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DESCRIPTION OF UNITS OF THE FAO-UNESCO SOIL MAP OF THE WORLD LEGEND

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D. Creutzberg

ATIONAL SOIL REFERENCE AND INFORMATION CENTRE

ACRISOLS

Strongly weathered soils that have a horizon with accumulation of illuvial silicate clay of low base status, at least in the lower part of the profile.

Ferric Acrisols	red mottles or concretions of iron/manganese
Plinthic Acrisols	plinthite
Humic Acrisols	high content of organic matter
Gleyic Acrisols	characteristics of wetness at shallow depth
Orthic Acrisols	ochric A horizon only

Diagnostic characteristics

- argillic B horizon with a base saturation of less than 50 percent (by NH_4OAc) in at least a part of the argillic B horizon within 125 cm of the surface,
- no mollic A horizon,
- not all the characteristics which are diagnostic for Planosols, Nitosols, or Podzoluvisols,
- no aridic moisture regime.

Parent material: Weathered materials, derived from a wide variety of rocks, in situ or as colluvium or alluvium.

Environment: Gently undulating to hilly; warm to tropical humid; evergreen and deciduous forest, savanna.

Profile development: Leached acid soils due to moist and warm to hot conditions. Illuvial accumulation in the subsoil of silicate clay with low base saturation.

Use: Having reached an advanced stage of weathering, these soils are inherently unproductive soils with restricted suitability under traditional management.
Nutrients are concentrated in the surface horizon and their maintenance depends on continuous recycling through vegetation unless fertilizers are added.

ANDOSOLS

Weakly developed soils from volcanic ash. They have soil materials with low bulk density, and many have a high content of amorphous colloidal weathering products, often with thixotropic properties.
Some Andosols are not thixotropic. They consist dominantly of silt, sand and gravel, composed of volcanic glass.

Ochric Andosols	structured subsurface horizon
Mollic Andosols	thick dark coloured surface horizon, rich in organic matter with a high base status
Humic Andosols	thick dark coloured surface horizon, rich in organic matter with a low base status
Vitric Andosols	dominantly silt, sand and gravel, composed of volcanic glass

Diagnostic characteristics

- mollic or an umbric A horizon, or an ochric A horizon and a cambic B horizon,
- no other diagnostic horizon,
- to a depth of 35 cm or more:
  a bulk density of less than 0.85 g/cm^3 and an exchange complex dominated by amorphous material,
  or 60 percent or more coarse vitric volcanic materials,
- no hydromorphic properties within 50 cm of the surface,
- no high salinity,
- not all of the characteristics which are diagnostic for Vertisols.

Parent material: Volcanic ash and other pyroclastic deposits, basic effusive materials.

Environment: Undulating to mountainous, humid, arctic to tropical climates with a wide range of vegetation types.

Profile development: Rapid weathering of volcanic materials results in the formation of high concentrations of allophane.

Use: Many Andosols are intensively cultivated with a wide variety of crops. Their use may be restricted, however, by the presence of amorphous hydrated oxides, which induces a high fixing capacity of phosphorus and other major and minor elements. In some cases steep topography is the chief limitation.

ARENOSOLS

Soils in unconsolidated sandy materials other than alluvial deposits, showing a weakly developed subsurface horizon.
Soils consisting of deep, strongly leached sands are included.

Luvic Arenosols	subsurface horizon with lamellae of illuvial clay
Cambic Arenosols	subsurface horizon showing colouring or alteration
Ferralic Arenosols	very low cation exchange capacity of the clay fraction
Albic Arenosols	light coloured, strongly leached sand in the upper part of the profile

Diagnostic characteristics

- formed from coarse-textured unconsolidated materials, exclusive of recent alluvial deposits,
- no diagnostic horizons other than an ochric A horizon,
- either show characteristics of an argillic, cambic or oxic B horizons which, however, do not qualify as diagnostic horizons because the material is too sandy,
  or have albic material over a depth of at least 50 cm from the surface,
- no hydromorphic properties within 50 cm of the surface,
- no high salinity.

Parent material: Coarse textured materials, derived from sandstone or other highly siliceous rocks.

Environment: Level to mountainous, dry to moist, temperate to tropical climates.

Profile development: Very weak due to sandy nature of parent material; may have a weak indication of clay illuviation or formation of soil structure. Some Arenosols consist of strongly leached sands.

Use: Low moisture and nutrient content, due to lack of clay, are the main restricting characteristics. May be used for arable cropping if properly managed. Best left under permanent vegetation to prevent erosion.

CAMBISOLS

Soils that have a subsurface horizon, characterized by pedogenetic alteration of the original parent material, under wet, moist or dry conditions. This is evidenced by the neoformation of silicate clays and iron oxides, and the destruction of the original rock structure, including that of sediments, and the formation of soil structure.
Alteration is not extreme since some primary weatherable minerals are still present. There is no significant illuviation of clay, organic matter or iron and aluminium compounds.
Soils that have only a thick surface horizon, rich in organic matter of low base status are included in Cambisols.

Gelic Cambisols	permanently frozen subsoil
Gleyic Cambisols	characteristics of wetness in the subsoil
Vertic Cambisols	deep cracks in the dry season
Calcic Cambisols	appreciable accumulation of carbonates or gypsum
Ferralic Cambisols	very low capacity to retain cations
Dystric Cambisols	low base status
Eutric Cambisols	high base status
Chromic Cambisols	surface horizon, rich in organic matter with a low base status

Diagnostic characteristics

- cambic B horizon or an umbric A horizon,
- no diagnostic horizons other than an ochric or umbric A horizon, a cambic B horizon, or a calcic or gypsic horizon,
- no high salinity,
- no hydromorphic properties within 50 cm of the surface,
- not all the characteristics diagnostic for Vertisols or Andosols,
- no aridic moisture regime.

Parent material: Medium and fine textured weathering materials, derived from a wide range of rocks, in situ or as colluvium or alluvium; glacial and fluvio-glacial deposits; loess.

Environment: Level to mountainous, arctic to tropical climates; wide range of vegetation types.

Profile development: Moderately developed soils, characterized by slight to moderate degree of weathering of the parent material and the formation of a structured B horizon, without appreciable illuviation of clay, organic matter, aluminium or iron compounds.

Use: Highly important soils where use is not limited by climatic conditions, topography, shallowness or stoniness, or low base status. They can be used for a wide variety of crops, grazing and forestry.

CHERNOZEMS

Soils that have a brownish black or black surface horizon, rich in organic matter with a high base status, and have accumulation of carbonates and/or gypsum in the subsoil.

Luvic Chernozems	accumulation of clay in the subsoil
Glossic Chernozems	tongues of material from the surface horizon into the subsoil
Calcic Chernozems	appreciable accumulation of carbonates and/or gypsum
Haplic Chernozems	no appreciable accumulations of clay, carbonates and/or gypsum, no tongues

Diagnostic characteristics

- mollic A horizon with a moist chroma of 2 or less to a depth of at least 15 cm,
- calcic or gypsic horizon, or concentrations of soft powdery lime within 125 cm of the surface,
- no high salinity, no natric B horizon,
- no hydromorphic properties within 50 cm of the surface when no argillic B horizon is present,
- no bleached coatings on structural ped faces when the mollic A horizon has a moist chroma of 2 or less to a depth of at least 25 cm,
- not all the characteristics which are diagnostic for Rendzinas, Vertisols, Planosols or Andosols.

Parent material: Calcareous glacial and fluvio-glacial deposits, loess, silty deposits.

Environment: Level to undulating, steppe climates: cold to cool subhumid conditions; grassland.

Profile development: Intensive rooting by grasses and churning by soil organisms have created a thick, very dark coloured, strongly structured surface horizon with stable humic substances. Carbonates have been leached only partly and are deposited as pseudomycelia or concretions in the subsoil.

Use: High natural fertility, very good structure and high water-holding capacity make these soils highly suitable for agriculture. Drought hazard in some years. Traditionally these soils are used for grain crops, mainly wheat.

FERRALSOLS

Deep, very strongly weathered soils. They have a subsurface horizon consisting mainly of kaolinitic clay and residual concentrations of quartz and hydrated oxides of iron and aluminium. These constituents have a very low capacity to retain cations.

Xanthic Ferralsols	yellow to pale yellow colours
Rhodic Ferralsols	red to dusky red colours
Orthic Ferralsols	intermediate colours
Humic Ferralsols	high content of organic matter
Acric Ferralsols	extremely low capacity to retain cations
Plinthic Ferralsols	plinthite

Diagnostic characteristics

- oxic B horizon.

Parent material: Pre-weathered, mostly transported materials of old age, derived from a wide variety of rocks with a high silica and iron and aluminium content; easily weatherable basic and intermediate igneous rocks.

Environment: Level to undulating stable land surface of Pleistocene age or older, or on younger landforms on easily weatherable rocks with rolling to mountainous topography. Perhumid and humid climates, or as relicts in other climatic regions. Tropical rainforest, scrub and thorn forest, semi-deciduous forest and savanna.

Profile development: Prolonged deep and intensive weathering has resulted in a residual concentration of resistant minerals, mainly quartz, and the formation of stable minerals with a very low cation retention capacity such as kaolinitic clays and iron and aluminium oxides and hydroxides. This mineralogical composition is responsible for the strongly developed microstructure (pseudo-sand and pseudo-silt) and other yellowish (goethite) or reddish (hematite) colours.

Use: Lack of nutrients, and the virtual absence of weatherable minerals is the main limitation. Under traditional management shifting cultivation is a common practice. Heavy use of phosphates and other fertilizers on these chemically poor, but structurally good soils is required for continuous cultivation.

FLUVISOLS

Undeveloped or weakly developed soils in recent river, lake or sea deposits, or in colluvia, still showing stratification as a result or successive deposits of fresh material.

Eutric Fluvisols	high base status
Dystric Fluvisols	low base status
Calcaric Fluvisols	calcareous
Thionic Fluvisols	very acid andhave yellow jarosite mottles, or are waterlogged and have sulphides

Diagnostic characteristics

- no diagnostic horizons other than an ochric or an umbric A horizon, a histic H horizon, or a sulfuric horizon,
- one or more of the following properties that characterize alluvial deposits:
  - fine stratification,
  - receiving fresh material at regular intervals,
  - an organic matter content that decreases irregularly with depth or that remains above 0.35 percent to a depth of 125 cm,
  - sulfidic materials within 125 cm of the surface.

Parent material: Recent, medium and fine textured alluvial, lacustrine and marine deposits.

Environment: Wide alluvial plains and narrow valley floors, often subject to periodic flooding; tidal marshes. Arctic to equatorial, semiarid to perhumid.

Profile development: Slight, but a distinct Ah horizon may be present. The lower horizons show evidence of stratification and have no or only a weak structural development. Gleying may occur in the lower part of the profile.

Use: Many Fluvisols are highly fertile permitting a large range of crops and grazing. Their fertility, however, is directly related to the materials from which they are derived. Use varies widely with content of weatherable minerals, local climate and population density. In most cases flood control, drainage and irrigation are required to obtain optimal productivity.
Thionic Fluvisols are particularly difficult to develop owing to formation of toxic elements due to high acidity.

GLEYSOLS

Soils in unconsolidated materials, showing a strong influence of groundwater at shallow depth. This influence is evident from the occurrence of greyish or bluish colours in the matrix; with or without reddish, yellowish, brownish or black mottles.
Recent alluvial deposits are excluded from Gleysols.

Gelic Gleysols	permanently frozen subsoil
Plinthic Gleysols	plinthite in the subsoil
Mollic Gleysols	dark coloured surface horizon with a high organic matter content and a high base status
Humic Gleysols	dark coloured surface horizon with a high organic matter content and a low base status
Calcaric Gleysols	calcareous
Dystric Gleysols	low base status
Eutric Gleysols	high base status

Diagnostic characteristics

- formed from unconsolidated materials, exclusive of alluvial deposits,
- hydromorphic properties within a depth of 50 cm,
- no diagnostic horizons other than an A horizon, a histic H horizon, a cambic B horizon, a calcic or a gypsic horizon,
- no high salinity,
- not all of the characteristics which are diagnostic for Vertisols,
- no bleached coatings on structural ped faces when a mollic A horizon is present which has a chroma of 2 or less to a depth of at least 15 cm.

Parent material: Subrecent and old alluvial, lacustrine and marine deposits. Glacial and fluvio-glacial deposits. Weathered materials, derived from a variety of rocks.

Environment: Alluvial and coastal plains, river valleys, enclosed basins in poorly drained level or undulating areas with slowly permeable fine textured materials. Arctic to equatorial semi-arid areas with high groundwater, to humid and perhumid.

Profile development: Prolonged periods of saturation with water has resulted in grey colours with or without mottles in the subsoil, reflecting alternating oxidizing and reducing conditions. Waterlogging may also give rise to the accumulation of peat at the surface or cause a high water content in the upper part of the mineral soil.

Use: Poor drainage and excess of water are the dominating limitations. If properly drained they can be used for a wide range of crops. Many Gleysols in the (sub)tropics are suitable for crops adapted to wetness such as rice and jute. Under natural conditions they are used for grazing or left under forest-marsh vegetation.

GREYZEMS

Soils that have a brownish black or black surface horizon, rich in organic matter with a high base status and showing bleached coatings on structural aggregates.

Gleyic Greyzems	characteristics of wetness at shallow depth
Orthic Greyzems	no characteristics of wetness at shallow depth

Diagnostic characteristics

- mollic A horizon with a moist chroma of 2 or less to a depth of at least 15 cm,
- bleached coatings on structural ped surfaces of the mollic A horizon,
- no natric or oxic B horizon,
- not all the characteristics which are diagnostic for Rendzinas, Vertisols, Planosols or Andosols.

Parent material: Glacial and lacustrine deposits, loess, medium and fine textured deposits, many of alluvial origin.

Environment: Level to hilly. Cold, subhumid to humid climates in the northern hemisphere. Forest and forest steppe.

Profile development: Intensive rooting by grasses and churning by soil animals have created a thick, dark coloured, strongly structured surface horizon with stable humic substances. Vegetational changes have caused a slight acidification and the dispersion of soil materials. Silt particles are deposited on ped faces and structural aggregates in the dark coloured topsoil.

Use: Moderately to highly productive soils, but cultivation may be limited in cold regions and where poor drainage occurs. In hilly regions usually under forest.

HISTOSOLS

Peat and muck soils. They are saturated with water for prolonged periods, unless artificially drained.

Gelic Histosols	permanently frozen subsoil
Dystric Histosols	acid
Eutric Histosols	non-acid

Diagnostic characteristics

- H horizon of 40 cm or more (60 cm or more if the organic material consists mainly of Sphagnum or moss or has a bulk density of less than 0.1) either extending down from the surface or taken cumulatively within the upper 80 cm of the soil.

Parent material: Incompletely decomposed plant remains, accumulated under wet, reducing conditions, with or without admixtures of sand, silt or clay.

Environment: Poorly drained basins and depressions, coastal areas with high groundwater level, areas with high precipitation/evapotranspiration ratio, swamp vegetation.

Profile development: Transformation and alteration of the plant remains take place after deposition. Irreversible loss of water, compaction, biochemical desintegration and formation of stable humic substances, digestion and mixing by soil animals create a surface layer of mould. Translocated mobile organic material may accumulate in the deeper part of the profile.

Use: High costs prevent effective drainage and water control in many regions, leaving the soils under natural swamp/taiga/tundra vegetation. When carefully drained, they are used for grazing. Some arable cropping is feasible when mineral fertilizers, with both macro and micronutrients are taken into account.

KASTANOZEMS

Soils that have a very dark brown or dark brown surface horizon, rich in organic matter with a high base status, and have accumulation of carbonates and/or gypsum in the subsoil.

Luvic Kastanozems	subsurface horizon of accumulation of clay
Calcic Kastanozems	appreciable accumulation of carbonates and/or gypsum
Haplic Kastanozems	no appreciable accumulation of clay, carbonates and/or gypsum

Diagnostic characteristics

- mollic A horizon with a moist chroma of more than 2 to a depth of 15 cm,
- calcic or gypsic horizon, or concentration of soft powdery lime within 125 cm of the surface,
- no high salinity, no natric B horizon,
- no hydromorphic properties within 50 cm of the surface when no argillic B horizon is present,
- not all the characteristics which are diagnostic for Rendzinas, Vertisols, Planosols or Andosols.

Parent material: Calcareous glacial, fluvio-glacial and lacustrine deposits. Alluvium; calcareous rocks; basalt.

Environment: Level to undulating; cool to temperate, subhumid to semi-arid steppe climates; grasslands.

Profile development: Intensive rooting by grasses and churning by soil organisms have created a thick, dark coloured, strongly structured surface horizon with stable humic substances. Carbonates have been leached only partly and are deposited as pseudomycelia or concretions in the subsoil.

Use: Highly fertile soils, but low rainfall imposes restrictions on their utilization. Extensive cultivation of cereals, mainly wheat, or grazing.

LITHOSOLS

Very shallow soils that have hard continuous rock within a depth of 10 cm.

Lithosols are not subdivided.

Diagnostic characteristics

- continuous coherent hard rock within 10 cm of the surface.

Parent material: A wide variety of hard rocks.

Environment: Mainly at high and moderate altitudes with strongly dissected topography. Also occurring in areas with strong erosion. The cover ranges from pioneer vegetation or tundra to dwarf and low forests.

Profile development: Only a shallow soil layer of less than 10 cm has developed.

Use: The strong depth limitation and general poor soil quality pose severe problems for agricultural and forestry activities.

LUVISOLS

Soils that have a horizon of accumulation of illuvial silicate clay of high base status. There is a marked decrease of the clay content in the deeper part of the illuvial horizon.

Chromic Luvisols	strong brown to red colours
Calcic Luvisols	appreciable accumulation of carbonates
Vertic Luvisols	deep cracks in the dry season
Ferric Luvisols	red mottles or concretions of iron/manganese
Albic Luvisols	light coloured, bleached horizon, overlying the argillic horizon
Plinthic Luvisols	plinthite
Gleyic Luvisols	characteristics of wetness at shallow depth
Orthic Luvisols	other Luvisols

Diagnostic characteristics

- argillic horizon which has a base saturation of 50 percent or more (by NH_4OAc) at least in the lower part of the B horizon within 125 cm of the surface,
- no mollic A horizon,
- not all the characteristics which are diagnostic for Planosols, Nitosols or Podzoluvisols,
- no aridic moisture regime.

Parent material: Weathered materials, derived from a wide variety of rocks; loess; glacial and fluvio-glacial deposits; alluvial, lacustrine and marine deposits.

Environment: Level to hilly; cold to tropical climates; wide range of vegetation types.

Profile development: Downward percolation of water has caused the translocation of silicate clay and the formation of an Bt horizon. Weathering has proceded to a moderate stage.

Use: Because of their moderate stage of weathering and moderate to high base saturation these soils are suitable for a wide variety of crops.

NITOSOLS

Strongly weathered soils with a deeply developed subsurface horizon of illuvial silicate clay.

Typical Nitosols are dusky red to dark reddish brown. The clayey subsurface horizon has a fine blocky structure with shiny ped faces.

Eutric Nitosols	high base status
Dystric Nitosols	low base status
Humic Nitosols	high content of organic matter and a low base status

Diagnostic characteristics

- argillic B horizon with a clay distribution where the percentage of clay does not decrease from its maximum amount by as much as 20 percent within 150 cm of the surface,
- no mollic A or albic E horizon,
- no tonguing which is diagnostic for the Podzoluvisols,
- no ferric or vertic properties,
- no plinthite within 125 cm of the surface,
- no aridic moisture regime.

Parent material: Fine textured weathering products derived from basalts and other basic igneous rocks; limestones.

Environment: Level to hilly humid tropical and subtropical climate. Tropical rainforest and savanna vegetation.

Profile development: Easily weatherable basic rocks produce deep reddish brown clayey soils with a Bt horizon. High structural stability.

Use: These deep, well drained soils have a medium to high productivity and are suitable for a wide range of crops.

PHAEOZEMS

Soils that have a black to dark brown surface horizon, rich in organic matter with a high base status. There is no appreciable accumulation of carbonates or gypsum.

Luvic Phaeozems	horizon of accumulation of clay
Gleyic Phaeozems	horizon of accumulation of clay and show characteristics of wetness at shallow depth
Calcaric Phaeozems	calcareous at shallow depth
Haplic Phaeozems	no accumulation of clay, no characteristics of wetness and not calcareous at shallow depth

Diagnostic characteristics

- mollic A horizon,
- no calcic or gypsic horizon, or concentration of soft powdery lime within 125 cm of the surface,
- no natric or oxic B horizon,
- no hydromorphic properties within 50 cm of the surface when no argillic B horizon is present,
- no bleached coatings on structural ped faces when the mollic A horizon has a moist chroma of 2 or less to a depth of at least 15 cm,
- not all the characteristics which are diagnostic for Rendzinas, Vertisols, Planosols or Andosols.

Parent material: Loess, glacial and fluvio-glacial deposits, alluvium, weathered materials derived from basic igneous rocks and ash.

Environment: Level to undulating, hilly; cool to temperate continental climates, humid, subhumid and semi-arid; grasslands and forest.

Profile development: Intensive rooting by grasses and churning by soil organisms have created a thick, dark coloured surface horizon with stable humic substances. Carbonates have been leached to a great depth.

Use: High natural fertility; good structure and high water holding capacity make these soils highly suitable for agriculture. These soils are traditionally used for growing grain crops, mainly wheat.

PLANOSOLS

Soils that have a slowly permeable subsurface horizon causing stagnation of water in the overlying soil. The surface horizon is strongly leached and shows grey colours, with or without mottles.

Gelic Planosols	permanently frozen subsoil
Solodic Planosols	high exchangeable sodium percentage in the subsoil
Mollic Planosols	dark coloured surface horizon rich in organic matter with a high base status
Humic Planosols	dark coloured surface horizon rich in organic matter with a low base status
Dystric Planosols	low base status in the subsoil
Eutric Planosols	high base status in the subsoil

Diagnostic characteristics

- albic E horizon overlying a slowly permeable horizon within 125 cm of the surface, exclusive of a spodic B horizon,
- hydromorphic properties at least in a part of the E horizon.

Parent material: Clayey alluvial and colluvial deposits, derived from various rocks.

Environment: Depressed areas in level to gently undulating terrain; tropical and subtropical, semi-arid, subhumid and humid climates. Dry savanna and steppe, tree savanna and steppe.

Profile development: Removal of clay, or destruction of clay, in the upper part of the profile has resulted in an abrupt textural change to the underlying clayey subsoil. Impeded downward percolation of water is responsible for alternating oxidizing and reducing conditions in the upper part of the profile.

Use: The main limiting factor is the impervious subsurface clayey horizon. Flooding may occur in the rainy season and the soil may remain flooded for a considerable time. Severe moisture stress may occur in the dry season. The soils are most commonly used for wet rice cultivation and grazing.

PODZOLS

Soils that have a subsurface horizon of illuvial organic matter and aluminium compounds, with or without iron.

Humic Podzols	accumulation of dominantly organic matter
Ferric Podzols	accumulation of dominantly iron compounds
Orthic Podzols	accumulation of both organic matter and iron
Gleyic Podzols	characteristics of wetness at shallow depth
Placic Podzols	thin iron pan
Leptic Podzols	weakly developed Podzols

Diagnostic characteristics

- spodic B horizon.

Parent material: Coarse textured glacial and fluvio-glacial deposits, eolian, coastal and alluvial sands; coarse textured materials derived from siliceous rocks.

Environment: Level to hilly, usually humid to perhumid temperate and continental climates. Some occurrences in the tropics. Coniferous and mixed forests, tundra.

Profile development: Accumulation in the subsoil of illuvial organic matter and aluminium, with or without iron. Iron and aluminium in the surface horizon are complexed and mobilized by acid organic compounds and subsequently translocated and immobilized in the underlying horizon.

Use: Main limitations are the acidity, the low nutrient contents and the nature of the B horizon which often prevents root growth and downward percolation of water. Under natural conditions the soils are used for forestry and extensive grazing. With good management they may be used for arable cropping.

PODZOLUVISOLS

Soils that have a subsurface horizon of accumulation of illuvial silicate clay with an irregular or broken upper boundary. Vertical tongues of overlying bleached materials penetrate into this horizon, or this horizon consists of large nodules, the exteriors of which are enriched with iron.

Gleyic Podzoluvisols	characteristics of wetness at shallow depth
Dystric Podzoluvisols	low base status
Eutric Podzoluvisols	high base status

Diagnostic characteristics

- argillic B horizon showing an irregular or broken upper boundary, resulting from deep tonguing of the E into the B horizon, or from the formation of discrete nodules (ranging from 2 to 5 cm up to 30 cm in diameter) the exteriors of which are enriched and weakly cemented or indurated with iron and have redder hues and stronger chromas than the interiors,
- no mollic A horizon.

Parent material: Coarse and medium textured glacial and fluvio-glacial deposits; loess and loess-like deposits.

Environment: Level to gently undulating, cold and cool humid climates. Coniferous and mixed forest, taiga.

Profile development: Accumulation of illuvial silicate clay has preceded a stage of bleaching, breaking up the upper boundary of the Bt horizon by the formation of tongues of bleached material that penetrate into the subsoil.

Use: Poor drainage conditions, acidity and low natural fertility are the main limiting factors. The soils support a good quality forest, while grazing and arable cropping are of minor importance.

RANKERS

Soils that have a dark coloured surface horizon, rich in organic matter with a low base status, that is directly overlying unconsolidated siliceous material exclusive of alluvial deposits, or hard rock.

Rankers are not subdivided.

Diagnostic characteristics

- not formed from recent alluvial deposits,
- umbric A horizon which is not more than 25 cm thick,
- no other diagnostic horizon,
- no hydromorphic properties within 50 cm of the surface,
- not all of the characteristics which are diagnostic for Andosols.

Parent material: Silicate-rich hard to soft materials.

Environment: Usually at places with a strongly dissected topography. Mostly in (sub)humid temperate climates.

Profile development: These soils have a shallow, acid surface layer with high organic matter content. The slope position normally prevents the formation of deep soils.

Use: Mostly under forests. Less suitable for arable cropping because of slope and low nutrient content.

REGOSOLS

Undeveloped or weakly developed soils in unconsolidated materials other than alluvial deposits. There is no evidence of soil formation, except a slight accumulation of organic matter in the topsoil.

Eutric Regosols	high base status
Calcaric Regosols	calcareous
Dystric Regosols	low base status
Gelic Regosols	permanently frozen subsoil

Diagnostic characteristics

- formed from unconsolidated materials, exclusive of recent alluvial deposits,
- no diagnostic horizons other than an ochric A horizon,
- no hydromorphic properties within 50 cm of the surface,
- no high salinity,
- not all of the characteristics which are diagnostic for Vertisols and Andosols.

Parent material: Coastal quartz, calcareous or volcanic sands. Inland sands, loess, glacial deposits and colluvium derived from various rocks. Recent coarse and stony pyroclastic deposits.

Environment: Coastal and inland dunes and other eolian deposits with level to rolling topography. Erosional slopes with hilly to steeply dissected topography. Various glacial landforms. Wide range of climatic conditions.

Profile development: Young age, high permeability of the parent material, or the severity of the climate in arctic regions has precluded the formation of soil horizons other than a weakly developed ochric A horizon.

Use: Restricted, due to low moisture-holding capacity or to steep slopes. Many Regosols are under forest or grassland and used for pasture. Crop production mostly requires irrigation.

RENDZINAS

Soils that have a dark coloured surface horizon, rich in organic matter with a high base status, that is directly overlying a highly calcareous rock or sediment.

Rendzinas are not subdivided.

Diagnostic characteristics

- mollic A horizon which immediately overlies calcareous material that has more than 40 percent calcium carbonate equivalent,
- no hydromorphic characteristics within 50 cm of the surface,
- not all of the characteristics which are diagnostic for Vertisols,
- no high salinity.

Parent material: Limestone, dolomite, marl and gypsiferous rocks and other highly calcareous sediments.

Environment: Undulating to steeply dissected topography. Arid to humid, temperate to tropical. Usually well to excessively drained.

Profile development: Accumulation of residual fine-textured materials, due to dissolution of Ca-bearing minerals. High faunal activity promotes the formation of a strong structured, dark coloured surface horizon with stable humic substances. The slope position normally prevents the formation of deep soils.

Use: When topography and depth are not restricting, these are highly productive arable soils. In many places the agricultural potential is limited by slope, soil depth and the low water holding capacity.

SOLONCHAKS

Soils, exclusive of those formed from recent alluvial deposits, that have high contents of salts such as chlorides, sulphates and carbonates.

Gleyic Solonchaks	characteristics of wetness at shallow depth
Mollic Solonchaks	dark coloured surface horizon, due to the accumulation of organic matter
Takyric Solonchaks	heavy texture and a cracked, platy or massive surface crust
Ochric Solonchaks	weakly developed surface horizon

Diagnostic characteristics

- not formed from recent alluvial deposits,
- high salinity,
- no diagnostic horizons other than an A horizon, a histic B horizon, a cambic B horizon, or a calcic or gypsic horizon.

Parent material: Medium and fine textured, alluvial, lacustrine and marine deposits.

Environment: Level areas and depressions, mostly in arid and semi-arid climate; tidal flats in semi-arid and subhumid regions. Shrubland, grassland, halophytic vegetation.

Profile development: High content of water soluble salts such as chlorides, sulphates and carbonates of sodium, calcium, magnesium. The concentration is usually highest in the upper part of the profile, but may vary strongly with the seasons.

Use: Extremely limited by high sodium saturation. Utilization depends on the leaching of toxic salts. Irrigation of Solonchaks is successful only if drainage facilities are good.

SOLONETZ

Soils that have a subsurface horizon containing an illuvial accumulation of silicate clay with a high sodium saturation, often showing a columnar or prismatic structure.

Gleyic Solonetz	characteristics of wetness at shallow depth
Mollic Solonetz	thick dark coloured surface horizon, due to the accumulation of organic matter
Orthic Solonetz	ochric A horizon

Diagnostic characteristics

- natric B horizon,
- no albic E horizon with hydromorphic properties and an abrupt textural change.

Parent material: Fine textured alluvial and marine deposits; loess, glacial till.

Environment: Level areas, cool and warm arid, semi-arid and subhumid climates. Grasslands, shrubs, bare.

Profile development: Formation of textured B horizon due to destruction and removal of clay in the upper horizon, neoformation and illuviation of clay in the lower horizons.

Use: Productivity is restricted, due to high sodium saturation, slow permeability of the subsoil, and poorly developed soil structure.

VERTISOLS

Heavy clay soils, consisting of clay minerals that shrink and swell strongly on changes in moisture content. They have wide and deep cracks in the dry season. Structural aggregates in the subsoil are wedge-shaped and have polished and grooved surfaces.

Pellic Vertisols	black, dark grey and grey colours
Chromic Vertisols	very dark brown, greyish brown and brown colours

Diagnostic characteristics

- 30 percent clay or more to a depth of at least 50 cm,
- cracks at some period in most years that are at least 1 cm wide to a depth of 50 cm, unless the soil is irrigated,
- gilgai microrelief and/or intersecting slickensides or wedge-shaped structural aggregates at some depth between 25 and 100 cm.

Parent material: Lacustrine, alluvial, marine and colluvial deposits with a high amount of montmorillonitic clay. Mostly derived from weathered basic igneous rocks, such as basalt and volcanic ash, and from calcareous rocks.

Environment: Depressions and level to undulating areas. Subtropical and tropical, semi-arid to (sub)humid climates with a pronounced dry season. Savanna, natural grassland, woodland.

Profile development: Periodical swelling and shrinking of the expanding clay produces deep cracks in the dry season, wedge-shaped structural elements and slickensides in the subsoil. In many areas gilgai microrelief occurs.

Use: Heavy texture and poor internal drainage are the main adverse physical constraints. Poor workability, both in wet and dry conditions. With good management they are productive soils.

XEROSOLS

Soils in dry regions that have a surface horizon with little organic matter and a subsurface horizon of alteration, or of accumulation of silicate clay, carbonates, and/or gypsum.

Luvic Xerosols	subsurface horizon of accumulation of clay
Gypsic Xerosols	appreciable accumulation of gypsum
Calcic Xerosols	appreciable accumulation of carbonates
Haplic Xerosols	horizon of alteration

Diagnostic characteristics

- aridic moisture regime,
- weak ochric A horizon,
- cambic or an argillic B horizon, or a calcic or gypsic horizon,
- no other diagnostic horizons,
- no high salinity,
- no permafrost within 200 cm of the surface,
- not all the characteristics which are diagnostic for Vertisols.

Parent material: Weathering products derived from a wide range of rocks. Alluvium and colluvium.

Environment: Level to hilly, semi-arid and arid; cold to warm, continental climates. Scrubs, grasses, succulents, cacti.

Profile development: Soil forming processes operate slowly as a result of dry conditions. Changes in volume, accompanying seasonal changes in moisture content tend to produce prismatic structure. Carbonate and gypsum may have accumulated from ascending soil moisture. Illuvial accumulation of clay is considered to be a relict of earlier moister climatic conditions. There is only a small amount of organic matter in the surface horizon due to the sparse vegetation.

Use: Extensive grazing. Dryness is the main limitation. Wheat is grown under rainfed conditions in some areas. If irrigated, these may be productive soils.

YERMOSOLS

Soils in very dry regions that have a surface horizon with very little organic matter and a subsurface horizon of alteration or of accumulation of silicate clay, carbonates, and/or gypsum.

Luvic Yermosols	subsurface horizon with accumulation of clay
Gypsic Yermosols	appreciable accumulation of gypsum
Calcic Yermosols	appreciable accumulation of carbonates
Haplic Yermosols	horizon of alteration

Diagnostic characteristics

- aridic moisture regime,
- very weak ochric A horizon,
- cambic or an argillic B horizon, or a calcic or gypsic horizon,
- no other diagnostic horizons,
- no high salinity,
- no permafrost within 200 cm of the surface,
- not all the characteristics which are diagnostic for Vertisols.

Parent material: Weathering materials derived from a wide range of rocks. Alluvial, colluvial and eolian deposits.

Environment: Level to hilly, cool and warm, arid climates. Very sparse vegetation.

Profile development: Soil forming processes operate very slowly as a result of dryness. Carbonates, gypsum and soluble salts may have accumulated from ascending soil moisture. Illuvial accumulation of clay is considered to be a relict of earlier moister climatic conditions. There is only a very small amount of organic matter in the surface horizon due to the sparse vegetation.

Use: Extreme dryness, and often shallowness, stoniness and the presence of indurated carbonates or gypsum, or some salinity make these soils of very limited use, unless close to the rare rivers or wells for irrigation water.