PHYSICAL GEOGRAPHY – YEAR 11

CHAPTER 5
SOIL: NEW ZEALAND

CHAPTER 6
SOIL: FIJI

NOTES & WORKSHEETS

***(Instruction:** Our next topic in Physical Geography as planned to be covered in Term 2 is **Chapter 5 Soil: New Zealand.** After NZ, you have **Soil- Fiji** . You are **only required to go over the notes and understand** the concept. **Remember the work is weekly divided**, hence go accordingly. You can also to attempt to the questions that are given. Note that the work is divided weekly wise and you are expected to do it accordingly. All the best)*

[Week 1]

Soil: New Zealand

- Soil is a natural surface layer that contains living matter and can support plants. It consists of matter in all three states – **solid, liquid and gas**.
- Most soil contains varying quantities of mineral and humus (decaying organic plants and animal material) water, air and living organisms such as worms.
- The study of soil science is often known as **Pedology.**

Soil Types and Characteristics

- Particular temperature and amount of precipitation influence soil formation
- Cold climate such as tundra areas have soil of little use for agriculture
- Often this soil are frozen and decomposition of plant material to form humus is slow.
- The characteristics of soils are developed over a long period of time through a combination of processes acting together.
- Physical processes act to break down rock fragments of regolith into smaller pieces.

Soil Processes

Leaching - leaching is the removal of soluble components of the soil column. As water washes down through the soil it can carry away bases such as calcium, held as exchangeable ions in clayhumus complexes, as well as acidification through the substitution of hydrogen ions.

Leaching occurs in conditions of heavy consistent rainfall such as the tropical rainforest environment. The minerals and nutrients are deposited deep in the soil in B horizon.

Eluviation - here soil particles held in suspension, such as clay, are removed (eg. washed away).

Illuviation - here soil particles held in suspension, such as clay, are accumulated (eg. deposited).

Podsolisation - podsolisation occurs when strongly acid soil solutions cause the breakdown of clay minerals. As a result silica, aluminium and iron form complexes with organic substances in the soil. These minerals are removed from the surface zone of the soil and can accumulate in distinct dark sub-surface layers - very evident on inspection. Upland heaths and moors often contain podsols.

Gleying - gleying occurs in waterlogged, anaerobic conditions when iron compounds are reduced and either removed from the soil, or segregated out as mottles or concretions in the soil. Marshy wetlands often contain gleyed soils.

Water is important in soil formation. An important soil process operating in New Zealand is **alluviation** (**materials being deposited by the action of rivers**) includes materials laid down in river channels, on flood plains, in lakes and in foot of mountain slopes. This types of soil produced is often very fertile and suitable for intensive agriculture, dairy farming or horticulture because of its high nutrient content.

Calcification -occurs in dry and or very dry areas such as deserts. Rainfall is lacking and water in the soil move upwards towards the surface by **capillary action**. The humus content of the soil is low because vegetation is sparse.

- **[Capillary action** is the ability of a liquid to flow in narrow spaces without the assistance of, or even in opposition to external forces like gravity.]

Patterns of Soil in New Zealand

i. **Zonal Soils –** very young soils (are **matured soils**- had time to develop distinctive profiles)

- Soil in which climate and organic life are considered to have been the major influences in the formation

ii. **Azonal and Intrazonal Soils** (have more recent origin & had insufficient time to develop fully)

- Soils farming processes depends on all the five factors example parent material climate topography (relief) organism (biota) and time

- Weathering produces primary and secondary minerals as well as determines the rates of release of nutrients and the soil depth texture and drainage.

[Week 2]

Soil Type

i. The main type of zonal soils are **Spodosols/ podzols**- these are soils of the coniferous forests

- Low evaporation combines with summer water and rain causes heavy leaching and results in acidic soils.
- The vegetative remains on A-horizon are partially decomposed because of low temperatures.
- Naturally poor soils in terms of agricultural productivity

Ways to improve quality of this soil type

- Because of the acidic nature, application of lime is essential
- Heavy applications of fertilizers are also required

- With proper management and the input of the required industrial products, spodsols can be highly productive if the soil texture is favorable
- High yields of potatoes can be produced

ii. Brown Earths/ Brown Forest Soils

- This soil occupy areas under deciduous woodland
- The roots of trees penetrated deeply into the sub soil and tend to bring additional supplies of nutrients.
- The base rich nature of the soil attracts soil organisms such as earthworms, rodents(rats and mice) which carry humus downward or mineral materials upwards.

Primary Minerals	Secondary Minerals
Minerals that are present in the original parent material and remain unaltered.	Minerals that are produced by weathering reactions.

iii. Cherrnozems

- These are very fertile soils of the temperate grassland and regions where extensive wheat cultivation is carried out.
- The grass vegetation produces dense turfs and when these die, the humus is returned to the soil. They are rich in humus and there is little or no leaching.

iv. Laterite

- It occurs when leaching proceeds at a very rapid rate.
- These soils are formed in humid tropical areas
- They consists of aluminium iron compounds

v. Tropical black earths

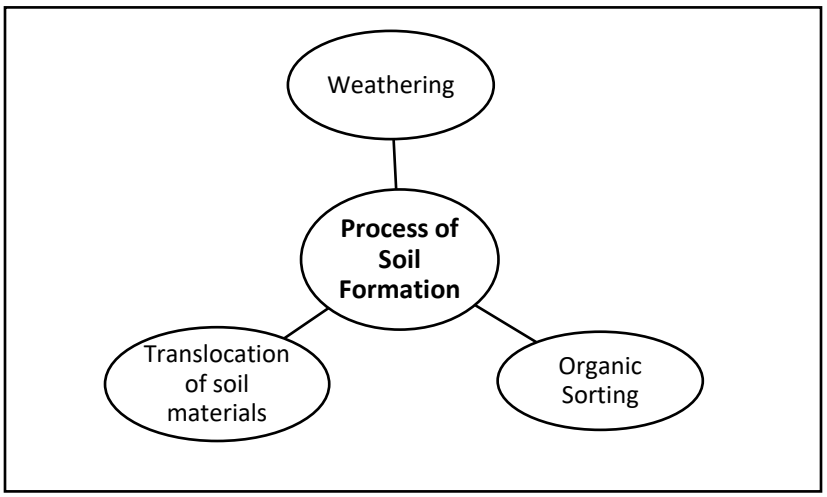
- These soils are formed from volcanic rocks, in humid tropical regions
- These soils are rich in calcium carbonate
- They are usually fertile and heavy and occur in low lying areas.
- Soil exhaustion
- Once the soil is cultivated, the salts taken up by crop are not returned since the crop is harvested. The available humus tend to be used up and the soil approached the conditions known as soil exhaustion

Nutrient Cycle

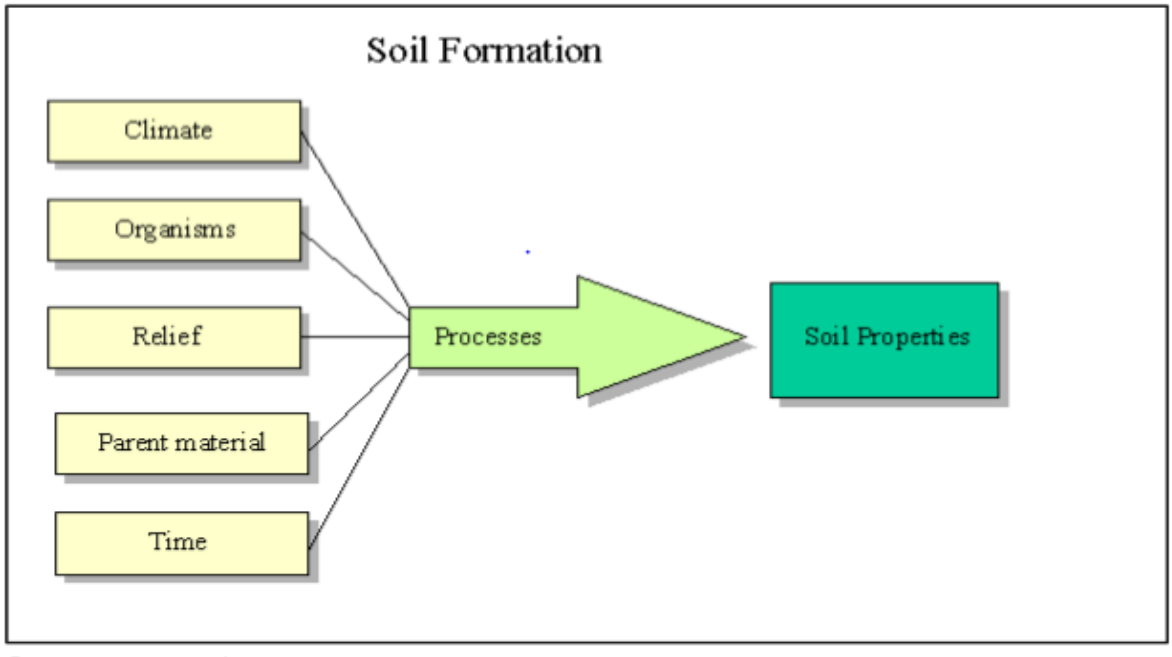
When the dry leaves/ twigs and branches and dead animals decay and are decayed through the help of fungi and bacteria. This then forms humus which is used by soil and is fertile.

Process of Soil Formation

- Soil forming process depends on all the five factors example, parent material, climate, topography (relief), organisms (biota) and time.



Factors of Soil Formation



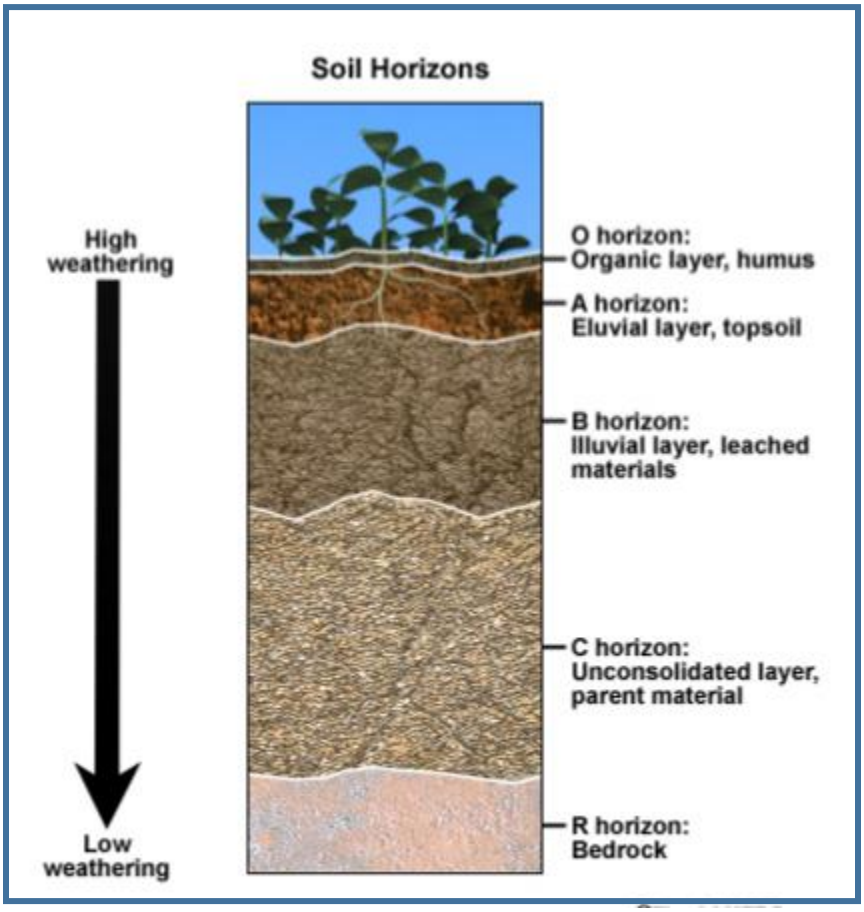
Climate	Topography (Relief)	Organisms (Biota)	Parent Material
• Weathering • Precipitation • Temperature	• Altitude • Aspect • Slope angle	• Organic matter • Nutrient cycle/recycling • Mixing and generation	• Permeability • Mineral content

[Week 3]

SOIL PROFILE

The influence of soil formation factors can be shown in a soil profile.

*[**Do not draw** this diagram as you will be given this when we meet, refer to this while you are going through notes on soil horizon]*



(Explanation on above diagram. Write this in your book)

- **O– Organic** material at the surface
- **A-Horizon** – the top soil which contains some weathered materials and organic elements rich in humus. It is where biological activity and humus content are at their maximum.
- **B- Horizon** contains weathered parent material and animals from the A-horizon may be deposited. The zone of accumulation or illuviation where clays and other materials are removed from A Horizon and are re-deposited. The A and B Horizons together make up the soil.

- **C- Horizon** – is the sub-soil (weathered parent material). Consists mainly of recently weathered regolith on the bedrock.
- **D – Horizon** – parent material
- The depth of each layer varies from several centimeters to several meters.
- **Soil minerals** are obtained mainly by the **weathering of the parent rock**.
- Texture refers to the degree of coarseness of the mineral matter in the soil. It is determined by the proportion of sand and clay particles. A loam soil is likely to be least susceptible.

Activity:

1. Differentiate between Zonal and Azonal Soils?
2. What is Leaching?
3. Differentiate between primary and secondary minerals?
4. Differentiate between Illuviation and Eluviation?
5. State two features of Podzols?

[Week 4]

SOIL STRUCTURE

Soil structure refers to the way in which soil particles are grouped together into larger masses called peds.

i. Organic Matter

- Organic matter and humus is derived mainly from decaying plants and animals and from the secretions of living organisms.
- The highest amount of humus is found in areas of temperate grassland forming the chernozems or black earth.
- In drier climate, there may be insufficient vegetation to give an adequate supply of humus.

Soil Moisture

- Soil moisture is important because it affects the upward and downward movement of water and nutrients.
- It supplies water for living plants and organisms
- It provides a solvent for plant nutrients
- It controls soil temperature and it determines incidence of erosion
- Clay has numerous small pore (microscopic structure which may retain water for long periods but also reduce infiltration rates.

ii. Air

- Air fills the pore spaces left unoccupied by soil moisture
- Biota needs oxygen but gives off carbon dioxide
- These gases are exchanged through the process of diffusion Soil Organisms (biota)

- Soil organisms include bacteria, fungi and earthworms
- Organisms are responsible for three important soil processes

iii. Development of structure

- Fungi helps to bind individual soil structure while burrowing animals create a passage way to help the circulation of air and water and facilitate root penetration

Soil Nutrient

- Nutrient is essential for plant growth and the maintenance of fertility of soils.

Soil exhaustion can be avoided by:

i. Adding natural fertilizers
   Example, animal manure or artificial fertilizer such as potash and sulphate
ii. Adapting crop rotation method example, certain ingredient of the soil extracted by one crop in one year may be replaced by cultivating a different crop in the next year.
iii. Using fallow- leaving an area of plantation fallow or not planted
iv. Practice Shifting Agriculture
   After a piece of land is exhausted the cultivation moves on to return to its natural vegetative cover.
v. Strip cropping of different crops in strips along the contours
vi. Mulching- the use of mulching and composting
vii. Inter- cropping of different crops in the same field

Soil Erosion

- ❖ Is the removal part of or all of the top layers of soil due to the action of wind and water.
- ❖ Extensive human activities and misuse of the land have caused the erosion of the soil

Causes of Erosion

(i) Lack of vegetative cover
(ii) Overgrazing
(iii) Shifting Agriculture-the land is left abandoned after its fertility have deteriorated, has no vegetative cover against erosion, example India
(iv) Monoculture

Soil Conservation

- ❖ Man depends on the soil for food production and therefore soil conservation programmes are necessary
- ❖ Soil conservation means the saving or preservation of soil at an acceptable level of fertility
- ❖ It involves saving the soil from erosion and improving its fertility and productivity

[Week 5]

AFFORESTATION

i. Vegetation Cover

- It is the first defense against soil loss from run offs.
- For forest and woodland this involves managed cutting and replanting of trees (afforestation)
- Crop land should be more intensively by mountain and improving soil fertility

ii. Contour ploughing/ terracing

- Crops are planted following the contour.

iii. Strip cropping

- Crops are grown in alternative strip and at different times
- This will prevent the land from erosion at the same time.

iv. Adopting artificial and natural fertilizers

v. Adopting crop rotation methods

Impacts of Climate Change on soil

- Affects production in agriculture
- Increases damage to the land or land degradation will occur in the form of soil erosion, desertification and salinization.
- Loss of peat soils, further impacting on the capability of soils to support the needs of agriculture.

Mono culture	Planting of one variety of crop
Poly culture	Planting of more than two variety crops
Sylvi culture	Planting of trees

Activity

1. Define the following terms?
   i. Alluviation
   ii. Cheluviation
   iii. Eluviation
   iv. Illuviation
   v. Regolith

vi. Primary Minerals

2. Name the two major types of soil present in New Zealand?
3. What important factors condition the nature and development of soil?
4. What is a soil horizon? How are soil horizons named? Provide example?

(Note this is a new chapter (6) whereby the topic is Soil with Fiji's case study. Hence you are to start this chapter on a new page.)

[Week 6]

SOIL – FIJI

- There is several soil types found in Fiji.
- **Climate** and **relief** play an important role in the formation and classification of soils.
- Hence, soils found in different parts of Fiji are determined by the relief and climate.

The main soil types include:

1. Andosols/Andisols

Characteristics/Features	Location
i. These are young soils formed from volcanic parent materials such as basalts and esites. ii. They are young, well drained soils, ii. Among the most fertile soils in the world because of their high clay content (that it, it holds nutrients and water well).	• Commonly found in Taveuni.

2. Recent Soils

Characteristics/Features	Type	Location
i. These include soils developed from marine and rifer deposits. ii. They are among the best agricultural soils in Fiji. iii. The A-horizon contains unleached material as they have been recently brought from other areas ant not formed by the weathering of the bedrock in the area where it is found. iv. These young soils are often fertile.	• Alluvial soils- formed from river deposition on floodplains, deltas & on river banks. • Colluviums-are soils deposited by surface run-off on the lower slopes and valleys.	• Rewa Delta • Navua • Sigatoka valley • Wainibuka • Yasawa • Dawasamu

3. Lateritic Soils (Laterites or Latosols)

Characteristics/Features	Location
i. Are deep reddish-brown or yellowish in colour. ii. These soils are deeply weathered and soluble minerals have been completely leached out of the A&B- Horizons. This has left the top layer of the soil high in iron content giving it the yellow-red color. iii. It has low fertility but if fertilized well can be valuable for agriculture.	• Laucala island • Koro areas between Suva and Navua (i.e. Naboro,Nabukavesi, etc.)

4. Talasiga Soils

Characteristics/Features	Location
i. Poor soils because they have been subjected to repeat burning and clearing over a long period. ii. Vegetation removal and exposure has changed the structure of the soil resulting in low fertility.	Common in cane growing areas: • Nadi • Lautoka • Ba • Labasa • Seqaqa, etc.

5. Hydromorphic or Gley Soils

Characteristics/Features	Location
i. Found in swampy areas where water tables are high. Have poor drainage. ii. Plant nutrients are not leached out due to the constant presence of water. iii. High fertile but very sticky and water logged. iv. Formed through the **gleying** process which occurs when water fills up the air spaces in the soil leaving the soil low in oxygen &iron compounds.	Mainly found at the mouths of the Rewa and Navua rivers and on the floodplains of Labasa, Wailevu and Dreketi rivers.

6. Vertisols

Characteristics/Features	Location

i. Dark brown or black in color. ii. Rich in clay content therefore they are able to hold plant nutrients. iii. Difficult to cultivate (swell and become sticky when wet and very hard and cracks when dry)	Found in large low-lying areas between hilly and rolling hill country of the larger islands.

7. <u>Lithosols (Mountain) Soils</u>

- Found on the steep mountain slopes of the high islands.
- Very thin due to high rate of erosion.
- Relief is the most important soil forming factor for the soil.

8. <u>Coral Limestone Soils</u>

- Found on sandy low-lying coral atolls and coastal areas.
- Is very porous (means soil contains a lot of air spaces)
- Contains little organic minerals and few plant nutrients.
- They are among poorest soils in Fiji.
- <u>Location:</u> Fulaga, Moala, Lakeba, etc.

<u>[Week 7]</u>

<u>Problems Related to Fiji Soils</u>

- ❖ There are several problems associated with soils in Fiji.
- ❖ Some are caused by nature while others are human induced.

1. <u>Erosion</u>

- ❖ Soil erosion is evident on slopes where natural vegetation has been removed.
- ❖ With increasing developments, large areas of natural vegetation have been replaced by plantation crops or settlements.
- ❖ When there is a loss of vegetation cover, the top soil is carried away by rain.
- ❖ Heavy rain may also increase leaching and remove nutrients and organic matter from the soil.

2. <u>Overgrazing</u>

- ❖ Overgrazing is when there are too many animals left to graze in an area than it can actually support. This can speed up erosion.
- ❖ As animals continuously graze on slopes, they eat up the grass and shrubs and loosen the soil.

3. <u>Burning</u>

- ❖ Repeated burning and clearing of vegetation reduces soil fertility.

- ❖ Sugar cane crops in many cane farms are repeatedly burned during harvesting season and this seriously affects the fertility of the soil.

4. Ploughing

- ❖ Ploughing can have serious impacts on soils.
- ❖ Deep ploughing destroys the soil structure by breaking up the particles and burying organic materials too deep for plant use.

5. Monoculture

- ❖ This is the cultivating of the same crops each year on the same piece of land.
- ❖ It repeatedly uses up the same nutrients and leads to soil degradation.

6. Use of Chemicals on Farms

- ❖ Pesticides and weedicides which are used to farms kill nutrients in the soild needed for plant growth.

Soil Conservation Measures

- ➢ The use of artificial fertilizers such as potassium and phosphorous.
- ➢ Afforestation and reforestation – if most serious cause of erosion is deforestation, then the best way to protect the soil is replanting trees.
- ➢ Soil can also be conserved by improving farming methods such as contour planting on slopes and crop rotation.
- ➢ Agro-forestry – this is the alternate planting of trees and crops uses and crops on the same land.
- ➢ Compositing and mulching.

Short Answers

1. State the difference between alluvial and colluvial soils?
2. Briefly explain why lateritic soils are reddish- brown or yellowish in color?
3. On an outline map of Fiji locate and name the following?
   - i. An area of alluvial soils
   - ii. An area of colluvial soils
   - iii. An area of young volcanic soils/andosols
   - iv. An area of latosols

(Paste the given map in your book and locate the above areas)

[Week 8]

Worksheet -Short Answers

CLIMATE

i. What is roaring forties

ii. Briefly explain how convectional rainfall occurs

iii. Describe one factor that influences the amount of solar radiation received by any place in New Zealand

iv. Explain one way costal area in Fiji may be affected by rising sea level

v. Explain why Fiji is prone to natural disasters

vi. Explain why the Southerly winds reaching New Zealand are generally cool and Northlies are warm

vii. Describe how one climate control affects the climate of New Zealand

viii. State the impact of El-nino on New Zealand climate

ix. Explain one way in which islands can be protected from sea level rise

x. State two ways in which sea influences the climate of an area