MINISTRY Of EDUCATION

PHYSICAL GEOGRAPHY

YEAR 11 & 12





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NTRODUCTION

What is Geography?

Geography is the study of the physical features of the earth and its atmosphere, and of human activity as it affects and is affected by these, including the distribution of populations and resources, land use, and industries.

Our approach in this book has been to provide a balanced level of the coverage of the field. Particular emphasis is placed on the understanding of change, balance and relationship of the processes of the physical and cultural environment. This includes problems and preventative measures.

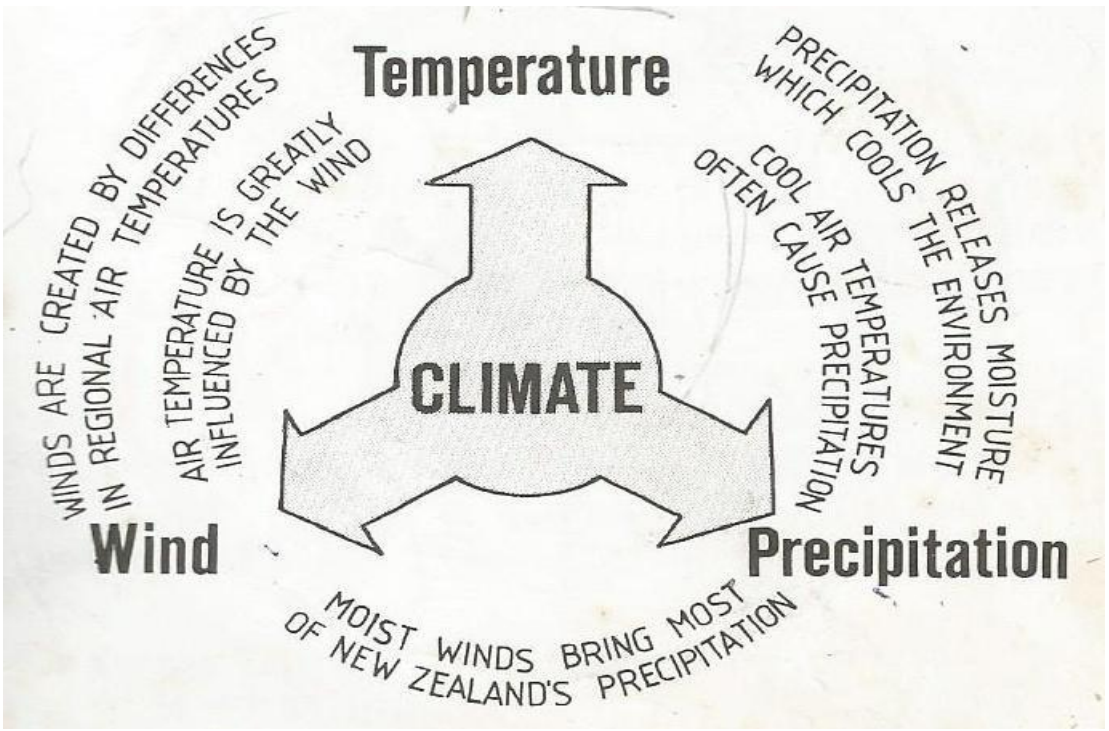
To meet the challenge of the future, a geography student should be able to know and understand facts and concepts, apply geographical skills, analyze information and use geographical perspective to evaluate, make decisions about and report on issues, processes and events.

CHAPTER 1

CLIMATE – NEW ZEALAND

Climate refers to average weather condition of a place or region taken over a several decade. Weather on the other hand refers to daily atmospheric condition of a place. Although weather may change markedly from one hour to another, a relatively stable general pattern can usually be observed each season of the year. The longer our weather conditions are measured and recorded, the more accurately climate can be determined.

The Elements of Climate



Source: New Zealand; a new geography

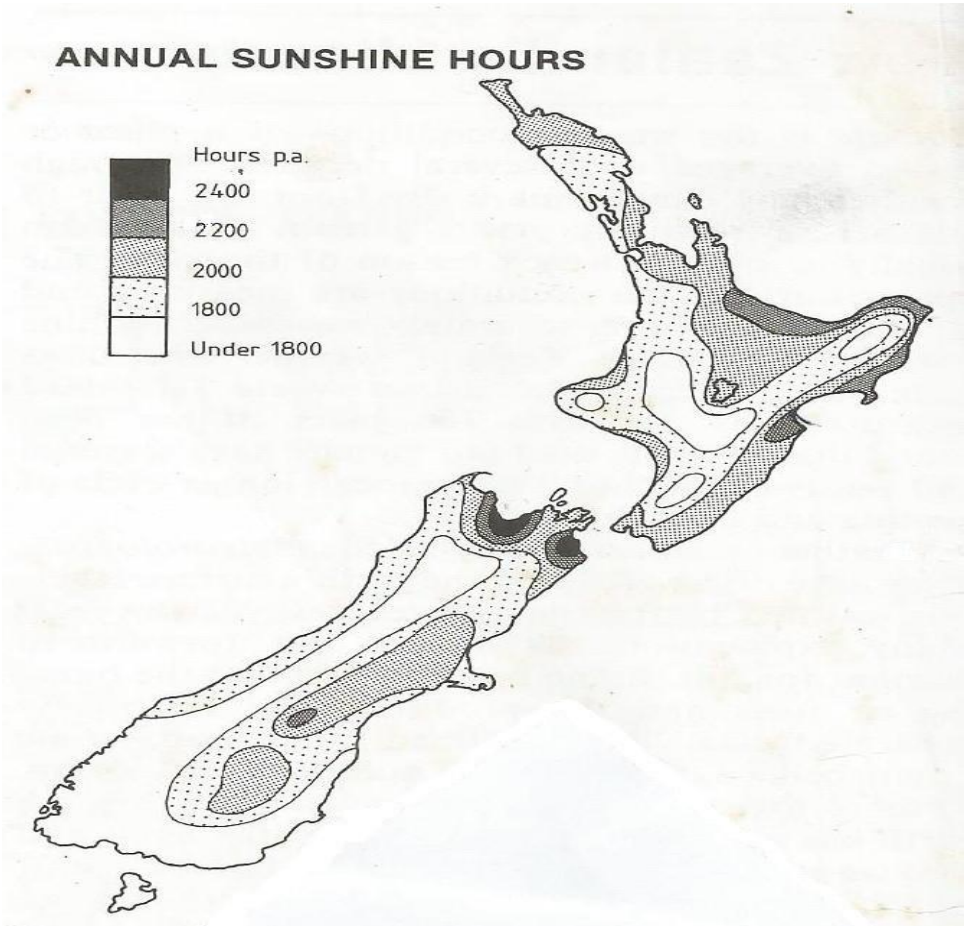
The long-term state of the atmosphere is a function of a variety of interacting elements.

Solar radiation

This is probably the most important element of climate. Solar radiation heats the earth's surface which in turn determines the temperature of the air above. The amount of solar radiation received by any place in New Zealand is determined by

- ⌘ The time of the day –in the 24 hour diurnal cycle
- ⌘ The time of the year – in the 12 month seasonal cycle
- ⌘ The atmospheric conditions – cloud or pollution cover
- ⌘ The height above sea level.

New Zealand stretches from 34 degrees South to 47 degrees South on the globe and is spread over a distance of some 1600 kilometers. It sits in the centre of the Southern Temperate zone. The northern parts of New Zealand are closer to the tropical zone and so they receive more concentrated solar radiation which produces a sub-tropical climate. The southern regions, on the other hand, are closer to the South Pole so they receive less solar radiation, and the temperatures are usually cooler.



Activity 1.0

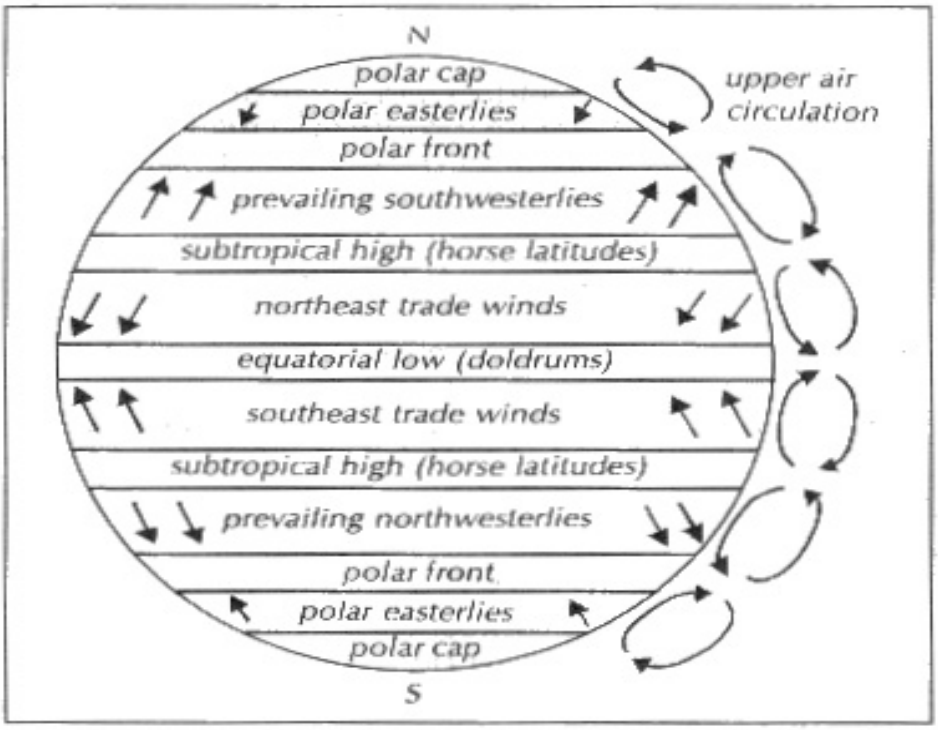
1. Why are summer temperatures warmer than winter?
2. Draw a diagram to show how summer and winter sun is received over New Zealand.
3. Approximately how many sunshine hours does Auckland receive each year?
4. Approximately how many sunshine hours does South Island High Country receive each year?
5. Why does Auckland receive more sunshine hours than the South of South Island?

Wind- is the moving air. It is expressed in kilometers per hour and measured with an anemometer.

Pressure System

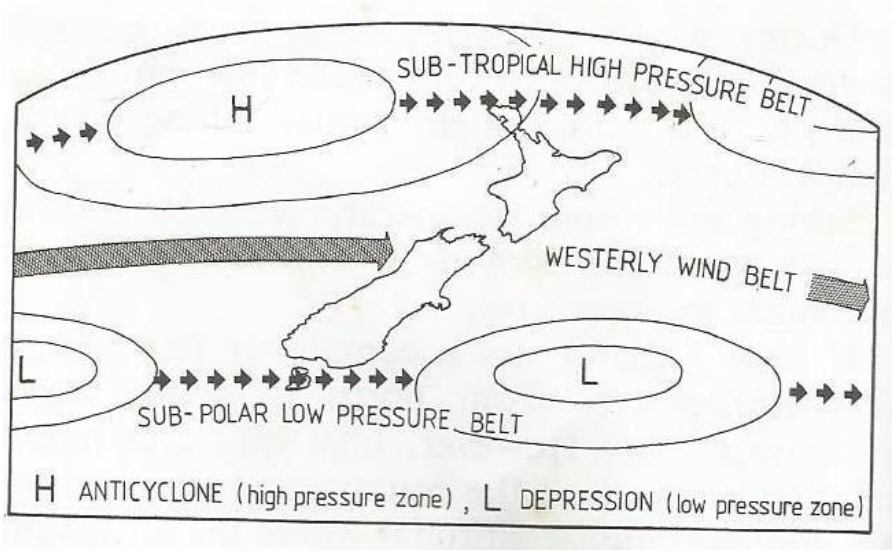
Air is made up of gases and when gases are heated up, they rise. Gases in the air have mass and weight. When air rises the particles that make up the air spreads out, and the weight, or pressure, of the air is lowered. Rising air brings low air pressure.

As cold air descends the air pressure increases. This is because the gravity draws the air particles downwards and the weight, or pressure of the air increases. Descending air pressure brings high air pressure.



Source: indshttps://www.google.com/search?q=Global+pressure+belts+images&client=firefox

In the Southern Hemisphere the Sub-tropical High Pressure Belt encircles the earth to the north of New Zealand. This pressure belt produces high pressure cells, called anticyclones that drift eastward and cross New Zealand every six to ten days.

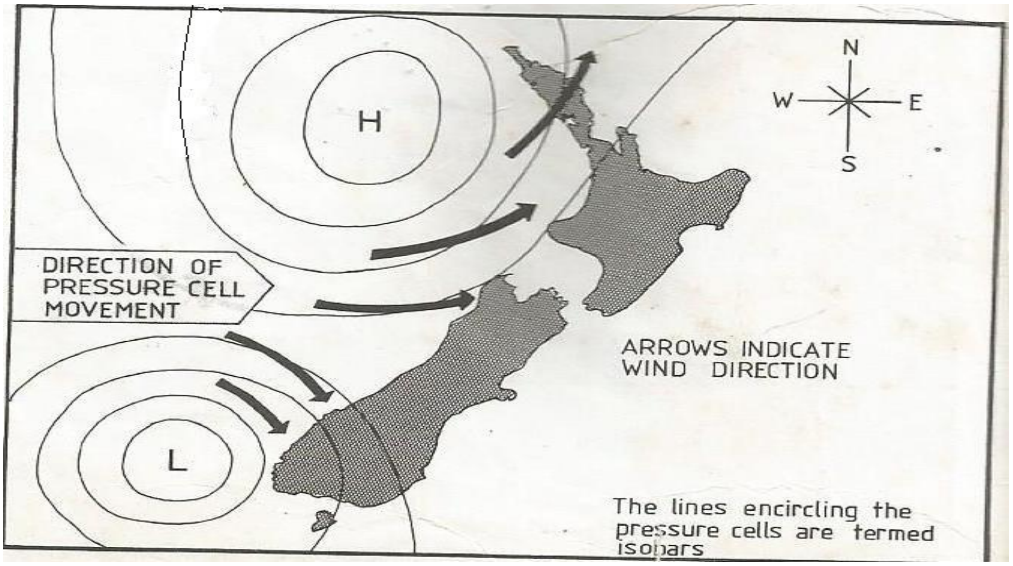


Source: New Zealand; a new geography.

A belt of low pressure circles the earth below New Zealand. The pressure belt produces low pressure cells, called depression, that drift eastward crossing New Zealand every 6 to 10 days in between anticyclones. A depression brings thick cloud cover and wet weather.

The regular passage of anticyclones and depressions over the country produces a very changeable climate that is described as New Zealand's 'six to ten day weather cycle'.

In summer the belt of anticyclones drift southwards, bringing finer weather to most parts of New Zealand. In winter the belt of depressions 'drift' northward bringing cloudier and wetter conditions to most part.



Source: New Zealand Geography; a new geography.

Activity 1.1

Mapping

On the outline map of New Zealand, locate and name the following:

i. the high pressure cell during summer

ii. the prevailing wind

iii. an area on the South Island that experiences 'fohn winds'

iv. the ' Roaring Forties'

CLIMATIC FACTORS/ CONTROLS AFFECTING CLIMATE

There are many different factors that affect climate around the world. New Zealand is also affected by the climatic controls. The most important natural factors are:

1. Distance from the sea.

The sea affects the climate of a place. Coastal areas are cooler and wetter than inland areas. The long narrow shape of New Zealand ensures that most places are close to sea. The sea influences New Zealand's climate in three main ways:

- The vast expanse of ocean and the warm currents to the west of New Zealand, ensure that the westerly winds that blow over the county are laden with moisture. The larger the expanse of warm water a wind moves across, the more moisture it evaporates and carries.
- Low land within fifty km of the coast kept a low moderate temperature throughout the year. This is because the ocean temperature remains more or less the same all year around. Breeze that blow onto the land warm the air over the land in the winter, and cools it in the summer.
- Winds that cross currents of warm sea water on their way to New Zealand are warmed and wind that cross cold currents are chilled.

2. Ocean Currents

Ocean moves in currents propelled by prevailing winds. The belt of westerly winds, around latitude 40 degrees south, drives the ocean currents in the westerly directions towards New Zealand. The main ocean current reaching New Zealand is West Wind Drift. It is a mixture of warm water that has flowed down the eastern seaboard of Australia (Warm Tasman Current), and cooler waters from the sub polar regions.

3. Direction of Prevailing Winds

Winds that blow from the sea often bring rain to the coast and dry weather to inland areas. The prevailing westerly's are an important feature of New Zealand's climate.

4. Relief

Climate can be affected by relief. The western slopes of New Zealand's mountains are the main areas where rain occurs. These areas have the highest rainfall recordings because the westerly winds that cross the Tasman Sea absorbs water vapor and reach the coast laden with moisture. On reaching the mountains the warm, moist air is forced to rise, it cools and the water vapor condenses and falls as rain.

5. Latitude

Places on or near the equator are warmer than places far away from it. At the north and south poles, the sun's rays are scattered over a wide area which shade the heat.

6. Altitude

As altitude increases, the temperature decreases. For every 1000m increase in height there is a decrease of about 6 degrees Celsius of the temperature.

Activity 1.3

Essay

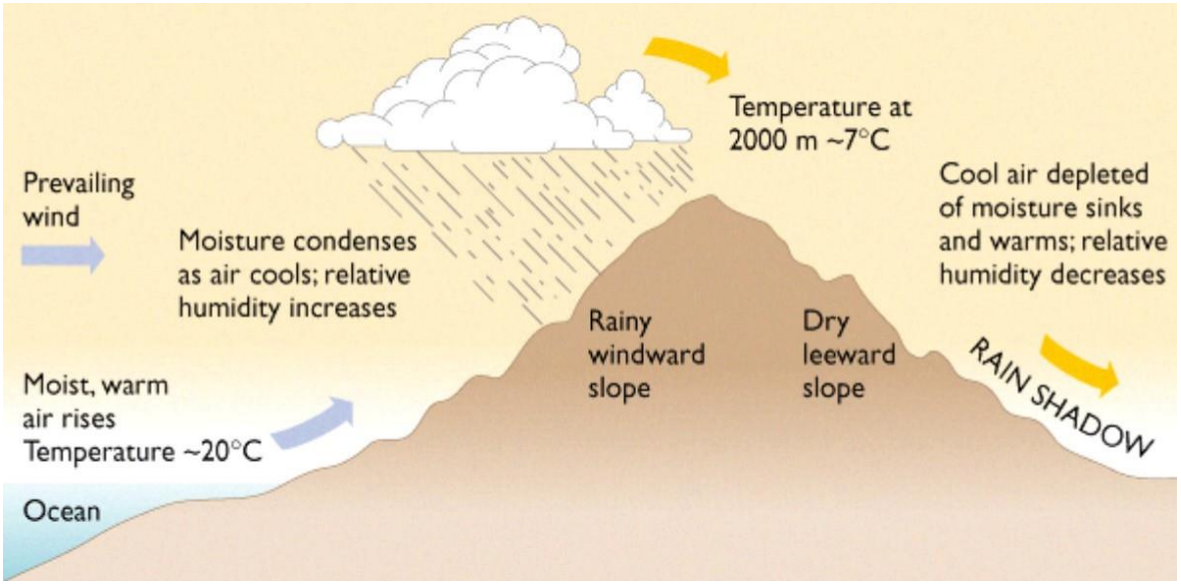
With reference to **climatic region** in New Zealand, discuss how the **climatic elements** interact with the **climatic controls** resulting in distinctive climatic features.

TYPES OF RAINFALL

There are three main types of rainfall:

Orographic rainfall

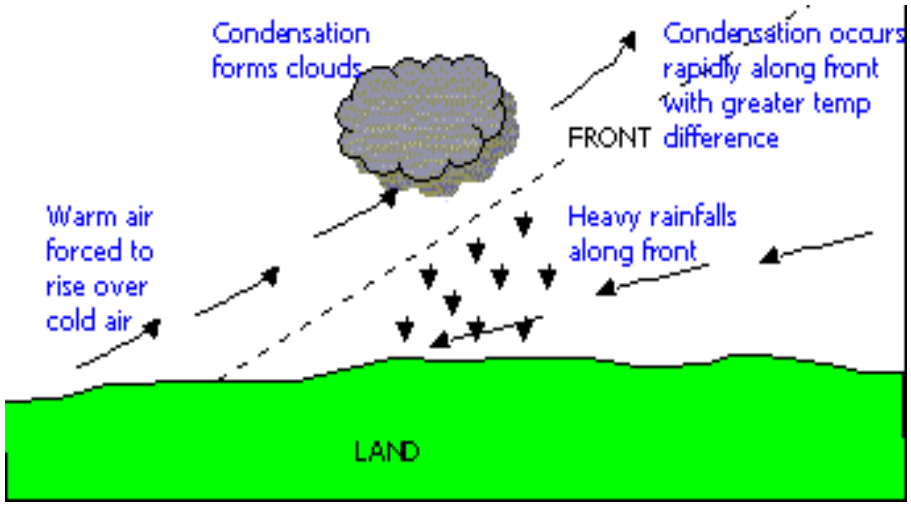
Commonly occurs on the windward slopes of mountain ranges. Warm, moist air meets the mountain barrier and tries to find a path around it. If there is none, the air is forced to rise up over the slope. In rising, the air will cool and release some of its moisture as rain.



Source :https://www.google.com/search?q=types+of+rainfall&client

Cyclonic (or frontal) rainfall

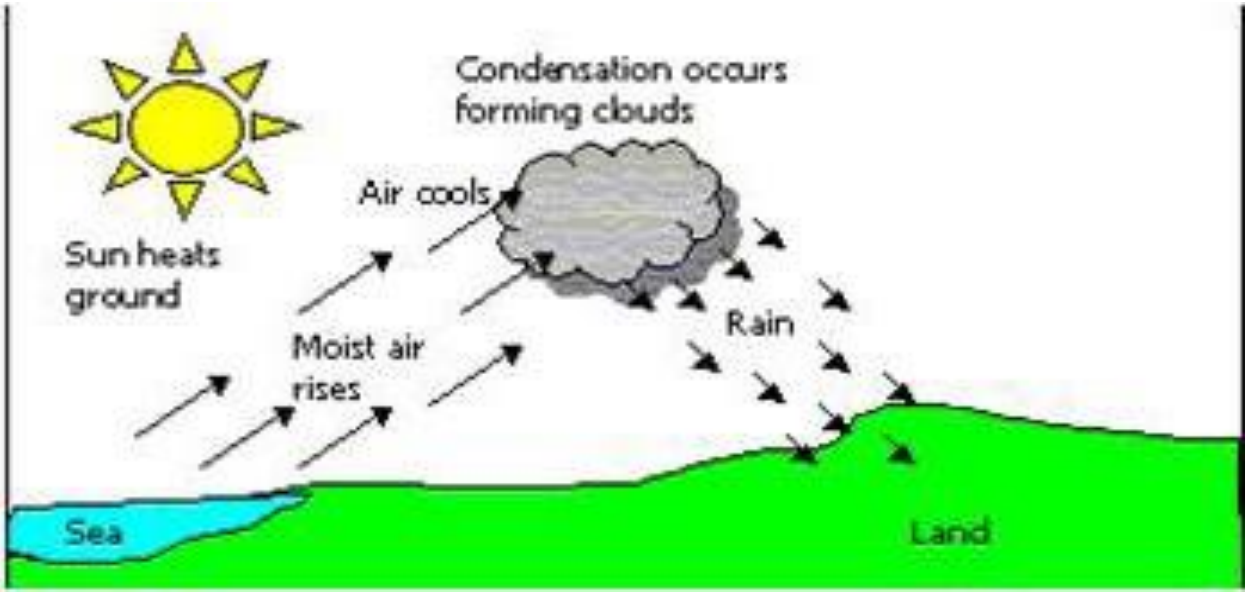
Occurs when warm, moist air comes into contact with cool air during the passage of a depression. The warm air rises up over the cooled air and as it does so it is cooled, clouds form and rain falls.



Source: https://www.google.com/search?q=types+of+rainfall&client

Convectional rainfall

Often occurs in some parts of the country, at the end of a hot, still day. During the day, hot sunshine from a clear sky forces the warm surface air to expand, rise and carry moisture up into the sky. As the ground surface continues to warm, incoming air is also warmed and forced to rise. Eventually, the buildup of rising warm air forces the air that has already risen to reach a much colder temperature zone causing condensation, cloud formation and precipitation.

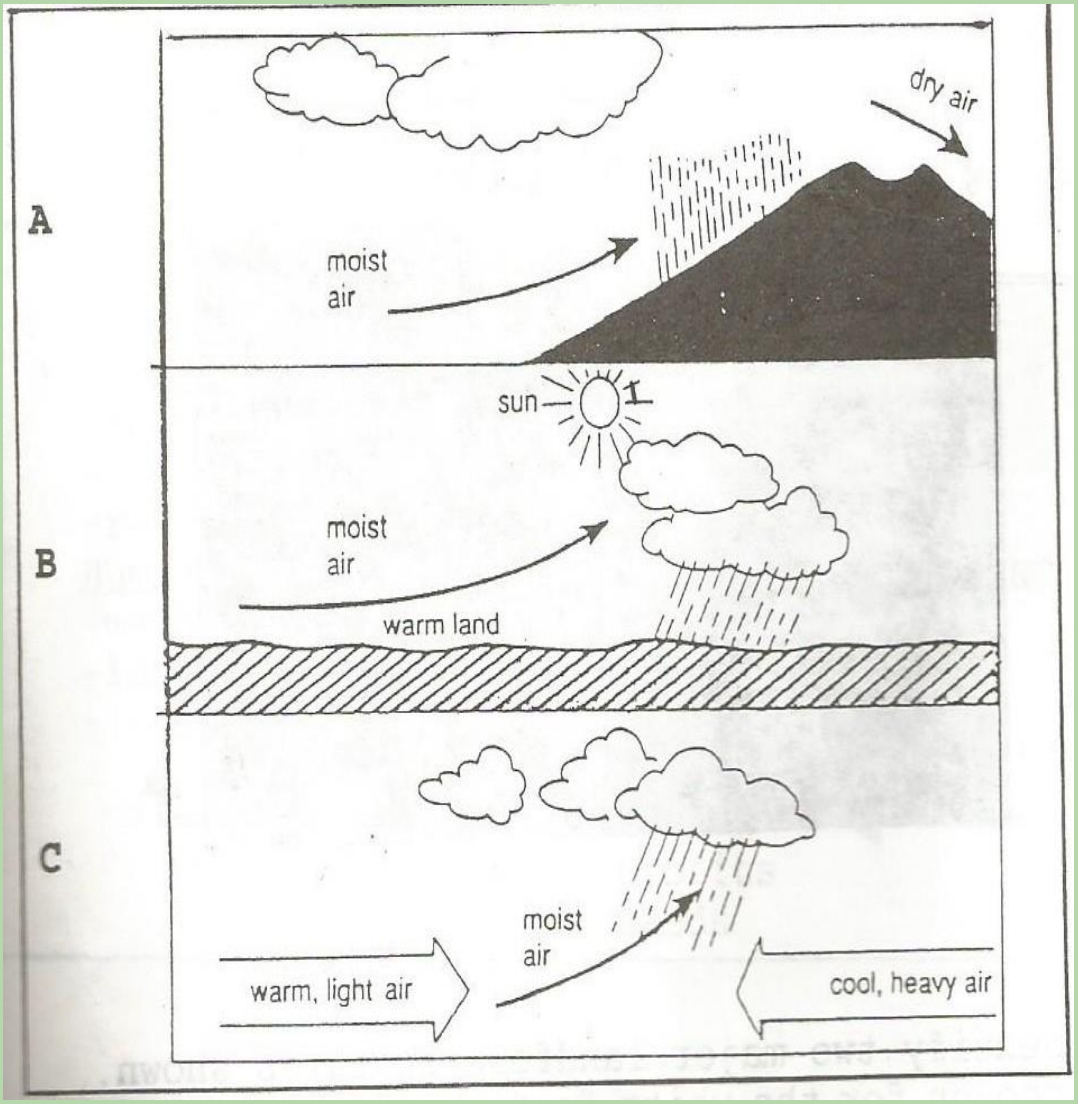


Source :https://www.google.com/search?q=types+of+rainfall&client

Activity 1.4

Resource Interpretation

Use the resource given below and you knowledge to answer the questions that follow.



Source: New Zealand; a new geography

a) Name any two of the types of rainfall shown.

b) State briefly how any one of these types of rainfall occurs.

c) During which part of the day would rainfall type B frequently fall?

d) After the rainfall in A, why would the wind be dry?

Global warming \ Greenhouse Effect

This refers to the warming up of the earth's atmosphere caused by emission of carbon dioxide and other poisonous gases into the atmosphere. These gases act like a blanket, preventing the natural escape of heat to the atmosphere and also damage the ozone layer making it ineffective to carry out its task of filtering the sun's rays. The situation has been developing in the world for over 150 years because of:

i) Burning of fossil fuels which releases vast amount of carbon dioxide to the atmosphere.

ii) Deforestation, which results in fewer trees being available to take in the carbon dioxide.

Effects of Global Warming

i. Rise in temperature would cause the development of new areas of desert making food production difficult.

ii. Huge ice sheets in the poles and in the higher mountainous region would half melt resulting in the side effects

- flooding in low lying coastal areas
- loss of life of men and other organisms that live in these areas
- loss of productive coastal farmland, food supplies, housing and industry.

What is El Niño?

El Niño is a naturally occurring event in the equatorial region which causes temporary changes in the world climate. Originally, El Niño was the name used for warmer than normal sea surface temperatures in the Pacific Ocean off the coast of South America. Now, El Niño has come to refer to a whole complex of Pacific Ocean sea-surface temperature changes and global weather events. The ocean warming off South America is just one of these events.

What causes an El Niño?

In normal, non-El Niño conditions, trade winds blow in a westerly direction along the equator. These winds pile up warm surface water in the western Pacific, so the sea surface is as much as 18 inches higher in the western Pacific than in the eastern Pacific. These trade winds are one of the main sources of fuel for the Humboldt Current. The Humboldt Current is a cold ocean current which flows north along the coasts of Chile and Peru, then turns west and warms as it moves out into the Central Pacific. So, the normal situation is warmer water in the western Pacific, cooler in the eastern.

In an El Niño, the equatorial westerly winds diminish. As a result, the Humboldt Current weakens and this allows the waters along the coast of Chile and Peru to warm and creates warmer than usual conditions along the coast of South America.

What is ENSO?

ENSO is the “El Niño-Southern Oscillation,” the name scientists use for what is often called El Niño. The Southern Oscillation is a see-saw shift in surface air pressure between the eastern and western halves of the Pacific. When pressure rises in the east, it falls in the west and vice versa. In the 1950’s scientists realized that El Niño and the Southern Oscillation were parts of the same event.

Source: http://www.dfg.ca.gov/marine/elnino.asp

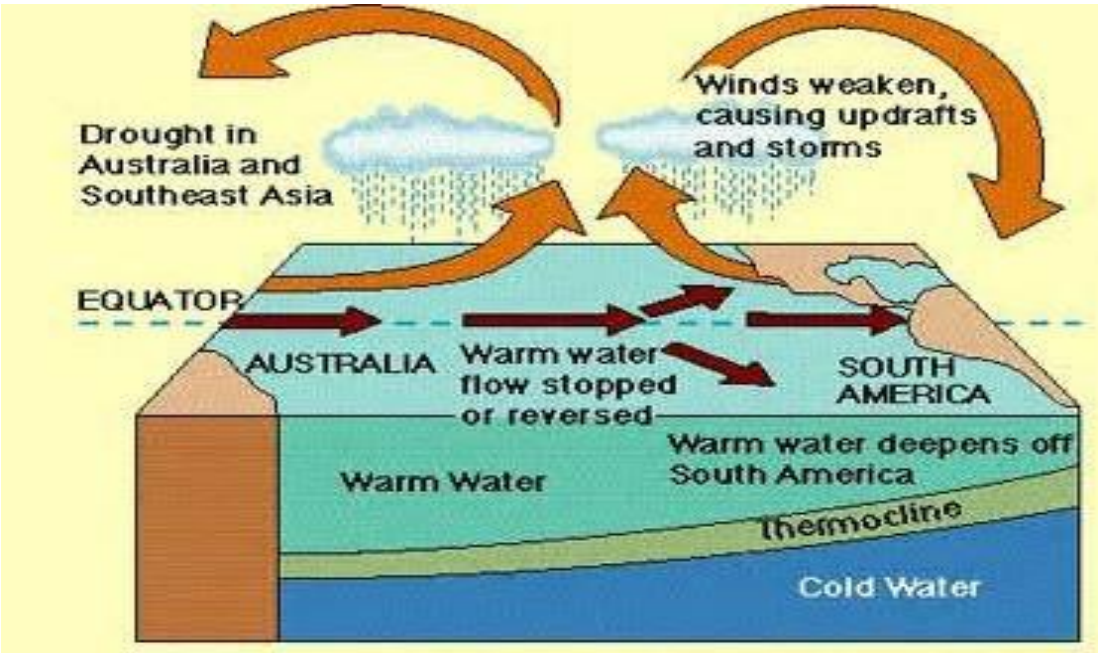
In New Zealand likely climate change impacts include:

- higher temperatures, more in the North Island than the South, (but still likely to be less than the global average)
- rising sea levels
- more frequent extreme weather events such as droughts (especially in the east of New Zealand) and floods
- a change in rainfall patterns - higher rainfall in the west and less in the east.

These changes will result in both positive and negative effects. For example:

- agricultural productivity is expected to increase in some areas but there is the risk of drought and spreading pests and diseases. It is likely that there would be costs associated with changing land-use activities to suit a new climate
- people are likely to enjoy the benefits of warmer winters with fewer frosts, but hotter summers will bring increased risks of heat stress and subtropical diseases
- forests and vegetation may grow faster, but native ecosystems could be invaded by exotic species
- drier conditions in some areas are likely to be coupled with the risk of more frequent extreme events such as floods, droughts and storms
- rising sea levels will increase the risk of erosion and saltwater intrusion, increasing the need for coastal protection
- snowlines and glaciers are expected to retreat and change water flows in major South Island Rivers.

Source: https://www.mfe.govt.nz/issues/climate/about/impacts.html



Source: www.ocean.tamu.edu

IMPACTS OF EL NINO IN NEW ZEALAND

Source: www.agweb.com.

CLIMATE OF NEW ZEALAND

FEATURES OF NEW ZEALAND's CLIMATIC REGIONS

Regions	Type of climate
i) Winterless North Region	- warm in all seasons as it is nearer to the equator compared to the rest of NZ - maritime and latitude influence - few forests - ample or enough rainfall
ii) Central North island	- relief and interior location influences - cool temperature - in any frosts - ample rain and snow
iii) Wet West (North/ South Islands)	- affected by changing westerly winds - plenty of sunshine and rain - South Island has heavier rainfall controlled by westerly winds, warm Tasman and mountains
iv) Dry East (North and South Island)	- rain shadow areas - plenty of sunshine - South Island has cooler temperature and experiences fohn winds
v) South Island mountains	- relief is a major influence - Very cold in all seasons - heavy rainfall and snow - snow and ice covered peaks
vi) Inland South Island	- relief and interior location influence - great daily and annual temperature ranges - moderate rainfall - presence of frosts and fogs
vii) Southern New Zealand	- maritime and latitude influence - low temperature and sunshine - moderate rainfall

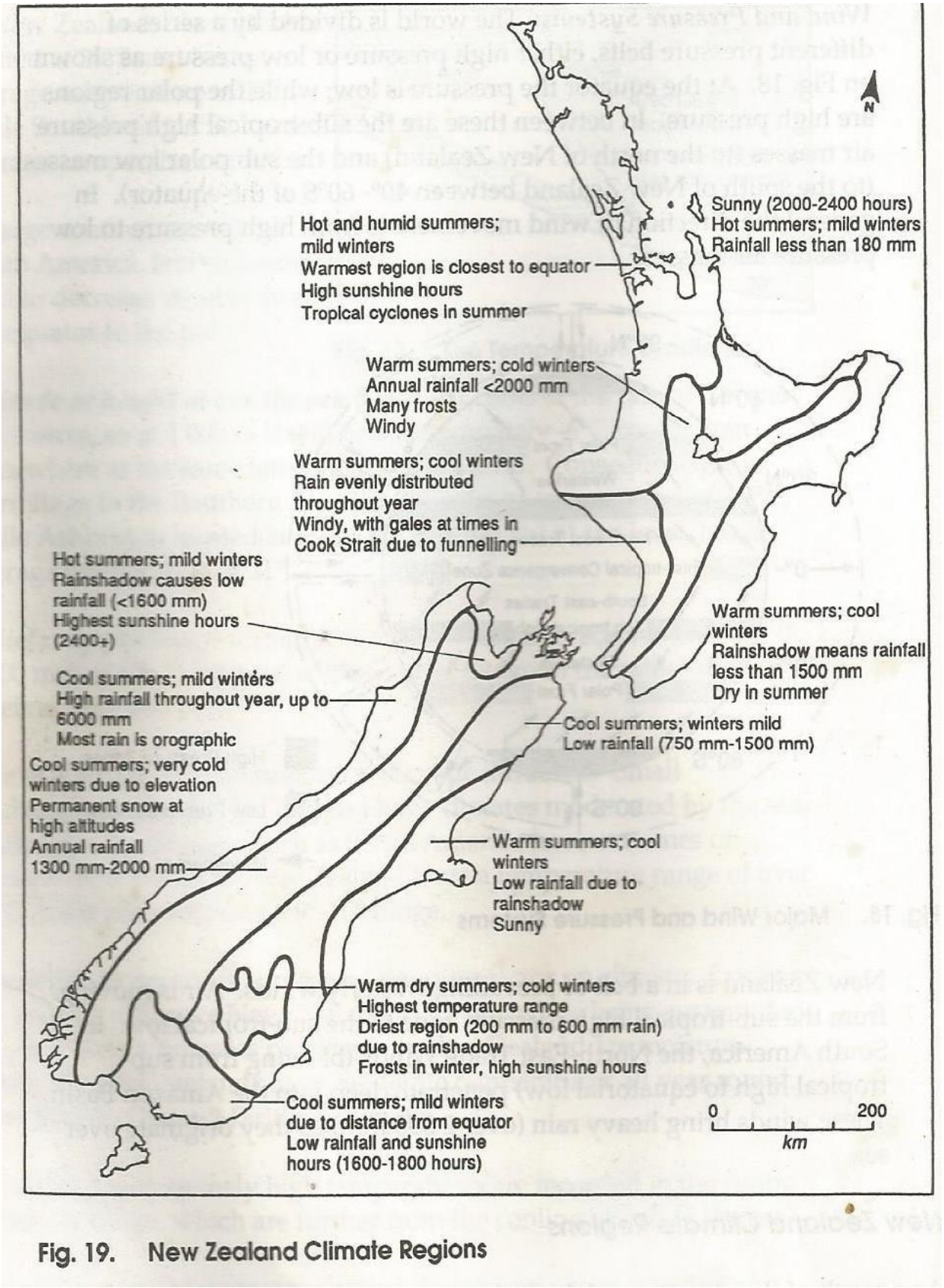


Fig. 19. New Zealand Climate Regions

Source: Form 6 Geography Revision

Economic Significance of Climate to New Zealand.

- Farming is the backbone of New Zealand. Approximately 50% of the country is suitable for farming. The interaction of relief, climate, vegetation and soils produce many different areas that can be used for farming. We will specifically look at how climate affects economic activities, specifically farming in New Zealand.

Farming types	**Location**	**Climatic characteristic**	**Landscape**	**Output**
Dairying	Northland Southland Manawatu Lowland	Hill/relief. Rainfall	Flat ,gentle slope or fertile soil	Milk & milk products
Mixed farming	Canterbury plains	Hot, dry summer, cool winter in South Island	Fertile soil	Crops such as wheat, peas, potatoes, barley, fat lambs, etc..
Horticulture (fruits, vegetables, flowers)	Nelson Bay of Plenty Hawkes Bay Northland Otago	Long warm summers Cool winter in the South Island	Flat land Fertile soil	Flowers, blue strawberry, vegetables such as kiwi fruit, lettuce, avocado, peas, etc.
Extensive sheep farming	East coast Hawkes Bay Wairarapa Hill Country South Is. Hill Country	Harsh climatic Extreme/ cool winters and dry summers	Rugged terrain in the South Island and lowlands in the North	Wool, mutton, lamb flaps, beef, etc.

Activity 1.5

Mapping

Draw an outline map of New Zealand, locate and name the following:

(i) The windiest area in New Zealand waters.
(ii) A large rain shadow region
(iii) The position of warm ocean current
(iv) The coldest lowland region in New Zealand
(v) The cool ocean current
(vi) An area with very high rainfall
(vii) An area that receives more than 2400 hours of sunshine per year
(x) The prevailing winds

Terms

Air pressure – the force exerted on to a surface by the weight of the air.

Climate –average conditions of the atmosphere over a long period of time.

Climatic elements - Any one of the properties or conditions of the atmosphere and ocean that together define the climate of a place (e.g., temperature, humidity, precipitation).

Convectional rain – rain which caused by the process of convection in the atmosphere. When the surface layers of the atmosphere are heated, the moisture laden air rises in a convection current, and in rising is cooled till the dew point is reached, and it's water vapour condenses to form clouds.

Cyclonic /frontal Rain – rain associated with a passage of cyclone or depression, and caused by warm, moist air moving upwards over colder, heavier air.

El nino – refers to abnormal conditions which might happen to prevailing winds and currents and results in their change or even reverse their directions.

Global warming - An increase in the average temperature of the earth's atmosphere, especially a sustained increase sufficient to cause climatic change.

Insolation – radiant energy received from the sun by the earth.

Orographic rain – rain which is caused by mountains standing in the path of moisture laden air; thus air is forced to rise, is hereby cooled, and if sufficient water vapor is present, rain is deposited on the higher ground.

Rainfall – the total amount of rain deposited on a given area during a given time, as measured by a rain gauge.

Solar radiation – is the heat energy that comes from the sun.

Temperature – how hot or cold an environment is.

Weather – is the day to day pattern of precipitation, temperature, winds and sunshine.

CHAPTER 2

CLIMATE: FIJI

Fiji enjoys a humid tropical maritime climate without great extremes of heat or cold. It is mainly dominated by the Southeast trade winds. Together with the topography, this controls the distribution of rainfall on the islands. Average annual precipitation ranges from 1500mm on the smaller islands to 4000mm on the larger islands. On the larger islands, topographic effects however cause a dry western climate suited for sugarcane and a similar distinctive wet and humid eastern climate where Suva (Viti Levu) is located.

The Elements of climate

1. Temperature

Temperatures at the lower level are fairly uniform. In the leeward side of the mountain, however on the western and northern sides of the main islands(including Taveuni) the day-time air temperatures often rise from 1degrees Celsius to 2 degrees Celsius above those on the windward sides or on the smaller islands. Also the humidity on the leeward side tends to be somewhat lower.

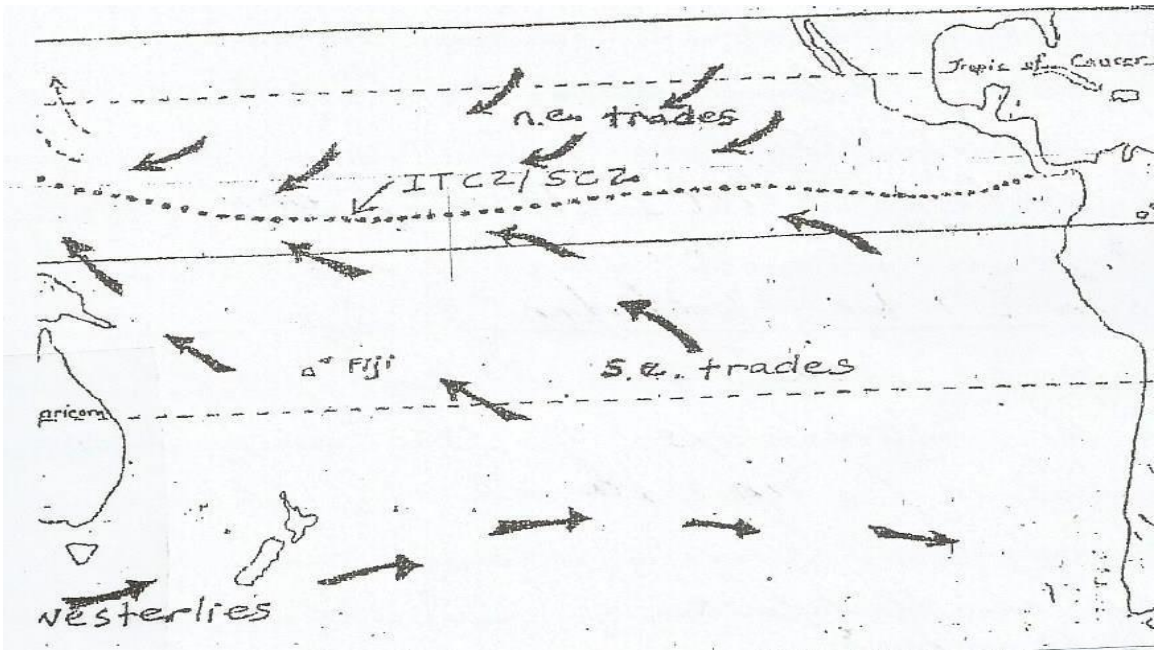
Due to the influence of the surrounding ocean, the changes in temperature from day to day and season to season are relatively small. The average temperatures change by only about two degrees Celsius to four degrees Celsius between the coolest months (July and August) and the warmest months (January and February). Around the coast the average night time temperatures can be as low as 18 degrees to 20 degrees Celsius and the average day-time temperatures can be as high as 30 -32 degrees Celsius. South Eastern coastal areas and the high interior often experience persistent cloudy humid weather.

2. Winds

The predominant winds over Fiji are the trade winds from the East to South East. On the coast of the two main islands day time sea breezes blow across with great regularity.

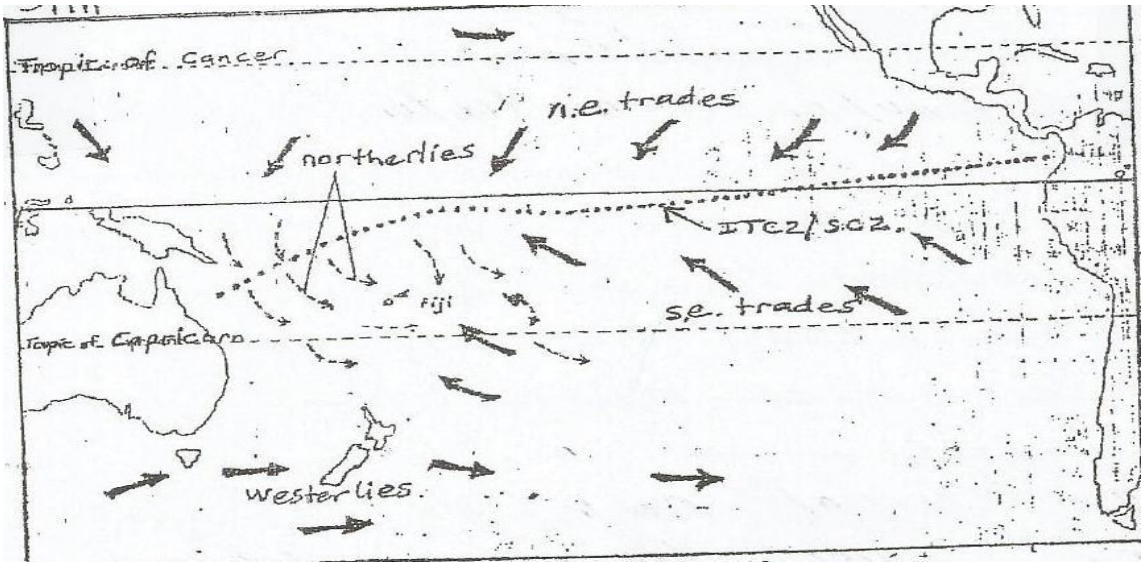
Generally, the winds in Fiji are light to moderate; strong winds are uncommon and are most likely to occur through channels and headlands in the period June to November when the winds are most persistent.

From May – October, when the overhead sun is north of Fiji, the group comes under the influence of the SE trade winds which blow from the high pressure belts(about 30 degrees latitude South) to the low pressure region. Also during the period, occasional depressions(low pressure) pass over Fiji bringing long steady periods of rain.



Main winds influencing Fiji in mid- winter- July

From November to April, winds are more variable, some easterlies, some westerlies and some northerlies. The northerlies in particular bring heavy rain to the northern and western sides of the larger islands. With more intense heat, there is a larger proportion of convectional rain. It is also a period of intense tropical storms.

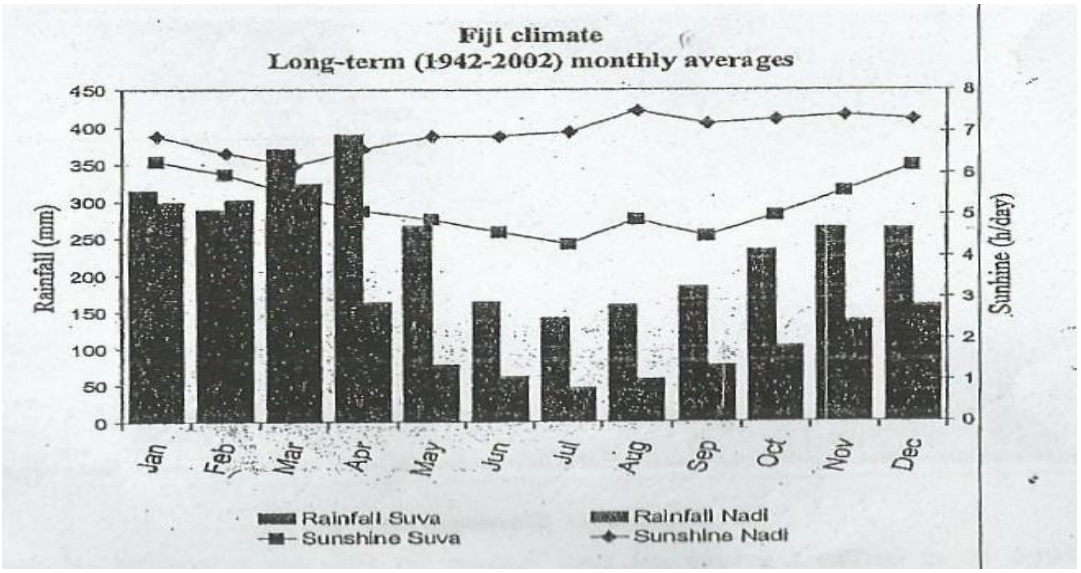


Main winds influencing Fiji in mid-summer (January)

The trade winds do not blow directly southwards towards the ITCZ but instead blow from southeast and northeast. This is because the earth spins on its axis once every 24hours. The force of the earth's rotation that causes the deflection is called coriolis force.

3. Precipitation

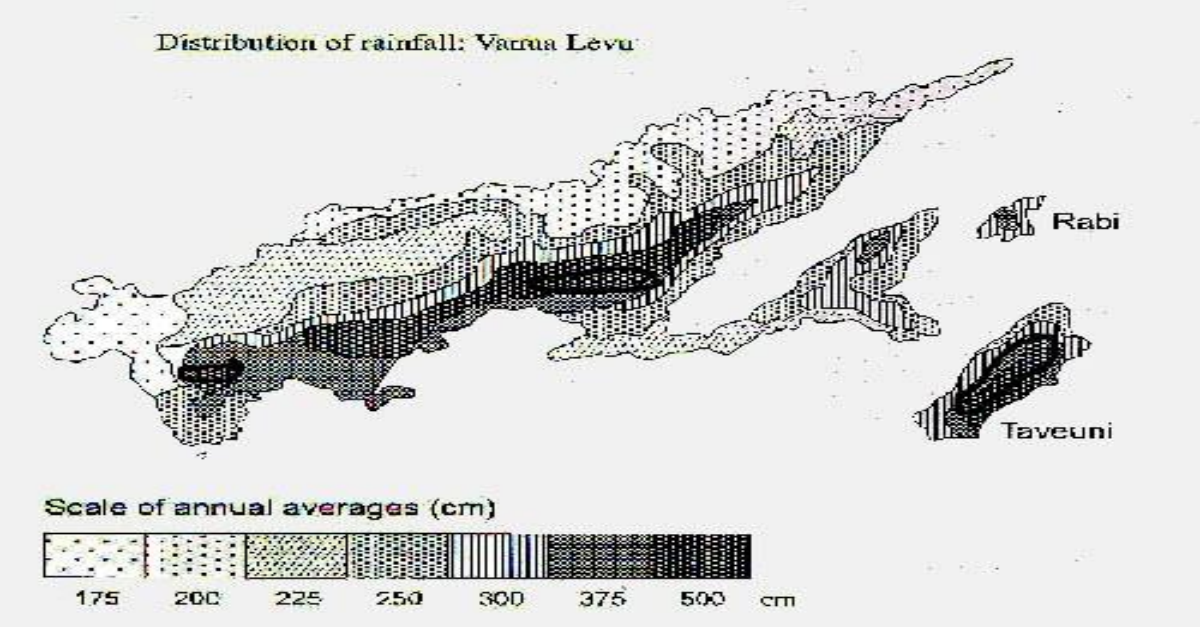
Rainfall is variable and mainly orographic (influenced by the island topography and the prevailing south east trades). The south –east trade winds are saturated with moisture, any high land mass lying in their path receives much of the precipitation.



Source: www.catalog.flatworldknowledge.com

Fiji experiences a distinct wet season (November to April) and dry season (May to October) that is largely controlled by the north and south movements of the South Pacific Convergence Zone which is the main rainfall producing system for the region.

Rainfall is usually abundant during the wet season especially over the larger islands and is often deficient during the rest of the year particularly in the dry zone in the northwestern sides of the main islands.

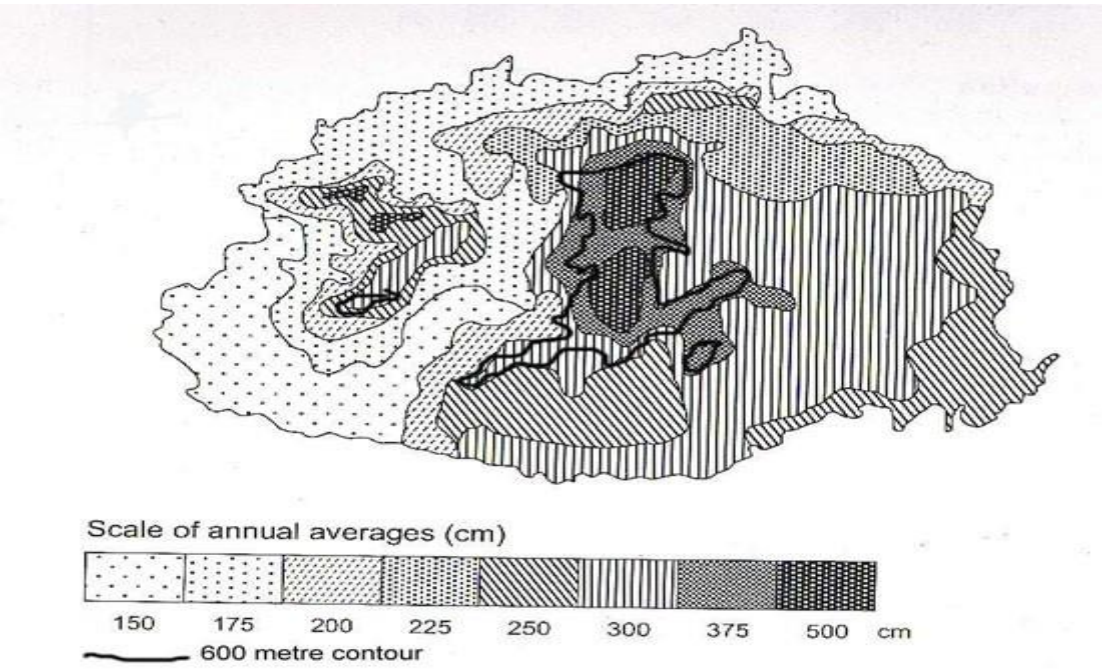


Source: www.fao.org

Wettest month is March and driest month is July,

During the warmer months, brief, heavy afternoon showers and thunderstorms are common known as convectional rainfall.

Fiji experiences prolonged dry spells quite often, usually for 3-4months duration, when the north-western parts of the main islands, receive little or no rain.



Source: www.fao.org

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Activity: 2.0

1. What are the three elements of climate?
2. What are the major seasons in Fiji and explain the causes ?
3. Briefly explain how winds influence the climate in Fiji.
4. Describe two factors that contribute to the formation of orographic rainfall in Fiji.

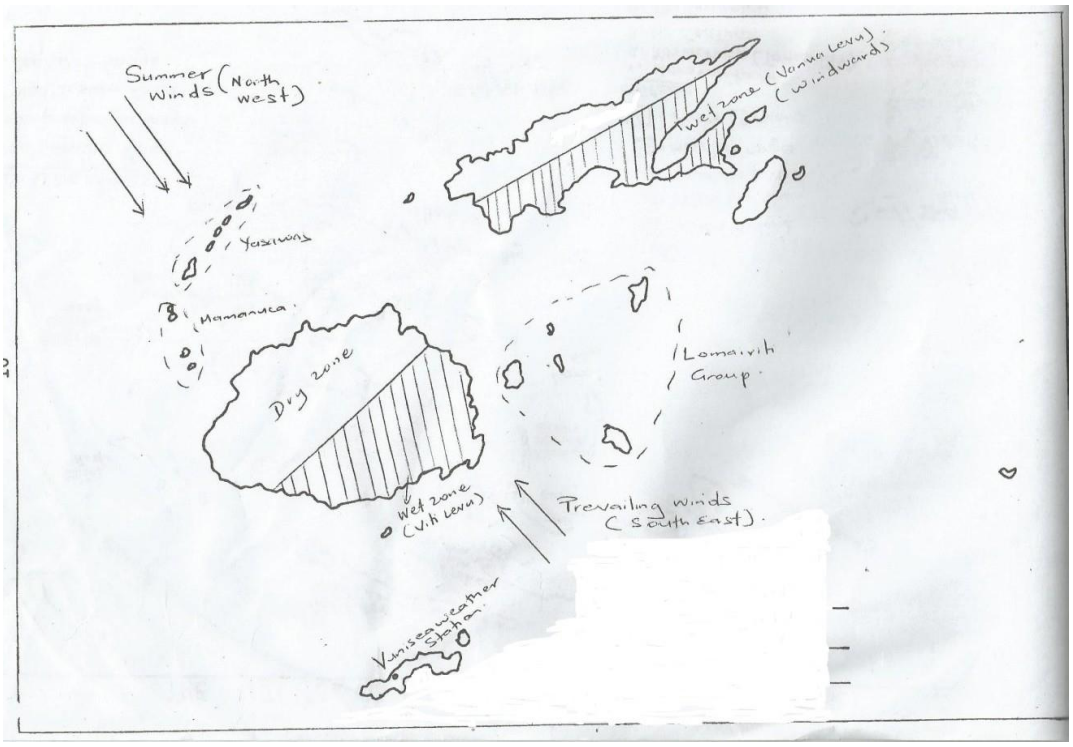
Climatic control factors/Factors affecting climate

Relief

The mountains on Viti Levu and Vanua Levu create wet climatic zones on their windward sides and dry climatic zones on their leeward sides; hence the main islands have pronounced dry and wet zones. Little climatic differentiation occurs on the smaller islands with low relief. Heaviest rainfall occurs on the windward parts of the larger islands.

The annual rainfall in dry zones – average – around 2000mm

Wet zones- ranges from 3000mm(coast) to 6000mm on the mountain sides.



Latitude

Does Latitude affect climate?

- Latitude exerts a large amount of control over any given area's climate.
- Latitude is probably the single most important determining factor in climate.

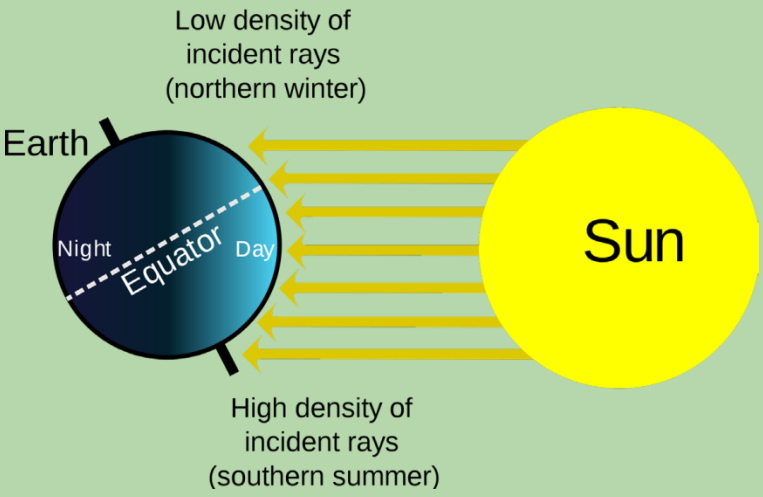
Fiji's position in the tropics (16 – 20 degrees south of the equator gives it 'high sunshine' conditions all year round. Consequently, the temperature is uniformly high, averaging about 25 degrees Celsius.

Proximity to the sea

The influence of the surrounding seas and oceans are the prominent factors behind the marine climate in Fiji. The flora and fauna is also according to the climatic condition.

Activity 2.1 Resource Study.

Use the resource given below and your own knowledge to answer the questions that follow.



Source: www.ei.leihighedu.com

(i) *Describe the effects of solar radiation on Fiji's climate.*

(ii) *Distinguish between low angle of incidence and high angle of incidence.*

(iii) *How does latitude influence climate.*

INFLUENCE OF CLIMATE ON LANDUSE

- Difference in climate – reflected in distribution of main cash crops – sugarcane, coconut and rice.
- Cane grown on dry side of Viti Levu and Vanua Levu because it needs a lot of sunshine to increase its sugar content. Average annual rainfall in these areas is 2000 – 2400mm rain is needed in the early stages of plant growth and a lot of warmth and sunshine is required for the crop to mature or have high sugar content.
- Harvesting usually last from about June to November
- Copra – main producing areas are wet eastern regions where there is no district dry season. Average annual rainfall in these areas is 4000 – 4800mm
- Rice grown in both wet and dry season according to various types used
- -Dry rice grown on many cane farms
- -Wet Irrigated rice – mainly in Nausori and Navua because it needs plenty of rainfall average rainfall in these areas are 3600-4000mm
- Banana's, dalo, yaqona, cocoa, ginger grows in areas of high rainfall where there is no marked dry season eg in interior of Viti Levu Wainibuka and Waidina areas and Naitasiri

Activity 2.1

Mapping

Draw an outline map of Fiji, locate and name the following features;

(iv) A water surplus region

(v) A water deficit region

(vi) A sugar cane growing area

(vii) A rice production area

CHANGE IN CLIMATIC PATTERN

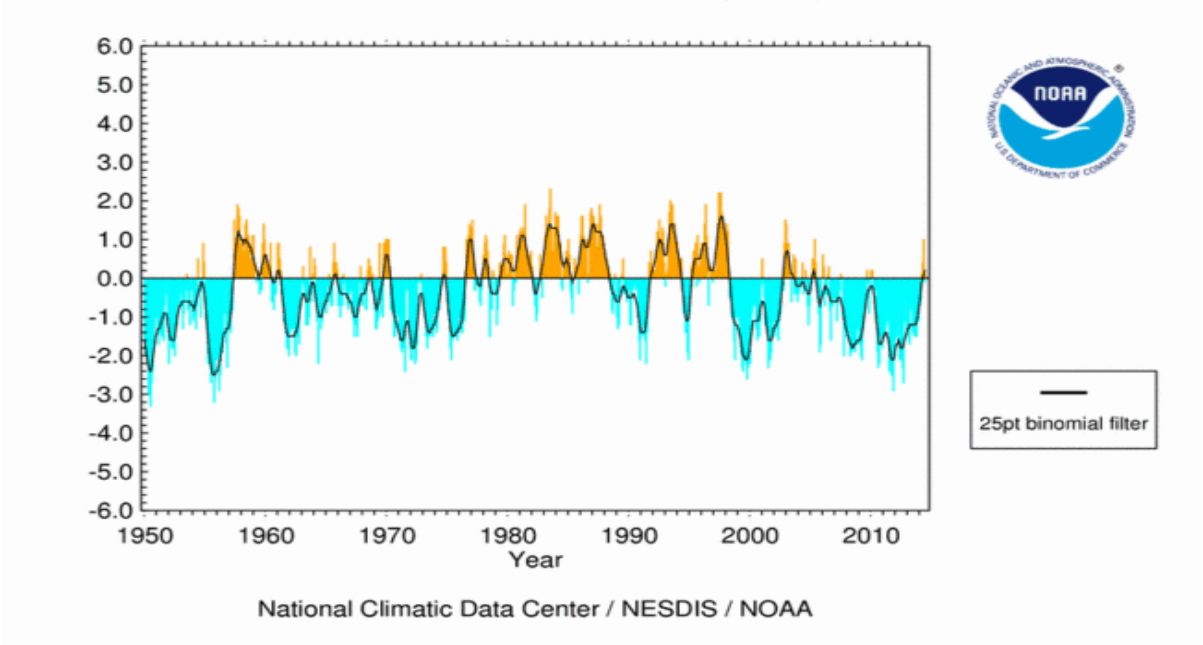
What causes change in climatic pattern?

Earth's climate is changing in the way it affects our weather, oceans, ecosystems and society. Human activities are contributing to climate change primarily by releasing billions of tons of carbon dioxide and other heat trapping gases known as greenhouse gases into the atmosphere every year. Manufacturing, driving, electricity generation and deforestation contribute to greenhouse gases which warms the planet.

Pacific decadal Oscillation (PDO)

The PDO is a long-lived El-Nino like pattern of Pacific climate variability. While the two climate oscillations have similar spatial climate fingerprints, they have very different behavior in time. The term PDO was coined by fisheries Scientist Steven Hare while researching connections between Alaska salmon productions and pacific climate.

The Pacific Decadal Oscillation (PDO) is a pattern of Pacific climate variability similar to ENSO in character, but which varies over a much longer time scale. The PDO can remain in the same phase for 20 to 30 years, while ENSO cycles typically only last 6 to 18 months. The PDO, like ENSO, consists of a warm and cool phase which alters upper level atmospheric winds. Shifts in the PDO phase can have significant implications for global climate, affecting Pacific and Atlantic hurricane activity, droughts and flooding around the Pacific basin, the productivity of marine ecosystems, and global land temperature patterns. Experts also believe the PDO can intensify or diminish the impacts of ENSO according to its phase. If both ENSO and the PDO are in the same phase, it is believed that El Niño/La Nina impacts may be magnified. Conversely, if ENSO and the PDO are out of phase, it has been proposed that they may offset one another, preventing "true" ENSO impacts from occurring.



Source: www.slate.com

Warm PDO

The broad area of above average water temperatures off the coast of North America from Alaska to the equator is a classic feature of the warm phase of the Pacific Decadal Oscillation (PDO). The warm waters wrap in a horseshoe shape around a core of cooler-than-average water. Impacts from the PDO depend in part on how it is aligned with the ENSO cycle; if the cycles are in opposite phases, then effects will be weakened. However, when both the PDO and ENSO are in the warm phase, meaning ENSO would be in the El Niño phase, expected impacts on the southeast include:

- Below average winter temperatures
- Above average winter precipitation

Cold PDO

Opposite of the warm PDO, the expansive area of below average water temperatures off the coast of North America from Alaska to the equator signals the cold phase of the PDO. The areas of warmer-than-average sea surface temperatures in the central Pacific are surrounded by below average temperatures near the North American continent. Expected impacts from a cold PDO and ENSO (La Nina) phase on the southeast include:

- Above average winter temperatures
- Below average winter precipitation

The ENSO

The ENSO (El Nino Southern Oscillation) phenomenon appears to be a major contribution to the fluctuations of climate, especially rainfall in the South Pacific. It has been seen that during the ENSO episode, the rainfalls are extremely low in the dry zones. El Nino(boy child) which is a warm phase and La Nina (girl child) is a cold phase are opposite phases of ENSO events are not always distinct.

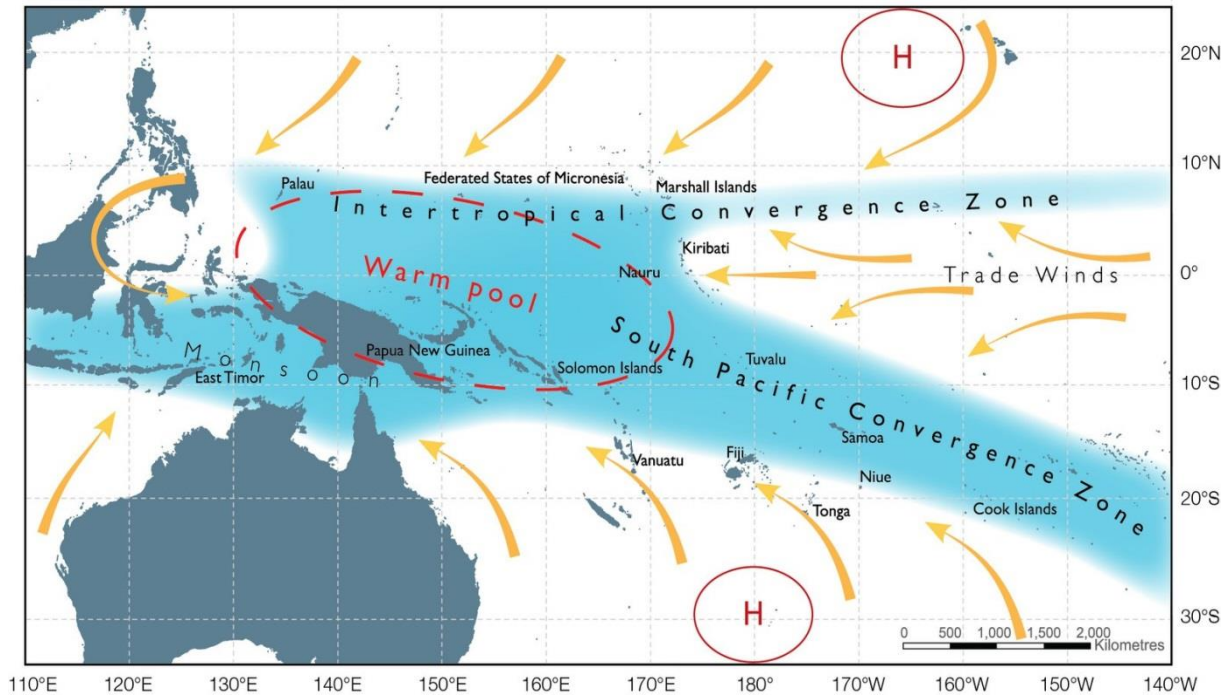
An El-Nino event usually results in drier and hotter conditions in Fiji during the wet and hot season, particularly from December to February and drier and cooler conditions in the cool and dry season , particularly between June and August. The most serious effect of strong El-Nino events in Fiji is the reduction in rainfall and increased likelihood of drought (e.g. in 1982 and 1997).However, El-Nino events beginning in the dry season may show up earlier in reduced rainfall (Kaloumaira,2002)

The opposite event –La-Nina can bring heavier rainfall in the wet season and occasionally above normal precipitation in the dry season. These events usually result in river flooding. The relationship between La-Nina and rainfall is strongest in the dry zones of the island.

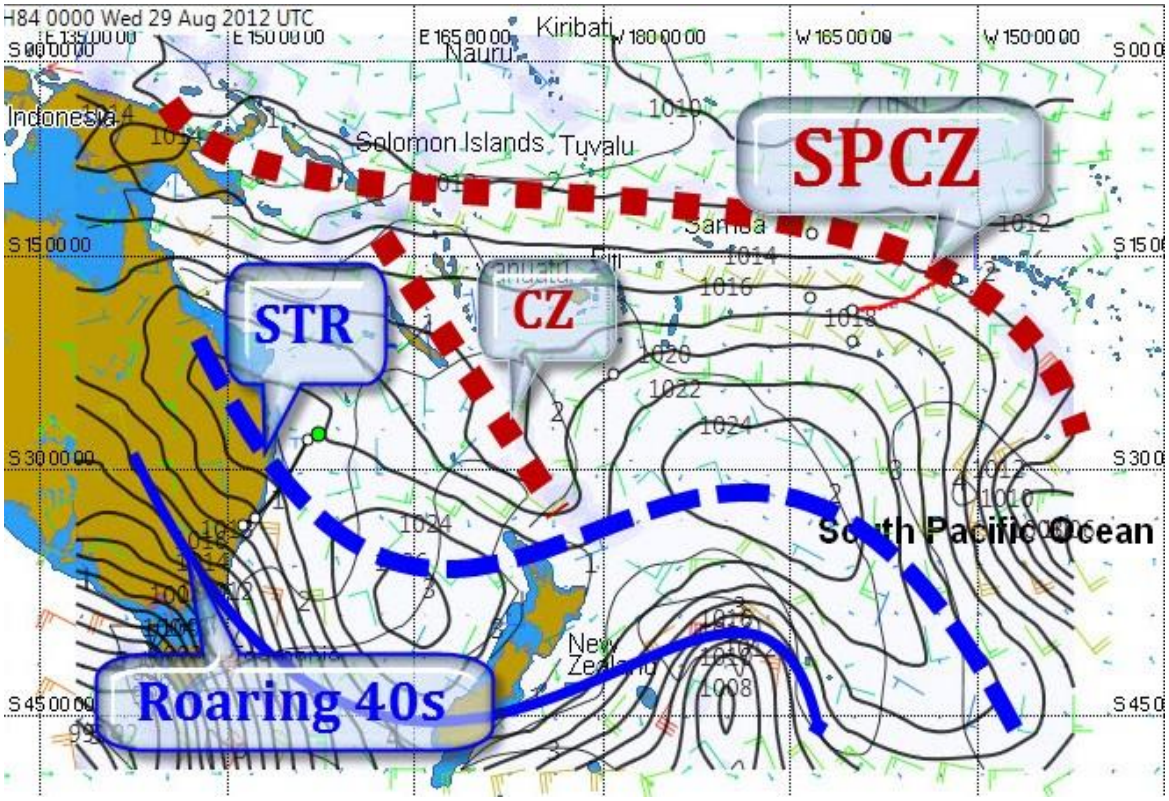
Historical data shows that the risk of Fiji being affected by tropical cyclones during an El-Nino event remains more or less the same as during a normal year, though the chances of high intensity tropical cyclones tend to increase. The data show more off-season tropical cyclones have occurred during El-Nino years. The chance of a tropical cyclone affecting Fiji during a La-Nina event has been shown to be low (Pahalad and McGree 2003).

South Pacific Convergence Zone and Inter- Tropical Convergence Zone.

The South Pacific Convergence Zone(SPCZ), a zone associated with high rainfall, fluctuates northeast and southwest of Fiji. During the southern hemisphere wet season, the heaviest rainfall occurs in the monsoon region and the Inter- Convergence .With Fiji in the SPCZ transition zone, there may be a delay between the onset of an ENSO event and the impact on the climate of Fiji, depending on when the SPCZ begins to shift eastward .



Source: www.takvera.blogspot.com



-it affects the population as a whole , a large degree of habitats.

⌘ extreme weather can cause disaster.

Global warming – Implications for Fiji

⌘ The average temperature has been proven an increase by one degree in the last century.

⌘ It is generally assumed that the current global warming is a result of rapid industrialization.

The sea level rise will produce

- Permanent coastal inundation
- Changes of coastline
- Coastal flooding
- Intrusion of seawater in freshwater lens
- Changes in coastal vegetation
- Increase in mud sediments in productive water.

Climate change impacts in Fiji

Climate change impacts in Fiji - what the IPCC 4th Assessment Report has found:

- Coastal erosion, water resources and human settlement on Pacific small islands will be at increasing risk with changes in temperature, rainfall and sea level rise. Accelerated coastal erosion, saline intrusion into freshwater sources and increased flooding from the sea may cause large effects on human settlements. Less rainfall coupled with accelerated sea level rise compound the threat on water resources .
- Beach erosion is prevalent due to sea level rise and human clearing of mangroves (1960s-1990s)
- It has been shown that port facilities would experience overtopping, damage to wharves and flooding of the hinterland if there were a 0.5 m rise in sea level combined with waves associated with a 1/50 year cyclone.

Small Islands

WWF Work

What WWF is doing on the ground in Fiji to protect against climate change:

WWF is testing its approach to build resilience in tropical mangroves and associate coral reefs including the Fiji Barrier Reef Eco region.

This project aims to build the capacity of nature resource managers to assess vulnerability and to adapt management strategies to respond to expected climate change impacts. Initial vulnerability assessments and adaptation planning point to the need for mangrove protection, reforestation with "climate-smart species," integrated land-use and marine planning, as well as activities to improve resource use technology.

Coordinating the testing of adaptation methods in geographically diverse locations within a common habitat type aims to increase the replicability so that the project results can be transferred to other conservation efforts around the globe.

Climate Witnesses

WWF runs the Climate Witness Programme to collect people's local observations of climate change that are then verified by scientists.

Example.

Penina Moce and her community have observed numerous changes because of global warming, such as sea-level rise and decreased and less predictable rain fall – a massive problem as drinking water is stored in tanks and water holding capacity is limited.

Activity 2.2

(i) State two causes of global warming.

(ii) Identify two impacts of global warming on the environment.

(iii) Suggest two measures to minimize the impacts of global warming.

Terms

Corioils force - an apparent force that as a result of the earth's rotation deflects moving objects (as projectiles or air currents) to the right in the northern hemisphere and to the left in the southern hemisphere.

Greenhouse gases - A greenhouse gas (sometimes abbreviated GHG) is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range.

ITCZ – Inter-Tropical Convergence Zone is the boundary where the trade winds converge.

SPCZ – South Pacific Convergence Zone is a zone associated with high rainfall, fluctuates northeast and southwest of Fiji.

Trade winds- Any of a consistent system of prevailing winds occupying most of the tropics, constituting the major component of the general circulation of the atmosphere, and blowing northeasterly in the Northern Hemisphere and southeasterly in the Southern Hemisphere.

Maritme climate- Oceanicity is a measure of the degree to which the climate of a region is influenced by a maritime airflow from the oceans.

Latitude - is an angle (defined below) which ranges from 0° at the Equator to 90° (North or South) at the pole.

Pacific Decadal Oscillation - is a pattern of Pacific climate variability similar to ENSO in character, but which varies over a much longer time scale.

CHAPTER 3

RELIEF - NEW ZEALAND

Relief refers to the differences in height and shape of the land. It also refers to the many different kinds of landforms like; mountains, valleys, gentle slope, steep slope, cliffs, saddle etc.

Structure of the Earth

The earth's structure is made up of the:

1. crust - outer layer
2. mantle – middle layer
3. core – inner most layer

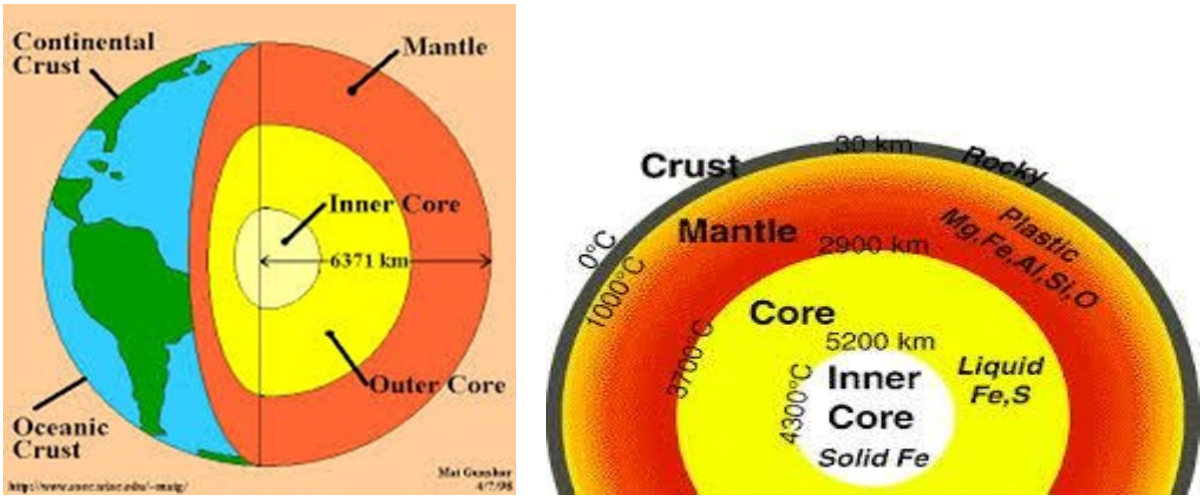


Diagram showing the concentric zones of the earth.

Source: http://www.claseshistoria.com/bilingue/1eso/relief/relief-structure.html

Crust

Refers to the outermost layer which is made up of a number of plates. On these plates are islands and continents sitting on them. The crust is called the lithosphere. The islands and continents sitting on the crust are made up mainly of granite rocks called SIAL, which means that the continents are made up mainly of Silica and aluminum rocks. Under the continents and the oceans there is a layer of basalt rock called SIMA which is rocks made from Silica and magnesium.

Mantle

Refers to the middle layer of the earth. It is the thickest of the 3 layers of the earth and is solid.

Core

Refers to inner most layer of the earth. There are 2 layers within the core.

1. Outer core - below the mantle and is liquid or contains hot molten rock known as magma

2. Inner core - inner most layer. It is solid.

Since the outer layer (crust) is lighter in density, the continents are said to be floating on the inner layers (mantle and core).

TECTONIC PLATES

Theory of Plate Tectonics

This theory states that the earth's crust is made up of a number of plates. Sitting on these plates, are continents and islands. These plates do move and the energy for plate movement comes from the liquid rock in the interior of the earth, which moves in massive convection currents.

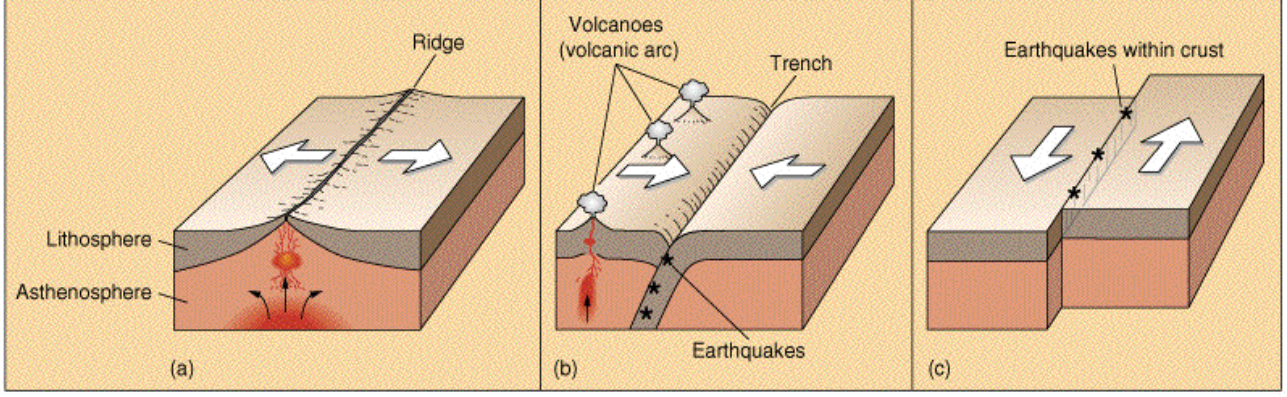
15 Major Plates of the Earth

Plates	Continents/ Islands on them
Arctic plate	Landmasses of the North Pole
Antarctic plate	Landmasses of the South Pole
Eurasian plate	Europe
African	Africa
Indo-Australian	India/ Australia
Philippines	Philippine Islands
Pacific	Pacific Islands
Fiji	Fiji
Coco's plate	Panama Isthmus
North American	North America
South American	South America
Caribbean	Caribbean Islands
NAZCA	Between South America and Pacific plate
Bismarck	PNG/ Solomon's
Gorda	Off the coast of San Francisco

Plates Movement

1. Divergent Zone

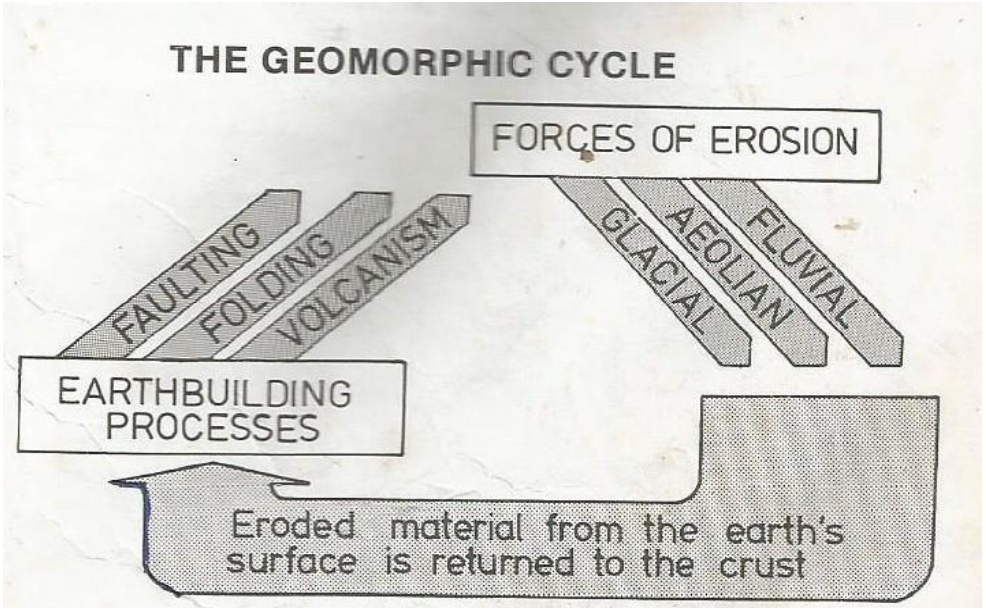
Type of Margin	Divergent	Convergent	Transform
Motion	Spreading	Subduction	Lateral sliding
Effect	Constructive (oceanic lithosphere created)	Destructive (oceanic lithosphere destroyed)	Conservative (lithosphere neither created or destroyed)
Topography	Ridge/Rift	Trench	No major effect
Volcanic activity?	Yes	Yes	No



Source: www.age-of-the-sage.org

THE GEOMORPHIC CYCLE

Geomorphic cycle refers to landforms that have been built up by earth building processes and slowly broken down by the processes of denudation.



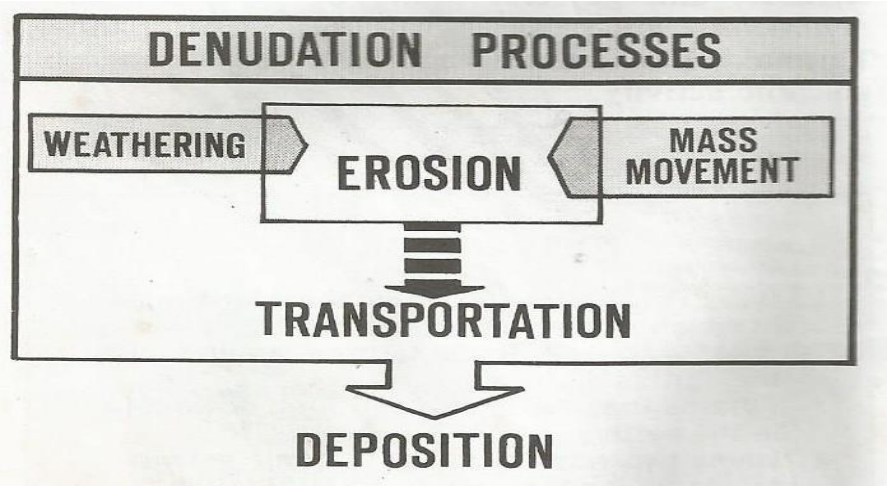
Source: New Zealand : a new Geography

Denudation is the stripping away of soil and rock from the landscape. Denudation process involves three main stages:

Stage 1 – wearing away of land surface by weathering, mass movement and erosion

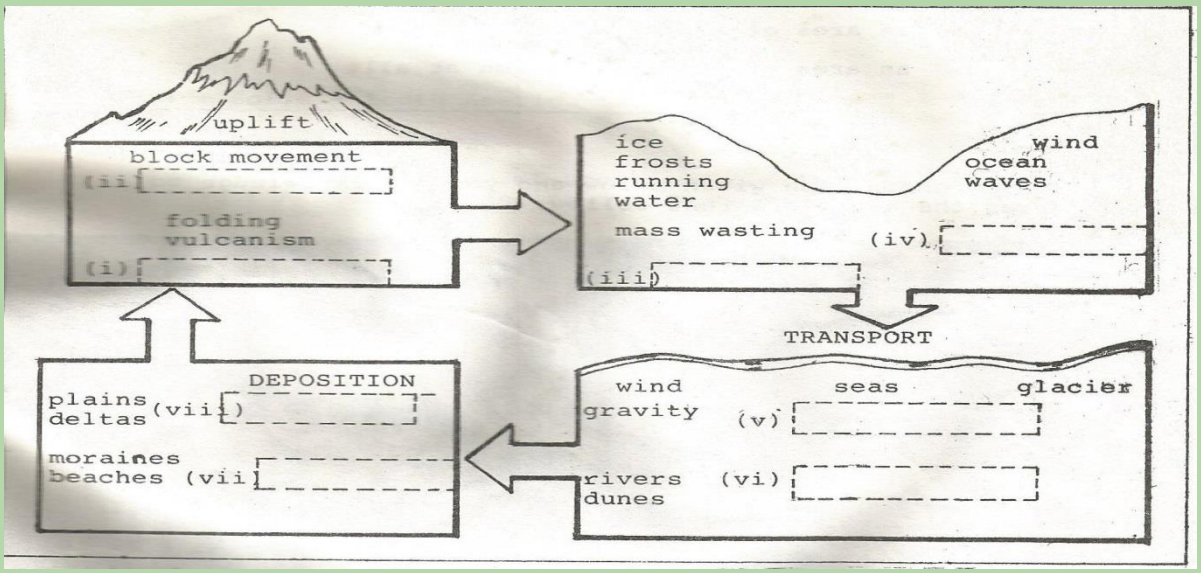
Stage 2 – transporting the material by rivers, winds and glaciers

Stage 3 – deposition, which is the laying down or eroded material to form a new landform somewhere else.



Source: New Zealand; a new Geography

Activity 3.0 Fill In The Blanks



Beside each number write the number of the appropriate processes from the list given below. Some processes may have to be repeated.

Slips	floods	eruptions	coastal erosion	earthquakes

Weathering

Refers to breaking down of rocks by physical, chemical and biological means.

1. Physical weathering- is the beak down of rocks by continuous cycle of freezing and thawing known as frost shattering.

2. Chemical Weathering- when rainwater reaches the earth it is mildly acidic and can react with and weaken the structure of rock such as limestone thus wearing away and breaking down of rocks.

3. Biological Weathering- are the worms, roots of plants and trees and burrowing insects which loosen the soil.

Earth Building Processes

The various earth building processes which contribute to relief operate over millions of years ago and continue to the present day. They are namely:-

1. Folding

2. Faulting and

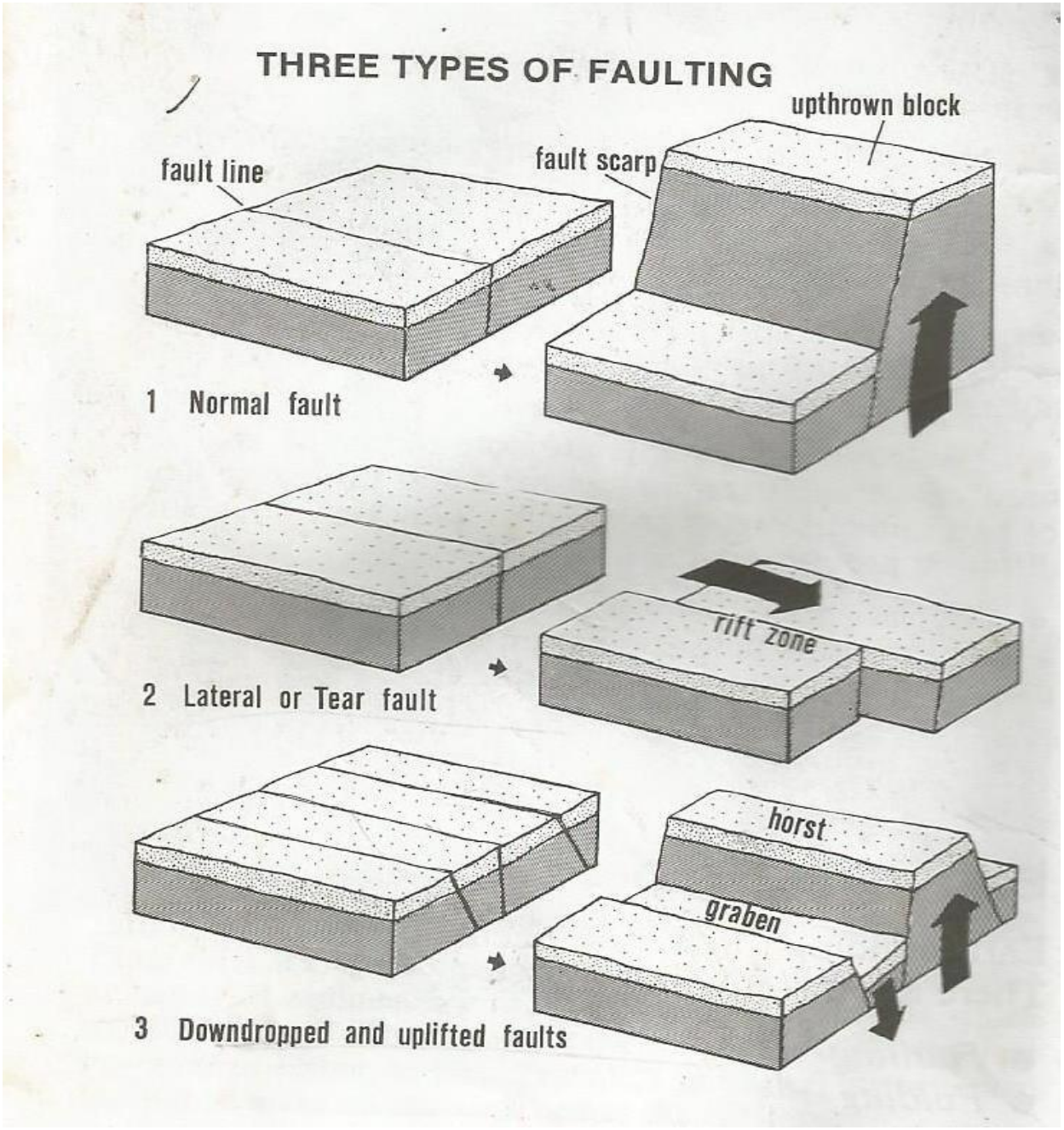
3. Volcanism.

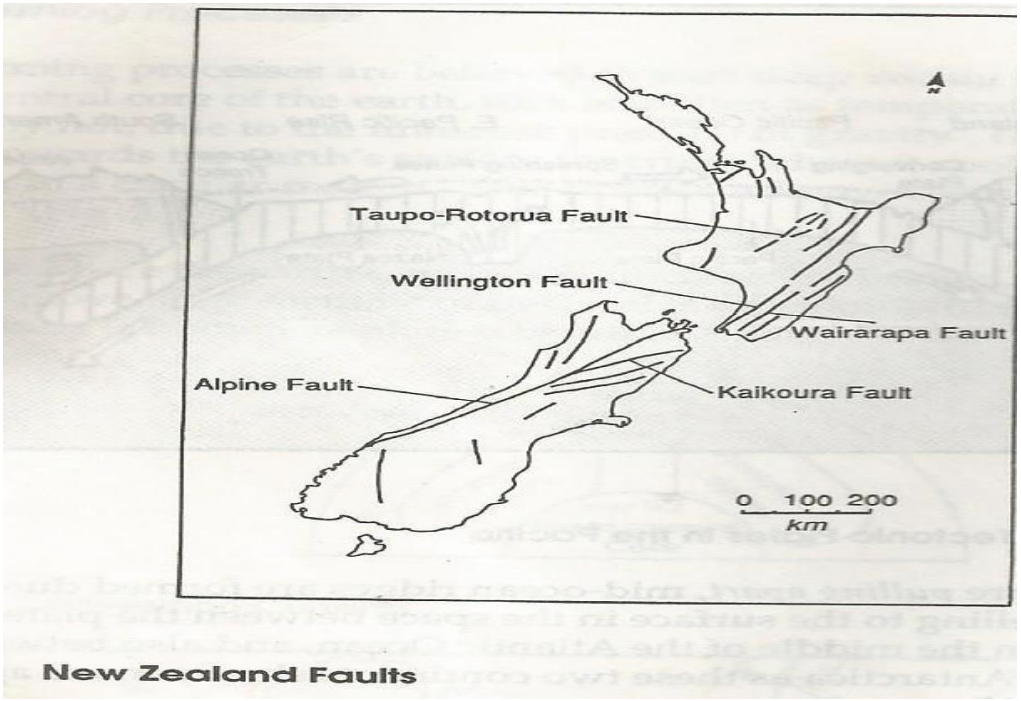
Faulting

Refers to the movement of the earth's plates along the zones of weakness. This is the result of the pressure building up causing the old brittle rocks to break and move in blocks. The land shifts in either an upward, downward or sideways direction. E.g. Alpine fault in NZ. Although movement along the fault line is slow, a sudden move results in an earthquake. E.g. Whakatane Earthquake (NZ) 1987.

Type of Faults

1. Normal fault
2. Reverse fault
3. Tear fault

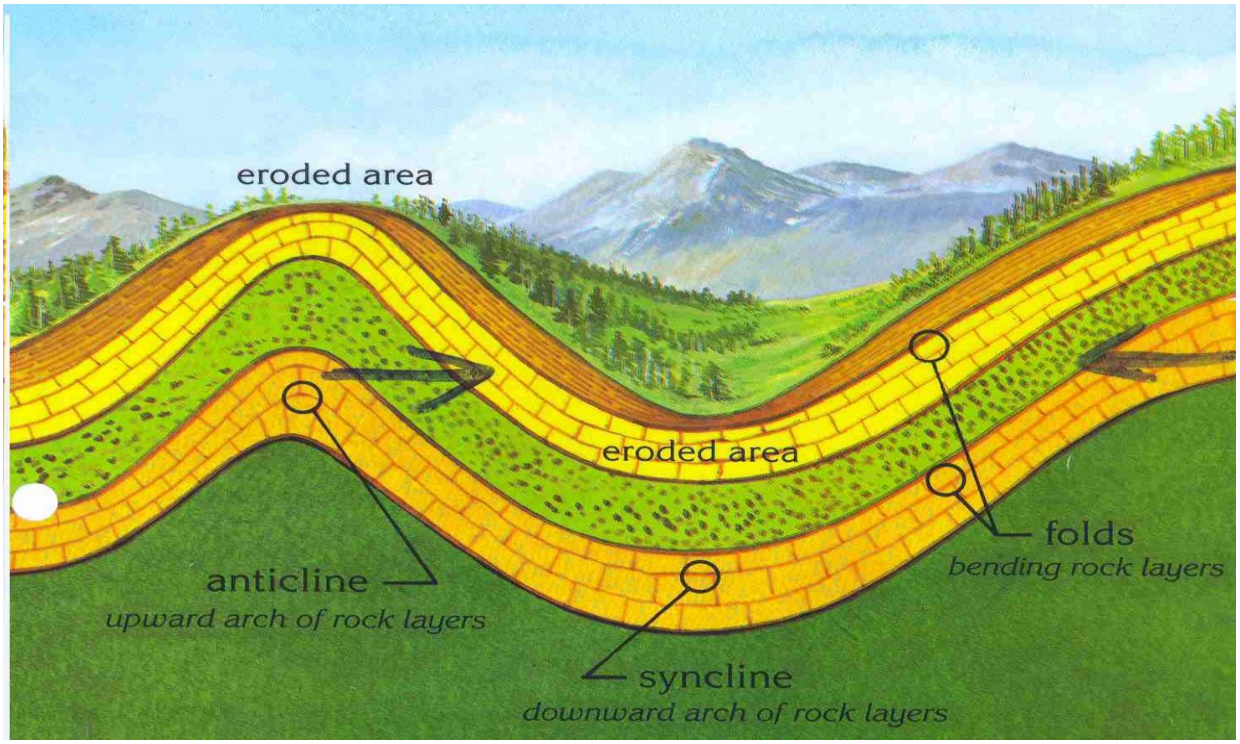




Source: New Zealand; a new geography.

Folding

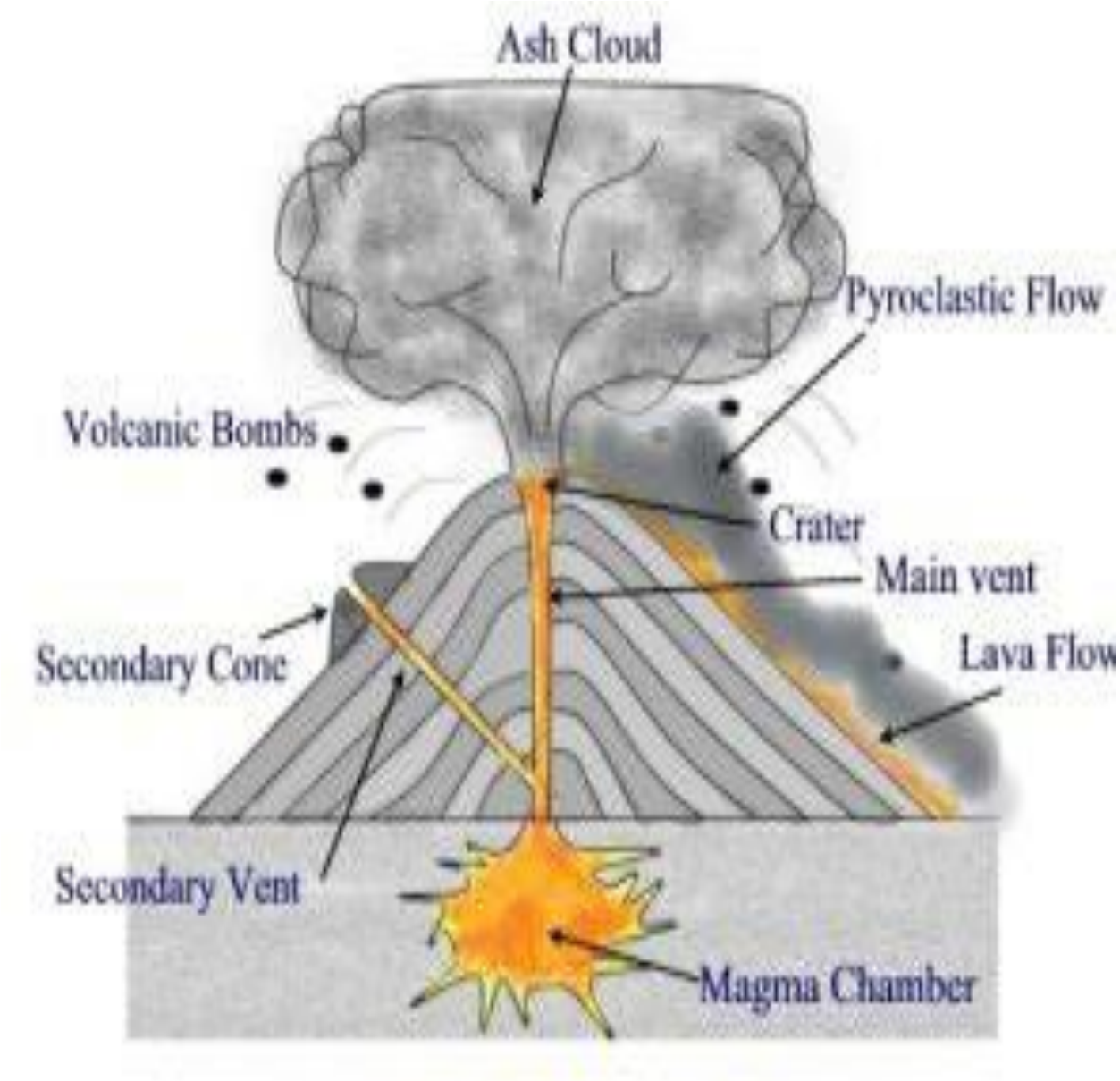
Refers to process in which soft rock is pushed and squeezed by hard rock that is moved by pressures from deep within the earth .Instead of cracking into smaller blocks ,the soft rock twists and bends into folds.



Source: www.oocities.org

Volcanism

Refers to process whereby the earth's hot molten rocks called magma are able to force their way up to the surface through the cracks or weaker surfaces. Typical volcanic landforms include lava or ash erupted from volcanoes, large explosions craters such as Lake Taupo.

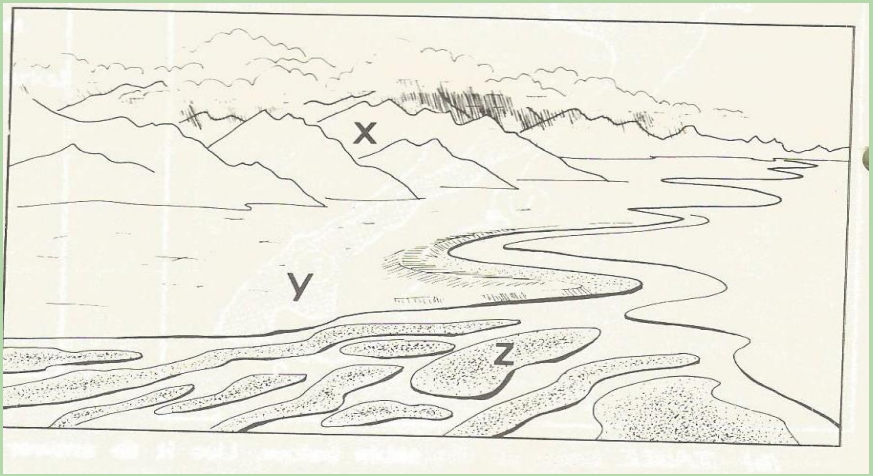


Source: www.library.fayschool.org

Activity 3.2

Sketch Interpretation

Use the picture below to answer the questions that follow:



Source: FSLC 1987

1. Suggests what process raised the mountains at **X**.

2. Suggest why only the mountains are receiving precipitation.

. Name the type of plain at **Y**.

4. Name the physical process which has built the island at **Z**.

Multiple Choice

1. As the latitude over New Zealand gets higher then

A. Precipitation increases

B. Time zone changes

C. Racial diversity increases

D. Temperature decreases

2. Plate tectonic is a theory that describes

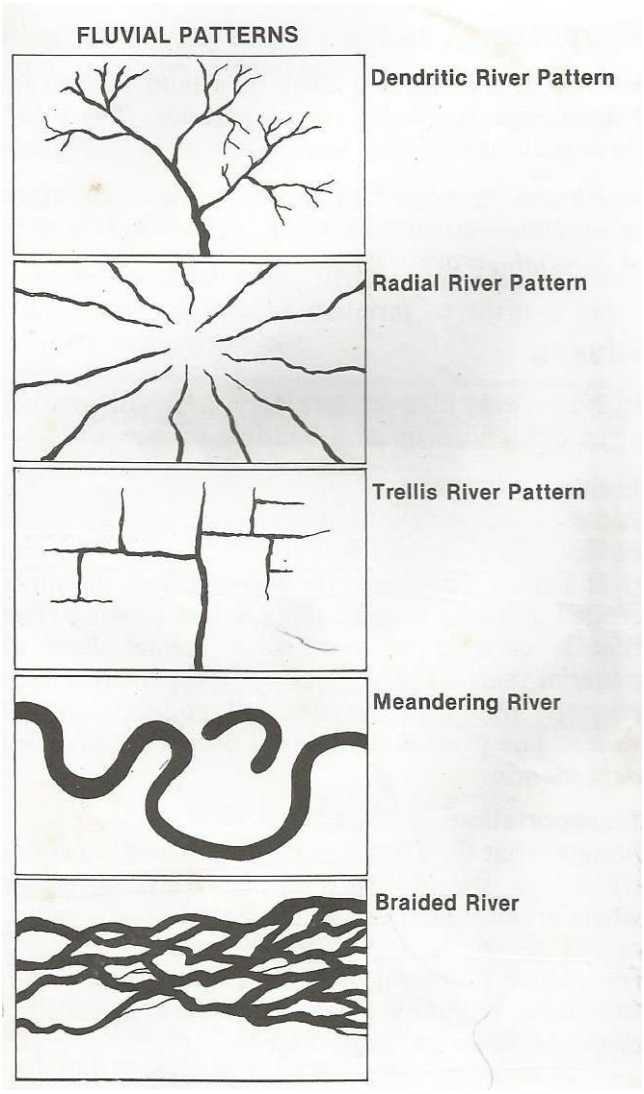
A. Movement of sections of the earth's crust

B. Uplift of mountains , valleys and hills

C. Movement of volcanoes, earthquake and faults

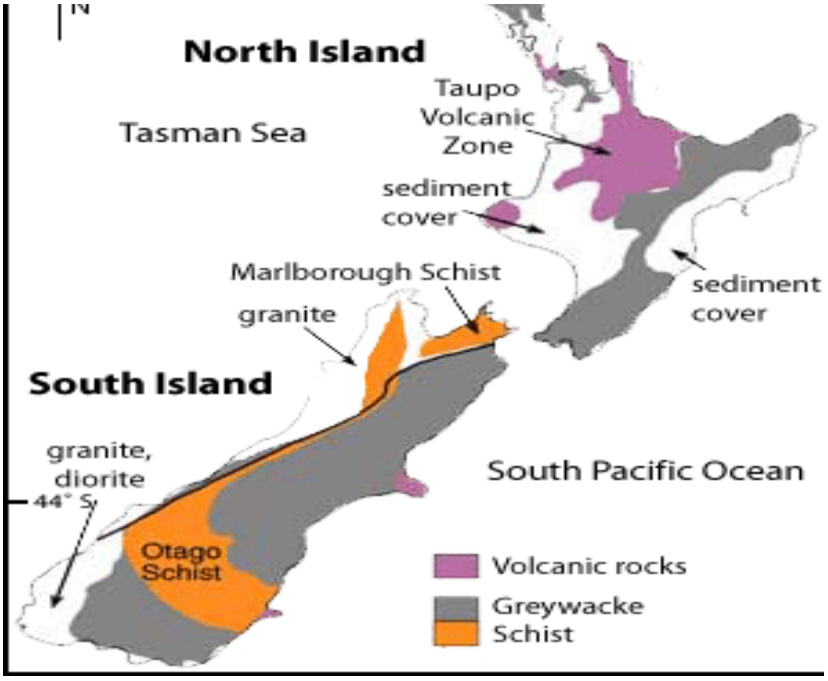
D. Down movement of valleys , river and coasts

Fluvial/ River Patterns



Tectonic location of New Zealand

New Zealand is sitting between the unstable Pacific Plate and the relatively stable Indo-Australian Plate. This means that it is sitting at a plate boundary at which enormous pressures are built up that causes the Earthquakes ,volcanism and moving blocks of land which shape much of the NZ landscape. Huge blocks of land have been thrust upwards to form mountains while other blocks of land, while in other blocks of land have been squashed and folded to form ranges of hills. In some places earthquakes have raised great areas of land while in other places they have lowered or tilted them.



Source: www.geology.um.maine.edu

New Zealand Geology

NZ's landmass is largely made up of rocks that were originally formed from the ocean floor. This has been proved by geologists who formed fossils of fish and other sea creatures embedded in rocks a long way from the sea.

The 'rock base' that forms NZ landmass continues below the sea to join the Pacific Plate.

This old and hard rock is called undermass. It is the foundation on which the landforms of the country are built upon on top of some undermass are layers of softer, more recent rocks called core rocks. The most common rock in NZ's undermass is grey wacke. It is an old hard form of sandstone. Others found in the undermasss are schist and gneiss. These rocks are mainly in the South Island where most of the large scale mountain building occurs. e.g. cover rocks (mudstones, limestone, basalt).

The rock that makes up NZ's under mass and cover are divided into 3 categories:

i) Sedimentary rocks

ii) Igneous rocks

iii) Metamorphic rocks

i) Sedimentary Rocks

- are rocks that are formed when sand, mud, silt and marine plants and animal remains build up and cement together. These materials accumulate under water millions of years ago.

The pressure on them increased as layer upon layer build up and was gradually compressed to form rock.

*sand deposits – formed grey wacke and sandstone

*mud – formed mudstone

* silt – formed siltstone

*marine animals - formed limestone and other calcium rocks

ii) Igneous Rocks

- are rocks that are formed by volcanic eruptions. All igneous rocks have been heated to very high temperatures by the volcanic process that brings them up to the earth's surface.

iii) Metamorphic Rocks

- they are either sedimentary or igneous rocks that have been changed in their structure and appearance by enormous pressure which causes from earthquakes and other tectonic forces and is often accompanied by friction and heat..

Main Relief Patterns of New Zealand

Relief is the difference in slope and height if any areas of land. The main types of relief in NZ are:

i) mountains

ii) rough hill country

iii) easy hill country and downland

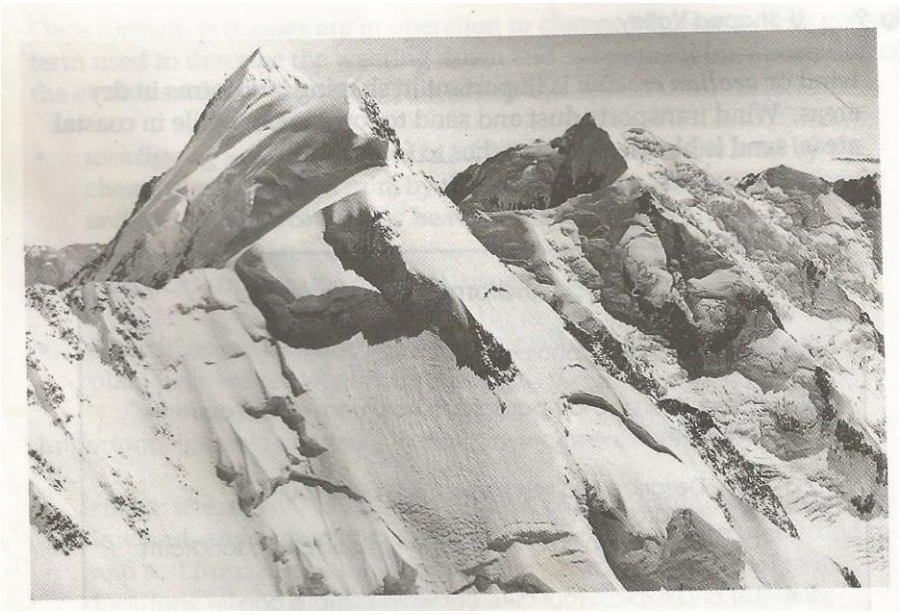
iv) plains

v) plateaus

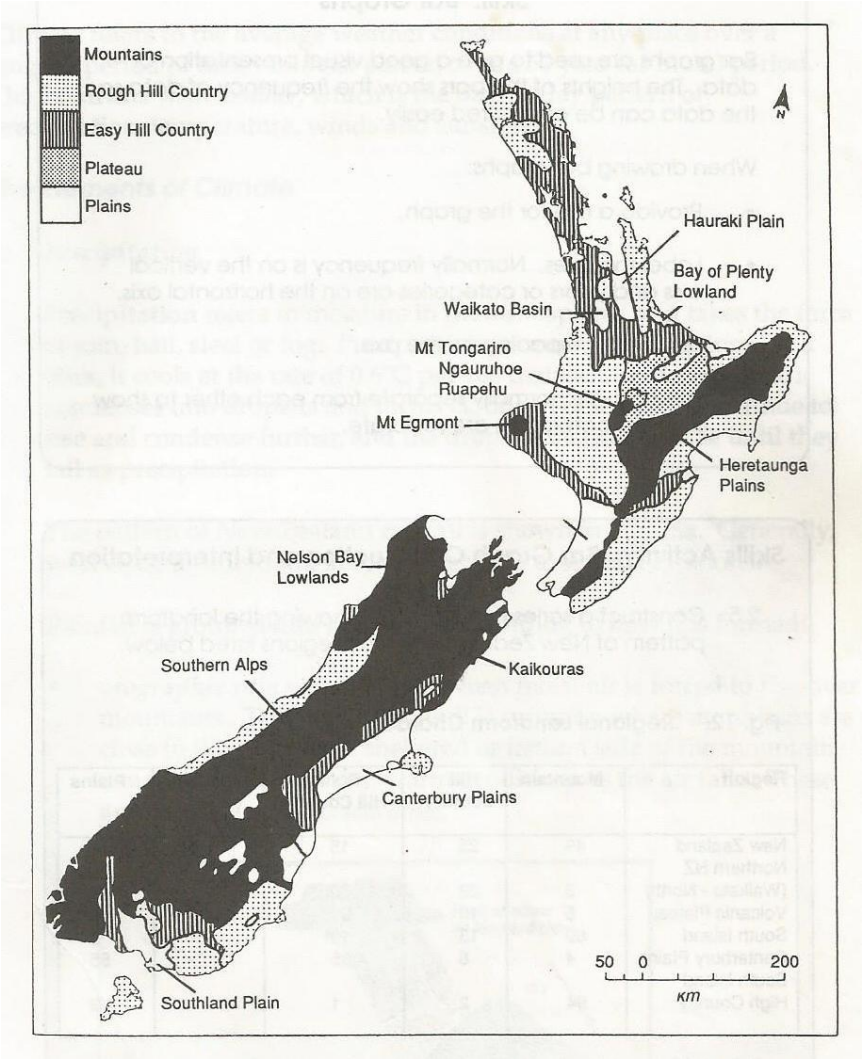
Lake Whakatipu

Canterbury Plains

Mt Ngauruhoe



Mt Cook – highest mountain in New Zealand



How Relief Affects Human Activities in New Zealand?

Relief plays a major role in determining what type of activities Humans will do –

i) e.g. NZ high country

cold/ steeply sloping mountainous districts like South Island High Country is used for Extensive Pastoralism.

- beef farming
- wool and sheep farming

ii) e.g. hill country (rolling to steep landform)

is used for semi-intensive agriculture

- wool and store sheep
- beef
- cattle
- forestry

iii) e.g. alluvial plain (flat to gently sloping land)

is used for arable crops, fattening, horticulture, dairying, forestry, urban development

How Human Activities have affected the Relief of New Zealand?

1. Extensive/ Intensive Pastoralism

E.g. in SIHC (Makaroa Station)

→Soil erosion on steep slopes caused by overgrazing

→ results in occasional flooding → river bank erosion (siltation of rivers/ farmlands)

2. Town/ Urban Development

→ Removal of hill. E.g. the removal of a large hill in the middle of Hamilton to enable inner city development (1936)

* flat land makes building roads, drains, cables and other amenities and services of modern settlements easier to establish

3. Hydro Dams (construction)

Flooding/submerged of relief .e.g. small hills

- Tokaanu
- Aratiatia
- Ohakuri
- Atiamuri
- Whakamaru
- Maraetai
- Waipapa
- Arapuni
- Karapiro
- Matahina

4. Mining

e.g. Waikato (large reserve of sub-bituminous coal)

→ open cast mining , destroys relief

5. Logging

- landslides
- erosion

6. Excavation

Plains – human activity is very intensive

Hill country – human activity is semi-intensive

High country – human activity is very extensive

Case Study – The Canterbury Plain

Location

It is located on the east coast of the South island , boarded on the west by the high hill country.

Processes involved in the Formation

These plains were formed from the alluvial fans of large rivers. The rivers carry large amount of alluvium down their valleys where the rivers reach the lower land, they slowed down and deposited the alluvium in the sea. The sea was filled with gravel and mud and a as result plain was formed. Frequently, nor- wester wind blowing from west have spread even loess -fine yellowish dust. The soils vary in fertility according to the thickness of loess and the proportion of the coarse sand they contain.

Economic Activities

The Canterbury plain is the chief mixed faming area in New Zealand. It's fertile nature and the possibility of the use of the machines favor a wide variety of farming. Numerous rivers have potential for irrigation as these plains are on rainshadow region of the South Island.

Activity 3.3 Mapping

Draw an outline map of the New Zealand, locate and name the following:

i. The highest mountain in New Zealand
ii. Waikato River
iii. Largest plain in South Island
iv. The largest plateau
v. Fiordland
vi. The active volcanic mountain
vii. Wellington fault
viii. An Intermontaine basin
ix. Hauraki Gulf
x. An area of downland and gentle hill country

Terms

Crust – outer layer of the planet

Mantle - is the middle layer of the earth

Core- inner most layer of theearth.

Outer core- below the mantle and is liquid or contains hot molten rock known as magma.

Inner core- inner most layer of the earth. It is solid.

Plate - A tectonic plate (also called lithospheric plate) is a massive, irregularly shaped slab of solid rock, generally composed of both continental and oceanic lithosphere.

Convergent plate boundary - is an area on Earth where two or more lithospheric plates collide.

Divergent plate boundary - are where adjacent plates move apart and new crust is created.

Transform plate boundary- are where plates slide along each other in opposite directions and no new crust is created or destroyed.

Tectonic movement - movement resulting from or causing deformation of the earth's crust.

Mountains - is a large landform that rises above the surrounding land in a limited area, usually in the form of a peak.

Plains- is a flat land.

Plateaus- an area of high land usually consisting of relatively flat terrain, that is raised significantly above the surrounding area.

CHAPTER 4

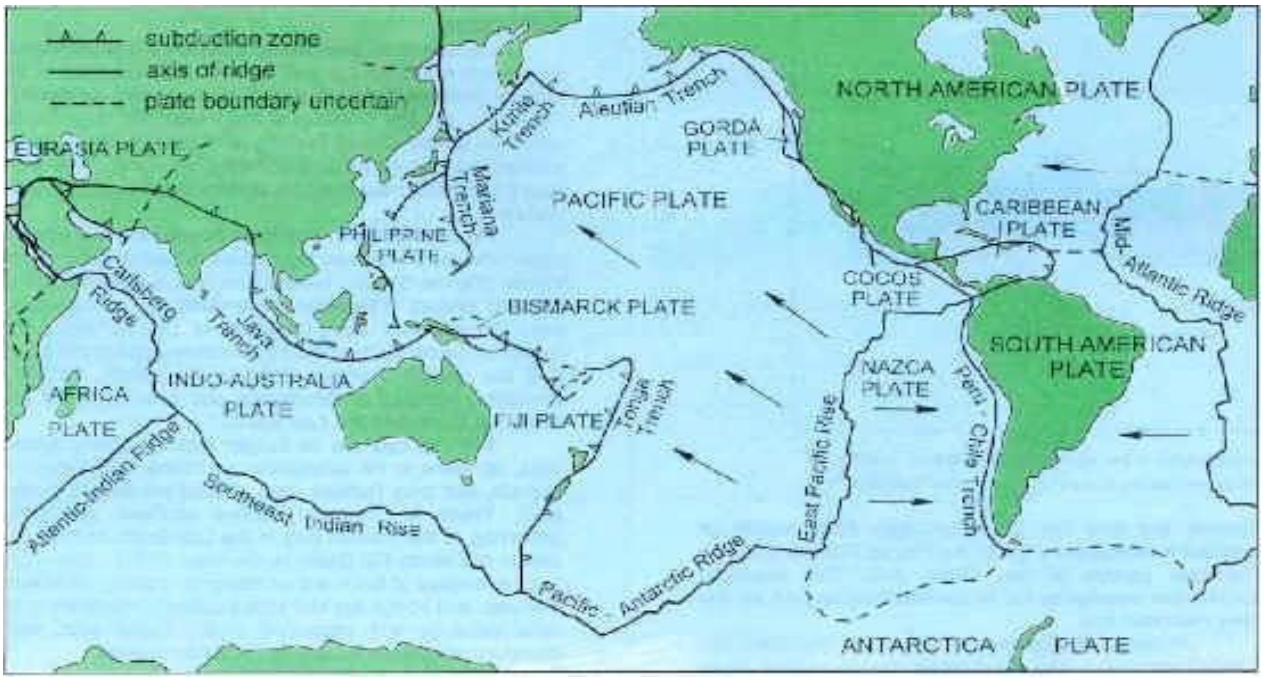
FIJI

RELIEF

Plate tectonics

Our planet earth is under constant change, and evidence that the earth is still active can be seen whenever a volcano erupts or an earthquake shakes the land. The lithosphere or outermost shell of the earth, which includes the crust and the upper mantle, is broken up like a cracked egg into a number of rigid plates which move around because of forces in the upper mantle (figure 3).

The Pacific lithospheric plates.



Source: : http://www.claseshistoria.com/bilingue/1eso/relief/relief-structure.html

The boundaries of these plates are zones of intense activity and associated with them are many of the large-scale geological features produced by such processes as mountain building, volcanism, creation and destruction of sea floor and earthquake activity. The movement and deformation of the plate is known as plate tectonics. Tectonic movements which indicate instability of the earth's crust , produce faulting(fracture and displacement), folding, subsidence and uplift of rocks. Over millions of years plate tectonics has been responsible for the formation of many great mountain ranges and ocean basins.

Plate Boundaries are where plates meet and move against each other . They are usually the locations of many violent earthquakes and volcanoes. Earthquakes and volcanoes tend to occur in belts (for example, the “Ring of Fire” on which Fiji is located, surrounding the Pacific Ocean). These belts are the locations of plate boundaries. There are three types of plate boundaries- divergent, convergent and transform

(a) Convergent

(b) Divergent

(c) Transform fault

Divergent boundaries (constructive boundaries) are where adjacent plates move apart and new crust is created. In the major oceans, there are long underwater mountain ranges called mid-ocean ridges. Mid-ocean ridges develop at edges of diverging plates and are the sites of volcanism and shallow earthquake activity. Along the centres of the ridges, new rock is forming from molten magma coming up from the upper mantle. The rocks produced are basaltic in composition. This process is also known as sea-floor spreading. An example of a mid-oceanic ridge is the Mid-Atlantic Ridge in the Atlantic Ocean.

Convergent boundaries (destructive boundaries) are where two adjacent plates Move towards each other and crust is destroyed. Along convergent boundaries are crumpled mountain ranges, deep sea trenches, shallow and deep earthquakes and volcanoes. The edge of the thin plate usually sinks under the other plate at an angle of between 30 degrees and 70degrees, usually forming deep trench. This process is called subduction and the movement of plates as they adjust produces earthquakes, as a plate edge sinks into the hot mantle, the rocks will be squeezed and heated and parts of it begin to melt. The rock melt, the magma thus formed would float upward, some of it reaching the surface as lava erupting from volcanic vents. The resultant volcanism often froms a chain of volcanoes along the plate boundary known as a volcanic island arc. The plate boundary can be seen at the earth’s surface as a deep ocean trench. The islands of Fiji, Vanuatu, Lau and Tonga were formed as volcanic island arcs by subduction-related processes; however Fiji and Lau are no longer active island arcs.

Transform boundaries are where plates slide along each other in opposite directions, and no new crust is created or destroyed. The famed San Andreas fault of California is such an example. There the Pacific plate slides past the American plate in a north westerly direction at rate of 10mm per year. When areas are stretched, they split, initially forming a rift and eventually a back-arc spreading centre.The weakest part of the upper plate is near the volcanic front (where volcanism is occurring),and the plate is both the hottest and has the thickest crust. Therefore the arc splits within about 50km of the volcanic front. the basin that usually opens up behind the volcanic island arc is known as a back-arc basin or a marginal basin and it usually becomes filled with lava and sediments. The North Fiji basin and the Lau basin are examples of back-arc basins.

The tectonic History of Fiji

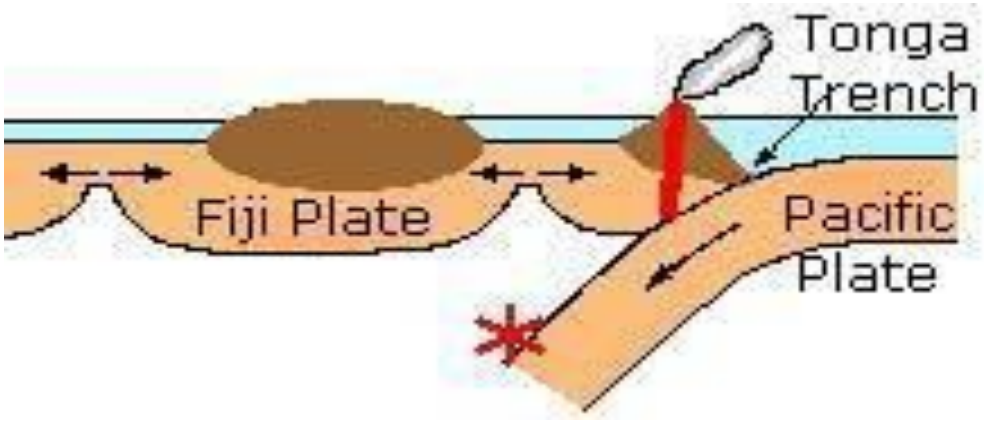
In the southwest Pacific two large plates, the pacific Plate and the Indo-Fijian Australian Plate, are moving towards each other, that is, converging. This area of the south pacific was formed in the last 65 million years of Earth's history by the growth of volcanic island arcs and associated marginal and oceanic basins. Fiji's tectonic history is very complex.

In Fiji, another island arc was formed, along with associated sedimentary basins that produced volcanic and sedimentary rocks of the Wainimala group which are exposed today in southern viti Levu, and in the Yasawa and Mamanuca group of islands. There was continued volcanism on the Lau – Tonga Arc due to the northwestward subduction of the pacific plate under the Indo-Australian plate along the Vityaz Trench. Fiji was caught in an area of increasing stresses during this period. Intrusions of plutonic rocks were common, and the earlier formed volcanic and sedimentary rocks were weakly folded, faulted and metarmophosed. Uplift near the end of this period may have produced the first significant landmasses of Fiji, mostly Viti levu.

12- 7 million years ago

During this period the pacific plate continued to obliquely subduct in a northwest direction under the Indo-Australian Plate south of Fiji, while the Indo-Australian plate probably moved north-east. The new stresses resulted in a major change in the nature of the plate boundary with the end result being splitting of the Vityaz Arc and the formation of a transform boundary north of Fiji called the Fiji Fracture Zone. At this boundary the two plates were moving past each other.

Fiji, therefore represents a portion of the old Vityaz Arc, which was split up, and rotated anti-clockwise to its present position. It forms a mini-plate, known as Fiji Plate. This was also a period of great volcanic activity in Fiji and the whole region. Fiji is located at the Indo-Australian and Pacific Plate boundary between two opposite facing subduction ones and hence has had a very complex tectonic history.



Source: www.mrd.gov.fj

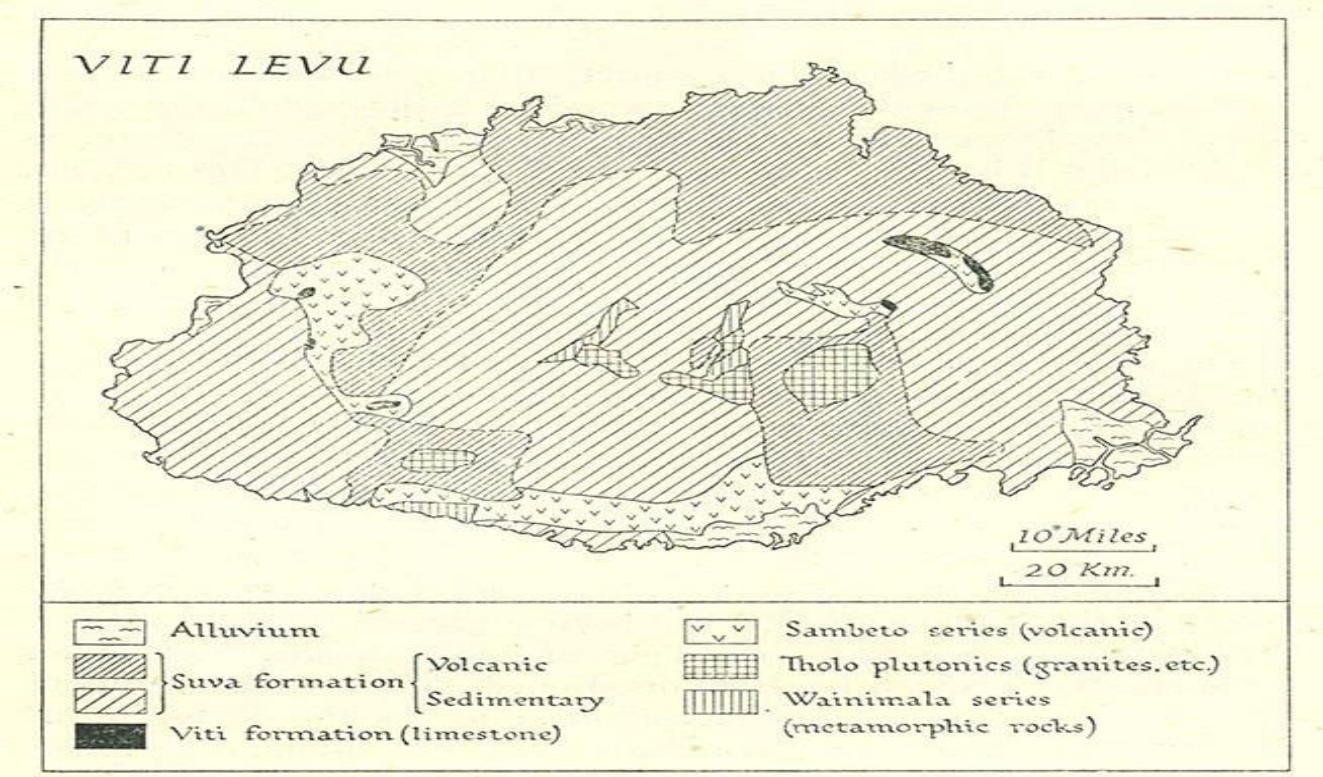


Fig. 35. Geological sketch map of Viti Levu
Based on H. S. Ladd, *Bernice P. Bishop Museum Bulletin*, no. 119, p. 16 (Honolulu, 1934).

Source: www.fijiearth.com

Activity 4.0

1. What happens at a divergent plate boundary?
2. What happens at convergent plate boundaries?
3. What happens at transform plate boundaries?
4. Explain why earthquakes and active volcanoes are found around the convergent plate boundaries in the Pacific Rim ("the Pacific Ring of Fire").
5. On an outline map of the Pacific , show the location of the divergent plate boundary in the Pacific. Name the plates on either side of it and show the directions in which they are moving.

Types of islands

Characteristic features of

1. **Volcanic high islands**

-high with rugged relief

- deep interior valleys

-jagged peaks and ranges

-lower coastal fringe

Examples – Viti levu, Vanua Levu, Taveuni,Lomaiviti group, Kadavu.

Explorers generally speak of 'high' and 'low' islands in relation to the structure, appearance, and size of islands themselves, their flora and fauna, and the lives and customs of their people. There are three types of islands in the archipelago. The majority are high islands of volcanic origin and low islands which include coral and limestone varieties. The volcanic islands, of which Viti Levu is an example, have sharply defined, mountainous landscapes, ancient volcanoes and rocky outcrops and shores inland, broken terrain with few stretches of flat excerpt in river valleys.

In the windward areas where rain is frequent, the hills are covered with thick vegetation and are smothered almost incessantly with rain. In the leeward, growth is sparse and hills are brown. Lively traces of the active volcanic period are hot springs, which are always found at low elevations. The best known in Fiji are the springs at Nakama, in the old coconut-plantation town of Savusavu on Vanua Levu.

The larger islands of the Fiji group of islands are the results of the volcanic activities of the past. The solidification of the molten lava and rocks erupting from the volcanoes is responsible for the formation of the islands. The mountainous relief still bears many dormant volcanoes that prove the activities of the past.

Source: www.go-fiji.com

2. Raised limestone islands

Features of limestone islands

- Uplifted limestone deposits fractured by volcanic action
- Rise up to 300m but generally at low relief.
- Examples- Kabara,Lakeba, Fulaga

Limestone islands may also appear to be low and flat topped, but have steep, sharp sides suggesting that they are huge masses of rock heaved up from the sea. This is exactly what they are- often surrounded by a succession of precipitous cliffs, undercut by the surf. Because the limestone erodes easily, the rock may be pitted and bristling with sharp pinnacles or cut by ravines or narrow canyons, inland, central depressions gives the islands a basin-like appearance. The depression floors are commonly cut up into rolling hills, fertile and well wooded. A good example of a typical limestone island is Vanua Balavu in the Lau group.

Fulaga island Lagoon

Source: www.ezt.com.my

3. Coral islands or islets

Features of coral islands or islets

- very low relief

- soil generally sand

Examples – Nukulau, Wailagilala

The smaller of the Fiji islands are ;made of coral .thus human habitation is impossible on most of them . They however are home to a large number of sea creatures who have taken shelter in and around the reefs.

Coral islands although low and small, have their own peculiarly Robinson Crusoe charm. Generally located near the inner margin of a broad reef, they are usually only a few metres above sea level are flat as a table and have beautiful white sandy beaches. Despite limited soil, they often support luxuriant vegetation including vines,grasses, broad leaved trees and of course, the coconut palm. A classic example is the resort on beachcomber island off Lautoka.

Of the hundreds of islands in the Fiji group, only a few may be classed as true atolls. The typical atoll, of which so much has been written in the romantic literature of the south seas, is basically long strips of broken coral and sand ranging from a few metres to half a km forming a circular or ring-like structure that surrounds a lagoon. Perhaps the best –known example of an atoll in Fiji is Wailagilala, on the eastern side of the Nanuku Passage, the main shipping path through the islands.

Wailagilala island –an uninhabited island in northern Lau

Source: www.cruiseguide.com.au

Reefs surround most islands.

Two types

1. Fringing reefs – these cover the surface of off-shore platforms and have little water over them.

Fringing reefs in Fiji

Source: www.britanica.com

2. Barrier reefs – are found at the edge of the underwater platform are separate from the land. Beyond the barrier reef the sea-floor drops sharply into the ocean floor depths

The Great Astrolabe Reef in Kadavu

Source : www.paddlefiji.com

Volcanic Islands

The islands of the Fiji archipelago are formed of volcanic materials and sediments, deposited towards the eastern margin of a massive platform of great age, and complicated series of events that built and shaped them to their present form and over an enormous period of time

The features of volcanic high islands are

Jagged peaks and ranges

Lower coastal fringe

Mountains on Viti Levu have a north to south trend and at both ends, they swing eastward to form two coastal ranges

- East and the west of the high ridges are the plateau which form the basins of the main rivers.
- In these uplands are 29 peaks of over 3000 ft.
- Highest mountain peak – Mt Victoria
- These uplands form a broken pattern of ridges and valleys, volcanic plugs, cones and almost vertical thumbs and spikes.

Nadrau Plateau

Source: www.fijibure.com

Lowlands – of the main islands are found along the coasts and along the river valleys leading back into the hills and interior.

Lowlands on Viti levu

- Found on broad, flat flood plains and deltas near the mouths of the larger rivers and the narrow flats along the coasts
- They form only a small part of the total land area, but they support the bulk of Fiji's population.
- Western lowlands are chief sugarcane growing areas
- East and south east lowlands grow coconuts and market garden crops.

Lowlands on Vanua Levu

-lowlands are restricted

-found on the northern side of the island where they are broken in to pockets by ranges of low hills running out to sea.

-Ranges of low hills are spurs

-these lowlands are known as Talasiga plains – as they are hot and dry throughout most of the year.

- Only Labasa lowlands has been greatly developed.

- southern side of Vanua Levu- coastal flats are interrupted by steep bluffs and headlands or by patches of mangroves near the mouths of the streams.

DRAINAGE PATTERNS

- Viti Levu- drainage pattern is radial
- Rivers flow from central plateau in all directions to the coast
- Largest rivers- have dendritic (fanshaped) drainage pattern. Their main tributaries from the plateau join together in the main stream which meanders across the lowland to the sea.
- Example- the Rewa River drains almost 1/3 of Viti levu.
- The tributaries- Wainibuka, Wainimala, Waidina and Waimanu
- Example – the Sigatoka River, Ba River, and Nadi River – all reach into the interior and drain the western side of Viti Levu.

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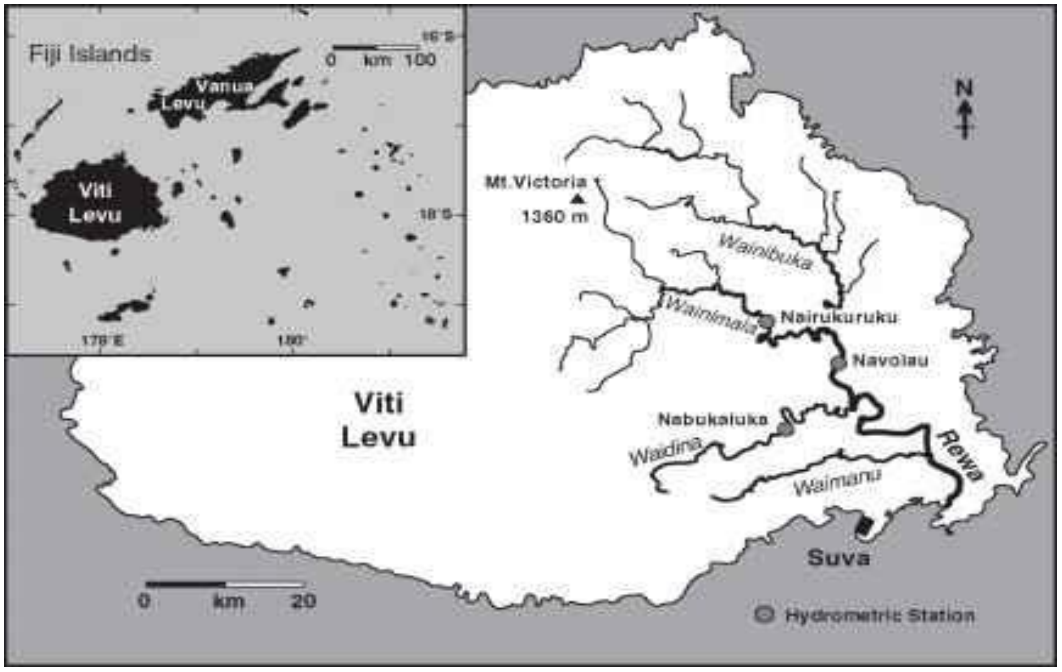


Rewa River tributaries

Source: www.briangwilliams.us

Nadi River

Source: www.autostylized.com

Vanua Levu

- Main rivers – Dreketi, Nasikawa,Yanawai and Wainunu – all flow from the long central upland area down to the coast

Old Volcanic Landforms

- No active volcanoes in Fiji, but there is evidence of early volcanic activity.
- Joske's Thumb- formed when lava from a volcano solidified in the neck, then the sides of the peak weathered away leaving hardened cone to be exposed.

Caldera

Example – Ovalau Island is the remains of the caldera.

-Caldera is formed when the centre of a mountain is blown off during an eruption

Hot Springs

- Major feature of past volcanic activity
- Many hot springs and mud pool in Fiji
- Most prominent – in Savusavu in Vanua Levu, Nawaikama in Gau and in Kadavu and Vanua Balavu

Hot Spring in Savusavu

Source: www.captaincook.com.fj

INFLUENCE OF RELIEF ON LANDUSE

- Except where they are cut by large rivers, the inland areas are high with steep slopes and broken with rugged hills.
- ⅓ of Fiji – too steep, too rocky or too poor to be used for farming
- It is only a small area of gentle relief that is intensively farmed, except where there are mangrove and swamp areas.
- Most cash cropping – done on coastal plans and the valleys
- High relief – increases cost of building roads which could enable farmers to tranasport cash crops to the ports and markets.
- Interior highlands – could be developed as planted forests or for extensive cattle grazing on grassland.

How relief affects human activities and vice versa

Case Study: Sigatoka Valley (known as the Salad Bowl of Fiji)

Location

Inland Sigatoka , along the west bank of the meandering river, flanked on both sides by a patchwork of flat green fields of vegetables that give the Sigatoka Valley its nickname: “Fiji’s Salad Bowl”.

Processes involved in the Formation

Valleys are one of the most common landforms on the Earth and they are formed through erosion or the gradual wearing down of the land by wind and water. In river valleys for example, the river acts as an erosional agent by grinding down the rock or soil and creating a valley. The shape of valleys varies but they are typically steep-sided canyons or broad plains, however their form depends on what is eroding it, the slope of the land, the type of rock or soil and the amount of time the land has been eroded.

Economic Activities

The Sigatoka Valley is known for its high production of vegetables, and thus referred to as Fiji’s “Salad Bowl”.Sigatoka’s economy is largely dictated by the flow-on effects of the broader Nadroga/ Navosa economy. Nadroga contains a high concentration of Hotels and Resorts outside of Nadi. There are several resorts in Sigatoka, for example, Shangri-La’s Fijian Resort & Spa, Outrigger on the Lagoon Fiji, Warwick Fiji Resort & Spa, Hideaway Hotel, Naviti Hotel. Recently, there has also been major growth in international residential developments.

Tourism accounts for a large number of employees and provincial development. Nadroga is also regarded and nicknamed the ‘Salad Bowl of Fiji’, specifically the Sigatoka Valley, which produces a high volume of the nation’s fruits, spices and vegetables, both for local consumption and export. Dalo (or Taro), often the domain of Eastern Fiji, is not so widely produced in Nadroga, however, cassava (tapioca) is produced for consumption and export. The province is one of Fiji’s sugar producing areas, however the number of farms and production have declined in the past 10 years as farmers seek to diversify their crops and move to more lucrative crop options. Expiring native land leases have also contributed to a decline in sugar production. Cattle (beef) farming used to be a major economic activity

led by the government-supported Yalavou Cattle Scheme, however this has also declined in recent years. Sigatoka's economy has benefited from the flow-on effect of tourists and agriculture in the greater Nadroga/Navosa province. The town provides an essential service point for hotel industry, hotel workers, farmers and so forth, in terms of provision of wholesale/retail goods, government services, police, utilities and administration. The international headquarters of Pacific Green Industries (Fiji) Limited is located in Sigatoka.

Source: http//en.wikipedia.org/wiki/Sigatoka,_Fiji

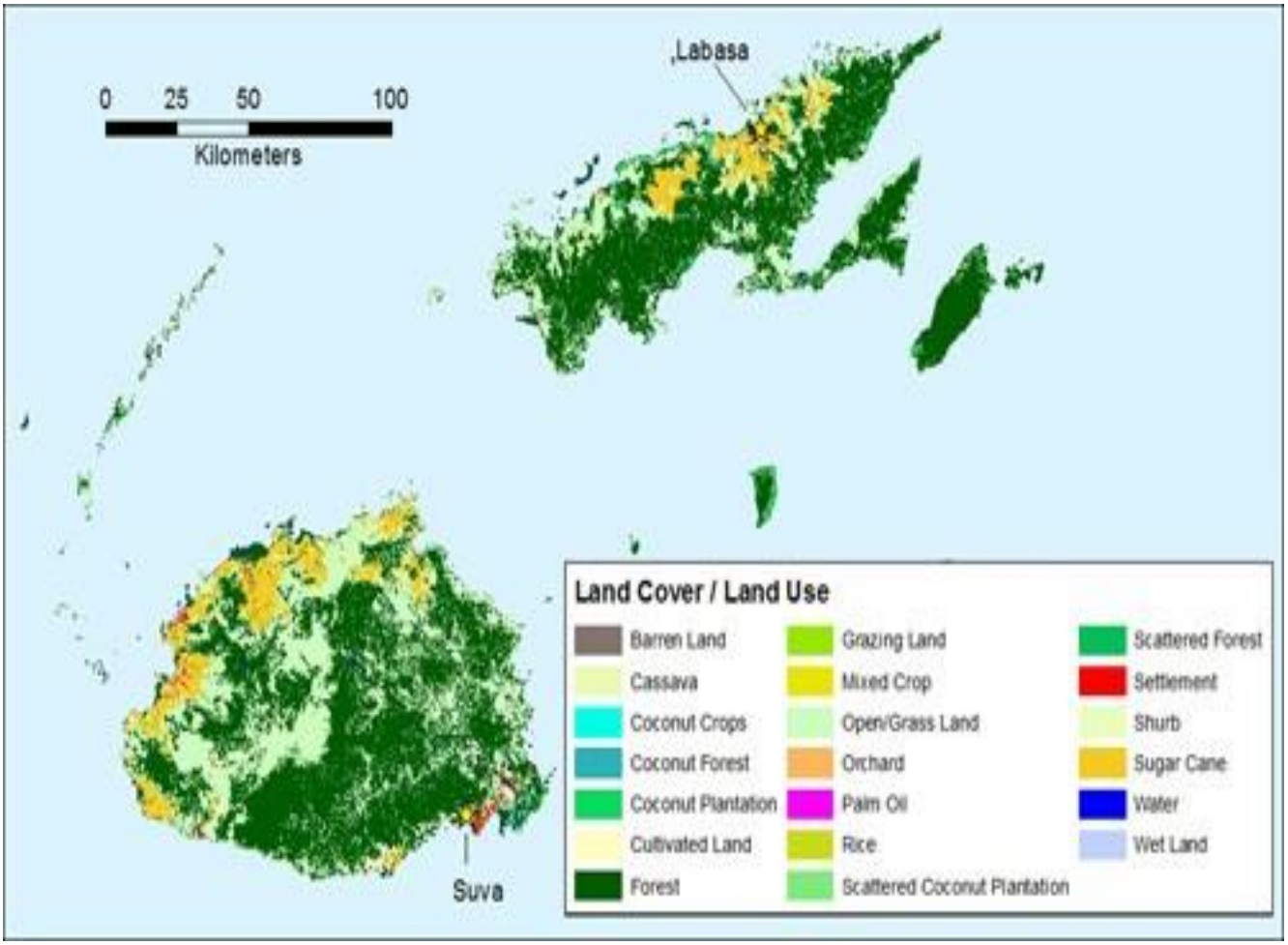
INFLUENCE OF HUMANS ON RELIEF

Since the beginning of human development, valleys have been an important place for people because of their presence close to rivers. Rivers enabled easier movement and also provided resources like water, good soils and food such as fish. The valleys themselves were also helpful in that valley walls often blocked winds and other severe weather if the settlement patterns were positioned correctly. In areas with rugged terrain, valleys also provided a safe place for settlement and made invasions difficult.

Source: http//.about.com/education

Eco-tourism up Luva River

Source : www.riversfiji.com



Source: www.air-worlwide.com

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

<u>Ways to improve quality of this soil type</u>

- 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.

(iii) Cherrnozems

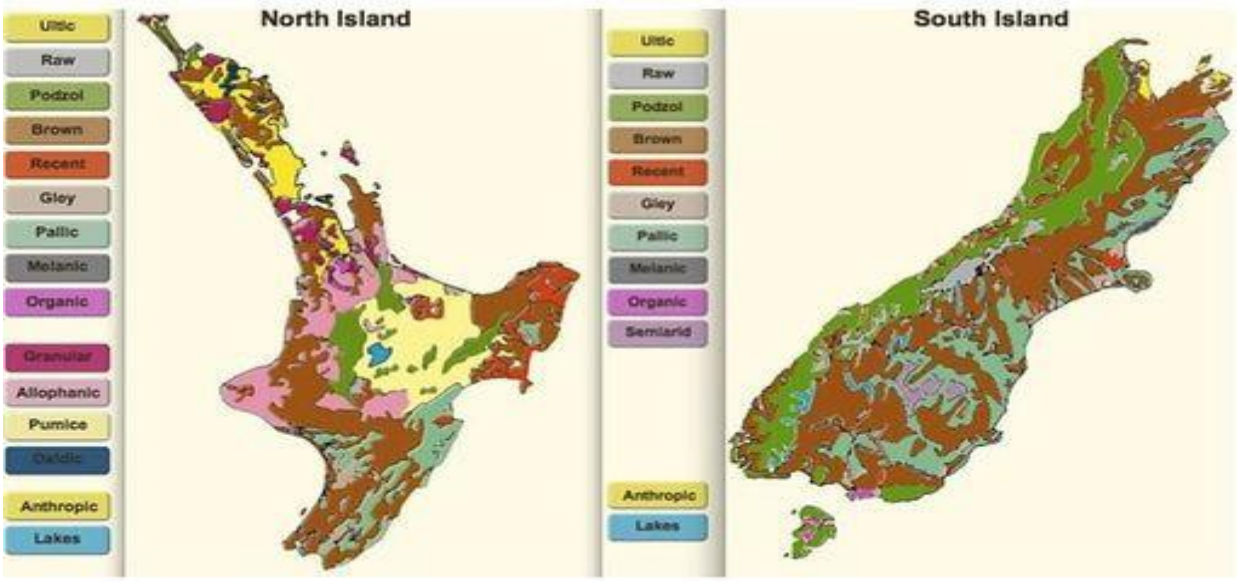
- These are very fertile soils of the temperate grassland and regions where extensive wheat cultivation is carried out.
- The grass vegetation produces dense turfs and when these die, the humus is returned to the soil. They are rich in humus and there is little or no leaching.

(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



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.

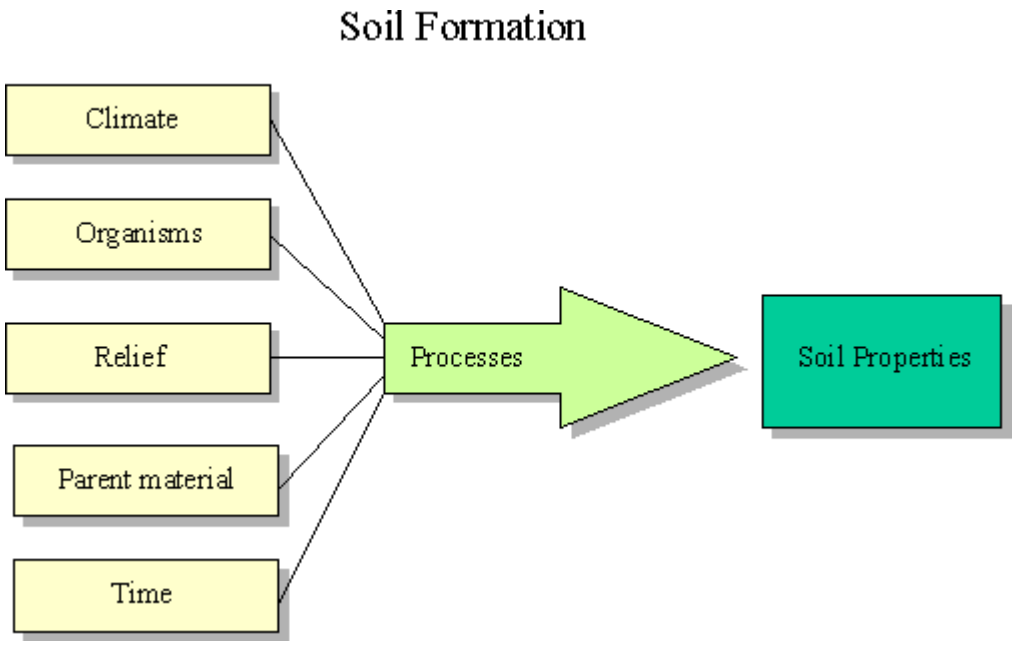
  (i) Weathering – produce primary and secondary minerals as well as determining the rate of release of nutrients and the soil depth, texture and drainage.

  (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)

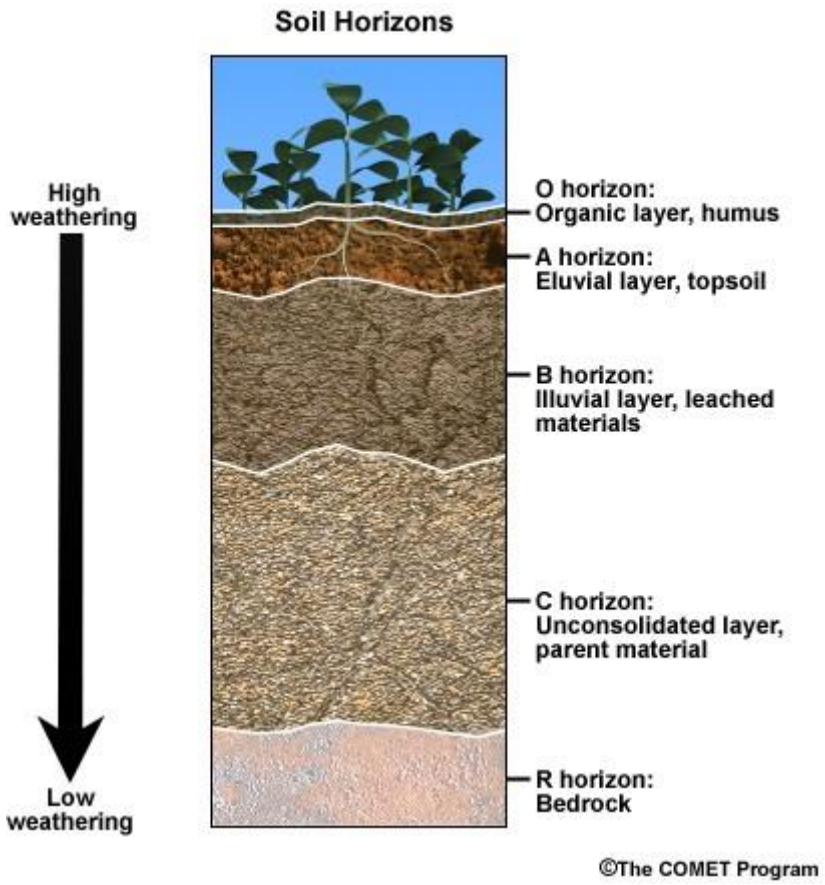
- Organic matter
- Nutrient cycle/recycling
- Mixing and generation

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**

Characteristics/Features	*Location*
• 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**

Characteristics/Features	*Type*	*Location*
• These include soils developed from marine and rifer 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)

Characteristic/Feature	*Location*
• 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

Characteristic	*Location*
• 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

Characteristic	*Location*
• 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 ***gleying*** 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

Characteristic/Feature	*Location*
• 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 soild needed for plant growth.

Soil Conservation Measures

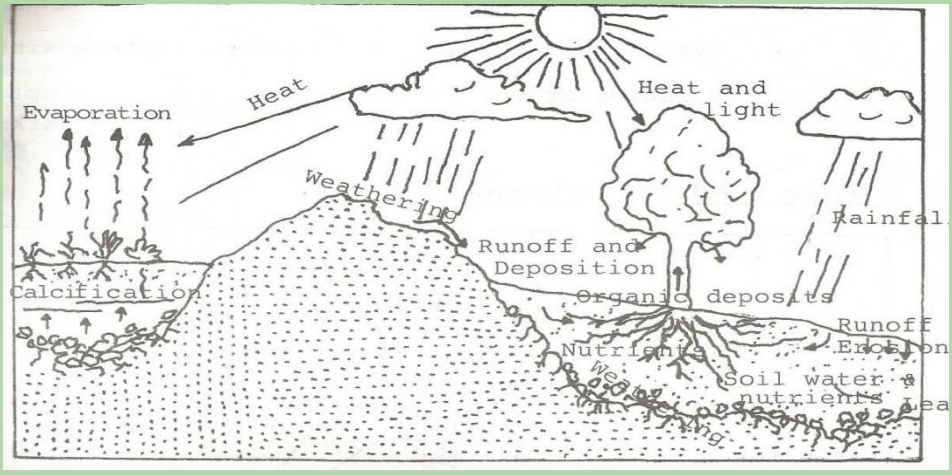
The various problems have led to the degradation of soil in certain areas around the country. Hence there is a need to conserve or protect the soil from further damage. Some methods of conservation used today are:

- 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.

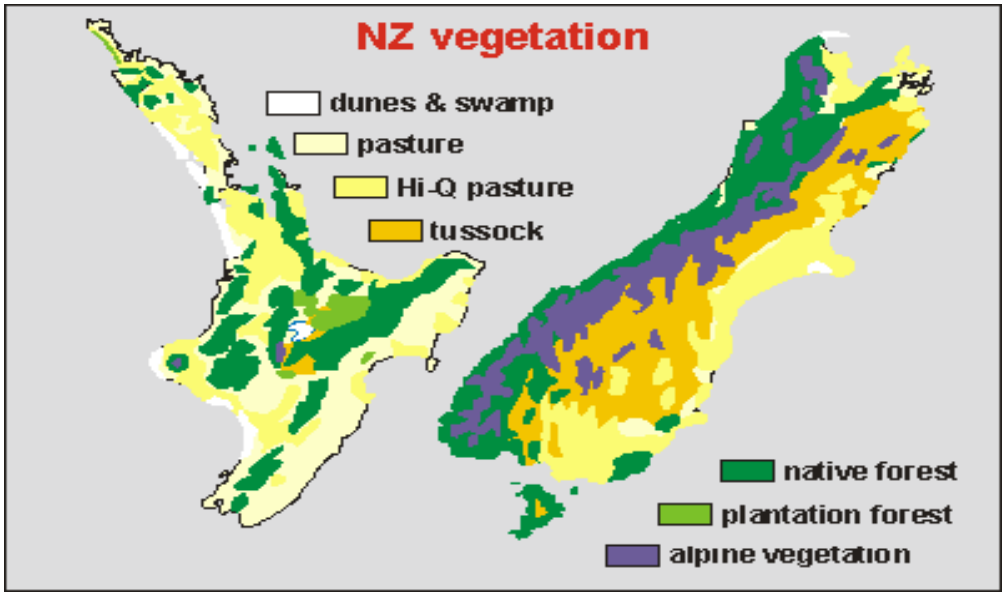
Climate

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 radiate pine because it grows over twice as it does in North America.
- Its fast growth rate makes radiate pine very popular with foresters because it matures and can be cut earlier than any other tree species.
- In particular, crop 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 slightly alteration such as growing a shelter belt of trees to reduce wind speed.
- Most method of climate modification is costly and is 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.
  -



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 Ecuado 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 continuos 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 adoptions 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 of 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 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 Northen 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, canterbuty Plains in new Zealand.
- Grasses grow upt 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. cacty.
  - 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 in to 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 topical 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

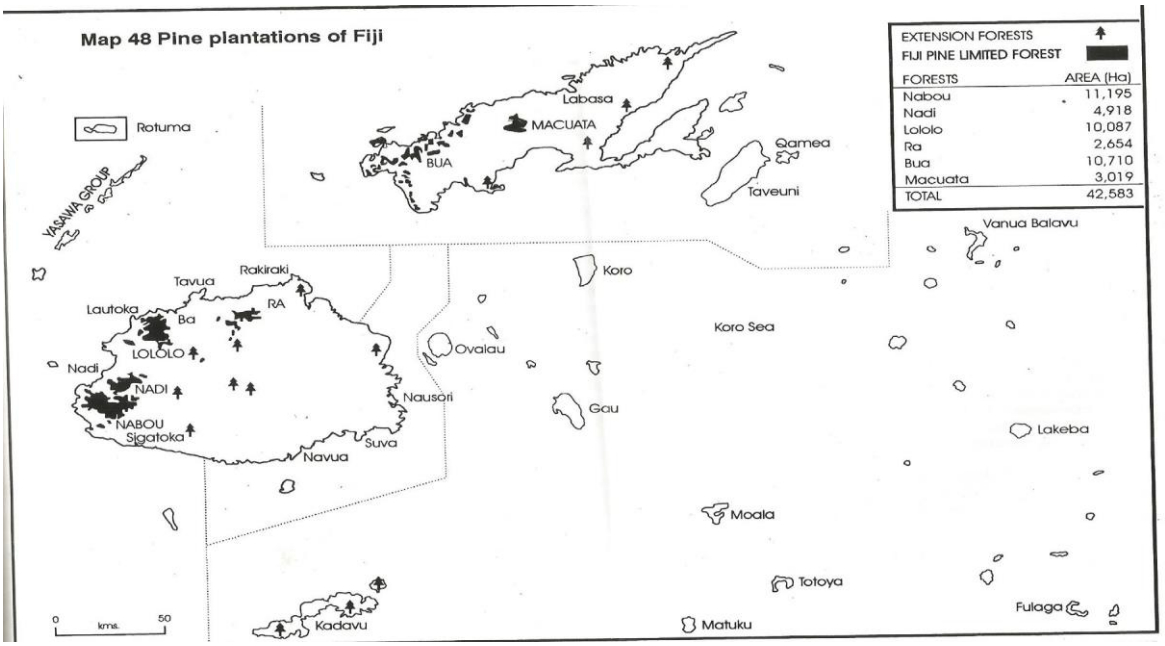
Source: www.panoramio.com

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 ah 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.

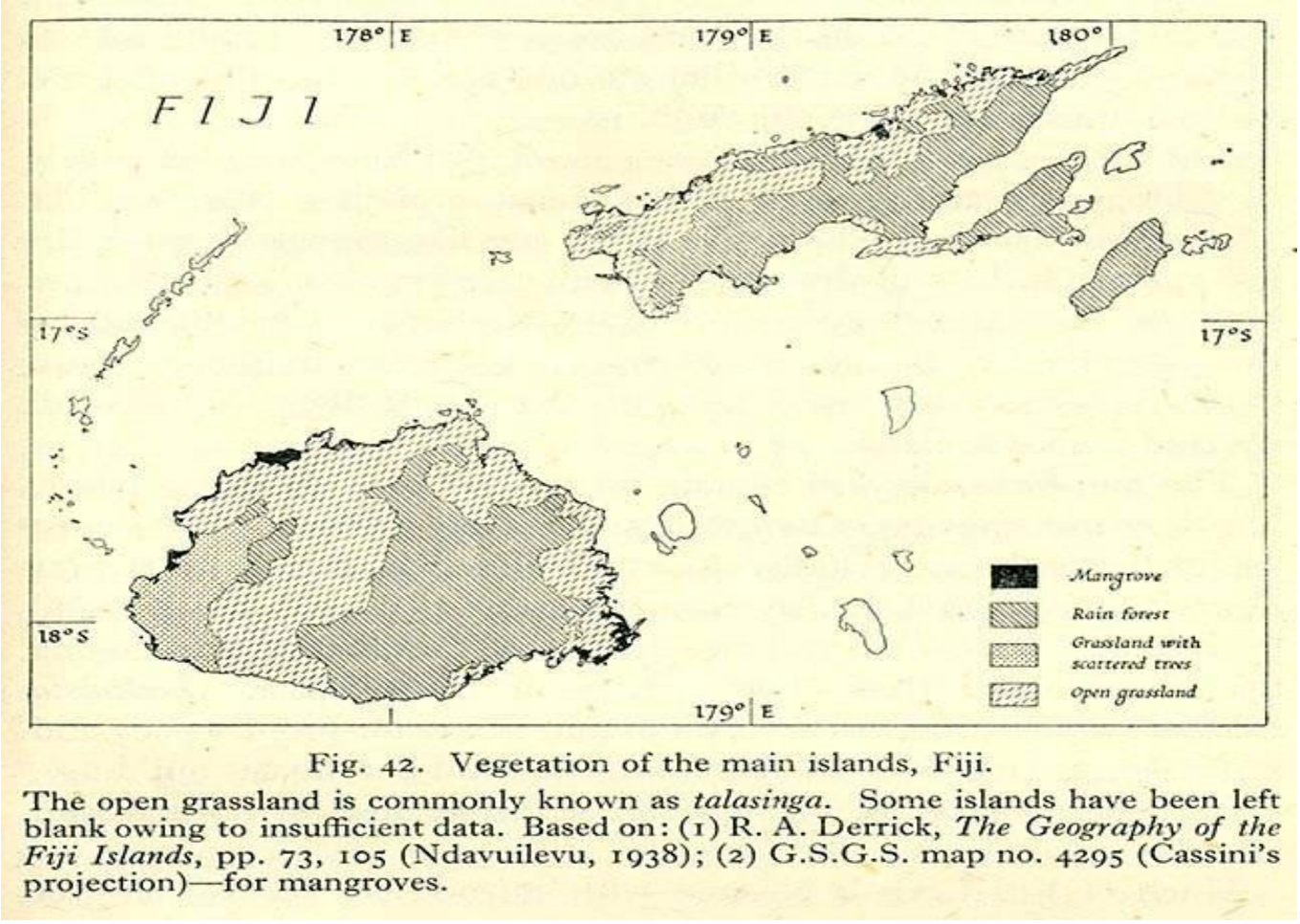


Fig. 42. Vegetation of the main islands, Fiji.
The open grassland is commonly known as *talasinga*. Some islands have been left blank owing to insufficient data. Based on: (1) R. A. Derrick, *The Geography of the Fiji Islands*, pp. 73, 105 (Ndavuilevu, 1938); (2) G.S.G.S. map no. 4295 (Cassini's projection)—for mangroves.

Source: www.maps.nationmaster.com

CHAPTER 9

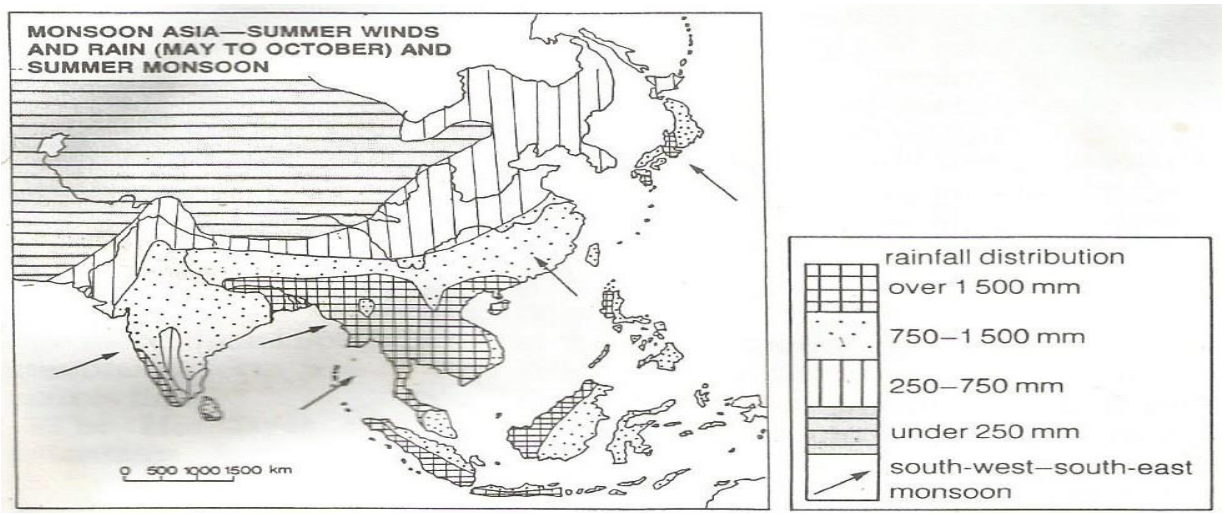
NATURAL HAZARD- MONSOON ASIA

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.

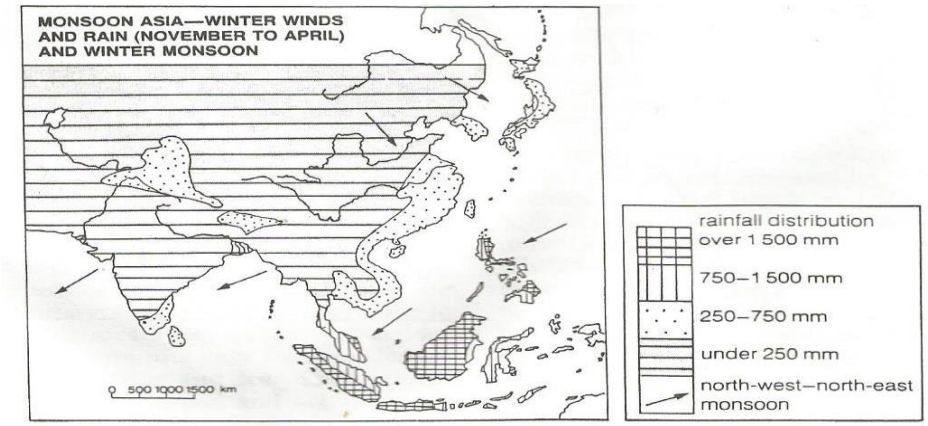
The summer monsoon is associated with the rainy season in most Asian countries.



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

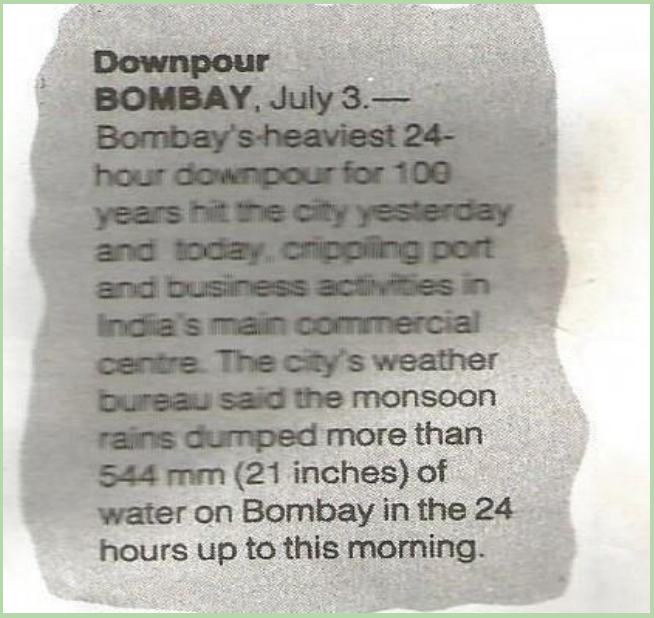
In general floods are caused by too much rain. In Monsoon Asia the area's most threatened by flooding are the major river basins and delta areas. During heavy rains, especially in the summer monsoon, the flow of water into a river and from tributaries of the river exceeds the outflow from the river mouth.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



Downpour

BOMBAY, July 3.— Bombay's heaviest 24-hour downpour for 100 years hit the city yesterday and today, crippling port and business activities in India's main commercial centre. The city's weather bureau said the monsoon rains dumped more than 544 mm (21 inches) of water on Bombay in the 24 hours up to this morning.

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?

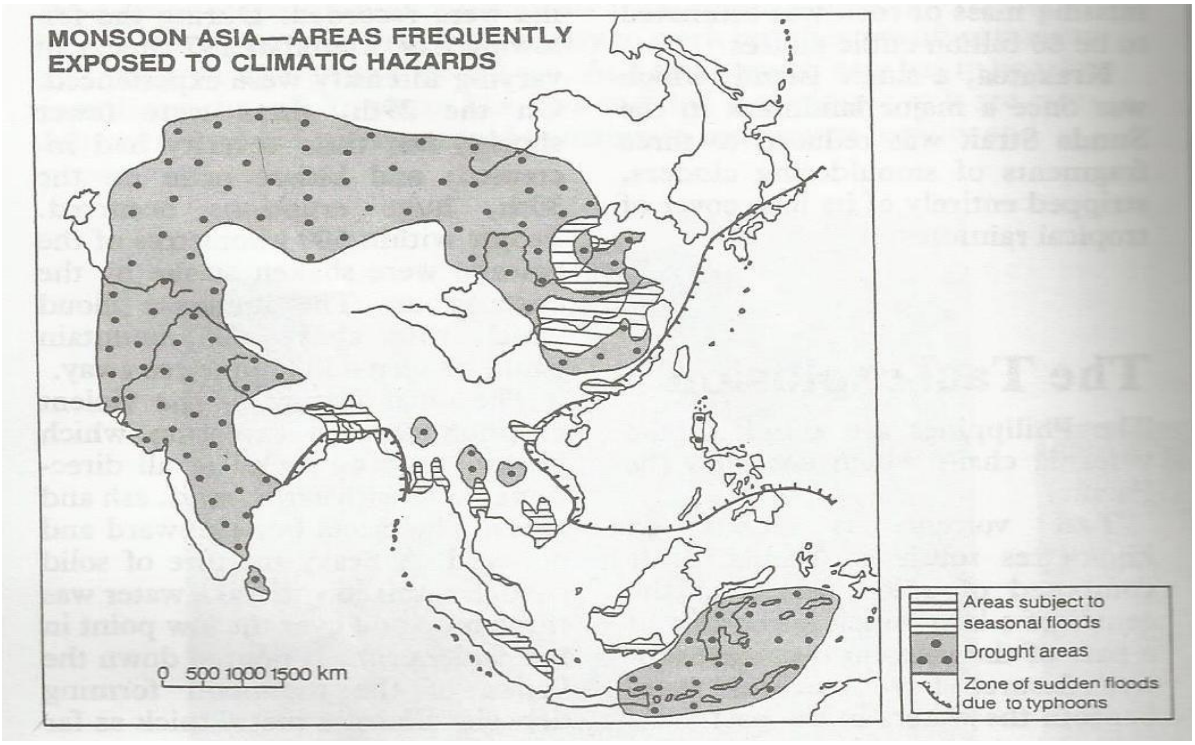
- Buildings dams to control river flow.
- Building embankments or stop banks up to stop the river from overflowing.
- Dredging the river (ie deepening the river channel).
- Improve flood warning systems.
- Providing relief supplies after the flood.

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 lesson 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

Tropical Cyclone Evans

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 Tangashan 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, 1996. The earthquake was so strong that it damaged well designed earthquake resistant build 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

Positive	Negative
• 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 injuiry. • 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 are 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 Phillipines 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 ganger 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 sever 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.

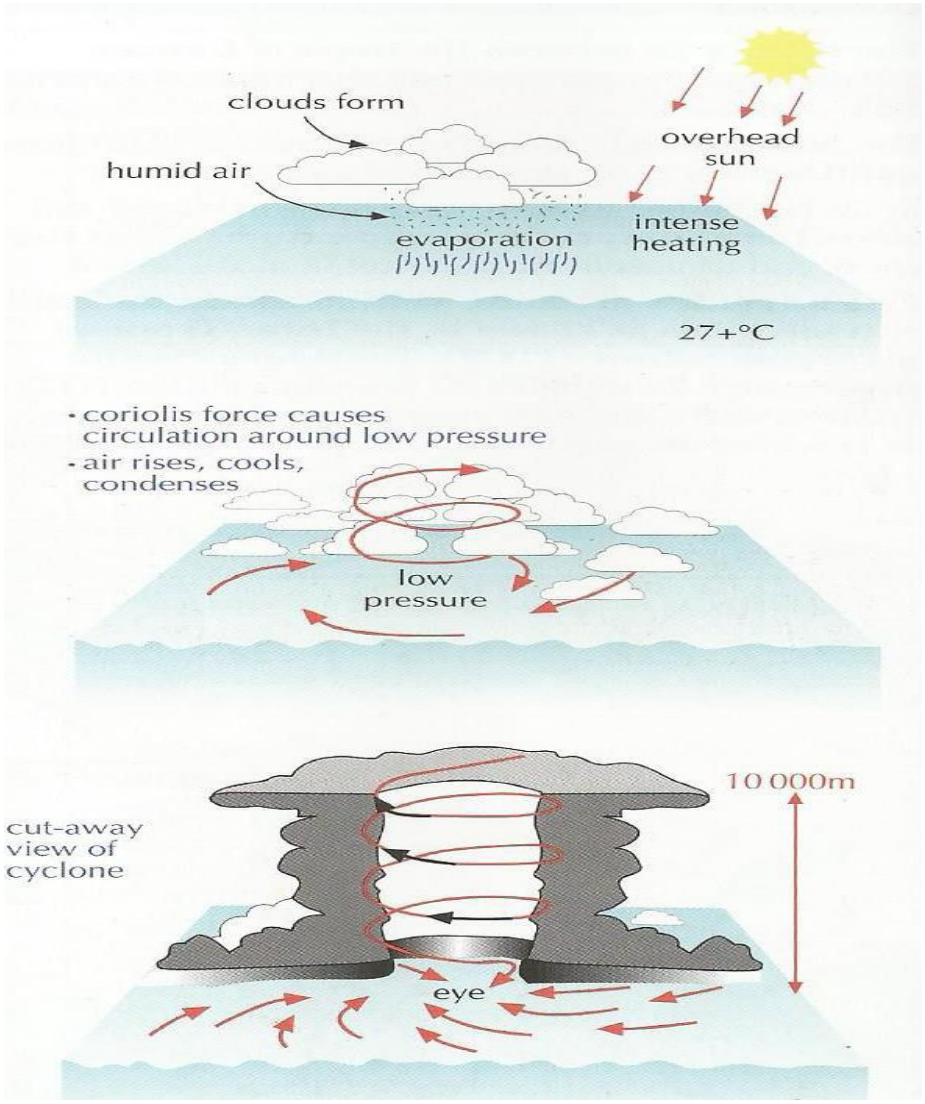
Causes

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

- High temperatures of at least 26 degrees celcius.
- A large expanse of warm ocean (heated to at least 26 degrees celcius)
- 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.



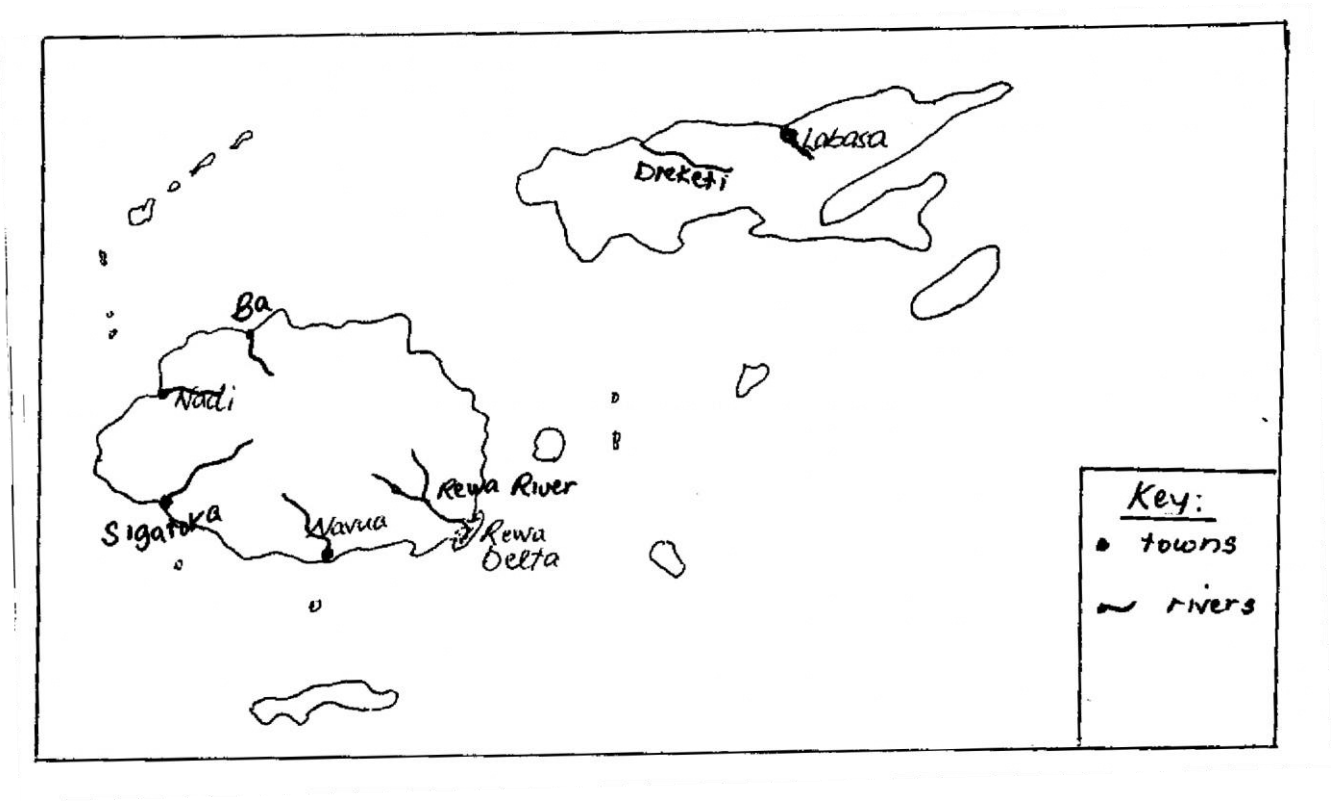
Formation of a tropical cyclone

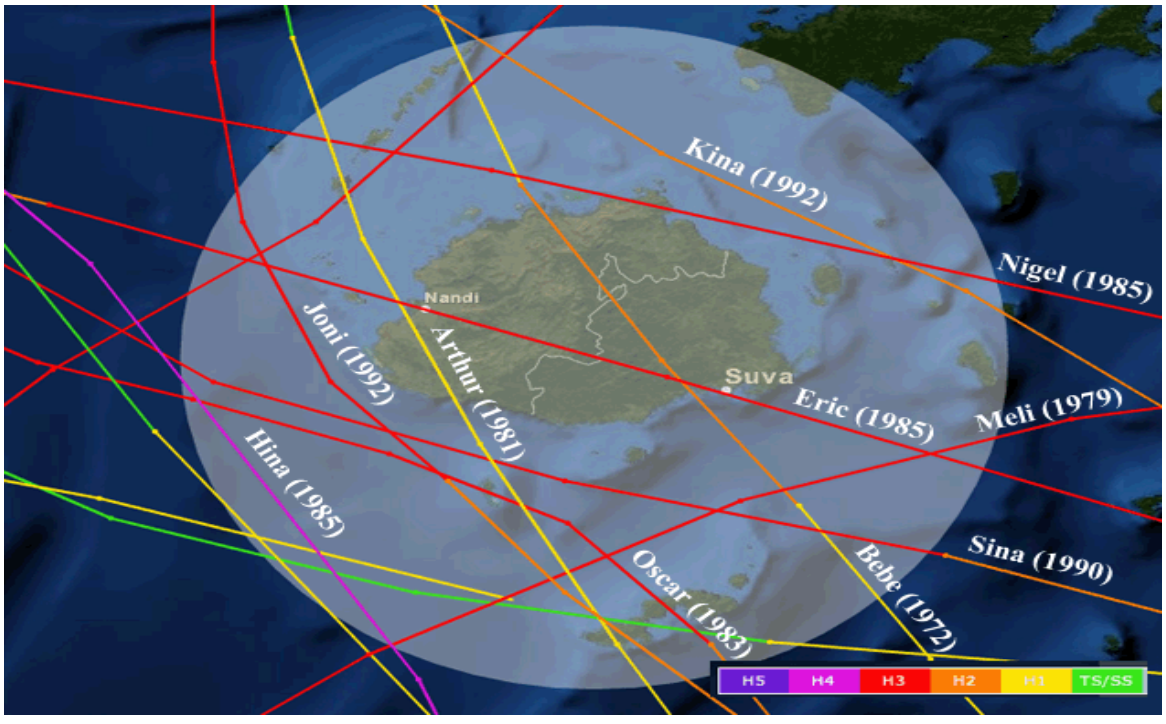
Source: Geography NCEA Level One

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

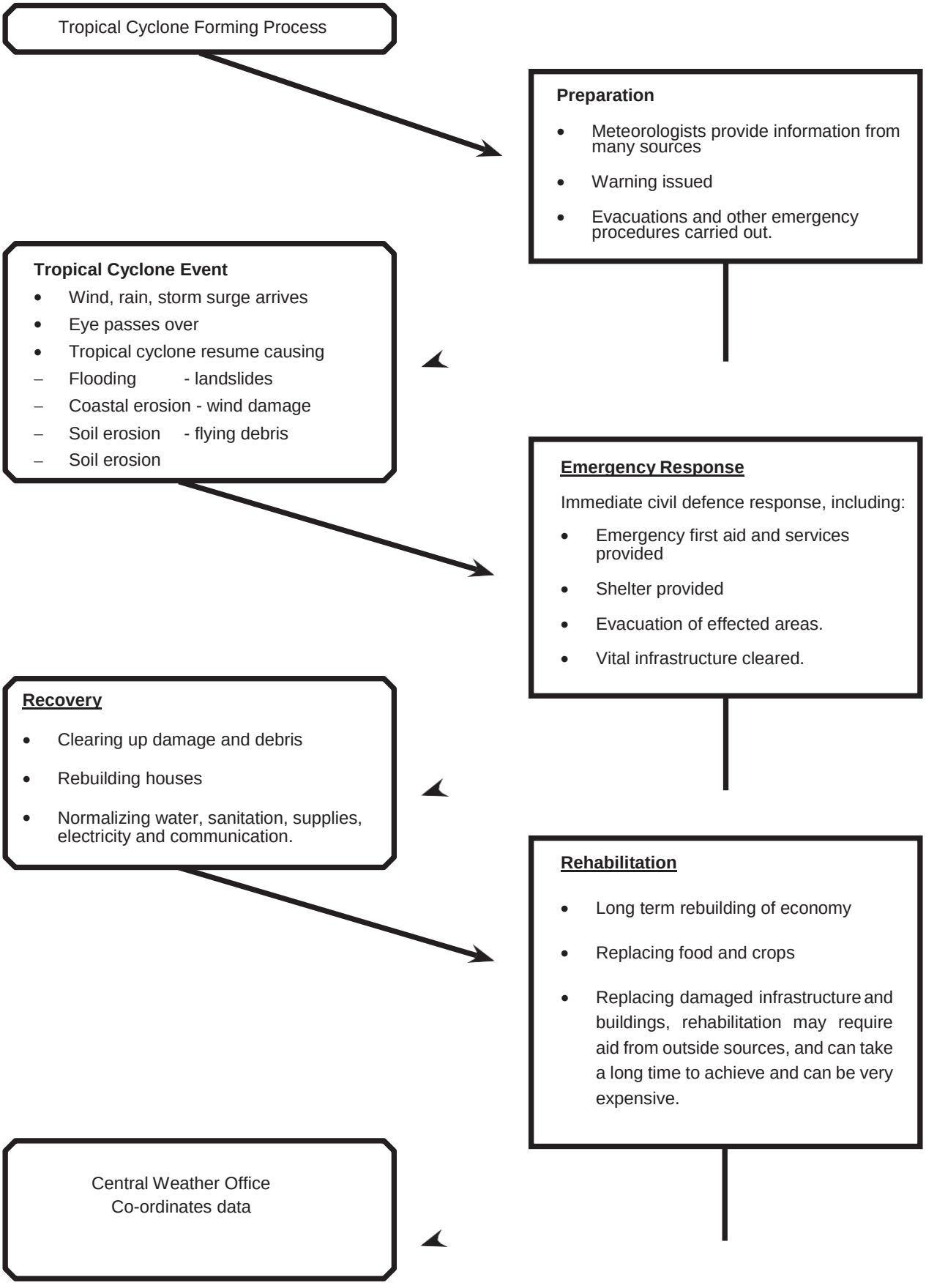
- Growing famine crops eg. Yams & nuts
- Fermenting & drying food for preservation.
- High level of co-operation & family ties.

(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, bridles 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

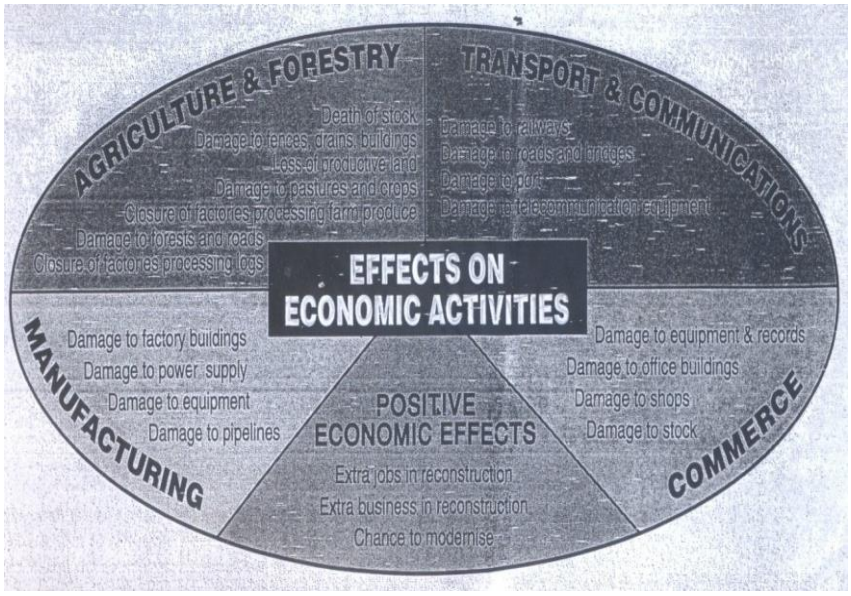
Source: www.fijilive.com

EFFECTS OF FLOODS

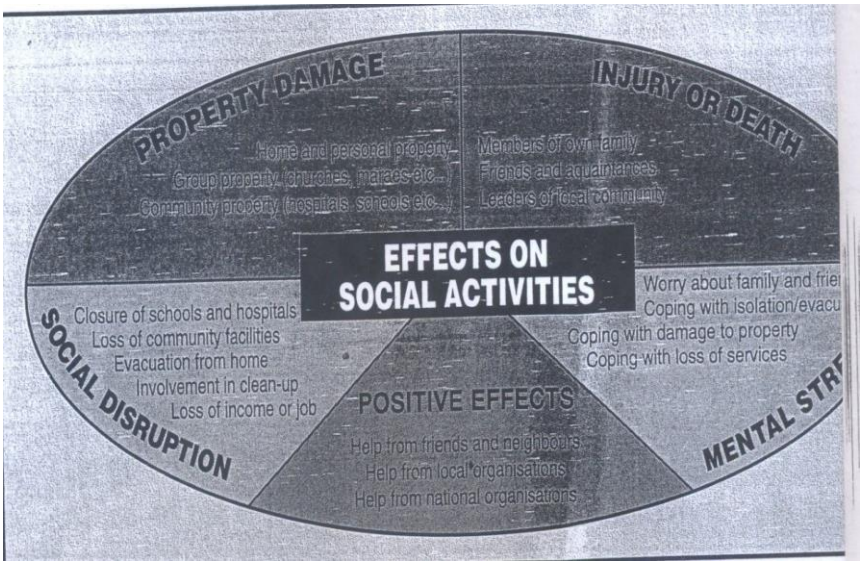
A. Physical/Environmental Effects :

Positive effects	***Negative effects***
• Builds up landforms such as floodplains, deltas, leeves, 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 FLOOIDNG?

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.

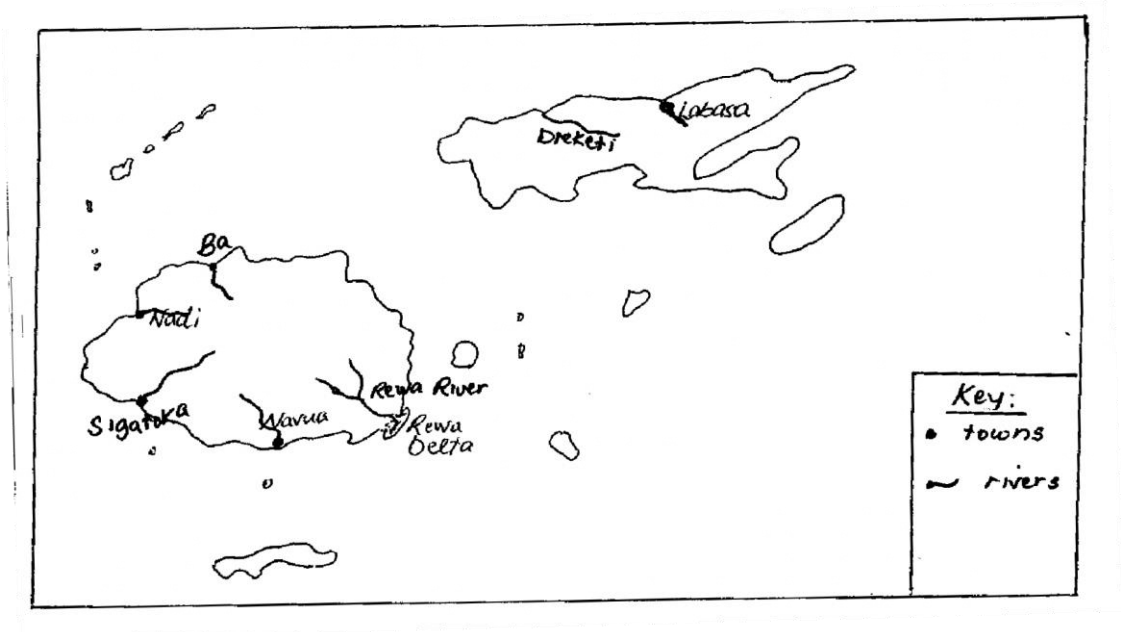
All these activities result in the removal of trees and forests which in turn will lead to an increase in run-off and sedimentation. Run-off becomes greater and faster than it would have been when forests were there. As a result, rivers will flood much faster.

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



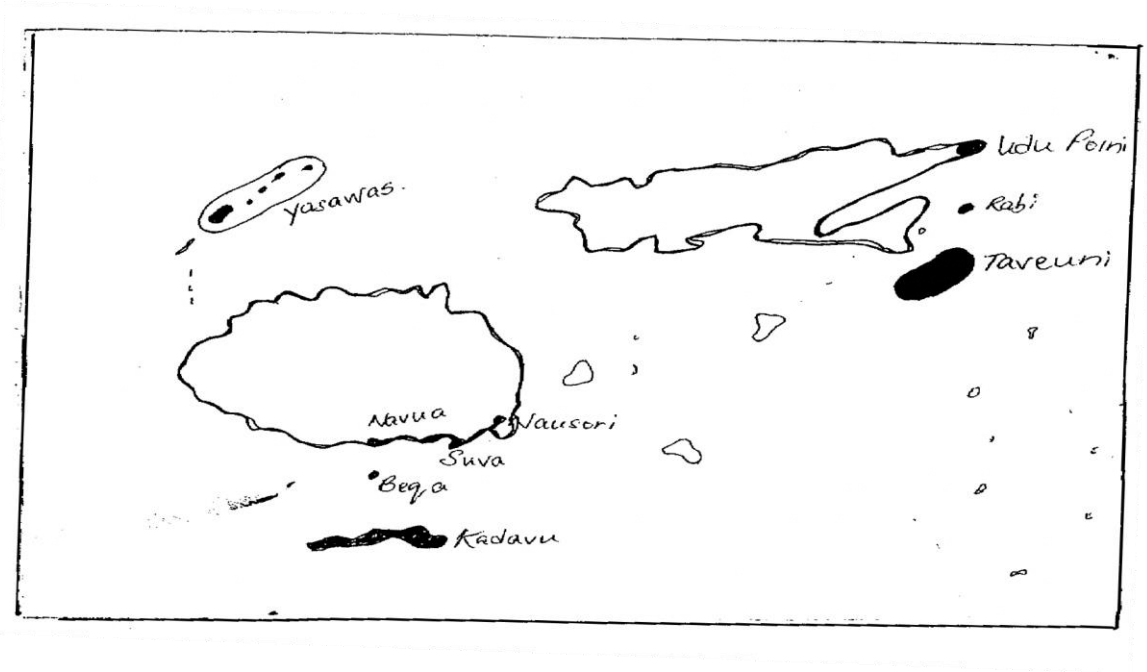
EARTHQUAKES

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

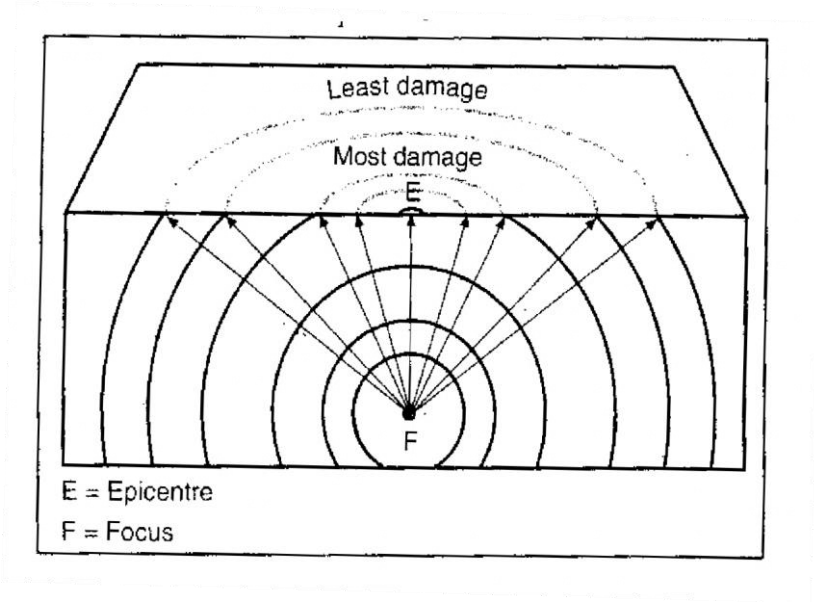
1. Improving building & design codes such as the use of special strength concrete or rubber pad in the foundation of buildings.
2. Limiting the height and density of buildings in earthquake prone areas.
3. Creating greater awareness eg. Having earthquake drills, survival kits and networks to cope with 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.



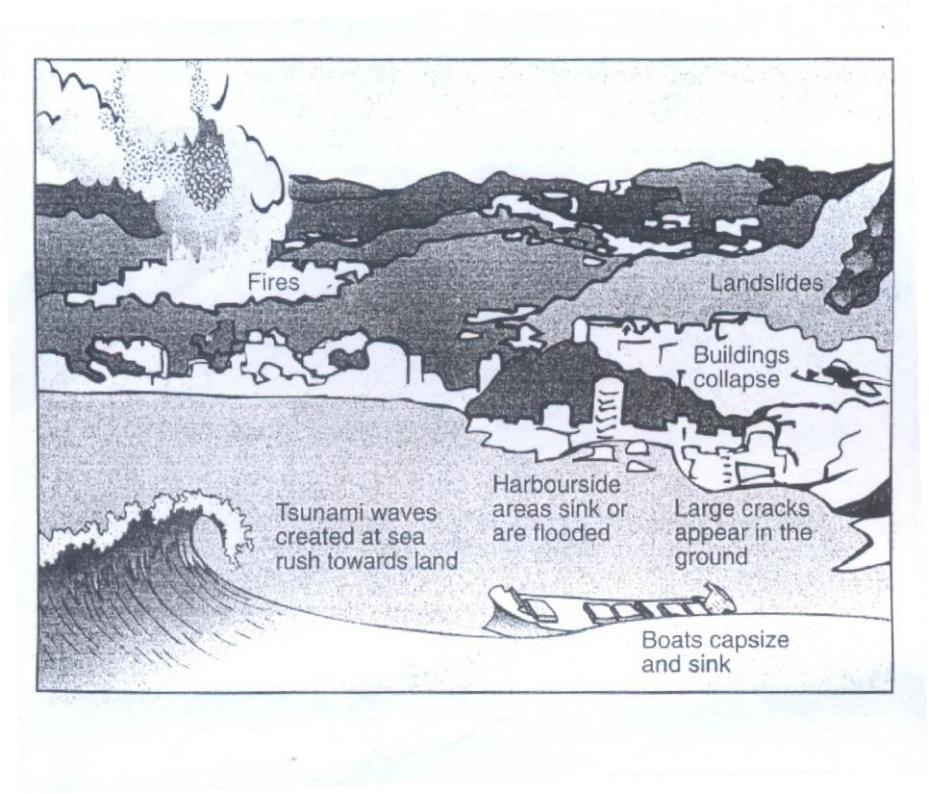
Measuring Earthquakes

1. Richter scale – instrument which measures the force or maginitude 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 Produces 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.

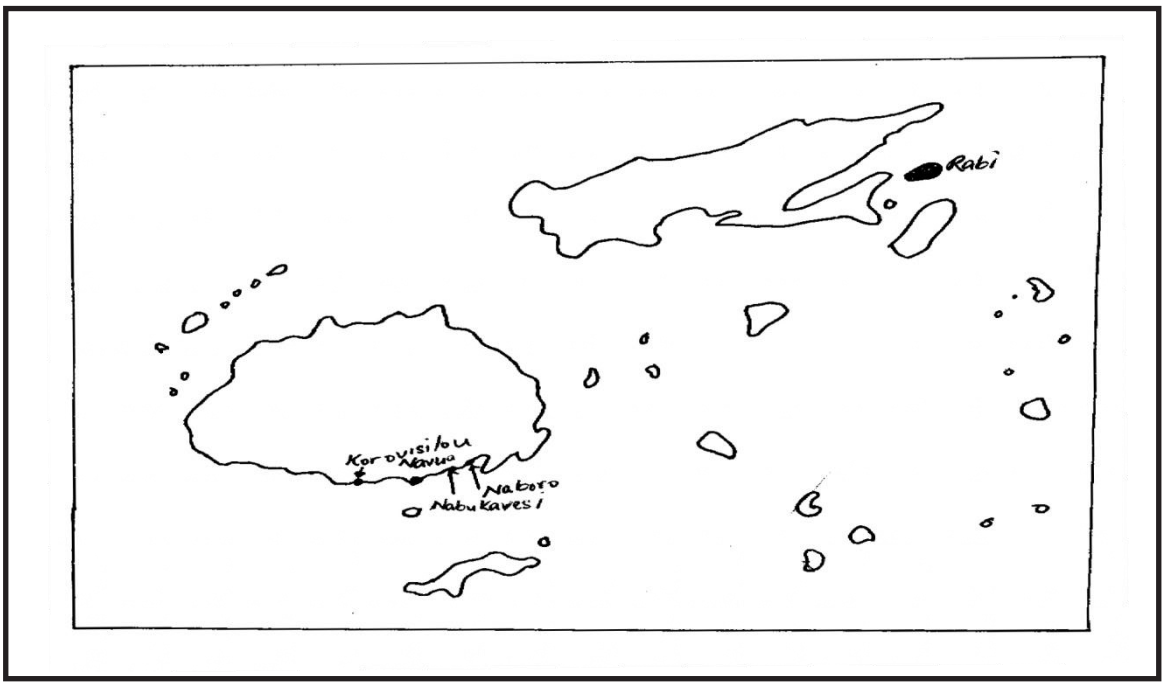
LANDSLIDES

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.

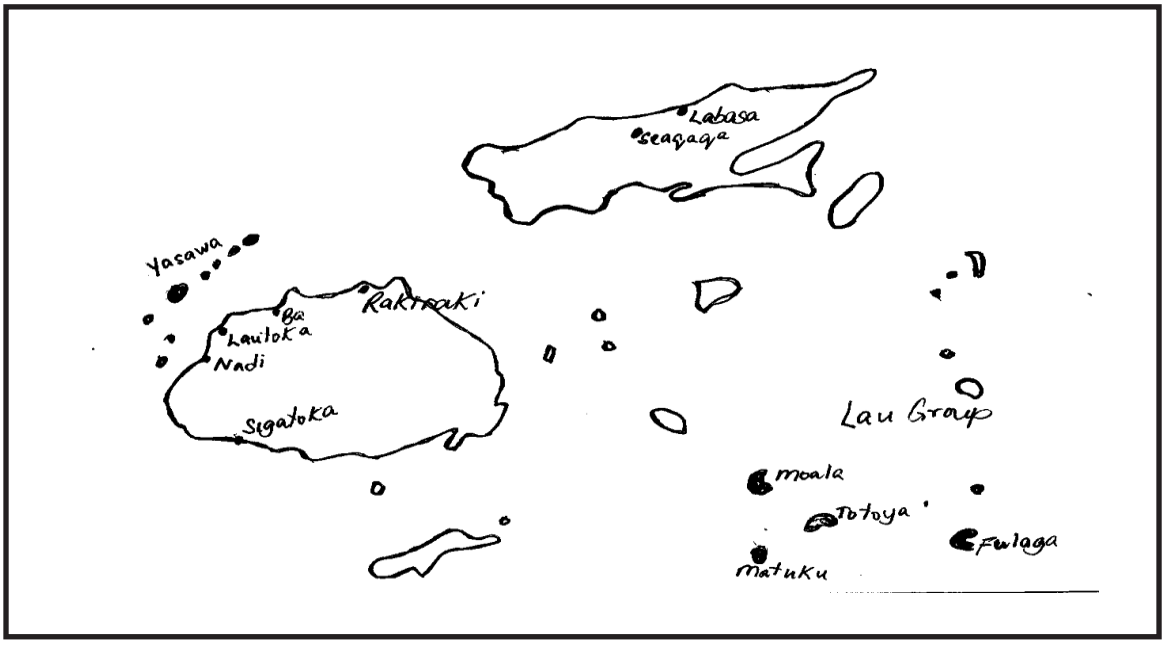
DROUGHTS

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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