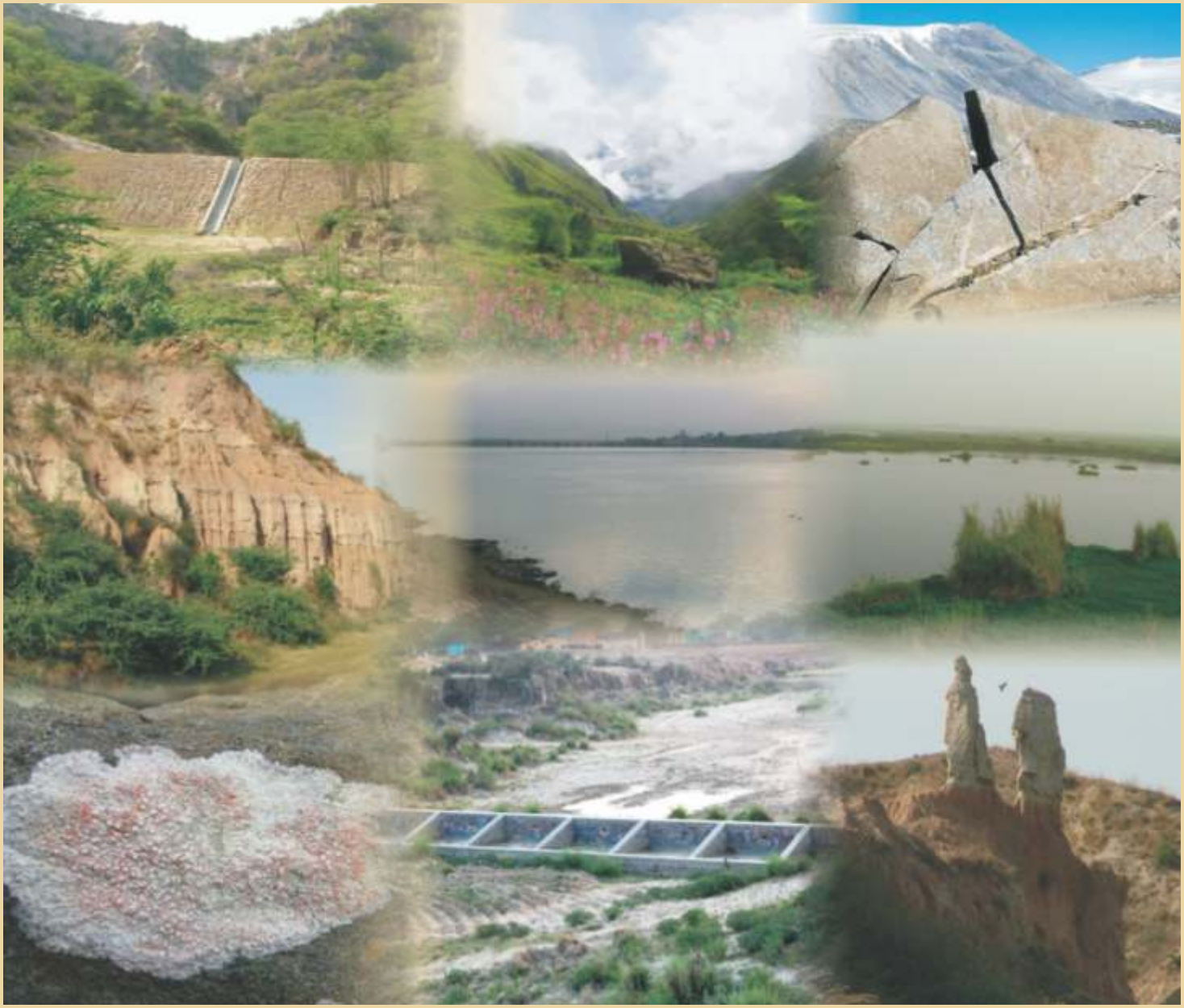
Punjab ENVIS Centre

NEWSLETTER

on

Status of Environment & Related Issues



SOILS OF PUNJAB

Vol. 7 No. 4, 2010

EDITORIAL

Soils are our most precious natural resource. Together with water, air and landscapes, soils form the very foundation of our life support system and an essential link between the components that constitute our environment. Nature has blessed us with a huge variety of soils that differ from region to region and even from one field to another. They perform a number of functions that are vital to health of our ecosystems and the well being of humanity at large.

The concept of soil quality, defined as "the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries to sustain plant and animal productivity, maintain or enhance water & air quality and support human health & habitation" provides a focal point for assessing the severity of this degradation.

More than 99% of food worldwide comes from the soil ecosystem. Soil was also recognized as a significant carbon reservoir by the Kyoto Protocol. But unsustainable soil management practices are reducing food production, causing serious losses in biodiversity, leading to environmental degradation (e.g. salinization, compaction, erosion, contamination of ground and surface waters with nitrate, phosphorus, pesticides, or other materials).

It is therefore important that we understand our soils and do what is needed in a manner that they continue to provide the goods and services to increasing population in a sustainable manner.

This newsletter is an effort to generate awareness about soil resources with a special reference to Punjab. It has four main segments: Introduction, soil formation, soil characteristics (including, composition, profile, density, porosity, plasticity & cohesion and temperature) and soil types with an overview of India and details of Punjab.

To make ENVIS Centre's activities more effective and worthwhile we seek active participation of readers in terms of providing information, news views, photographs and articles on the issue of soil conservation for incorporation into ENVIS website.

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INTRODUCTION

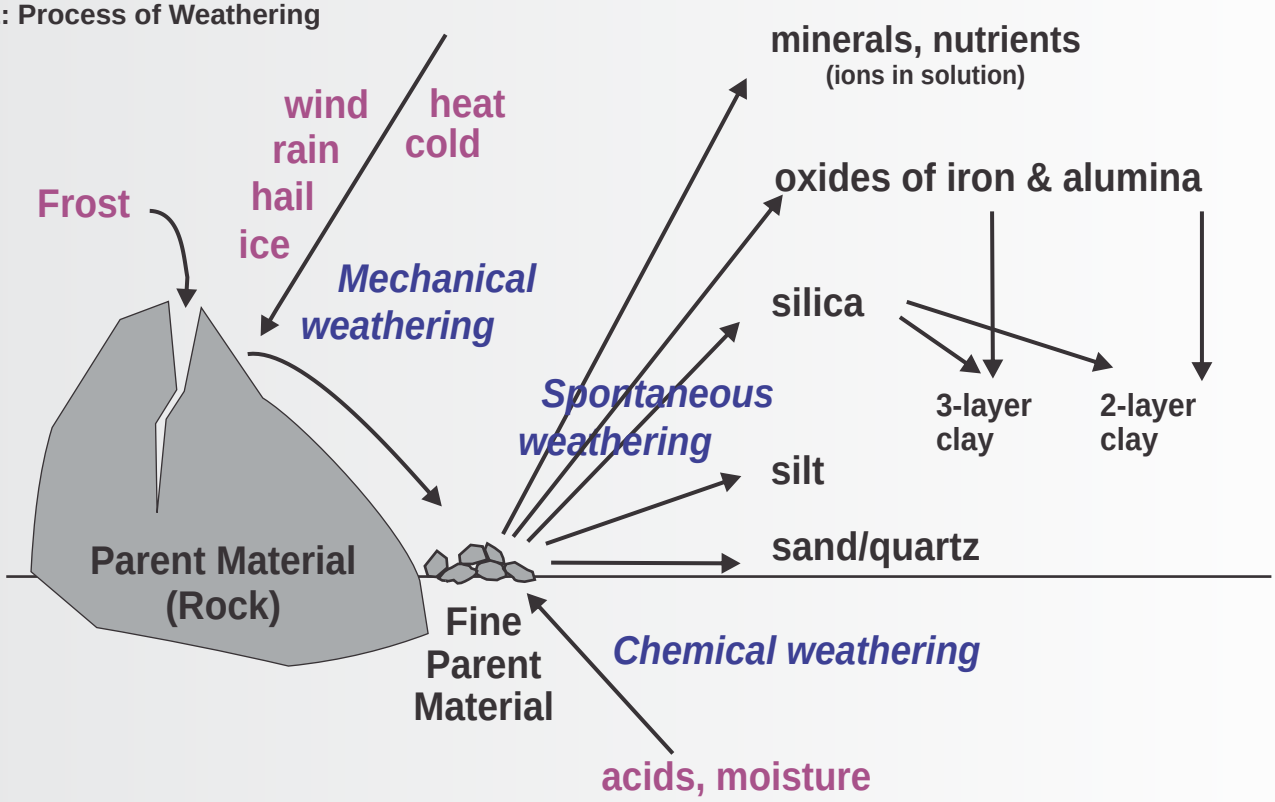
The word "Soil" has its origin from the Latin word 'solum' which means 'ground'. As per, Soil Taxonomy, Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occur on the land surface, occupies space, and is characterized by one or both of the following: horizons or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment (Soil Survey Staff, 1994).

Soil formation

Soil formation takes place when many things interact, such as air, water, plant life, animal, life, rocks and chemicals. It is a long process which is initiated by the weathering (Box 1 & Fig. 1) of rocks (the parent material) & minerals on the surface of earth and is then mixed with organic matter which further forms a thin layer of soil over the thousands of year (PACA, 2010).

BOX 1. WEATHERING

Fig. 1: Process of Weathering



Weathering is the process of the breaking down of rocks. There are two different types of weathering.

- Physical weathering (Mechanical & Spontaneous)
- Chemical weathering.

In physical weathering the material stays the same whereas in chemical weathering there is chemical alteration or decomposition. For instance, a hard material may change to a soft material after chemical weathering.

Source: *www.librarythinkquest.org & www.geography.hunter.cun.*

Soil Composition

As stated above, soils are mixture of different things; rocks, minerals, and dead, decaying plants and animals. Soil can be very different from one location to another, but generally consists of organic and inorganic materials, water and air .

The inorganic materials are the rocks that have been broken down into smaller pieces. The size of the pieces varies. It may appear as pebbles, gravel, or as small as particles of sand or clay.

The organic material is decaying living matter. This could be plants or animals that have died and decayed until they become part of the soil. The amount of water in the soil is closely linked with the climate and other characteristics of the region and the amount of water in the soil affects the amount of air. The composition of the soil affects the plant growth and therefore the animals that live there.

Soil Profile

Soil Profile refers to the horizontal layers of soil, often termed as horizons (O, P, A, B, E, C, D & R). Soil consists of eight layers. They range from rich, organic upper layers (consisting of humus and topsoil) to underlying rocky layers (consisting of subsoil, regolith and bedrock). It is not necessary that all the layers are present everywhere (Soil Survey Staff, 2010). However, the commonly occuring layers (Fig. 2) are explained below:

- **O horizons:** Horizons or layers dominated by organic soil materials. Some are saturated with water for long periods or were once saturated but are now artificially drained or others that have never been saturated. Some O layers consist of un-decomposed or partially decomposed litter (such as leaves, needles, twigs, moss, and lichens) that has been deposited on the surface.

- **A Horizon** - This layer is called topsoil and it is formed at surface or below the O horizon and above the E horizon. Seeds germinate and plant roots grow in this dark-colored layer. It is made up of humus (decomposed organic matter) mixed with mineral particles.

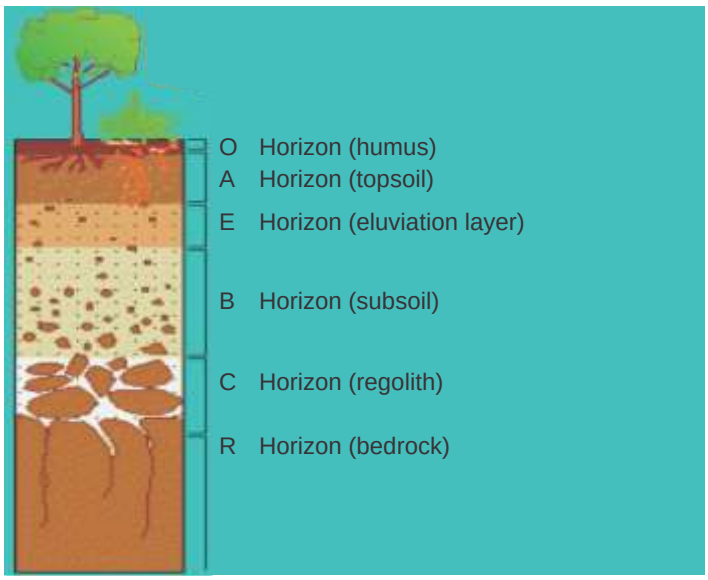
- **E Horizon** - This eluviation (leaching) layer is light in color. This layer is beneath the A Horizon and above the B Horizon. It is made up mostly of sand and silt, having lost most of its minerals and clay as water drips through the soil (in the process of eluviation).

- **B Horizon** – It is also termed as the subsoil. This layer is beneath the E Horizon and above the C Horizon. It contains clay and mineral deposits (like iron, aluminum oxides, and calcium carbonate) that it receives from layers above it when mineralized water drips from the soil above.

- **C Horizon** – It is also termed as regolith. It is the layer beneath the B Horizon and above the R Horizon. It consists of slightly broken-up bedrock. Plant roots do not penetrate into this layer & very little organic material is found in this layer.

- **R Horizon** – The unweathered rock (bedrock) layer that is beneath all the other layers.

Fig.2. Soil Horizons



Source: *www.enchantedlearning.com*

Soil Structure

Soil structure refers to the arrangement of soil particles. It is one of the important properties of soil, since it influences aeration, permeability and water capacity.

The soil particles vary in shape from spherical to angular and this determines their name (as shown in Table 1). The major shapes are:

- Platy - Horizontal alignment
- Prism - Columnar type
- Block like - Angular or sub - angular types
- Spiroidal - Granular & Crumb type

They differ in size from gravel and sand to fine clay. Soil classification based on grain size is shown in Table 1.

Table: 1. Classification of Soil based on particle size

Name	Particle Size (mm)
Gravel	> 2.0
Very coarse sand	1.0-1.999
Coarse sand	0.500-0.999
Medium sand	0.250-0.499
Fine sand	0.100-0.249
Very fine sand	0.050-0.099
Silt	0.002-0.049
Clay	<0.002

Source: *Loxnachar et al., 1999.*

Soil Texture

The varying proportions of particles of different size groups in a soil constitute the soil texture. The principle textural classes are (discussed in Box 2)

- **. Sandy soil**
- **Silty Soil**
- **Clayey Soil**
- **Loamy Soil**
- **Peaty Soil**
- **Chalky Soil**

Box 2. Principle Textural Classes

i. **Sandy soil :**The size of the particles is the largest. It is granular and consists of rock and mineral particles that are very small. The texture is coarse. It is easier to cultivate if the soil is rich in organic material but either it might quickly drain water out, resulting in dehydrating of the plants in summer or too wet in winters and rainy season. Sandy soil is composed of 60-70% sand, 20-25% silt and 10-15% clay.

ii. **Silty Soil -** Silty soil is the most fertile soil. It is found either as soil or as suspended sediment in water column of a water body on the earth's surface. It is richer in nutrients and minerals like Quartz than sandy soil and has better drainage property.

iii. **Clayey Soil** - Clay is very fine grained soil and hence there is very less air spaces between the particles. Water logging might harm the roots of the plant. Clay soil becomes very heavy when wet. Blue or grey clays are poorly aereated and thus must be loosened to support healthy growth of plants. Red coloured clay soil has good aeration. Plants grow well in clay if drainage is adequate because of high nutrient levels.

iv. **Loamy Soil -** This soil is the perfect soil for plantation. The granular soil retains water very easily, yet the drainage is well. Loamy soil is composed of 40 % sand, 40% silt and 20% clay.

v. **Peaty Soil -** This kind of soil contains more organic matter than other soils whereas the fewer nutrients are present in the soil. This kind of soil is formed in wet climate. Well fertilized and well drained Peaty soil is ideal for growing plants.

vi. **Chalky Soil -** Chalky soil is very alkaline in nature and consists of stones. This kind of soil drys quickly and also blocks the absorption of nutritional elements by plants. Soil can be Acidic or Alkaline soil depending on the amount of humus, organic matter and the underlying bedrock.

Soil Colour

Colour gives a ready clue to soil conditions and some important properties which are due to either mineral or organic matter and mostly to both.

Red, yellow or brown colors are usually related to the different degrees of oxidation, hydration and diffussion of iron oxides in the soil.

Dark colors of a soil are associated with one or a combination of several factors, including impeded drainage conditions, content and state of decomposition of organic matter, the presence of titaniferous magnetite etc.

Soil Density

Soils having larger particles are usually heavier in weight per unit volume than those having smaller particles. True density of a soil is based on the individual densities of soil constituents and according to their proportionate contribution. The bulk density or apparent density is the weight per unit volume of dry soil as a whole i.e. particle and pore space and hence it is lower than the true density.

Soil Porosity

The shape and arrangement of soil particles help determine porosity. Porosity or pore space is the amount of air space or void space between soil particles.

Sands have low pore space (about 30%) whereas clays may have as much (50-60%). Although clays possess greater total porosity than the sands the pore spaces in the latter being individually larger are more conducive to good drainage and aeration.

Soil Plasticity and Cohesion

Plasticity is the property that enables a moist soil to change shape on the application of force and retain this shape even when the force is withdrawn. On this basis, sandy soils may be considered to be non-plastic and clayey soils to be plastic.

Cohesion is the tendency of the particles to stick to ine another. Plastic soils are cohesive. Plasticity and cohesion reflect the soil consistency and workability of the soils.

Soil Temperature

Soil temperature is one of the important factors that control the microbiological activity and all the processes involved in the growth of plants. Heat is necessary for seed germination, root growth and other biological activities.

TYPES OF SOIL

The soils can be classified in many types on the basis of color, texture, structure, and mineral content, however, as per the Indian Council of Agricultural Research (ICAR), the soils in India can be grouped into the following major eight groups (www.icar.org), and which further can be classified in to twelve orders (BOX 3) with unique characteristics:

1. **Alluvial Soils:** These soils are formed by deposition of alluvium by rivers and occupy 15 lakh sq km of the land area in India (PACA, 2010 & www.icar.org). These are the most important soils from the agriculture point of view.

   Newly formed alluvial soils are called 'Khader' and old soils are called 'Bhangar'. The soils are sandy loam to clay loam with light grey colour to dark, structure is loose and more fertile. But the soils are low in NPK and humus. They are well supplied with lime, Base Exchange capacity is low, pH ranges from 7 to 8.

   These soils are distributed in Indo-Gangetic plains, Brahmaputra valley and all most all states of North and South.

   Most of the alluvial soils have been classified in the orders 'Entisols', ' Inceptisols' and ' Alfisols'.

2. **Black Soils:** This is well known group of soils and covers 5.4 lakh sq km area (PACA, 2010). These soils characterised by dark grey to black colour with high clay content and also known as Regur or Black Cotton soil.

   They are neutral to slightly alkaline in reaction. Deep cracks develop during summer, the depth of

the soil varies from less than a meter to several meters. Poor free drainage results in the soils, Base Exchange is high with high pH and rich in lime and potash.

Major black soils are found in Maharastra, Madhyapradesh, Gujarat and Tamilnadu. Cotton is most favourable crop to be grown in these soils.

These soils are classified in the order 'Entisols', ' Inceptisols' and ' vertisols'.

3. **Red Soils:** Formed due to weathering of old crystalline rocks and covers 3.5 lakh sqkm area in India (http://www.wiziq.com).

   Red colour is due to various oxides of iron. They are poor in N, P, K and with pH varying 7 to 7.5. These soils are light textured with porous structure. Lime is absent with low soluble salts.

   Red soils occur extensively in Andhra Pradesh, Assam, Bihar, Goa, Parts of Kerala, Maharastra, Karnataka, Tamilnadu and West Bengal.

   Most of the red soils have been classified in the order ' Alfisols' (PACA,2010).

4. **Lateritic Soils:** Formed under high temperature and rainfall with wet and dry spell & occupy 1.26 lakh sq km area (http://examrace.com/geography). Under high rainfall conditions silica is released and leached down wards and the upper horizons of soils become rich in oxides of iron and alluminium.

   The texture is light with free drainage structure. Clay is predominant and lime deficient, pH 5 to 6 with low in Base Exchange capacity, contains more humus and are well drained.

   They are distributed in top of hills of Daccan Karnataka, Kerala, Madhya Pradesh, Ghat regions of Orissa, Andhra pradesh, Maharastra and also in West Bengal, Tamilnadu and Assam. Most of the laterite soils have bee classified in the order 'ultisols' and a few under ' oxisols' (http://www.wiziq.com).

5. **Desert Soils:** These soils are originated by mechanical disintegration & wind deposit. Mostly sandy to loamy fine sand with brown to yellow brown colour. It contains large amounts of soluble salts and lime with pH ranging 8.0 to 8.5.

   These soils occupy nearly 6-7% of India's land area area (PACA,2010). Nitrogen content is very low. The presence of Phosphate and Nitrate make the desert soils fertile and productive under water supply. They are distributed in Haryana, Punjab, and Rajasthan. They are classified in the order' Aridisols' and ' Entisols'.

6. **Mountain Soils:** This group of soils occurs in Himalayas and formed by deposition of organic matter from forest. They are more acidic and are of following three types:

   a) **Brown Forest Soils:** Formed at an elevation of 900-1800m and characterized by rich humus and high fertility.

   b) **Podzols:** Formed at an elevation of 1800m and characterized by high phosphoric content, thick coniferous forests and orchids.

   c) **Alpine Meadow Soils:**

      - These soils are silty loam to loam in texture and dark brown in colour.

      - Found in hills of deccan, eastern ghats, western ghats, valley and hill slopes of Himalayas etc.

      - Deficient in potash, phosphoric acid and lime (http://examrace.com/geography).

7. **Saline-Sodic Soils:** These soils contain excess of natural soluble salts dominated by chlorides and sulphates which affects plant growth.

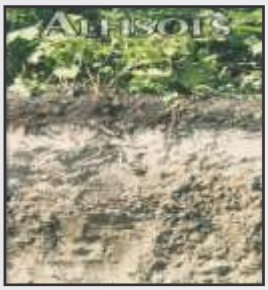
   Sodic or alkali soils contain high exchangeable sodium salts. Both kinds of salt effected soils occur in different parts of India like Uttarpradesh, Haryana, Punjab, Maharastra, Tamilnadu, Gujarat, Rajastan and Andhra pradesh.

   These soils are classified under ' Aridisols', ' Entisols' and ' Vertisols'.

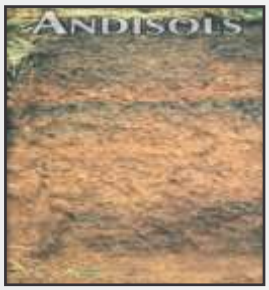
8. **Peaty and Marshy Soils:** These soils occur in humid regions and formed by accumulation of high organic matter. Soils are black clay and highly acidic with pH of 3.5. Free alluminium and ferrous sulphate are present. The depressions formed by dried rivers and lakes in alluvial and coastal areas some times give rise to water logged soils and such soils are blue in colour due to the presence of ferrous iron.

   Peaty soils are found more in Kerala and marshy soils are found more in coastal tracks of Orissa, West Bengal and South - East coast of Tamilnadu (http://indiaonline.in).

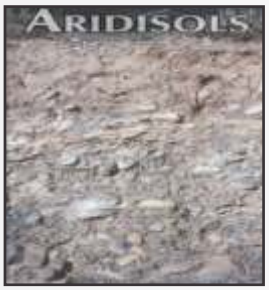
BOX 3. THE TWELVE ORDERS OF SOIL TAXONOMY



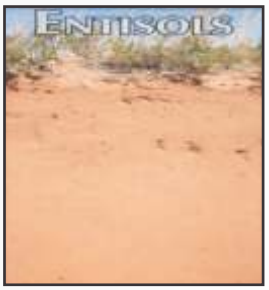
Alfisols are moderately leached soils that have relatively high native fertility, mainly formed under forest Alfisols are primarily found in temperate humid and subhumid regions of the world & divided into 5 suborders: Aqualfs, Cryalfs, Udalfs, Ustalfs, and Xeralfs.



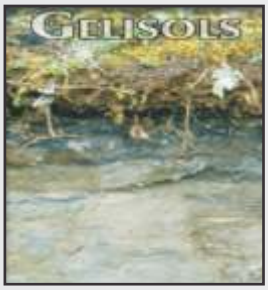
Andisols are formed in volcanic. They are typically dominated by glass Andisols have high water-holding capacity Andisols are divided into 8 suborders: Aquands, Gelands, Cryands, Torrands, Xerands, Vitrands, Ustands, and Udands.



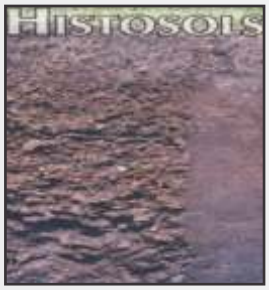
Aridisols are $CaCO_3$-containing soils of arid regions. They are characterized by being dry most of the year and limited leaching. Aridisols are divided into 7 suborders: Cryids, Salids, Durids, Gypsids, Argids, Calcids, and Cambids.



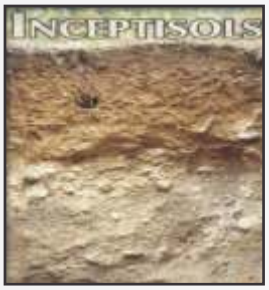
Entisols are soils of recent origin and characterized by great diversity, both in environmental setting and land use. Enttisols are divided into 6 suborders: Wassents, Aquents, Arents, Psamments, Fluvents, and Orthents.



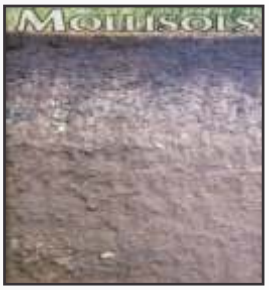
Gelisols are soils of very cold climates that contain permafrost within 2 meters of the surface. These soils are limited geographically to the high-latitude polar regions and localized areas at high mountain elevations. Gelisols are divided into 3 suborders: Histels, Turbels, and Orthels.



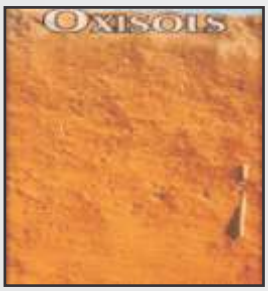
Histosols are composed mainly of organic materials. Most Histosols form in settings such as wetlands. Often referred to as peats and mucks. Histosols are divided into 5 suborders: Folists, Wassists, Fibrists, Saprists, and Hemists.



Inceptisols are more developed than Entisols, widely distributed & occur under a wide range of ecological settings. Often found on fairly steep slopes & on resistant parent materials. Inceptisols are divided into 7 suborders: Aquepts, Anthrepts, Gelepts, Cryepts, Ustepts, Xerepts, & Udepts.

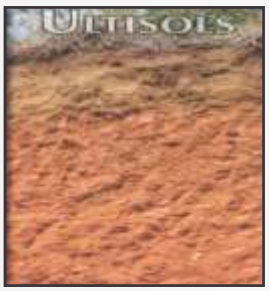


Mollisols are the soils of grassland ecosystems & characterized by a thick, dark surface horizon which is known as a mollic epipedon. Mollisols are extensive in prairie regions. Mollisols are divided into 8 suborders: Albolls, Aquolls, Rendolls, Gelolls, Cryolls, Xerolls, Ustolls, and Udolls.



Oxisols are highly weathered soils that are found primarily in the intertropical regions of the world. Most of these soils are characterized by extremely low native fertility. Oxisols are divided into 5 suborders: Aquox, Torrox, Ustox, Perox, and Udox.

Spodosols are acid soils characterized by a subsurface accumulation of humus that is complexed with Al and Fe. Often occur under coniferous forest in cool, moist climates. Spodosols are divided into 5 suborders: Aquods, Gelods, Cryods, Humods, and Orthods.



Ultisols are strongly leached, acid forest soils with relatively low native fertility. Primarily found in humid temperate and tropical areas of the world with strong yellowish or reddish colors due to presence of Fe oxides. Ultisols are divided into 5 suborders: Aquults, Humults, Udults, Ustults, and Xerults.

Vertisols are clay-rich soils that shrink and swell with changes in moisture content. During dry periods, the soil volume shrinks, and deep wide cracks form. The soil volume then expands as it wets up. Vertisols are divided into 6 suborders: Aquerts, Cryerts, Xererts, Torrerts, Usterts, and Uderts.

Source: www.soils.usda.gov

PUNJAB SOILS

Punjab state covers a total geographical area of 50,362 sq km and it lies between 29^{0}30' and 32^{0}31' N latitude and 73^{0}53' and 76^{0}55' E longitude. The climate of the state is dominantly subtropical semi-arid and monsoonic type.

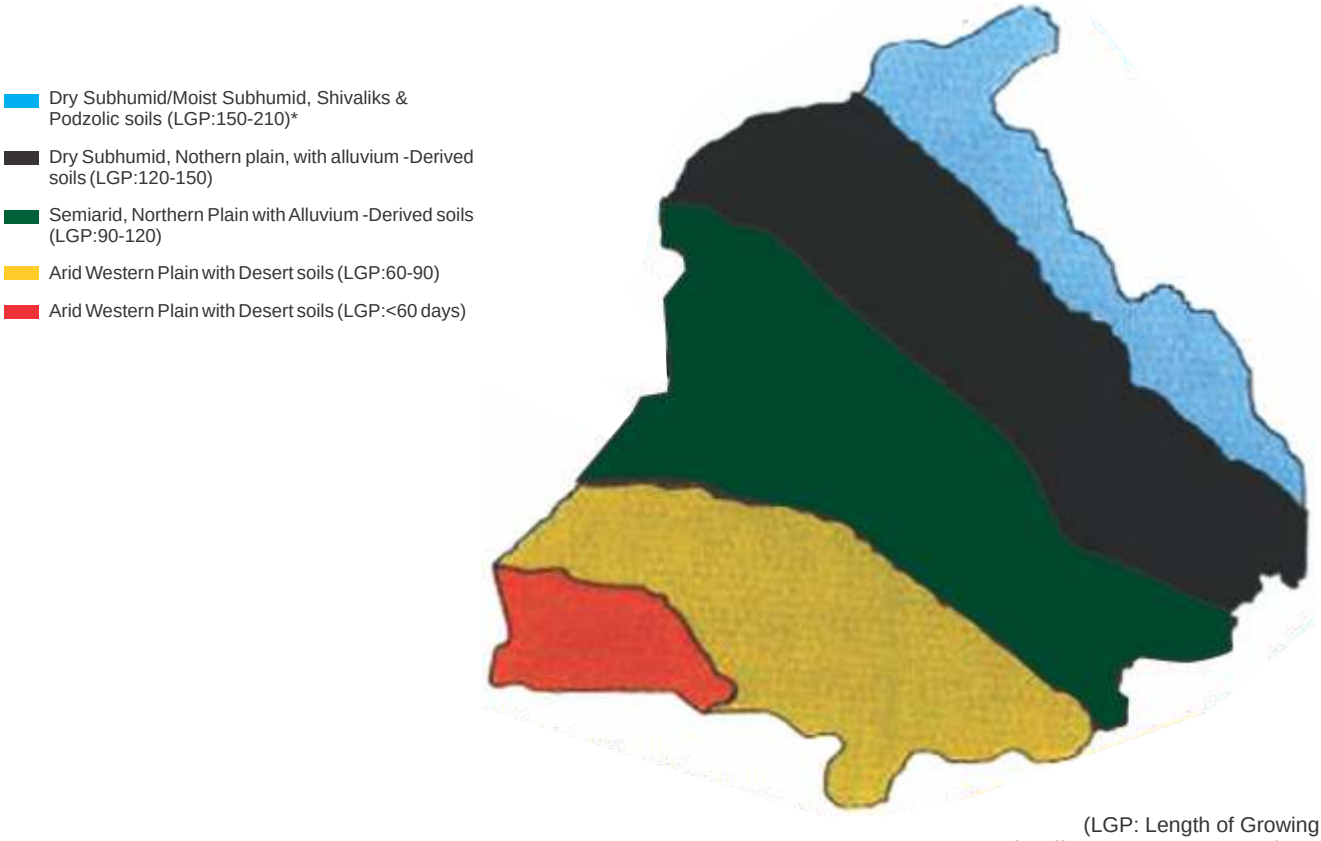
The soil temperature regime is mainly hyperthermic where the mean annual soil temperature (MAST) ranges between 22^{0}C-28^{0}C and soil moisture regimes are udic (humid), Ustic (sub-humid) and aridic (arid or dry). The aridic regime is found in the south-western districts of Punjab (Map 1). The maximum part of the state has ustic regime. Only some northern parts of Pathankot tehsil of Gurdaspur district has udic regime (Manku, 2002). The major soils types of state are shown in Map 2.

The state can be divided into following five agro-ecological sub-regions (Map 1):

- Dry Subhumid/Moist Subhumid, Shiwaliks (LGP:150 -210)*
- Dry Subhumid , Nothern plain, with alluvium –Derived soils (LGP:120-150)
- Semiarid, Northern Plain with Alluvium –Derived soils (LGP:90-120)
- Arid Western Plain with Desert soils (LGP:60-90)
- Arid Western Plain with Desert soils (LGP:<60 days).

*LGP: Length of Growing Period

Map 1. Agro-ecological Subregions of Punjab



(LGP: Length of Growing Period)
Source : Deptt. of Soil & Water Conservation, Punjab

There are different subjects have different perspectives (Box 4. & Fig. 3) to elucidate the state soils but on the basis of the area, soils of Punjab can be grouped into following three major categories & four orders i.e Entisols, Inceptisols, Alfisols & Aridisols (description in Box 3.)

1) **Soils of Shivalik Hills**
2) **Soils of Piedmont Plain**
3) **Soils of Alluvial Plain**

BOX 4. Punjab Soils: Different Perspectives

The soils of Punjab can be studied under different perspectives as follows:

Geological Perspective

Geologically, it is a part of the Indo-Gangetic plain which owes its origin to a depression of synclinal nature i.e. sloping downward toward each other to create a trough. This trough was later on filled up with enormous quantities of sediments brought down from the mountains by the rivers of the Indo-Gangetic system. (Sehgal *et al.,* 1973; Wadia, 1976). Geological facts also reveal that the state of Punjab is formed by the alluvial deposits of various rivers flowing through Punjab, namely Ravi, Beas, Satluj, Ghaggar and their tributaries.

The Shivalik range in the north-east of Punjab includes middle and lower Shivaliks. These hills are formed as a result of the latest phase of Himalayan orogeny. These are composed of Pinjore boulders, conglomerates and poorly lithified, soft and friable-sand stone and shales. The age of these deposits vary from Upper Miocene to Lower Pleistocene. The piedmont plain in Kandi Belt of Punjab state is characterized by coarse textured, poorly sorted, sediments mixed with gravels and pebbles (Manku,2002).It is formed due to coalescence of alluvial fans and is confined to narrow belt along the Shivalik foothills.

Geomorphological Perspective

The orogenic processes, associated with fluviatile actions, have modified this area into a vast stretch of old and recent alluvium of greater depths. The original deposits were further modified by the change in the courses of the Ravi, Satluj, Beas and Ghaggar rivers. The Satluj was originally an independent river, not belonging to the Indus system and joined the Ghaggar in Bikaner. It abandoned its course finally in the thirteenth century and joined the Beas river near the south-west corner of Kapurthala at Harike. Change in this river system has resulted in abandoning of tributaries which were silted up in due course. The fluviatile sedimentation pattern has been strongly influenced by the relief and the climate. These processes induced the rivers to braid with the formation of sand bars. It is believed that the localized Aeolian redeposition of the sand bars has probably caused the formation of the sand dunes, locally known as tibbas.

Drainage & Canal Network

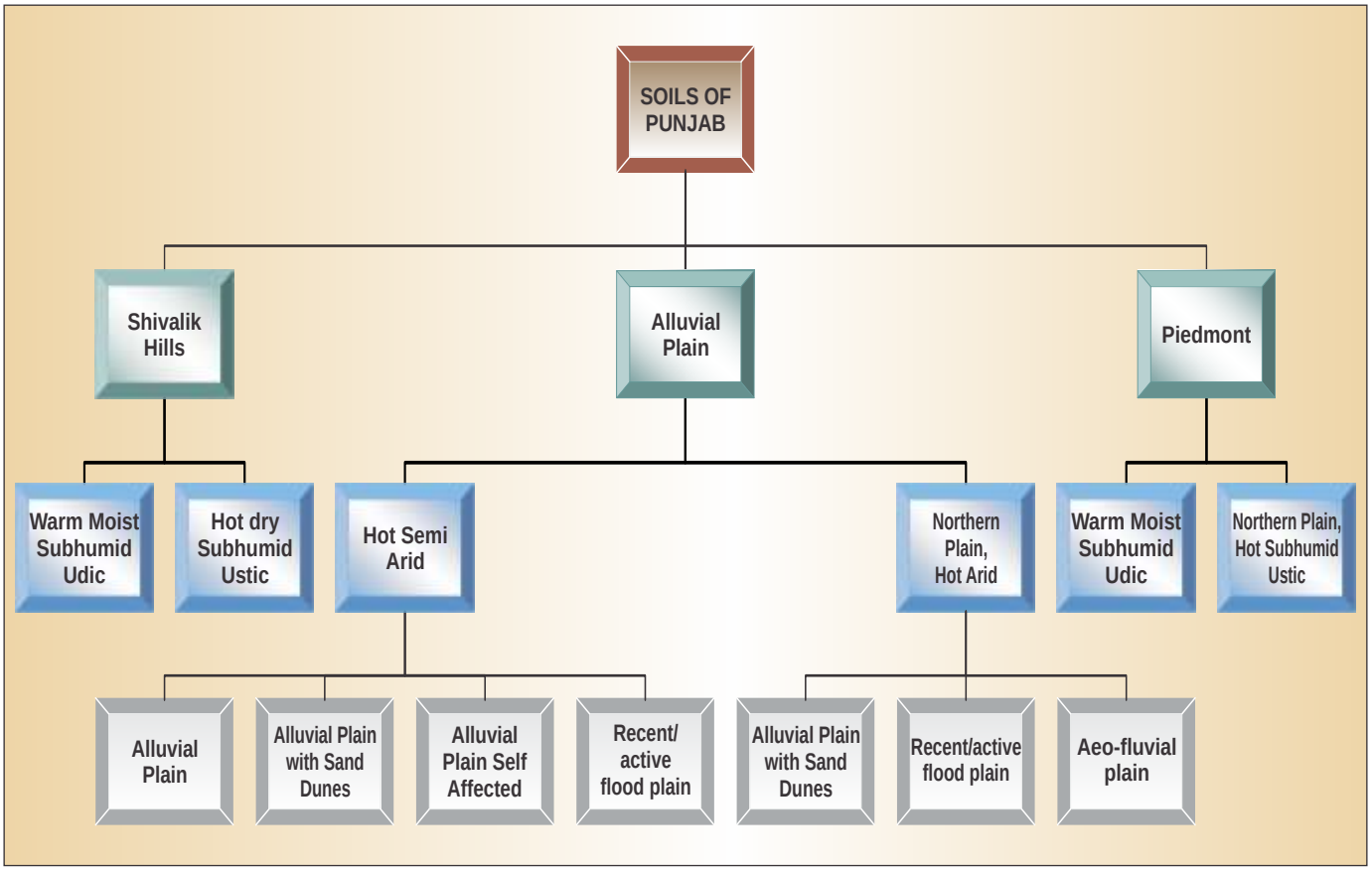
The drainage system plays an important role in shaping the landscape of an area. The Satluj, Beas and Ravi rivers form the main drainage system in the state of Punjab. The other main drainage channels in Punjab are Ghaggar river, White Bein, Black Bein, Kiran Nala, Chakki river and Sakki Nala. In addition to these major drainage channels, there are numerous choes (seasonal rivulets), originating in the Shivalik hills and drian the Kandi area. In Punjab, out of the total irrigated area, 29 %cent is irrigated by canals and remaining 71 per cent by tube wells. There are six major canal systems viz. Upper Bari Doab, Sirhind, Bikaner, Rajasthan, Bist Doab and Bhakra. Only Upper Bari Doab Canal is taking off from river Ravi and the other five canals from river Satluj (Sharma *et al.,* 2008 & http://www.ncap.res.in).

Physiographic Perspective

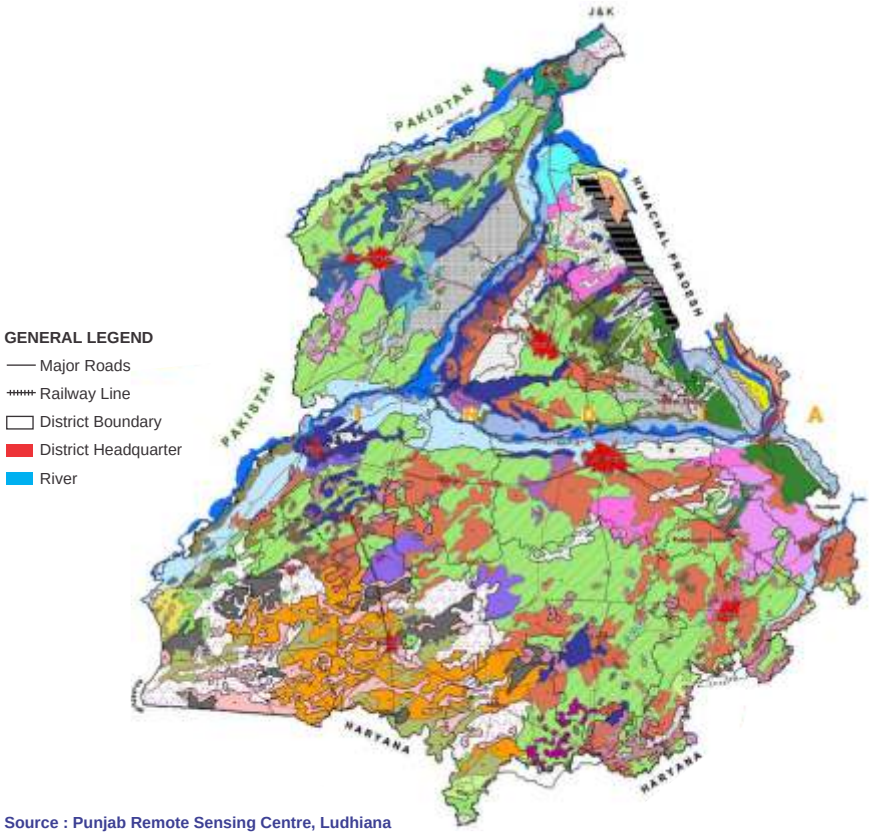
The Punjab state forms a part of Indo-Gangetic alluvial plain and is composed of sediments of Shivalik hills and Himalayas brought down and laid by the rivers of Indus system. The exact depth of the alluvium has not been ascertained, though it varies from a few metres to over 2000 metres (Wadia, 1976).

Further, the state can be divided into three major physiographic units i.e Shivalik hills, Piedmont plain & Alluvial plain.

Fig. 3. Classification of Soils of Punjab



Map 2. Soils of Punjab



Source : Punjab Remote Sensing Centre, Ludhiana

DESCRIPTION OF CODES

FAMILY PARTICLE SIZE CLASS
C.L. Coarse Loamy
F.L Fine Loamy
F.S. Fine Silty
S.Sk. Sandy Skeletal
LSk. Loamy Skeletal

CALCAREOUS CLASS
CAL. Calcareous
(other units are non-calcareous)

SOIL DRAINAGE CLASS
Dr_2-Poorly Drained
Dr_3-Imperfectly Drained
Dr_4-Moderately Well Drained
Dr_5-Well Drained
Dr_6-Somewhat Excessively Drained
Dr_7-Excessively Drained

SOIL EROSION CLASS
e1-Slight Erosion
e2-Moderate Erosion
e3-Severe Erosion

SOIL SALINITY (EC dS/m)
S1 Slight Salinity (0.8-1.6)
S2 Moderate Salinity (1.6-2.5)
S3 Strong Salinity (2.5-5.0)

SOIL SODICITY (pH 1:2)
N1 Slight Salinity (8.7-9.2)
N2 Moderate Salinity (9.2-9.8)
N3 Strong Salinity (>9.5)

FLOODING (% AREA FLOODED)
F1 Slight Flooding (>25%)
F2 Moderate Flooding (25-50%)

(1) C. L soils, Cal., Dr6,e3,mod. stony (Typic Udorthents) / C.L. soils, Dr7, e2 (Typic Eutrochrepts)

(2) F.L. soils, Cal., Dr6.e2,mod. stony (Typic Udorthents) F.L. soils, Cal., Dr7, e2 (Typic Eutrochrepts)

(3) Snady soils Cal.Dr7.e3.stony(Typic Udorthents) / Sandy soils, Dr7.e3 (Typic Ustipsameents) / L.Sk.soils, Cal., Dr7, e3, mod.stony (Typic Ustorthents)

(4) S.Sk.soils, Cal.,Dr7.e3 moderately stony (Typic Udorthents) / Sandy soils, Dr7, e3(Typic Ustipsamments)/C.L. soils, Cal.,Dr7,e3, mod.stony (Typic Ustorthents)

(5) L.Sk soils, Cal., Dr6, e3, mod. (Typic Udorthents) / Sandy soils, Dr7.e3 (Typic Ustipsamments)/ C.L. soils with loamy surface, Dr6, e2 slightly stony (Typic Ustorthents)

(6) L.Sk.soils, Cal., Dr5,e1, mod. gravelly (Typic Udorthents)/F.L. soils, Cal., Dr5, e2, mod stony (Fluventic Eutrochrepts).

(7) C.L. Soils,Cal.,Dr5.e2 (Typic Eutrochrepts) / F.L. soils, Cal.,Dr5.e2, (Fluventic Eutrochrepts)

(8) C.L. soils, Cal., Dr5.e1 (Typic Eutrochrepts) / F.L. soils, Dr5, e1, (Dystric Eutrochrepts)

(9) C.L. over sandy soils, Cal., Dr6,e1 (Typic Ustifluvents) / Sandy soils, Cal., Dr7, e2, mod. stony (Typic Ustipsamments) C. L. soils, Cal., Dr5,e1 (Typic Ustochrepts)

(10) Sandy soils, Dr7,e2 (Typic Ustipsamments) / C.L. Soils with loamy surface, Cal. Dr5, e2(Fluventic Ustochrepts) / C.L. over sandy soils, Cal., Dr6, e1 (Typic Ustifluvents)

(11) C.L. soils Cal., Dr5,e2 (Typic Ustifluvents) / Sandy soils, Dr7, e2 (Typic Ustipsamments) / C.L. soils, Cal., Dr5, e1 (Typic Ustrochrepts)

(12) C.L. soils, Cal.,Dr5,e1 (Typic Ustifluvents) / F.L. soils, Dr5,e1 (Typic Ustrochrepts)

(13) C.L. over sandy soils, Dr5,e1 (Typic Ustifluvents) / C.L. soils, Dr5 e1 (Typic Ustochrepts)

(14) C.L. soils, Cal., Dr5,e1 (Typic Ustochrepts) / Sandy soils, Dr7, e2 (Typic Ustipsamments) C.L. soils, Cal., Dr5,e2 (Fluventic Ustochrepts)

(15) C.L. soils, Cal., Dr5,e2 (Typic Ustochrepts) / C.L. soils Dr5, e2 (Typic Ustifluvents) Sandy soils, Dr7,e2 (Typic Ustipsamments)

(16) F.L. soils, Cal., Dr5.e1 (Typic Ustochrepts) / C.L. soils, Cal., Dr5, e1 (Typic Ustochrepts)

(17) Sandy soils, Dr7,e2 (Typic Ustipsamments) C.L. soils, Cal soils, Cal., Dr5,e1 (Typic Ustochrepts).

(18) C.L. soils, Cal., Dr5,e1 (Typic Ustochrepts) / F.L. soils, Cal., Dr5, e1 (Typic Ustochrepts)

(19) C.L. soils, Cal., Dr5,e1 (Typic Ustochrepts) / Stratified C.L. soils, Cal., Dr5, e1 (Typic Ustifluvents)

(20) C.L. soils, Dr5,e1 (Typic Ustochrepts) / F.L. soils, Dr5, e1 (Typic Ustrochrepts) / C.L. soils, Cal., Dr5,e1 (Fluventic Ustifluvents)

(21) C.L. soils, Cal., Dr5, e1 (Typic Ustochrepts) / F.L. soils, Dr5, e1 (Typic Ustochrepts) / C.L. soils , Dr5, e2 (Typic Ustorthents)

(22) C.L. soils, Cal., Dr5,e1 (Typic Ustochrepts) / Sandy over loamy soils, Cal., Dr6, e1 (Typic Ustochrepts)

(23) C.L. soils, Cal., Dr5, e1(Typic Ustochrepts) / F.L. soils, Dr5, e1 (Typic Haplustalfs)

(24) F.L. soils, Dr5,e1 (Typic Ustochrepts) / F.L. soils, Cal., Dr4, e1 (Vertic Ustochrepts)

(25) F.L. soils, Cal., Dr5,e1 (Typic Ustochrepts) / F.L. soils, Dr6, e1 (Typic Haplustalfs)

(26) C.L. soils, Cal., Dr4,e1 (Fluventic Ustochrepts) / F.L. soils, Cal., Dr5, e1 (Typic Ustochrepts)

(27) C.L. soils, Cal., Dr4, e1 (Fluventic Ustochrepts) / C.L. soils, Cal., Dr5, e1 (Typic Ustifluvents)

(28) F.L. soils, Cal., Dr5, e1 (Typic Ustochrepts) / C.L. soils, Cal., Dr5, e1 (Typic Ustochrepts) / ***F.L. soils, Dr5, nearly level e1 (Typic Haplustalfs)

(29) C.L. soils, Cal., Dr5, S1, N1 (Typic Ustochrepts) / F.L. soils, Cal., Dr5, S1, N1 (Typic Ustochrepts)

(30) C.L. soils, Cal., Dr5,S1,N1 (Typic Ustochrepts) / Sandy soils, Cal., Dr7, S1,N1 (Typic Ustipsamments)

(31) C.L. soils, Cal., Dr4,S1,N1 (Typic ustochrepts) / F.L. soils, Cal., Dr3, S2, N2 (Aeric Halaquepts)

(32) C.L. soils, Cal., Dr5, S1, N1 (Typic Ustochrepts) / C.L. Soils, Cal., Dr4, e1, S2, N2 (Natric Ustipsamments)

(33) C.L. soils, Cal., Dr4,S2,N2 (Natric Ustochrepts) / F.L. soils, Cal., Dr4,S2,N2 (Typic Halaquepts)

(34) F.L. soils, Cal., Dr5, N1 (Typic Ustochrepts) / F.L. soils, Cal., Dr4, S2, N3 (Natric Ustipsamments) / F.L. soils, Cal., Dr2,S2,N2 (Aeric Halaquepts)

(35) F.L. soils, Cal., Dr4, S1, N1 (Typic Ustochrepts) / C.L. soils, Cal., Dr4, S1, N1 (Typic Ustipsamments)

(36) F.L.soils, Cal., Dr4. e1, S2,N3(Typic Natrustalfs) / C.L. soils, Cal., Dr4, S1, N1 (Natric Ustipsamments)

(37) C.L. soils, Cal., Dr4 (Typic Ustochrepts) / C.L. soils, Cal., Dr4, S1, N1(Fluventic Ustochrepts)/ F.L. soils, Cal., Dr4, S2,N2 (Natric Ustochrepts)

(38) Sandy soils, Cal.,Dr7,F1 (Typic Ustipsamments) / C.L. over sandy soils, Cal., Dr5, F1 (Typic Ustifluvents)

(39) Sandy soils, Cal., Dr7,e2 (Typic Ustipsamments) / C.L. over sandy soils, Cal. Dr5,e2 (Typic Ustifluvents) / F.L. soils, Cal., Dr5,e2 (Typic Ustochrepts)

(40) C.L. over sandy soils, F2., Cal., Dr5 (Typic Ustifluvents) / Sandy soils, F2., Cal., Dr7 (Typic Ustipsamments)

(41) C.L. over sandy soils, F2., Cal., Dr5 (Typic Ustifluvents) / F.L. over sandy soils, Cal., Dr5 (Typic Ustifluvents) / Sandy soils, Cal., Dr2,e2, (Typic Ustipsamments)

(42) F.L. soils, F1., Cal., Dr2 e1, S2,N1 (Aeric Halaquepts) / F.L. soils, Cal., Dr4, S1(Typic Ustochrepts)

(43) Sandy soils, Dr7, Moderate wind erosion (Ustic Torripsamments) / C.L. soils, Cal., Dr5, Moderate wind erosion (Ustic Haplocambids)

(44) C.L. soils, Cal., Dr5, e1 (Ustic Haplocambids) / Sandy soils , Cal., Dr7,e1 (Ustic Torripsamments)

(45) C.L. soils, Cal.,Dr5,e1 (Ustic Haplocambids) / Sandy over loamy soils, Cal., Dr5,e1 (Ustic Haplocambids)

(46) C.L. soils, Cal., Dr5,e1 (Ustic Haplocambids) / F.L. soils, Cal., Dr5,e1 (Ustic Haplocambids)

(47) F.L. soils, Cal., Dr5,e1 (Ustic Haplocambids) / C.L. soils, Cal., Dr5, e1 (Ustic Haplocambids)

(48) Sandy soils, Dr7,e1 (Ustic Torripsamments) / F.L. over sandy soils, Cal., Dr5,e1 (Ustic Torrifluvents)

(49) Sandy soils , Cal., Dr6, S1, N1 (Ustic Torripsamments) / C.L. soils, Cal., Dr4, S2, N1 (Ustic Haplocambids)

(50) C.L. soils, Dr4, S2, N2 (Ustic Haplocambids) / C.L. soils, Dr4, S2, N3 (Ustic Haplocambids).

1) Soils of Shivalik Hills

This region covers northern and northeastern parts of the State and includes northern parts of Gurdaspur, Hoshiarpur and Rupnagar districts, at an elevation between 300 and 900 MSL.

It covers a total area of 1,47,083 ha (2.9%) of the geographical area of the State.

The soils of Shiwalik hills are described in the two main distinct agro-ecological sub-regions (Table 2 a & b):

- Warm Moist Subhumid, Udic
- Hot Dry Subhumid, Ustic

Table: 2 (a & b) Characteristics of Agro-ecological subregions of Shivalik Hills' soil

Table : 2 (a)

Sub-regions	Occurrence & development	Occupied area & districts
Warm Moist Subhumid, Udic	Moderately steep slopes and developed over sandstones, shales and conglomerate of Shiwalik formation.	● 26393 ha (0.5% of the state area) ● covering northern parts of Gurdaspur district
Hot Dry - Subhumid, Ustic	Moderately steep slopes and developed over sandstones, shales and conglomerates.	● 1,20,690 ha (2.4% of the state area) ● covering parts of Hoshiarpur and Rupnagar districts

Table : 2 (b)

Sub-regions	Rainfall & MAST	pH
Warm Moist Subhumid, Udic	1200 mm to 1500 mm & 20°C	7.1 - 8.5
Hot Dry - Subhumid, Ustic	1000 to 1200 mm & 23°C	6.7 - 8.5

The soils of Shivalik Hills consist of two moisture regimes, Udic and Ustic. These regimes can further be categorized into various subgroupes on the basis of their particle size. The description of moisture regimes, their classification and covered area are given in the Table 3 (a & b).

Table: 3 (a). Classification of Soils of Shiwalik Hills under Udic moisture regime

Subgroup with family (particle-size class)	Area ha(%)
Typic Udrothents	**13196 (50.0)**
Coarse-loamy	5553 (41.3)
Fine-loamy	7643 (57.9)
Typic Eutrocherpts	**10903 (41.3)**
Coarse-loamy	3887 (35.7)
Fine-loamy	7016 (64.3)
Typic Hyplaudalfs	
Fine-loamy	2294 (8.7)

Table: 3 (b). Classification of Soils of Shiwalik Hills under Ustic moisture regime

Subgroup with family (particle-size class)	Area ha(%)
Typic Ustorthents	**96516 (100)**
Sandy	44508 (46.1)
Sandy-skeletal	6877 (7.1)
Loamy-skeletal	31269 (32.4)
Coarse loamy over fragmental	4325 (4.5)
Coarse-loamy	9537 (9.8)
Typic Ustochrepts	
Coarse-loamy	7471 (30.9)
Udic Ustochrepts	
Coarse-loamy	16703 (69.1)

*The Great group area is expressed as % of total landform subunit area; subgroup area as % of the Great group area and family (particle-size class) area as % of subgroup area.

Source: Sidhu *et al.,* (1995).

The soils of Shivalik Hills are moistly barren or wastelands supporting bushy type vegetation, however, some soils support horticultural crops. These soils face erosion hazards and require intensive conservation and plantation measures (Box 5).

BOX: 5. Land use, Constraints and Potentials of Soils of Shiwalik Hills

	Agro-ecological sub-regions	
	Warm Moist Sub-humid Ustic	**Hot Dry-Subhumid Ustic**
Land Use	● Mostly barren associated with rock outcrops and support thin grasses and shrubs. ● Some soils are good enough to support forests and horticultural crops.	● Mostly wastelands with sparse bushy type forests. ● Occasionally cultivated for growing cereal and oilseed crops under rainfed conditions.
Constraints	Severe to very severe erosion hazard, coarse soil texture and often face rapid run off resulting in low water storage.	Moderate to severe erosion, coarser soil texture, and low to medium water capacity and low fertility.
Potential	The soils of this region require intensive soil conservation measures and plantation of erosion resistant varieties of grasses and plants.	Productivity is low to medium which can be increased by adopting suitable dry farming and watershed techniques.

2) Soils of Piedmont Plain

They occur on nearly level to moderately sloping (1-8 %) transitional zone between Siwalik hills and the river terraces and occupy a total area of 3, 50,437 ha accounting for 6.9% area of the State, covering parts of Gurdaspur, Hoshiarpur and Rupnagar district. The soils are severely dissected by seasonal streams (Choes).

The soils of this region have two main distinct agro-ecological sub-regions are given in Table 4 (a & b):

- Warm Moist Subhumid, Udic
- Northern plain, Hot Subhumid, Ustic

Table:4. (a) & (b) Characteristics of Agro-ecological sub-regions of Soils of Piedmont Plain

Table 4 (a)

Sub- regions	Occurrence & development	Occupied Area & districts
Warm Moist Subhumid, Udic	Moderately steep and developed over sandstones, shales & conglomerate	● 46726 ha (0. 9% of the state area) ● covering parts of Gurdaspur, Hoshiarpur & Rupnagar district.
Northern Plain, Hot Subhumid, Ustic	Moderately steep slopes & developed over sandstones shales & conglomerates	● 303711 ha (6.0% of the state area) ● covering upper plains of Gurdaspur, Hoshiarpur & Rupnagar, districts.

Table 4 (b)

Sub- regions	Rainfall & MAST	PH
Warm Moist Subhumid, Udic	1200 mm to 1500 mm & 20°C	7.1-8.5
Northern Plain, Hot Subhumid Ustic	1000 to 1200 mm & & 23°C	7.5-8.8

*The Great group area is expressed as % of total landform subunit area; subgroup area as % of the great group area and family (particle-size class) area as % of subgroup area.

Source: Sidhu et al., (1995).

The soils of Piedmont Plain consist of Udic and Ustic moisture regimes. These regimes can further be categorized into various subgroups on the basis of their particle size. The description of moisture regimes, their classification and covered area are given in the Table 5 (a & b).

Table:5. (a) Classification of Soils of Piedmont Plain under Udic moisture regime

Subgroup with family (particle-size class)	Area ha (%)
Typic Udorthents	
Loamy-seletal	6086 (13.0)
Typic Udipsamments	**4449 (9.5)**
Sandy	36121 (77.4)
Typic Eutrochrepts	19519 (54.0)
Coarse-loamy	12289 (63.0)
Fine-loamy	7230 (37.0)
Dystric Eutrochrepts	
Fine-loamy	7069 (19.6)
Fluventic Eutrochrepts	
Fine-loamy	9533 (26.4)

*The Great group area is expressed as % of total landform subunit area; subgroup area as % of the great group area and family (particle-size class) area as % of subgroup area.

Table:5. (b) Classification of Soils of Piedmont Plain under Ustic moisture regime

Subgroup with family (particle-size class)	Area ha (%)
Typic Ustpsamments	**81720 (26.9)**
Typic Ustifluvents	**37439 (12.3)**
Coarse-loamy over sandy	8178 (21.8)
Coarse-loamy	26265 (70.2)
Fine-loamy over sandy	2996 (8.0)
Typic Ustochrepts	**3865 (1.3)**
Fine-loamy	180687 (59.5)
Typic Ustorthents	**93235 (1.3)**
Coarse-loamy	29490 (31.6)
Fine-loamy	63785 (68.4)
Udic Ustochrepts	**83039 (46.0)**
Coarse-loamy	69745 (84.0)
Fine-loamy	13294 (16.0)
Fluventic Ustochrepts	4413 (2.4)
Coarse-loamy	2415 (54.7)
Fine-loamy	1998 (45.3)

Source: Sidhu et al., (1995).

The soils of Piedmont Plain are mostly barren & supporting bushy type vegetation, however, some soils support horticultural & oil crops. These soils face erosion hazards and require immediate conservation measures (Box 6).

Box 6. Land Use, Constraints & Potentials of Piedmont Plain Soils

	Agro-ecological sub-regions	
	Warm Moist Subhumid, Udic	**Nothern plain, Hot, Subhumid, Ustic**
Land Use	Mostly barren & occur as wastelands but some soils are under forests, pastures and cultivated for climatically adapted crops.	• The soils of this region are mostly barren lands supporting bushes like *Saccharum, Dedonia, Lantana* etc. • Some soils are cultivated mainly for wheat, pulses, oilseeds, maize, potato, rice and horticultural crops.
Constraints	The main threats to these soils include, severe erosion, stoniness, gravelliness, low fertility rapid runoff, less water storage.	The major threats to these soils are due to their coarse texture, severe erosion, low to moderate AWC & poor fertility.
Potentials	These soils are suitable for cultivation of wheat, maize rice & horticultural plants. The degraded lands may be put under protective pastures and forestry.	These soils require immediate soil conservation measures like by provision of irrigation, lining of choes and plantation of grasses.

3) Soils of Alluvial Plains

The soils of alluvial plain are most extensive occupying a total area of 45,38,230 ha representing 90% of the state area. They extend over the northern, eastern central and south-western parts of the State, covering Gurdaspur, Amritsar, Kapurthala, Jalandhar, Rupnagar Patlala, Ludhiana, Sangrur, Fatehgarh, Sahib and northern parts of Firozpur, Faridkot, and Bathinda districts.

The soils of alluvial plain are described under following two main agro-ecological subregions of the State:

1.Hot Semi-arid , agro-ecological subregion (Ustic Zone)

The soils of this agro-ecological subregion occurred on moderately steep slopes & developed over sandstones, shales & conglomerate. These soils occupy an area of 35, 80,457 ha (71% of the state area) and covering parts of Gurdaspur, Amritsar, Jalandhar, Kapurthala Patiala, Sangrur, Ludhiana and Northern parts of Firozpur, Bathinda and Faridkot districts. The annual rainfall ranges from 400-800 mm and the mean annual soil temperature is 25^{0}C. This region falls under Ustic moisture regime and described under various subunits (Table 6).

Table 6. Subunits of Hot Semi-arid, Agro-ecological sub-region soils

Sub-units	Charatcteristics	Occupied area & districts
a) Alluvial Plains	● Soils are non calcareous to slightly calcareous in central to northern parts of the region. ● These soils are very deep, well to Moderately well drain. ● Texture varying from Sandy loam to silty clay loam. ● pH varying from 7.6 to 8.6. ● The major soil types are given in Table 7 (a)	● 19, 15, 402 ha (38.9% of the state area) ● Covering parts of Gurdaspur, Amritsar, Sangrur, Ludhiana, Jalandhar, Kapurthala and Patiala districts.
b) Alluvial Plains with sand dunes	● The level alluvial plains are dotted by sand dune and sand bars. ● Formed by Aeolian reworking of alluvial deposits. ● The classification of these soil are given in Table 7 (b).	● 3,15, 816 ha (6.3% of the state area). ● Covering northern parts of Firozpur, Faridkot, Bathinda and Mansa districts and some part os Ludhiana, Sangrur, Jalandhar, Kapurthala and Hoshiarpur
c) Alluvial plains-salt affected ● Sodic Soils in North Western & Central parts ● Saline-Sodic soils in the south western parts	● Occur mostly in localized depressions. ● The soils are very deep, loamy, poorly to imperfectly drained, calcareous and sodic in nature. ● pH ranges from 8.2 to 10.6. ● Confined to lowlying areas and water logged areas. ● The classification of these soils is given in Table 7 (c).	● The total area of salt affected soil is 8,12,940 ha. ● Covering parts of Firozpur, Faridkot, Bathinda, Mansa, Kapurthala, Patiala and Rupnagar districts.
d) Recent/active Flood Plains	● These soils are extensive in flood plains of Beas, Satluj, Ravi and Ghaggar rivers. ● These soils are very deep, excessively to well and moderately well drained and of variable texture. ● pH ranges from 7.3 to 8.9. ● The classification of these soils is given in Table 7 (d).	● The total area of recent/active flood plains is 5,36,399 ha (10.65% of the of the state. ● Covering parts of Firozpur, Amritsar, Kapurthala, Patiala, Sangrur and Rupnagar districts.

The four major subunits of this region can be further classified into various subgroups on the basis of the particle size. This classification and the covered area are given in the Tables 7 (a-d).

Table 7 (a-d). Classification of Soils of Alluvial Plains

(Subunits of Hot Semi-arid, Agro-ecological sub region)

Table 7 (a) Soils of Alluvial Plain

Subgroup with family	Area ha (%) (particle-size class)
Typic Haplustalfs	**197025 (100.0)**
Fine-loamy	147115 (74.7)
Fine-silty	49910 (25.3)
Typic Ustipsamments	
Sandy	40338 (2.1)
Typic Ustifluvents	
Coarse-loamy	45015 (2.4)
Typic Ustochrepts	**1153459(85.3)**
Coarse-loamy	558888 (48.5)
Fine-loamy	577219 (50.0)
Sandy over-loamy	17352 (1.5)
Udic Ustochrepts	**402884 (24.4)**
Coarse-loamy	200920 (49.9)
Fine-loamy	201964 (50.1)
Fluventic Ustochrepts	**72102 (4.4)**
Coarse-loamy	24611 (34.1)
Fine-loamy	47491 (65.9)
Vertic Ustochrepts	
Fine	4574 (0.3)

Table 7 (b) Soils of Alluvial Plain with sand dunes

Typic Ustipsamments	
Sandy	134940 (42.7)
Typic Ustochrepts	**134393 (74.3)**
Coarse-loamy	80222 (59.7)
Fine-loamy	54171 (40.3)
Udic Ustochrepts	**46483 (25.7)**
Coarse-loamy	42639 (91.7)
Fine-loamy	3844 (8.3)

Table 7 (c) Soils of Alluvial Plains-salt affected

Subgroup with family	Area ha (%) (particle-size class)
Typic Haplustalfs	
Fine-loamy	15103 (1.9)
Type Natrustalfs	
Fine-loamy	9140 (1.1)
Typic Ustipsamments	
Sandy	42187 (5.2)
Typic Ustifluvents	
Coarse-loamy	6623 (0.8)
Aeric Halaquepts	
Fine-loamy	21458 (2.6)
Typic Ustrochrepts	**588095 (81.8)**
Sandy over-loamy	4122 (0.7)
Coarse-loamy	272096 (46.3)
Fine-loamy	289265 (49.2)
Fine-Silty	22612 (3.8)
Udic Ustochrepts	**4866 (0.7)**
Coarse-loamy	1946 (40.0)
Fine-loamy	2920 (60.0)
Natric ustochrepts	**93946 (13.1)**
Coarse-loamy	23319 (24.8)
Fine-loamy	70627 (75.2)
Fluventic Ustochrepts	**15108 (2.1)**
Coarse-loamy	5174 (34.2)
Fine-loamy	9934 (65.8)
Vertic Ustochrepts	
Fine	16414 (2.3)

Table 7 (d) Soils of Recent/Active flood plain

Typic Ustipsamments	
Sandy	200751 (37.4)
Typic Ustifluvents	**304287 (56.7)**
Coarse-loamy over sandy	150052 (49.3)
Fine-loamy over sandy	133392 (43.8)
Fine-silty over sandy	20843 (6.9)
Typic Ustochrepts	
Fine-loamy	24618 (4.6)
Aeric Halaquepts	
Fine-loamy	6741 (1.3)

*The Great group area is expressed as % of total landform subunit area; subgroup area as % of the great group area and family (particle-size class) area as % of subgroup area.

Source: *Sidhu et al.,* (1995).

Box: 7. Land Use, Constraints and potentials of Hot Semi-arid Agro-ecological Sub-region soils

Sub-units (Ustic Zone)	Land Use	Constraints	Potentials
Alluvial Plains	Cultivated for wheat, rice, potato, sugarcane, oilseed, etc.	low to medium fertility	Produce very high yields of wheat, rice, potato, sugarcane, etc. Productivity of fine text-tured soils can be improved by maintaining proper soil-water-air relationship.
Alluvial Plain with sand dunes	Cultivated for wheat, paddy, mustard & potato	• Sandy texture • Low CEC & AWC* • Low fertility	Production potential is low to medium
Alluvial Plain Salt affected:			
a) Sodic soils in the North-western & Central parts	• These soils are either left as uncultivated or cultivated for rice, wheat and other salt-tolerant crops. In some soils, sugarcane & fodder crops are also grown.	• Moderate to strong salinity • Low hydraulic conductivity of sub soil causing water logging. • Low nutrient availability	• The soils can be improved by providing irrigation water of good quality with proper drainage.
b) Saline-Sodic soils in the south western parts	• Most of these soils are left uncultivated except in some areas where they are culti-vated to salt-tolerant crops.	• High salt content and logging problem.	• Low production potential
Recent/active flood	Mostly under natural vegetation, some soils are cultivated for nice and wheat while some are left as barren lands.	• Moderate to high flooding hazard, slight to moderate erosion, high water table & slight salinity/sodicity in some localized areas and sandy texture.	• Production potential is low to medium & can be utilized for social forestry, short duration Rabi vegetable crops.

*Cation exchange capacity & available water capacity

1. **Nothern Plain, Hot, Arid agro-ecological subregion (Aridic Zone)**

The soils of this subregion occurred on moderately steep slopes & developed over sandstones, shales & conglomerate and occupy an area of 9, 57,773 ha (19 % of the state area), covering sub extreme southwestern parts of the state including Bathinda district and parts of Firozpur, Faridkot and Mansa districts The annual rainfall is less than 300 mm and the mean annual soil temperature is 27^{0}C. This region falls under Aridic moisture regime and described under three subunits (Table 8).

Table:8. Subunits of Nothern Plain, Hot, Arid agro-ecological subregion soils

Subunits	Characteristics	Occupied area & districts
(a) Alluvial plains with sand dunes	• These dunal soils are very deep, excessively to well drained sandy in texture and occur on very gentle to moderate dune slopes. • Texture varying from Sandy loam to silty clay loam. • pH ranges from 8.0-9.5 in interdunal soils.	• 8,87,699 ha (17.6 % of the state area) • Covering southern parts of Firozpor, Faridkot, and Mansa district. • Bathinda district is largely covered by wind blown sands.
(b)Recent/active Flood plains	• These soils are stratified, very deep, well drained, yellowish brown to dark yellowish brown or olive to pale brown and calcareous.	• Occupy very limited area of 38,548 ha (0.77% of the state area) • These soils are confined along the river Satluj in south western parts of Firozpur district.
(c)Aeo-fluvial plains	• Formed by Aeolian reworking of alluvial deposits. The other Properties of these soils are similar to those of alluvial pains with sand dunes • The classification of these soil is given in Table 9.	• These soils occupying only 3,152 ha area which represents only 0.6% of the total state area. • Covering extreme southern parts of Firozpur, Faridkot, Bathinda and Mansa districts.

Box 8. Land Use, Constrains and Potentials of Northern Plain, Hot Arid Agro-ecological Subregion's (Aridic Zone) soils

Sub-units	Land use	Constraints	Potential
Alluvial plain with sand dunes	Cultivated to single crops of wheat, gram, guar, bajra & pulses.	Soils have sandy texture, gentle slopes, wind erosion, low nutrient status and AWC and hard substratum of lime ($CaCO_3$)	These soils are extensive in food plain areas of the Beas, Satluj, Ravi and Ghaggar rivers forming sand bars and point bars complexes as a result of braiding and meandering action of these rivers. They are subject to inundation during rainy seasons. This unit occupies 5.36,399 ha which represents 10.65 % of the total area of the state.
Recent/active flood plain	The land use constraints and potentials of these soils have been discussed along with other such soils in sub-units of alluvial plain (Box 7)		
Aeo-fluvial Plain	The land use constraints and potentials of these soils are similar to those of aluvial plain with sand dunes (Box 7).		

Table:9. Soils of Alluvial Plain under Aridic moisture regime

Subgroup with family (particle - size class)	Area ha (%)
Soils of Alluvial Plain With Sand Dune	
Ustic Torripsarnments	
Sandy	168282 (19.3)
Ustochreptic Camborthids	**706061 (70.5)**
Sandy over loamy	106167 (15.0)
Coarse-loamy	466155 (66.0)
Fine-loamy	133/39 (18.9)
Ustochreptic Calciorthids	
Coarse-loamy	13356.(1.5)
Soils of Recent Flood Plain	
Ustic Torripsamments	
Sandy	23128 (60.0)
Ustic Torrifluvents	
Fine loamy over sandy	13600 (35.3)
Ustochreptic Camborthids	
Coarse-loamy	1820 (4.7)
Soils of Aeo-fluvial Plain	
Ustic Torripsamments	
Sandy	12610 (40.0)
Ustochreptic Camborithds	
Coarse-loamy	18916 (60.0)

*The Great group area is expressed as % of total landform subunit area; subgroup area as % of the great group area and family (particle-size class) area as % of subgroup area.

Source: *Sidhu et al.,* (1995).

As discussed above that some soils in Punjab suffer from varying degree of soil problems. These soils are degraded because of the deleterious effects of human interference, adverse physiographic setting & climatic conditions, unfavorable soil texture and other adverse soil characteristics i.e. high pH and high salinity and sodicity etc. Majority of the soils in Punjab are sodic and require the application of gypsum to ameliorate high pH and ESP conditions. As such these soils are not economically feasible for producing food, fodder or cash crops, under the existing conditions. However, crop yields on these soils can be improved by following proper soil-water-fertilizer-crop management and reclamation measures.

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NEWS

GIANT BANYAN TREE NEEDS CONSERVATION

Spread over an area of nearly three acres, one of the centuries-old banyan trees of the Fatehgarh Sahib region stands in immediate need of conservation. Drawing the district administration's attention towards the issue, District Forest Officer (DFO) Balbir Singh said it should be conserved immediately to save it from the vagaries of time, weather and human behavior. “It has been continuously spreading for the past many years and now has occupied nearly three acres of agricultural private land,” said the DFO during a recent meeting of district administrative officials, presided by Deputy Commissioner, Fatehgarh Sahib, Yashvir Mahajan. The tree nests a number of birds and animals like sparrows, owls and insects. People, on whose land the tree stands, are reluctant to axe down the tree as they venerate it due to religious beliefs and its medicinal value. “The tree seems to be more than a century-old. Since my childhood, I have seen villagers worshipping it. The Government should intervene to save it and the farmers on whose land the tree has spread over,” pointed out village Sarpanch Ranjeet Singh.

He added that people didn't want to axe the tree because of its Hindu mythological significance. They believe that anyone who tries to cut even a twig would be damned. Balbir Singh said the tree attracts many visitors from nearby areas and even abroad. Its conservation can be beneficial from tourism point of view as well. A temple and a resthouse (dharamshala) have been constructed under the tree. Believing that the tree has unique healing power, people suffering from different ailments, too, visit this place to spend some time under its shade in order to get cured.

Source: The Tribune : May 27, 2010

CALL FOR CRUSADE TO SAVE FOREST COVER

The Punjab Governor and UT Administrator, Shivraj V Patil, called for a crusade against the degradation of environmental heritage and loss of forest cover, adding the conservation of flora and fauna and the preservation of forest resources are essential for maintaining ecological balance and livelihood security. Patil planted a Buddha coconut tree to mark the celebrations of World Forestry Day at the Nepli Forest of Sukhna Wildlife Sanctuary today.

Chandigarh has a green cover of 38 per cent and to maintain this, the UT administration has organised a campaign, 'Save Trees, Save Planet'. A 'Greening Chandigarh Action Plan 2010-11' was released on the occasion to spread awareness among the younger generations. The plan describes plantation targets of various departments and strategies to convert tree planting activity into a mass campaign involving the participation of students, NGOs, Resident Welfare Associations and government local bodies Speaking on the occasion Patil said, “On this day, we are reminded of our duty to maintain ecological balance and environmental stability and the urgent need to save our forest resources. It is the sacred duty of every citizen to contribute towards making the city greener by planting saplings in the coming monsoon.”

He emphasised the involvement of every individual, village panchayats, municipal bodies, educational institutions and NGOs as active partners in this environment-friendly programme. Patil gave away prizes to schoolchildren who won competitions pertaining to pollution control and environment.

Songs and skits were performed by children to promote afforestation and to give a message of peace and commitment towards a greener, cleaner and more beautiful Chandigarh. UT Adviser, Pradip Mehra, said in the recent past, the green cover of Chandigarh has increased tremendously and the Chandigarh Administration is committed to increase it further by undertaking short and long-term measures. Secretary Forests, Sanjay Kumar, while speaking on the occasion said the target has been fixed to plant 1.90 lakh saplings in Chandigarh during 2010-2011. “We'll fulfill this target and in the next five years we would expand our green cover to 42 per cent. We aim to ameliorate and rehabilitate degraded ecosystems by undertaking programmes for land, water, vegetation, livestock development both under the arable and non-arable land uses,” he added. Director Forests Ishwar Singh, Municipal Commissioner Dr Roshan Sunkaria, Additional Deputy Commissioner Capt P S Shergill and Secretary to Governor M P Singh were present on the occasion.

Source: The Indian Express : March 22, 2010

RS 400 CRORE FOR GREEN DRIVE

The Finance Minister's passion to make “Punjab green” has found an expression in the state's Budget presented in the House today. Finance Minister Manpreet Singh Badal has earmarked over Rs 400 crore for cleaning up of rivers, research to develop temperature-resistant crops, water conservation, reducing air pollution and other measures that would make Punjab more environmental-friendly. Manpreet told The Tribune that he put special emphasis on making the state green because Punjab is likely to most severely affected by climate changes over the next few decades due to its location, dependence on Himalayan waters, and intensive agriculture. Funds have been allocated for what he calls “climate change action plan”. It is a comprehensive strategy to address concerns presented by experts at the world conference on climate change held at Copenhagen. These include increased emissions of carbon dioxide due to burning of fossil fuels (coal, petrol, diesel etc), changes in the monsoon pattern, less snowfall and melting of glaciers in the Himalayas. These changes could adversely affect crops grown in Punjab, besides significantly reducing water resources. The government's action plan consists of three programs focusing on agriculture, energy and water. This will be done through developing climate resilient agriculture, reducing carbon emissions through energy conservation and development of renewable energy and water conservation, water treatment and recycling.

Source: The Tribune : March 17, 2010

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