

Feature

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Although we use soil for various purposes, many of us may not know about the soil and how it is formed. Based on the purpose of using the soil, there are different definitions brought forward by people. In agriculture, soil is defined as a live medium for crop cultivation. In engineering, it is the basic foundation of a construction and also a raw material for building constructions. Thus, it is difficult to give a universal definition of the soil.

Soil is formed from a rock by subjecting it to soil formation process. This is a long-term process and soils we see today have been formed millions of years ago. Therefore, soil is considered as a non-renewable resource. Soil is one of the key pillars determining the existence of the life in the earth. Thus, conserving the soil is a responsibility vested on all of us.

At the early stage of a soil development, a rock is decomposed into a parent material. This process is known as rock weathering. Parent material is the soft material we find in deep layers of soils often which shows the structure (appearance) of the rock from which it is formed.

Various factors influence the subsequent transformation of a parent material to a soil. Scientists have categorised them into five factors namely, climate, topography, organisms including the vegetation, nature of the parent material and the time spent on soil formation.

Primarily, combined action of climate phenomena such as rainfall, temperature changes and organisms (micro to macro organisms) dominate to gradually convert a parent material to a soil starting from the surface of the earth. Thus, old and well developed soil is found in the surface of the earth.

Thus, surface layer of soil having plenty of organic matter (A horizon) is the most contributing part for plant growth.

Many services

Soil provides many services and many products. Without the soil, the crop cultivation is impossible, thus the food security of a nation is dependent on a healthy soil. The elements such as N, P, K, Ca, Mg, and so on in the soil serve as essential nutrients for all living beings. Thus, origin of nutrients for living beings is the soil. Unhealthy soils result in unhealthy nations.

Soils can absorb a large quantity of rainwater, helping to regulate water within the landscape and reduce downstream flooding. Soil can also hold or sequester large amount of carbon in the form of organic matter or humus. Soil organic matter plays a considerable role in plant growth while improving the productivity of the soil.

That is why the incorporation of organic fertilisers such as composts is an important part in commercial agriculture. Moreover, organic carbon stored in the soil serves as a major regulator of climate change by minimising the CO₂ emission to the atmosphere. There are global initiatives to increase the organic carbon level of the soil as a mitigation measure of climate change.

Clay obtained from soil is used in making ceramics, or pottery. Many of today's medicines, such as antibiotics, antifungal and antidepressants were developed from bacteria and fungi that live in the soil. Many common beauty products use soil as ingredients and have been used for thousands of years. Therefore, the soil has many agricultural, economic and ecological values.

Food security in a country also depends on the sustainability of that country's soil. In 2015, United Nations (UN) General Assembly adopted 17 Sustainable Development Goals (SDGs) to protect the planet and end poverty. Out of these goals, achievement of five sustainable development goals depends on the soil. These are, SDG 2: Zero hunger, SDG 3: Good health and well-being, SDG 6: clean water and sanitation, SDG 13: climate action and SDG 15: Life on Land.

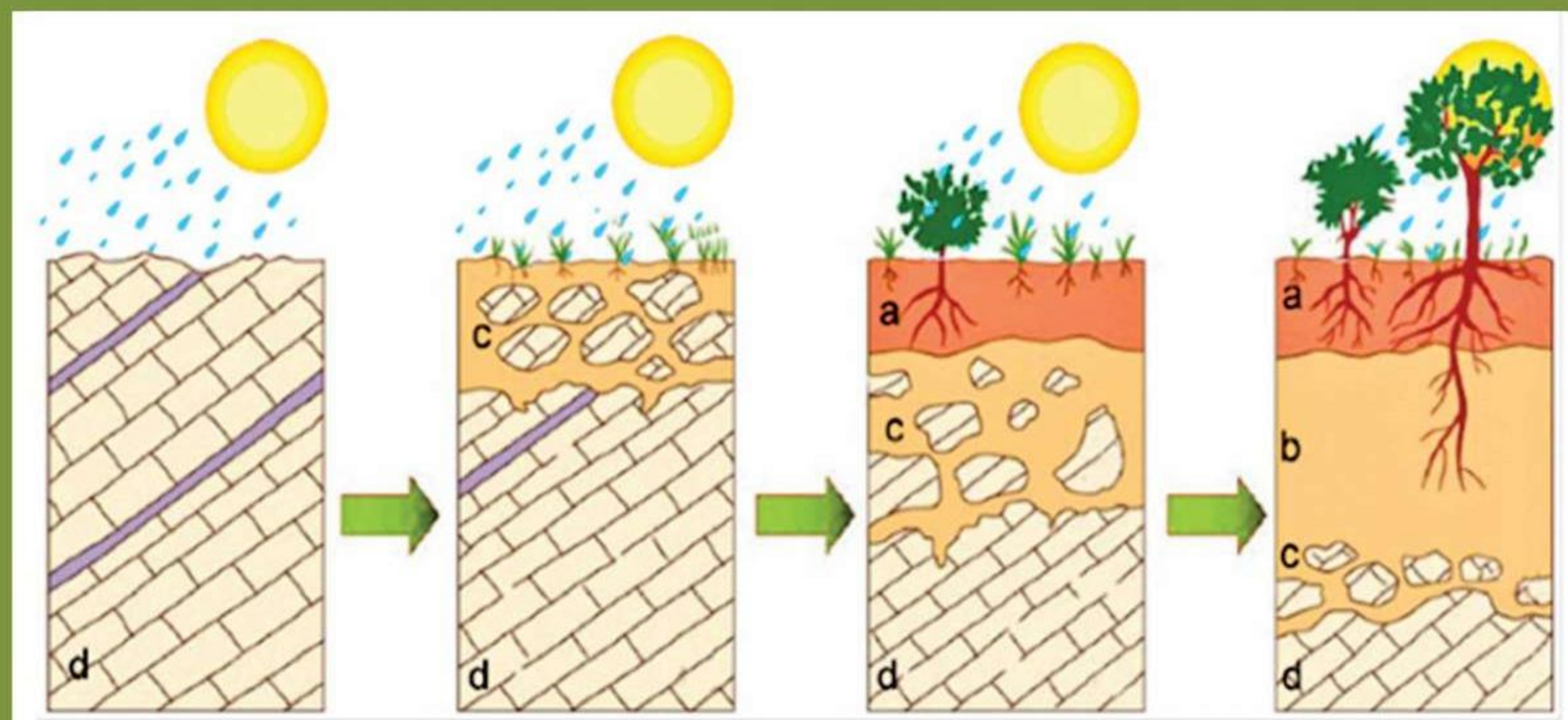
Inappropriate land use and management practices have caused the degradation of the soil resource of the world. The population growth has exerted tremendous pressure on existing land resource.

Scientists have identified erosion by wind and water, organic matter decline, salinisation and sodification, compaction and landslides of soil and rock material, soil sealing and soil contaminant as major soil degradation processes. It is estimated that 34 percent of land cover of Sri Lanka is in the danger of degradation.

Being a key pillar determining the existence of the life in the earth, protecting the soil is a responsibility vested on all of us.

World Soil Day

"Halt soil salinisation, boost productivity"



Soil formation from a rock (left) to a well developed soil (right)



Prof. Udaya Vitharana

World Soil Day (WSD) is held annually on December 5, as a means to focus attention on the importance of healthy soil and making awareness for the sustainable management of soil resources.

International day

An international day to celebrate soil was recommended by the International Union of Soil Sciences (IUSS) in 2002. Under the leadership of the Kingdom of Thailand within the framework of the Global Soil Partnership, Food and Agriculture Organization (FAO) of the United Nations has supported the formal establishment of World Soil Day as a global awareness raising platform.

In December 2013 the United Nations General Assembly responded by designating December 5, 2014 as the first official World Soil Day. In 2021, we celebrate eighth Soil Day in the world. The theme of this year's Soil Day is "Halt soil salinisation, boost soil productivity".

At present, soil salinisation and sodifi-

cation are major soil degradation processes threatening our ecosystem and are recognised as being among the most important problems at a global level for agricultural production, food security and sustainability in arid and semi-arid regions.

Soil salinity is the accumulation of soluble salts above a critical limit in the soil. The process of increasing the salt content is known as salinisation. Salts such as Chloride and Sulfates of Calcium, Magnesium, Potassium and Sodium contribute for soil salinity. Sodification is a type of salinisation which accumulation sodium occurs.

There are various reasons for the development of saline conditions in our soils. Salinity development in soils can be caused by natural process, such as release of soluble salts during rock weathering, movement of sea water to inland areas and atmospheric deposition.

Nowadays, human influences have caused rapid increase of salt affected agricultural lands. At present, about one-third of world's irrigated lands experience salinity problem affecting the global food production. Following are the some causes of soil salinity development aggravated by human:

- Rising groundwater table due to over irrigation.
- Use of saline groundwater for irrigation.
- Deforestation.
- Sea water intrusion due to excessive extraction of ground water in coastal areas.
- Poor on-farm water management and cultural practices in irrigated agriculture.
- Replacement of deep rooted perennial vegetation with shallower rooted annual crops and pastures that use less water leading to the rise of saline groundwater.
- The climate change caused by human activities has further contributed for the soil sal-



Highly developed soil of the wet zone. Whitish colour material in the bottom layer is the parent material

linity development.

- Excessive use of fertiliser.
 - Blocking drainage channels of agricultural fields.
- When the soil is saline, it negatively affects the water availability for plants. Thus, even we irrigate the lands, plants will not be able to take up water for its growth. Technically this is known as the physiological drought.
- Moreover, accumulated salts are toxic for soils. The accumulation of sodium salts damages the soil structure and convert a fertile soil into desert like soil.
- Ultimately, soil salinity causes low productivity in agricultural lands.
- As the salt concentration increases the crop yield also decrease similarly. For example, 30 percent yield drop in paddy is expected when the soil is even slightly saline.
- There is an urgent need to take action to minimise human induced salinisation of soils. In addition, action should be taken to recover saline soils and make such soils productive. Moreover, plant breeders have a great responsibility vested on them to develop new varieties those perform well under saline soil conditions.

WE SHOULD ALWAYS TRY TO WORK IN A WAY THAT DOES NOT CAUSE SALINISATION. TESTING THE SOIL FOR SALINITY DEVELOPMENT IS ALSO IMPORTANT

How to identify salinised areas?

Identification of saline areas is very important to recover the soil and also avoid further salinisation. When the soil is affected by salinity, we can observe patches of the field showing leaf burn and patches of salt tolerant plants. Growth of small palm plants known as *Katu Idi* is one of the sign of soil salinity development in the dry zone of Sri Lanka.

Also irregular of crop growth and lack of plant vigour can be seen in salinised lands. Normally, these areas are becoming bare. There are white spots and streaks in the soil and white crusting on the surface when large amount of salts are accumulated in the soil. Farmers notice a drop of the yield when soil becomes saline.

Often, the signs of soil salinity are not observable. Therefore, often soil salinity can emerge as a hidden danger.

Measurement of soil salinity

Soluble salts cause higher electrical conductivity in soils. Therefore, soil samples taken from the field are measured for electrical conductivity to determine whether a soil is saline. Such laboratory methods are time consuming. There are various new methods to measure salinity.

Use of electromagnetic induction sensors has become a very popular method. These sensors can obtain large number of salinity measurements within a very short period of time and using geographical information system (GIS) mapping of saline soils can be done.

How do we manage saline soils?

Compared to arid and semi-arid countries, agricultural lands of Sri Lanka are less affected by soil salinity development.

However, there are research findings to show that large areas of paddy lands in coastal areas and major irrigation systems in Sri Lanka have become saline. Paddy lands affected by soil salinity are gradually increasing both in coastal and inland areas.

Therefore, it is very important to adopt proper soil management practices to halt salinity development and maintain the crop productivity of already salt affected. For that, three key principles following approaches of management of saline soils can be followed.

- Selection of salt tolerant crops suitable for saline soils. For example, rice research and development institute of Sri Lanka has developed BG369 variety which is tolerant for salinity.
- Dilution of salts in the root zone - drip irrigation allows the dilution of salts in the root zone.
- Improving soil structure with organic amendments to improve infiltration and hydraulic conductivity. This will allow to wash off the salts accumulated in the soil.
- Improving leaching of salts by irrigation and drainage. Extra water is needed to leach excess salts out of the root zone.
- Reducing evaporation with mulch or cover crops, because evaporation increases the salt concentration in surface soil and increases the movement of salty ground into the soil.
- Maintaining the groundwater table at a safe depth below the root zone. This avoids the movement of salts into the soil.
- Maintaining a crop while the soil salinity is being corrected (reclamation). The crop will be benefited from the management practices and compensate for the cost of reclamation.
- Following some physical methods like land levelling (laser levelling) and salt scraping and flushing.

Prevention is better than cure! So we should always try to work in a way that does not cause salinisation. Moreover, testing the soil for salinity development is also important.

Soil productivity

Soil productivity is the ability of a soil to support crop production. This is determined by the entire spectrum of its physical, chemical and biological properties of soil.

Loss of soil fertility, nutrient imbalances in soils, erosion, desertification, salinisation, water logging, soil carbon depletion, structural changes and pollution are major threats of soil productivity.

Sustainable soil management is the key to halt such soil degradation processes and boost the productivity of soils.

Thus, as a country we need to enhance awareness among people to protect our precious soil resources and make it a sustainable resource for future generations provide food and other essential eco-system services.

The theme of this year's World Soil Day "Halt soil salinisation, boost soil productivity" highlights us to use sustainable soil management action to halt soil salinisation.

This will lead to productive agricultural lands that support to secure the food supply of world.

Let us strive to build a secure, productive future through sustainable soil management.

SOIL PROVIDES MANY SERVICES AND MANY PRODUCTS. WITHOUT THE SOIL, THE CROP CULTIVATION IS IMPOSSIBLE, THUS THE FOOD SECURITY OF A NATION IS DEPENDENT ON A HEALTHY SOIL. THE ELEMENTS SUCH AS N, P, K, CA, MG, AND SO ON IN THE SOIL SERVE AS ESSENTIAL NUTRIENTS FOR ALL LIVING BEINGS



Undergraduate students of the Faculty of Agriculture, University of Peradeniya observe saline soils in Mahalluppallama