

# **GLOSSARY OF TERMS USED IN SOIL SURVEY AND CLASSIFICATION WITH SPECIAL REFERENCE TO KUWAIT**

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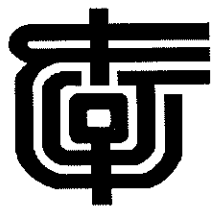
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by

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## FOREWORD

Vegetation assessment and soil survey are primary methods for providing technical guidelines and resulting baseline information for use by natural resource planners, users, and managers and serve as an educational tool. However, it is not always possible to understand the terminology and information used in reports, and therefore, a guide is always needed. The value of the glossary of terms used in vegetation, soil survey and classification with special reference to Kuwait lies in its ability to present clearly an easy language to understand the terminology used by a wide range of users not familiar with technical terms. The KISR staff of the Soil Survey Project are attempting to enhance the quality of the final report, which is easily understood by the users for future planning and management. This publication is a cornerstone in understanding the soil survey of Kuwait and a vital link between the users and the soil survey results. It is hoped that countless numbers of individuals would benefit from this document.



**Dr. Nader Al-Awadhi**  
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# GLOSSARY OF TERMS USED IN SOIL SURVEY AND CLASSIFICATION WITH SPECIAL REFERENCE TO KUWAIT

The glossary is compiled and modified from a number of sources. In some cases, contributors' experience with local soils and vegetation is also introduced. This is prepared with special reference to the soils and ecology of Kuwait. Attempts are made to use the same terms reported either in the Soil Survey of Kuwait documents or in the related Soil Information and Data Base Management Systems. The complicated terms are briefed for easy understanding. The glossary presented in this document is not static; technology is dynamic and each case is different. The terms can be modified, improved and new ones may also be introduced. The sources used are presented as bibliography.

## A

**AASHTO classification.** The classification of a soil material for highways and airfield construction. This is based on the particle size distribution of <75 mm and on the liquid limit and the plasticity index. AASHTO is the abbreviation of American Association of State Highway and Transportation Officials.

**Absorption.** The physical uptake of water and/or ions by a substance. For example, soils absorb water.

**Abundance.** The total number of individuals of a species or amount of resources present in a specific area. The term is often used in a qualitative, relative, or subjective manner rather than in reference to exact numbers or amounts.

**Accelerated erosion.** An increased rate of erosion caused by humans.

**Accelerated erosion, classes.** There are four accelerated erosion classes.

- **Slight.** Soil loss is < 25% of A and E horizons, surface layer is A horizon.
- **Slight to Moderate.** Soil loss is 25-75% of A and E horizons, surface layer is A and B horizons.
- **Moderate.** Soil loss is > 75% of A and E, surface layer is B and A.
- **Severe.** Soil loss is all of A and E horizons, surface layer is B horizon.

**Accumulation.** The buildup or increase in the amount of one or more constituents in the soil at a given position as a result of translocation. The buildup may be a residue due to the translocation of material out of the horizon or may be due to an addition of material. Usually refers to soluble substances and clay particles.

**Accuracy.** Freedom from error.

**Acre.** A unit of English measure of area.  $1 \text{ km}^2 = 247.11 \text{ acre}$ ,  $1 \text{ ha} = 2.4711 \text{ acre}$

**Adsorption.** The attachment of a particle, ion or molecule to a surface. Calcium is adsorbed onto the negatively charged surface of clay or humus.

**Adsorption complex.** The various substances in the soil that are capable of adsorption; these are mainly the clay and humus.

**Adventitious roots.** Roots appearing in places where they usually do not grow, as on stems of plants above the ground. The prop roots of corn and mangroves are examples of adventitious roots.

**Aeolian.** Pertaining to or formed by wind action.

**Aeolian deposits.** Fine sediments transported and deposited by wind; they include loess, dunes and desert sand.

**Aerial mosaics.** The matching and assembling individual photographs to form a continuous image of an area are called aerial mosaics.

**Aerial photograph.** A photograph of the earth's surface taken from an aeroplane or some other type of airborne equipment.

**Afforestation.** Reforestation; the process of turning open land into forest.

**Aggregates.** Discrete clusters of particles formed naturally or artificially, and include such units as crumbs, granules, clods, faecal pellets, fragments of faecal and concretions.

**Aggregation.** The process by which particles coalesce to form aggregates.

**Agric horizon.** Agric (L. ager, field): an illuvial mineral soil horizon, in which clay, silt, and humus derived from an overlying cultivated and fertilized layer have accumulated. The wormholes and illuvial clay, silt, and humus occupy at least 5% of the horizon by volume.

**Agricultural drainage.** Can be defined as the removal and disposal of excess water and salt from agricultural land to provide a good environment in the soil for plant growth.

**Agriculture.** Work of cultivating the soil, growing crops, and raising livestock, the practice of farming.

**Agronomy.** That part of agriculture devoted to the production of crops and soil management, the scientific utilization of agricultural land.

**A horizon.** The mineral horizon at or near the surface in which humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of the B horizon.

**Alkaline.** 1) The opposite of acidic, also called basic; having a high pH value more than 7 and thus a low concentration of hydrogen ions and a high concentration of hydroxide ions. 2) Containing alkalies, as in alkaline soil or an alkaline chemical reaction.

**Alkaloid.** A diverse group of complex organic compounds containing nitrogen and having alkaline properties, produced by plants and often having commercial uses for humans. Over 1000 different



alkaloids are known from 1200 species of plants; some of the more common include nicotine, quinine, caffeine, strychnine, cocaine, morphine, atropine, and mescaline.

**Alluvial.** Pertaining to material or processes associated with transportation and/or subaerial deposition by concentrated running water.

**Alluvial plain.** A flat area built up of alluvium.

**Alluvial soil.** A general term for those soils developed on fairly recent alluvium. A soil formed in material emplaced by the action of running water, such as flood plain, alluvial fan, or deltaic deposits.

**Alluvial terrace.** It refers to stream terrace.

**Alluvium.** A sediment deposited by streams and varying widely in particle size. Unconsolidated clastic material such as sand, silt, and clay deposited on land by geologically recent action of flowing water in rivers and streams. The stones and boulders, when present, are usually rounded or sub-rounded. Some of the most fertile soils are derived from alluvium of medium or fine texture.

**Altimeter.** This is a small piece of equipment used to determine elevation and to establish location relative to contours on topographic maps.

**Altitude.** The vertical distance measured between a point above earth's surface and a fixed datum such as a bench mark or sea level. Altitude also refers to a star or a planet's angular distance above the horizon (its angular height in the sky for an earthbound observer).

**Amendment, soil.** Any substance other than fertilizers, such as lime, sulfur and gypsum, used to alter the chemical or physical properties of a soil, generally to make it more productive.

**Amorphous.** Having no regular, definite shape or form.

**Analyte.** The specific component measured in a chemical analysis.

**Andopedon.** Horizons developed at subsurface are called andopedon or subsurface horizons.

**Anhydrous.** Non hydrated; refers to salts and oxides containing no water of crystallization or water of combination.

**Animal unit (AU).** The combined weight of one cow and one calf, set as 454 kg. The measure is used as a standard unit for weighing the grazing pressure from different kinds of grazing animals, assuming that they consume the same kinds of forage. For example, 1 AU = 7.7 white-tailed deer or 5.8 mule deer.

**Anion.** Negatively charged ion. During electrolysis, it is attracted to the positively charged anode. The major anions in the soils of Kuwait are chlorides ( $\text{Cl}^{1-}$ ), sulfates ( $\text{SO}_4^{2-}$ ), and bicarbonates ( $\text{HCO}_3^{1-}$ ).

**Anion exchange capacity.** The sum total of exchangeable anions that a soil can adsorb. Expressed as centimoles per kilogram (cmol/kg) of soil or of other adsorbing material such as clay.

**Annual.** 1) Occurring or happening once every year. 2) A plant that completes its life cycle in only one year or season.

**Anthropogenic soils.** Soils developed through human influence.

**Apparent field texture.** The soils that are not dispersed completely in the standard particle size analysis; for these, the field texture is referred to as apparent because it is not an estimate of the results of a laboratory operation.

**Aquic moisture regime.** The aquic (L. aqua, water) moisture regime signifies a reducing regime in a soil that is virtually free of dissolved oxygen because it is saturated by groundwater or by water of capillary fringe.

**Aquifer.** Any hydraulically active body of porous rock or permeable unconsolidated material that is capable of producing water. Aquifers function as natural storage areas for groundwater.

**Aquisalids.** A subdivision (great group) under the suborder *salids* and order *aridisols*. The salids that are saturated with water in one or more layers within 100 cm of the mineral soil surface for one month or more per year in 6 or more out of 10 years.

**Arable land.** Land that is suitable for plowing and growing crops.

**Argids.** Subdivision (suborder) of order *aridisols* which have an argillic or natric horizon that has its upper boundary within 100 cm of the soil surface and do not have a petrocalcic horizon that has an upper boundary within 100 cm of the soil surface.

**Argigypsid.** A subdivision (great group) under the suborder *gypsid* and order *aridisols* which have an argillic horizon that has its upper boundary within 100 cm of the soil surface.

**Argillic horizon.** An argillic (L. argilla, clay) horizon is a layer that contains significant accumulation of illuviated layer lattice silicate clays in the B horizon.

**Arid.** A term applied to a region or climate in which precipitation is too low to support crop production. 1) Less than 250 mm (10 inches) of rainfall per annum. 2) where total evaporation exceeds actual precipitation.

**Aridic and torric moisture regime.** In the aridic (L. aridus, dry, and L. torridus, hot and dry) moisture regimes, the moisture control section is, in six or more out of ten years, dry in all parts of more than half the cumulative days per year when the soil temperature at a depth of 50 cm from the soil surface is above 5 °C and moist in some or all parts for less than 90 consecutive days when the soil temperature at a depth of 50 cm is above 8 °C.

**Aridisols.** One of the eleven soil orders in the USDA soil taxonomy, representing the soils of dry regions. They have pedogenic horizons, low in organic matter, that are never moist as long as three consecutive months. They have an ochric epipedon and one or more of the following diagnostic horizons: argillic, natric, cambic, calcic, petrocalcic, gypsic, petrogypsic, salic, or a duripan. Most of the soils of Kuwait especially in the north are classified as aridisols.

**Arid zone.** A dry climatic region in which annual precipitation averages less than 250 mm (10 inches).

**Association, soil.** It consists of two or more dissimilar components occurring in a regularly repeating pattern. The major components of an association can be separated at a scale of about 1:24,000. The major components are sufficiently different in morphology or behavior that the map unit cannot be called a consociation.

**Association (vegetation).** Communities of definite floristic composition, uniform physiognomy, and occurring in uniform habitat conditions. They are also referred to a relatively small vegetation unit, a unit below the level of consociation. In simplicity, they are units that are floristically defined and in contrast to sociation, association doesn't have to show a single dominant species in each layer. Instead more than one species per layer may be used to define any association.

**Atterberg limits.** It is a general term that encompasses liquid limit, plastic limit and, in some references, shrinkage limit.

**Available water.** That part of the water in the soil that can be taken up by plant roots.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is expressed as centimeter of water per centimeter of soil. The capacity, in centimeter, in a 150 centimeters profile or to a limiting layer is expressed as: very low (0 to 7.62 cm), low (7.62 to 15.24 cm), moderate (15.24 to 22.86 cm), high (22.86 to 30.48 cm) and very high (more than 30.48 cm).

## B

**Backslope.** The hillslope profile position that forms the steepest and generally linear, middle portion of the slope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below. They may or may not include cliff segments (i.e. free faces). Backslopes are commonly erosional forms produced by mass movement, colluvial action, and running water.

**Badlands.** A landscape which is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes with narrow interfluves. Badlands develop on surfaces with little or no vegetative cover, overlying unconsolidated or poorly cemented materials (clays, silts, or in some cases sandstones) sometimes with soluble minerals such as gypsum or halite.

**Bar.** A unit of pressure equal to one million dynes per square centimeter ( $10^6$  dynes/cm<sup>2</sup>).

**Barchan dune.** A crescent-shaped dune with tips extending leeward (downwind), making this side concave and the windward (upwind) side convex.

**Barrens.** A level area with poor, usually sandy or serpentine soils that are poorly forested or unable to support normal vegetative cover, and that generally have low levels of productivity. Plants growing in barrens are usually much smaller and stunted in comparison to individuals grown on more fertile soils. Frequently, barrens are dominated by specialized groups of endemic plants. Pine barrens, serpentine barrens, and sand barrens are examples.

**Basalt.** A fine grained igneous rock forming from lava flows or minor intrusions. It is composed of plagioclase, augite and magnetite; olivine may be present.

**Base saturation.** The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K) expressed as a percentage of the total cation exchange capacity.

**Basin.** 1) An area of bowl-shaped sedimentary strata. 2) The area drained by a stream or river. 3) A down-faulted block of the earth's crust with internal drainage.

**Bay.** Any terrestrial formation resembling a bay of the sea, as a recess or extension of lowland along a river valley or within a curve in a range of hills.

**Beaches.** These are sandy, gravelly, or cobbly shores washed and re-washed by waves. The areas may be partly covered with water during high tides or storms.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bench mark.** 1) A fixed reference point used in land surveys. A bench mark is a point of known elevation. 2) An area of land used as a reference to assess optimum condition of rangeland.

**Berm.** The area of level ground between the raised mound of a barrow or other earthwork and the ditch surrounding it.

**Bicarbonate.** Any salt containing the hydrogen carbonate ion  $\text{HCO}_3^-$ . Bicarbonate of soda (sodium bicarbonate, baking soda) is a well-known example. The ion occurs naturally in some bodies of water, where it acts to buffer the acidity of the water.

**Biennial.** A plant whose life cycle spans two years, germinating in the first season and maturing to produce fruit in the second season. Parsley is a biennial.

**Biodiversity.** The number and relative abundance of all the species within a given area.

**Biomass.** 1) The total amount of all the biological material, the combined mass of all the animals and plants living in a specific area, or of a given population. Usually expressed as oven-dry weight per area (grams per square meter, kilograms per hectare, or pounds per acre). 2) Organic matter used as fuel (biomass fuel).

**Biome.** A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.

**Biota.** 1) The flora and fauna of a specific region or period. 2) The total aggregation of organisms in the biosphere.

**Biotic.** 1) Concerning or produced by living organisms, such as environmental factors created by plants or microorganisms. 2) Refers to living components of an ecosystem, e.g., plants and animals.

**Bioturbation.** Mixing of soil components by soil fauna and flora.

**Brackish water.** Slightly saline water with salt content less than those in the sea water.

**Break-slopes.** An abrupt change or inflection in a slope or profile.

**Buffer.** A substance that prevents a rapid change in pH when acids or alkalis are added to the soil, these include clay, humus and carbonates.

**Buffering capacity.** The ability of a soil to resist changes in pH. Commonly determined by presence of clay, humus, and other colloidal materials.

**Bulk density.** Soil bulk density ( $\rho_b$ ) is the ratio of the mass of the dry solids to the bulk volumes of the soil (solid plus pores) and expressed in either  $\text{g cm}^{-3}$  or megagram per cubic meter ( $\text{Mg m}^{-3}$ ).

**Bunker.** An underground bombproof shelter.

**Buried.** Landforms, geomorphic surfaces covered by younger sediments e.g aeolian, glacial and alluvial.

**Buried horizon.** Buried horizon (designated "b") is a special feature. It is obviously not in the same deposit as horizons in the overlying deposit.

**Buried soil.** A soil is considered to be buried if it is covered with a surface mantle of new soil material that is either 50 cm or more thick, or is 30 to 50 cm and has a thickness that equals at least half the total thickness of the named diagnostic horizons that are preserved in the buried soil.

## C

**Calcareous.** When the material effervesces with cold dilute hydrochloric acid (HCl).

**Calcareous soil.** A soil that contains enough calcium carbonate so that it effervesces when treated with cold 0.1 N hydrochloric acid (HCl).

**Calciargids.** Great group under suborder *argids* which have a calcic horizon that has its upper boundary within 150 cm of the soil surface.

**Calcic aquisalids.** A subdivision (subgroup) under the order *aridisols*. The aquisalids which have a calcic or petrocalcic horizon that has an upper boundary within 100 cm of the soil surface.

**Calcic horizon.** The calcic (L. calx, calc-, lime) horizon is an illuvial horizon in which secondary calcium carbonate or other carbonates have accumulated to a significant extent, is more than 15 cm thick, has a calcium carbonate equivalent of more than 15 percent, and has at least 5 percent more calcium carbonate equivalent than the underlying C horizon.

**Calcic petrogypsis.** A subdivision (subgroup) under the order *aridisols* which have a calcic horizon overlying the petrogypsic horizon.

**Calcids.** A subdivision (suborder) of the order *aridisols*, which have a calcic or petrocalcic horizon that has its upper boundary within 100 cm of the soil surface.



**Calcification.** It refers to the processes of calcium carbonate accumulation in the soil profile through leaching and recrystallization.

**Calcigypsiids.** A subdivision (great group) under the suborder *gypsiids* and order *aridisols* which have a calcic horizon that has its upper boundary within 100 cm of the soil surface.

**Calcium carbonate.**  $\text{CaCO}_3$ , a naturally occurring form of calcium that is also called calcite. Chalk and limestone are both calcium carbonate. Dissolved in hydrated form (calcium hydrogen carbonate), it is what makes hard water "hard". It is used in Portland cement. Calcium carbonate in the form of ground limestone is the most common (and least expensive) form of lime used in agriculture to improve soils.

**Calcrete.** A general term for a prominent zone of secondary carbonate accumulation in surficial materials of warm, subhumid to arid areas. Calcrete is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in non-indurated forms to very strong in types that are indurated (same as caliche)..

**Caliche.** A layer near the surface, more or less cemented by secondary carbonates of calcium or magnesium precipitated from the soil solution. It may occur as a soft, thin soil horizon; as a hard, thick, bed just beneath the solum; or as a surface layer exposed by erosion.

**Cambic horizon.** The cambic (L. *cambiare*, change) horizon is an altered horizon that does not have the dark color, organic matter content, and structure of a histic, a mollic, or an umbric epipedon.

**Canopy.** 1) The vertical projection downward of the aerial portion of vegetation, usually expressed as a percent of the ground so occupied. 2) the aerial portion of the overstory vegetation. cf. *Canopy cover*.

**Canopy cover.** The percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included. It may exceed 100%. Syn. *Aerial cover*.

**Capillarity.** The process by which moisture moves in any direction through the fine pore spaces and as films around particles.

**Capillary fringe.** The zone just above the water-table that remains practically saturated with water.

**Capillary water.** That amount of water that is capable of movement after the soil has drained. It is held by adhesion and surface tension as films around particles and in the finer pore spaces..

**Carbonate clay.** It is a soil separate (made up of  $\text{CaCO}_3$ ) with  $< 0.002$  mm particle diameter.

**Carbonatic.** As a mineralogy class at the family level, more than 40 percent (by weight) carbonates (expressed as  $\text{CaCO}_3$ ) plus gypsum, with carbonates constituting of more than 65 percent of the total weight of carbonates plus gypsum, either in the fine earth fraction ( $< 2$  mm) or in the less than 20 mm fraction, whichever has a higher percentage of carbonates plus gypsum.

**Carrying capacity.** 1) The maximum population of a species that a specific ecosystem can support over long periods of time. 2) The maximum *stocking rate* possible which is consistent with maintaining or improving vegetation or related resources. It may vary from year to year on the same area due to fluctuating forage production. cf. *grazing capacity*.

**Catena.** A sequence of soils developed from similar parent material under similar climatic conditions, but whose characteristics differ because of variations in relief and drainage.

**Cation.** An ion carrying a positive charge of electricity. The common cations in the soils of Kuwait are calcium ( $\text{Ca}^{2+}$ ), magnesium ( $\text{Mg}^{2+}$ ), sodium ( $\text{Na}^+$ ) and potassium ( $\text{K}^+$ ).

**Cation exchange.** The exchange between cations in solution and cations held on the exchange sites (adsorption sites) of minerals and organic matter.

**Cation exchange capacity.** The total amount of exchangeable cations that can be held by the soil expressed in terms of milliequivalents per 100 grams (me/100 g) of soil at neutrality or at some other stated pH value.

**Cemented.** Indurated; having a hard, brittle consistency because the particles are held together by cementing substances such as humus, calcium carbonate, or the oxides of silicon, iron, and aluminum.

**Cemented pan.** A soil horizon or layer having hard, brittle consistency because particles are held together by cementing substances such as gypsum. Hardness and brittleness persist even when the soil is wet.

**Chiseling.** Breaking or loosening the soil, without inversion, with a chisel cultivator or chisel plow. A practice used for grassland or pasture renovation. cf. *ripping*.

**C horizon.** A soil layer of unaltered parent material and relatively unaffected by biologic activity and soil-forming processes, which alter the overlying horizon. The C horizon is transitional between unweathered bedrock below and developing soil above.

**Chroma.** One of the three variables of Munsell Color Notation. The relative purity of a color directly related to the dominance of the determining wavelength.

**Class, soil.** A group of soils having a definite range in a particular property such as acidity, degree of slope, texture, structure, land-use capability, degree of erosion, or drainage.

**Classes, soil structure.** A grouping of soil structural units or peds on the basis of size from the very fine to very coarse.

**Classification.** The assignment of items or concepts into classes based on similarity of selected attributes.

**Clast.** An individual constituent, grain, or fragment of sediment or rock, produced by the mechanical weathering (disintegration) of a large rock mass.

**Clastic.** Pertaining to rock or sediment composed mainly of fragments derived from preexisting rocks or minerals and moved from their place of origin. The term indicates sediment sources that are within and outside the deposition basin.

**Clay.** The mineral soil particles less than 0.002 mm diameter. As a soil textural class, soil material that contains 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay bridges.** The clay coating that links together adjacent mineral grains.

**Clay dune.** In deserts, local wind movements may mix and pile up soil material of different textures or even material that is very rich in clay. Piles of such material have been called "clay dunes" or "soil dunes".

**Clay film.** A thin coating of oriented layer silicate clay minerals (phyllosilicates) on the surface of a ped or lining pores or root channels. These are formed through dispersion of clay minerals, their translocation and redeposition on the surfaces of conducting pores. Synonymous: argillan, clay coating, clay skins.

**Claypan.** A dense compact layer in the subsoil having a much higher clay content than the overlying material from which it is separated by a sharply defined boundary; formed by downward movement of clay or by synthesis of clay in place during soil formation. Claypans are usually hard when dry and plastic and sticky when wet. They usually impede the movement of water and air. cf. *hardpan*.

**Climate.** 1) The average or prevailing weather condition of a place over a period of years. 2) Aggregate of general weather patterns occurring at a place or in a region over an extended number of years, including average and extreme conditions of temperature, humidity, precipitation, winds, and cloud cover. Climate also takes topography and nearness to oceans or ocean currents into account.

**Climatic climax.** A regional type of plant community that is stable over long periods of time and maintained by climatic factors. The early 20th century plant ecologist F.E. Clements suggested that plant communities, given enough time, would develop into a climax community determined by the regional climate.

**Climax.** 1) The final or stable biotic community in a successional series which is self-perpetuating and in dynamic equilibrium with the physical habitat, the assumed end point in succession. cf. *potential natural community*. 2) Final phase of succession in an ecosystem in which populations of animals and plants remain in a relatively self-perpetuating state.

**Clod.** A compact, coherent mass of soil produced artificially, usually by such human activities as plowing and digging, especially when these operations are performed on soils that are either too wet or too dry for normal tillage operations.

**Clone.** A group of plants, growing in close association, derived by asexual reproduction from a single parent plant. Such plants are therefore of the same genetic constitution.

**Closed area.** An area closed to certain types of use for management purposes.

**Closed range.** Any range on which livestock grazing or other specified use is prohibited. cf. *livestock exclusion*.

**Coarse texture.** The texture exhibited by sands, loamy sands and sandy loam, except very fine sandy loam.

**Coastal plain.** A low, generally broad plain that has its margin an oceanic shore and its strata horizontal or gently sloping toward the water.

**Coating.** A layer of a substance completely or partly covering a surface. Coatings are composed of a variety of substances separately or in combination. They include clay coatings (clay skins), calcite coatings, whole soil coatings, etc. Coatings may become incorporated into the matrix or be fragmented.

**Coefficient of linear extensibility.** The ratio of the difference between the moist and dry lengths of a clod to its dry length,  $(L_m - L_d)/L_d$  when  $L_m$  is the moist length (at 1/3 atmospheres) and  $L_d$  is the air-dry length. The measure correlates with the volume change of a soil upon wetting and drying.

**COLE.** An abbreviation of coefficient of linear extensibility.

**Colloid.** The inorganic and organic material with very fine particle size and therefore high surface area that usually exhibits exchange properties.

**Colluvial.** Pertaining to material or processes associated with transportation and/or deposition by mass movement (direct gravitational action) and local, unconcentrated runoff on sideslopes and/or at the base of slopes.

**Colluvium.** Unconsolidated, unsorted earth material being transported or deposited on sideslopes and/or at the base of slopes by mass movement (e.g. direct gravitational action) and by local, unconcentrated runoff.

**Community.** 1) All the groups of organisms living together in the same area, usually interacting or depending on each other for existence. Also called biological community. 2) An assemblage of populations of plants and/or animals in a common spatial arrangement.

**Compaction.** Increase in bulk density due to mechanical forces such as tractor wheels.

**Competence (stream).** The ability of a current of water or wind to transport sediment, in terms of particle size rather than amount, measured as the diameter of the largest particle transported. It depends upon velocity: a small but swift current for example, may have greater competence than a larger but slower moving current.

**Competition.** The interaction between organisms as a result of the removal or reduction of a common, required resources from the environment. Resources may include water, nutrients, light, oxygen, carbon dioxide, food and shelter.

**Complex, soil.** A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas. The major components of a complex soil cannot be mapped separately at a scale of about 1:24,000.

**Concretion.** A local concentration of a chemical compound, such as calcium carbonate or iron oxide, in the form of grains or nodules of varying size, shape, hardness, and color. In Kuwaiti soils, calcium carbonate concretion is common.

**Condition.** 1) The state of being of an entity or system. Examples include the condition of one's health or of the environment. 2) To prepare for severe conditions, such as runners having to condition their bodies for a marathon, or the hardening of young seedlings by gradually acclimating them from stable indoor conditions to unstable garden conditions.

**Confined aquifer.** Also known as artesian or pressure aquifers, occur where groundwater is confined under pressure greater than atmospheric by overlying relatively impermeable strata.

**Conglomerate.** A coarse-grained, clastic sedimentary rock composed of rounded to subangular rock fragments larger than 2 mm, commonly with a matrix of sand and finer material, and iron oxides. The consolidated equivalent of gravel.

**Conservation.** The use and management of natural resources according to principles that assure their sustained economic and/or social benefits without impairment of environmental quality.

**Consistence, cementation.** Rupture resistance class for block-like (25-30 mm) specimens, air-dried and submerged. Following are the classes.

- **Extremely weakly cemented.** The specimen fails under slight finger force.
- **Very weakly cemented.** The specimen fails under moderate finger force.
- **Weakly cemented.** The specimen fails under strong finger force.
- **Moderately cemented.** The specimen fails with hand or gentle foot force.
- **Strongly cemented.** The specimen fails with full body weight on foot.
- **Very strongly cemented.** The specimen fails with less than three joules hammer blow.
- **Indurated.** The specimen cannot fail by less than three joules hammer blow.

**Consistence, dry soil.** Rupture resistance class for block-like (25-30 mm) specimens in the moderately dry or very dry state. Following are the classes:

- **Loose.** Specimens are not obtainable.
- **Soft.** The specimen fails under very slight finger force.
- **Slightly hard.** The specimen fails under slight finger force.
- **Moderately hard.** The specimen fails under moderate finger force.
- **Hard.** The specimen fails under strong finger force.
- **Very hard.** The specimen fails with hand or gentle foot force.
- **Extremely hard.** The specimen fails with full body weight on foot.
- **Rigid.** The specimen fails with less than three joules hammer blow.



- **Very Rigid.** The specimen cannot fail by less than three joules hammer blow.

**Consistence, moist soil.** Rupture resistance class for block-like (25-30 mm) specimens in the slightly dry or wetter state. Following are the classes:

- **Loose.** Specimen not obtainable.
- **Very friable.** The specimen fails under slight finger force.
- **Friable.** The specimen fails under slight finger force.
- **Firm.** The specimen fails under moderate finger force.
- **Very firm.** The specimen fails under strong finger force.
- **Extremely firm.** The specimen fails with hand or gentle foot force.
- **Slightly rigid.** The specimen fails with full body weight on foot.
- **Rigid.** The specimen fails with less than three joules hammer blow.
- **Very rigid.** The specimen cannot fail by less than three joules hammer blow.

**Consistence, soil.** 1) The resistance of the soil to deformation or rupture as determined by the degree of cohesion or adhesion of the soil particles to each other. 2) The feel of the soil and the ease with which a soil ped can be crushed by the fingers. Terms commonly used to describe consistence are:

**Friable** - When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

**Firm** - When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

**Consociation, soil.** Mapping unit dominated by a single taxa and similar soils. As a rule, at least one-half of the pedons in each delineation of a soil consociation are of the same soil components that provide the name for the map unit. The total inclusion of other components generally does not exceed about 15 percent if limiting and 25 percent if non-limiting. A single component of dissimilar limiting inclusion generally does not exceed 10 percent if very contrasting.

**Consociation (vegetation).** Can be used if only the upper stratum of a several-layered community is dominated by one species. As a type consociation, a consociation can also be understood as a class composed of individual concrete associations, whose upper strata are dominated by the same species, while the lower strata may be dominated by different species in each vegetative sample.

**Contamination.** The process of making a substance unclean, harmful, or impure by the addition of another substance. Drinking water supplies become contaminated if untreated sewage enters them.

**Control section.** The part of the soil on which classification is based. Thickness varies among different kind of soils; but, for many, it is that part of the soil profile between depths of 0 to 200 centimeters.

**Coppice dunes.** The windblown soil material accumulated around widely spaced plants in arid regions.

**Corrosion (Geomorphology).** A process of erosion whereby rocks and soils are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

**Corrosive.** High risk of corrosion to uncoated steel or deterioration of concrete.

**Creep.** Slow mass movement of earthy material down slopes. The rolling of soil particles on the surface of soil with the action of wind or water.

**Creep, wind.** The rolling of soil particles on the soil surface due to wind action.

**Crest.** (Slope morphology type). The commonly linear, narrow summit of a ridge, hill or mountain. Smooth convex, higher than most adjacent terrain.

**Crop.** Plants grown for harvest, especially food plants.

**Cropland.** Land used primarily for the production of cultivated crops.

**Crust.** 1) It is a surficial subzone, usually less than 50 mm thick, that exhibits markedly more mechanical continuity of the soil fabric than the zone immediately beneath. 2) A surface layer of soils that becomes harder than the underlying horizons.

**Cultivar.** A named variety selected within a plant species. Distinguished by any morphological, physiological, cytological, or chemical characteristics. A variety of plant produced and maintained by cultivation which is genetically retained through subsequent generations.

**Cutans.** Coatings or deposits of material on the surfaces of peds, stones, etc. A common type is the clay cutan caused by translocation and deposition of clay particles on ped surfaces.

## D

**Debris.** 1) Accumulated plant and animal remains. 2) Any surficial accumulation of loose material detached from rock mass by chemical and mechanical means, as by decay and disintegration. It consists of rock clastic material of any size and sometimes organic matter.

**Deciduous.** Describing plants that shed their leaves at the end of each growing season. Most broad-leaved trees such as aspens and maples are deciduous; many shrubs and vines are as well. Deciduous can also refer to the shedding of other plant parts such as sepals, stipules, anthers, etc.

**Deep ripping.** The fracturing or breaking a part of a cemented pan, such as gypsum pan, to a depth of about one meter by tillage with an implement having one or more soil-penetrating points.

**Deflation.** The sorting out, lifting and removal of loose, dry, fine-grained soil particles (clays, silts and fine sands) by the turbulent eddy action of wind, a form of wind erosion.

**Deflation basin.** A topographic basin excavated and maintained by wind erosion which removes unconsolidated material and commonly leaves a rim of resistant material surrounding the depression. Unlike a blowout, a deflation basin does not include adjacent deposits derived from the basin.

**Deflocculate.** 1) To separate the individual components of compound particles by chemical and/or physical means. 2) To cause the particles of the disperse phase of a colloidal system to become suspended in the dispersion medium. An alternate to disperse.

**Defoliation.** The removal of plant leaves, i.e., by grazing or browsing, cutting, chemical defoliant, or natural phenomena such as hail, fire, or frost.

**Degradable.** Substance that can be broken down into smaller, less complex molecules.

**Degradation.** 1) The lowering of the land surface by physical processes. 2) Decline in quality of the natural resources.

**Dehydration.** The removal of water constituent, particularly one from a chemical compound.

**Delineation, map.** Each individual area separated on a map is a delineation.

**Delta.** A body of alluvium, nearly flat and fan shaped, deposited at or near the mouth of a river or stream where it enters a body of relatively quite water, usually a sea or lake.

**Delta plain.** The level or nearly level surface composing the land-ward part of a large delta; strictly, a flood plain characterized by repeated channel bifurcation and divergence, multiple distributary channels, and interdistributary flood basins.

**Density.** 1) The mass per unit of volume of a substance, usually stated in grams per cubic centimeter (or pounds per cubic foot). Density gives an indication of how closely packed the molecules of a substance are; for example, liquid water has a density of 1 gram per cubic centimeter, while liquid mercury has a density of 13.59 grams per cubic centimeter. 2) The size of a population of a given species in a given area.

**Deposit.** Earth material of any type, either consolidated or unconsolidated, that has accumulated by natural processes.

**Deposition.** The laying down of any material by any agent such as wind, water, ice or by other natural processes.

**Depression.** Any relatively sunken part of the Earth's surface; especially a low-lying area surrounded by higher ground. A closed depression has no natural outlet for surface drainage (e.g. a sinkhole). An open depression has a natural outlet for surface drainage.

**Desalinization.** Removal of soluble salts from saline soils, usually by leaching.

**Desert.** An arid area with insufficient available water for dense plant growth.

**Desert crust.** A hard surface layer in desert regions containing calcium carbonate, gypsum, or other cementing materials (locally called gatch).

**Desertification.** 1) The process by which an area or region becomes more arid through loss of soil and vegetative cover. The process often accelerated by excessive continuous overstocking and drought. 2) The process of climate and environmental modification leading to the formation of a more

arid-appearing landscape. 3) The land degradation in arid, semi-arid and subhumid areas resulting from various factors, including climatic variations and human activities.

**Desert pavement.** A layer of gravel or stones remaining on the surface of the ground in deserts after the removal of the fine material by wind.

**Desert soils.** An older term applied to zonal soils having a light-colored surface horizon underlain by a caliche or hardpan layer.

**Desert varnish.** A glossy sheen or coating on gravel and stones in arid regions.

**Desiccation.** To dry out, the loss of water from sediments.

**Desorption.** The opposite of adsorption; the release of materials from being adsorbed onto a surface.

**Diagenesis.** It is process of physical and chemical change which take place within a sediment after its deposition and before the onset of either metamorphism or weathering.

**Diagnostic horizons (as used in soil taxonomy).** Combinations of specific soil characteristics that are indicative of certain classes of soils. Horizons that occur at the soil surface are called epipedons; those below the surface are called andopedons or diagnostic subsurface horizons.

**Differential erosion.** Unequal reaction of soils due to their differential resistance to a uniform process of erosion.

**Dike.** An embankment 1 to 2 meters high to confine or control low velocity floodwater.

**Diking.** The construction of dike(s) to control low velocity surface water flow.

**Disperse.** 1) To break up compound particles, such as aggregates, into the individual component particles. 2) To distribute or suspend fine particles, such as clay, in or throughout a dispersion medium, such as water. Alternate to deflocculate

**Dissected.** Cutting up of a land surface by eroding streams.

**Dissimilar soils.** These are the soils in the map unit that differ sufficiently from the named soil to affect major interpretations.

**Disturbance.** An event that changes the local environment by removing organisms or opening up an area, facilitating colonization by new, often different, organisms. When a large tree falls in a mature forest, it opens up a hole in the canopy that lets light fall onto the forest floor; this disturbance allows light-loving plants to grow in a spot that would otherwise be too shaded for them.

**Diurnal.** Active during daylight hours.

**Diversity.** 1) The number of different species, and their relative abundance, in an area. Diversity is a measure of the complexity of an ecosystem, and often an indication of its relative age. Newly established communities are low in diversity; older, more stable communities usually have high diversity. 2) The distribution and abundance of different plants and animal communities within an area.

**Dolomite.** A white rather soft mineral, carbonate of calcium and magnesium,  $\text{CaCO}_3 \cdot \text{MgCO}_3$ .

**Drainage.** Process of discharge of water.

**Drainage basin.** 1) The landform or surface shape of a watershed. 2) The area contributing runoff to a stream system.

**Drainage, class.** It refers to common depth of water table or saturated zones that effect plant growth and use of the soil for buildings and septic tanks. There are seven classes: excessively drained, somewhat excessively drained, well-drained, moderately well-drained, somewhat poorly drained, poorly drained and very poorly drained.

**Drainage, surface.** Runoff, or surface flow of water from an area.

**Drainageway.** A general term for a course or channel along which water moves in draining an area.

**Dredgic material.** The material containing shells and marine muds.

**Dredging.** The deepening of the bottom area of a water body by the digging, dragging, or hauling out of materials.

**Drift.** 1) The general term for any sediment or rock material deposited by a glacier or by water from melting glaciers. 2) The term for sediment transported by near shore currents along a coastal area.

**Drip irrigation.** A watering method used in agriculture and for residences in which a network of small pipes or hoses brings water directly to the soil above the plants' roots, and releases it (through emitter valves) at a slow rate. Drip irrigation is the most efficient form of irrigation because water loss through evaporation is drastically reduced.

**Drought.** 1) A period without precipitation during which the soil water content is reduced to such an extent that plants suffer from lack of water. 2) Extended period of unusually low precipitation.

**Droughtiness, soil.** The water retention difference is less than 8 centimeters to a depth of 150 centimeters or to a restricting layer. Crops require additional application of irrigation water for normal development and maturity.

**Drought resistance.** The evolution of traits that conserve moisture to enable organisms to withstand and remain metabolically active during dry seasons and climates, rather than avoiding them. In plants, adaptations providing drought resistance include narrow leaves (sometimes reduced to only spines), thick waxy cuticles, sunken stomata, coatings of fine hairs, and even modified metabolic processes enabling some plants to keep their stomata (gas exchange pores) closed during the heat of the day (crassulacean acid metabolism).

**Drought tolerant.** Able to withstand prolonged periods of little precipitation. Xeriscaping, landscape design emphasizing drought-tolerant (xerophytic) plants, is becoming increasingly popular in areas where water use is restricted.

**Droughty.** The soil holds too little water for crops to develop and mature properly. The water retention difference is less than 8 centimeters to a depth of 150 centimeters or to a restricting layer.



**Dry farming.** 1) A method of farming in arid and semi-arid areas without using irrigation, the land being treated so as to conserve moisture. 2) Cultivation techniques for crops that minimize or eliminate the need for irrigation.

**Dumps.** Areas of smoothed or uneven accumulations or piles of waste rock and general refuse.

**Dune.** A low mound, ridge, bank or hill of loose, windblown, granular material (generally sand), either bare or covered with vegetation, capable of movement from place to place but always retaining its characteristic shape.

**Dune field.** A group or aggregates of moving and fixed sand dunes in a given area, together with the sand plains and the ponds, lakes, or swamps produced by the blocking of streams by sand.

**Dunes, sand.** Ridges or small hills of sand that have been piled up by wind action on sea coasts, in deserts and elsewhere.

**Durids.** A subdivision (suborder) of order *aridisols*, which have a duripan that has its upper boundary within 100 cm of the soil surface.

**Duripan.** The duripan (L. *durus*, hard, meaning hardpan) is a subsurface horizon that is cemented by illuvial silica to the degree that less than 50 percent of the volume of air-dry fragments slake in water or during prolonged soaking in hydrochloric acid (HCl).

**Dust.** Particulates so fine that they can remain suspended in air.

**Dust mulch.** A loose, finely granular, or powdery condition on the surface of the soil, usually produced by shallow cultivation.

## E

**Easterly.** A minor element of global wind patterns. In general, winds moving from high-pressure regions at the poles towards low-pressure regions found roughly above the Arctic and Antarctic circles move from east to west. These prevailing winds are therefore called polar easterlies.

**ECe.** The electrical conductivity of the soil saturation extract.

**Eccesis.** Establishment and development of a plant in the community.

**Ecology.** The study of the interrelationships between individual organisms and between organisms and their environment.

**Ecosystem.** 1) Interaction of the soils, plants, animals, and water that are part of the ecology of an area. 2) Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.

**Ecotone.** A transitional area between two (or more) distinct habitats or ecosystems, which may have characteristics of both or its own distinct characteristics. The edge of a woodland, next to a field or lawn, is an ecotone, as are some savanna areas between forests and grasslands.

**Ecotype.** A locally adapted genetic variant within a species. Different selection pressure of different environments results in the development of different ecotypes within a single species. Unlike ecads, ecotypes retain their physiological and morphological differences when transplanted to a single location. Also called ecological races, physiological races, or ecodemes.

**Edaphic.** Of or pertaining to the soil. Influenced by soil factors.

**Effective rooting depth.** The depth of soil material that plant roots can penetrate readily to obtain water and nutrients.

**Effervescence.** The fizzing reaction caused when a carbonate mineral is treated with acid. The evolution of CO<sub>2</sub> in the form of bubbles when adding 1M HCl to check carbonates in soil. Four classes of effervescence are used; 1) very slightly effervescent - few bubbles seen; 2) slightly effervescent - bubbles readily seen; 3) strongly effervescent - bubbles form low foam; and 4) violently effervescent - thick foam forms quickly.

**Efflorescence, salt.** The accumulation of dissolved substance (usually simple salts) at a soil surface due to evaporation.

**Elevation (survey).** The vertical distance from a datum (usually mean sea level) to a point or object on the surface of the earth; especially the height of a ground point above the level of the sea.

**Elutriation.** The separation of the lighter from the heavier particles from soils, such as sand by a process of sedimentation and washing.

**Eluvial horizon.** A horizon from which material has been removed either in solution or suspension.

**Eluviation.** The movement of material in true solution or colloidal suspension from one place to another within the soil. The soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

**Embankment.** 1) The steep boundary area along the edge of a stream. 2) A ridge or slope separating areas of differing elevations. 3) Artificial emplacement of earth or rock, as in a dike or a levee.

**Endangered species.** Any species whose populations have been reduced to the point that it is at risk of becoming extinct over much or all of its range in the near future.

**Endemic.** 1) Indigenous to, and restricted to, a particular area; also, an endemic plant or animal. 2) Describing a disease regularly found in low levels in a particular area but not epidemic or sporadic, confined to a few regular incidences.

**Endogenous plant.** Species of plant found in the area in which they originate.

**Entisols.** One of the 11 soil orders in the USDA soil taxonomy, representing the recently-formed soils (sandy desertic soils). Soils have no diagnostic horizon. They may be found in virtually any climate on very recent geomorphic surfaces. Soils of Kuwait in the south are mainly classified under entisols.

**Environment.** The whole sum of the surrounding external conditions within which an organism, a community, or an object exists. Environment is not an exclusive term; organisms can be and usually part of another organism's environment.

**Environmental degradation.** Depletion or destruction of a potentially renewable resource, such as soil, grassland, forest, or wildlife by using it at a faster rate than that at which it is naturally replenished.

**Eocene.** Geological, period lasting from 65 to 38 million years BP.

**Eolian soil material.** Soil material transported and deposited by wind action. The most extensive areas in Kuwait are mixtures of sand and silty deposits (loess), but large areas of sandy deposits also occur.

**Ephemeral stream.** A stream, or reach of a stream, that flows only in direct response to precipitation

**Epipedon.** A diagnostic surface horizon that includes the upper part of the soil that is darkened by organic matter, or the upper eluvial horizons, or both.

**Erosion.** The wearing away of the land surface by water, wind, or other geologic agents and by such processes as gravitational creep.

**Erosion pavement.** A layer of gravel or stones left on the surface of the ground after the removal of the fine particles by erosion.

**Erosion remnant.** A topographic feature that remains or is left standing above the general land surface after erosion has reduced the surrounding area.

**Erosion surface.** A land surface shaped by the action of erosion, especially by running water.

**Escarpment.** A relatively continuous cliff or relatively steep slope, produced by erosion or faulting, breaking the general continuity of more gently sloping land surfaces.

**Essential elements.** Chemical elements necessary for the life of an organism. They are C, H, O, N, P, K, S, Ca, Mg, B, Mn, Cu, Zn, Mo, Cl, Co, Si and F. These must be taken up and utilized in sufficient quantities for plants to complete their life cycles.

**Estuary.** 1) The mouth of a freshwater river that is now filled with seawater due to rising sea levels.  
2) A drowned river valley where tidal effects are evident.

**Euryhaline.** Describing organisms that can tolerate a wide range of salt levels or salinity in either water or soils.

**Evaporation.** The process whereby a liquid becomes a vapor.

**Evaporation basin.** Enclosed depression from which evaporation occurs.

**Evaporite.** A sediment derived by chemical precipitation as salt-saturated water evaporates.

**Evapotranspiration.** The combined process by which water is transferred from the earth's surface to the atmosphere. It includes evaporation of liquid or solid water from soil and plant surfaces plus transpiration of liquid water through plant tissues expressed as the latent heat transfer per unit area or its equivalent depth of water per unit area.

**Excavation difficulty, horizon.** The difficulty of horizons in the profile for an excavation. On the basis of resistance in excavation, five classes generally describe the excavation difficulty state. They are:

- **Low.** Excavated with spade and normal arm-applied pressure.
- **Moderate.** The arm pressure is insufficient; excavation is possible by spade with foot pressure.
- **High.** The excavation with spade can be accomplished with difficulty; only possible with a full length pick using an over-the-head swing.
- **Very high.** The excavation with a full length pick is moderately to markedly difficult; it is possible in a reasonable period of time with a backhoe mounted on a 40 to 60 kW (50-80 hp) tractor.
- **Extremely high.** The excavation is nearly impossible with a full length pick using an over-the-head arm swing, and cannot be accomplished in a reasonable time period with a backhoe mounted on a 40 to 60 kW (50-80 hp) tractor.

**Exchangeable cations.** The positively charged ions that are adsorbed onto the surface of clay or humus colloids within a soil. Exchangeable cations may replace one another as soil conditions change. Calcium, magnesium and potassium are important exchangeable cations in plant nutrition.

**Exchangeable sodium percentage (ESP).** The extent to which the adsorption complex of a soil is occupied by sodium. It is expressed as follows:

$$\text{ESP} = \frac{\text{Exchangeable sodium (cmol/kg soil)}}{\text{Cation exchange capacity (cmol/kg soil)}} \times 100$$

**Exclosure.** An area fenced to exclude animals.

**Exhumed.** Formerly buried landforms, geomorphic surfaces that have been re-exposed by erosion of the covering mantle.

**Exotic species.** 1) One that is not native to an area. 2) A plant species that has been introduced to an area or region through human action, but has now naturalized to the point of being self-sustaining. Also, called alien species.

**Extractable cations.** The sum of soluble and exchangeable cations.

## F

**Fallow.** 1) Leaving the land uncropped for a period of time. This may be to accumulate moisture, improve structure or induce mineralization of nutrients. 2) Describing land that is not being used for growing crops for an entire growing season or longer. In some crop rotations, land is left fallow after growing crops that greatly deplete the soil (such as corn or cotton) so that the soil can build up nutrients and organic matter again.

**Family, soil.** One of the categories in soil classification intermediate between the soil subgroup and the soil series. Families are defined largely on the basis of physical and mineralogical properties of importance to plant growth.

**Fan (Geomorphology).** A gently sloping, fan-shaped mass of detritus forming a section of a low angle cone commonly at a place where there is a notable decrease in gradient; specifically an alluvial fan.

**FAO (Food and Agricultural Organization).** An agency of the United Nations responsible for a wide range of programs in food, agriculture, forestry, and related matters.

**Fault.** A fracture or a fracture zone of the earth with displacement along one side in respect to the other.

**Fault line.** The trace of a fault plane on the ground surface or on a reference plane.

**Fauna.** The animal life of a region. All of the animals of a particular region or a particular era. For example, the fauna of New Zealand.

**Feedlot.** A small enclosure (pen) where cattle are confined in order to fatten them.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Fertilizer.** Any substance that adds nutrients to soil, improving its ability to grow crops and other vegetation. Organic fertilizers are derived from animal or plant sources such as manure, cottonseed meal, bone meal, etc. Inorganic fertilizers can refer either to natural minerals (such as rock phosphate, greensand, and Chilean nitrate) or to synthetic chemical fertilizers.

**Field capacity or field moisture capacity.** The total amount of water remaining in a freely drained soil after the excess has flowed into the underlying unsaturated soil. It is expressed as a percentage of the oven-dry soil.

**Fine clay.** It is a soil separate with  $< 0.2 \mu\text{m}$  ( $< 0.0002 \text{ mm}$ ) particle diameter.

**Fine earth fraction.** The fraction of earth passed through a 2 mm sieve ( $< 2 \text{ mm}$ ).



**Fine texture.** The soil containing > 35 percent clay. Also consisting of large quantities of the finer fraction, particularly of silt and clay (includes clay loam, sandy clay loam, silty clay loam, sandy clay, silty clay, and clay textural classes).

**Flocculate.** To aggregate or clump together individual, tiny soil particles, especially fine clay, into small clumps or floccules. Opposite of deflocculate or disperse.

**Flood plain.** The nearly level plain that borders a stream and is subject to inundation unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the streams.

**Floor (Geomorphology).** A general term for the nearly level, lower part of a basin or valley.

**Flora.** All of the plants of a particular region or a particular era. For example, the flora of the Florida Keys.

**Fluve.** A linear depression of any size, along which water flows, at some times.

**Fluvial.** Pertaining to or produced by the action of a stream or river.

**Foliage.** All the leaves on a plant or in a plant community.

**Forage.** Food for animals, especially that obtained by grazing or browsing. Also, to look for food.

**Foredune.** A coastal dune or dune ridge oriented parallel to the shoreline, occurring at the landward margin of the beach, along the shoreward face of a beach ridge, or at the landward limit of the highest tide, and more or less stabilized by vegetation.

**Forest.** A large group of trees, especially (but not necessarily) those growing close enough that the tops of most touch or overlap, shading the ground below. Forests may or may not have extensive undergrowth.

**Fractionation.** It refers to a process used in separating soil particles into separate and distinct classes according to their sizes. Fractionation is usually made through sieving and the sedimentation process.

**Fragipan.** The fragipan (*L. fragilis*, brittle, meaning brittle pan) slakes or fractures when placed in water. A genetically developed layer having a combination of firmness, brittleness and commonly higher bulk density than adjacent layers.

**Fragmental.** Family or series particle size class. When the soil contains rock fragments and voids more than 90 percent and fine-earth component less than 10 percent (including associated medium and finer pores) of the total volume.

**Freely drained.** A soil that allows water to percolate freely.

**Friable.** A term applied to soils that when either wet or dry crumble easily between the fingers.

## G

**Garbic material.** It refers to garbage deposits.

**Gatch.** A local term for a hard subsurface layer containing calcium carbonate, gypsum, silica or other cementing material. If surface is truncated, it appears at the surface.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of solum, or true soil, from the unconsolidated parent material.

**Genetic diversity.** Variability in the genetic makeup among a group of individuals in a population.

**Genetic engineering.** Altering genes or genetic material to produce desirable new traits in organisms or to eliminate undesirable ones. It is accomplished primarily through gene-splicing, artificially transferring genes from one organism to a similar or entirely different organism. It is sometimes also used to refer to controlled breeding. Also called genetic manipulation or recombinant DNA technology.

**Geographic information system (GIS).** A computer mapping software system that links geographically referenced data with graphic map features. These systems allow for manipulation, analysis, and display of spatial information in either raster-matrix or vectorline formats.

**Geomorphic surface.** A mappable area of the earth's surface that has a common history; the area is of similar age and is formed by a set of processes during an episode of landscape evolution. A geomorphic surface can be erosional, constructional or both. The surface shape can be planar, concave, convex, or any combination of these.

**Geomorphology.** The science that treats the general configuration of the Earth surface; specially the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and of the history of geologic changes as recorded by these surfaces features. The term is especially applied to the genetic interpretation of landforms.

**GIS.** See GEOGRAPHIC INFORMATION SYSTEM.

**Gleying.** The reduction of iron in an anaerobic environment leading to the formation of gray or blue colors.

**Gravel.** A clastic rock particle between 2 mm and 75 mm in average diameter.

**Gravelly soil material.** Material that is over 15 percent (volume) of rock fragments.

**Gravitational water.** The water that flows freely through soils in response to gravity.

**Grazing.** The act of animals feeding on fresh grass and herbaceous plants.

**Great soil group.** One of the categories in soil classification. A subdivision of suborder in the USDA soil taxonomy. The classes in this category contain soils that have the same kind of horizons in the same sequence and have similar moisture and temperature regimes.

**Grid.** 1) A network of evenly spaced lines or squares, such as those used on maps to locate positions. 2) The network of electrical lines that delivers electricity from a power plant to users such as individual homes and businesses. 3) When capitalized, the acronym for the Global Resource Information Database of the Earthwatch Program.

**Ground truth.** Measurements or observations made on the ground for the purpose of verifying interpretations made from aerial photography or remote sensing.

**Groundwater.** Subsurface water occupying all the voids within a geologic stratum. This saturated zone is to be distinguished from an unsaturated or aeration zone where voids are filled with water and air, or water occurring in the zone of saturation. The top surface of the ground water is the "water table".

**Groundwater table.** The upper limit of the groundwater.

**Gully.** A small channel with steep sides cut by running water and through which water ordinarily runs only after a rain.

**Gully erosion.** It is the consequence of water that cuts down into the soil along the line of flow. In contrast to rills, gullies cannot be obliterated by ordinary tillage. Deep gullies cannot be crossed with common types of farm equipment. The gullies developed are either V-shaped or U-shaped.

**Gypcrete.** Sedimentary deposit of soil material cemented by gypsum

**Gypsiargids.** A great group under suborder *argids* that have a gypsic horizon that has its upper boundary within 150 cm of the soil surface.

**Gypsic.** As a mineralogy class at the family level, more than 40 percent (by weight) carbonates (expressed as  $\text{CaCO}_3$ ) plus gypsum, with gypsum constituting more than 35 percent of the total weight of carbonates plus gypsum, either in the fine earth fraction or in the less than 20 mm fraction, whichever has a higher percentage of carbonates plus gypsum.

**Gypsic aquisalids.** A subdivision (subgroup) under the great group "aquisalids" of suborder "salids" under the order "aridisols". The aquisalids which have a gypsic or petrogypsic horizon that has its upper boundary within 100 cm of the soil surface (see also aquisalids).

**Gypsic haplosalids.** A subdivision (subgroup) under the great group "haplosalids" of suborder "salids" under the order aridisols. The haplosalids which have a gypsic horizon that has its upper boundary within 100 cm of the soil surface (see also haplosalids).

**Gypsic horizon.** It is an illuvial horizon in which secondary gypsum has accumulated to a significant effect; it is more than 15 cm thick.

**Gypsids.** A subdivision (suborder) of the order "aridisols", which have a gypsic or petrogypsic horizon that has its upper boundary within 100 cm of the soil surface and lacks a petrocalcic horizon overlying any of these horizons.

**Gypsum.** Soft crystalline mineral which is of the hydrated form of calcium sulphate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ )

**Gypsum land.** It consists of exposures of nearly pure soft gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ).

**Gypsum pan.** A hard soil layer cemented with crystalline gypsum that restricts root growth (see also cemented pan).

## H

**Habitat.** The place where an animal or plant normally lives or grows, usually characterized either by physical features or by dominant plants. Deserts, lakes, and forests are all habitats.

**Halomorphic soils.** Soils containing a significant proportion of soluble salts.

**Halophyte.** A plant that naturally grows in salty soils (as near the ocean) or in the mud of saltwater environments, one that has developed adaptations allowing it to tolerate high concentrations of sodium in soil and in ocean spray, such as sea oats or saltmarsh hay. Some halophytes require high salt concentrations around their roots whereas others are facultative.

**Hamada.** An accumulation of stones at the surface of deserts, formed by the washing or blowing away of the finer material.

**Haplocalcids.** A subdivision (great group) under the suborder (calcids) and order "aridisols" that do not have petrocalcic horizon that has its upper boundary within 100 cm of the soil surface (see also calcids).

**Haplosalids.** A subdivision (great group) under the suborder (salids) and order "aridisols". The salids that are not saturated with water (see also salids).

**Hardpan.** A hardened soil layer, or nearly impermeable rockline soil layer. Formed in the lower A or in the B horizon, caused by cementation of soil particles with organic matter or with materials such as silica, sesquioxides, or calcium carbonate. The hardness does not change appreciably with changes in moisture content, and pieces of the hard layer do not slake in water.

**Hardsetting.** The condition of a dry surface soil when a compact, hard and apparently apedal condition prevails.

**Harvest.** 1) A technique for measuring the productivity of an ecosystem by weighing the growth produced in a single season. 2) The time when crops are gathered, or the crops that are gathered.

**Heavy soil.** A soil that has a high content of clay and is difficult to cultivate.

**Hectare (ha).** Unit of measurement of area. 1 ha = 2.47 acres in 10,000 m<sup>2</sup> and 100 ha = 1 km<sup>2</sup>

**Herbaceous.** Resembling a herb, a green, leafy plant that does not produce persistent woody tissue. Herbaceous plants form the lowest layer of vegetation in most plant communities.

**Herbarium.** 1) A collection of pressed plant specimens. 2) A place where such a collection is stored or displayed.

**Hierarchical soil classification system.** The system with different levels of classification. The USDA soil taxonomy has six levels, i.e., order, suborder, greatgroup, subgroup, family and series.

**Hillock, slope morphological type.** Narrow short crest and short adjoining slopes.

**Histic epipedon.** A surface horizon rich in organic matter.

**Holocene.** The epoch of the Quaternary Period of geologic time, extending from the end of the Pleistocene Epoch (about 10 to 12 thousands years ago) to the present.

**Horizon.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers of lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

**O horizon.** An organic layer of fresh and decaying organic residue at the surface of a mineral soil.

**A horizon.** The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

**E horizon.** The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combinations of these.

**B horizon.** The mineral horizon below an O, A, or E horizon. The B horizon is, in part, a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

**C horizon.** The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

**Cr layer.** Consolidated rock (weathered bedrock or saprolite) beneath the soil. The weathered bedrock or materials that show isovolumetric weathering commonly underlie a C horizon, but can be directly below a B horizon.

**R layer.** Rock (unweathered bedrock) beneath the soil. The bedrock commonly underlies a C horizon, but can be directly below an A or a B horizon.

**Horizon boundary.** It is a surface or transitional layer between two adjoining horizons or layers in the soil profile.

**Horticulture.** Cultivation of flowers, fruits, vegetables, or ornamental plants; also, the study of such cultivation methods.

**Hue.** The dominant spectral color and one of the three color variables in the Munsell Color Notation.

**Hummock.** A rounded or conical mound or knoll, hillock, or other small elevation. Also, a slight rise of ground above a level surface. Differentiated from a dune by the lack of steepness.

**Humus.** An organic soil material so thoroughly decayed that the identity of the biologic source cannot be recognized.

**Hydration.** A process whereby a substance takes up water.

**Hydraulic conductivity.** The rate at which water will move through soil in response to a given potential gradient.

**Hydric soils.** Soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in their upper parts.

**Hydrologic cycle.** Disposal of precipitation from the time it reaches the soil surface until it re-enters the atmosphere by evapotranspiration to serve again as a source of precipitation.

**Hydrologic soil groups.** It refers to soils grouped according to their runoff potential. The soil properties that influence this potential are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not a factor. The classes are:

**A** - Saturated hydraulic conductivity is very high or in the upper half of high, and internal free water occurrence is very deep.

**B** - Saturated hydraulic conductivity is in the lower half of high or in the upper half of moderately high, and free water occurrence is deep or very deep.

**C** - Saturated hydraulic conductivity is in the lower half of moderately high or in the upper half of moderately low, and internal free water occurrence is deeper than shallow.

**D** - Saturated hydraulic conductivity is below the upper half of moderately low, and/or internal free water occurrence is shallow or very shallow and transitory through permanent.

**Hydromorphic soil.** Soils developed in the presence of excess water.

**Hyperthermic.** The mean annual soil temperature is 22°C or higher, and the difference between mean summer and mean winter soil temperatures is more than 5°C either at a depth of 50 cm from the soil surface or at a lithic or paralithic contact, whichever is shallower. Kuwait falls under the hyperthermic temperature regime.

## I

**Illuvial horizon.** A soil layer or horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension. The layer of accumulation of layer-silicate clay, humus, oxides or iron and aluminum.

**Illuviation.** The process of movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

**Immature soil.** A soil with indistinct or only slightly developed horizons because of the relatively short time it has been subjected to the various soil-forming processes. A soil that has not reached equilibrium with its environment.

**Impeded drainage.** Restriction of the downward movement of water by gravity.

**Impervious.** Not easily penetrated by roots or water.

**Inceptisols.** One of the 11 orders in the USDA soil taxonomy. Soils that are usually moist with pedogenic horizons of alternation of parent materials, but not of illuviation. Generally, the direction of soil development is not yet evident from the marks left by various soil-forming processes or the marks are too weak to classify in another order. Very few soils of Kuwait are classified under the order "inceptisols".

**Indigenous.** Born, growing, or produced naturally (native) in an area, region, or country. cf. *endemic*.

**Induration.** A continuous or nearly continuous cementation of soil material. This is designated by "m" with the master horizons (Bm).

**Infiltration.** The entry of water into the soil profile. It is a process of great practical importance to irrigation design. It is the infiltration capacity of the soil that determines the rate that water can be applied to the surface without runoff.

**Infiltration rate.** The rate of water moving in the soil downward by gravity and capillarity. It also moves laterally and upward by capillarity where shape permits it.

**Interdune.** The relatively flat surface, whether sand free or sand covered, between dunes.

**Interfluvial.** A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction.

**Intergrade.** A soil that possesses moderately well-developed distinguishing characteristics of two or more genetically different soils.

**Interstructural pores.** That are delimited by structural units. They are at least crudely planar.

**Irrigation.** A system for, or the process of, bringing water to plants to help them grow and to supplement scanty natural rainfall.

**Irrigation water requirement.** The net irrigation water requirement per unit area is that which must be supplied by irrigation to satisfy evapotranspiration, leaching and other miscellaneous water requirements that are not provided by water stored in the soil and precipitation (rain) that enters the soil.

**Island.** 1) an area of land surrounded by water. 2) an elevated area of land surrounded by swamps, or marsh, or isolated at high water during floods.

**Isohyperthermic.** The mean annual soil temperature is 22°C or higher.

**Isothermic.** The mean annual soil temperature is 15°C or higher, but lower than 22°C.

## J

**Joint.** Fracture in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.

**Jurassic.** Geologic time period from 180 to 135 million years BP.

**Juvenile water.** Water that is derived from the interior of the earth and has not previously existed as atmospheric or surface water.

## K

**Keys to soil taxonomy.** A standard United States Department of Agriculture (USDA) book for the classification of soils.

**Kilometer (km).** Unit of distance in the Systeme International d Unites (SI), equal to 1,000 meters. 1 km = 1094 yards = 0.621 miles.

**Knoll.** A small, low, rounded hill rising above adjacent landforms.

**Krotovinas.** An animal burrow that has filled with material from another horizon.

## L

**Lagoon.** 1) a shallow stretch of salt or brackish water, partly or completely separated from a sea or lake by an offshore reef, barrier island, sand or spit. 2) A shallow lake, one near or communicating with the sea or a river.

**Land capability classification.** A grouping of kinds of soil into special units, subclasses, and classes according to their capability for intensive use and the treatments required for sustained use. One such system has been prepared by the USDA Soil Conservation Service.

**Land classification.** The arrangement of land units into various categories based upon the properties of the land or its suitability for some particular purpose.

**Land degradation.** The processes of erosion by wind and water and deposition elsewhere, long term reduction in the amount of natural vegetation, and salinization of soils.

**Landfill site.** Site where solid waste is disposed; either these are trenches or in successive layers on the ground surface.



**Landform.** Any physical, recognizable form or feature on the earth's surface, having a characteristic shape and range in composition, and produced by natural causes.

**Land reclamation.** The restoration of productivity to lands made barren through processes such as erosion, mining or land clearing.

**Landscape (soils).** A collection of related, natural landforms; usually the land surface which the eye can comprehend in a single view.

**Land suitability.** The appropriateness of a particular land type for a specific land use. Usually includes consideration of economic and social factors as well as the physical environment.

**Land-use planning.** The development of plans for the uses of land that, over long periods, will best serve the general welfare, together with the formulation of ways and means for achieving such uses.

**Leachate.** Liquid which has percolated through solid wastes and extracted dissolved and suspended materials; liquid that drains from the compost mix.

**Leaching.** The washing out of material from soil, both in solution and suspension. The process by which nutrient chemicals or contaminants are dissolved and carried away by water, or are moved into a lower layer of soil.

**Levee (streams).** An artificial or natural embankment built along the margin of a water course, to protect land from inundation.

**Life form.** 1) The overall body type (morphology) of a plant or other organism. A given life form usually characterizes a particular biome; for example, grasslands are dominated by grasslike plants rather than a particular species, and tropical forests may be dominated by trees and lianas. 2) Part of a specific plant classification system developed by Raunkiaer in 1934.

**Light soil.** A soil which has a coarse texture and easily cultivated.

**Lime.** A general term for material that is mostly composed of calcium carbonate.

**Limestone.** Any chemical or organic sedimentary rock that is primarily composed of calcite minerals.

**Limitations for use.** Limits for use as sites of local roads, paths, motorcycle trails, lawns, turfgrass, and picnic areas. Some limiting feature phrases are:

**Area Reclaim.** The area is difficult to establish good vegetation on after soil is removed.

**Low Strength or Subsidence.** The soil is not strong enough to support heavy vehicles or buildings.

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**Thin Layer.** The suitable layer of soil is too thin.

**Restricted Layer.** The layer occurs within 50 cm, which restricts root growth.

**Wetness.** The water table is high enough to affect land use.

**Depth to Garbage.** Household garbage occurs within 50 cm.

**Seepage.** The water moves very rapidly into aquifers and deep layers.

**Saline.** Too much salts to grow crops successfully.

**Linear extensibility.** The linear extensibility of a soil layer is the product of the thickness, in centimeters, multiplied by the COLE of the layer in question (see also COLE).

**Liquid limit.** This is the water content at the change between the liquid and the plastic state. It is measured on thoroughly puddled soil material that has passed a number 40 sieve (0.43 mm) and is expressed on a dry weight basis.

**Lithic contact.** A lithic contact is the boundary between soil and a coherent underlying material.

**Lithification.** The conversion of unconsolidated sediment into a coherent and solid rock, involving processes such as cementation, compaction, desiccation, crystallization, recrystallization, and compression. It may occur concurrently with, shortly after, or long after deposition.

**Lithosol.** A shallow soil composed of rock fragments and lacking a well-developed horizon.

**Litter.** 1) Dead and partially decomposed leaves and other recognizable plant residues on the soil surface of the forest floor, also called the litter layer. 2) Trash discarded by people.

**Loam.** A general term for a soil mixture containing sand, silt, and clay in nearly equal parts. In particular, soil material that is 7 to 26% clay particles, 28 to 50% silt particles, and 23 to 52% sand particles.

**Loamy skeletal.** When the soil contains 35 percent or more (by volume) rock fragments, 10 percent or more (by volume) particles less than 2.0 mm in diameter (fine-earth fraction) with a texture of loamy very fine sand, very fine sand, or finer, including less than 35 percent (by weight) clay.

**Loess.** Material transported and deposited by wind and consisting predominantly of silt size. However, some young deposits of windblown material (loess) are mainly silt and very fine sand and are low in clay.

**Lysimeter.** Apparatus installed in the soil for measuring percolation and leaching.

## M

**Mangroves.** The trees and shrubs that grow in the tidal zone between the sea and the land.

**Manure.** Animal excreta with or without a mixture of bedding or litter.

**Mapping legends.** The designation given on the map to provide the degree of refinement of map units required by the objectives of the survey.

**Maps legibility.** This is an easiness to read map.

**Map unit.** It is a collection of areas defined and named the same in terms of their soil components or miscellaneous areas or both.

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**Micromorphology, soil.** 1) It is tool that attempts to study soil microfabrics in their natural, undisturbed arrangements, and it can be viewed simply as the study of soil morphology in the size range where an optical aid is needed for the naked eye. 2) It is a method of studying undisturbed soil samples with the aid of microscopic techniques, which permits the identification of different constituents and allows their natural relation in space and, as far as possible, in time to be studied.

**Microrelief (soil survey).** 1) Slight variations in the height of a land surface that are too small to delineate on a topographic or soils map at commonly used map scales (1:24,000 and 1:15,840). 2) It is difference in relief within 10 meters of the site.

**Microrelief, classes.** Following are the classes:

- **Smooth.** Surface more or less even.
- **Small hummocks.** Small rounded sandy hummocks < 10 cm high, often sparse and topped by perennial plants.
- **Medium hummocks.** Medium rounded sandy hummocks 10-50 cm high, sparse to dense, usually topped by perennial plants.
- **Large hummocks.** Large rounded sandy hummocks > 50 cm high, usually dense and topped by perennial plants.
- **Small ridges.** Small, more or less parallel, windblown sandy ridges < 10 cm high.
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- **Irregular.** Irregular surface.

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**Mixed.** Mineralogy class at the family level that has less than 40 percent (by weight) of any single kind of mineral, other than quartz or feldspars, in the 0.02 to 2.0 mm fraction.

**Moderately coarse texture.** Consisting predominantly of coarse particles. In soil textural classification, it includes all the sandy loams, except the very fine sandy loam (See also coarse texture).

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**Mottling (redoximorphic features).** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage.

**Mottling, abundance.** The frequency by which the mottles occur in the horizons of a profile. Following are the abundance classes:

- **Few.** Mottles less than 2 percent.
- **Common.** Mottles 2-20 percent.
- **Many.** Mottles more than 20 percent.

**Mottling size.** It refers to how big the mottles are, following are the classes:

- **Fine.** The size is less than 5 mm.
- **Medium.** The size ranges between 5 and 15 mm.
- **Coarse.** The size of mottles is more than 15 mm.

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**Mottling size.** It refers to how big the mottles are, following are the classes:

- **Fine.** The size is less than 5 mm.
- **Medium.** The size ranges between 5 and 15 mm.
- **Coarse.** The size of mottles is more than 15 mm.

**Mound.** A low, rounded hill, natural or artificial, constructed of earthy material.



**Mulch.** Material such as paper and/or grass spread on the surface of soil to conserve the soil moisture.

**Munsell notation.** A standard USDA designation of color by degree of three simple variables: hue, value, and chroma. For example, a notation 10YR 6/4 is a color with the hue of 10YR, value of 6, and chroma of 4.

## N

**National park.** Areas set aside for the protection of wildlife and the natural landscape.

**Native species.** Endemic species, those indigenous to specific areas.

**Natric horizon.** The natric (NL. natrium, sodium) horizon is a special kind of argillic horizon that has exchangeable sodium percentage of 15 or more or sodium adsorption ratio of 13 or more and special structure makeup.

**Niche.** 1) An organism's physical location and function within an ecosystem. 2) The ecological role of a species in a community.

**Nitrification.** The oxidation of ammonia to nitrite and nitrate by microorganisms.

**Nitrogen fixation.** The transformation of elemental nitrogen to an organic form by microorganisms.

**Non-calcareous, soil.** When the soil does not effervesce in all parts with cold dilute hydrochloric acid (HCl).

**Nutrient.** Any food constituent or ingredient that is required for or aids in the support of life.

**Nutrient deficiency.** The lack of an adequate amount of a plant nutrient. Nutrient deficiency may result in a number of symptoms, including poor plant growth, chlorosis or necrosis. Nutrient deficiency symptoms can easily be confused with toxicity symptoms.

***n* value.** It characterizes the relation between the percentage of water in a soil under field conditions and its percentage of inorganic clay and humus. It is important to predict whether a soil can be grazed by livestock or can support other loads, and in predicting what degree of subsidence would occur after drainage.

## O

**Ochric epipedon.** A surface horizon of mineral soil that is too light in color, too high in chroma, too low in organic carbon, or too thin to be a plaggen, mollic, umbric, anthropic, or histic epipedon, or that is both hard and massive when dry.

**Oilic material.** The soils with unburnt oil that escaped to form oil lakes in low lying areas.

**Oil wasteland.** Areas where liquid oily wastes, principally salt water and oil, have accumulated. Oily wasteland in Kuwait occurs in the south.

**Order, soil.** The category at the highest level of generalization in the USDA soil classification system (soil taxonomy). The properties selected to distinguish the orders are reflections of the degree of horizon development and the kind of horizons present.

**Ordinancic material.** Contaminated soils from bombing and shelling that contain uranium, copper and steel.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition.

**Other coats.** They are iron, aluminum, manganese oxides, organic matter, salts, gypsum, and carbonates coatings. Their confirmation is either made in the field or by laboratory tests.

**Outcrop.** That part of a geologic formation or structure that appears at the surface of the earth.

**Overburden.** Soil and unconsolidated rock material overlying subsurface strata.

**Overgraze.** To allow too many animals to graze in one area, causing a gradual change in the vegetation to less desirable species, or causing increased erosion so that portions of the pasture or the rangeland become bare. Although overgrazing may provide short-term economic gain, in the long term it produces land that supports fewer animals or even destroys the land for grazing, greatly reducing the potential for economic gain.

## P

**Pans.** Horizons or layers in soils that are strongly compacted, indurated, or very high in clay content (see also caliche, claypan, fragipan, and hardpan).

**Parabolic dune.** A sand dune with a long, scooped-shaped form, convex in the downwind direction so that its horns point upwind, whose ground plain, when perfectly developed, approximates the form of a parabola.

**Paralithic contact.** It is a boundary between soil and a continuous, coherent underlying material.

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Particle size analysis.** It is a measurement of the size distribution of individual particles in a soil sample.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedogenesis.** The natural process of soil formation.

**Pedology.** The study of soils as naturally occurring phenomena taking into account their composition, distribution and method of formation.

**Pedon.** The smallest volume that can be called "a soil". A pedon is three-dimensional and large enough to permit study of all horizons. Its area ranges from about 1 m<sup>2</sup> to 10 m<sup>2</sup>, depending upon the variability through the soil.

**Pedoturbation.** All mixing of soil components that is not caused by illuviation.

**Penetration resistance, soil.** It is the capacity of the soil in its confined state to resist penetration by a rigid object. It depends on water state, which should be defined.

**Perched water.** An accumulation of water within the soil due to an impermeable layer such as a pan, or gatch.

**Percolation.** The downward or lateral movement of water through soil.

**Perennial plant.** A plant whose life cycle continues for more than two years and continues to live from year to year.

**Perennial vegetation cover class.** The area covered by perennial vegetation. Following are the foliar cover classes:

- **Dense or closed.** More the 70% and plants are overlapping.
- **Mid-dense.** From 30-70 % coverage, plants touching or slightly separated.
- **Sparse.** From 10-30 % coverage, plants clearly separated, spaces less than plant diameter.
- **Very sparse.** The coverage is less than 10%, plants are well separated, spaces 1-20 times plant diameter.
- **Isolated plants.** Occasional and scattered individual plants.
- **Isolated clumps.** Occasional and scattered groups of individual plants.

**Permeability.** The quality of the soil that enables water to move through the profile. It varies from very slow (less than 0.15 cm per hour) to very rapid (more than 50.80 cm per hour). Terms describing permeability are:

Very Slow	Less than 0.15 cm per hour
Slow	0.15 to 0.51 cm per hour
Moderately slow	0.51 to 1.52 cm per hour
Moderate	1.52 to 5.08 cm per hour
Moderately Rapid	5.08 to 15.24 cm per hour
Rapid	15.24 to 50.80 cm per hour
Very Rapid	More than 50.08 cm per hour

**Petrocalcic horizon.** The petrocalcic (Gr. Petra, rock) horizon is an illuvial horizon in which secondary calcium carbonate or other carbonates have accumulated to the extent that the horizon is cemented or indurated.

**Petrocalcic petrogypsid.** A subdivision (subgroup) under the order "aridisols", a petrogypsid which have a petrocalcic horizon overlying the petrogypsic horizon.

**Petrocalcids.** A subdivision (great group) under the suborder (calcids) and order "aridisols" which have a petrocalcic horizon that has its upper boundary within 100 cm of the soil surface.

**Petrogypsic horizon.** The petrogypsic horizon is an illuvial horizon 10 cm or more thick in which secondary gypsum has accumulated to the extent that the horizon is cemented or indurated.

**Petrogypsid.** A subdivision (great group) under the suborder (gypsid) and order "aridisols" which have a petrogypsic horizon that has its upper boundary within 100 cm of the soil surface.

**pH.** The negative logarithm of the hydrogen ion concentration of a solution. It is the quantitative expression of the acidity and alkalinity of a solution and has a scale that ranges from about 0 to 14. The pH 7 is neutral, less than 7 is acidic and greater than 7 is alkaline.

**pH, soil.** The negative logarithm of the hydrogen ion activity of a soil. The degree of acidity or alkalinity of a soil as determined by means of a glass, quinhydrone, or other suitable electrode or indicator at a specified moisture content or soil/water ratio, and expressed in terms of the pH scale.

**Phase, soil.** A subdivision of a soil series based on features that affect its use and management. For example, slope, saline, sodic, erosion, texture, stoniness and flooding.

**pHs.** The pH of the saturated soil paste. A standard measure of soil pH specified by the USDA.

**Physical properties, soils.** Those characteristics, processes, or reactions of a soil that are caused by physical forces and that can be described by, or expressed in, physical terms or equations. Examples of physical properties are bulk density, water-holding capacity, hydraulic conductivity, porosity, pore-size distribution, etc..

**Planimeter.** An instrument used to measure area by measuring the length of the boundary of the delineation. The value indicated on the planimeter is converted to land area by using an appropriate conversion factor related to map scale.

**Plastic.** A moist or wet soil that can be moulded without rupture.

**Plasticity index.** This is the range in water content over which soil material is plastic. The value is the difference between the liquid limit (LL) and the plastic limit (PL).

**Plasticity, soil.** It refers to the degree to which puddled soil material is permanently deformed without rupturing by force applied continuously in any direction. The classes are:

- **Non-plastic.** A roll of 4 cm long and 6 mm thick that supports its own weight cannot be formed.

- **Slightly plastic.** A roll of 4 cm long and 6 mm thick can be formed and supports its weight; however, a roll of 4 mm thick will not support its weight.
- **Moderately plastic.** A roll of 4 cm long and 4 mm thick can be formed and supports its weight; however, a roll of 2 mm thick will not support its weight.
- **Very plastic.** A roll of 4 cm long and 2 mm thick can be formed and will support its own weight.

**Plastic limit.** This is the water content at the boundary between the plastic and semisolid states.

**Playas.** These are barren flats in closed basins in arid regions. These may be subject to wind erosion, and many are saline, sodic, or both. The water table may be near the surface at times.

**Pleistocene.** The epoch of the Quaternary Period of geologic time, following the Pliocene Epoch and preceding the Holocene (from approximately 2 million to 10 thousands years ago).

**Pliocene.** The last epoch of the Tertiary Period of geologic time, following the Miocene Epoch and preceding the Pleistocene Epoch (approximately 5 to 2 million years ago).

**Polygon.** A type of patterned ground consisting of a closed, roughly equidimensional figure bounded by more or less straight sides, some sides may be irregular.

**Polypedon.** 1) A soil consists of contiguous similar pedons that are bound on all sides by pedons of unlike characters. Such a group of contiguous similar pedons is called polypedon or a soil mapping unit, which is a basic unit of soil classification. 2) Two or more contiguous pedons, all of which are within the defined limits of a single soil series; commonly referred to as a soil individual.

**Pond.** 1) A natural body of standing fresh water occupying a small surface depression, usually smaller than a lake and larger than a pool. 2) A small artificial body of water, used as a source of water.

**Pool.** A small, natural body of standing water, usually fresh e.g., stagnant body of water in a marsh, or a transient puddle in a depression following a rain.

**Pores.** A discrete volume of soil atmosphere completely surrounded by soil. It is a general term for voids in the soil material. The term includes matrix, non-matrix and interstructural pore space:

- **Matrix pores.** Pores created by the agencies that control the packing of the primary soil particles.
- **Non-matrix pores.** Relatively large voids that are expected to be present when the soil is moderately moist or wetter, as well as under drier states.
- **Interstructural pores.** They are delimited by structural units and are at least crudely planar.

**Pore space.** The continuous and interconnecting spaces in soils.

**Porosity.** The volume percentage of the total soil bulk not occupied by solid particles.

**Potential evapotranspiration.** The rate at which water, if available would be removed from the soil and plant surface expressed as the latent heat transfer per unit area or its equivalent depth of water per unit area.

**Profile, soil.** A section of two dimensions extending vertically from the earth's surface so as to expose all the soil horizons and a part of the relatively unaltered underlying material.

**Primary succession.** The sequential development of communities on an area that was not previously occupied by organisms.

**Psamments.** A subdivision (suborder) under the order "entisols", which have less than 35 percent (by volume) rock fragments and a texture of loamy fine sand or coarser in all layers between either an Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and either a depth of 100 cm or a lithic, paralithic, or petroferic contact, whichever is shallower. Soils of Kuwait in the south are dominantly classified in the "psamments" suborder.

## Q

**Quality.** An estimation of accessibility or suitability for a given purpose of an object, item or tangible thing.

**Quality assessment.** The overall system of activities whose purpose is to provide assurance that the quality control activities are done effectively. Quality assessment involves a continuing performance evaluation of the production system and the product quality.

**Quality assurance.** A system of activities whose purpose is to provide to the producer and/or to the user of a product or service the assurance that defined standards of quality have been met. Quality assurance consists of quality control and quality assessment, i.e., two separate but related activities.

**Quality control.** The overall system of activities whose purpose is to control the quality of a product or, service so that it meets the users needs, i.e., to provide quality that is satisfactory, adequate, dependable, and economic.

**Quarry pits.** These are open excavations from which soil and commonly underlying material have been removed, exposing either rocks or other material. Commonly, pits are closely associated with dumps.

**Quartz.** A very hard glassy-looking mineral, the common crystalline silica (SiO<sub>2</sub>) often in hexagonal forms.

**Quartz sand.** The soil particle greater than 0.050 mm diameter composing of SiO<sub>2</sub>.

**Quaternary.** The period of the Cenozoic Era of geologic time, extending from the end of the Tertiary Period (about 2 million years ago) to the present and comprising two epochs, the Pleistocene (Ice Age) and Holocene (Recent); also, the corresponding (time-stratigraphic) "system" of earth materials.

# R

**Range (vegetation).** Any land supporting vegetation suitable for grazing including rangeland, grazable woodland and shrubland.

**Range (statistics).** For a finite number of values, the simplest measure of variability is the range, which is difference between the largest and smallest values.

**Range condition.** A method for estimating how close a particular area of rangeland is to reaching its potential for producing (and sustaining) vegetation that can be used by grazing or growing animals.

**Rangeland.** Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing.

**Range management.** A form of intentional land use that attempts to maximize the number of grazing animals that can be kept on a given area of rangeland. Good range management avoids overgrazing, which can result in the replacement of good forage species with less nutritious weed species and can eventually damage grassland so extensively that it converts to desert.

**Reaction, soil.** A measure of the acidity or alkalinity of a soil expressed in pH values. According to USDA, the following are the soil reaction classes. The soils of Kuwait generally fall in the range 7.4-8.4).

Ultra acid	< 3.5
Extremely acid	3.5 - 4.4
Very strongly acid	4.5 - 5.0
Strongly acid	5.1 - 5.5
Moderately acid	5.6 - 6.0
Slightly acid	6.1 - 6.5
Neutral	6.6 - 7.3
Slightly alkaline	7.4 - 7.8
Moderately alkaline	7.9 - 8.4
Strongly alkaline	8.5 - 9.0
Very strongly alkaline	> 9.0

**Reclamation.** A general term for the filling, grading, and reseeding or replanting of land that has been disturbed by a natural disaster such as fire or flood.

**Reclamation, soil.** To achieve the original state of soil. Generally deals with salinity and sodicity.

**Reconnaissance.** A general examination or survey of a region with reference to its main features, usually as a preliminary act to a more detailed survey.

**Recreation area.** A developed or undeveloped land area reserved and managed for recreational purposes.

**Redoximorphic features.** The soil features produced during oxidation and reduction conditions of soils through drying and wetness. These features usually show drainage conditions.

**Reduction, soil.** Change in oxidation state of iron and manganese that changes the color of their compounds and how soluble the compounds are.

**Regolith.** The unconsolidated mantle of weathered rock, soil and superficial deposits overlying solid rock.

**Rehabilitation.** To bring back into good condition.

**Rejuvenation.** The latest stage in a cycle of erosion during which a regional uplift increases stream gradients and a new phase or erosional dissection of the landscape begins.

**Relief.** The elevation or inequalities of a land surface, considered collectively.

**Remote sensing.** 1) Refers to the full range of photographic/imagery activities that collect information from a distance. 2) Defined as the collection of information about an object/target by a device that is not in physical contact with the object/target.

**Resiliency, soil.** It is an interpretation that relates to the ability of a soil to rebound from depletion of plant nutrients or organic matter or to rebound from the degradation of physical and chemical properties.

**Revegetation.** Establishing or re-establishing desirable plants on areas where desirable plants are absent or of inadequate density, by management alone (natural vegetation) or by seeding or transplanting (artificial vegetation). cf. *range seeding*.

**Ridge, slope morphological type.** A long, narrow elevation of the land surface, usually sharp crested with steep sides and forming an extended upland between valleys. The term is used in areas of both and mountain relief.

**Rill.** A small intermittent water course with steep sides.

**Rill erosion.** The removal of soil through the cutting of many small, but conspicuous, channels where runoff concentrates. It is intermediate between sheet and gull erosion.

**Ripping.** The mechanical penetration and shearing of soils for the purpose of breaking hardpan layers to facilitate penetration of plant roots, water, organic matter, and nutrients.

**Rise.** A slight increase in slope and elevation of the land surface, usually with a broad summit and gently sloping sides.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 mm or more, for example, gravels (2-75 mm), cobbles (75-250 mm), stones (250-600 mm), and boulders ( $\geq 600$  mm).

**Root restricting depth.** Depth in the profile when root penetration is strongly inhibited (physical effect), and incapable to support more than a few fine and very fine roots. The depth usually shows high bulk density. The classes are:



Very shallow	< 25 cm
Shallow	25-50 cm
Moderately deep	50-100 cm
Deep	100-150 cm
Very deep	≥ 150 cm

**Root zone.** The part of the soil that can be penetrated by plant roots.

**Runoff.** The proportion of precipitation not immediately absorbed into or detained upon the soil and which thus becomes surface flow.

**Runoff surface.** That part of runoff that travels over the soil surface to a stream channel.

## S

**Sabkha.** Salt encrusted flat on the shores of a lagoon or shallow sea.

**Salic horizon.** The salic (L. sal, salt) horizon is a horizon of accumulation of salts that are more soluble than gypsum in cold water. The salic horizon is 15 cm or more in thickness. The horizon occurs mainly in the coastal areas and Bubiyan Island of Kuwait.

**Salids.** A subdivision (suborder) of order "aridisols", which have a salic horizon that has its upper boundary within 100 cm of the soil surface. Salids in Kuwait occur in the coastal areas and in Bubiyan Island.

**Saline-sodic soil.** A soil containing sufficient soluble salts to interfere with the growth of most crop plants and sufficient exchangeable sodium to affect the soil properties and plant growth adversely by the degradation of soil structure. The electrical conductivity of the soil saturation extract is equal to or greater than  $4 \text{ dSm}^{-1}$  (at  $25^\circ\text{C}$ ), the pHs may be less or more than 8.5, and exchangeable sodium percentage is equal to or greater than 15.

**Saline soil.** A saline soil contains sufficient soluble salts to impair its productivity. The electrical conductivity of the saturation extract (at  $25^\circ\text{C}$ ) is more than  $4 \text{ dSm}^{-1}$ , the exchangeable sodium percentage (ESP) is less than 15, sodium adsorption ratio (SAR) is less than 13, and the pHs is usually less than 8.5. These soils are usually recognized by the presence of white salt crust during some part of the year.

**Salinity, soil.** A measure of soluble salts in soil based on electrical conductivity of the saturation extract. Only salt-tolerant plants can grow in soil with high salinity levels.

**Salinization.** The process of accumulation of soluble salts in the soil.

**Saltation.** Particle movement in water or wind where particles skip or bounce along the stream bed or soil surface. The saltation range is 500-63  $\mu\text{m}$  diameter sized particles.

**Salt flats.** These are undrained flats that have surface deposits of crystalline salt overlaying stratified, very strongly saline sediments.

**Salt marsh.** Flat, poorly drained area that is subject to periodic or occasional overflows by salt water, containing water that is brackish, to strongly saline, and usually covered with a thick mat of grassy halophytic plants.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 to 2.0 mm in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sand or silt coats.** They are sand or silt material adhering to the surface. They are commonly found in eluviated horizons from where the finer materials have been removed, and sometimes the horizon is free from finer material.

**Sand plain.** Extensive sandy level to gently undulating landform with little topographic relief and without stream channel.

**Sand sheet.** A large, irregularly shaped, commonly thin, surficial mantle of eolian sand, lacking the discernible shape that are common on dunes.

**Sandy skeletal.** When the soil contains 35 percent or more (by volume) rock fragments, 10 percent or more (by volume) particles less than 2.0 mm in diameter (fine earth fraction) with a texture of sand or loamy sand, including less than 50 percent (by weight) very fine sand.

**Sandstone.** Sedimentary rock containing sand-sized clastic particles.

**Satellite image.** An image of the Earth's surface taken from space.

**Saturated hydraulic conductivity.** Rate (inches/hour) of water movement through a saturated horizon. The classes are: very high > 14.17; high -14.17 to 1.417; moderately high - 1.417 to 0.1417; moderately low - 0.1417 to 0.01417; low - 0.01417 to 0.001417; very low - < 0.001417. (14.17 inches/hour is equal to 0.01 cm/s).

**Saturated zone.** The saturated zone extends from the upper surface of saturation down to underlying impermeable rock, and, all interstices are filled with water under hydrostatic pressure.

**Saturation.** Water will not flow from the soil into an open hole when the soil is saturated, and all the air spaces in the soil are filled with water.

**Saturation extract.** The solution extracted from a saturated soil paste for the measurement of electrical conductivity (EC) and the soluble anions and cations.

**Saturation percentage.** The water content of a saturated soil paste, expressed on an oven dry weight percentage.

**Scarp.** An escarpment, cliff, or steep slope of some extent along the margin of a plateau, mesa, terrace, or structural bench. A scarp may be of any height.

**Secondary carbonates.** It refers to translocated authigenic calcium carbonate that has been precipitated in place from the soil solution rather than inherited from a soil parent material such as calcareous loess or till.

**Sedimentary rock.** A consolidated deposit of clastic particles, chemical precipitates, and organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and aeolian, lacustrine, marine deposits, clay-stone, shale, conglomerate, limestone, dolomite, coal, etc.

**Segregation.** The concentration of features that are identifiable bodies within the soil that were formed by pedogenesis, e.g., plinthite, nodules, crystals and concretions.

**Septic tank.** An underground tank used in the deposition of domestic wastes. Organic matter decomposes in the tank, and the effluent is drained into the surrounding soil.

**Sequum.** It is a B horizon together with any overlying eluvial horizons.

**Series, soil.** The lowest level of soil classification in the USDA soil taxonomy. It is a group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Sewage sludge.** Settled sewage solids combined with varying amounts of water and dissolved materials, removed from sewage by screening, sedimentation, chemical precipitation, or bacterial digestion.

**Sheet erosion.** More or less uniform removal of soil from an area without the development of conspicuous water channels.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silcrete.** Sedimentary deposit of soil material cemented by silica.

**Siliceous.** Containing silica.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 mm) to the lower limit of very fine sand (0.05 mm). As a soil texture class, soil that is 80 percent or more silt and less than 12 percent clay.

**Similar soils.** These are soils that differ so little from the named soil in the map unit that there are no important differences in interpretations.

**Sink-hole.** A surface depression in the ground caused by collapse due to dissolution of the underlying rocks or minerals, such as gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) dissolution in Kuwait.

**Slaking, soil.** The physical disruption of soil fragments in distilled water.

**Slickensides.** These are polished and grooved surfaces (common in swelling clays) that are produced by one soil mass sliding past another.

**Slick spots.** Areas having a puddled or crusted, very smooth, nearly impervious surface.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 meters in 100 meters of horizontal distance.

**Sociation (vegetation).** A recurring plant community of essentially homogenous species composition with at least certain dominant species in each layer. It is the basic unit of vegetation classification.

**Sodicity, soil.** It presents percentage distribution of exchangeable sodium in the cation exchange capacity. If saturation is more than 15 percent, it is sodic.

**Sodic soil.** A soil that contains sufficient exchangeable sodium to affect soil properties and plant growth adversely. The electrical conductivity of the saturation extract at 25 °C is less than 4 dSm<sup>-1</sup>, exchangeable sodium percentage (ESP) is equal to or greater than 15, and pHs generally ranges between 8.5 and 10 and may be as high as 11. The low E<sub>Ce</sub> and high ESP tend to deflocculate soil aggregates and hence lower permeability.

**Soil.** It is a collective term used for the natural bodies, made up of mineral and organic materials, that cover much of the earth's surface, contain living matter and can support vegetation outdoors, and have in places been changed by human activity.

**Soil association.** See association, soil.

**Soil auger.** A tool used for boring into the soil and withdrawing small samples for field or laboratory examination.

**Soil classification (soil taxonomy).** The systematic arrangement of soils into groups or categories on the basis of their characteristics.

**Soil compaction.** The reduction in pore space and the consequent increase in density of a soil. Mechanical soil compaction can be used to increase the engineering suitability of a soil.

**Soil drainage.** A characterization of the percolation behavior of a soil.

**Soil erosion.** The loss or removal of soil material by a transport process, such as rill erosion, gully erosion, sheet erosion, and wind erosion.

**Soil gradient.** It is the percent inclination of the surface of the soil from the horizontal. If the difference in elevation is 1 m over a horizontal distance of 100 meters, slope gradient is 1%.

**Soil map.** A map showing the distribution of soil types or other soil mapping units in relation to the prominent physical and cultural features of the earth's surface.

**Soil moisture content.** The amount of water released by a soil between field capacity and permanent wilting point is the available water or the soil water content that can be used by plants.

**Soil moisture regime.** It refers to the presence or absence either of groundwater held at a tension of less than 1500 kpa, in the soil or specific horizons, by periods of the year.

**Soil monolith.** A vertical section through the soil preserved with resin and mounted for display.

**Soil potentials.** Numerical ratings that give the relative ranking of soils for a given use.

**Soil productivity.** It is the output of a specified plant or group of plants under a defined set of management practices, and is the single most important evaluation for farming.

**Soil science.** It deals with soils as a natural resource on the surface of the earth, including soil formation, classification and mapping and the physical and chemical, biological and fertility properties of soils per se, and these properties in relation to their management for the growth of plants to clean the environment.

**Soil separate.** Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The USDA uses the following size separates:

Very coarse sand	2.0 - 1.0 mm
Coarse sand	1.0 - 0.5 mm
Medium sand	0.5 - 0.25 mm
Fine sand	0.25 - 0.10 mm
Very fine sand	0.1 - 0.05 mm
Silt	0.05 - 0.002 mm
Clay	< 0.002 mm

**Soil survey.** The systematic examination and mapping of soil.

**Soil taxonomy.** The systematic arrangement of soils into groups or categories on the basis of their characteristics.

**Soil taxonomic unit.** A general term for a grouping of soils based on similarities of the soils within the group, and differences compared with other groups.

**Soil texture.** Is the relative proportions of sand, silt and clay present in the particle size analysis.

**Soil water zone.** Water in the soil-water zone exists at less than saturation except temporarily when excessive water reaches the ground surface as rainfall or irrigation. The zone extends from the ground surface down through the major root zone. Its thickness varies with soil type and vegetation, because of the agricultural importance of soil water in supplying moisture to roots.

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons.

**Sootic material.** Soils with soot and fragments formed from burning oil well polluting the air.

**Species composition.** The particular species found in a given community or area.

**Splash erosion.** The spattering of small soil particles caused by the impact of raindrops on very wet soils. The loosened and separated particles may or may not be subsequently removed by surface runoff.

**Spolic material.** It refers to the spoils from quarries.

**Spur.** Prominent projection of land from a mountain or ridge.

**Stickiness, soil.** It refers to the capacity of a soil to adhere to other objects. The classes are non-sticky, slightly sticky, moderately sticky and very sticky.

**Stratified.** Formed, arranged, or laid down in layers. The term refers to geologic deposits. Layers in soils that result from the processes of soil formation are called horizons, those inherited from the parent material are called strata.

**Stratigraphy.** The branch of geology that deals with the definition and interpretation of layered earth materials; the conditions of their formation; their character, arrangement, sequence, age, and distribution; and especially their correlation by the use of fossils and other means. The term is applied both to the sum of the characteristics listed and a study of these characteristics.

**Stream.** Any body of running water that moves under gravity to progressively lower levels, in a relatively narrow but clearly defined channel on the ground surface, in a subterranean cavern, or beneath in a glacier. It is a mixture of water and dissolved, suspended, or entrained matter.

**Stress surfaces.** They are smoothed or smeared surfaces formed through reorientation of soil material resulted from shear forces.

**Structure, soil.** The combination or arrangement of primary soil particles (sand, silt and clay) into secondary particle units, or peds. These secondary units may be, but usually are not, arranged in the profile in such a manner as to give a distinctive characteristic pattern. The secondary units are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types, and grades, respectively.

**Grade, Soil Structure.** It describes the distinctness of units. Criteria are the ease of separation into discrete units and the proportion of units that hold together when the soil is hardened. Three grade classes are used: **weak** - the units are barely observable; **moderate** - the units are well-formed and evident in undisturbed soil and; **strong** - the units are distinct in undisturbed soil.

**Types, Soil Structure.** A classification of soil structure based on the shape of the aggregates or peds and their arrangement in the profile, including platy, prismatic, columnar, blocky, sub-angular blocky, granulated, and crumb. Briefly they are:

- 1) **Platy:** The units are flat and plate-like, and are generally oriented horizontally. In lenticular type, the plates are thick in the middle and thin towards the edges.
- 2) **Prism-like:** These are vertically oriented peds or aggregates that are longer than they are wide (prism). They are of two subtypes:
  - **Columnar** - When the tips of the columns are rounded. The vertical faces are either flat or slightly rounded.
  - **Prismatic** - When the prisms have angular edges and tops are plane, level and clean cut. Vertical faces are angular or sub-rounded.

- 3) **Blocky** : In this structural type, the peds are reduced to blocks, irregularly six faced, with their three dimensions more or less equal. They are of two subtypes:
- **Angular** - If the aggregate corners are not rounded.
  - **Sub-angular** - If the aggregates have rounded corners.
- 4) **Spheroidal**: Soil with mostly spheroidal or rounded aggregates or granules. They are of two subtypes:
- **Granular** - These are relatively non-porous aggregates.
  - **Crumb** - When the granules are especially porous.
- 5) **Single-grained structure**. When there is no coherence among the soil particles, e.g., loose desert sandy soils in Kuwait.
- 6) **Massive and structureless**. The particles adhering without any regular cleavage (lines of separation), as in many hardpans.

**Subgroup**. The fourth level in the USDA soil taxonomy. The great groups are subdivided into central concept subgroups that show the central properties of the great group, intergrade subgroup that shows properties of more than one great group, and other subgroups for soils with typical properties that are not characteristic of any great group.

**Suborder**. The second category in the USDA soil taxonomy. This category narrows the ranges in soil moisture and temperature regimes, kinds of horizons, and composition, according to which of these is most important.

**Subordinate distinctions**. Lowercase letters used as suffixes to designate specific kinds of master horizons and layers. They are:

Letter	Distinction
a	Organic matter, highly decomposed
b	Buried soil horizon
c	Concretions or nodules
d	Dense unconsolidated materials
e	Organic matter, intermediate decomposition
f	Frozen soil
g	Strong gleying (mottling)
h	Illuvial accumulation of organic matter
i	Organic matter, slightly decomposed
k	Accumulation of carbonates
m	Cementation or induration
n	Accumulation of sodium
o	Accumulation of Fe and Al oxides

p	Plowing or other disturbance
q	Accumulation of silica
r	Weathered or soft bedrock
s	Illuvial accumulation of organic matter and Fe and Al oxides
t	Accumulation of silicate clays
v	Plinthite (high iron, red material)
w	Distinctive color or structure
x	Fragipan (high bulk density)
y	Accumulation of gypsum
z	Accumulation of soluble salts

(Phase I of the Soil Survey of Kuwait clearly illustrates that only k, y, m are frequently used and b, t, g, w, z are less commonly used for the soils of Kuwait)

**Subsidence.** Downward movement of the ground surface caused by dissolution of underlying soluble deposits, such as gypsum deposits.

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** The part of the soil below solum.

**Succession.** The gradual change between types of transient communities or ecosystems that involves changes in the plant and animal species composition. Given a sufficient period of time, and a lack of repeated interruptions, succession eventually leads to a steady-state community, a climax community.

**Supratidal flat.** Extensive flat area subject to occasional inundation by water that is usually salty or brackish.

**Sustainable agriculture.** An economically viable method of agriculture that emphasizes stewardship (long-term rather than solely short-term returns), soil conservation, and integrated pest management to ensure that there is no degradation of the environmental quality or the capacity of the system to continue to produce.

**Swale.** A slight, open depression which lacks a defined channel that can funnel overland or subsurface flow into a drainageway. Soils in swales tend to be more moist and thicker compared to surrounding soils.

## T

**Taxajuncts.** Polypedons that have properties outside the range of any recognized series and are outside higher category class limits by one or more differentiating characteristic of the series.

**Taxonomy, soil.** A basic system of soil classification for making and interpreting soil surveys.



**Terrace.** A step like surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, or lake or sea shore. The term is usually applied to both the relatively flat summit surface (tread), cut or built by stream or wave action, and the steeper descending slope (scarp, riser), graded to a lower base level of erosion.

**Tertiary.** The period of the Cenozoic Era of geologic time (approximately from 65 to 2 million years ago).

**Textural class, soil.** A grouping of soil textural units based on the relative proportions of the various soil separates (sand, silt, and clay). These textural classes, listed from the coarsest to the finest in texture, are sandy, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. There are several subclasses of the sand, loamy sand, and sandy loam classes based on the dominant particle size of the sand fraction (e.g., loamy fine sand, coarse sandy loam).

**Texture, soil.** It refers to the weight proportion of the separates for particles less than 2 mm as determined from a laboratory particle size distribution.

**Texture triangle.** A triangle used to plot the values of percent sand, silt, and clay to locate textural class of soil.

**Thermic.** The mean annual soil temperature is 15°C or higher, but lower than 22°C, and the difference between mean summer and mean winter soil temperatures is more than 5°C either at a depth of 50 cm from the soil surface or at a lithic or paralithic contact, whichever is shallower.

**Thin-section, soil.** Resin-impregnated soil cut on the glass slide as 25 - 30 µm thick, to be studied microscopically to trace soil-forming processes operative in the soil.

**Tidal flat.** An extensive, nearly horizontal, marshy or barren tract of land that is alternately covered and uncovered by the tide, and consists of unconsolidated sediment mostly clays, silts and/or sand. It may form the top surface of a deltaic deposit.

**Tilth, soil.** The physical condition of the soil related to tillage, seedbed preparation, seedling emergence, and root penetration.

**Topography.** The relative position and elevations of the natural or manmade features of an area that describe the configuration of its surface.

**Toposequence.** A sequence of related soils that differ, one from another, primarily because of topography and soil drainage.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter.

**Torrripsamments.** The great group under suborder "psamments" that has a torric moisture regime (common in the south of Kuwait).

**Total dissolved salts.** A measurement of the total amount of soluble salts that occur in a soil. This can be estimated by making a soil paste with distilled water and measuring the electrical conductivity in the soil saturation extract.

**Toughness, soil.** It relates to plasticity. The classes are low, medium, and high, and are based on the relative force necessary to form with the fingers a roll of 3 mm in diameter of < 2 mm soil material at a water content near the plastic limit.

**Transects.** A planned line of travel to determine the composition of map units.

**Transverse dune.** A very asymmetric sand dune elongated perpendicular to the prevailing wind direction, having a gentle windward slope and a steep leeward slope standing at or near the angle of repose of sand; it generally forms in areas of sparse vegetation.

**Trench.** A long narrow cut in the earth, often used in warfare as a cover for troops.

## U

**Udic moisture regimes.** The udic (*L. udus*, humid) moisture regime implies that, in six or more out of 10 years, the soil moisture control section is not dry in any part for as long as 90 cumulative days per year. It is common to the soils of humid climates.

**Unconfined aquifer.** One in which a water table varies in undulating form and in slope depending on areas of recharge and discharge. Rises and falls in water table correspond to changes in the volume of water in storage within an aquifer.

**Unconsolidated.** Sediments that are loose and not hardened.

**Undifferentiated groups.** Consists of two or more taxa components that are not consistently associated geographically and, therefore, do not always occur together in the same map delineation. The same principles regarding proportion of inclusions apply to undifferentiated groups as to consociations.

**Unified classification.** Classification of soil material designed for general construction purposes and is dependent on the particle size distribution of the <75 mm, the liquid limit, and the plasticity index, and on whether the soil material is high in organic matter.

**Unsaturated flow.** The movement of water in the soil that is not completely filled with water.

**Unsaturated zone.** The unsaturated zone, aeration zone, consists of interstices occupied partially by water and partially by air.

**Upland.** An area where soils are generally relatively well drained such that the water table is significantly below the soil surface most of the year.

**Urban land.** The land mostly covered by streets, parking lots, buildings and other structures of urban areas.

**Urbic material.** It refers to deposition of urban rubble from demolished buildings mixed with soils.

**USDA.** United States Department of Agriculture.

**Ustic moisture regime.** The ustic (*L. ustus*, burnt, implying dryness) moisture regime is intermediate between the aridic and the udic regimes.

## V

**Valley.** A generally elongated depression of the land surface which commonly contains a stream.

**Valley flat.** A flood-plain landform. A general term for broad, nearly level flood-plain surfaces that are not subject to frequent inundation.

**Valley floor.** A general term for the nearly level to gently sloping, lowest surface of a valley. Landforms include axial stream channels, the flood plain, and, in some areas, low terrace surfaces (compare-flood plain landforms, meander, braided channel, valley side).

**Variante, soil.** A soil that has characteristics outside the limits of any defined series and is less than 80 hectares.

**Varve.** A layer representing the annual deposit of a sediment, it usually consists of a lighter and darker portion due to change in rate of deposition during the year.

**Vegetation.** All of the plants growing in and characterizing a specific area or region; the combination of different plant communities found there.

**Vesicles.** Relatively large circular voids formed by the entrapment of air in the pores due to surface sealing and crusting.

**Vesicular structure.** The structure where dominant voids are vesicular.

**Voids.** The portions of rock or soil not occupied by solid mineral matter can be occupied by groundwater. These spaces are known as voids, interstices, pores, pore-space.

**Volatile.** Substance susceptible to evaporation or to becoming a gas.

## W

**Wadi.** Dry stream beds found in desert environments and subject to occasional flash flooding.

**Waterlogging.** A term applied to a soil in which the water table stands at or near the land surface. Only hydrophytic plants can survive in a waterlogged soil.

**Water retention.** The soil water content at a given soil suction.

**Water retention difference.** It is a calculated value that denotes the volume fraction for water in the whole soil that is retained between 15 bar suction and an upper limit of usually 1/3 or 1/10 bar suction.

**Watershed.** The total area of land surface from which an aquifer or a river system collects its water.

**Water table.** 1) The upper limit of groundwater within an unconfined aquifer of soil or bedrock. The water table forms the boundary between the zone of saturation and the zone of aeration. 2) The surface below which all empty spaces within the soil are filled with water.

**Water table elevations.** Water table is a dynamic rather than a static condition in artificially drained soil. The water table rises during periods of recharge and falls during periods of drainage.

**Weathering.** All physical and chemical changes produced by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

**Weed.** Any plant growing where it is not wanted, usually a wild plant that grows without much care or cultivation and may be invasive in cultivated areas.

**Wilting point.** The permanent wilting point or percentage is the soil water content below which plants growing in that soil remain wilted even when transpiration is nearly eliminated. It represents a condition where the rate of water supply to the plant roots is very low. The soil next to the root surfaces will usually be drier than the bulk soil, because water cannot move toward the root surface fast enough to supply plant demands and a water content gradient develops near the root.

**Windbreak.** Planting of trees, shrubs, or other vegetation perpendicular, or nearly so, to the principal wind direction to protect soils, crops, homesteads, etc., from wind and snow.

## X

**Xeric.** 1) Lacking available moisture for organisms to utilize. 2) Referring to xerophytes, plants adapted to survive environments where moisture is quite scarce.

**Xeric moisture regime.** The xeric moisture regime (Gr. Xeros, dry) is the typical moisture regime of Mediterranean climates, where winters are moist and cool and summers are warm and dry.

**Xeromorphy.** The development of adaptations enabling plants to retain water in order to survive environments lacking fresh water, including deserts but also including saltwater marshes or highly alkaline soil where the concentration of salts tends to draw water out of plant tissues. Xeromorphy can include a thickening of the outer protective layer (epidermis), reduction of leaf size, or alterations of the normal pathway for photosynthesis (crassulacean acid metabolism).

**Xerophyte.** 1) Plants that grow in extremely dry areas. 2) A plant that is very efficient in retaining water and can grow in deserts, on very dry ground, or in environments with high salt concentrations that tend to draw water out of plant tissues by osmosis. Cactus, creosote bush, and sagebush are all xerophytes.

## Y

**Yearlong grazing.** Continuous grazing for a calendar year.

**Yearlong range.** Range that is, or can be, grazed yearlong.

**Yield.** 1) The quantity of a product in a given space and/or time. 2) The harvested portion of a product.

**Young valley.** A valley in its early stages, when it is relatively straight, has steep slopes, a high gradient, and a V-shaped cross section, while its tributaries are short.

## Z

**Zonation.** 1) The occurrence of distinct distributions of different species, forming recognizable (usually parallel) bands of characteristic vegetation, along ecological gradients. Zonation occurs along the increasing altitude of a mountain slope as well as across the intertidal zone. Unlike succession, these different communities all occur at the same time but spread out over different areas.  
2) The state of separation of earth materials, such as minerals or rocks, into distinct areas or regions.  
3) The distribution of organisms or of fossils into biostratigraphic regions.

**Zoning.** A means by which governmental authority is used to promote the proper use of land under certain circumstances.

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