

CHAPTER 5

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

There are five key processes by which soil is formed, they are:

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 clay-humus complexes, as well as acidification through the substitution of hydrogen ions.

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.

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. The result is the tropical laterite soil. Laterite soils (latosols support tropical rainforests such as in the tropical rainforests environment, p[people often imagine they are fertile and rich). Although there is plentiful vegetation

debris, the rapid organic decomposition caused by the high temperature means humus does not accumulate. These soils often have poor drainage.

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.

PATTERNS OF SOIL IN NEW ZEALAND

Two major divisions are recognized

- (i) Zonal Soils – very young soils
 - Soil in which climate and organic life are considered to have been the major influences in the formation
- (ii) Azonal and Introzonal Soils
 - 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.

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, spodosols 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.

(iii) Chernozems

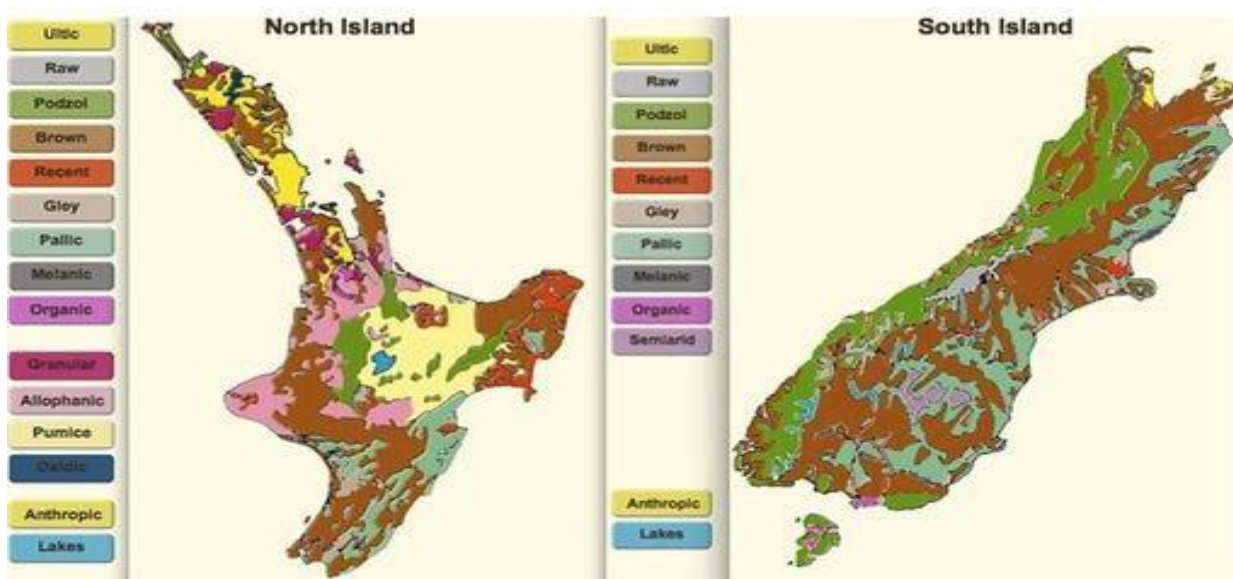
- These are very fertile soils of the temperate grassland and regions where extensive wheat cultivation is carried out.
- The grass vegetation produces dense turfs and when these die, the humus is returned to the soil. They are rich in humus and there is little or no leaching.

(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



Source: www.sciencelearn.org.nz

PROCESS OF SOIL FORMATION

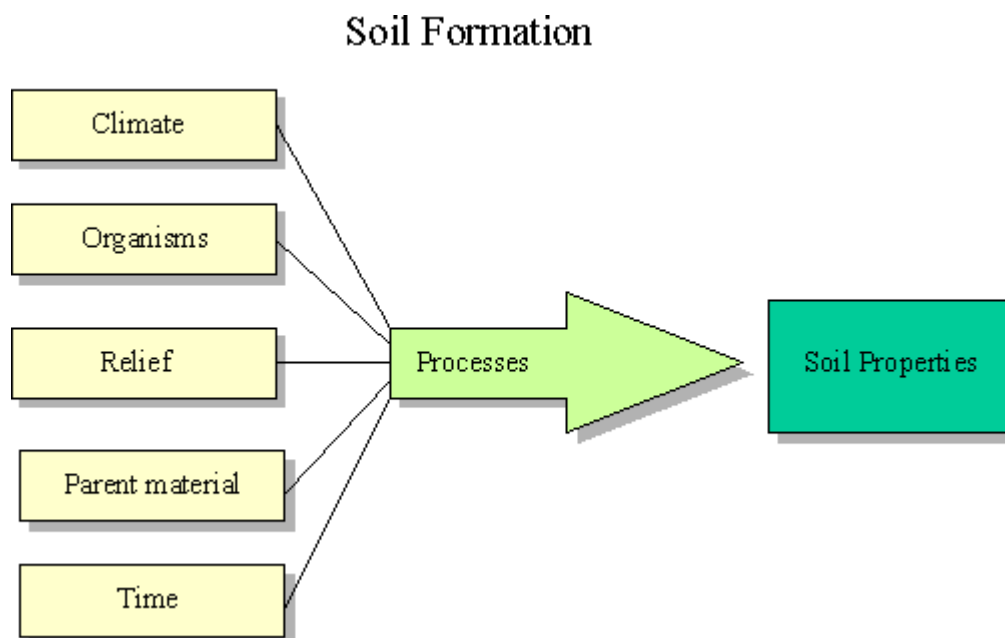
- Soil forming process depends on all the five factors example, parent material, climate, topography(relief), organisms(biota) and time.

- (i) Weathering – produce primary and secondary minerals as well as determining the rate of release of nutrients and the soil depth, texture and drainage.
- (ii) Organic sorting – several processes operate within the soil to reorganize mineral and organic matter into horizons, to contribute in to the aggregation of particles and the formation of peds.

Earthworm activity is a significant factor in sorting material in to different particles and sizes.

- (iii) Translocation of soil materials – translocation is the movement of soil components in any form (solution or suspension, mixture of water and solid) or direction downward and upward. It usually takes place in association with soil moisture.

FACTORS OF SOIL FORMATION



Source: www.yeowart.co.za

Climate

- Weathering
- Precipitation
- Temperature

Topography (Relief)

- Altitude
- Aspect
- Slope angle

Organisms (biota)

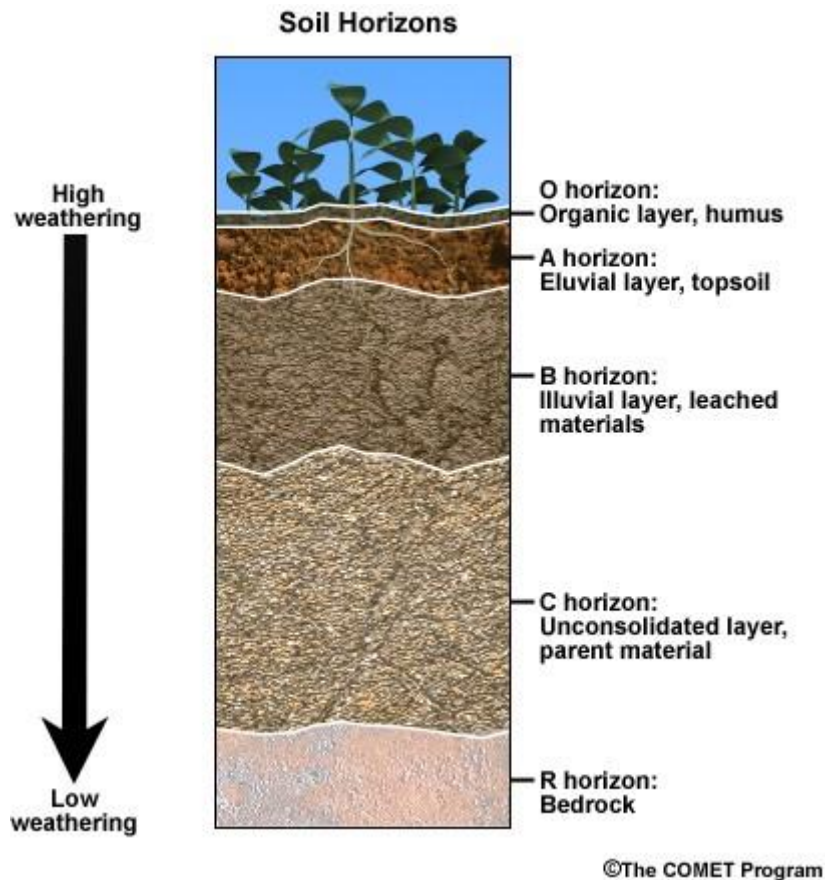
- Organic matter
- Nutrient cycle/recycling
- Mixing and generation

Parent Material

- Permeability
- Mineral content

SOIL PROFILE

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



Source: www.wegc203116.uni-graz.at

A soil profile is a vertical section through a particular soil from the surface to the underlying rock.

- 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 metres.

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.

Soil Structure

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

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.
- 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
- 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

AFFORESTATION

(i) Vegetative 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.



Activity 5.0

1. Which important factors condition the nature and development of soil?
2. What is a soil horizon? How are soil horizons named? Provide two examples.
3. Identify four classes of soil-forming processes and describe each?
4. What are translocation processes?
5. Name the two major types of soil present in New Zealand.
6. Describe two characteristic features of azonal soils.

Essay

Discuss three impacts of human activities on soil and suggest three conservation measures that can minimize these impacts.

KEY TERMS

Alluviation – the process that results in deposits of clay, silt, sand or gravel at places in rivers or estuaries or along the shores of lakes or seas.

Cheluviation – the leaching of chelates through soil

Eluviation – soil-forming process consisting of the downward transport of fine particles, particularly the soil colloids (both mineral and organic) carrying them out of an upper soil horizon.

Humification is the process by which organic matter is decomposed to form humus.

Illuviation – accumulation in a lower soil horizon (typically the B horizon) of materials brought down from a higher horizon; a soil forming process.

Soil – natural terrestrial surface layer containing living matter and supporting or capable of supporting plants.

Parent material – inorganic, mineral base from which the soil is formed, usually consists of regolith.

Primary minerals – the original unaltered silicate minerals of igneous rocks and metamorphic rocks

Regolith – layer of mineral particles overlying the bedrock, may be derived by weathering of bedrock or transported from other locations by fluid agents.

Soil texture – refers to the proportions of sand, silt and clay that are present in the soil.

Soil colloids – are the finest particles in soils and are important as they retain nutrients or bases that are used by plants.

Soil horizons – distinctive layer of the soil, more or less horizontal, set apart from other soil zones or layers by differences in physical and chemical composition, organic content, structure or a combination of those properties, produced by soil forming processes.

Soil profile – display of soil horizons on the face of a freshly cut vertical exposure through the soil.

Secondary minerals – minerals that are stable in the surface of the environment, derived by mineral alteration of the primary minerals.

CHAPTER 6

SOILS - 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

<i>Characteristics/Features</i>	<i>Location</i>
- These are young soils formed from volcanic parent materials such as basalts and esites. - They are young, well drained soils, - 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

<i>Characteristics/Features</i>	<i>Type</i>	<i>Location</i>
- These include soils developed from marine and river deposits. - They are among the best agricultural soils in Fiji. - The A- Horizon contains unleached material as they have been recently brought from other areas and not formed by the weathering of the bedrock in the area where it is found. - 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 and Dawasamu.

3. Lateritic Soils (Also known are Laterites or Latosols)

<i>Characteristic/Feature</i>	<i>Location</i>
• Are deep reddish-brown or yellowish in colour. • 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 colour. • It has low fertility but if fertilized well can be valuable for agriculture	Laucala Island, Koro area between Suva and Navua (ie Naboro, Nabukavesi, etc.



Activity 6.0

A. Mapping

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.

B. Short Answers

1. State the difference between alluvial and colluvial soils.
2. Why are they referred to as recent soils?
3. Describe two features of alluvial soils.
4. Describe 3 characteristics of andosols or volcanic soils.
5. Briefly explain why lateritic soils are reddish-brown or yellowish in colour.

4. Talasiga Soils

<i>Characteristic</i>	<i>Location</i>
• Poor soils because they have been subject to repeated burning and clearing over a long period. • Vegetation removal and exposure has changed the structure of the soil resulting in low fertility.	May be found in the cane growing areas of Nadi, Lautoka, Ba, Labasa, Seaqaqa, etc.

5. Hydromorphic or Gley Soils

<i>Characteristic</i>	<i>Location</i>
• Found in swampy areas where water tables are high. They have poor drainage • Plant nutrients are not leached out due to the constant presence of water. • they are highly fertile but very sticky and water-logged. • They are formed through the <u>gleying</u> process which occurs when water fills up the air spaces in the soil leaving the soil low in oxygen and 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

<i>Characteristic/Feature</i>	<i>Location</i>
• Dark brown or black in colour • Rich in clay content therefore they are able to hold plant nutrients • Difficult to cultivate because they 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. Lithosols (Mountain) Soils

- 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. Coral Limestone Soils

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

Problems Related to Fiji Soils

There are several problems associated with soils in Fiji. Some are caused by nature while others are human induced. Throughout history man has been dependent on soil. With the increasing human activities soil has been degraded. The problems related to soil include:

1. Erosion

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. Overgrazing

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. Burning

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 soil needed for plant growth.

Soil Conservation Measures

The various problems have led to the degradation of soil in certain areas around the country. Hence there is a need to conserve or protect the soil from further damage. Some methods of conservation used today are:

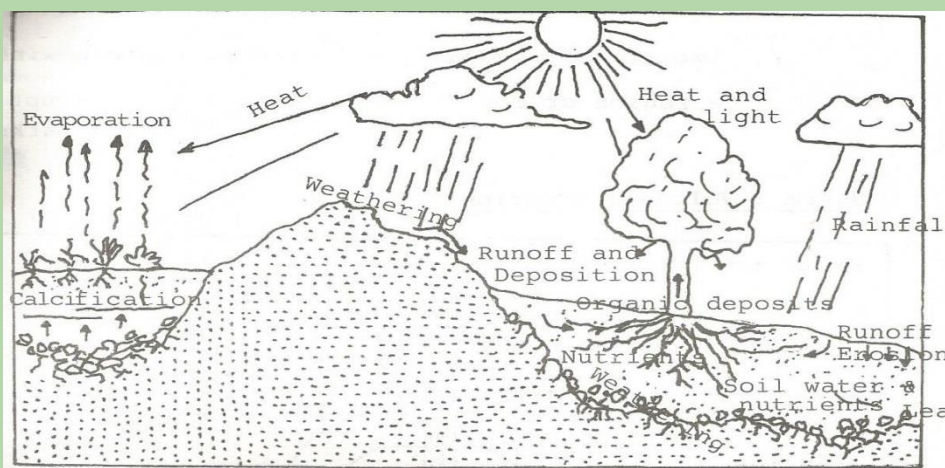
- The use of artificial fertilizers such as potassium and phosphorous.
- Aforestation and reforestation – if most serious cause of erosion is deforestation, then the best way to protect the soil is replanting trees.
- Soil can also be conserved by improving farming methods such as contour planting on 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.



Activity 6.2

Diagram Interpretation

Use the diagram given below and you knowledge to answer the questions that follow:



Source: FSLC 1989

1. What is leaching?
2. In what type of environment is the process of leaching is accelerated?
3. How does heat help in the calcification process?
4. What does un-off mean?

Essay

With reference to Fiji, discuss the problems related to soils and suggest some solutions to the problems mentioned.

CHAPTER 7

VEGETATION : NEW ZEALAND

Types of Vegetation

- Indigenous or native
- Exotic vegetation

Indigenous or native vegetation

Indigenous vegetation of an area refers to the plants that are found in that particular place before they have been altered by people. They are the result of interactions between climate, relief and soils.

Factors affecting their distribution.

Climate

Rainfall is an important factor in determining the vegetation. A plant needs water to survive so different quantities of water gives rise to different types of vegetation.

Consequently, vegetation varies as water availability changes with latitude.

For instance, in temperate latitude , trees grow in areas with over 750mm of rain while grasses grow in areas of low rainfall.

In tropical zones where temperatures are hotter , the trend is more marked, as tree size is also influenced by rain.

The trends are also shown in New Zealand. Before settlement those areas which receive over 1000mm of rainfall per year were generally forested, while drier areas were covered with drought resistant tussock grassland.

The biggest forest trees such as Kauri and the most rapidly growing forests were located in the warm, moist and humid northern areas of the north island.

Relief

Relief also influences vegetation, particularly through altitude. Air cools as it rises. So high areas have cold temperatures and generally thin soil. Consequently, these areas have sparse and short vegetation types.

Areas of low elevation have relatively warmer climates and are characterized by taller forest trees. In between, trees become progressively shorter as altitude increases. This process is known as altitudinal zonation.

Effects of People on Vegetation

Human Activities

- Hydro –electric power
- Tourism activities
- Generated electric powers from lake
- Extensive Pastoralism (sheep farming)
- The pattern of indigenous vegetation is often modified by people and animals. People when they use different level of farming.

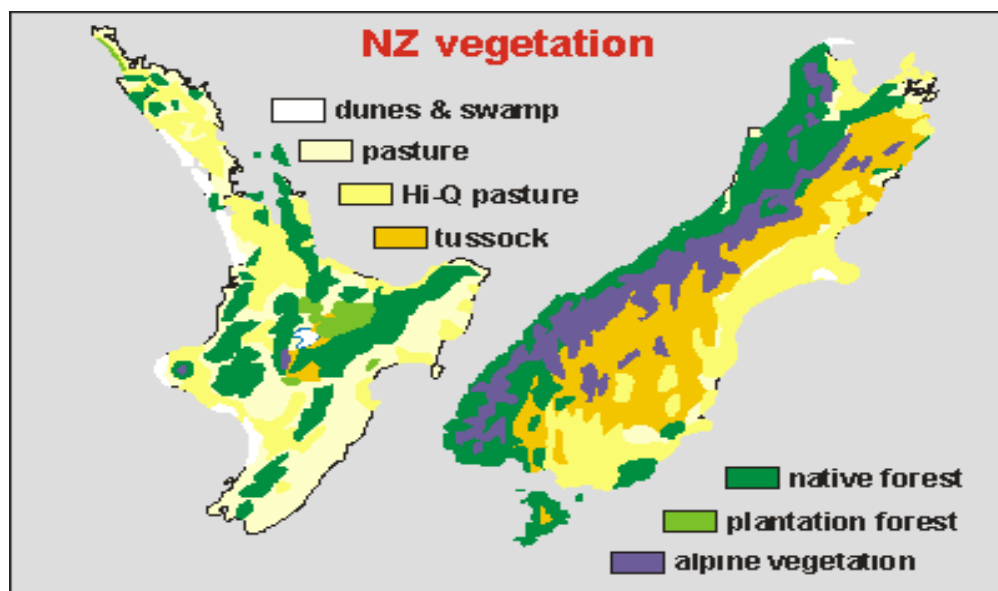
Climate

All plants and animals have acclimatization but in New Zealand these difficulties have been largely overcome by the introduction of the development of a wide variety of plant species and animal breed which suits their varying climate conditions.

- The most common tree in New Zealand's climatic conditions is radiata pine because it grows over twice as fast as it does in North America.
- Its fast growth rate makes radiata pine very popular with foresters because it matures and can be cut earlier than any other tree species.
- In particular, crops still cannot be grown because of an unsuitable climate other options are open such as glass houses for vegetables or irrigation, orchards and livestock.
- It may be that the climate needs only a slight alteration such as growing a shelter belt of trees to reduce wind speed.
- Most methods of climate modification are costly and are only worthwhile if the produce grown has a relatively high value.

- Soil Fertility

- It has a major influence of land use in many districts
 - High fertility is particularly favorable for cropping and market gardening.
 - High soil fertility can assist a farmer in overcoming disadvantages such as poor accessibility because higher yield of good quality produce will fetch better prices of the market, offsetting the extra freight charges.
 - Low fertility was an important reason for the establishment of the 'man-made' forest in the central North Island.
 - A soil deficiency prevented animals from being farmed but pine trees flourished.
 - Poor fertility is less of a problem today than it was in earlier years.
 - Scientifically –based farm management and the regular applications of artificial fertilizers allow poor soils to be improved and fertile soils to be maintained.
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Source: www.seafriends.org.nz

Types of Land use

Extensive pastoralism

- Very large farm holdings
- Vast open pasture land
- Low output per hectare
- Low population density
- Poor road access to farms

Intensive pastoralism

- Farms often between 5 – 50ha
- Land is divided in to small blocks
- Excellent road access
- High rural population density

(i) Tropical rainforests

(a) Location

- found in the tropics within the equatorial climate belt, 5 degrees on either sides of the equator. It includes the Amazon and Zaire basin, the coastal land of Ecuador towards Africa and South East Asia.

Characteristics

- Rainforest needs higher solar radiation and all year growing season, heavy rainfall, a constant moisture budget surplus, a rapid decay of leaf litter and the recycling of nutrients.
- vegetation consists of trees of many different species. Trees include, rosewood, mahogany, palm and rubber.
- trees are mainly hardwoods and have an evergreen appearance.
- the tallest trees , emergents may reach up to 50m in height and form the habitat for numerous birds and insects. Below the emergents are the three layers all competing for sunlight.
- the top layer of canopy forms an almost continuous cover up which absorbs 70 percent of the light and intercepts 80 percent of the rainfall.
- The canopies of the underlying species protect the soils from erosion and provide a habitat for birds and animals of the rainforest.
- The second layer, the understory or under canopy consists of trees growing up to 20metres.
- The lowest or shrub layer consists of shrubs and small trees which are adapted to the shade of the taller neighbors.

- The trees grow tall to try to reach the sunlight and the tallest has buttress roots which emerge above ground level to give support.
- tree trunks also provide support for lianas, they climb up the plant and long branches before plugging back down to the forest floor.
- Epiphytes which do not have their roots on the soil grow on trunks, branches and even on the leaves and shrubs.

ADAPTATION

- Trees of tropical rainforest tend to be broadleaved, evergreen plants which can keep most of the broadleaf all year round. The large surface area of the leaf allows them to collect sunlight for photosynthesis and also radiate heat during hot summer.

(ii) Temperate Deciduous Forest

- Location
- Located on west coast of continent between latitude of 40 degrees and 60 degrees north and south of the equator.
- North west Europe(include great layer, the Britain), North west of the US, Britain, Columbia, Southern Chile, Tasmania and South island of new Zealand.
- Characteristics;
- Deciduous trees shed their leaves during the winter season
- Leaves fall as the effect of the reduced transpiration when cooler weather reduces the effectiveness for photosynthesis and when roots find it harder to take in water and nutrients.
- Temperate deciduous forests contain few species, some stratification is evident.
- The canopy layer, the sub-canopy, the herb and shrubs layer and the ground layer of forest floor has a thick layer of leaf litter which is readily broken down by the numerous mixing agents living in the relatively warm soils.
- The leaching of humus and nutrients and the mixing of biota produce a brown colored soil in a climate with cold and sometimes dry winter keeping such leaves would cause plants to lose too much heat and water for survival.
- In such climate, broad leaved deciduous plants such as maple trees survive drought and cold by shedding their leaves and become dormant during such period.

(iii) Coniferous Forest

Location

- Canadian Shield, St Lawrence valley, and higher parts of Rockies and Andes.

Characteristic

- The coniferous has developed distinctive adaptations which enable them to tolerate long cold winters, cool summers with a short growing season, limited precipitation and podzolic soils.
- The trees are evergreen giving them the potential for year round photosynthesis
- The trees are softwoods
- Conditions for photosynthesis become favorable in spring as incoming radiation increases and water becomes available from snow melt.
- The needle like leaves are small and the thick cuticles helps to reduce transpiration during times of strong winds and during the winters
- The conical shape of the tree and its downward sloping branches allow the winter snow to slide off without breaking the branches.
- The conical shape also gives stability against strong winds as the tree roots are usually shallow.
- There is usually one layer of vegetation in the coniferous forest.
- The amount of ground cover is limited due to the lack of sun's heat reaching the forest floor which results in deep acidic layer of non-decomposed needles.
- Plants which can survive on the forest floor include mosses and lichens.
- The cold climate and soil discourage earthworms and bacteria, needles therefore decompose very slowly.
- Most of the nutrients are held in the litter.
- Few animals are found because of lack of food.

Tundra

Location

- the tundra areas include Canada, Russia and Greenland and also high elevations
- the ground apart from the top few centimeters in summer remains permanently frozen

Characteristics

- Low organic productivity
- Must have a high degree of tolerance of extreme cold and of moisture deficient condition (water is unavailable for most of the year when it is stored as ice or snow).
- Plants are very slow and low growing, compact and rounded to gain protection against the wind and moist.
- There is no stratification of vegetation by height
- Have to complete their life cycle within 50 – 66 days.
- The dominant plants are lichens, mosses, grass, cushion plants and low shrubs
- Most have small leaves to limit transpiration and short roots to avoid the permafrost.
- Lichens are pioneer plants.

(v) Grassland- The Tropical Grass Land

Location

- Found in central parts of continents between latitude 5 degrees and 15 degrees north and south of the equator.
- Venezuela, Brazil, Central Africa, parts of Mexico and Northern Australia.

(a) Tropical Savanna grass land

- scattered deciduous trees lose their leaves, grasses turn yellow and dry up
- trees shed their leaves or produce thin, waxy and even thorn like leaves to try to keep transpiration to a minimum.
- trees are xerophytic (drought resistant)
- grasses grow tall and coarse in tufts often separated by patches of bare soil.
- Roots are long and extend to tap any underground water supplies or thick bark to store water in their trunks like the baobab tree.
- their seeds may lie dormant on the ground for several months of drought.

(b) Temperate grass land

Location

- Northern American prairie and the Russian steppes, Canterbury Plains in New Zealand.
- Grasses grow up to 50cm and form a relatively even coverage.

- **Desert vegetation**

- Has the lowest productivity level
- Plants are xerophytic because the lack of water hinders the ability of roots to absorb nutrients and of any green part of the plants to photosynthesize.
- Many plants are succulents that is they can store water in their tissues
- Succulents have fleshy stems and shallow leaves, this is a plant that can live in desert places e.g. cactus.
- Absorbs a large amount of water during a period of rainfall and later moisture is lost through transpiration.
- Cactus has small spiky waxy leaves to reduce transpiration and long roots to tap underground water supplies or near the surface to take maximum advantage of any rain or dew.
- Bushes are widely spaced to avoid competition for water
- Some plants are ephemerals which means plants that live for a very short time, can complete life cycle in 2 – 3 weeks.
- Other plants are halophytic that can survive in salty areas/salty water.
- Desert vegetation has low capacity to sustain life

Importance of vegetation

Economic Importance of Forest/Vegetation

- Forest provide timber for housing, biomass, wood, pulp for paper and medicine
- Main forest lands are also used for mining, logging, grazing livestock and recreation
- Fifty five percent of the timber cut each year is needed as fuel wood and charcoal or heating and cooking, mostly in developing countries.
- Saw logs are converted into building materials, lumber, plywood and chip board.

Ecological importance of forest / vegetation

- Forested watershed act as a giant sponge slowing down run-off and holding water that recharges springs, streams and ground water.
- They regulate the flow of water from mountains, highlands to crop lands.
- They reduce the amount of sediment washed in to streams, lakes and reservoirs by reducing erosion.
- Forest also influence climate, e.g. 50 to 80 percent of moisture in the air above is produced by tropical rainforests through the process of evapotranspiration.
- If large areas of forests are cleared, annual precipitation drops and become drier. This process can eventually convert a tropical forest in to sparse grassland or even a desert.

Effects of climate change on vegetation

Climate has environmental consequences; it largely controls the nature and distribution of vegetation and this is the potential for commercial crops and livestock.



Activity 7.0

- (i) What is an indigenous vegetation?
- (ii) What is an exotic vegetation?
 - i. What are the factors that influence the growth and distribution of vegetation.
 - ii. How do humans influence vegetation?.
 - iii. Suggest some conservation measures to encourage the sustainability of rainforests.
 - iv. Identify mitigation measures to reduce the impacts of climate change on vegetation.
 - v. Describe the adaptive features of desert vegetation.
 - vi. How does elevation influence vegetation. Provide an example of how vegetation zonation is related to elevation.

Essay

Discuss the ecological and economic importance of vegetation.

KEY TERMS:

Complex vegetation – a variety of vegetation cover dominated by a group of plants which forms a stable plant community. E.g. tropical vegetation.

Desertification – non desert land being turned in to desert.

Desert – dry conditions where rainfall is less than the requirements for plants.

Ecological succession – is the development stages that an ecosystem or plant community passes through before finally achieving a balanced or equilibrium state.

Endemic species – species found in only one site or habitat.

Endangered species – species which became extinct due to habitat destruction

Exotic- vegetation introduced by man in to a country.

Optimum temperature- the best or favourable temperature for the growth of plants.

Plant succession – process by which a simple plant community changes into a complex.

Pioneer plant community- it is the first plant to colonise an area.

Primary succession – occurs when there is stability in transfer of materials and energy, in the ecosystem between plant cover and physical environment.

Primary succession – succession – succession that starts on a bare surface

Secondary succession – the coming back of colonizer plants.

Sub-climax vegetation occurs when a vegetation is prevented from reaching its climax stage due to interruption by local features of the soil or human interference.

CHAPTER 8

VEGETATION - FIJI

The types of vegetation found in Fiji vary according to the weather conditions experienced in an area together with the parent materials or soil found in that particular area. We can therefore, conclude that there is a close relationship between climate, soils and vegetation.

Fiji has some of the most unique diversity of plants found in the Pacific. The two main islands (Viti Levu & Vanua Levu) contain a rich diversity of plants. The smaller islands have a smaller number of plant species.

Types of Vegetation found in Fiji

Fiji's vegetation types can be classified under 3 broad groups:

1. Forests
2. Grassland
3. Aquatic/freshwater vegetation

Forests

Importance/Benefits

- Habitat to a variety of plants and animals.
- provides cover for the soil and reduces the rate of erosion.
- source of food, fuel, medicine, timber for processing industries, etc.

Fiji has several types of forests which include :

(a) Tropical lowland forest

- These forests consist of mainly evergreen broadleaf trees with little undergrowth and a closed canopy.
- Most trees are hardwoods and are of great value for export.
- They are mainly found in the South eastern and central parts of Viti Levu and Taveuni and parts of Vanua Levu.



Tropical rainforest

Source: www.tourism maker.com

(b) Mangrove Forests

- Covers the tidal flats around rivers, bays and estuaries.
- This forests type consists of trees that are very important for fishery.



Source: wwf.panda.org.

(c) Plantation / Exotic forests

These forests consist of introduced tree species and have been developed to provide timber as well as to replace native forest which has been removed.

2. Grassland

- Is common in the dry sides of the two larger islands – Western Viti Levu (Nadi, Sigatoka, Lautoka, Ba, etc.) and Northern Vanua Levu (Labasa and Seaqaqa).
- The hills of the dry sides of Viti Levu and Vanua Levu are covered with grass and shrubs (short plants/trees). This indicates the intensity of burning and grazing.



Grassland in the Nabou Forest Estate of the **Fiji** Pine Limited

Source: www.panoramio.com

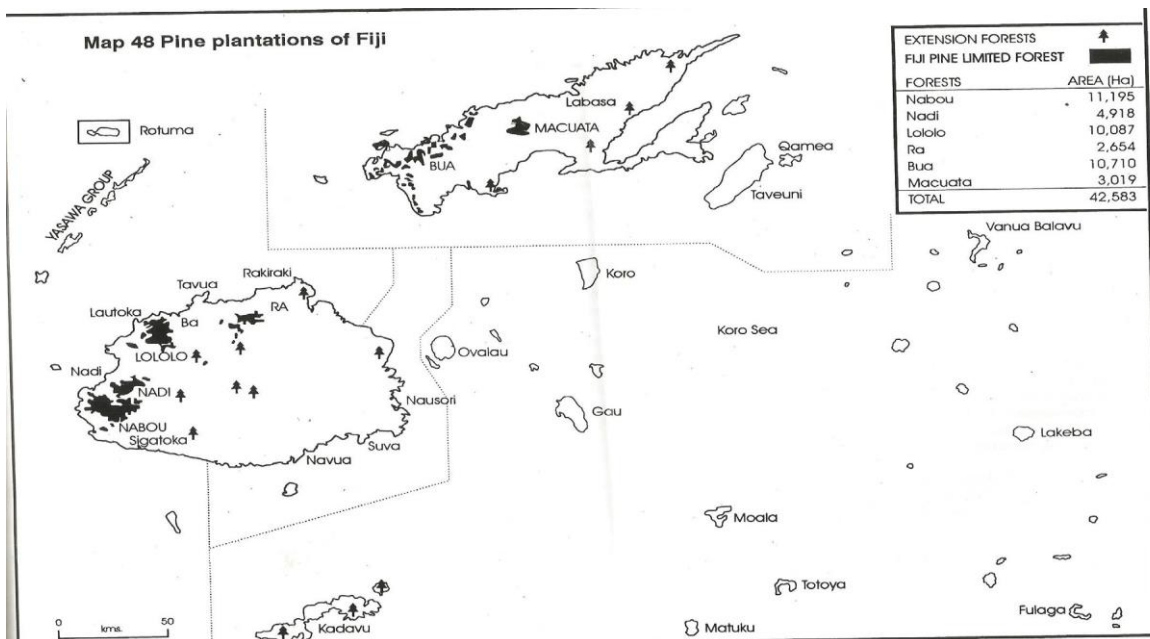


water hyacinth in the Rewa River

Source: www.goggle.com

4. Aquatic vegetation

This type of vegetation includes reed swamps, floating plants, and aquatic weeds. They are found in rivers and ponds around the country.



Source : Population of Fiji.

FACTORS AFFECTING VEGETATION DISTRIBUTION

This distribution of vegetation in Fiji is influenced by several physical factors:

1. Climate

The amount and regularity of seasonal distribution of rainfall influences forest growth. The windward sides of the main island receive high annual rainfall and during the warmer months it experiences conventional rainfall. Hence the growth of tropical lowland forests is encouraged in such areas (Namosi, Naitasiri, Taveuni). Areas with low annual rainfall contain a more open woodland forest with smaller trees and open grassland.

2. Soil

The type of soil and level of fertility also influences plant growth. Mountain soils are exposed to high degree of weathering and are therefore able to support certain plant growth.

3. Relief

Relief affects drainage which in turn influence vegetation distribution whereby steep slopes have a high rate of drainage (run-off) compared to flat areas. Rolling hill country has fairly good drainage and supports the growth of shrubs and grassland. In some areas drainage is poor resulting in swamps and supports mangrove forests.

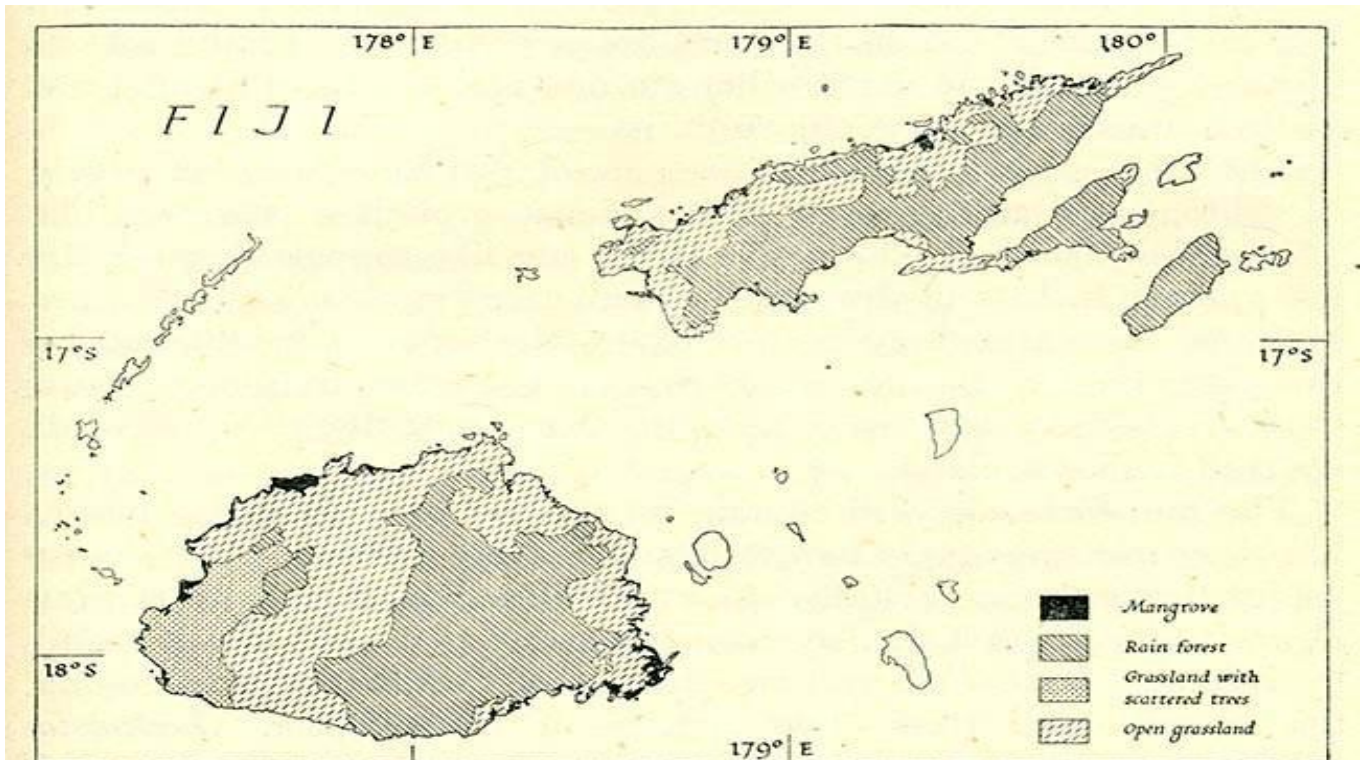


Fig. 42. Vegetation of the main islands, Fiji.

The open grassland is commonly known as *talasinga*. Some islands have been left blank owing to insufficient data. Based on: (1) R. A. Derrick, *The Geography of the Fiji Islands*, pp. 73, 105 (Ndavuilevu, 1938); (2) G.S.G.S. map no. 4295 (Cassini's projection)—for mangroves.

Source: www.maps.nationmaster.com

CHAPTER 9

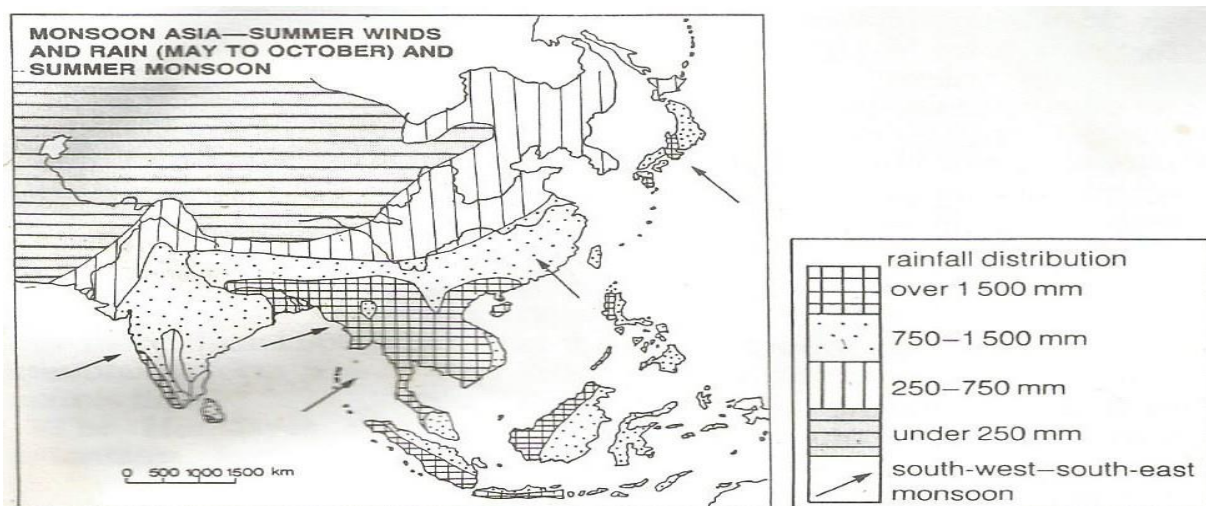
NATURAL HAZARD- MONSOON ASIA

The monsoon can mean life or death for many people in Monsoon Asia. The burst of the monsoon rains are eagerly awaited by farmers, to signify life and the start of the planting season. Excessive rain, on the hand, accompanied by strong winds can cause death and disaster.

The summer monsoon

The air over the land is warmed and rises. This creates a huge area of low pressure. A stream of moist air is drawn in from the Indian and Pacific oceans towards this low pressure area. It rushes in across the land bringing torrential rain and thunderstorms.

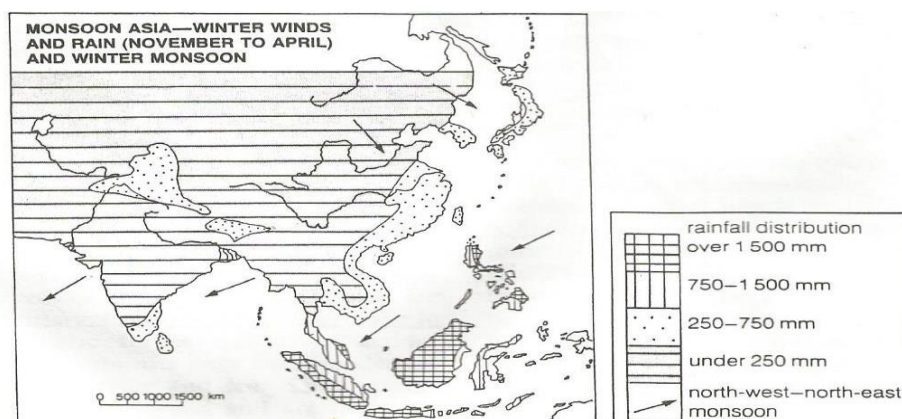
The summer monsoon is associated with the rainy season in most Asian countries.



Source : Monsoon Asia – A New Geography

The winter monsoon

During the winter months, opposite occurs. Being cut off from the modifying influence of the ocean, the interior of Monsoon Asia becomes extremely cold. Cold air descends. The entire area becomes a high pressure zone. The wind direction is north-east and the temperature of countries near central Asia falls to freezing point.



Source : Monsoon Asia – A New Geography.

Climatic Hazard

In many parts of Monsoon Asia people are regularly subjected to climatic hazard such as flooding, drought or typhoons (tropical cyclones).

Floods

In general floods are caused by too much rain. In Monsoon Asia the area's most threatened by flooding are the major river basins and delta areas. During heavy rains, especially in the summer monsoon, the flow of water into a river and from tributaries of the river exceeds the outflow from the river mouth. River flooding in Monsoon Asia is also aggravated by heavy silting of river channels and mouth zones, especially in the delta regions.

In South Asia, especially the Ganges Delta and Bangladesh, where land is very low-lying, flooding is an annual occurrence and it is often accompanied tropical cyclones. Other places prone to flooding are Mumbai and Kuala Lumpur.

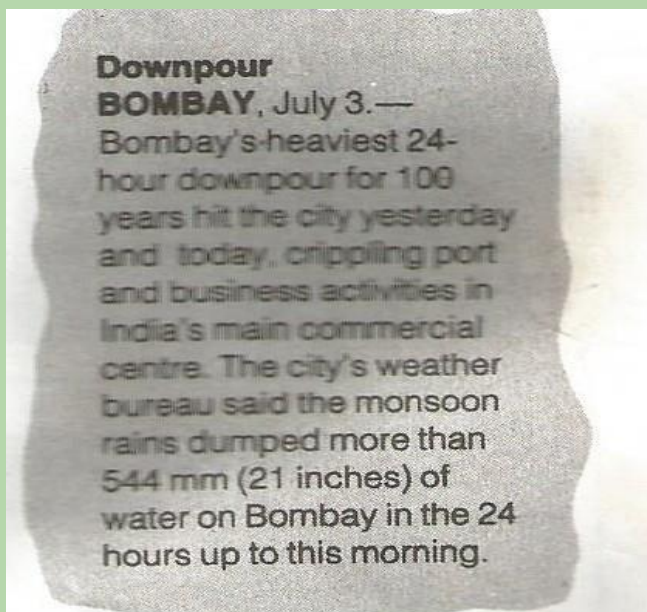


Source: www.goggle.com



Activity 9.0

1. What is a flashflood?
2. List down negative and positive consequences of flood.
3. Name the main river basins of Monsoon Asia most prone to flooding.



Source : Monsoon Asia – A New Geography.

- a. Why should port and business activities be crippled during such heavy rains?
- b. What monsoon wind would Bombay experience in July?
- c. If you were a town planner in Mumbai, what precautions would you take to cope with such high rainfall in the city?

Case Study : Bangladesh

Bangladesh is prone to natural hazards than most countries in Monsoon Asia. Floods, typhoons and famine are common. Each year the country is struck by flooding and typhoons. In 1998, it was hit by one of the worst floods in history affecting 22 million people and causing over 4 million homeless. The flood left the capital city (Dhaka) under water. Other effects included :

- Polluted reservoirs and gas outlet which caused the lack of clean water and cooking fuel.
- Increasing threat of disease such as dysentery and diarrhea.
- Destruction of crops & and people's livelihood.

What makes Bangladesh vulnerable to natural hazards?

- Bangladesh lies on the Ganges Brahmatputra river deltas.
- It is flood prone because it is almost entirely low lying (80% of the country is less than 6 metres above sea-level).
- It lies towards the apex of the Bay of Bengal where Monsoon winds funnel, bringing intense rain. The country also lies in the path typhoons.

How does Bangladesh cope with floods?

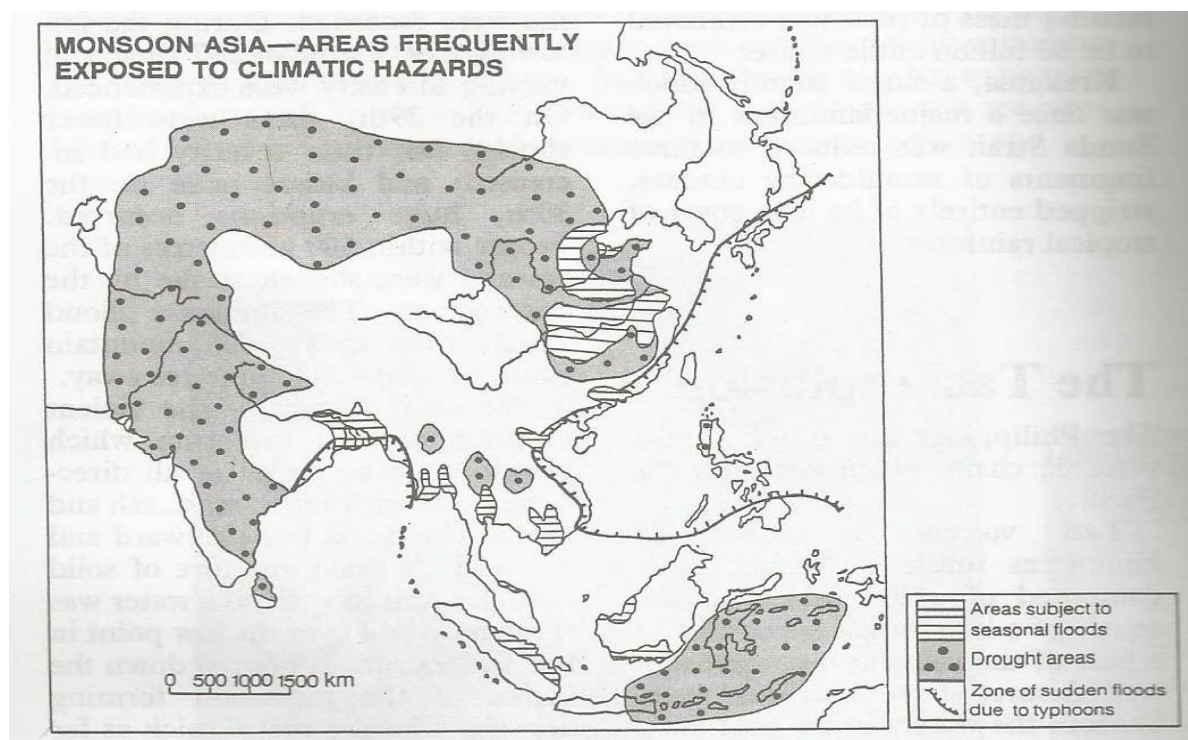
- Buildings dams to control river flow.
- Building embankments or stop banks up to stop the river from overflowing.
- Dredging the river (ie deepening the river channel).
- Improve flood warning systems.
- Providing relief supplies after the flood.

Drought

Drought is a serious problem in Monsoon Asia. It occurs during the Winter Monsoon (November to April) as cold air descends from the Himalayan mountains. Food production is seriously affected bring about malnutrition, hunger and death.

Drought Affected Areas

- India
- Pakistan
- Northern and Interior China
- Sind
- Rajasthan provinces



Source : *Monsoon Asia A new geography*



Activity 9.1

1. Explain the difference between tectonic and atmospheric hazards.
2. Which of the following would not be considered a natural hazard?
 - a. A volcanic eruption in the vicinity of Taupo.
 - b. A flood in California
 - c. A tropical cyclone on an uninhabited island in the Pacific
 - d. An earthquake in the Kanto plain area of Japan.

MPACTS OF DROUGHT

(a) On the Environment

- Soil fertility declines as soil dries up.
- Soil turns saline (salty) and useless for cultivation eg. In the Sind area
- Soil is prone to wind erosion.
- Vegetation becomes sparse as it dies.
- Water resources become scarce as rivers & wells dry up.

(b) Social & Economic Effects

- Health & nutrition problems arise.
- Loss of life may occur when famine strikes.
- People migrate eg. In Rajasthan and interior Deccan plateau in India, many villages have been abandoned when famine occurred.
- Food crisis arise as agricultural yield decline.

Dealing with Drought

- Placing water restrictions.
- Using irrigation pumps on farms.
- Provide relief supplies to those affected.



Activity 9.2

1. Explain the measures that have or could be taken to lessen or overcome drought problem.
2. Discuss the importance and development of irrigation in Pakistan or India or China.
3. What problems are encountered in implementing and operating the irrigation schemes?

TROPICAL CYCLONE

Tropical storms in Monsoon Asia take a number of forms , such as tropical cyclone , typhoons and hurricanes. In all cases, high and strong winds are accompanied by heavy rains and in coastal areas storm surges may occur. Tropical cyclones occur between July and December. The areas affected by cyclones are :

- Coastal area of China
- Japan
- Bangladesh
- India



Source : www.heraldson.com



Activity 9.3

1. Find out how tropical cyclones develop.
2. Why is Bangladesh so subject to flood o cyclones?
3. What are storm surges and how are they created. How do they differ from tsunami?

Essay

With reference to **Bangladesh**, discuss the problems faced by the famers and explain the solutions to these problems.

EARTHQUAKES

Earthquakes are common along long narrow belts or zones along plate boundaries. In Monsoon Asia, the countries most prone to earthquakes are those that lie along the boundaries of the Indo-Australian and Pacific plates & the Indo-Australian and Eurasian plates. As these plates move (tectonic movements), they send out seismic waves which in turn cause earthquakes.

Earthquake prone countries in Monsoon Asia have over the decades been struck by many earthquakes which have caused widespread death damages.

Earthquake zones and Countries prone to earthquakes in Monsoon Asia

1. Indian Earthquake – 1993

India's worst earthquake occurred on 30th September, 1993 killing more than 25,000 people. The quake measured 6.4 on the Richter scale and happened at night when people were indoors asleep. Fifty towns and villages in the state of Maharashtra were devastated. The earthquake occurred in a region which was totally unprepared for earthquakes and building standard regulations were unlikely to be enforced. In terms of its death toll, it was one of the nation's worst natural disasters of any kind for twenty years.

2. The Tangshan Earthquake in China (1976)

Tangshan, an industrial and mining city in the North-east of China, was struck by a massive earthquake with a force of 11 on the Richter scale, in the early hours of 28th July, 1976. The earthquake was so strong that it damaged well designed earthquake resistant buildings.

Most homes and factories were wiped out and the loss of life staggering. Official reports said that 242,000 people died and it is believed that total casualties were over 500,000. Factory equipment and coal mines were also destroyed.

The massive destruction was partly due to poor building structure and a poorly planned and overcrowding city. There had been little equipment available to monitor earthquake activity and signs such as rises in the water table were not taken seriously.

Today, there is a greater awareness in china of the need to lessen the danger of natural hazards. Research institutions now keep record of earth tremors and use modern equipment. There is also an improvement in building construction techniques and designs.

VOLCANOES

Volcanoes are opening in the earth's crust through which magma, ash, poisonous gas and steam are forced onto the surface. Just like earthquakes, volcanoes are common along narrow zones along plate boundaries, especially along mid-ocean ridges (boundary where two plates are moving apart) and subduction zones (area where the oceanic plate is pushed beneath the continental plate). Hence the distribution of earthquakes and volcanoes are closely related.

The zone of volcanoes that run around the edge of the Pacific plate is known as the "Pacific Ring of Fire". This zone is famous for its major volcanic eruptions.

Volcanic Prone Areas

Countries prone to volcanic activity in Monsoon Asia include:

- Japan
- Indonesia
- Phillipines
- China

What causes volcanoes to erupt?

Volcanoes can erupt with explosive force and this comes from the buildup of gas and steam which escapes from the magma. The strength of the eruption depends on the amount of gas contained in the volcano.

Volcanic Hazards

These include :

- Lava glows
- Ash falls
- Poisonous gas
- Lahars (rapid mudflows)
- Volcanic bombs (large pieces of lava thrown out of volcano)

Impact of Volcanoes

<u>Positive</u>	<u>Negative</u>
• Increase soil fertility. • Rocks formed from the cooling of lava can be used for quarrying for building & road materials. • Major volcanic peaks are used as tourist attraction. • Steam produced by geothermal activity can be used to generate electricity. • Community spirit can be strengthened.	• Loss of lives and injury. • Damage to farms and decline in food production. • Damage to infrastructure (eg. Bridges, road, power and water supplies, etc.) • Loss of earnings from tourism and agriculture. • Destruction to vegetation.

Reducing the Damaging Effects of Volcanic Eruptions

- Civil defense – people should be made aware of what to do during an eruption through evacuation plans, drills, survival kits.
- Improve methods of prediction which would indicate warning signs and help scientists forecast eruptions. E.g. Tilt meters, sampling gas emissions from volcanoes, heat sensitive satellite cameras.

Case Studies

1. Krakatoa Eruption (1883)

Krakatoa is part of the island arc of Indonesia, located between Java and Sumatra. In 1883 after a series of earthquakes in the region, the island (which was an active volcano) erupted and sent out massive clouds of steam and ash. The explosions were heard all over Java where windows rattled and homes shook. It also caused huge tsunamis as high as 40 meters which flooded the coasts of Java & Sumatra. A total of 36,000 people died as a result of the tsunamis. The ash falls caused darkness for several hours in the region. As a result of the eruption, the island of Krakatoa was reduced to three fragments.

2. The Taal Explosion (1911)

Taal volcano is located in the Philippines which erupted in 1911. The eruption caused huge ash falls, volcanic bombs and lahars. It resulted in the deaths of 1300 people. Some were buried under the debris or suffocated by poisonous gas. In one village, all the victims died instantly while on the shores of the lake in the area, four small towns disappeared.

Activity

Students carry out research on Japan's Mount Ontake Volcanic eruption, September 2014

Terms

Tropical cyclone - A violent storm originating over tropical or subtropical waters, characterized by violent rainstorms and high-velocity cyclonic winds.

Storm surge - A storm surge is a coastal flood or tsunami-like phenomenon of rising water commonly associated with low pressure weather systems (such as tropical cyclones and strong extratropical cyclones), the severity of which is affected by the shallowness and orientation of the water body relative to storm path, and the timing of tides.

Gale force winds – are very strong winds

Seismic waves - a wave of energy that is generated by an earthquake or other earth vibration and that travels within the earth or along its surface.

Beaufort scale - A scale of wind force ranging from 0 (calm) to 12 (hurricane), corresponding with the velocity of wind at a set distance above ground or sea level.

Richter scale - a scale for expressing the magnitude of an earthquake

Jet stream - are fast flowing, narrow air currents found in the atmosphere of some planets, including Earth.

Lapilli - is a size classification term for tephra, which is material that falls out of the air during a volcanic eruption or during some meteorite impacts

Scoria - is a dark-colored igneous rock with abundant round bubble-like cavities known as vesicles.

Lahars - A mass of volcanic fragments, often mixed with water, moving rapidly down the side of a volcano.

Seismograph - An instrument for automatically detecting and recording the intensity, direction, and duration of a movement of the ground, especially of an earthquake.

Aftershocks - A quake of lesser magnitude, usually one of a series, following a large earthquake in the same area.

Cultural hazard - Cultural or lifestyle hazards - result from the place we live, our socioeconomic status, occupation, or behavioral choices.

Atmospheric hazard - hazards that occur above the earth's surface, e.g. Thunderstorms, Tornadoes, High Winds

Tectonic hazards - are events caused by the Tectonic plates below the Earth's crust.

CHAPTER 10

NATURAL HAZARDS – FIJI

Are extreme natural events that poses a risk or danger to people and their property. For these events to become a hazard, they must occur in areas where people live. A hazard becomes a disaster when it results in the destruction of lives and property.

Tectonic Hazards

Are those which originate inside the earth. For eg. Volcanoes, earthquakes

Atmosphere Hazards

Hazards that occur in the atmosphere eg. Tropical storms, typhoons, hurricanes, cyclones, tornadoes & droughts.

Cultural Hazards

Are people made events which causes danger for people and their property. They include events such as water, air, noise pollution, violence, cannibalism, fires and nuclear wars.

TROPICAL CYCLONE

Is a severe storm of extremely low pressure which forms in tropical areas. In Asia they are known as typhoons and in the US, Europe and the Caribbean they are called hurricane.

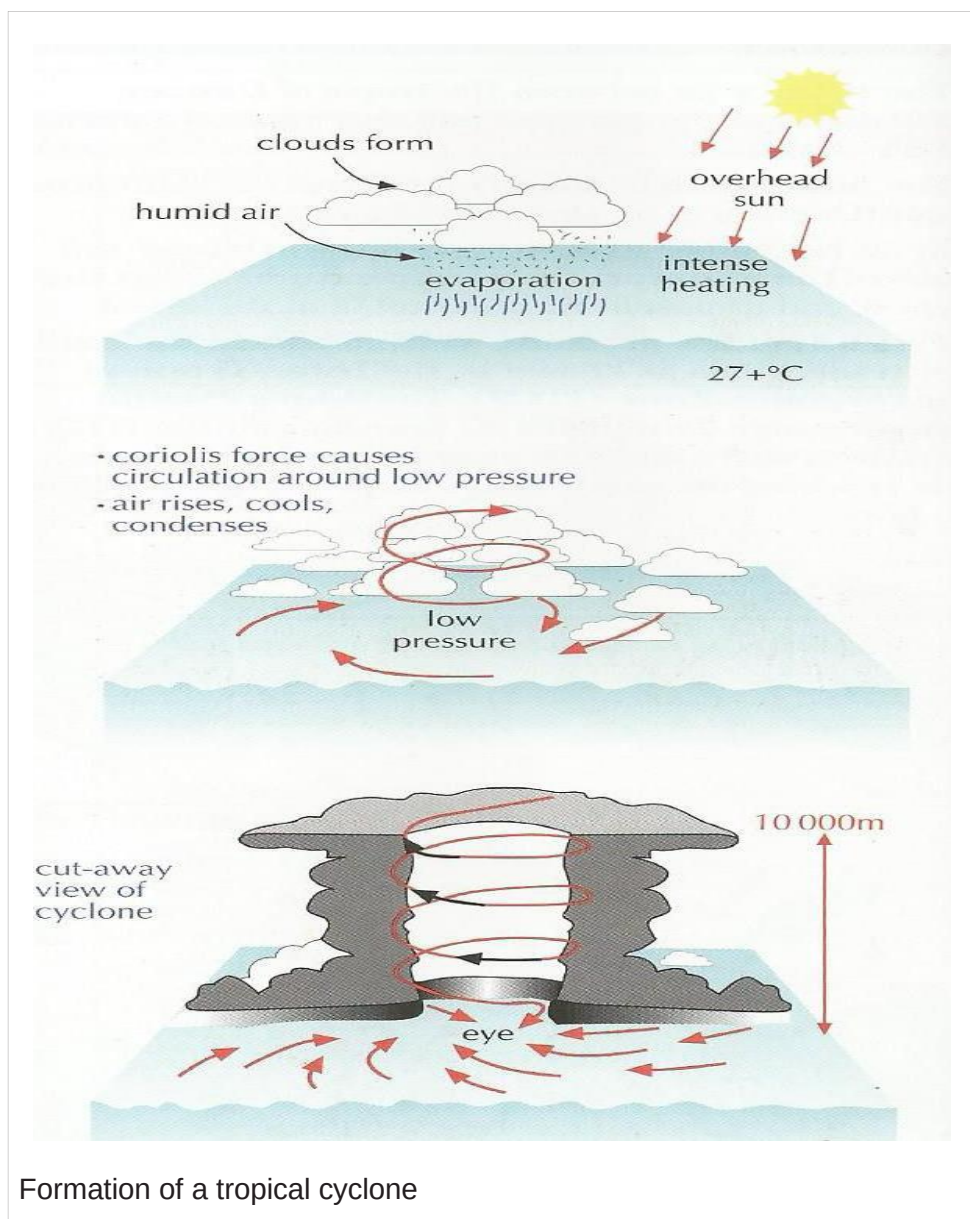
Causes

All cyclones start near the equator. They form over warm ocean surface within the tropics. The major causes are :

- High temperatures of at least 26 degrees Celsius.
- A large expanse of warm ocean (heated to at least 26 degrees Celsius)
- Jet stream over head (ie high speed air currents which circle the earth between 10 degrees to 30 degrees latitude at high altitudes).

Formation Process

- As temperatures rise it causes an increase in evaporation rates over a large expanse of ocean resulting in a warm wet cloud of rising air. This rising air spins in a clockwise direction (in the southern hemisphere) due to the Coriolis force.
- The cloud of rising air continues to rise while at the same time leaves behind an intense low pressure.
- The jet streams causes the air movement in the forming cyclone to increase speed as they suck more air from surrounding areas further upwards.
- The spiral of air and heavy rain produced by this process moves across the ocean causing destruction in its path.

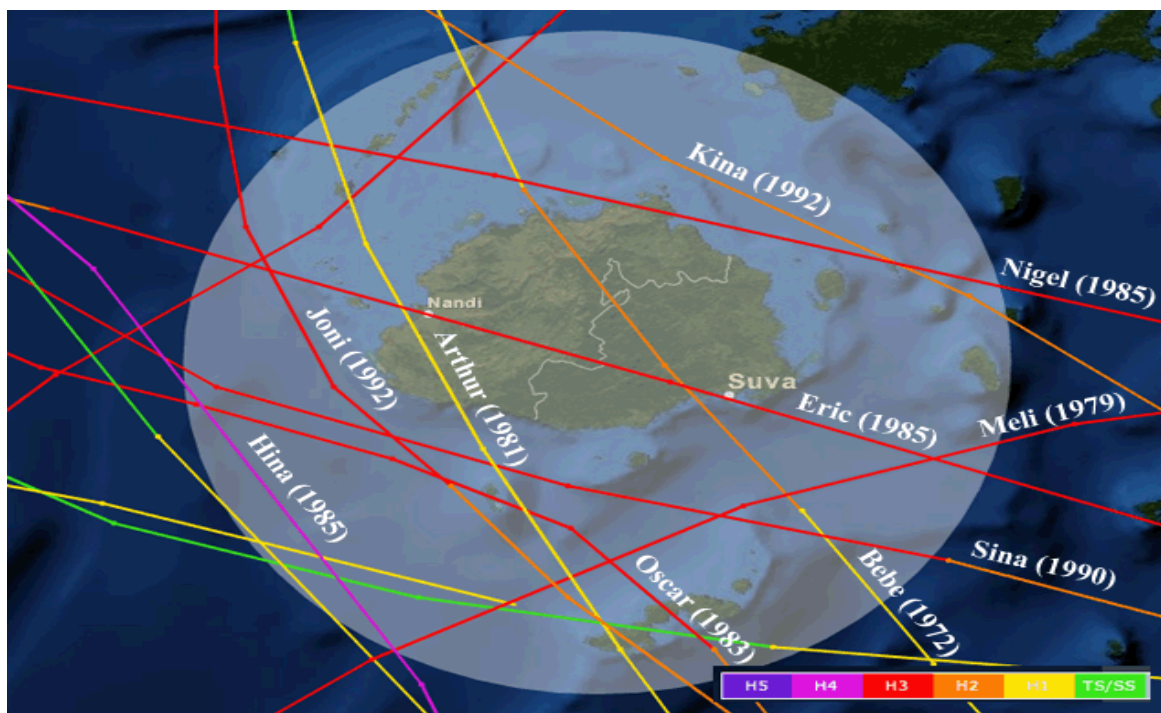
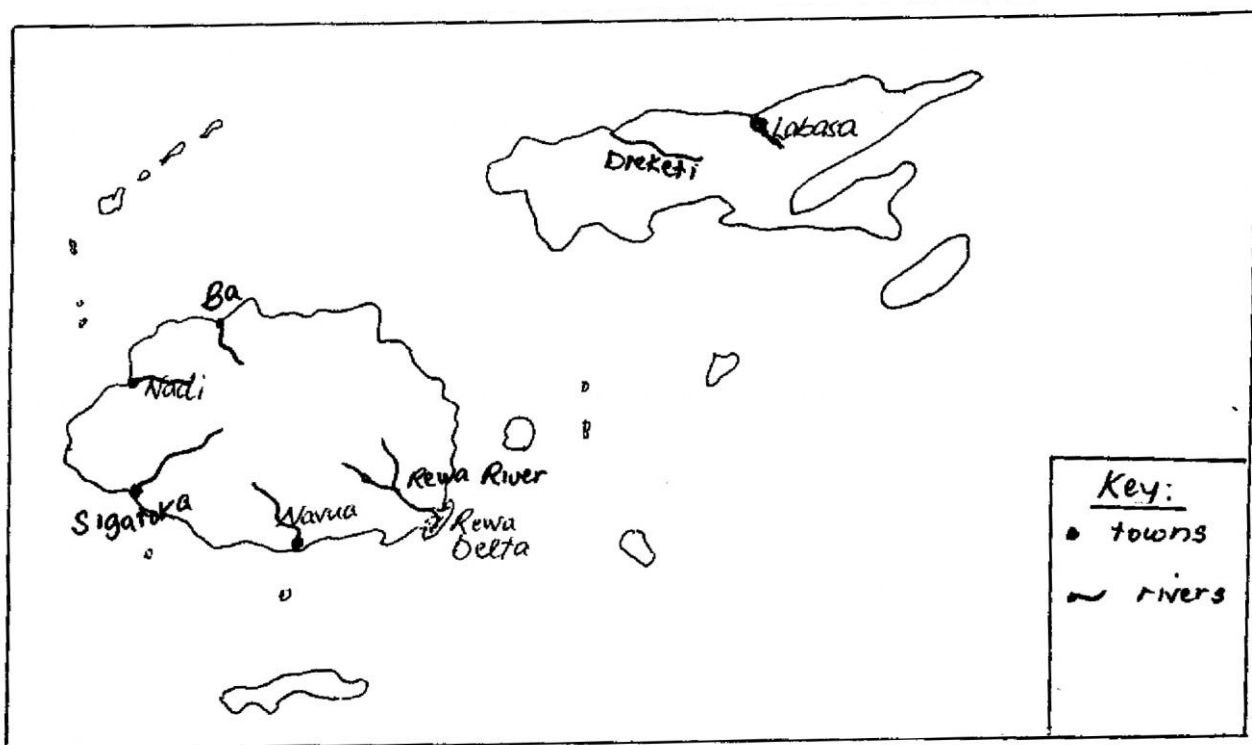


Source: Geography NCEA Level One

Cyclone Hazards

- Strong winds
- Heavy rainfall which can result in flooding
- Storm surge – a temporary and rapid rise in sea level caused by the moving cyclone.

Cyclone Prone Areas in Fiji



Source: www.wunderground.com

EFFECTS OF TROPICAL CYCLONES :

(a) On the Environment

- Destruction of vegetation & crops
- Landslides may occur
- Soil damaged by deposition of mud from floods & salt deposited by storm surge.
- Coastal erosion.

(b) On Social & Economic Activities

- Injury & loss of lives
- Reduction in food supply due to crop destruction.
- Reduction in export earnings
- Destruction of buildings
- Damage to infrastructure such as roads, power & water supplies, bridges, airports, etc
- Reduction in tourist arrivals.
- Decline in economic growth which may lead to job loss.

Positive Impacts

- Increase in community spirits as people rally to support each other.

Allows nations to rebuild and modernize the infrastructure of the country.



Banana and sugar cane crops destroyed

Source: www.bellaacycloneyasi.wordpress.com



Activity 10.1

- (i) Explain why is Fiji frequently hit tropical cyclones?
- (ii) State the characteristic features of a tropical cyclone.
- (iii) Identify three economic impacts of cyclones in Fiji.
- (iv) Identify two positive effects of cyclones.

Reducing the Impacts of Tropical Cyclones :

(a) Traditional Methods

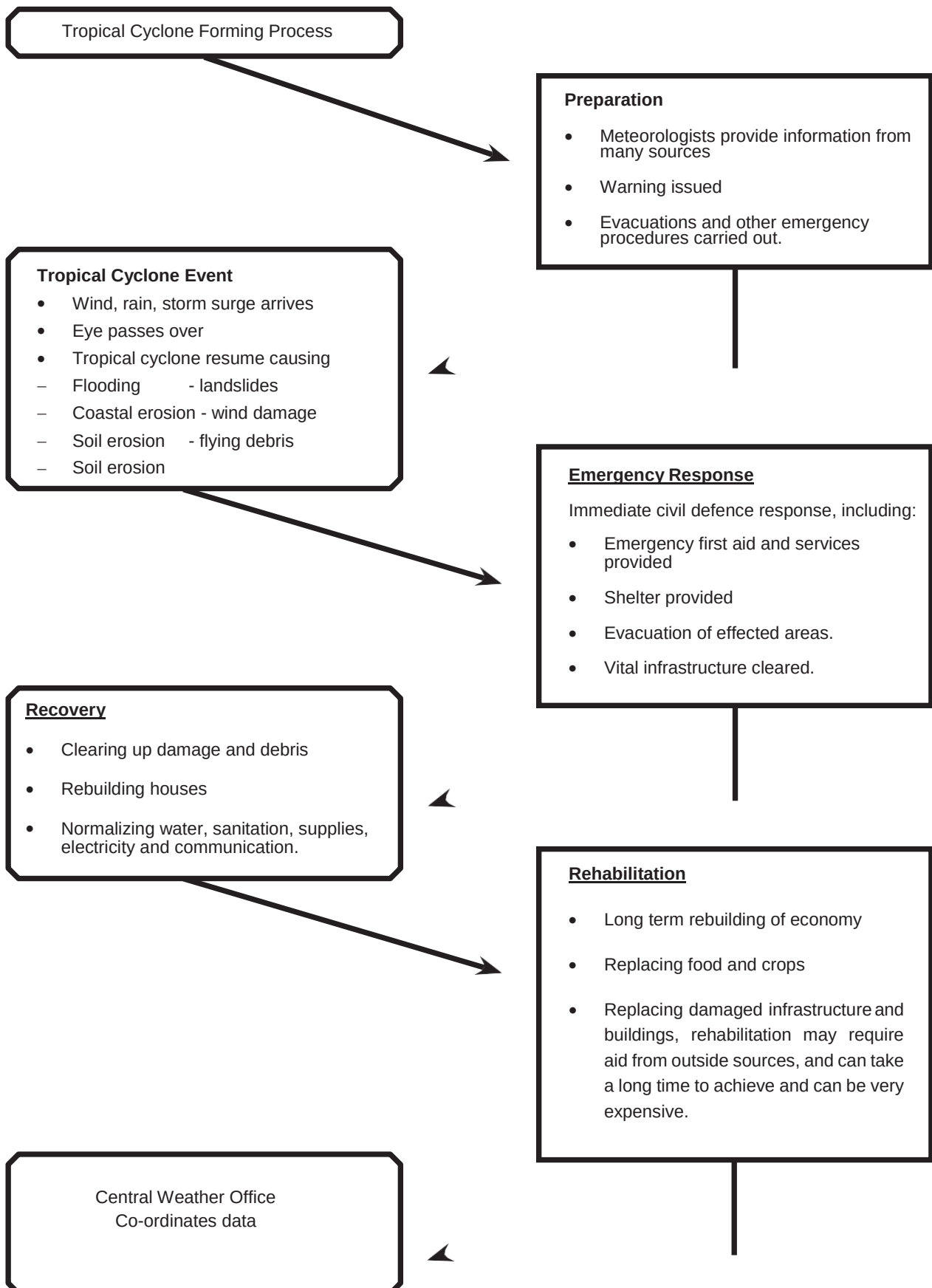
- Growing famine crops eg. Yams & nuts
- Fermenting & drying food for preservation.
- High level of co-operation & family ties.

(b) Modern Methods

- Developing warning systems & better weather services.
- Developing emergency response & civil defence procedures.
- Developing sound infrastructure eg. Dams for flood control and tarsealed roads.
- Store essential resources such as medicine, pumps, tents etc.
- Diversifying the economy, especially agriculture, so if one crop is wiped out the impact will be lessened.

THE SEQUENCE OF EVENTS IN A TROPICAL CYCLONE

While tropical cyclones differ in their location and magnitude, most tropical cyclones follow a similar sequence of events.



When a Tropical Cyclone Occurs

Civil Defense Suggests:

Immediately

- Turn off the electricity, gas and water
- Keep candles, torch and a battery powered radio in a safe, dry place
- Turn the radio on at regular intervals
- Stay indoors if it is safe to do so. If not, leave low-lying areas straight away Watch for a temporary lull.
- Stay clear of power lines
- Where appropriate move to radio stations to try and establish contact with outside world.

If Time Permits

- Move boats or valuable possessions to safety.
- Move stock to higher ground.

After the Storm

- Avoid sightseeing as it often hinders rescue operations.
- Check for broken sewers and water mains.
- Ration food. Make a reserve of fresh water available
- Listen to the local radio station for further advice and instructions.
- Drive with care along the streets as they may be undermined and could collapse under the weight of the car.

CASE STUDY : CYCLONE KINA, 1993

Cyclone Kina struck Fiji on January 1993. Twenty two people died as a result of the cyclone, while damage was estimated at \$140 million. Most of the deaths were caused by drowning in the flooded waters, although at least two people were killed by flying debris.

Kina began as a small depression 1000km to the north-west of Fiji on 26 December. Over the next week, it moved slowly in a south-east direction. By 31 December, it had increased in intensity and began to pick up speed as it neared Fiji, finally hitting the islands at 6.30pm on 2 January. During its height, Kina's maximum wind speed was 120 knots spanning 250km from the eye and it moved at 20 knots. The heavy rainfall, high winds and storm surge associated with Kina caused much damage including:

- Widespread flooding throughout Viti Levu, forcing over 2,000 people to evacuate their homes.
- Damage to important infrastructure, such as roads, bridges and power. Major bridges at Korovou, Vunidawa and Sigatoka were destroyed. Over 3,000 telephone lines were knocked out by flying debris, winds and flooding;

- 30 per cent of the sugar cane crop was destroyed by high winds and flooding, depriving many farmers of their only source of income. The rice crop and the dairy industry were also wiped out;
- Piped water supplies were cut and water at the coast was affected by salt water. Rivers were contaminated by silt;
- Landslides occurred in inland areas;
- Trees were uprooted.

In towns, there were signs of wreckage everywhere. Central Suva was littered by debris blown by the hurricane-force winds. In other residential areas, trees were uprooted and homes, shops and other buildings were covered with mud well above ankle depth. Many houses had their roofs blown off by the heavy winds.

Hotels and resort on the Coral Coast faced a massive clean-up exercise. Buildings were damaged, while beaches were eroded and covered with debris. Some hotels were forced out to close because they lacked water, electricity and communications.

There was a considerable health hazard posed by the lack of water. Cut off from piped water, people used muddy, contaminated water from creeks and rivers for drinking and household use. Widespread outbreaks of diarrhea were caused by people eating food that had gone off due to the power cuts.

Damage could have been worse. It appears fewer houses than in the past had lost their roofs, thanks to rigid building codes introduced in 1985 when substantial number of new houses lost their roofs in cyclone Nigel. Also, radar weather-monitoring systems allowed some early warnings to be given, although a computer malfunction hindered the operation of the weather office.



Debris left by cyclone.

Source: www.theaustralian.com.au

FLOODS

Floods in Fiji are common in most low-lying areas, floodplains and major delta areas. They are a result of intense rainfall.

CAUSES OF FLOODS

Floods occur due to:

- Heavy rainfall – this is the initial cause of floods
- Overflowing rivers
- Storm surge
- An increase in run-off and erosion on hill slopes due to deforestation may increase the risk of floods. The sediments washed into the river through erosion makes the river shallow and causes it to flood quickly.



Flooded Ba Town

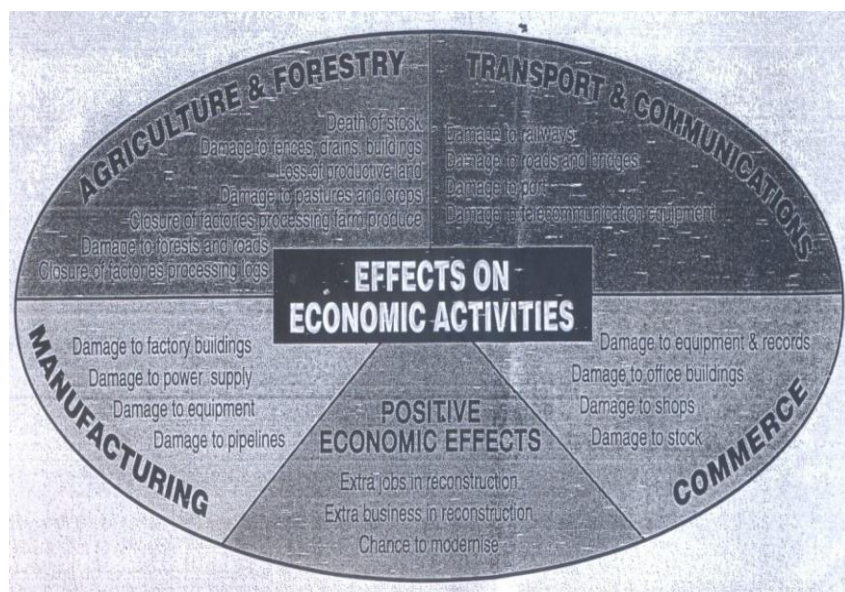
Source: www.fijilive.com

EFFECTS OF FLOODS

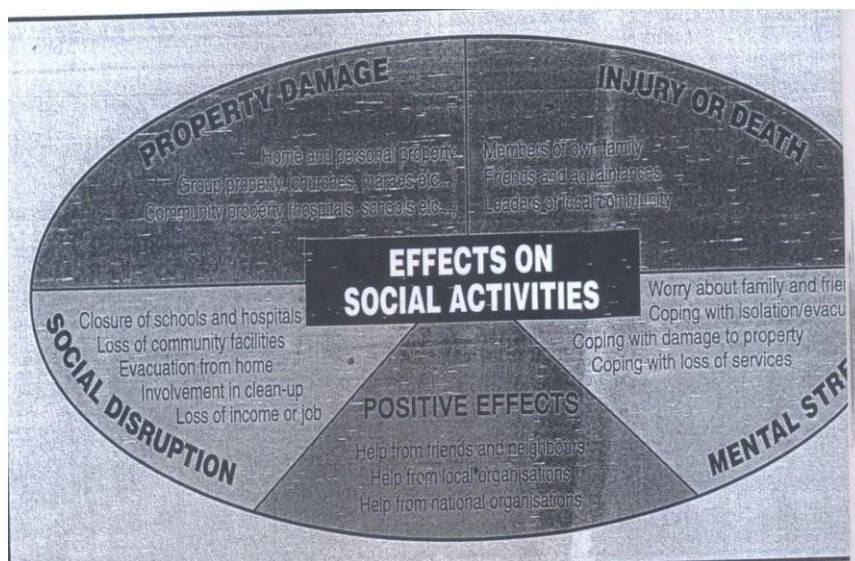
A Physical/Environmental Effects :

<i>Positive effects</i>	<i>Negative effects</i>
• Builds up landforms such as floodplains, deltas, levees, alluvial fans, etc • Increases the fertility of the soil through the deposition of alluvium.	• Causes erosion and mass movement on slopes eg. Landslides, rilling, slumps, etc • Erodes river banks and stop banks. • Cause changes in the river course • Storm surges causes an increase in soil salinity (ie. Increases the salt levels in the soil) which is a problem for farm-lands.

Economic Effects:



Social Effects:



HOW HAVE PEOPLE INCREASED THE EFFECTS OF FLOODING?

Floods are natural event however human activities have increased the risk of flooding in low-lying areas; such activities include:

- Establishment of settlement near river systems and fertile lowland.
- Building of roads, mining activities, logging and improper farming practices along slopes and near river systems.

All these activities result in the removal of trees and forests which in turn will lead to an increase in run-off and sedimentation. Run-off becomes greater and faster than it would have been when forests were there. As a result, rivers will flood much faster.

HOW CAN PEOPLE DECREASE THE NUMBER OF DAMAGING FLOODS?

The impacts of floods can be reduced by:

1. Modifying the flood event by:

- Constructing dams
- Building stop banks
- Planting trees in front of stop banks to slow down flood waters.

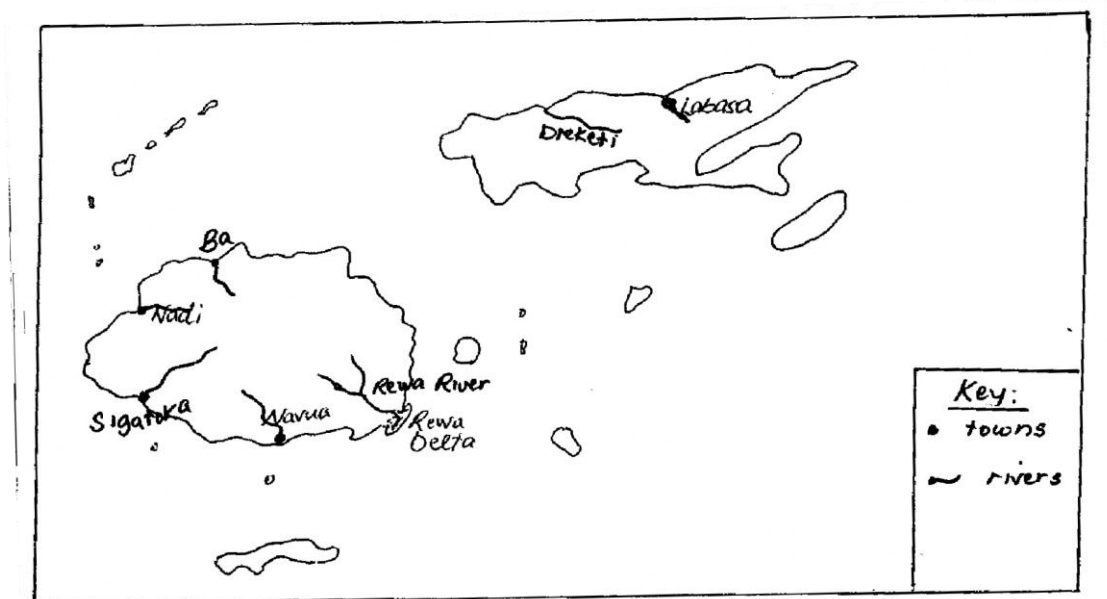
2. Modifying people's vulnerability to flood loss by :

- Retaining forest in a river catchment
- Re-afforestation – this is the planting of trees in areas which are deforested.

3. Modifying the effects of flood by:

- Insurance – this will help people recover the damages.
- Community assistance – people within a community co-operating to recover the losses. This involves sharing and helping one another.
- Government assistance – government may help victims by providing funds for rebuilding, food rations, etc.
- Preparedness – people living in flood prone areas need to know flood safety rules.
- Flood forecasting – the meteorological service provides early warning of heavy rain giving people time to prepare.

FLOOD PRONE AREAS



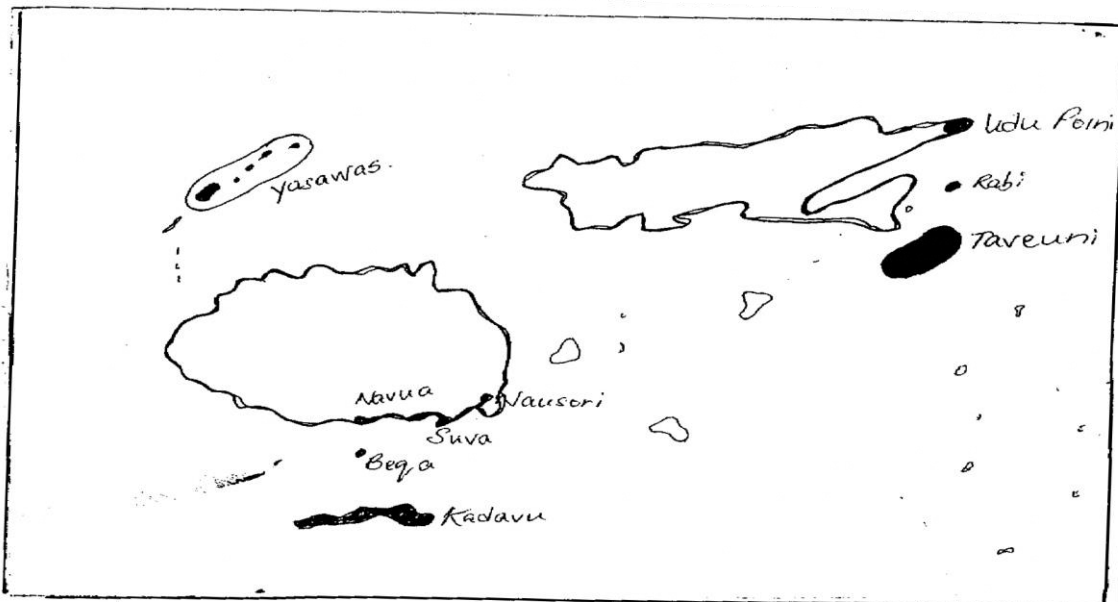
EARTHQUAKES

Earthquakes are sudden movements in the earth's crust. They occur mainly along plate boundaries. Fiji sits at the back of basin of the Pacific plate which is close to the boundary of the Indo-Australian and Pacific plates. Then those two plates collide, the friction that is caused results in earthquakes.

Causes of Earthquakes

- Tectonic movement along plate boundaries or fault lines.
- Violent volcanic eruptions can also cause earth movements.

Earthquake Prone Areas in Fiji



CASE STUDIES:

A major earthquake hit Fiji on September 14th, 1953 killing 8 people and injuring many others. The earthquake struck at 12.27 pm. Immediately after the earthquake the sea level dropped at Suva harbor. Within 10 seconds, tsunami wave broke over the reef and the wave rose over the sea wall into Nasese, the Grand Pacific Hotel, across Victoria Parade and Albert Park.

In 1979 an earthquake occurred near Taveuni and Rabi causing landslides and severe damage to buildings. The area was also affected by strong earthquakes in 1919 & 1932.

In 1990, an earthquake with a magnitude of 7.4 had its epicenter located 500km southwest of Suva (near Ceva-i-Ra). It resulted in the complete flooding of Nukulau and Mokuluva islands.

b) Socio-economic effects

- Loss of life and injury.
- Destruction of bridges, motorways and roads.
- Job losses as a result of closure of business.
- Disruption of water and power supplies as well as sewerage may lead to an outbreak of disease.
- Damage to property and farmlands.
- Social disruption leading to temporary closure of schools.
- Strengthening of community spirits.

Minimizing the Effects of Earthquakes

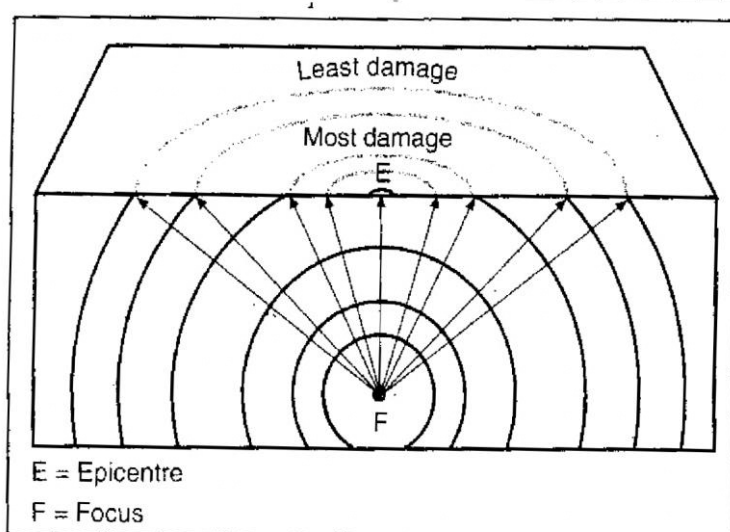
1. Improving building & design codes such as the use of special strength concrete or rubber pad in the foundation of buildings.
2. Limiting the height and density of buildings in earthquake prone areas.
3. Creating greater awareness eg. Having earthquake drills, survival kits and networks to cope with the event.
4. Having insurance against damage so people are able to replace buildings and belongings quickly.
5. Provide open refuge areas such as parks in densely populated areas.

SAFETY IDEAS

- During an earthquake, if indoors get under strong furniture. Stay near the centre of the room.
- Keep away from concrete buildings.
- If outside, stay in the open away from buildings and power lines.
- After the shaking, check your water & electricity wires and turn them off at the primary control point.
- Stay out of damaged buildings as aftershocks can occur.

Future of Earthquakes

- When an earthquake occurs it sends out vibrations or shock waves called seismic waves.
- The point in the crust where earthquakes originate is called the focus.
- The point on the earth's surface where the shock wave is first felt is called the epicenter. It is found on the earth's surface directly above the focus.
- The first seismic waves that are released from the focus are called the P-waves or primary waves. They travel very fast and are followed by a second set of waves known as the S-waves or secondary waves. Both seismic waves travel below the crust and they send out a series of seismic waves on the surface called surface waves.
- After shocks – are smaller shallow earthquakes which are felt for days after the main earthquake.



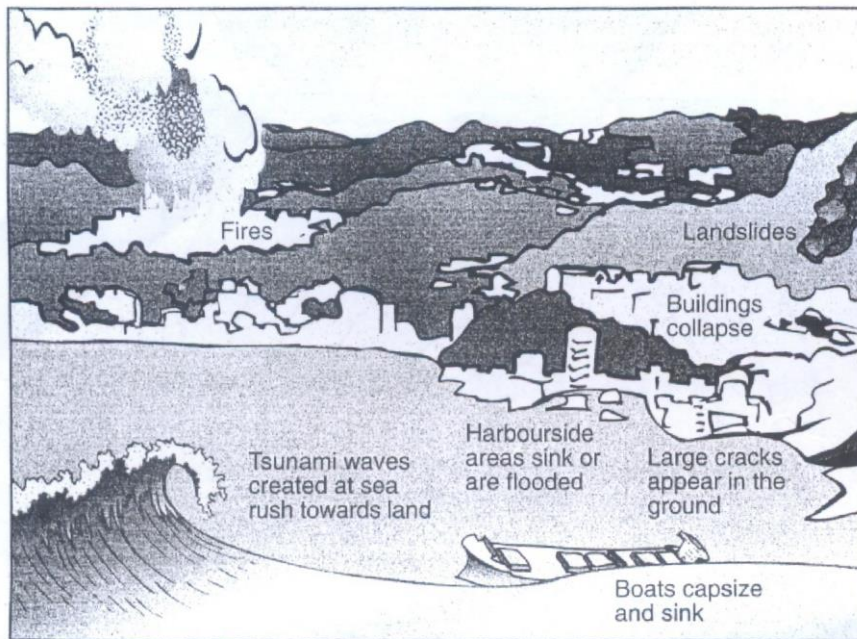
Measuring Earthquakes

1. Richter scale – instrument which measures the force or magnitude of an earthquake.
2. Mercalli scale – instrument which measures the effects of an earthquake on the surface.
3. Seismograph – instrument which detects the epicenter of an earthquake.

Hazards Produced by Earthquakes

There are a number of potential hazards caused by earthquakes :

- The shaking of the ground can cause buildings to collapse.
- Fires may start as gas or oil leak from broken pipes.
- Earthquakes at sea can cause tsunamis (giant waves).
- Landslides may occur on steep slopes.
- Diseases may spread due to disruption to water supplies, sewerage and other essential services
- Avalanches (massive snow slides) on snowcapped mountains.



Effects of Earthquakes

a) Physical or Environmental Effects

- Landslides can occur
- Rivers can change direction.
- Trees can be uprooted.
- Cracks can appear on the ground.
- Flooding of coastal areas due to tsunamis.



Activity 10.3

Essay

With reference to Fiji, discuss the cause of earthquakes and three impacts it may have on the people.

TSUNAMIS

Tsunamis are a series of huge freak waves which can travel great distances.

Causes of Tsunamis

Tsunamis are generated by submarine earthquakes.

They can also be started by volcanic eruptions on the ocean floor.

EFFECTS OF TSUNAMIS

(a) Environmental

- Flooding of coastal areas.
- Destroys vegetation.
- Salinization of coastal areas. This is when salt is deposited on the land and contaminates the soil.

(b) Social effects

- Drowning and loss of life.
- Disruption to social activities, e.g. closure of schools.
- Outbreak of water-borne disease due to disruption in water supplies.

(c) Economic effects

- damage to hotels and resort along coastal areas.
- damage to infrastructure eg. Roads, bridges, ports, power and communication network.
- damage to farms leading to loss in agricultural exports.

Reducing the effects

- Creating awareness through literature eg. Posters, pamphlets, education system, etc
- The Pacific Tsunami Warning Centre in Hawaii issues warning for large tsunamis which are capable for travelling long distance this enables people to respond and take preventive measures.
- The South Pacific Applied GeoScience Commission (SOPAC) in Suva helps in promoting awareness and conducting research to keep the public fully informed.

CASE STUDY

The major Tsunami that hit Fiji was in September 14th, 1953. It followed the earthquake which happened on the one day. Eye witness accounts record that the tsunami took only a few minutes to reach Suva as the epicenter earthquake was just offshore to the west of Suva. It caused damage worth \$50,000. Three people drowned in Suva and two in Kadavu.

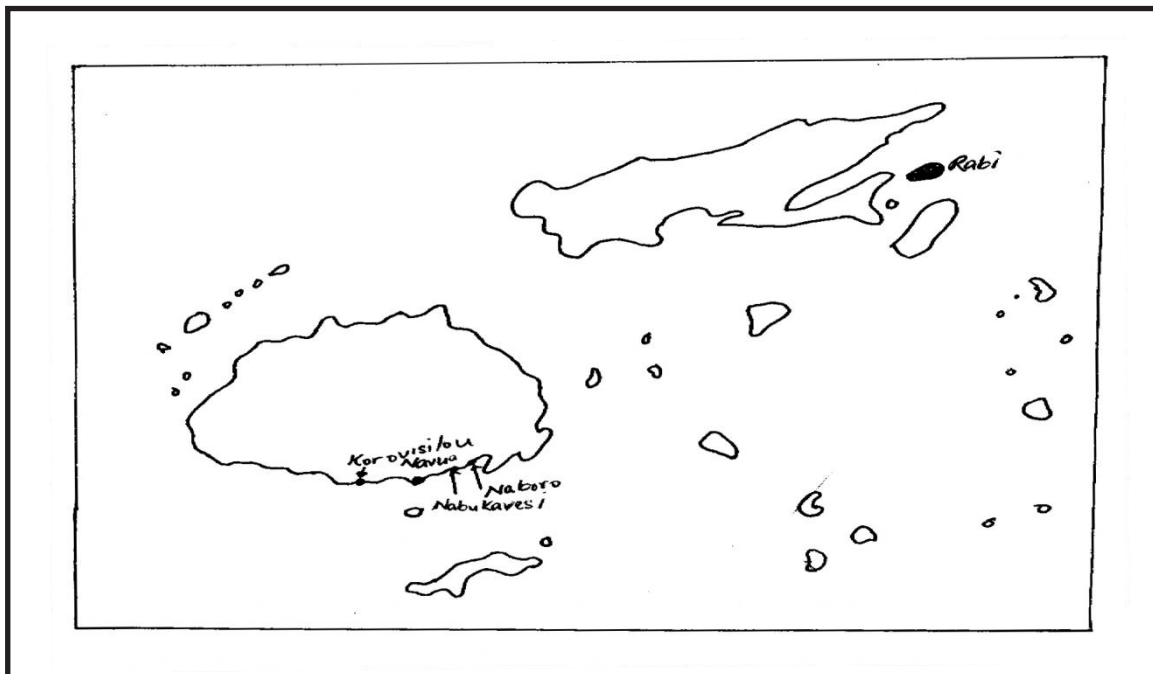
LANDSLIDES

This is the sudden movement of soil and rock down slope.

Causes of Landslide

- heavy rainfall
- increase in surface run off due to deforestation on slopes.

Landslide Affected Areas



Reducing the Effects of landslides

1. Re-afforestation.
2. Contour planting along slopes.
3. Terracing
4. Agro-forestry along slopes.

Case Studies

May 5th 1979 – Areas between Suva and Navua experienced landslides resulting in 5 deaths and buried houses.

April 1980 – heavy rainfall associated with cyclone Wally triggered landslides along the Queen's Highway causing the evacuating of more than 500 villagers from Korovisilou.

2006 – Landslide in Wainibuka killed 10 people in a bus that ended up in the river.

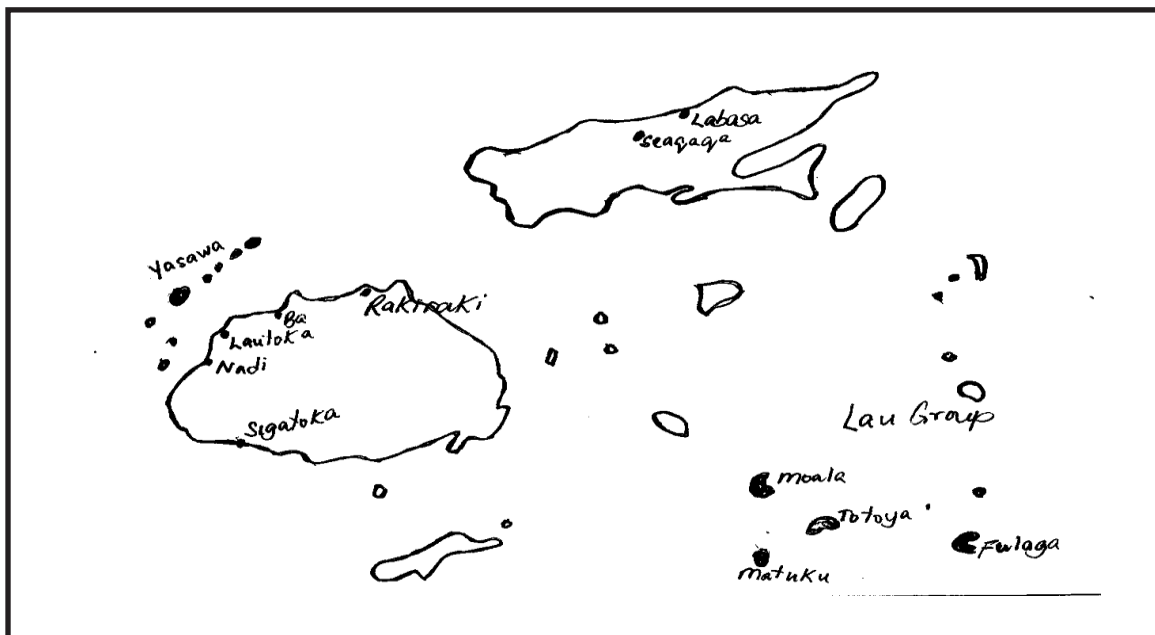
DROUGHTS

Drought is a long period without rainfall. It occurs when there is insufficient water to support human survival.

Causes

- Low annual rainfall over a long period of time.
- High evaporation rates.

Drought Prone Areas in Fiji



Effects of Drought

a) On Land

- Creek and rivers drying up.
- Plants dying.
- Cracks evident on the ground.

b) Social Effects

- Health & nutrition problems arise.
- Water shortage.
- Low food production.
- Increased hunger.

c) Economic effects

- Low crop yield leading to reduction in exports.
- Decrease in foreign earning.
- Increase in imported goods.

Minimising the Effects of Drought

- Provision of relief supplies.
- Place water restriction on the public.
- Use of irrigation pumps for farmers in affected areas.

CASE STUDY

Fiji experienced a drought in 1998 which caused devastating effects on the economy and the people. Because the Western areas of Viti Levu and northern Vanua Levu were mostly affected, the sugar industry was mostly crippled. The drought caused many families in the affected areas in need of relief supplies farmers experienced low income and on the whole, the economy experienced low export earnings.



Activity 10.4

Mapping

Draw an outline map of Fiji, locate and name

- (i)An area that is frequently affected by cyclones
- (ii)An area that is frequently affected by floods
- (iii)An area that is prone to earthquake tremors
- (iv)An area that is prone to droughts.

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