# G.C.E (Advanced Level)

# Geography

## Teachers' Guide
## Grade 12
## (To be implemented from 2017)


**Department of Social Sciences**
**Faculty of Languages, Humanities and Social Sciences**
**National Institute of Education**
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**Sri Lanka**

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**Geography**

Grade 12

Teachers' Guide

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# Director General's Message

With the primary objective of realizing the National Educational Goals recommended by the National Education Commission, the then prevalent content based curriculum was modernized, and the first phase of the new competency based curriculum was introduced to the eight year curriculum cycle of the primary and secondary education in Sri Lanka in the year 2007.

The second phase of the curriculum cycle thus initiated was introduced to the education system in the year 2015 as a result of a curriculum rationalization process based on research findings and various proposals made by stake holders.

Within this rationalization process the concepts of vertical and horizontal integration have been employed in order to build up competencies of students, from foundation level to higher levels, and to avoid repetition of subject content in various subjects respectively and furthermore, to develop a curriculum that is implementable and student friendly.

The new Teachers' Guides have been introduced with the aim of providing the teachers with necessary guidance for planning lessons, engaging students effectively in the learning teaching process, and to make Teachers' Guides will help teachers to be more effective within the classroom. Further, the present Teachers' Guides have given the necessary freedom for the teachers to select quality inputs and activities in order to improve student competencies. Since the Teachers' Guides do not place greater emphasis on the subject content prescribed for the relevant grades, it is very much necessary to use these guides along with the text books compiled by the Educational Publications Department if, Guides are to be made more effective.

The primary objective of this rationalized new curriculum, the new Teachers' Guides, and the new prescribed texts is to transform the student population into a human resource replete with the skills and competencies required for the world of work, through embarking upon a pattern of education which is more student centered and activity based.

I wish to make use of this opportunity to thank and express my appreciation to the members of the Council and the Academic Affairs Board of the NIE the resource persons who contributed to the compiling of these Teachers' Guides and other parties for their dedication in this matter.

Dr. (Mrs.) JayanthiGunasekara
Director General
National Institute of Education
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# Message from Ven. Deputy Director General

Learning expands into a wider scope. It makes life enormous and extremely simple. The human being is naturally excellent in the skill of learning. A country when human development is considered the main focus uses learning as a tool to do away with malpractices identified with intellect and to create a better world through good practices.

It is essential to create valuable things for learning and learning methods and facilities within the adhere of education. That is how the curriculum, syllabi, teachers' guides and facilitators join the learning system.

Modern Sri Lanka has possessed a self–directed education system which is a blend of global trends as well as ancient heritage.

It is necessary to maintain the consistency of the objectives of the subject at the national level. However, facilitators are free to modify or adapt learning teaching strategies creatively to achieve the learning outcomes, competency and competency level via the subject content prescribed in the Syllabus. Therefore, this Teachers' Guide has been prepared to promote the teachers' role and to support the students as well as the parents.

Furthermore, at the end of a lesson, the facilitators of the learning- teaching process along with the students should come to a verification of the achievement level on par with ones expected exam by a national level examiner, who evaluates the achievement levels of subjects expected. I sincerely wish to create such a self-progressive, motivational culture in the learning- teaching process. Blended with that verification, this Teachers' Guide would definitely be a canoe or a raft in this endeavor.

**Ven. Dr. Mabulgoda SumanarathanaThero**
**Deputy Director General**
**Faculty of Languages, Humanities and Social Sciences**

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# Content

# Geography
# Syllabus

## Grade 12
**(To be Implemented from 2017)**

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# Introduction

Geography is a Discipline that helps to grasp the dynamism of the bio-world. This dynamism is incorporated in the geographical landscape which is the synthesized product of the interaction between the physical and human environment in space and time. Thus Geography is a discipline concerned with the understanding of environmental and social processes and their interrelationships at local to global levels from a spatial and temporal perspectives. It is in this context that the School Geography curriculum has been developed.

In the process of developing the curriculum proposed to be implemented from 2017, the research findings on the curriculum during the past five years, classroom observations and teacher-student experiences have been taken into consideration. It is expected that the proposed curriculum will be able to provide subject knowledge and understanding, skills and attitudes and in particular, the ability to capture opportunities and assess various development alternatives. It is hoped that this curriculum will provide an insight into managing resources which promotes sustainability both in the short and long term.

Furthermore it envisages improving the ability to view the eco-societal interrelationships in the context of ecological principles.



The current syllabus has been formulated paying due consideration to the changing competency levels that varies by age and the capacity of learning of the students. In the process it is expected that the teacher should play a transforming role using interacting teaching methods to develop competencies.

This curriculum proposed to be implemented from the year 2017 is the collective effort of a group consisting of Senior University Academics, Educationists, Educators and the Geography Project Team of the NIE. The ten major competencies related to the subject of Geography incorporated in the formulation of this curriculum are mentioned below:

1. Lives with an awareness of the nature and processes of the environment in which he lives.
2. Reviews the basic concepts and methodologies that help to understand the physical and human landscape.
3. Acts with awareness of the components, characteristics and processes in the physical and human landscape
4. Acts with awareness of the manner in which the physical and human interaction impacts on the geographical environment.

5. Uses geographical techniques to collect, analyze, interpret and present data and information.
6. Applies the holistic approach in understanding, analyzing and interpreting the physical and human landscape.
7. Acts with sensitivity inculcating positive attitudes helpful in conserving and maintaining the physical and human landscape
8. Acts with an awareness of the earth and its people in order to promote a harmonious interrelationship between the environment and society.
9. Fosters special survival skills that help to overcome challenging life situations.
10. Develops skills needed for active participation in the world of work.

# National Goals

i. Nation building and the establishment of a Sri Lankan identity through the promotion of national cohesion, national integrity, national unity, harmony and peace and recognizing cultural diversity in Sri Lanka's plural society within a concept of respect for human dignity.

ii. Recognizing and conserving the best elements of the nation's heritage while responding to the challenges of a changing world.

iii. Creating and supporting an environment imbued with the norms of social justice and a democratic way of life that promotes respect for human rights, awareness of duties and obligations and a deep and abiding concern for one another.

iv. Promoting the mental and physical well- being of individuals and a sustainable life style based on respect for human values.

v. Developing creativity, initiative, critical thinking, responsibility, accountability and other positive elements of a well- integrated and balanced personality.

vi. Human resource development by educating for productive work that enhances the quality of life of the individual and the nation and contributes to the economic development of Sri Lanka.

vii. Preparing individuals to adapt to and manage change, and to develop capacity to cope with complex and unforeseen situations in a rapidly changing world.

viii. Fostering attitudes and skills that will contribute to securing an honorable place in the international community, based on justice, equality and mutual respect. (Adapted from National Education Commission Report -2003)

# Basic Competencies

The following Basic Competencies developed through education will contribute to achieve the above National Goals.

**(i) Communication Competencies**

Competencies in communication are based on four subsets: Literacy, Numeracy, Graphics and IT proficiency

| | | |
|---|---|---|
| Literacy | : | Alternative listening, clarity in speech, reading to understand, accurate and lucid working and effective communication of ideas. |
| Numeracy | : | Use numbers to denote things, space and time, count, calculate and measure systematically. |
| Graphics | : | Make sense of line and form, express and record details, instructions, and ideas with line from and colour. |
| IT proficiency | : | Computer literacy and the use of information and communication technologies (ICT) in learning, in the work environment and in personal life. |

**(ii) Competencies relating to personality Development**

- Generic skills such as creativity, divergent thinking, initiation, decision making, problem solving, critical and analytical thinking, team work, inter - personal relations, discovery and exploration;
- Values such as integrity, tolerance and respect for human dignity;
- Emotional intelligence.

**(iii) Competencies relating to the Environment**

These competencies relate to the social, biological and physical environment.

| | | |
|---|---|---|
| Social Environment | - | Awareness of the national heritage, sensitivity and skills associated with members of a plural society, concern for distributive justice, social relationships, personal conduct, general and legal conventions, rights, responsibilities, duties and obligations. |
| Biological Environment | - | Awareness, sensitivity and skills linked to the living world, people and the eco system, the trees, forests, seas, water, air and life - plant, animal and human life. |
| Physical Environment | - | Awareness, sensitivity and skills linked to space, energy, fuels, matter, materials and their links with human living, food, clothing, shelter, health, comfort, respiration, sleep, relaxation, rest, wastes and excretion. |



Included here are skills in using tools and technologies for learning, working and living.

**(iv) Competencies relating to preparation for the World of Work**

Employment related skills to maximize the potential and to enhance capacity.

- To contribute to economic development.
- To discover one's vocational interests and aptitudes,
- To choose a job that suits to their abilities, and
- To engage in a rewarding and sustainable livelihood.

**(v) Competencies relating to Religion and Ethics**

Absorption and assimilation value that leads individuals to function in a manner consistent with the ethical, moral and religious modes of conduct in everyday living, selecting the most appropriate.

**(vi) Competencies in Play and the Use of Leisure**

Pleasure, joy, emotions and such human experiences as expressed through aesthetics, literature, play, sports and athletics, leisure pursuits and other creative modes of living.

**(vii) Competencies relating to ' learning to learn'**

Empowering individuals to learn independently and to be sensitive and successful in responding to and managing change through a transformative process, in a rapidly changing, complex and interdependent world.

(Adopted from National Education Commission Report -2003)

# Aims of teaching Geography is to:

1. Act with an awareness of the concepts, characteristics and processes of the physical and human landscape.
2. Study the interrelationships, their patterns and processes in nature and society from a spatial and temporal perspective.
3. Adapt oneself to use geographical techniques to collect, analyze, interpret and present data and information.
4. Comprehend the diversity of the world; adapt oneself to live harmoniously with the environment as well as with one an
5. Inculcate positive attitudes supportive of conserving and sustaining the physical and human landscape.
6. Foster special survival skills that help to overcome challenging life situations.
7. Develop skills needed for active participation in the world of work.

| Physical Geography | | | | |
|---|---|---|---|---|
| Competency | Competency Level | Content | Learning Outcomes | Periods |
| 1.0 Acts with an awareness of the basic concepts of Geography | 1.1 Introduces Geography. | • Scope of Geography<br>- spatial relationships and temporal changes<br>- grasp the dynamism of the life world<br>- composite expression of the physical and human phenomena<br>- these processes and changes range from local to global level | - Explains spatial relationships and temporal changes<br><br>Describes how Geography explains the dynamism of the life world<br><br>- Explains that geographical processes and relationships range from local to global levels<br><br>- While being aware of the issues and problems of geographical significance communicates the same to the wider community | 04 |
| 2.0 Describes the nature of Physical Geography | 2.1 Explains the physical basis of Geography | • Introduction to the components of physical basis of Geography<br>- land forms<br>- rocks<br>- soils<br>- water<br>- climate<br>- bio factors<br><br>• Discussion of the components of the physical basis of Geography from a synthesizing perspective | - Describes concisely the components of the physical basis of Geography<br><br>- Synthesizes the interrelationships of the components of the physical basis of Geography | 04 |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| 3.0 Examines the nature and processes of one's environment and contributes to maintain its balance | 3.1 Explains the geo-system | • Introduces the geo-system<br>• Processes of the geo-system | Explains what a "system" is<br>Describes the nature of the geo-system and its components | 12 |
| | 3.2 Explains the nature and importance of the atmosphere | • Nature and importance of the atmosphere | Describes the structure, composition and processes of the atmosphere | |
| | 3.3 Explains the structure and importance of the lithosphere | • Nature and importance of the lithosphere | Describes the structure, composition and processes of the lithosphere | |
| | 3.4 Explains the nature and importance of the hydrosphere | • Nature and importance of the hydrosphere | Explains the distribution, composition and processes of the hydrosphere | |
| | 3.5 Explains the nature and importance of the biosphere | • Nature and the importance of the biosphere | Explains the composition and processes of the biosphere | |
| | 3.6 Explains the importance of maintaining the balance of the geo-system | • Balance of the geo-system and its significance | Describes the interrelationships among the components of the geo-system<br>Emphasizes the importance of maintaining the balance of the geo-system | |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| 4. Review components, characteristics and processes of the earth's physical landscape and focuses on its conservation | 4.1 Describes the Earth's structure and its characteristics | • Structure and composition of the Earth<br>- Earth's crust,<br>- mantle,<br>- core<br>- rock formation,<br>- rock types<br>- soil formation and characteristics<br>- importance of soil conservation | - Describes the structure of the Earth<br>- Describes the composition of the Earth<br>- Explains the formation of rocks and their characteristics<br>- Explains the nature of the soil profile<br>- Emphasizes the significance of soil conservation | 16 |
| | 4.2 Examines rocks, minerals and soils of Sri Lanka | • Rocks, Minerals and soils of Sri Lanka<br>• Explaining the distribution of rocks, minerals and soils with the help of maps | - Describes the nature and distribution of rocks in Sri Lanka<br>- Explains the distribution of minerals in Sri Lanka<br>- Explains the distribution of soil types in Sri Lanka | |
| 5.0 While reviewing the processes of the physical landscape acts with sensitivity to the physical landscape | 5.1illustrates with examples endogenic forces influencing Geomorphic forces | • Geomorphic processes Endogenic forces<br>- plate tectonics<br>- earth movements<br>- earthquakes<br>- volcanoes | - Describes the geomorphic process<br>- Describes plate tectonics with the help of diagrams<br>- Mark and name the main tectonic plates on a map of the world<br>- Illustrates landforms resulting from endogenic forces | 48 |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| | 5.2 Illustrates with examples the exogenic forces influencing geomorphic processes | • Exogenic forces<br>- running water<br>- wind<br>- glaciers<br>- waves<br>- groundwater<br>- mass movements | - Describes with Illustrations the landforms resulting fromdenudation agents<br>- Gathers information on events resulting from endogenic and exogenic forces | |
| | 5.3 Describes the process of the hydrological cycle | • Hydrological cycle | - Explains the processes of the hydrological cycle with the help of a diagram | |
| | | • influence of the hydrological cycle on landscape | - Describes how processes of the hydrological cycle influence the landscape | |
| 6.0 Identifies and responds to basic concepts and methodologies of weather and climate that help understand the physical and human landscapes | 6.1 Defines weather and climate | • introduces weather and climate | - Explains the difference between weather and climate | 32 |
| | 6.2 Explains the elements of weather | • elements of weather<br>- temperature and sun light<br>- pressure and winds<br>- humidity<br>- clouds<br>- precipitation<br>- visibility<br>• measurement of weather elements and recording of data | - Introduces the elements of weather<br>- Describes the instruments used for measuring weather elements<br>- Explains how weather data are maintained<br>- Describes diurnal weather with the help of data | |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| | 6.3 Explains with examples factors controlling climate | • Factors controlling Climate<br>- Intensity of insolation and its variation by latitude<br>- distribution of land and water<br>- ocean currents<br>- location of low and high pressure systems<br>- prevailing winds<br>- Altitude and mountain barriers | - Names the factors controlling climate<br>- Explains with the help of examples basic features of climatic controls<br>- Presents with the help of diagrams and maps factors controlling climate | |
| | 6.4 With reference to Koppen's climatic classification explains tropical humid types | • Koppen's climatic classification<br>- introduction<br>- A type<br>- Af,<br>- Aw<br>- Am Climate types | - Introduces the criteria used in Koppen' climatic classification<br>- Explains the tropical climate type in Koppen's classification<br>- Mark and name tropical climate type on World map | |
| 7.0 Explains the uniqueness of Sri Lanka's climate | 7.1 Studies the nature of Sri Lanka's climate | • Introduction to the climate of Sri Lanka<br>• Factors affecting Sri Lanka's climate | - Provides comments whilst appreciating the uniqueness of the climate of Sri Lanka<br>- Explains the factors that influence the climate of Sri Lanka | 24 |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| | 7.2 Reviews the distribution of temperature in Sri Lanka and its determining factors | • Distribution of Temperature in Sri Lanka<br>• Factors affecting temperature distribution in Sri Lanka | - Explains the reasons for variations in the distribution of temperature in Sri Lanka | |
| | 7.3 Studies the manner in which Sri Lanka receives its rainfall and its distribution | • Methods of Receiving rainfall in Sri Lanka<br>- Monsoons<br>- Convection<br>- Cyclones<br>• Distribution of rainfall | - Describes the manner in which Sri Lanka receives its rainfall<br>- Describes seasons receiving rainfall in Sri Lanka<br>- Illustrates the distribution pattern of Rainfall in Sri Lanka with the help of a map | |
| | 7.4 Explains the differences in climatic zones of Sri Lanka | • Climatic Zones<br>- basis of demarcating climatic zones<br>- characteristics and distribution of climatic zones | - points out the basis of delimiting climatic zones of Sri Lanka<br>- describes with examples the characteristics of the major climatic zones<br>- illustrates the distribution of climatic zones of Sri Lanka with the help of a map | |

| Human Geography | | | | |
|---|---|---|---|---|
| Competency | Competency Level | Content | Learning Outcomes | Periods |
| 1.0 While understanding the nature of Human Geography explains the meaning of human landscape | 1.1 Explains the scope of Human Geography | • Scope of human geography | - Describes concisely the scope of human geography | 04 |
| | 1.2 Examines the spatial diversity of human landscape | • Spatial variations in human landscape | - Explains variations in human landscape<br>- Explains how human activities result in spatial variations in the human landscape | |
| | 1.3 Examines the temporal changes in human landscape | • Temporal changes in human landscape | - Explains temporal changes in human landscape | |
| 2.0 Reviews the characteristics of population and acts with an understanding of the importance of minimizing population problems | 2.1 Indicates the characteristics, recent trends and problems of world population | • World population characteristics and trends<br>- size and growth<br>- distribution<br>- structure (age and sex ratio)<br>- composition (ethnic, religious, rural and urban)<br>• Issues relating to world population<br>- ageing<br>- disability<br>- gender<br>- poverty<br>- food security<br>- displacement | - Describes the characteristics of the world population<br>- Explains with the help of data the size and growth of world population<br>- Describes with the help of a map the distribution of world population<br>- Explains the composition of world population<br>- Examines issues relating to world population | 48 |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| | 2.2 Analyzes the factors that contribute to world population dynamics | • Dynamics of world population<br>- births (differences in developed and developing countries)<br>- deaths (differences in developed and developing countries)<br>- Migration numbers, origins and destinations<br>- characteristics of migrants<br>- issues and problems associated with migration | - Explains population dynamics<br>- Describes world birth and death rates and their trends<br>- Describes world Migration and its trends | |
| | 2.3 Explains the characteristics, trends and problems of Sri Lanka's population | • Population of Sri Lanka<br>- size<br>- growth<br>- distribution<br>- structure (age and sex ratio)<br>- composition (ethnic, religious, rural and urban)<br>- trends and problems<br>ageing<br>disability<br>gender<br>poverty<br>displacement | - Describes with the help of data the size and growth of Sri Lanka's population<br>- Analyses with the help of a map the population distribution of Sri Lanka<br>- Explains the basic characteristics of Sri Lanka's population<br>- Explains the population trends in Sri Lanka<br>- Discusses the population problems of Sri Lanka | |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| | 2.4 Examines the dynamics of population of Sri Lanka | • Population dynamics of Sri Lanka<br>- Births<br>- Deaths<br>- Migration | - Discusses the trends associated with birth and death rates of Sri Lanka<br>- Describes trends in population migration in Sri Lanka | |
| **3**.0 Identifies the main settlement types and explains their characteristics | 3.1 Explains the main elements, types and patterns of settlements | • World settlements<br>- definition<br>- main elements of a settlement<br>- evolution of settlement<br>• Settlement types<br>- rural settlements<br>urban settlements<br>- rurban settlements | - Explains what is human settlement<br>- Explains world settlement types<br>- Describes the evolution of a settlement<br>- Explains settlement patterns | |
| | 3.2 Classifies the main settlements in Sri Lanka by their functions | • Settlements in Sri Lanka by their functions<br>- rural settlements<br>- urban settlements<br>- rurban settlements<br>• characteristics of human settlements in Sri Lanka<br>- planned or unplanned<br>- functions<br>- population | - Describes with examples the settlement types in Sri Lanka<br>- Describes the main characteristics of the settlement types in Sri Lanka<br>- Describes the distribution and trends in the settlement types of Sri Lanka | |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| 4.0 Studies the nature of world urbanization and examines problems | 4.1 Explains the nature of world's urbanization | • World urbanization<br>- introduction,<br>- processes<br>- levels<br>- patterns,<br>- recent trends<br>• Positive aspects of urbanization<br>- cities as catalysts of knowledge and technology, cultural diffusion and international linkages<br>- Contribution of the informal sector | - Describes urbanization<br>- Provides reasons for urbanization<br>- Explains different levels of urbanization<br>- Explains patterns and trends in urbanization<br>- Describes positive aspects of urbanization | 16 |
| | 4.2 Analyses with examples the problems of urbanization in developing countries | • Social and economic problems of urbanization<br>- pressure on resources<br>- urban congestion<br>- urban poverty<br>- urban crimes and abuses<br>- lack of housing and unauthorized settlements<br>- social segregation<br>• Urban environmental problems<br>- environmental pollution (water and air)<br>- solid waste disposal<br>• Health and sanitation problems<br>- lack of drinking water<br>- sanitation problems<br>- epidemics and diseases | - Analyses urbanization related social and economic problems in developing countries<br>- Explains with examples urbanization related environmental problems in developing world<br>- Describes the urbanization related health and sanitation problems in developing countries | |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| 5.0 Studies the nature of urbanization and its problems in Sri Lanka | 5.1 Studies the nature of urbanization in Sri Lanka | • Nature of urbanization in Sri Lanka<br>- introduction<br>- definition<br>- process<br>- levels<br>- trends and issues | - Explains urbanization in Sri Lanka<br>- Describes the urbanization process in Sri Lanka<br>- Explains the levels of urbanization in Sri Lanka<br>- Examines the trends and issues of Sri Lanka's urbanization | 14 |
| | 5.2 Examines urbanization problems in Sri Lanka | • problems of urbanization in Sri Lanka<br>- problems of common amenities<br>- urban poverty<br>- environmental pollution and solid waste disposal<br>- housing shortage<br>- health and sanitation problems<br>- urban crimes and abuses<br>- marginalized urban people (nature, consequences and solutions) | Discusses urbanization related social, economic and environmental problems in Sri Lanka<br>Presents solutions to urbanization related social, economic and environmental problems in Sri Lanka<br>- | |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| 6.0 Analyses recent trendsin World Agriculture | 6.1 Explains the characteristics, technology and production of world agriculture | • Introduction to World Agriculture<br>• Agricultural technology<br>- Agricultural technology associated with Green Revolution (Paddy and Wheat)<br>- Gene Technology<br>- Organic farming<br>• Expansion in production<br>- Intensification<br>- Expansion of cultivated area<br>- Short-term crops | - Describes concisely the basic characteristics of world agriculture<br>- Presents facts on the technology used in world agriculture<br>- Accounts for the expansion of world agricultural production | 36 |
| | 6.2 Reviews challenges facing agriculture | • Problems and challenges associated with agricultural technology<br>- use of chemicals<br>- land degradation/ desertification<br>- disappearance of traditional knowledge<br>- agricultural monopoly<br>- agriculture related health problems | - Examines the problems and challenges relating to technology used in world agriculture<br>- Offers suggestions to minimize problems relating to world agriculture | |
| | 6.3 Explains the nature, production, technology, marketing process, problems and trends in the agriculture of Sri Lanka | • Agriculture in Sri Lanka<br>- introduction<br>- subsistence agriculture<br>- commercial agriculture | - Discusses concisely the origin and evolution of agriculture in Sri Lanka | |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| | | • Agricultural technology<br>- irrigation technology and indigenous agricultural knowledge<br>- impact of green revolution<br>- use of modern machinery<br>- gene technology<br>- organic farming | - Explains basic characteristics of subsistence and commercial agriculture in Sri Lanka<br>- Discusses the agricultural technology practiced in Sri Lanka | |
| | | • Trends in Production<br>- raising yields<br>- Post-harvest technology<br>- Use of modern machinery | - Explains the production trends in Sri Lanka's agriculture | |
| | | • Marketing process<br>- dedicated economic centres<br>- Emphasis on quality<br>- interest in consumer preference and convenience<br>- super markets | - Describes the trends in the marketing process of Sri Lanka's agriculture | |
| | | • Problems and challenges<br>- decline and degradation of agricultural<br>- problems associated with modern technology<br>- rise in production cost<br>- marketing problems | - Examines the problems and challenges facing Sri Lanka's Agriculture | |

| Practical Geography | | | | |
|---|---|---|---|---|
| Competency | Competency Level | Content | Learning Outcomes | Periods |
| 1.0 Uses geographical techniques to describe, analyze and present data and information | 1.1 Examines the importance of practical geography in geographical studies<br><br>1.2 Describes the importance of techniques used in practical geography | • Importance of practical geography in geographical studies<br><br>• Techniques used in practical geography<br>- Maps<br>- Graphs<br>- Photographs<br>- Statistical techniques<br><br>• Geographical information that could be presented by different techniques<br><br>• Use of techniques in practical geography to arrive at informed decisions | - Describes the importance of practical geography<br><br>- Describes that geographical information could be presented by different techniques<br><br>- Explains that practical geography helps to arrive at informed decisions | 06 |
| 2.0 Emphasizes the importance of cartographic techniques used to present and interpret data and information | 2.1 Describes the importance of cartographical techniques used in geography | • Introduction to different types of map and their importance<br><br>- Thematic maps<br>- Topographic maps | - Explains with examples different types of thematic maps<br>- Describes the basic characteristics of topographic maps<br>- Explains the difference between thematic and topographic maps<br>- Examines the importance of thematic and topographic maps | 24 |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| | 2.2 Identifies the modern cartographic techniques in geography and examines their importance and uses | • New techniques used in cartography and their uses<br><br>• Common features associated with modern cartographic techniques<br><br>• Geographical Information Systems (GIS)<br>- What is GIS?<br>- Main components<br>- Spatial and aspatial (attribute) data<br>- raster and vector data<br>- uses of GIS<br><br>• Geographical Positioning System (GPS)<br><br>- Introduction<br>- segments of GPS<br>- space segment<br>- control segment<br>- user segment<br>- uses of GPS<br>• Remote sensing<br>- introduction<br>- platforms<br>- areal photographs<br>- satellite images<br>- uses of RS | - Introduces modern cartographic techniques<br><br>- Describes the common characteristics of modern cartographic techniques<br><br>- Describes the uses and importance of modern cartographic techniques | |

| Competency | Competency Level | Content | Learning Outcomes | Periods |
|---|---|---|---|---|
| 3.0 Acts with an understanding of the basic concepts necessary to interpret physical and human landscape depicted in a map | 3.1 Identifies the peripheral information provided in a map | • Peripheral information in 1:50,000 topographic map<br>- Location<br>- scale<br>- orientation<br>- legend | - Explains the peripheral information that helps in reading 1`:50,000 topographic maps | 20 |
| | 3.2 Identifies the physical and cultural features depicted in a topographic map | • Physical and cultural features depicted in a topographic map<br>- Physical features depicted in a 1:50,000 topographic map<br>- Cultural features depicted in a 1:50,000 topographic map | - Draws physical and cultural features depicted in a topographic map | |
| 4.0 Interprets holistically physical and human landscape shown in a map | 4.1 Analyzes the information contained in a map | • Analysis of information in 1:50,000 topographic map<br>- physical features<br>- cultural features<br>- interrelationships between physical and cultural features | - Analyzes the physical and cultural features in 1:50,000 topographic map<br>- Describes the interrelationships between physical and cultural features | 16 |
| | 4.2 Uses maps and related equipment for practical purposes | - Importance of using maps and technical equipment for practical purposes<br>- compass<br>- GPS<br>- Google maps<br>- mobile phones<br>- navigation equipment | - Describes how maps are used in practical purposes<br>- Explains mapping equipment and when they can be used. | |

**Competency : 1.0 Acts with an understanding of the basic concepts of Geography**.

**Competency Level :** 1.1 Introduces Geography.

**Time periods :** 04

**Learning Outcomes :**

- Explains spatial relationships and temporal changes
- Describes how Geography explains the dynamism of the life world
- Explains that geography studies the interrelationship between physical and human phenomena
- Explains that geographical processes and relationships range from local to global levels
- While being aware of the issues and problems of geographical significance communicates the same to the entire community

**Introduction :**

The subject of Geography studies the components of the landscape, relationships between those components and how they change in time and space. Accordingly, various approaches of study could be seen in geography. In this context, the definitions like "studying the relationship between man and his environment" are of importance. It comprises of three questions.

- How environment affects man?
- How does man change the environment?
- What are the consequences the interaction between man and environment?

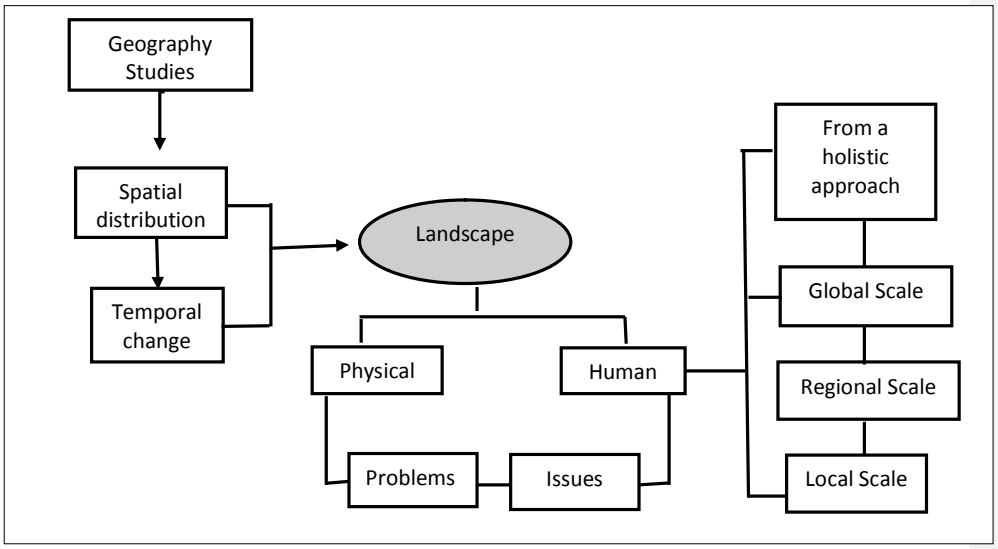
These three questions indicate the phenomena and processes that should be paid attention in geographical studies. The study of "areal differentiation of the earth surface", a definition introduced by Richard Hartshorne is also of importance. It explains the diversity of the man's environment. It signifies the changing physical and human environments and their dynamic nature. The components embedded in that definition pay way to study other fields related to geography. They may be analyzed as follows:

- What are the geographical patterns emerging from spatial variations?
- What are the factors responsible for those patterns?
- How those patterns are distributed on the earth's surface?
- What are the effects of those patterns?

Suggesting solutions to the issues and problems emerging from the diversity of physical and human landscapes and making the community aware of those issues and problems are major functions of the subject of geography. The explanation, grouping, classification, analysis and synthesis of the physical and human landscapes from a holistic perspective, are carried out in this exercise. To clarify it further, the diversity and dynamism of the physical and human landscapes are examined as a whole. In this unit, the diversity and dynamism of the physical and human landscapes are studied from spatial and temporal perspectives.

**A guide to clarify the subject matter:**
**The subject matter of Geography**

- The physical landscape changes in time and space due to endogenic and exogenic processes in the Earth.
- Generally, the physical landscape is changing slowly.
- However, earthquakes and eruption of volcanoes do change the landscape suddenly.
- In some instances, the intensity of change caused by physical processes are aggravated by human interventions. Such interventions have affected the physical landscape favorably as well as unfavorably.
- Man is of significance as the special life organism in the physical environment. Using his thinking power he has changed the biological environment for his survival.
- The nature of the subject of geography is explained in the following diagram:




Above diagram shows that geography studies the interrelationship between physical and human landscapes in time and space at local, regional and global scales through a holistic approach.

**Competency : 2.0 Describes the Nature of Physical Geography**

**Competency Level :** 2.1 Explains the physical basis of Geography

**Learning Outcomes :**

- Describes concisely the components of the physical basis of Geography.
- Synthesizes the interrelationships of the components of the physical basis of Geography

**Introduction :** Physical Geography studies the phenomena, processes and patterns of the physical bases of the Earth, namely the hydrosphere, lithosphere, atmosphere and biosphere considered as a system. Thus, physical geography consists of many sub-fields. In this unit, it is expected to pay special attention to landforms, rocks, soils, water, climate and biological factors, the components of the physical basis, and to study the processes of their formation, distribution and characteristics synthesizely.

**A guide to clarify the subject matter**

**Physical Basis of Geography**

- Geography studies the phenomena, processes and patterns of the hydrosphere, lithosphere, atmosphere and biosphere.
- All these phenomena are related to physical features of the Earth. As such, physical geography pays attention to the nature of the physical landscape.
- Physical landscape varies spatially and changes in time.
- Physical Geography consists of many sub-fields, namely, geomorphology, hydrology, glaciology, biogeography, climatology, meteorology, soil geography, paleogeography, oceanography, geodesy, coastal geography, quaternary sciences, landscape ecology and environmental geography.

**Landforms**

- The process of landform formation is determined by endogenic and exogenic forces.
- Geomorphology studies the landforms on the earth's surface and the past and current processes that formed them.
- The subject of Physical Geography acquires a special place within Geography.
- Epeirogenic and orogenetic movements create landforms and affect their evolution. They result in uplifts, submergence and the formation of ocean floors.

- Volcanism through emission of lava and the earthquakes resulting in fractures make changes on the earth's surface.
- Vertical earth movements create landforms such as shields.
- Orogenetic movements create large scale mountain ranges on the earth's surface. Ocean floors and mid-oceanic ridges are also formed by these movements.
- Landforms are also created by endogenic forces like compressional and tensional movements.
- Denudation is also responsible for landforms. For example, running water, wind, waves and glaciers create various landforms.
- Landforms have been classified according to their size as follows:

| | |
|---|---|
| First Order Landforms: | Continental masses and Ocean basins |
| Second Order Landforms: | Shield areas in continents, mountain systems, Continental slopes, ocean ridges and basin floors |
| Third Order Landforms: | Landforms created by denudation agents; e.g., V-shaped valleys, waterfalls and pot holes created by running water |

As such, physical geography, through observation, physical experimentation and mathematical models explains the history, changes and changes that could occur in future in the land masses.

**Rocks**

Landforms on the earth's surface are based on rocks.

- Earth's rocks consist of minerals.
- The diversity of minerals found in rocks have resulted in different types of rocks.
- In the Earth's crust a large number of rocks can be seen.
- Rocks have been classified by their origin.
- They are classified as igneous, sedimentary and metamorphic rocks.
- Igneous rocks have been classified by their texture, chemical composition and age.
- Sedimentary rocks are classified by their physical, chemical and organic traits.
- Metamorphic rocks are classified as igneous metamorphic and sedimentary metamorphic rocks. Metamorphic rocks are formed due to the transformation of their component minerals.
- In geography, attention is paid to the formation process of rocks and factors responsible for their formation and distribution.

**Soils**

- In geography various aspects related to soils are studied.
- In soil geography, the physical characteristics of soils, their use and spatial distribution patterns are studied.
- The thin layer of debris found on the rocks is known as soil.
- Soils are formed by the decaying of rocks and organic matter due to the physical and chemical processes taking place on the earth's crust.
- The factors like climate, parent rock, relief, water and drainage, organisms, time and man are responsible for soil formation.
- The interaction of the above factors in time determine the nature of soil.
- The inorganic matter, organic matter, soil water and soil air are important ingredients of soil.
- The physical characteristics of soil are its permeability, texture, porosity and soil aeration; the $P^H$ value (acidity or alkalinity), salinity and hardness are the chemical properties of soil.
- Soil profile consists of a number of layers grown from bottom to the top. They are called A,B and C horizons.
- In this unit paying attention to the physical features of soil, the interrelationships between soil and cultural, social and economic characteristics are studied.

**Water**

- Water is the most abundant component on Earth. It is the medium connecting the lithosphere, atmosphere and biosphere.
- It is distributed in oceans, seas, ice sheets, inland reservoirs, rivers, soils, ground water and water vapor.
- All these sources of water receive their supply from rains.
- Water is responsible for making various landforms and activating dynamic processes. Weather and climate is greatly influenced by water. It is responsible for various kinds of depositions. It has created water deficit areas as well as water surplus areas.
- Water resources have unevenly distributed over the earth's surface resulting in varying physical and human processes.
- Natural environmental systems as well as human activities have adapted themselves to water deficiencies and surpluses.

**Climate**

- Geography studies climate, its components, characteristics, processes and distribution.
- In studying climate, attention is paid to water vapor and its distribution and the behaviour of solar radiation and heat in the atmosphere. The average of the atmospheric conditions in a particular location over a long period is considered as climate.

- To determine the climate of a particular location, data on its weather conditions for at least 30 years are analyzed.
- As such, in arriving at conclusions on climate long term observations and measurements of data on rainfall, temperature, humidity, air pressure, winds, clouds, sunshine, etc., are taken into account.
- In this unit, elements of weather, factors controlling climate, and the atmospheric circulation are studied.
- The distribution of climatic zones and their characteristics are studied paying attention to the variations in climate controlling factors.
- Based on those variations climates have been classified.
- In the classification of climates temperature and rainfall are considered.

**Biotic factors**

The organisms found on the earth are a result of the interaction of various components of the geo-system.

- Plants, animals and micro-organisms are considered as biotic factors.
- The existence of the geosphere is determined by the interaction of biotic and abiotic components.
- Utilizing the air in the atmosphere, water in the hydrosphere and soils in the lithosphere, the solar energy through photosynthesis produces food.
- Energy is exchanged between organic and inorganic systems of the biosphere. These exchanges occur through food chains, food networks and environmental pyramids.
- Accordingly, the cycles found in the environmental systems, food chains, networks, major zones of the biosphere, biomes, man as a changing agent of the environment, man-environment relationships and their impacts and related issues are discussed.
- As such physical geography, rather than considering landforms, soils, water, climate, and biotic factors individually the relationships between them are discussed from a synthesizing perspective.

**Competency : 3.0 Examines the nature and processes of one's environment and contributes to maintain its balance**

**Competency Levels :**

3.1 Explains the geo-system.
3.2 Explains the nature and importance of the atmospheric system
3.3 Explains the structure and importance of the lithosphere
3.4 Explains the nature and importance of the hydrospheric system
3.5 Explains the nature and importance of the biospheric system
3.6 Explains the importance of maintaining the balance of the geo-system

**Time Periods :** 12

**Learning Outcomes :**

- Explains what a system is
- Describes the nature of the geo-system and its components
- Describes the structure, composition and processes of the atmosphere
- Describes the structure, composition and processes of the lithosphere
- Explains the distribution, composition and processes of the hydrosphere
- Explains the composition and processes of the biosphere
- Describes the interrelationships among the components of the geo-system
- Emphasizes the importance of maintaining the balance of the geo-system

**Introduction**

Objects or a collection of objects connected to each other according to a certain structure is called a system. Our Earth is a very large system. In turn, it belongs to the Geo-system.

Geo-system is divided into four sub-systems, namely, lithosphere, hydrosphere, atmosphere and biosphere. Although they are divided into sub-systems they interact with each other. The interaction takes place through the exchange of energy and matter.

It is expected from this unit to identify the basic characteristics and understand the significance of the geo-system by studying its four major sub-systems.

**A guide to clarify the subject matter**

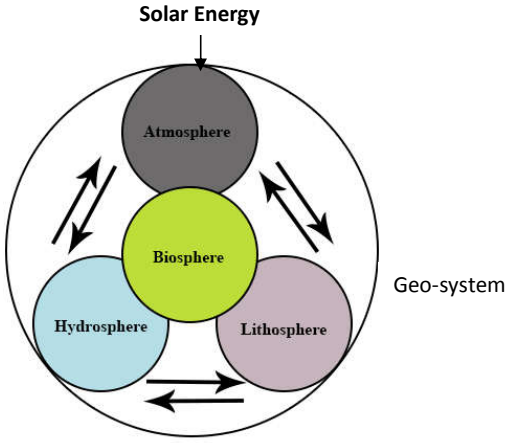
- Clarifying what is a system
  "System is a structure comprising a number of interrelated components operating within a specific boundary" (Department of Educational Publications, ***Physical Geography*** Part 1).

- According to the nature of exchange of energy and matter systems are divided into three types.
  - Isolated system: Exchange of energy and matter takes place only within the system; e.g. Solar System
  - Closed System: No exchange in matter; only energy is exchanged; e.g. Earth System
  - Open system: Open to exchange of both energy and matter; majority of the world's systems belong to this type. e.g. Drainage basins, Environmental systems

- **Sub-systems of the Geo-system**
  The Geo-system consists of four sub-systems.
  - Lithospheric system
  - Hydrospheric system
  - Atmospheric system
  - Biospheric system

  The geo-system is formed by the inter-connection and interaction among these four sub-systems.

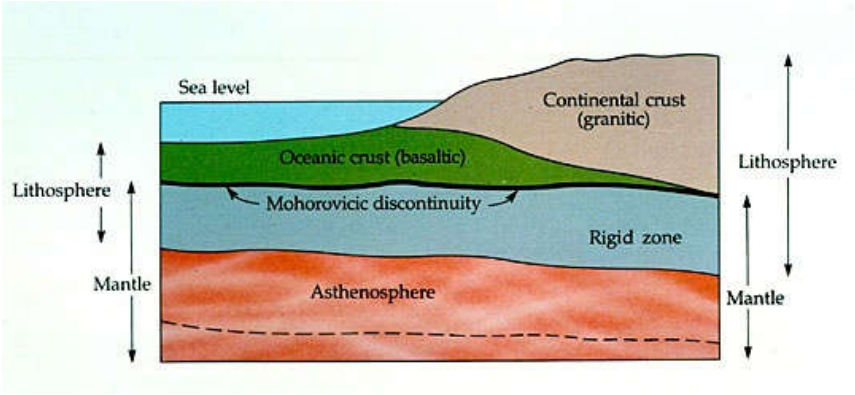
  Each of these sub-systems consist of more sub-systems (e.g. Biomes and environmental systems are sub-systems of the biosphere). The interaction among all these sub-systems depends on solar energy.




**Source:** Department of Educational Publication

**Lithospheric System**

- The earth's interior is composed of a number of spherical layers. They can be differentiated by their chemical and physical properties.
- The uppermost layer of the earth is composed of solid material and known as the lithosphere.
- Lithosphere consists of the Earth's Crust and the Upper Mantle.




Source: www.bosick7.wikispace.com

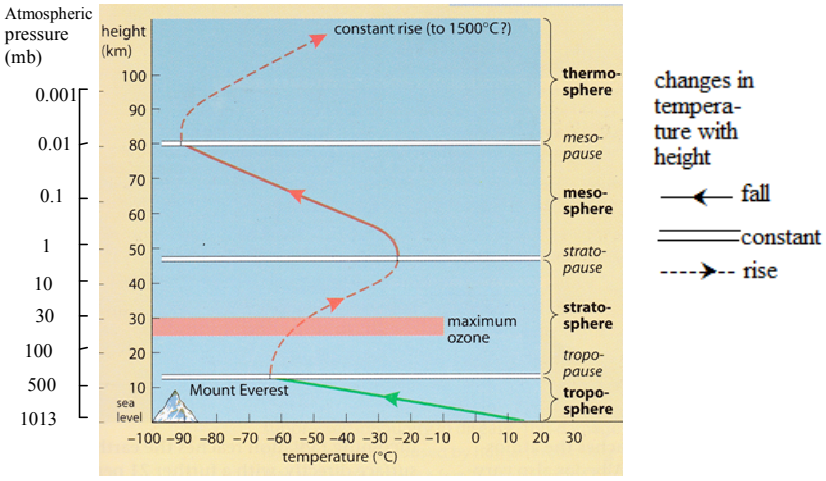
- The upper segment of the lithosphere consists of two parts, namely the continental crust and the oceanic crust.
- Continental masses, ocean floors, rocks, and soil are sub-systems of the lithosphere. The processes like tectonic activity and soil formation take place within this subsystem.
- It must be borne in mind that the lithosphere consists of tectonic plates separated from each other and various changes take place in the crust due to plate tectonics.
- The rocks and soils on the upper layer of the lithosphere are factors that affect human activities directly.

**Atmospheric System**

- The transparent and odorless air cover that envelops the earth's surface owing to the gravitational power of the Earth is known as atmosphere.
- It is generally considered that the atmosphere extends to a maximum height about10,000km from the surface of the earth.
- The upper limit of the atmosphere where weather phenomena occur is 16km in the equatorial region and 8km in the Polar Regions from the Earth's surface.
- The atmospheric pressure decreases rapidly and continuously from the sea level vertically.

- The temperature changes in the atmosphere are somewhat complex. Based on the temperature changes atmosphere is divided into four distinctive layers.

- A diagram depicting the four strata of the atmosphere is given below.




Source: David Waugh, 1995 - Geography An Integrated Approach

**1. Troposphere**

- This is the Earth's nearest strata of the atmosphere. It extends vertically from 8 to 10 km from the earth's surface.
- A specific characteristic of this strata is the decrease in temperature at the rate of 6.4$^{o}$C for every 1000 m upward. The decrease in temperature with altitude is known as lapse rate.
- 96% of the gases of the entire atmosphere is concentrated in this zone.
- There is a tendency to decrease pressure with altitude within this zone.
- The average pressure at sea level is 1013mb. At an altitude of 7km from the Earth's surface the atmospheric pressure decreases to 470mb.
- The incoming solar radiation heats the Earth's surface and the atmosphere is heated by the terrestrial radiation of the Earth.
- The water vapor and clouds are concentrated in the troposphere. In this layer of the atmosphere various weather phenomena could be seen.
- The upper boundary of the troposphere is Tropopause. A stable temperature could be seen this zone.

**2. Stratosphere**

- The upper limit of the stratosphere is about 50km from the sea level.
- The special characteristic of this layer is the increase in temperature with altitude.
- The ozone gas found in this layer is the reason for the escalation of temperature with altitude. Since the ultra-violet rays emitted by the sun is absorbed by the ozone layer the air in the stratosphere becomes warmer. The absorption of the ultra-violet rays at the upper part of the stratosphere is higher than that in the lower part.
- Most of the meteorites coming towards the Earth are burnt in the stratosphere.
- By destroying the incoming meteorites and absorbing the sun's ultra-violet rays, the stratosphere renders a significant service to the sustenance of the biosphere.
- The upper boundary of the stratosphere is known as Stratopause.

**3. Mesosphere**

- The upper limit of the mesosphere is about 50-80km from the earth's surface.
- In this layer temperature decreases with altitude. This is the layer with the lowest temperature in the atmosphere. It is about $-90^0$C. High velocity winds could be seen in this layer (3000km/hr).
- Water vapor, clouds, or dust, cannot be seen.
- The upper limit of the mesosphere is known as mesopause and in that zone the temperature is stable.

**4. Thermosphere**

- The upper limit of the Thermosphere is about 120 km from the Earth's surface.
- Temperature increases with altitude; Average temperature is around $1500^0$C.

**Composition of the Atmosphere**

| Gas | | Percentage by volume |
|---|---|---|
| Permanent Gases: | Nitrogen | 78.09 |
| | Oxygen | 20.95 |
| Variable gases : | Water vapour | 0.20-4.0 |
| | Carbon dioxide | 0.03 |
| | Ozone | 0.00006 |
| Inert Gases : | Argon | 0.93 |

| | | | |
|---|---|---|---|
| | | Helium, neon, krypton | marginal |
| Non-gases | : | Dust | marginal |
| Pollutants | : | Sulpher dioxide, nitrogen oxide, methane | marginal |

Source: David Waugh, 1995 - Geography - An Integrated Approach

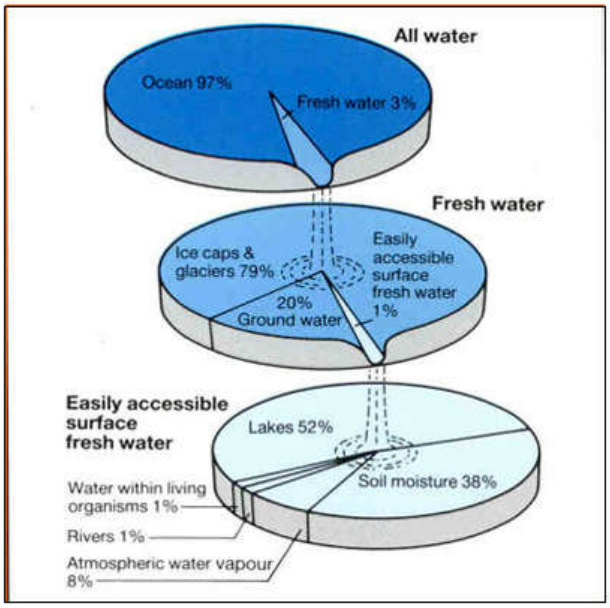
**Significance of the Atmospheric system**

- The nearest strata to the earth is troposphere. The weather phenomena that affects the earth is limited to this strata.
- Atmosphere is an essential factor for the sustenance of life on Earth.
- Ozone layer controls the ultra-violet rays.
- Burning of meteorites coming towards the Earth is also a significant service of the atmosphere,

**Hydrospheric System**

- The entire mass of water of the Earth found in the oceans, seas, lakes, reservoirs, and rivers as surface water and beneath the surface as ground water is called the hydrosphere.
- It has been estimated that this mass of water is about 1386 million cubic meters *(www.en,wikipedia.org)*

- **Global Distribution of Water and its Composition**




Source: www.emaze.com/water on earth

**Functioning of the Hydrospheric System**

- Water can be found in solid and liquid states in the lithosphere, as water vapor in the atmosphere and in animal and plants in the biosphere. This water circulates cyclically between the lithosphere, atmosphere and biosphere. The circulation of water within the geo-system is known as the hydrological cycle, (See Unit 5 for an image of the Hydrological Cycle)

- Hydrosphere is an important sub-system of the geo-system. Hydrosphere also consists of many sub-systems. Water is exchanged between these sub-systems.
    - Exchange of water between oceans and atmosphere
    - Exchange between surface water and atmosphere
    - Exchange between surface water and ground water

- Water contributed immensely to the origin of life on Earth and its sustenance. All human activities depend on the availability of water.

**Biospheric System**

- Biosphere is the constantly active sub-system of the geo-system.
- The environment within which all plants and animals live belongs to the biosphere.
- Organisms are found in the lithosphere, hydrosphere and atmosphere. Organisms ranging from micro-organisms to gigantic animals and plants ranging from algae and lichens to large trees comprise the biosphere.
- Air from the atmosphere, water from the hydrosphere and land and rocks of the lithosphere are essential for the existence and functioning of the biosphere. Sun is the source of energy.
- Biosphere consists of several organizational levels which are separable from each other distinctively.
- Organism, population, community, environmental systems and biosphere are those organizational levels.
- A special characteristic of the biosphere is the biodiversity i.e., the diversity of its animals and plants.

- **Balance of the geo-system and its significance**

    - The lithosphere, hydrosphere and atmosphere are abiotic subsystems of the geo-system. The biosphere is a biotic subsystem.

    - According to the scientific information gathered to date, Earth is the only planet where life is found. Due to the existence of life Earth has become a dynamic planet.

- Biosphere has been created by the interaction between the lithosphere, hydrosphere and atmosphere.

- The functions of the biosphere are related to soils, (lithosphere) air (atmosphere) and water (hydrosphere). The $CO_2$ from the atmosphere, water from the hydrosphere and energy from sun results in the photosynthesis process in plants.

- Another example for the interaction among the subsystems of the geo-system is the repeated (cyclically) use of the matter found in the geo-system. e.g. Hydrological Cycle, Carbon Cycle, Oxygen Cycle.

- Energy and matter are constantly exchanged between the organic and inorganic systems of the biosphere.

- Plant and animal species in the biosphere do not exist in isolation but depend on and interact with each other.

- The sustainability of the biosphere is determined by the proper maintenance of interrelationships and balance of its subsystems.

**Competency : 4.0 Reviews components, characteristics and processes of the earth's landscape and focuses on its conservation.**

**Competency Level :** 4.1 Describes the Earth's structure and its characteristics

4.2 Examines rocks, minerals and soils of Sri Lanka**.**

**Time Periods :** 16

**Learning Outcomes :**

- Describes the structure of the Earth
- Describes the composition of the Earth
- Explains the formation of rocks and their characteristics
- Explains the nature of the soil profile
- Emphasizes the significance of soil conservation
- Describes the nature and distribution of rocks in Sri Lanka
- Explains the distribution of minerals in Sri Lanka
- Explains the nature and distribution of soil types in Sri Lanka

**Introduction :** The Earth could be considered as a unique planet in the solar system. It is believed, the Earth, the habitat of the mankind, had its origins about 4,600 million years ago. The uniqueness of the Earth has made it mankind's habitat. However, because of the limitless intervention of the mankind the balance of the earth has been collapsing. As a result, mankind encounters numerous problems. Paying attention to this situation, it is expected to study the components and characteristics of the Earth as well as the rocks, minerals, and soils of Sri Lanka in this Unit.

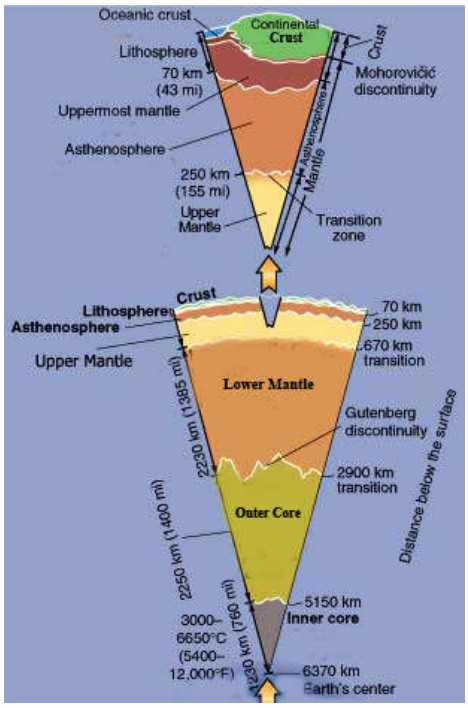
**A guide to clarify the subject matter:**

- Structure and composition of the Earth
  - Earth consists of three main layers.
    - Crust
    - Mantle
    - Core

**The Crust**

- The thin layer of the Earth's surface is known as the Crust.
- The depth of this layer is not uniform; in the Oceans it is about 5km but in the continental areas it is about 60km.
- About 1% of the Mass of the Earth belongs to this layer.
- The Earth's Crust consists of two strata known as Sial and Sima.

- Sial strata is called the Continental Crust; Sima strata is known as the Oceanic Crust
- The boundary separating the Sial and Sima strata is called the **Conrad Discontinuity.**
- This Discontinuity is not found in the Ocean. It is found only in Continental land mass.
- Silica (Si) and Aluminium (Al) are found abundantly in Sial region.
- Silica and Magnesium (Mg) are found abundantly in the Sima region.

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**The Mantle**

- The layer between the Crust and the Core
- The Crust and the Mantle is separated by the **Mohorovicic Discontinuity**.
- The Mantle is extended 2,650 km downward from the Mohorovicic Discontinuity.
- This zone accounts for 2/3 of the Earth's mass.
- The mantle is divided into two parts, namely the upper mantle and the lower mantle.

**The Core**

- This is the innermost zone of the interior of the Earth.
- The boundary that separates the core from the mantle is known as the **Gutenberg Discontinuity**.
- The Core extends 2,250 km downward from the Gutenberg Discontinuity.
- The Core is divided into two parts namely the Outer Core and the Inner Core
- Inner Core extends about 1,220 km downward from inner boundary of the Outer Core.

**Characteristics of the Earth**

- The nature of the earth's interior as well as the surface is constantly changing.
- The temperature of the Earth increases toward its interior.
- It increases $25^0$C per km but the rate of increase is not uniform.

- The availability of solid rocks at a depth of 700km points to the fact that the increase in temperature by depth is not uniform.
- At the boundary of the Core the temperature exceeds $6,000^0$C.
- It has been discovered that the radioactive elements in the interior rocks is responsible for the high temperature.
- The pressure also increases as you go towards the interior.
- It is said that at the centre of the earth the pressure is 3.15kg per $1cm^2$.
- It has been discovered that the rocks in the outer core is in a fluid state and that of the inner core is in a solid state.
- The mantle is composed of silicate rocks with high content of iron and magnesium.
- Research on the nature of the Earth is being continued further.

**Formation of rocks and their characteristics**

**Formation of Rocks**

1. Rocks are formed by the minerals with inorganic matter and the metamorphosed organic matter.
2. The lithosphere that contains the crust and the upper mantle consist of rocks which can be seen in abundance.

**Types of Rocks**

1. Rocks are of three types according to their origin.
   - Igneous Rocks
   - Sedimentary Rocks
   - Metamorphic Rocks
2. Above mentioned rocks are subject to change constantly.

**Igneous Rocks**

1. Igneous rocks are formed when magma in the earth's interior comes to the surface through joints
2. Igneous rocks are of two types.
   - Intrusive igneous
   - Extrusive igneous

Intrusive Igneous Rocks

- Intrusive igneous rocks are formed when magma is solidified in the rock layers close to the earth's crust.
- There are two sub-types of intrusive igneous rocks:
  1. Plutonic Intrusive Igneous rocks
  2. Sub-Plutonic Intrusive Igneous rocks

Extrusive Igneous Rocks

- Extrusive igneous rocks are formed by cooling and solidification of liquid magma that erupted onto the earth's surface through weak places in the crust.

Igneous rocks could be classified according to their color.

- Black color : Basalt rocks with high content of Fe, Mg
  Examples: Gabbro, Dolerite
- Light color : Acid rocks with lesser content of Fe, Mg
  Example: Granite
- Intermediate : Intermediate rocks Example: Diorite

Igneous rocks could also be classified according to their chemical composition.

- Acidic Igneous rocks: Silica content is more than 65%; Iron content is 20%-25.
  Examples: Granite, Diorite, Obsidian
- Basic Igneous Rocks: Silica content is less than 55%; Iron content is about 45%
  Examples: Gabbro; Basalt
- Intermediate Igneous Rocks: Silica content 65% - 55%;
  Example: Andesite
- Ultra-Basic Igneous Rocks Silica content is less than 55%; Iron content is more than 50%;
  Example: Peridotite

**Sedimentary Rocks**

- Sedimentary rocks are formed by solidification of the debris of pre-existing rocks broken and transported away by weathering and erosion.

- According to their origin, sedimentary rocks are of three types.

1. Disintegrated igneous rocks
   - i Rudaceous e.g. Breccia, Pebbles, Boulder Clay
   - ii Arenaceous e.g. Sand, Sandstones
   - iii Argillaceous e.g. Mud, Clay, Shale

2. Chemically deposited sedimentary rocks
   - i Carbonate e.g. Carbonate, Dolomite
   - ii Sulphate e.g. Gypsum
   - iii Chloride e.g. Salt, salt rocks
   - iv Silicate e.g Fire stones
   - v Iron stone e.g. Limonite, Hematite

3. Organic Sedimentary rocks
   - i Calcareous e.g. Carbonate, Dolomite
   - ii Siliceous e.g. Gypsum
   - iii Carbonaceous e.g Peat, Coal
   - iv Iron mixed e.g. Iron stones

**Metamorphic Rocks**

- Igneous and sedimentary rocks which have been changed from their original form due to heat or pressure beneath the surface of the earth are called metamorphic rocks. The physical and chemical composition of the rocks are changed during the metamorphism process.

  A few examples for metamorphic rocks:

| **Original rock** | **Metamorphosed** |
|---|---|
| Granite | Gneiss |
| Sand Stone | Quartzite |
| Limestone | Marble |
| Schist | Shale |

**Soil Formation and Characteristics of Soils**

- The uppermost layer of the Earth's crust is composed of soil.
- Soil is formed by the long term accumulation of debris resulting from weathering of rocks and organic matter.

**Factors affecting soil formation**

1. Parent rock
2. Climate
3. Relief
4. Time
5. Functions of plants, animals and micro organisms
6. Water and drainage
7. Human activities

**Parent Rock**

- Parent rock is the foundation for growth of a soil profile
- The physical properties of the soil is determined by the nature of the parent rock.
- A parent rock could be a hard rock or a sediment rock.

**Climate**

- Climate is a major factor in the formation of soil.
- Rainfall, temperature, humidity, light and wind and their diurnal and seasonal changes affect soil formation.
- Rainfall and temperature are more important.
- Temperature tends to disintegrate parent rock.
- Rainfall contributes to soil formation by erosion and accelerating chemical weathering.
- In humid climates micro-organisms grow fast and accelerate soil decay.

**Relief**

- The surface morphology of the earth is called relief.
- Temperature changes according to increase in altitude.
- Factors relating to relief such as slope and its intensity affect soil formation.
- Relief plays a role in determining the physical properties of soils in a particular location.

**Time**

- It takes time for soil growth.
- The nature and maturity of soil are affected by time.

**Functions of plants, animals and micro organisms**

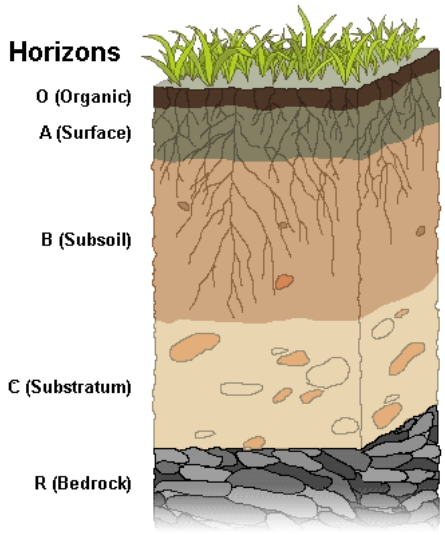
- The changes in plant species and their numbers affect the supply of organic matter in soil formation
- The micro-organisms in soil, worms and large animals contribute to soil formation by adding organic matter and mixing them.

**Water and Drainage**

- Rocks are weathered by water received directly from rainfall and its run-off.
- The pressure exerted by water accumulated in joints in the rocks and its chemical reactions result in weathering.

**Nature of the Soil Profile**

- According to the nature of factors related to soil formation a profile is developed with a number of layers of soil growing from the bottom.
- There are a number of layers (Horizons) in a soil profile.
- In some instances the boundaries of the layers take various shapes; sometimes they take the form of straight lateral lines.
- Soil profiles exhibit geographical variations.




Source: www.google.lk/

- A fully developed soil profile has a number of horizons such as O, A,B,C and R.

O : - A thin layer
- A zone where weathered or weathering organic matter is found

A : - Located below O horizon; soil is enriched by minerals by the decomposition of organic matter
- Rich in soil organisms
- Due to rainfall minerals are leached; hence a leached horizon

B : - A zone where the leached material from A horizon is deposited.
- A nutritious zone
- Minerals like iron and aluminium can be seen in this horizon.
- A light colored zone compared to A horizon

C : - Composed of the weathered material from the parent rock

R : - Parent rock layer

**Importance of Soil Conservation**

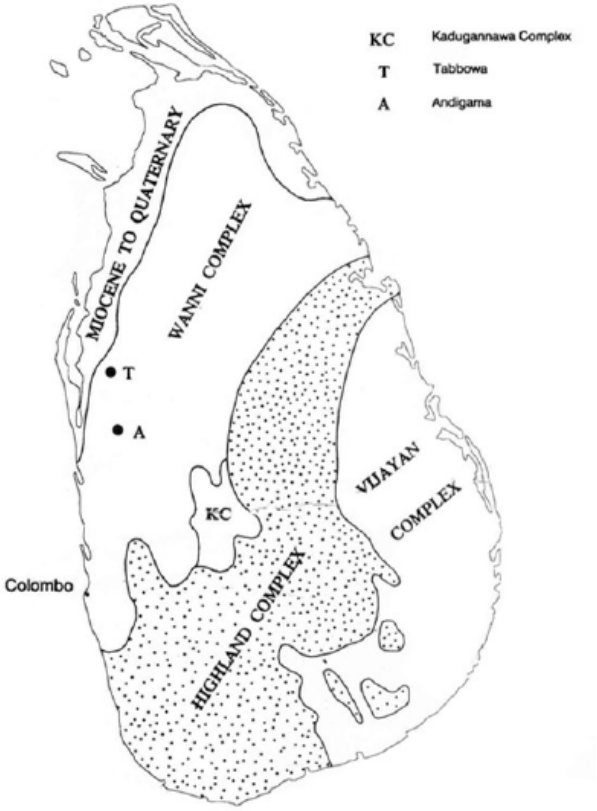
- To protect soil quality for agricultural purposes.
- To prevent natural hazards
- To protect water resources

## 4.2 Rocks, Minerals and Soils of Sri Lanka

### Rocks

- Over 90 per cent of the land area of Sri Lanka is composed of Pre-Cambrian rock formations
- This could be divided into three types:
    - Highland Series
    - Wanni Complex
    - Vijayan Series

**Major Rock Series in Sri Lanka**




Source: Arjuna's Atlas of Sri Lanka

1. Highland Series

    - Composed of metamorphosed igneous rocks such as metamorphosed acid rocks and metamorphosed basalt rocks.

- The highland series rocks found in the Central Highlands are the oldest (P.G. Cooray, 1967).

- This series is the spinal code of the rock foundation of Sri Lanka (P.W. Withanage, 1972).

- The highland series has spread from a narrow strip in Trincomalee through the Mahaweli river valley, Central highlands and Rakwana to Hambantota.

- The Kataragama hills lying outside this zone also belong to this series.

- The highland series rocks are divided into two types:

    1. Kondelite rocks
    2. Charnokite rocks

Kondelite Rocks

- It is believed that they have been formed from metamorphosed sedimentary rocks.
- A black dotted granite rock with crystalline limestones.

Charnokite Rocks

- A metamorphosed basalt rock intruded into Gneiss and Shist
- They are known commonly as Gneiss.
- Charnokite rocks are found in abundance in the southern region of the central highlands and Rakwana hills.
- Bulutota and Haputale escarpments are entirely composed of Charnokites.

2. **Wanni Complex**
    - It has been revealed that rocks in the Wanni Complex are old more than 1000 million years.
    - Although the rocks in the Wanni Complex is less metamorphosed compared to those of in the Highland Series no clear cut distinction could be observed.

**3. Vijayan Series**

- Composed of metamorphosed igneous rocks.
- These rocks could be found to the east of highland series rocks in the central highlands and in the North West.

- Gneiss rocks with various Hornblendes could be found. They contain metamorphosed quartzites and silicates.

- In addition to the three main rock groups following rocks are also found in Sri Lanka.

1. **Miocene limestones**

    - The Miocene limestones found in Jaffna Peninsula are metamorphosed hard rocks. Light yellow in color.
    - The Miocene lime stones found in Akurukaduwa in the Uwa Province is a sedimentary rock formed in the Tertiary period.

2. **Jurassic Deposits**

    - Jurassic deposits are composed of sand stones, grit, and brown and black colored shales.

    - The Jurassic deposits more than 70 million years old could be found in the fault basins of Tabbowa, Andigama and in Pallama north of Chilaw.

## Minerals

- A naturally occurring inorganic solid substance with a definite chemical composition and crystal shape is called a mineral.
- Minerals are formed by the combination of one or more elements.
- Minerals can be found as elements, combinations of elements or as ferrous or non-ferrous minerals.
- Minerals have been formed in various geological eras and can be found in different rock types in various areas.
- Minerals in Sri Lanka, according to their nature and production objectives could be divided into three main groups.
    1. Energy minerals (fuel minerals)
    2. Ferrous minerals
    3. Non-ferrous minerals

**1. Energy minerals**

Examples: Peat, Thorianite, Monazite

Peat:

- Formed due to the decaying of submerged plants in marshy lands.

- Peat can be found in moderate amounts in Muthurajawela Marsh, North of Colombo and in limited quantities in areas such as Diyatalawa, Bandarawela and Nuwara Eliya.

Thorianite and Monazite:

- Belong to the radioactive energy group.
- Needed for the production of nuclear energy.
- Thorianite is distributed in Ratnapura district in small quantities.
- Monazite could be found in coastal areas of Kaikawala and Induruwa.

**2. Ferrous Minerals**

Examples: Iron Ore, Copper, Magnesium, Nickel, Chromium, Tungsten, Silican

- Two types of iron ore could be found in Sri Lanka
  1. Limonite
  2. Magnetite
- Limonite: Could be found as dispersed iron ore heaps in hill tops in the districts of Ratnapura, Galle and Matara.
- Magnetite: Wilagedara in Puttalam district and Seruwila.

**3. Non-ferrous Minerals**

Examples: Sand, Clay, Pebbles, Salt, Gems, Graphite, Mica, Dolomite, Apatite, Feldspar

- Mineral sands could be found in Kudiramale, Polkotuwa, Kaikawala and Pulmoddai
- Largest mineral sand deposits are found in Pulmoddai.
- Of this deposit, 70%, 10%and 8% are composed of Ilmenite, Zircon and Rutile respectively.
- It has been revealed recently that mineral sands are distributed in the coastal strips of Mulativu, Nilaweli, Nayaru, Puduwaikkattu, and Thevikallu.
- Deposits of Ilmenite, Rutile, Zircon and Monezite are found in the coastal areas mixed with sand.

**Clay**

- Clay is used in industries like ceramics, tile and brick making, and cement production.

- Kaolin, boulder clay, tile and brick making clay are found in many areas.
- Apart from Boralesgamuwa, Kaolin is distributed in areas like Meetiyagoda and Waskaduwa.
- Boulder clay is found in flood plains in the south west region. The best deposit is found in Dediyawela.

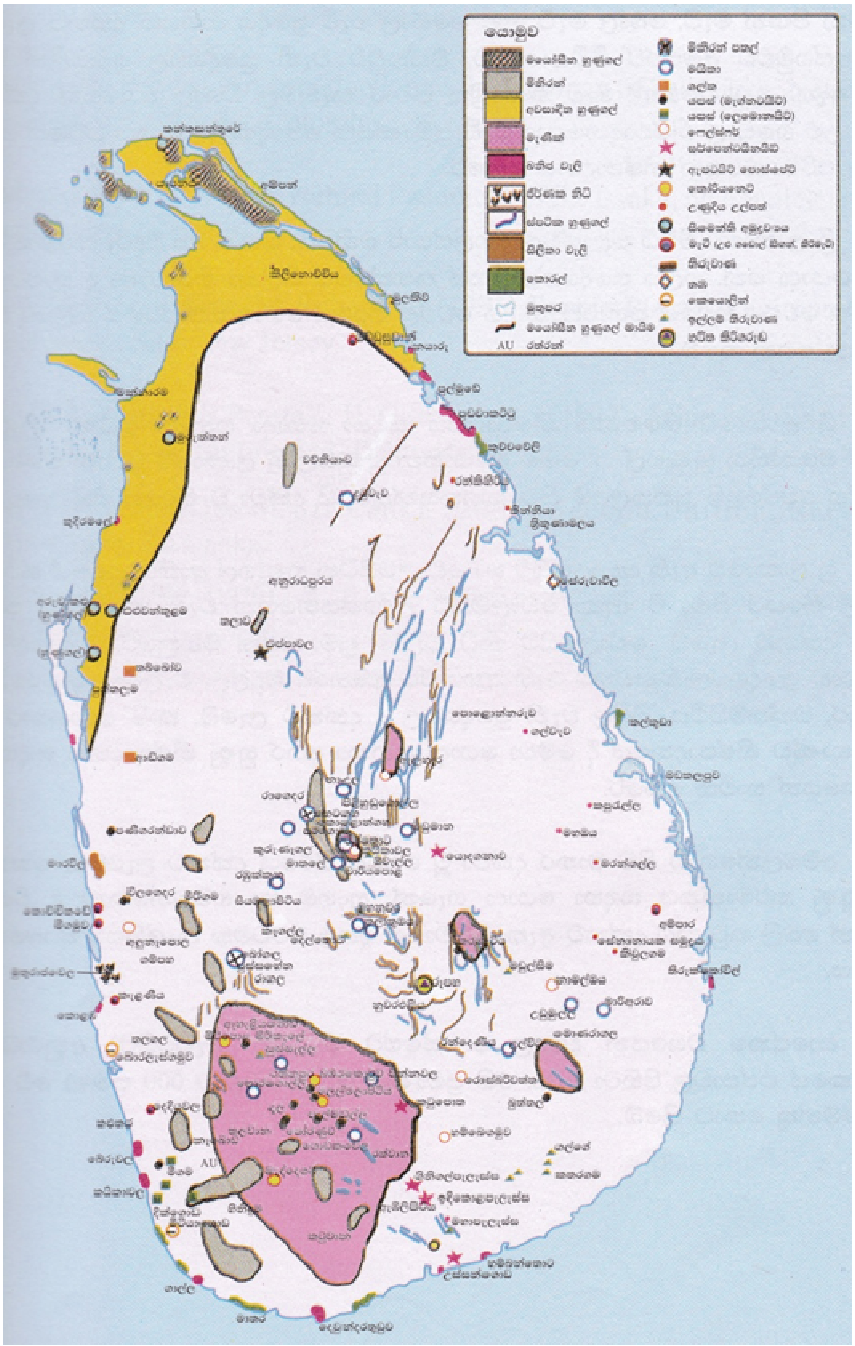
**Gems**

- The mineral resource that brings the highest income to Sri Lanka
- The veins of gems are found in the alluvial deposits in the districts of Ratnapura, Moneragala, Matale and Matara
- Corundum is the most important gem found in Sri Lanka. The dark red corundums are called Rubies.
- Blue, Yellow, Pink, Green and Brown colored Corundums are also available.
- Ruby (*Padmaraga)* is an endemic gem of Sri Lanka.

**Graphite**

- World's best graphite is found in Sri Lanka with a carbon content of 97 – 99%.
- Graphite is distributed in large quantities in the Southwest, Northwest and Central highland regions in Sri Lanka.
- Dumbara, Kolongaha and Bogala are the famous graphite mines in Sri Lanka.
- Economically valuable graphite type is vane graphite.
- Mica can be found in Central, Uwa, North Central and Sabaragamuwa provinces.

Mineral Distribution in Sri Lanka

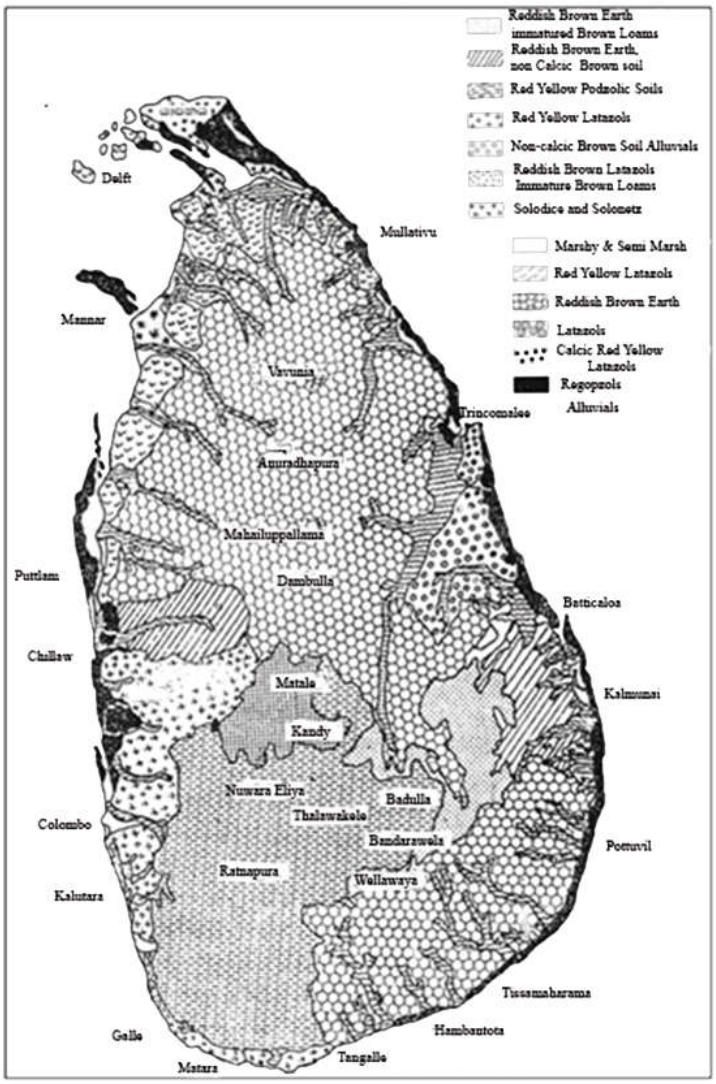


Source, Department of Survey, Sri Lanka (2007)

**Soils**

- In his seminal study of soils in Sri Lanka Joachim (1935) identified seven (07) major soil groups.

- Subsequently, C.R. Panabokke and Mooreman (1961), paying attention to morphological characteristics of soil profiles introduced another classification of soils of Sri Lanka. It identified 12 soil groups.




Source: Department of Educational Publications

- Major Soil Groups of Sri Lanka

- Soil types limited to the Wet Zone
  1. Reddish Brown Latosols
  2. Red Yellow Podzol soils
  3. Swamp and semi-swamp soils

- Soil types limited to the Dry Zone

  1. Reddish Brown Earth
  2. Non-alkaline Brown Earth
  3. Red Yellow Latosols
  4. Grumusols
  5. Alkaline and Saline soils

- Soils found in both Dry and Wet zones

  1. Humic soils with poor drainage
  2. Alluvial soils
  3. Regozols

Reddish Brown Latosols

- Well drained
- Fine texture and reddish brown in color
- Nitrogen, Potassium, Calcium and magnesium are found in moderate amounts; high soil fertility
- Extensively found in mountain and undulating landscapes and valley landscapes
- Distributed in a larger area of Kandy and Kegalle districts. Also found in the southwest Matale district.
- Highly suitable for cultivation of cocoa and banana
- This soil is distributed in the marshy lands adjacent to major rivers in the districts of Colombo, Kalurara and Galle.

Reddish Brown Earths

- Moderate depth; well-drained 13-25 cm in thickness
- 'A' horizon of this dark brown soil is moderately fine in texture.
- Mainly composed of feldspar, pebbles and iron stones
- Organic material consists of calcium and magnesium and, the nitrogen content is low.
- These soils are distributed in the dry zone districts of Anuradhapura, Polonnaruwa, Vavuniya, Hambantota and Moneragala and adjacent districts.
- Suitable for grains, grams, pulses, oil seeds and other food crops.

Alluvial Soils

- A depositional soil formed in association with water.
- Ranges from well-drained to poorly drained.
- Soil texture is sandy clay
- Distributed in land areas adjacent to rivers and flood plains
- Highly suitable for paddy. Could be used for vegetable cultivation also.

References:


- Department of Educational Publications, G.C.E. (A/L) Physical Geography, Part I
- Department of Educational Publications (1996) Environmental Geography
- National Institute of Education (2014) G.C.E. (A/L) Grade 12, Agricultural Science Reference Book
- National Institute of Education (2010) Geography Teachers' Guide Grade 12
- Weerakkody, Upali (2009) Physical Geography Part I


Proposed Activities

1. Draw a diagram showing the different strata of the Earth's structure.
2. Prepare an information sheet on the nature of the different strata of the Earth.
3. Prepare a project to display the various types of minerals in the Geography Laboratory or at any other suitable place ensuring their security.
4. Conduct a field study to get an understanding of varying nature of the soil profiles.
5. Draw a map depicting the distribution of soil types of Sri Lanka.
6. Prepare a table showing the soil types of Sri Lanka and their distribution.
7. Organize an exhibition consisting of creations that display soil types of Sri Lanka.

**Competency** : **5.0** **Reviews the processes of and behaves sensitively to the physical landscape**

**Competency Levels** :

5.1 Illustrates with examples endogenic forces influencing geomorphic processes

5.2 Illustrates with examples the exogenic forces influencing Geomorphic processes

5.3 Describes the process of the hydrological cycle

**Time periods** : 48

**Learning Outcomes** :

- Describes the geomorphic processes
- Describes plate tectonics with the help of diagrams
- Mark and name the main tectonic plates on a map of the world
- Illustrates landforms resulting from endogenic forces
- Describes with illustrations the landforms resulting from denudation agents
- Gathers information on events resulting from endogenic and exogenic forces
- Explains the processes of the hydrological cycle with the help of a diagram
- Describes how processes of the hydrological cycle influence the landscape

**Introduction** : The surface of the earth consists of various relief features. Continents and oceans, large mountain systems, plateau, rivers, volcanoes, sand dunes, deltas are few of them. The factors that create and change landforms could be identified as endogenic and exogenic forces.

Continental land masses and ocean basins, mountains, plateau, basins and mid-oceanic ridges are formed by endogenic forces. These landforms are altered by the exogenic forces such as water, wind, glaciers and waves. The landforms thus created on the earth surface are of varying scales.

It is expected to study the landforms, how they have been created and their impact on human activities from this unit.

**A guide to clarify the subject matter:**

Large and small mountain ranges as well as landforms of lesser scale are located on continental land masses and ocean floors. There are three groups of landforms according to their scale.

1. First Order Landforms (Large scale landforms)
2. Second Order Landforms (Medium scale landforms)
3. Third Order Landforms (Small scale landforms)

Two forces are in operation in creating and altering the above mentioned landforms.

1. Endogenic forces
2. Exogenic forces

**Endogenic forces**

- The forces operating in the earth's interior are called endogenic forces.
- It is believed that geomorphic forces are caused by the movements slowly taking place in the viscous stratum beneath the earth's crust. Sometimes they might originate due to the temperature differences caused by the radioactivity in the outer part of the mantle.
- The first order landforms are created by endogenic forces.
- The continental masses and ocean basins, the largest landforms of the Earth's surface are first order landforms.
- Many hypotheses have been forwarded to explain their origin.
- Presently, it is in the hypothesis of Plate Tectonics that acceptable evidence could be found.

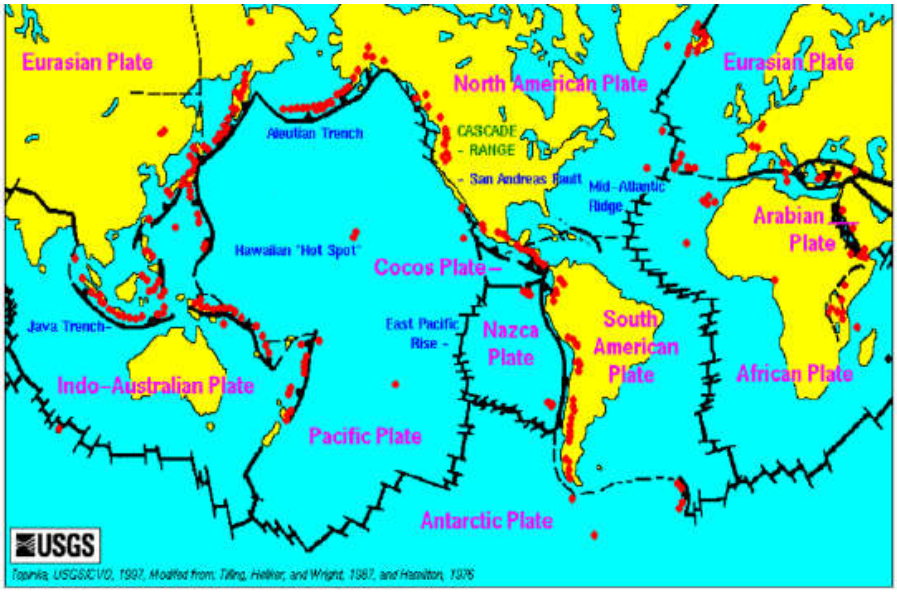
**The process of Plate Tectonics**

- Although there is scientific evidence contained in various theories on the origin of continents and oceans, it is from the 1950s that studies were conducted using modern technology.
- Around 1960, a large amount of information on faults, oceanic ridges and deeps in that direction was revealed from the rocks and the photographs obtained through the exploration of the ocean bottom.
- As a result of those research the hypothesis of Plate Tectonics was constructed.
- According to the hypothesis of Plate Tectonics the Earth's lithosphere consists of 7 major plates and a number of minor plates.

Major Plates

1. Pacific Plate
2. Indo-Australian Plate
3. Eurasian Plate
4. African Plate

5. North American Plate
6. South American Plate
7. Antarctic Plate




- According to the hypothesis of Plate Tectonics, the thermal convectional currents that originate in the asthenosphere flow vertically and at the upper limit of the asthenosphere travel in opposite direction.
- In the process, the thermal convectional currents would cool and increase in density and submerge. The submerging currents become warm again.
- As a result of the recurrent movement of thermal convectional currents the plates of the lithosphere begin to move.
- Movement of plates take place in three ways:

    1. Divergent movements
    2. Convergent movements
    3. Transform movements

Divergent movements

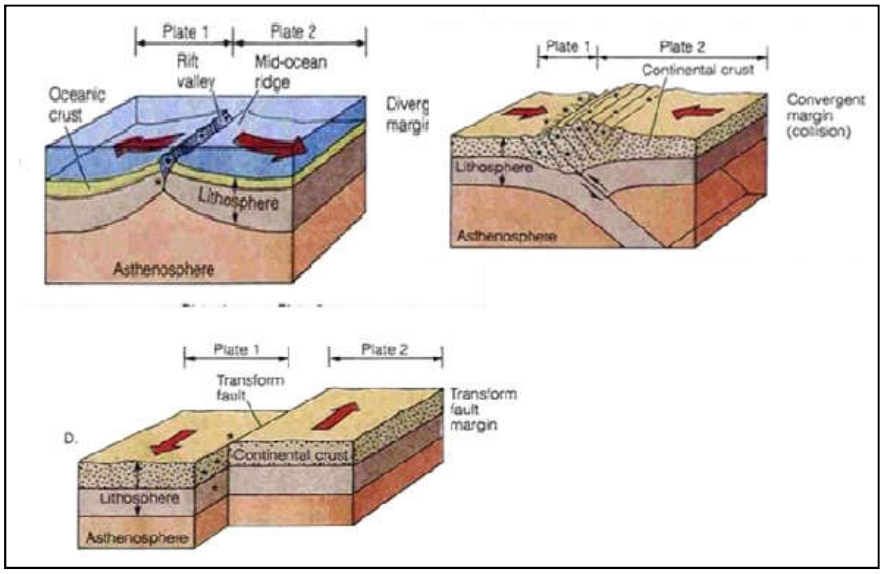
- When two plates move away from each other the process is called a divergent movement.
- In the process, magma comes to the surface from the upper region of the mantle thereby paving way to create a new ocean floor. e.g. mid-oceanic ridges

Convergent movements

- Two plates move toward each other.
- When two plates collide the weaker plate is destroyed and the sandwiched material or land between the two plate undergo numerous changes.
- As such, convergent plate boundaries are destructive.
- In the collision one plate submerges under the other and the pressure generated in the process results in fold mountains. e.g. the Himalayas
- When an oceanic plate submerges under a continental plate deeps/trenches are created.
  e.g. Mariana Trench
- When an oceanic plate is pushed up to the mantle the rocks will be melted and volcanic island arcs will be formed.
  e.g. Hawaii Islands

Transform movements

- Two plates moving parallel to each other
- Faults occur at plate boundaries




**Effects of Plate movements**

- Emergence of new ocean floors
- Formation of fold mountains
- Formation of oceanic trenches
- Emergence of island arcs

- Formation of rift valleys
- Occurrence of earthquakes
- Volcanic eruptions
- Occurrence of tsunami
- Land slides
- Avalanches

**Earth Movements**

- One of the major endogenic forces that creates the second order landforms is earth movements.

- The geo-thermal convection currents in the earth's interior emitted by the radioactive minerals result in earth movements. They are of two types:

    1. Vertical movements (epeirogenic movements)
    2. Horizontal movements (orogenic movements)

- The horizontal movements are divided into two types according to the nature of their movement.
    1. Compressional movements
    2. Tensional movements

**Compressional movements**

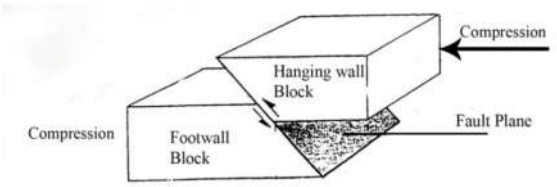
Compression is the thrust that occurs due to the converging forces. Compression results in folds, faults and ripples in the rock layers.

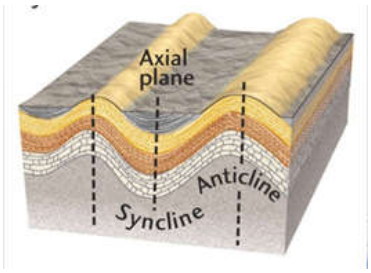
Examples: Himalayas, Rockies, Alps, Andes

Different types of folds are associated with compressional movements

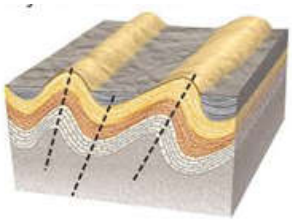
1. Symmetrical folds
2. Assymetrical folds
3. Monoclinal folds
4. Isoclinal folds
5. Recumbent folds
6. Overturned folds
7. Anticlinorium and Synclinorium

Landforms associated with Compressional movements

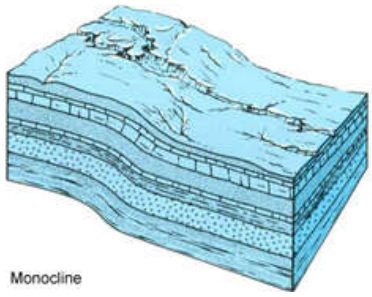


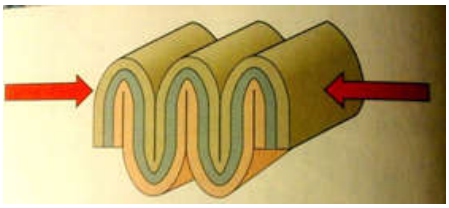

Symmetrical Folds



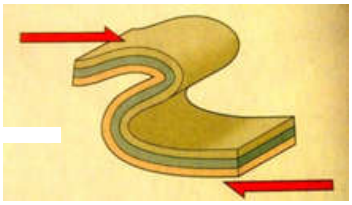
Asymmetrical Folds



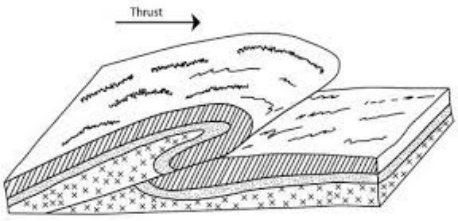

Monocline Folds



Isoclinal Folds



Recumbant Folds




Thrust Fold

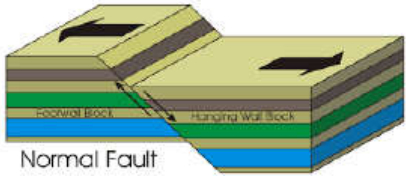
**Tensional movements**

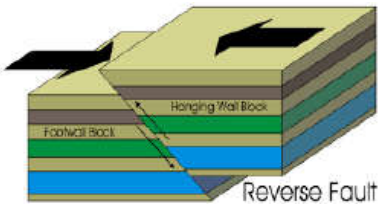
- Two forces moving away from a particular point
- Due to tensional movements the crust is fractured and subsides
- It is known as faulting
- In faulting one block is elevated while the other being submerged
- The slope of a fault is called escarpment

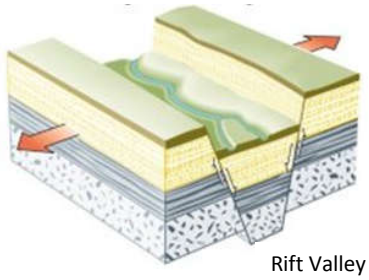
Many land forms are associated with tensional movements. They are:

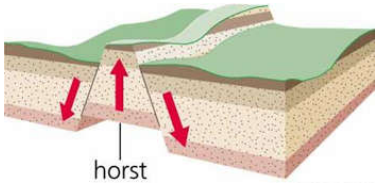
1. Normal fault
2. Step fault
3. Horst
4. Block fault
5. Thrust fault
6. Rift valley

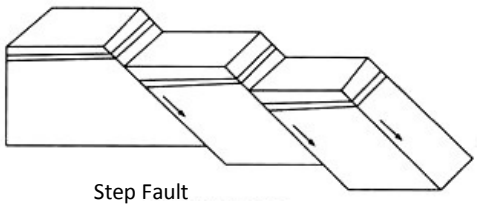
Landforms associated with tensional movements

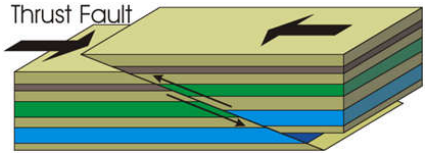




Rift Valley





Step Fault



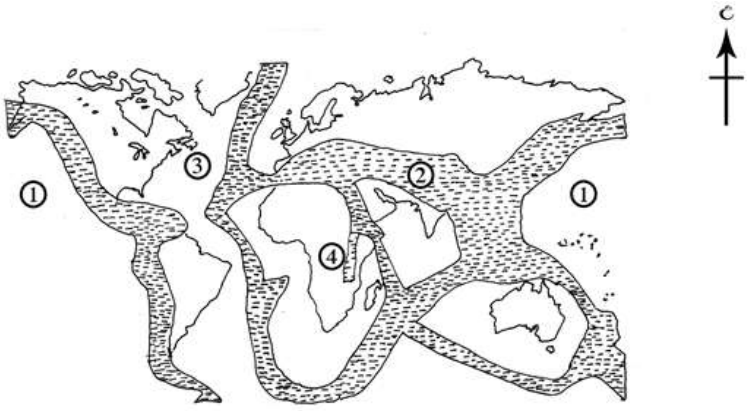
**Earthquakes**

- Earthquakes occur due to the sudden release of energy stored in the melted rocks found in or under the crust. This sudden and violent release of energy moves along the fault lines or weaker zones of the crust.
- As such, an earthquake is an abrupt movement or shattering of the earth's crust due to the sudden release of energy stored in the earth.

- The released energy moves along the surface or through the crust as P (primary), S (secondary) and L (long) waves.
- The location in the earth's interior where earthquake waves originate is called focus (pl. foci) or hypocentre and the location directly above the focus as the epicenter.
- The intensity of an earthquake is measured according to the Richter Scale, introduced by Charles F. Richter in 1935.

**World distribution of earthquakes**

- Earthquakes occur in specific areas.
- They occur mostly at plate boundaries.
- There are four major regions where earthquakes occur:
    1. Circum-Pacific region
    2. Mediterranean-Himalaya region
    3. Mid-Atlantic oceanic ridge
    4. African Rift valley region
- Epicentres of more than 70 per cent of the world's earthquakes are located around the Pacific Ocean.
- It is known as the Pacific Ring of Fire.




Source: Physical Geography, Department of Educational Publications

- Many disasters are associated with earthquakes.

1. Tsunami
2. Land slides
3. Avalanches
4. Shattering of the crust
5. Change in the nature of the water resources
6. Loss of life
7. Loss of property
8. Destruction of infrastructure facilities

**Volcanism**

- The second endogenic force that creates second-order landforms is volcanic activity.

- Volcanism means not only the eruption of volcanoes. The processes involved in the extrusion of the material that exists in solid, liquid and gaseous forms in the earth's interior on to the earth's surface as well as the formations that takes place before they reach the surface are all considered as volcanic activity.

- There are four factors that affect volcanic activity.
    1. Temperature
    2. Pressure
    3. Fissures and joints
    4. Time

- There are four major volcanic zones on the earth.
    1. Circum-pacific zone (Pacific Ring of Fire)
    2. Mediterranean zone
    3. Mid- Atlantic Oceanic ridge
    4. African Rift Valley Zone

- Most volcanic eruptions occur along the plate boundaries.

- About 70 per cent of the active volcanoes in the world are located around the Pacific Ocean.

- Major volcanoes of the world:
    - Visuvius - Italy
    - Etna - Sicily
    - Krakatoa - Indonesia
    - Fujiyama - Japan
    - Pinatubo - The Philippines

- Hecla - Iceland
- Mona Loa - Hawaii islands
- St. Helena - United States of America

Volcanoes could also be classified according to their functional nature. They are,

1. Dead/Extinct Volcanoes (once active but now dysfunctional)
2. Sleeping/Dormant Volcanoes (currently silent but could erupt in future)
3. Active Volcanoes (erupted recently and they would erupt soon emitting smoke, lava etc.)

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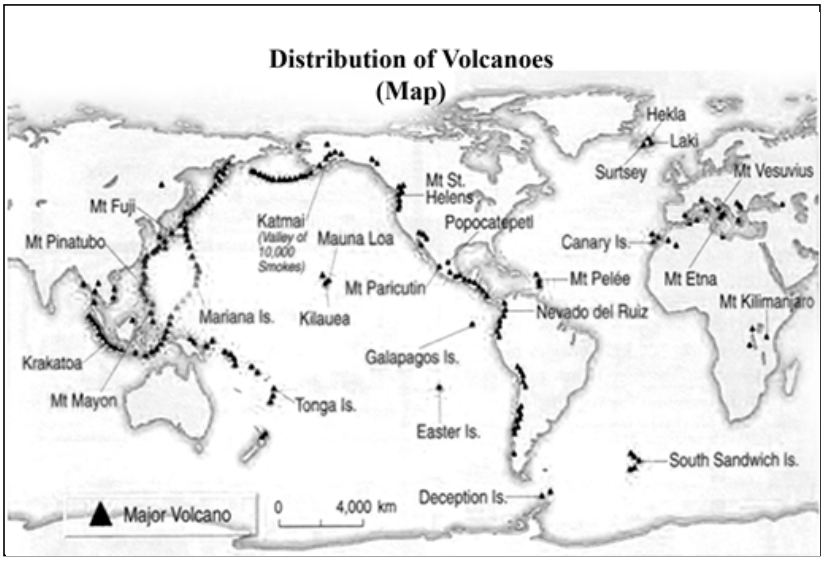



**Landforms associated with volcanic activity**

Volcanism is of two types:

1. Intrusive volcanism
2. Extrusive volcanism

**Intrusive volcanism**

- Intrusive volcanic land forms occur when magma is cooled and solidified in the rock layers below the surface.

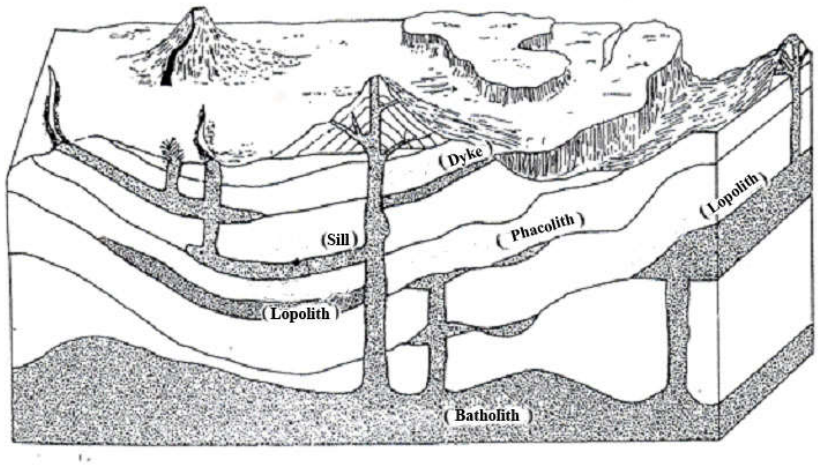
- Location of hard rocks in the passage through which magma flows, lack of strength to pierce through the rocks due to the low pressure of magma emissions are factors that account for the formation of intrusive volcanic landforms.

- When rocks on the surface of the crust is eroded volcanic landforms are exposed.
  Example: the pink granite rocks at Thonigala in Sri Lanka

**Intrusive volcanic land forms:**

1. Dyke
2. Sill
3. Laccolith
4. Lopolith
5. Phacolith
6. Batholith

**Intrusive Volcanic Land Forms**



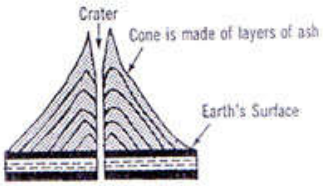

**Extrusive volcanism**

- The landforms created on the earth's surface by the eruption of volcanoes are called extrusive volcanic landforms.
- Magma coming to the earth's surface through joints, faults and boundaries of the plates become cooler and solidified.
- When magma reaches the surface it is called Lava.
- A volcano has been defined as follows:
  'volcano is a fissure in the earth's crust through which liquid or hot rocks are ejected with smoke to the surface. It could be a mountain formed by the material emitted during the eruption. Such a mountain could totally or partly be cone-shaped. In most cases there is a depression at its peak'.

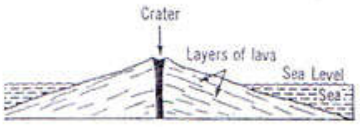
- According to the composition of the lava the shape of the volcano created on the earth's surface varies.
- If the silica content of magma is more than 50 per cent, its viscosity is high. High viscosity magma cools and solidify as soon as it comes to the surface forming taller volcanoes.
- This is acid lava.
- When the silica content of magma is below 50 per cent its viscosity is low and cools slowly allowing it to flow covering a large area.
- This is basic lava.

**Extrusive volcanic land forms**

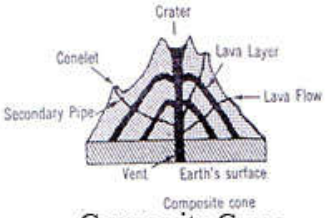
1. Volcanic Cones
2. Volcanic ash cones
3. Composite cones
4. Caldera
5. Lava plateau
6. Lava Plug



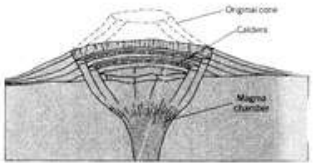

Volcanic Cones/Volcanic Ash Cones




Lava Plateau




Composite Cone




Caldera

- Although not landforms, hot water springs and geysers could be seen in association with extrusive volcanism.
- However, not all hot water springs are associated with volcanism.

- Since temperature increases with depth the water is also hot in those areas. However, the water associated with magma is hotter.
- High temperature, the presence of hot air and rocks are the reasons for water associated with magma to be hot.
- When, such hot water reaches the surface it is called hot water springs.
- Geyser is a spring that sprays water and steam vertically at high speed.
- When vapor is accumulated in the Geyser tube due to high temperature it erupts water into air.

## 5.2 Exogenic Forces

- These are the forces that originate on the earth's surface.
- They create smaller landforms that belong to the Third Order land forms.
- There are a number of exogenic forces that changes the face of the earth's surface.
- They are:
    1. Running water
    2. Wind
    3. Glaciers
    4. Waves
    5. Mass Movements

- They are termed denudation agents.
- Denudation means the removal of material on the earth's surface.
- Removal of rock material is done through weathering, erosion, and transportation by the denudation agents.
- Due to denudation the original physical landscape is changed.
- The American Geologist W.M. Davis explained that denudation is a cyclical process.
- In his cyclical hypothesis, Davis explained that structure, process and stage affect the formation of landforms.

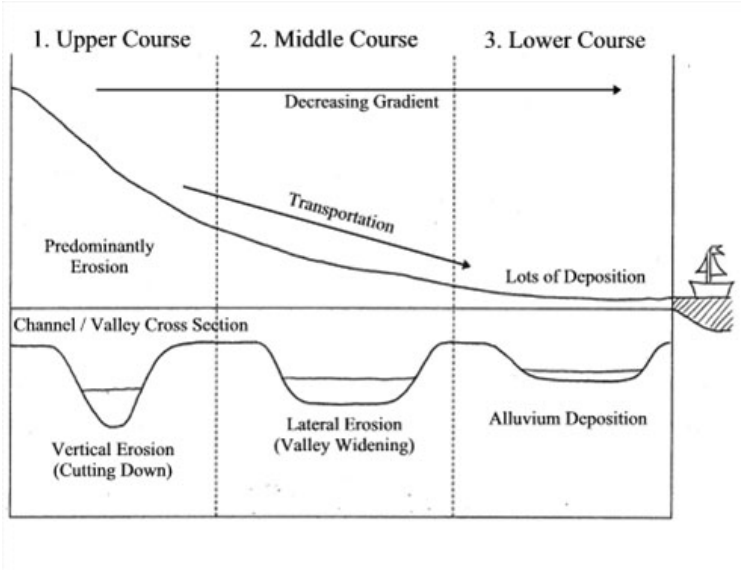
**The process associated with running water**

- A river may originate from a spring, lake, water in a glacier or from an area with heavy rainfall.
- The body of water flowing from such means is called by various names such as river, stream or creek.
- If water flows without rainfall it is known as sheet wash. When water flows on the surface after the saturation of ground reserves it is known as run off.

- A river originating from a highland and flowing along its slopes is called consequent river. The branches that join the consequent river are called subsequent rivers. The branches that join a subsequent river are known as obsequent rivers.

- The long profile of a river from the origin to the destination could be divided into three parts.
    1. Youth Stage
    2. Maturity Stage
    3. Old Stage

Long Profile of a River




**Characteristics of the Youth Stage**

- Steep slope
- Less amount of water
- Velocity of water flow is high
- Corrosion is high
- Mainly eroded land forms can be seen

**Characteristics of Maturity Stage**

- Slope gradually decreases.
- The amount of water in the river increases due to joining of branches
- Lateral erosion begins
- The width of the river channel increases due to lateral erosion
- The river has power to transport its load

  Methods of transportation of the river load:
  - Solution
  - Suspension
  - Saltation
  - Traction

**Characteristics of Old Stage**

- River gradient very low
- Carries large amount of water
- Water flows slowly
- High river load
- Depositional process occur
- As W.M. Davis says, the action of a river that flows according to the above mentioned stages, is also of three types. They are:

1. Erosion
2. Transportation
3. Deposition

**Erosional Land Forms**

- The nature of the erosional land forms are determined mainly by the structure.
- By the term structure Davis meant the composition of the rocks, their permeability or impermeability, resistance, and the nature of distribution.
- Erosion means the abrasion or solution of rocks that make wearing them off.
- Erosion occurs in three ways:

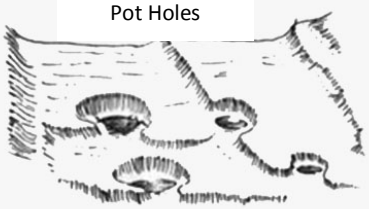
1. Solution
2. Attrition
3. Corrosion

They result in many erosional land forms:

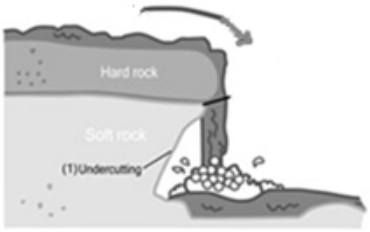
1. Narrow V-shaped valleys
2. Pot Holes
3. Gorges
4. Interlocking Spurs
5. River Terraces
6. Water Falls

Eroded Landforms

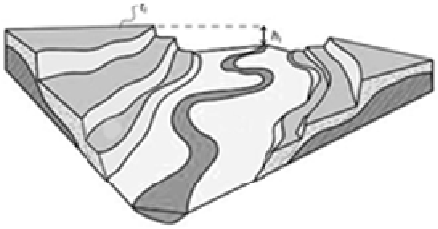
Pot Holes



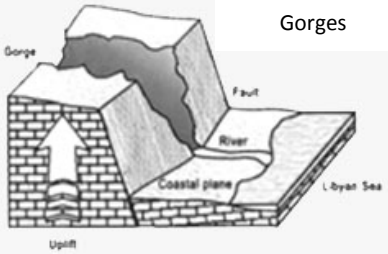
Water Falls



River Terraces



Gorges



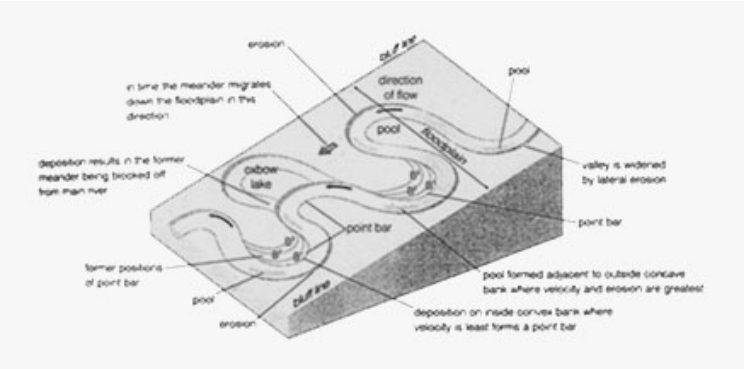

Narrow V-shaped Valley & Interlocking Spurs

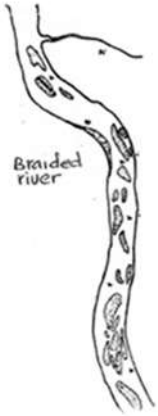

- Another feature that could be found at this stage is river capture.
- When a more powerful river captures a weaker river a capture occurs.

**Depositional Landforms**

- It is in the old age that a large number of depositional landforms could be found.
- In old stage the low velocity of the river fails to carry a heavy load and as a result the depositional process starts.
- There are many depositional landforms:

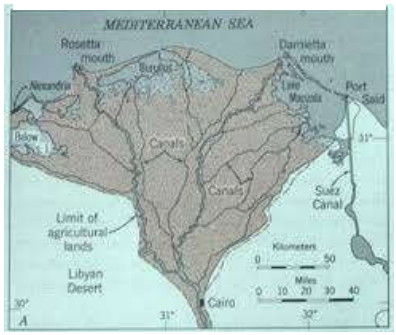
  - Braided Rivers
  - River Levees
  - Floods Plains
  - Delta, are few of them.



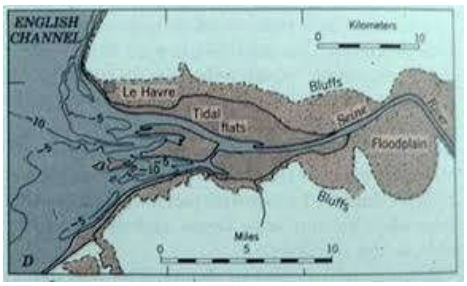




Delta

Arcuate (River Nile)




Estuarine (River Seine)




Cuspate (River Tiber)


Bird's Foot (River Mississippi)

- Water creates various landforms in desert areas, too.
- Although aridity is the hallmark of deserts, due to the rare but heavy rainfalls many changes in the landscape occur.
- The erosion due to the rain that falls on bare land is acute.
- The amount of the debris transported by the water and the rapidity of the evaporation of that water result in the following landforms:

    1. Wadi
    2. Alluvial Fans
    3. Playa Lakes
    4. Pediment
    5. Bajada

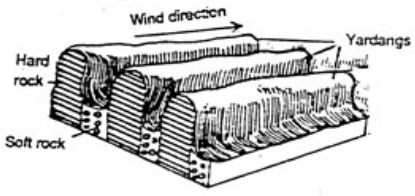
**Wind action and associated landforms**

- Wind is a major denudation agent in arid regions.
- 1/6 of the earth's surface are arid regions found in desert areas.
- Some of them are areas with rocky surfaces and the remainder is covered with sand or rocks.
- Wind creates landforms in arid areas in three ways:
    1. Erosion
    2. Transportation
    3. Deposition

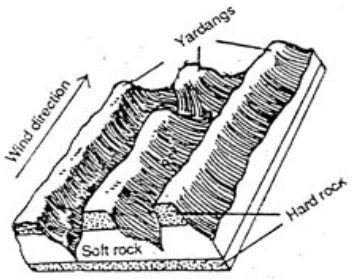
**Erosion**

- Erosion takes place due to the wind itself and also by the material it transports.
- Erosion takes place in three ways:
    1. Deflation
    2. Abrasion
    3. Corrosion
- Deflation means the removal of sand and dust particles and carrying away.
- The removal of rocks by deflation creates large depressions on the Earth'ssurface. Example: Qattara Depression in North West Egypt.
- The deflating rock particles collide with each other and turn into small particles.
- Abrasion means scraping the earth's surface by the rock and sand particles carried away by the wind. In the process they are polished.
- Corrosion means the collision of rock particles with masses of rocks on the earth.
- A large number of landforms are created by the above methods.
    1. Deflation Hollow/Blowouts
    2. Ventifacts
    3. Yardangs
    4. Zeugens
    5. Inselbergs
    6. Mesa
    7. Butte

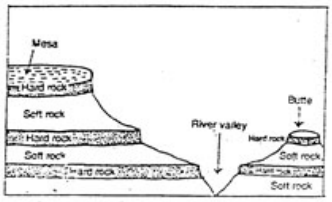
Mushroom rock



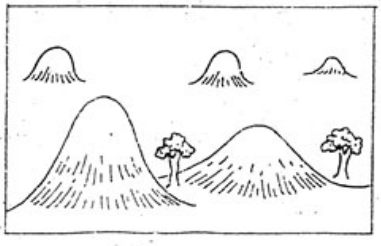

Formation of Yardangs




Formation of Zeugen




Mesas and Buttes



Inselburgs

**Transportation**

- The eroded material in arid regions like large and small rocks and dust particles are transported in three ways:

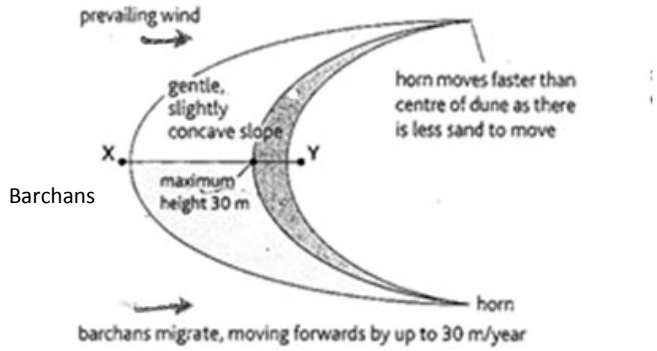
1. Suspension
2. Saltation
3. Traction

- The fine sand particles rolling along the surface and bouncing into the air when they hit each other is called suspension.
- The velocity of wind and the weight of the suspended load determine the distance they are carried away. In some instances, they are transported over 100 km.
- Saltation means the bouncing movement of somewhat weighty rocks and sand particles with wind.
- Traction means the rolling of material of more weight along the surface of the desert.

**Deposition**

- When it is difficult for the wind to transport sand, dust and other material further deposition process commences.
- The result is the formation of sand mountains and sand dunes of varying shape and height.
- There are a large number of depositional landforms:
  1. Sand dunes
  2. Barchans
  3. Longitudinal sand dunes/Linear dunes
  4. Sword-like sand dunes
  5. Star dunes
  6. Loess deposits

**Depositional Land forms**




**Glaciation and associated landforms**

- Ice is formed by the solidification of water by freezing and snow fall in cold regions.
- At present, 10 per cent of the earth's surface is covered by glaciers.

- Glacier is a large layer of ice.
- Glaciers are formed by the accumulation of ice due to the prolonged snow fall.
- Glaciers are found in high latitude areas and high altitude areas.
- Landforms created by the erosion and deposition due to the movement of glaciers are known as glacial landforms.

**Glacial regions of the Earth**

Two types of glaciers can be identified according to their location.

1. Valley glaciers (Mountain glaciers)
2. Continental glaciers (Sheet glaciers/polar glaciers)

Valley Glaciers/Mountain Glaciers

- Glaciers formed in high mountain areas of the earth are known as mountain/valley glaciers.
- As temperature decreases for every 100 meters at the rate of $0.62^0$C, at a height of 6000 meters temperature decreases to freezing point and glaciers are formed.
- In mountain areas over 6000 meters in height glaciers are constantly flowing down along the valleys. These are also called mountain glaciers.
- In mountain regions such as Himalaya, Atlas, Rocky, Andes, Alps, and Ural glaciers of several meters in thickness and about hundred kilometers in length could be seen.
- Valley glaciers act in three ways:

1. Erosion 2. Transportation 3. Deposition

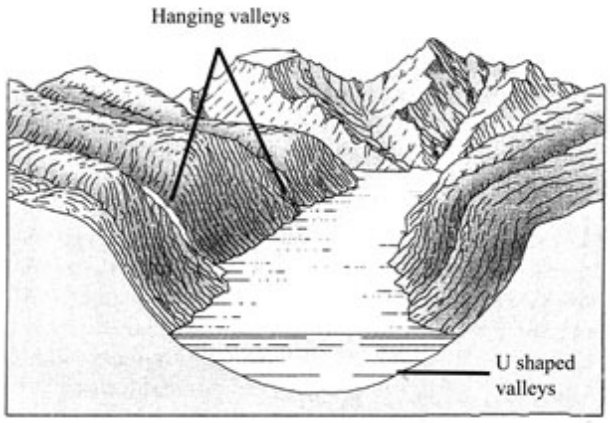
**Erosion**

- Erosion takes place three ways:
  1. Plucking
  2. Abrasion
  3. Sweeping

- Plucking means dislocation of loose bedrock by the glacier.
- When the water in joints and openings in the bedrock is frozen, the pressure of ice rises and removes the loose particles of the bedrock.
- This could happen even in summer due to melting of ice.
- Abrasion is the grinding and polishing of the surface by the moving glacier
- Rock particles, pebbles and sand contained in the glacier exert a pressure on the land.
- When the glacier moves downward using its weight abraids and polishes the surface of the bedrock.

- Sweeping means the removal of material of the surface by large rocks contained in the glacier. This process results in elongated trough-like landforms.
- Erosive action of the glaciers have created many landforms:

1. Cirques
2. Tarn
3. Arête
4. Pyramid-shaped peaks
5. U-shaped valleys
6. Hanging valleys
7. Ribbon lakes

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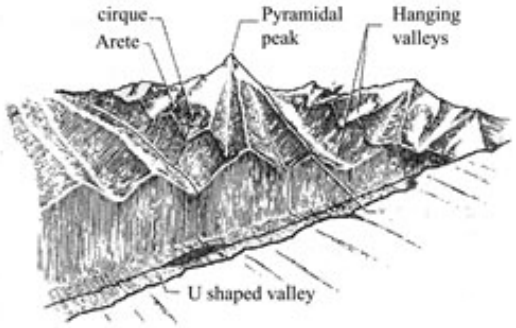
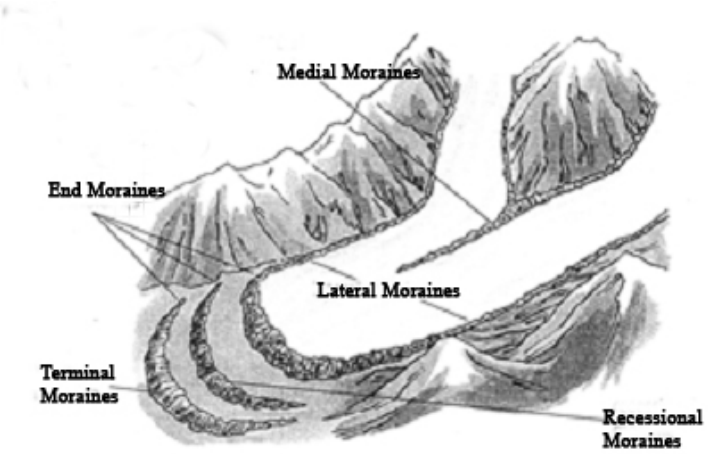



**Deposition**

- The glacier load comprises rocks and soils.
- The heavy material contained in the glacier is deposited when it flows.

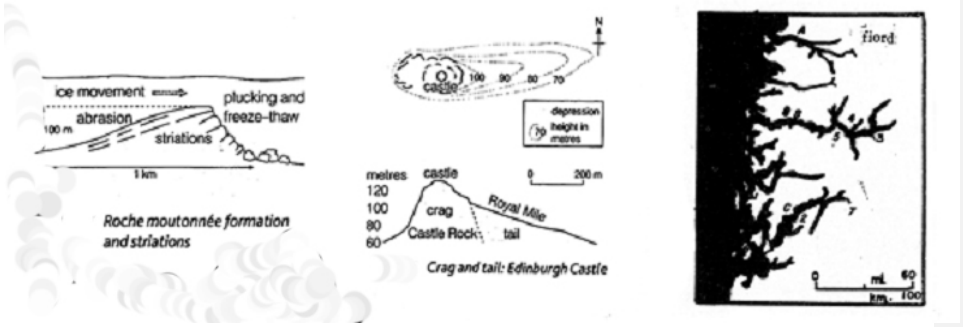
- Moraine is an important landform created by the deposition action of the glacier.
- Moraines are formed by material accumulated by a valley glacier from its banks and the bottom and also the material fallen on the glacier from the mountains peaks.
- Four types of moraines can be identified according to location:
    1. Lateral moraines
    2. Medial moraines
    3. Ground moraines
    4. Terminal moraines




Depositional landforms

**Continental glaciers**

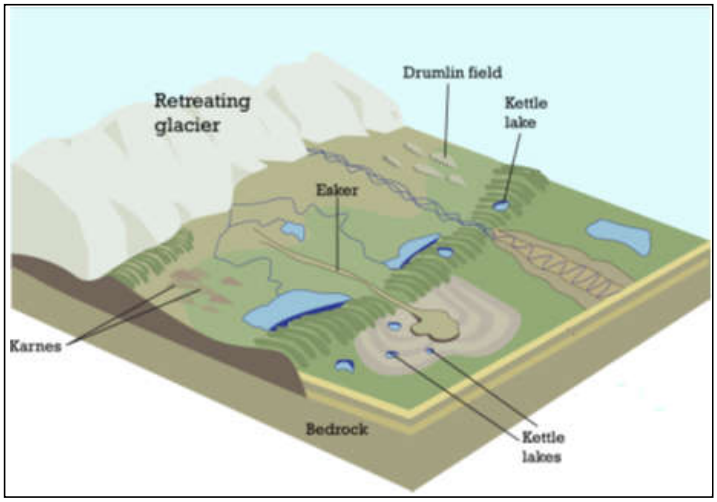
- Continental glaciers are the World's largest glacier type
- Ice sheets found in polar regions are called continental glaciers
- 96 per cent of the glaciers of the earth is located in polar regions
- The depth of these glaciers is about 2,300 meters.
- They are located mainly in Antarctic and Arctic regions, Antarctic ice sheet is the World's largest continental glacier
- In addition, continental glaciers are found in Greenland, Iceland, Siberia, and Alaska
- The temperature decreases from the equatorial region to Polar areas and when it declines below the freezing point glaciers are formed.
- The erosive action of the moving glaciers in these areas have created many landforms.
    1. Roschemutonne
    2. Nunatacks
    3. Fjords




Landforms created by erosion in Continental Glacier regions

**Depositional landforms**

- When continental glaciers are melted they move towards ocean areas as large blocks of ice.
- The moving glacier deposits pebbles, clay etc. as it melts
- There are many depositional landforms:
    1. Drumlins
    2. Basket of Eggs
    3. Eskers
    4. Keme
    5. Boulder clay
    6. Erratics



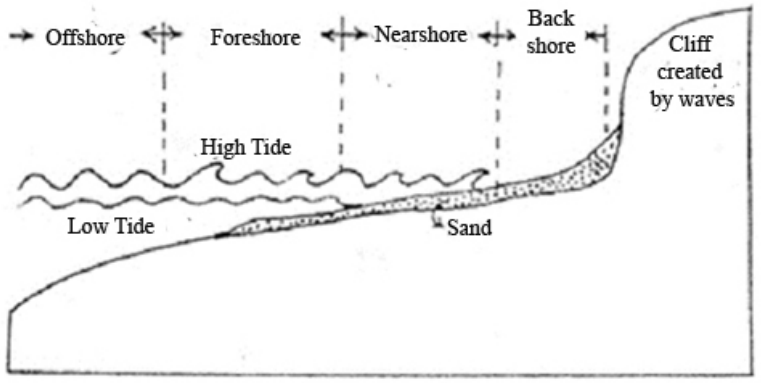

Depositional landforms created by Continental glaciers

**Wave Action and Associated Landforms**

- The fluctuations occurring on water surfaces due to wind is known as waves.
- The landforms created by wave action in the coast line are called coastal

landforms.

- Coast is the strip of land that combines the mainland and the sea.
- There are 4 sections in a coast:
    1. Backshore
    2. Near-shore
    3. Foreshore
    4. Off-shore




- There are a few agents of erosion that forms coastal landforms.

    1. Waves
    2. Tides
    3. Currents

- Of the above, the main agent that contributes to the formation of costal landforms is waves.
- When waves coming from the sea reach the shallow area they break.
- The breaking waves armed with sand, stones and rocks hit the shore hard. It is known as “swash”.
- When the swash returns to the sea under the incoming waves it is called the “backwash”.
- The backwash carries the sand, stones and rocks back to the sea.
- This process takes place again and again resulting in the erosion of the coastal area and making the land area smaller.
- The process of the formation of landforms associated with waves takes place in three ways:
    1. Erosion 2. Transportation 3. Deposition

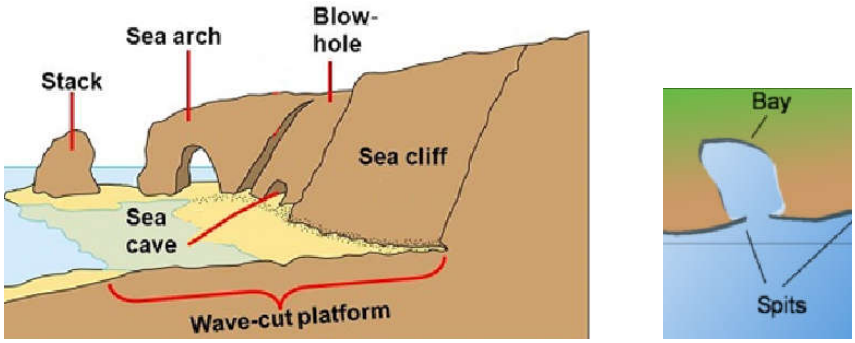
**Erosion**

Erosion occurs in three ways:

1. Hydraulic action
2. Corrosion
3. Abrasion

- The joints in the masses of rocks located along the coast is filled with air.
- When the breaking waves hit those rocks the pressure within joints increases.
- When waves return, the pressure within the joints tends to expand and disintegrate the rocks.
- This process is known as hydraulic action.
- As the wave breaks, the sand, pebbles and pieces of rocks it contains undercut the base of the cliffs. As a result, the rocks fall down and the process is known as "corrosion".
- The breaking waves containing sand, pebbles and rocks scrape and polish the rocky surface of the coast. This is called abrasion.
- The combined action of the above processes results in various landforms:

1. Sea Cliffs
2. Sea Caves
3. Wave-cut Platform
4. Bay
5. Promontory
6. Arch
7. Sea Stacks
8. Blow Holes




Erosional landforms in coastal areas

**Transportation**

- Various material brought to the shore by waves are known as load.
- They comprise shingle, sand and mud.

- These material are transported back and forth along the beach by the push and pull action of the wash and backwash
- Material on the beach are carried away to the deep sea by under currents

**Deposition**

- The material brought by the waves from the sea and rivers from the land play a major role in deposition process.
- Depositional landforms are many:

1. Beach
2. Sand bars and sand spits
3. Mud sheets
4. Islands
5. Tombolo


**Action of Ground Water**

- The water received from either rainfall or snow after saturating the soil layer of the surface infiltrates down.
- The infiltrated water is stored in the joints and openings in the rocks located above the impermeable rock layer. It is called ground water.
- The movement of ground water through various agents of weathering such as rock disintegration, oxidation, carbonation, and hydration and also by solution and deposition produces various landforms.
- It is in the limestone areas that the action of ground water circulation can be clearly seen.

- There are two major limestone areas in the world.

1. Yucatan peninsula in the Middle America

2. Karst region in Slovenia (this area is 640 km long and 100 km wide)

- In Sri Lanka, too, limestone areas and associated landforms could be found. Examples:
  Miocene limestone region in the North
  Under-ground limestone caves at Wavulpone

- Lime stones are formed by two main methods.
  1. Organic method
  2. Chemical precipitation

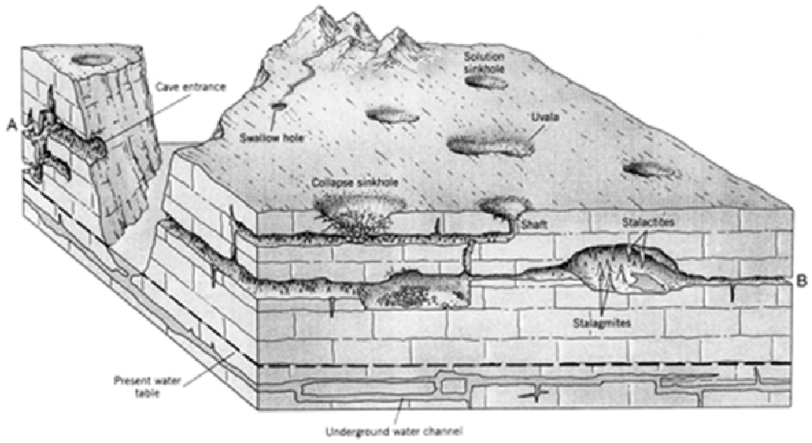
- The formation of limestones by various organisms found in the ocean is known as the organic method.
- The skeletal fragments of marine organisms such as coral, molluscs and fish shells are primarily composed of calcium carbonate. When they die and decay limestones are formed.
- When ocean water containing chemicals such as calcium carbonate, magnesium sulphate and sodium chloride is precipitated due to evaporation limestones are formed.
- The landforms produced in such lime stone layers are also known as "Karst Landforms".

**Karst Landforms**

- Limestone is a rock composed of calcium carbonate.
- The structure of limestones is composed of horizontal as well as vertical joints.
- Rain water mixed with carbon dioxide in the atmosphere produces carbonic acid.
- The water infiltrated through the joints of limestones result in various landforms both on the surface as well as underground.
- The landforms found in limestone regions are known as "Karst Landforms". The term was derived from the landscape in the Karst region in Slovenia.
- Now the term is being commonly used for limestone landscapes. There are many Karst landforms.

Comment [P1]:

1. Lapies
2. Ponore
3. Doline
4. Uvala
5. Polje
6. Limestone caves
7. Stalactite
8. Stalagmite
9. Hums




Karst Landforms

- An intermittent drainage pattern could be seen in limestone regions.
- When caveats in a sand layer are filled by groundwater mixed with lime particles are cemented and a lime-mixed sand stone is produced.
- When ground water contains silica the lime coating in the stone is removed and a Feldspar stone with silica is created.

**Mass Movement**

- In geology, mass movement means landslides.
- Landslide is the gravitational movement of soils, rocks, pebbles, clay, mud and its vegetation along the steep slopes of mountains or loose soil areas

**Pre-indications of a landslide**

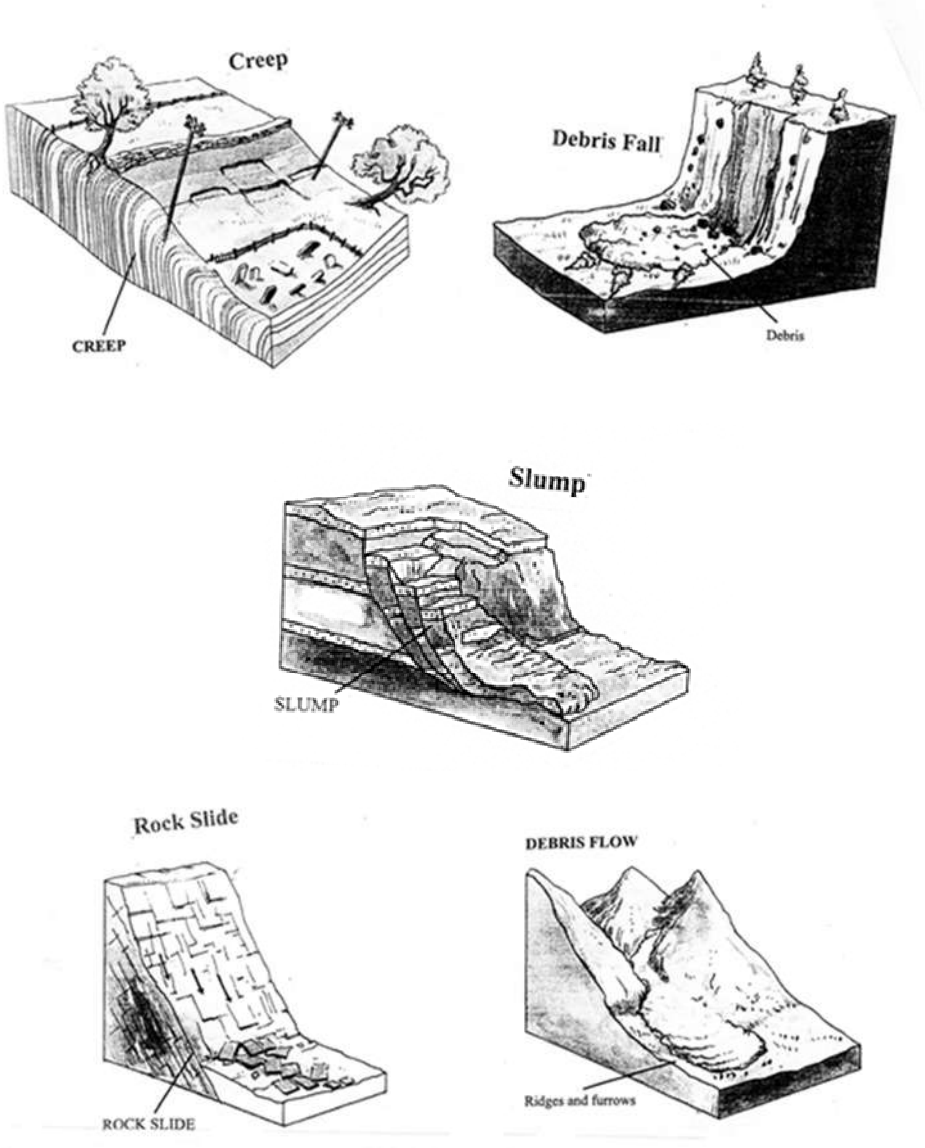
- Sudden emergence of water springs
- Flowing of muddy water
- Drying up of existing springs
- Sudden inclination of trees, lamp posts, and telephone wire posts, etc.
- Emergence of cracks, deep rifts on the surface
- Cracks on the house walls located on slopes
- Subsidence of the earth's surface
- Abnormal behaviors of animals

**Probable areas of landslides**

- Slopes where the slope angle has been increased
- The foothill of slope area consisting of rocks with excessive number of joints and fragmented blocks of stones
- Areas where landslides have occurred in the past
- Foothill areas with streams
- Slope areas with human settlements

**Types of landslides**

- Creeping
- Falling
- Sliding
- Rolling
- Flowing




Types of landslides

**Factors leading to landslides**

- Different factors lead to landslides in different areas
- They are mainly of two types:

1. Physical (natural) factors
2. Human factors

**Physical factors**

1. Intensity of rainfall
2. Nature of slope
3. Geological structure
4. Earthquakes
5. Rock weathering
8. Ground water
9. Snow

**Human Factors**

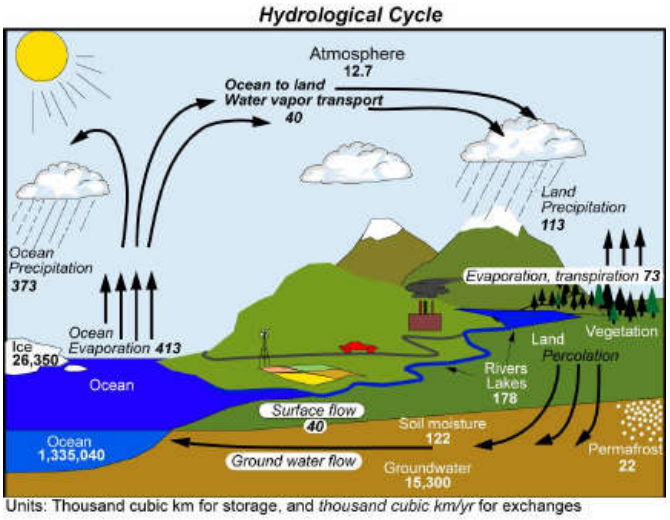
1. Irregular land use
2. Constructions made in slope areas without adhering to geological or engineering advice
3. Deforestation in mountain slopes
4. Vibration due to various explosions
5. Obstruction of natural waterways and containment of water in hilly areas
6. Illegal mining

- A landslide could occur due to one or more above mentioned Factors
- Sri Lanka, too, has become a country with frequent landslides
- In Sri Lanka, landslides occur frequently in hilly areas
  (e.g. Districts of NuwaraEliya, Badulla, Kandy, Kegalle, Ratnapura)

## 5.3 Hydrological Cycle

- Earth is considered as a unique planet due to the availability of water needed to sustain life
- Water is composed of two atoms of hydrogen and one atom of oxygen.
- Water is an inorganic compound.
- Water received by the Earth is result of the interaction between the atmosphere and Earth's surface.
- This process has several stages. They are the main components of the hydrological Cycle.
- Hydrological cycle is the circulation of water from one place to another aided by the solar energy.
- Components of the hydrological cycle:

1. Evaporation/Evapotranspiration
2. Condensation
3. Precipitation
4. Run-off
5. Percolation and infiltration



Units: Thousand cubic km for storage, and *thousand cubic km/yr* for exchanges

- Water is transmitted to the atmosphere through evaporation of water from the ocean and other water surfaces and evapotranspiration from vegetation.
- Water is stored in the atmosphere as water vapor.
- Water molecules transmitted to the atmosphere is seen as clouds.
- Later, they will be condensed.
- When water is condensed the size of the drops becomes larger and fall on the earth's surface.
- Precipitation takes place in the form of rainfall, snow and dew.

- A portion of this water is flows along the surface and another percolates into the earth and remains as ground water.
- this water is transmitted again to the atmosphere through evaporation and transpiration.
- It will be subject to condensation again and the process will continue as a cycle.

This global process is known as the hydrological cycle.

**How hydrological cycle affects the landscape?**

- In the formation of the landscape in many parts of the world, the hydrological cycle plays a major role.
- It helps to maintain the temperature of the earth's surface at a constant level and plays a significant role in sustaining life.
- The main component of the hydrological cycle is ocean. It contains 97.2 per cent of the water volume of the globe.
- The evaporation and condensation of water resulting in precipitation affects the landscape.
- How hydrological cycle affects the landscape could be discussed in two ways:
    1. Short-term effects
    2. Long-term effects

**Short-term effects**
**Effects of evaporation**

- Excessive evaporation leads to salinization. It causes less vegetation density.
  (In desert areas)
- When evaporation exceeds the amount of rainfall received an arid landscape will emerge.
- Evaporation and potential evaporation result in increased physical weathering and create a rock surface of sand, stones and dust.

**Effects of cloud formation**

- A large amount visual light received from the Sun is reflected back by the cloud cover.
- By maintaining a cooler environment it helps vegetation and animal growth.
- Clouds contain carbon dioxide, nitrous oxide and sulfur oxide. When it rains these acids falls on the earth as acid rains and destroy the vegetation cover.

**Effects of precipitation**

- Landslides due to high rainfall
- Acceleration of soil erosion
- Siltation of reservoirs and river beds
- Burring the landscape in snow
- Erosion of earth's surface by water from melted ice and rainfall
- Formation of dense forests in tropical areas due to heavy rains

**Effects of Run-off**

- Change in morphology of river basins
- Exposure of rock layers due to erosion
- Increased erosion leads to lessening of nutrients in soil
- It leads soil infertile and results in low vegetation density
- Changes in river valleys due to lateral erosion caused by floods
- Filling of low lying areas with deposits transported by the rivers
- Rivers and streams change the roads

**Long-term effects**

- Rainfall and run-off change gradient of the land
- Solution of lime stones by rain water changes the landscape in those regions
- Snow fall in polar and high latitude areas through erosion and deposition creates various landforms.
- Running water during continuous heavy rains create various landforms.
- Continuous rains leads to emergence of springs
- Rivers originating from springs and their tributaries creates various patterns in the landscape.

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**Competency : 6.0 Describes the basic concepts and methodologies that help understand the physical and human landscape**

**Competency Levels :**

6.1 Defines weather and climate
6.2 Explains the elements of weather
6.3 Explains with examples factors controlling climate
6.4 With reference to Koppen's climatic classification explains tropical humid types

**Periods :** 32

**Learning Outcomes :**

- Explains the difference between weather and climate
- Introduces the elements of weather
- Describes the instruments used for measuring weather elements
- Explains how weather data are maintained
- Describes diurnal weather with the help of data
- Names the factors controlling climate
- Explains with the help of examples basic features of climatic controls
- Presents with the help of diagrams and maps factors controlling climate
- Introduces the criteria used in Koppen' climatic classification
- Explains the tropical climate type in Koppen's classification
- Mark and name tropical climate type on World map

**Introduction :**

Weather and climate are very important elements of our physical environment. The elements of weather such as temperature, precipitation, humidity, pressure, winds and their changes determine the nature of weather and climate of a region. It is in the lowest strata of the atmosphere, i.e. the troposphere, that the weather and climatic conditions which we experience occur.

Climate is the major factor that determine the nature of the biosphere and its distribution. Also, it directly or indirectly affects the human activities. The weather conditions as well as the extreme weather conditions and events such as climate change which have caught the attention of the world exert an impact on human activities.

As such, it is important for students of geography to acquire competency in weather and climatic phenomena which are significant elements of the physical environment. It is expected from this unit to provide a basic understanding of the elements of weather, factors controlling climate and world climatic classifications.

**A guide to clarify the subject matter:**

**Introduction :**
**Weather and climate**

- **Weather**

  - The atmospheric condition prevailing at a location at a particular time is called weather. It varies by time and place.
  - The weather prevailing in a particular location could develop into a hazardous situation.
  - Weather is consistently changing due to the changes in elements of weather.

- **Climate**
  - The average situation of the weather or atmospheric phenomena at a particular location prevailing over a long period of time is called climate.
  - Climate is determined by analyzing the weather conditions at least over a period of 30 years.
  - On such occasions, observations and measurements of the elements of weather such as rainfall, temperature, humidity, air pressure, wind, clouds, sun shine are analyzed.

## 6.2 Elements of weather

- Weather of a particular location at a particular time is determined on the basis of temperature, rainfall, humidity, pressure, wind, visibility, clouds etc.
- Since the weather condition of a particular location at a particular time is determined on the basis of above criteria they are called elements of weather.

- Temperature and Sun shine

  - Temperature is the amount of heat contained in air, liquids and solid matter.
  - The major factors that determines the temperature which is significant in determining weather and climate are sun shine and solar radiation.
  - The solar radiation emitted by the sun reaches the earth as short waves and they are re-radiated by the earth as long waves to the atmosphere. This is terrestrial radiation. Since this reflected radiation is absorbed by water vapor, dust particles in air and clouds the atmosphere is heated.
  - Temperature is significant as a factor that directly affects weather and climate. It affects the other weather elements such as pressure, winds, humidity and rainfall.

- **Distribution of Earth's temperature**

  The distribution of Earth's temperature varies due to various factors.
  - Latitudinal location
  - Elevation from the sea level
  - Distribution of continents and oceans
  - Surface winds, are few of them.

  - Due to the effects of these physical factors the distribution of global temperature varies in time and space.
  - This could be explained with the help of vertical and horizontal distribution of temperature.

- **Vertical distribution of temperature**

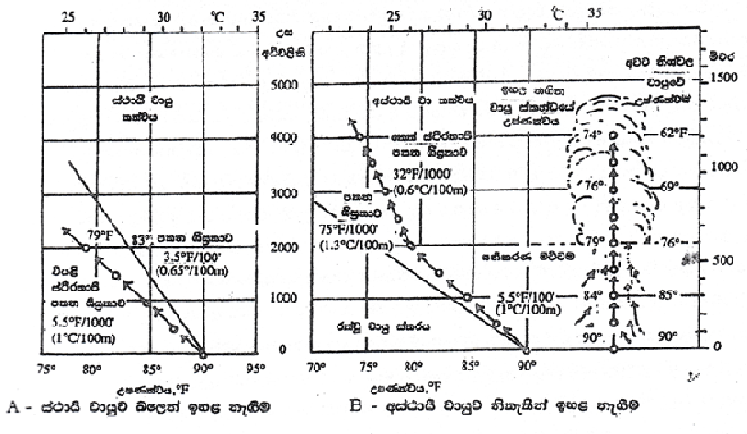
  - The change in temperature with altitude is complex. The change varies by different strata of the atmosphere.
  - In troposphere temperature declines with altitude. It is known as lapse rate or environmental lapse rate.
  - The decline in temperature has been calculated as $6.5^0$C per 1000 meters.
  - However, due to the variations in different locations of the earth's surface temperature inversions could take place.

- According to the nature of the decline in temperature in rising air, lapse rate take two forms.

- Dry Lapse Rate
  - Dry lapse rate
    The lapse rate up to the point where rising air reaches the condensation level is known as dry lapse rate.

- Wet Lapse rate
  - If the temperature of the rising air beyond the condensation level continues to decline and creates humid condition it is called wet lapse rate.

**Dry and Wet Lapse rates**




Source: Department of Education Publications, ***Parisarika Bhugola Vidyawa***

- Temperature Inversion

  - A reversal of the normal behavior of temperature in the troposphere in which a layer of cool air at the surface is overlain by a layer of warmer air.
  - When a warmer air mass rises over a cooler air mass it creates a situation in which the temperature at the earth's surface is higher than in the layer above it.
  - Since the cooler air cannot rises over the upper layer of warmer air the temperature in the upper portion of the troposphere remain higher.
  - In environments where the cooler air masses cannot travel horizontally or vertically temperature inversions occur.

- **Horizontal distribution of temperature**

  - The variations in the vertical and horizontal distribution of pressure occur due to the factors such as the air and water vapor composition in the atmosphere, temperature, rotation and revolution of the earth, differences in heating of land and ocean and altitude.

  - Atmospheric pressure continuously decreases with the increase in elevation from the sea level. This is due to the decrease in the density of air with altitude. For example, at the Everest peak at an altitude of 8848 meters, the pressure decreases by 300 mb from the sea level.

  - The cooling of land and water surfaces tales place differently. Heating as well as cooling off of land areas take place quicker than that of water surfaces. Water surfaces are heated slowly and in turn they cool off slowly. As such, in accordance with the distribution of land and water surfaces the horizontal and vertical distribution of pressure vary.

  - This is how land and sea breezes activate. Also, variations in pressure leads to air circulation.

  - Wind vane is used to detect wind direction and anemometer is the instrument used for measuring wind speed. Beaufort Scale is used to categorize the wind speed.

**Humidity**

- The amount of water vapor in the atmosphere is defined as humidity. Water vapor in the atmosphere is provided by evaporation and transpiration.

- Atmospheric humidity varies in time and space. In the areas over water surfaces the humidity in air is higher than that of over land surfaces.

- A major factor that determines humidity is temperature. The amount of water vapor bearable by a unit of air depends on its temperature.

- The Hygrometer used for measuring humidity consists of a wet bulb thermometer and a dry bulb thermometer.

- There are two ways of measuring humidity:
  Absolute humidity
  Relative humidity
  The amount of water vapor contains in a unit of air (cubic centimeter/cubic meter) is called absolute humidity. Example: at a temperature of $22^0$C humidity is 80g.

- Relative humidity is defined as the amount of water vapor contained in a unit of air at a certain temperature as a percentage of the amount of water vapor bearable by that unit at that temperature (saturation point).

  Example:
  - At a temperature of $23^0$C the maximum amount of water bearable by a unit of air is 120g.
    However, the absolute humidity is 90g.
    Therefore, relative humidity of that unit of air is,

$$\frac{90}{120} \times 100 = 75\%$$

- When relative humidity is 100 (saturated) water vapor is condensed.

**Clouds**

- The water vapor in the atmosphere becomes cooler and condensed due to its rise or confrontation with a cool air mass.
- The condensed water vapor floats in the atmosphere in the form of snow or water droplets. The nature, shape, height and movement of clouds are important in weather forecasting.
- The measurement used to describe cloud cover in the atmosphere is called Oktas. It means the parts of digit eight. If the sky is fully covered with clouds it is interpreted as 8/8. Four Oktas (4/8) means the sky is half covered with clouds.
- In the classification of clouds, their nature, height and appearance are used as criteria.
- Accordingly four main types of clouds have been identified:
  - High clouds
  - Middle clouds
  - Low clouds
  - Vertically formed cumulous clouds located at an elevation between 2000 – 3000 feet but with no fixed height.

**Precipitation**

- The small water droplets in clouds tends to accumulate together creating larger water droplets.
- When these larger water droplets are unable to float further due to their increased weight they precipitate on the earth's surface. Precipitation could take various forms:
  - Frost
  - Mist
  - Dew
  - Hail
  - Rain

- Rain or rainfall is the main method of precipitation in tropical and low latitude regions. Snowfall and mist are the main methods of precipitation in countries in the temperate zone.
- Rainfall could be divided into several types on the basis of the factors responsible for them.
    - Convection
    - Pressure depressions/pressure variations
    - Surface winds
    - Air masses

Convectional rains

- Convectional process takes place mostly in the tropical regions where air is excessively heated during day time and also in the interior land masses of the mid-latitude regions where air is heated in the summer.
- When convectional currents take warm air with water vapor into higher elevations in the atmosphere they are condensed and formed into cumulous clouds with horizontal distributions.
- By evening these clouds are pushed further up by the convectional currents. The result is high temperatures during day time and storms and rains with thunder in the evenings.

Pressure depressions

- When the air temperature of a particular location is above the minimum it rises and expands.
- To fill the low pressure space created in that location air streams are flown in from the surrounding high pressure areas. The speed of these air streams or winds is determined by the difference in pressure values in the two areas known as pressure gradient.
- Generally, low pressure belts are located above oceans in the tropical regions and winds are flown into these regions from the high pressure belts located on land masses.
- In the area between the eye of the cyclone and the outer limit heavy rains occur.

Precipitation associated with surface winds

- The movement of air resulting from the variations in pressure in large areas due to their latitudinal location is known as surface winds.
- Due to the fact that they blow along the surface of the Earth they are called surface winds.
- In some areas of the tropical zone, they are known as Monsoon winds.
- The amount of water vapor contained in these winds is much higher due to the evaporation from ocean surfaces.
- The precipitation from these winds depends on the location of mountains that induce the air to rise.

Atmospheric visibility

- Visibility is a measure of the distance at which an object or light can be clearly discerned in the atmosphere.
- Depending on the objects and conditions prevailing in the atmosphere visibility varies.
- In general, if the atmosphere is clear no problems will arise regarding visibility.
- Clouds, mist and fog associated with unfavorable weather conditions reduce visibility. Especially when misty or foggy conditions in the atmosphere obstruct sunlight to penetrate the visibility decreases.
- Mist means the floating water droplets resulting from the condensation of water vapor at the surface level.
- Fogs occur due to the condensation of water vapor mixed with dust and other pollutants emitted by the industrial plants and houses. As such, foggy conditions could be seen in industrial areas.
- Visibility affects human activities. Decrease in visibility adversely affects air travel, motor transportation and military operations.

## 6.3 Factors Controlling Climate

The objectives of this unit are to study the factors controlling climate and inquire into the factors that create a variation in climate geographically.

- Intensity of solar radiation
  - Intensity of solar radiation is the main factor that affects climate on the Earth's surface. It is from the radiation emitted by the Sun that the Earth receives thermal energy and light.
  - Of the total solar radiation, 13 per cent is absorbed by the various gases in the atmosphere. Another 36 per cent is reflected back to the space due to the effect of various factors. It is the remaining 51 per cent that heats the Earth's surface and hydrosphere. Temperature means the effect of this heating.
  - From the incoming solar radiation, a certain amount is reflected again without being absorbed by the Earth's surface.
  - This percentage of radiation reflected back by the Earth's surface is known as Albedo. As such, albedo is a measurement of the ability of the earth's surface to reflect back radiation.

    Albedo of,

    | | |
    |---|---|
    | Snow surfaces: | 90 per cent |
    | Water surfaces: | 2 per cent |
    | Land surfaces: | 16 per cent |

  - The air temperature generated by solar radiation is the foundation for a number of events of climatic significance.
  - Temperature determines pressure variations that in turn result in air movement. Air movements effect humidity and precipitation.

**Solar radiation by latitude**

- The reception of solar radiation varies by the latitudinal location of a place on the Earth's surface. As such, differences in climate could be seen according to the latitudinal location.
- Due to the inclination of the Earth, tropical regions receive radiation perpendicularly. However, towards polar areas, it falls on the surface at oblique angles. As a consequence, temperature decreases from the Equator toward polar regions.
- Seasons, a salient feature of the climate in higher latitude regions are determined by the amount of solar radiation received (summer in the period during which more radiation is received and winter in the period during which radiation is less).

Distribution of Oceans and Land Masses

- Heating and the time taken to be heated vary in the Oceans and Landmasses.
- Ocean waters are heated layer by layer from top to the bottom. A much higher amount of thermal energy is needed to heat up ocean waters and the process

takes a longer time. Land masses are heated through particles by conduction. Therefore, they heat up and cool off quicker.

- Air over land masses is heated quickly but air over water surface takes a longer time to be heated.
- As such, a major factor that determines the climate in the coastal areas, islands, interior of the continents is the location of oceans and land masses.

**Ocean currents**

- Ocean currents are movements of ocean waters resulted from the differences in temperature in water and winds.
- According to the latitudinal location the temperature in ocean waters in the tropical regions is higher. The surface temperature in those areas, on average, is around $15^0$C. In the ocean waters in mid and higher latitude regions the temperature is between $1^0$C and $0^0$C.
- The ocean currents flowing from the tropical regions toward higher latitude regions are warm currents; conversely, the ocean currents flowing from higher latitude regions toward tropical regions are cold currents. Another characteristics is that cold currents flow along the ocean bottom areas.
- The distribution pattern of warm and cold currents and their circulation exerts a considerable influence on the temperature, rainfall and general climatic conditions of the adjoining land masses.

**Mountain barriers**

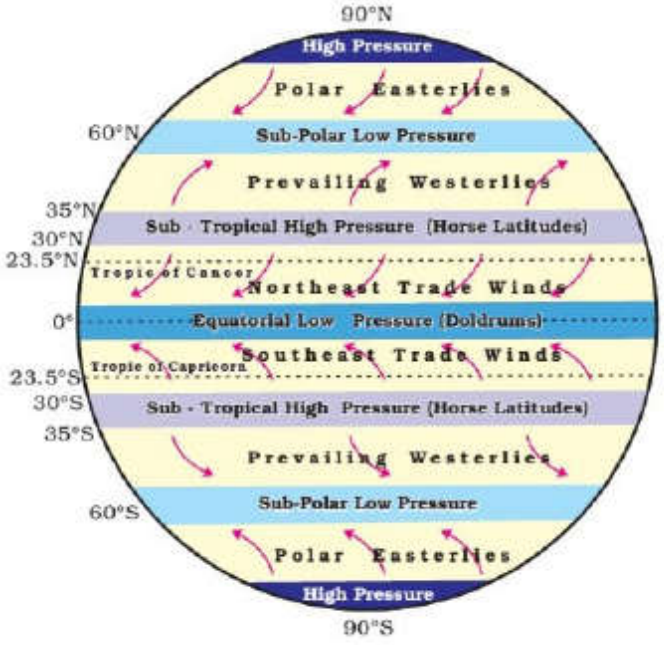
- Altitude and the location mountain ranges are of significance as factors controlling regional or local climates.
- In the troposphere, temperature declines with altitude.
- The air contained in the winds that rise along the mountains slopes condenses and brings rain to the windward side of the mountains. Thus mountains slope areas would receive rains although the foothill areas are rainless.
- In the northwestern region in Malaysia, western New Zealand, mountain areas in Assam, India, Rockies in North America and in Central highlands of Sri Lanka such rains could be discerned.
- The opposite side of the mountain that does not receives rain is known as the leeward side.

**The location of high pressure and low pressure systems**

- The circulation of winds over the Earth's surface occur according to a specific pattern. It is called the planetary wind circulation.
- It occurs due to the differences in the pattern of distribution of pressure belts.

**Global pressure belts**

- The equatorial low pressure belt is located in the region $5^0$ North and South of the Equator. Since the temperature in this region is high the air expands and rises in the form of convectional currents. This is a zone of converging winds.
- In the region around latitudes $30^0$ north and south, the Sub-tropical high pressure belts are located. In this area dry air prevails. It is an area of anti-cyclones with diverging winds.
- Around latitudes $60^0$ north and south, the temperate zone low pressure belt is located. It is an area of cyclone activity with converging winds.
- In the Northern and Southern Polar regions the polar high pressure belts are located.




*Major Pressure Belts and Wind System*

**Planetary wind circulation**

- Winds blow from high pressure belts to low pressure belts. The direction of the winds is affected by the Coriolis force or deflection force of the Earth's rotation.
- In the Northern Hemisphere winds blow with a deflection to the right (clockwise) and in the Southern Hemisphere the deflection is to the left (counter clockwise).

- Blowing of winds between pressure belts is a complex process. Many hypotheses
  have been introduced to explain it and the tri-cellular hypothesis is a widely accepted one.

- Atmospheric circulation could be divided into three segments.
  - Primary circulation (general circulation)
  - Secondary circulation
  - Tertiary circulation
- Primary circulation or general circulation means the wind pattern established between the pressure belts of the Earth. This includes trade winds, westerlies, and polar winds.
- Cyclones and anti-cyclones activity belongs to the secondary circulation.
- Both types of circulation mentioned above and other prevailing winds belong to the tertiary circulation. Monsoon winds, diurnal winds line land breezes and sea breezes, mountain and valley winds are examples.

**Inter-tropical Convergence Zone (ITCZ)**

- The air belt with the lowest pressure oscillating between $0^0$ – $20^0$in both northern and southern latitudes is known as the Inter-tropical Convergence Zone.
- In the summer of the Northern hemisphere (June-July), the ITCZ is located between $15^0$ – $20^0$ northern latitudes.
- During this period a high pressure system is established in the Indian Ocean region in the southern hemisphere between $15^0$ - $20^0$ latitudes. From this high pressure system wind blows into low pressure systems in the Northern Hemisphere.
- This is the South-west Monsoon that blow across Sri Lanka and India.
- In the summer of the Southern Hemisphere (Dec-Jan), the ITCZ is located between $15^0$ – $20^0$ south latitudes.
- During this period, winds blow from high pressure systems in the Northern Hemisphere to the Inter-tropical Convergence Zone located in the Southern Hemisphere.

## 6.4 Koppen's Climatic Classification

- Climatic classifications
  - The purpose of the climatic classification is the identification and naming of climatic conditions found in various regions in the world. One or more common criteria are used in this exercise.
  - The earliest attempt to classify climates has been made by the Greeks. They have done it on the basis of the differences in temperature found in various regions of the world. In these attempts they have not used temperature values but the sensitive temperature.
  - In 384 B, C. Aristotle, divided the Earth into three broad zones (Warm, Temperate and Cold) based on the temperature differences.
  - More recent attempts have been made by Strahler, US Air Force Aeronautical Service (1954), Austin Miller (1936/1948), Thornthwaite, Flohn, Oliver and Koppen.

- Koppen's climatic classification

  - Koppen, a climatologist and a plant scientist presented a concise classification in1918 initially to be reformulated in 1948. In 1953, it was again reformulated by Geiger.
  - This is the climatic classification used in almost all countries of the world even at present.

Criteria used in Koppen's climatic classification

- Koppen has identified five (5) major climatic types in the world. These major types have been divided into sub-climatic types. The average values of temperature and rainfall in the regions in question have been used as the basis. Major climatic types have been named as A, B, C, D and E. As mentioned above they have been classified into sub-types:

  A - Tropical Climates
  Mean temperature is above $18^0$C. No winter season. Annual rainfall is high and it exceeds the amount of annual evaporation. This type has been divided into three (3) sub-types.

  B - Potential evaporation is higher than the average rainfall. No water surplus.
  Average annual rainfall is less than 70mm. This type has been divided into four (4) sub-types.

C- Warm Temperate Climates
Temperature in the coldest month is less than $18^0$C but does not decrease beyond $-3^0$C. A clear summer season and a clear winter season can be seen.
This has been divided into eight (8) sub-types.

D- Cold Climates
Temperature in the coldest month is less than $-3^0$C. Winter season is long.
Land is covered with snow at least for few months. This type has been divided in to twelve (12) sub-types.

E - Polar Climates
No summer season. Temperature in the warmest month is less than $10^0$C.
This type has been divided into two (2) sub-types.

Only A climate and its sub-climates of the Koppen's classification are discussed in detail.

**Tropical Wet Climate (Af)**

- Distribution
  Amazon Basin
  Congo Basin
  East Indies Islands
  Western Colombia
  Eastern Madagascar
  Eastern Brazil
  Guinea

- Characteristics
  High temperature (over $18^0$C) distributed year-round
  No winter season
  No conspicuous Dry season
  Rainfall exceeds evaporation

  Main vegetation type is tropical rain forest (with tall trees with large trunks)

**Tropical Monsoon Climate (Am)**

- Distribution
  South west and coastal regions in India
  Wet Zone in Sri Lanka
  Western promontory in New Guinea
  Borneo Island of Indonesia
  Sierra Leone and Liberia in Africa

- Characteristics
  Main method of rainfall is Monsoons
  Heavy rainfall during the Monsoons
  Less rainfall in other months
  Year-round surplus of water; rainfall exceeds evaporation
  Uniform temperature over $18^0$C year-round
  Short dry season

**Tropical Wet and Dry Climate (tropical Savanna climate) (Aw)**

- Distribution
  Regions in Africa between $10^0 – 15^0$ in both Southern and Northern latitudes
  Deccan region in India
  Myanmar
  Thailand
  Northern coastal region of Australia
  North-western coast of Madagascar
  The Caribbean Islands

- Characteristics
  Dry winter season
  Rainfall is lesser than in Af and Am climate types
  However, rainfall is spread year-round; rainfall is less than 600mm
  Conspicuous dry and wet seasons
  Main vegetation type is tropical Savanna

**Competency :** **7.0 Explains the uniqueness of Sri Lanka's climate.**

**Competency Levels :**

7.1 Studies the nature of Sri Lanka's climate
7.2 Reviews the distribution of temperature in Sri Lanka and its determining factors
7.3 Studies the manner in which Sri Lanka receives its rainfall and its distribution
7.4 Explains the climatic zones of Sri Lanka

**Time periods** : Each competency level is given 3 time periods. The total number of time periods are 12.

**Learning Outcomes:**

- Provides comments whilst appreciating the uniqueness of the climate of Sri Lanka
- Explains the factors that influence the climate of Sri Lanka
- Explains the reasons for variations in the distribution of temperature in Sri Lanka
- Describes the manner in which Sri Lanka receives its rainfall
- Describes the seasonal pattern of rainfall in Sri Lanka
- Illustrates the distribution pattern of Rainfall in Sri Lanka with the help of a map
- Points out the basis of delimiting climatic zones of Sri Lanka
- Describes with examples the characteristics of the major climatic zones
- Illustrates the climatic zones of Sri Lanka with the help of a map

**Introduction :** Sri Lanka, being a small island located in close proximity to the equator possesses unique climatic conditions.

In this unit, it is expected to study the main characteristics of the climate of Sri Lanka, the factors determining those characteristics, climatic zones and their distribution and characteristics.

It is also expected to develop attitudes among students with a view to prepare them to appreciate the uniqueness of Sri Lanka’s climate.

**A guide to clarify the subject matter**

- Sri Lanka is an island with unique climatic characteristics
- The main factor that determines the unique climatic characteristics of Sri Lanka is its latitudinal location.
- Revolution of the Earth is the main reason for the temporal variations in climate of Sri Lanka
- The insular location and relief are the main reasons for spatial variations in the climate in Sri Lanka.

- **Factors affecting Sri Lanka's climate**

**Global factors**

- Latitudinal location
- Location in proximity to the equator (between $5^0$ -$10^0$ northern latitudes)
- Location in a region subject to the influence of the Inter Tropical Convergence Zone (ITCZ).
- In January ITCZ is located in the Southern Indian Ocean south of the Equator. In June it is located across northern Indian region.
- Due to the oscillation in the location of the ITCZ the wind pattern varies.

**Regional factors**

- Location in the northern Indian Ocean; Inward winds with water vapor
- Proximity to the Indian sub-Continent; influence of warm and dry winds
- Location in proximity to the Bay of Bengal; influence of low pressure belts

**Local Factors**

- Being an Island: influence of the ocean
- Distance from the sea to any location of the island is less than 120km
- Altitude: changes in temperature
- Relief: variability in rainfall due to the nature of location of Central highlands
- Influences of water surfaces, soil conditions and forest cover

- **Temperature and its Distribution**

- Although located close to the Equator there are variations in temperature
- The average annual temperature in lowland areas is around 27. $5^0$ C
- Temperature declines with altitude; In Nuwara Eliya of which the altitude is 1800m above sea level, the average annual temperature is around 15.9 $^0$C.
- Diurnal maximum temperature is found few hours after noon and the minimum occurs at dawn.
- Annual mean temperature ranges between $1^0$-$5^0$C.
- Areas around Nuwara Eliya experience hail about four to five days in a year. (See National Atlas of Sri Lanka, p.79).

- **Rainfall and its Distribution**

- Main rainfall receiving methods
  1. Monsoons (Southwest and Northeast)
  2. Convection (Inter-monsoon)
  3. Cyclones (Inter-monsoon)

- Monsoon rains
- Sri Lanka receives rainfall from two monsoons. They are named according to the direction from which they blow.
  1. Southwest Monsoon winds
  2. Northeast Monsoon winds

Southwest Monsoon winds
- From May to September
- Due to the oscillation of ITCZ to the north of Sri Lanka winds blow from the southwest.
- Winds blowing over the Indian Ocean carry a large amount of water vapor
- Owing to the relief features western slopes of the central highlands receive a large amount of rainfall. Eastern side of the mountains gets less rainfall
- Floods and landslides are frequent

Northeast Monsoon winds
- From December to February
- Due to the oscillation of ITCZ to the south of Sri Lanka between south latitudes $5^0 – 10^0$ winds blow from the north east
- Winds blowing over a huge land mass carry a less amount of water vapor. Low rainfall
- Northern and Eastern parts of the island receive rainfall; northeastern regions of the mountains receive high rainfall (e.g. Knuckles region)

Convectional rains
- A large amount of water vapor owing to its location in proximity to the equator and to a huge ocean surface brings year round convectional rains to Sri Lanka

- The effects of convectional rains are submerged during the monsoons and cyclones, but in the months of March and April the effects are clearly seen.

- Clear skies in the mornings, cloudy afternoons and storms and lightning in the evenings are main characteristics
- At night sky is clear
- Mountain slopes receive high rainfall; coastal areas receives less rainfall.

Cyclone rains

- Effects of cyclones is much higher in the months of November and December.
- Low depressions can develop into cyclones.
- Low depressions originate in the Bay of Bengal blow across the island in the Northwest direction.
- North and Eastern regions of the island are mostly affected.
- Rains could be disastrous as cyclone gets stronger. Disasters like floods, Landslides, damages to properties could occur.

Rainfall statistics

- The mean value of the annual rainfall in Sri Lanka is 1861mm. It ranges from 900mm in the dry regions to over 5000mm in the wet regions.
- Maximum rainfall values for certain locations in the western slopes of the central highlands are given below:

  Yatiyantota: 5259 mm
  Watawala: 5021 mm
  Maliboda: 5330 mm

Rainfall in upland area is relatively low. E.G., Nuwara Eliya: 1905 mm
Towards coastal areas rainfall declines slightly. Colombo: 2423 mm
Rainfall in the eastern slopes of the mountains is relatively low. Badulla: 1762mm

Knuckles: over 3000 mm
Rainfall in arid areas is less than 1000 mm. Yala: 927 mm; Mannar 963 mm

Seasonal Rainfall Statistics

| Period | Method | Values |
|---|---|---|
| March-April | First Inter-Monsoon | 268 mm |
| May – September | Southwest Monsoon | 556 mm |
| October – November | Second Inter-Monsoon | 558 mm |
| December - February | Northeast Monsoon | 479 mm |

Climatic Zones

Sri Lanka could be divided into five climatic zones based on temperature and rainfall.

1. Lowland Wet Zone
2. Lowland Dry Zone
3. Highland Wet Zone
4. Highland Dry Zone
5. Semi-Arid Zone

1. Lowland Wet Zone
   - Average annual temperature is around $27^0$ C
   - Year-round bright sun shine
   - Average annual rainfall is over 2000 mm
   - Heavy rainfalls during the Southwest Monsoon
   - Availability of a rainfall surplus
   - Rainfall is spread year round
   - Favorable climatic conditions for plant growth

2. Lowland Dry Zone
   - Average annual temperature is around $30^0$ C. However, North and Eastern regions experience higher temperatures.
   - Bright sun shine
   - Average annual rainfall is between 125- - 2000 mm.
   - Northeast Monsoon and cyclones bring rains
   - May to September is a dry season
   - Trees able to resist dry season
   - From the earliest times large reservoirs have been built to store water

3. Highland Wet Zone
   - Low temperatures than in the lowlands
     E.g.; Kandy: just over $20^0$ C
     Hatton: less than $20^0$C
     Nuwara Eliya: around $15.9^0$ C
   - Rainfall is spread year round
   - Average annual rainfall is around 3000 mm
   - Southwest Monsoons and Convections bring heavy rainfall
   - Evergreen rain forests can be seen e.g. Sinharaja forest
   - Area is vulnerable to floods and landslides

4. Highland Dry Zone
   - Due to altitude temperatures are less than in the lowland dry zone regions
   - Average annual rainfall is between 1500 – 2000 mm. In the highlands like the Knuckles rainfall is around 3000mm.
   - More rainfall is received during the Northeast monsoon.
   - Dry weather prevails during much of the year due to its leeward location

5. Semi-Arid Zone
   - Average annual rainfall is less than 1250 mm.
   - Temperature is slightly higher than in other areas of the island.
   - A longer drought period prevails.
   - Aridity occurs due to high temperatures and cloudless skies

- Uniqueness of Sri Lanka's climate
  - Favorable climate to sustain life of people, animals and plants
  - Variation in climate in spite of the small size of the country – existence of wet, dry, temperate semi-arid climates, absence of extreme climatic conditions
  - No extra cost has to be borne due to the absence of extreme climatic conditions
  - Diversity in human activities according to climatic conditions

**Teaching Learning activities**

- Preparation of a report on the climatic zone to which your school belongs

  Prepare the report according to the following sub-topics
  - Location of the zone and introduction
  - Temperature and its variability
  - Rainfall receiving methods
  - Distribution of rainfall
  - Uniqueness in climate

  (Allow to use maps, diagrams and data to prove information presented)
- This could be done either as an individual activity or group activity.
- Prepare a few assessment criteria based on learning outcomes.
- Evaluate student activities according to those criteria.
- Allow them to present activities of high standard.

**Sources**

Department of Surveys, National Atlas of Sri Lanka, Volume 1.
www.meteo.gov.lk Department of Meteorology

**Competency : 1.0 While understanding the nature of Human Geography explains the meaning of human landscape**

**Competency Levels :**

1.1 Explains the scope of Human Geography

1.2 Examines the spatial diversity of human landscape

1.3 Examines the temporal changes in human landscape

**Periods :** 04

**Learning Outcomes :**

- Describes concisely the scope of human geography
- Explains variations in human landscape
- Explains how human activities result in spatial variations in the human landscape
- Explains temporal changes in human landscape

**Introduction :** In human geography the landscape created by man and his activities is studied. Special attention will be paid on the spatial distribution and diversity of that landscape in that study. In the past, the human landscape was simple, but it is very complex today.

By studying this unit it will be possible to gain an understanding of the field of human geography, how human activities have been responsible for the diversity in human landscape, and the temporal changes that have been occurred in human landscape. It is important to direct the teaching learning process emphasizing the above mentioned concepts with examples.

**A guide to clarify the subject matter:**

1.1 Field of Human Geography

- Human geography is the geographical explanation of human activities.

"Geography is the study of the relationship between man and environment".

**Carl Ritter and Alexander Von Humboldt**

"Geography is the study areal differentiation of the Earth".

**Richard Hartshorne**

- It is possible to delimit the boundaries of geography with the help of above age-old definitions that indicate the nature of geography. According to the first definition, it is possible to identify the following fields:

  - How environment affects man?
  - How environment is changed by man?
  - What are the consequences of the interaction of man and environment?

- According to the second definition it is clear that the physical environment, the human environment and human activities vary from place to place. Accordingly following questions could be raised:

  - What are the geographical patterns emerging from spatial variations?
  - What are the factors responsible for those patterns?
  - How those patterns have distributed over the Earth's surface?
  - What are the effects of those patterns?

- According to the above two definitions human geography is the "study of the spatial variation of human activities created by the interaction of man-environment relationships."

- Today, the scope of human geography has widened, and many areas such as human population, economic activities, social relationships, cultural and political activities and globalization are studied.

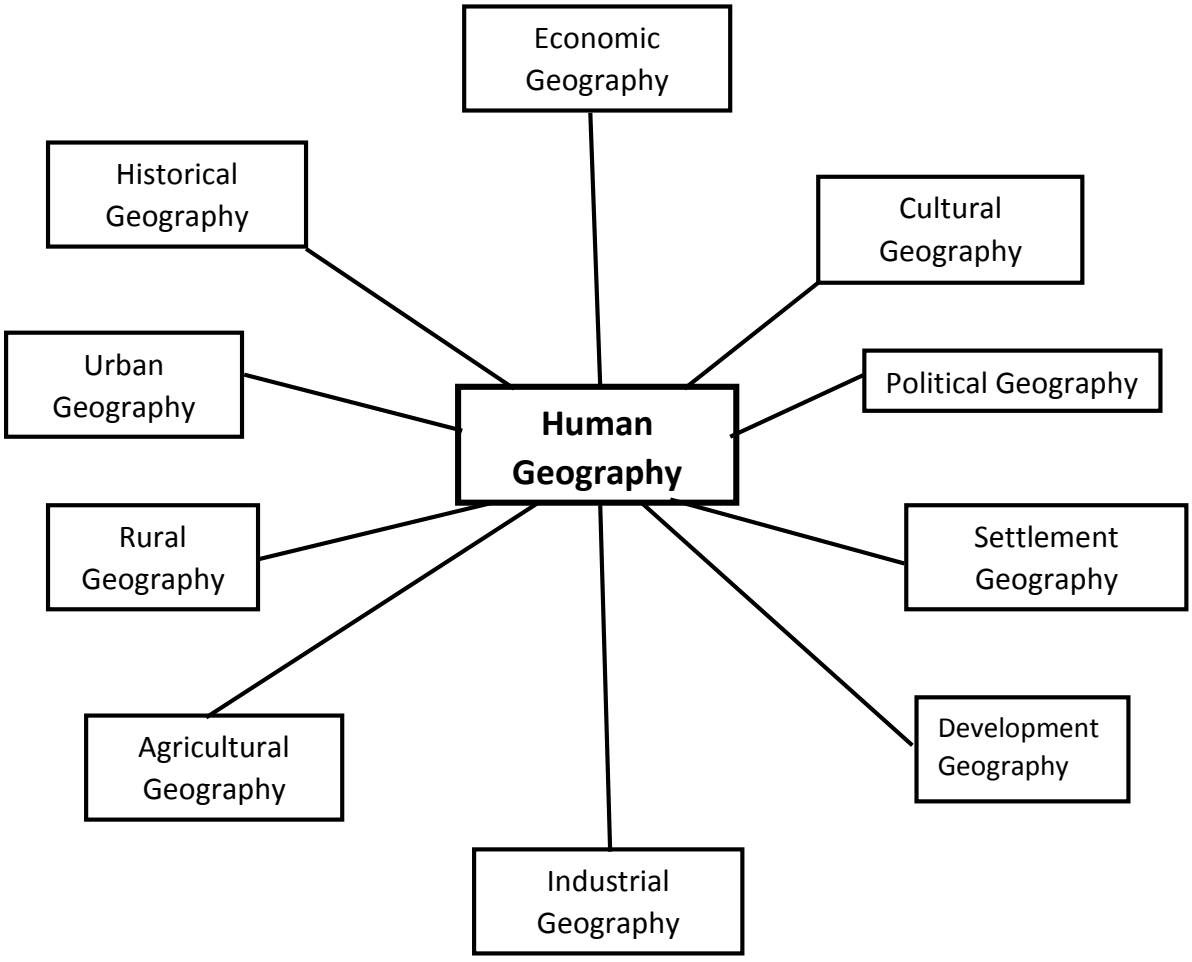
- The totality of the changes made by the man on the earth's surface is called "human landscape". It includes settlements, urbanization, industrialization, transportation, infrastructure facilities, and agricultural systems etc.

- Human landscape varies spatially.

- These spatial variations are effected by the physical environment and human decisions.

- It is the objective of human geography to study the spatial distribution and diversity of human landscapes thus created.

- In recent times, human geography has paid attention to the impact of human activities on the environment also. This has led to emphasize environmental management and sustainable development.




- The scope of human geography is expanding and sub-branches are being added continuously. For example, economic geography is rapidly expanding and one sub-branch of it is marketing geography.

**Suggested Learning activities:**

- Explaining the scope of geography with the help of definitions.
- Preparation of a handout depicting the field of human geography.

## 1.2 Diversity in Human landscape

- Changes in physical landscape due to human activities.
- Spatial variation in human landscape due to the diversity in physical landscape and the possibility of identifying of various patterns in it.
- For example, in rural areas more land is devoted to agriculture and dispersed settlements could be seen. In urban areas, more industrial and service activities are distributed and a high population density could be found. As such, a difference could be observed in rural and urban landscapes.
- The following images depict the land use pattern in rural areas and the spatial variation in settlements in urban and other areas. Various patterns and processes could be identified.

Distribution of Land use inRural Areas

Distribution Settlements in Urban Areas

Desert Settlements

- Emergence of landscapes based on physical resources

  The distribution of coal fields in the United States has determined the distribution of iron and steel industry.

- A spatial variation could be discerned in the human landscape of Sri Lanka, too. For example, plantations and vegetable cultivation in the central highlands, paddy cultivation in the dry zone and commercial, industrial and service activities in the southwestern lowland areas show the spatial variation in human activities.

Dry Zone landscape

Coastal areas

Colombo city

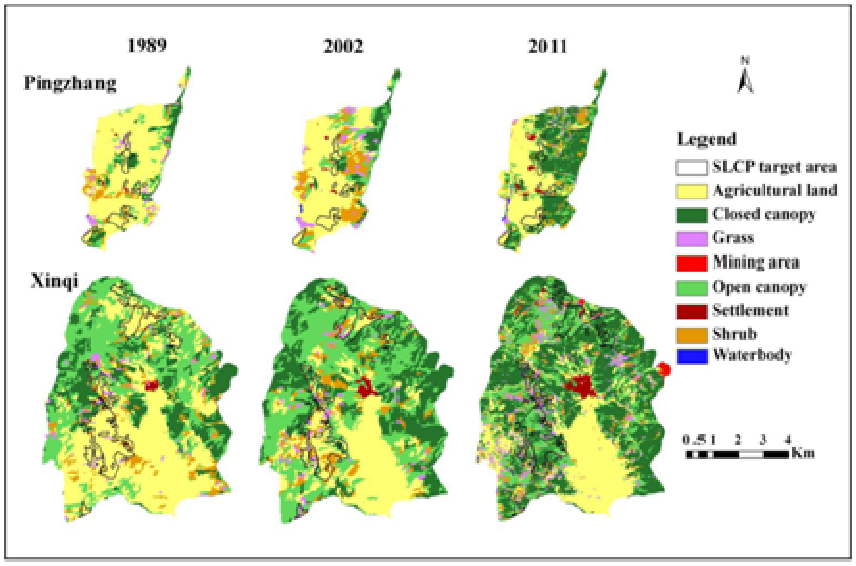
Tea Estate in the highlands

- Through the study of spatial variation in human activities various patterns and processes could be discerned.
- As such, spatial variation in human activities could be identified in every region in the world and physical landscape has been responsible for it.

## 1.3 Temporal changes in human landscape.

- Increase in the utilization of resources in the physical environment with increasing complexity in human needs
- Increase in the utilization of land, soil, water, minerals and other resources
- Continuously changing human activities in time and space
- The land use maps shown below display the temporal change in human landscape

Example: The temporal change in land use patterns in two cities in Southern China.




### Learning Activities

- Make a file containing information on the temporal change in physical and human landscape in different parts of the world with the help of photos, figures, and maps.
- Explain how land use and human landscape have changed in Sri Lanka with the aid of maps, figures and photos.
- Present how the environment has changed in your area or around the school during the period of last 20 to 30 years using sketch maps.

**Competency :** **2.0 Reviews the characteristics of population and acts with an understanding of the importance of minimizing population problems**

**Competency Levels :**

2.1 Indicates the characteristics, recent trends and problems of world Population

2.2 Analyzes the factors that contribute to world population dynamics

2.3 Explains the characteristics, trends and problems of Sri Lanka's Population

2.4 Examines the dynamics of population of Sri Lanka

**Periods :** 48

**Learning Outcomes:**

- Describes the characteristics of the world population
- Explains with the help of data the size and growth of world population
- Describes with the help of a map the distribution of world population
- Explains the composition of world population
- Examines issues relating to world population
- Explains population dynamics
- Describes world birth and death rates and their trends
- Describes world Migration and its trends
- Describes with the help of data the size and growth of Sri Lanka's population
- Analyses the population of Sri Lanka with the help of maps
- Explains the basic characteristics of Sri Lanka's population
- Explains the population trends in Sri Lanka
- Discusses the population problems of Sri Lanka
- Discusses the trends associated with birth and death rates of Sri Lanka
- Describes trends in population migration in Sri Lanka

**Introduction :** Population, is an important topic in geography. The main reason is that human activities have been a major factor in the creation of the world's landscape.

As such the students of geography should gain an understanding about the basic concepts of population. It is expected from this unit to impart knowledge on the basic concepts such as size, distribution, composition and growth of population and to develop humane attitudes toward population.

**A guide to clarify the subject matter:**

- Introduction to World Population
  - Population could be defined as the number of people living in a given geographical unit (world, continent, country, district or city) at a given time. As such the number of people in the world as a whole at a given time is called world population.

    Example: World population in 2015.

- Size of population

  The enumerated number of people in a given geographical unit at a given time is the size of population.

- Growth of population

  A population could increase or decrease. Nevertheless, the world population to date has been increasing. Population increases when the number of births exceeds the number of deaths.

  When historical data on population are examined, two major stages of world population could be discerned.

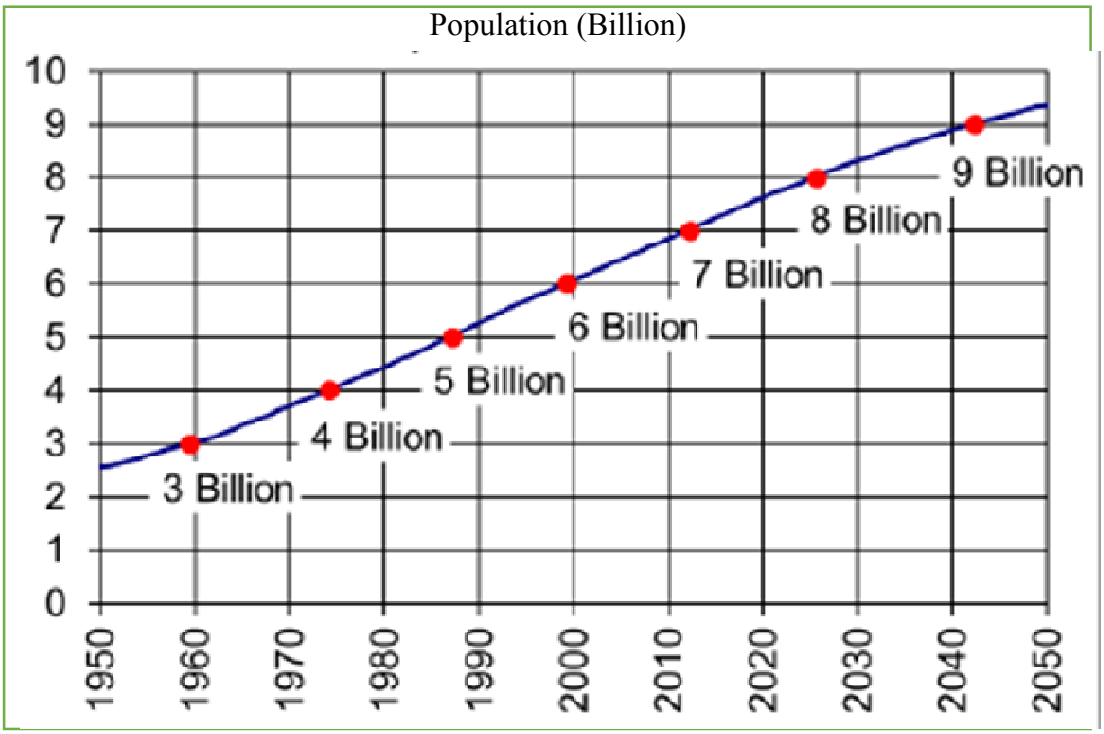
  1. Stage of slow growth over a long period of time (from the beginnings of mankind to 1750 AD)
  2. Stage of rapid growth over a short period of time (from 1750AD to date)

Table 2.1.1
Temporal growth of World Population

| Stage/Year | Time elapsed | Population |
|---|---|---|
| Slow growth (beginnings to 1750AD | | Approximately 500 million |
| Rapid growth | | |
| 1800 | | 1 billion |
| 1927 | 123 | 2 |
| 1959 | 32 | 3 |
| 1974 | 15 | 4 |
| 1987 | 13 | 5 |
| 1989 | 12 | 6 |
| 2011 | 12 | 7 |

The above table and the graph show how population increased billion by billion and the time elapsed to add another billion.

Fig. 2.1.1
Growth of World Population




Source: United Nations Population Reports, 2016

- In 1800 AD world's population was 1 billion. It has increased to 7 billion by the latter part of 2011.
- The discernible factor in this growth is the gradual shortening of the time taken to add another billion.
- It took 123 years to increase from one billion to two billion but to add the third it took only 32 years.
- Another characteristic in world population growth has been the rapid growth of population in the developing world since the 1950s.
- After the 5$^{th}$ billion mark it seems the time taken to add more billions has been decreasing.

Table 2.1.3
World Population Data, 2015

| Population | | World | More Developed Countries | Less Developed Countries |
|---|---|---|---|---|
| Births | per year | 145,973,000 | 13,760,000 | 132,213,000 |
| | per day | 399,926 | 37,700 | 362,226 |
| | per minute | 278 | 26 | 252 |
| Deaths | per year | 57,052,000 | 12,283,000 | 44,769,000 |
| | per day | 156,306 | 33,652 | 122,654 |
| | per minute | 109 | 23 | 86 |
| Natural Increase | per year | 88,921,000 | 1,477,000 | 87,444,000 |
| | per day | 243,620 | 4,047 | 239,573 |
| | per minute | 169 | 3 | 166 |
| Infant deaths | per year | 5,351,000 | 73,000 | 5,278,000 |
| | per day | 14,660 | 201 | 14,459 |
| | per minute | 10 | 0.1 | 10 |
| Population | | 7,336,435,000 | 1,254,199,000 | 6,082,235,000 |

Source: United Nations, World Population Report, 2015

- Distribution of World Population
  - World population has distributed unevenly.
  - Distribution of population could be identified at three levels:
    - Global distribution
    - Distribution by continents
    - Distribution by countries
  - At global level following regions could be identified:
    - High density regions
    - Sparsely populated regions
    - Moderately distributed regions
  - There are four population concentrations in the world:
    - East Asia
    - South Asia
    - South east Asia
    - Europe

    (Until recent times Northeastern America has been a major population concentration but other regions have rapidly grown surpassing the growth of American region).

  - Population Distribution by continents/Regions (as % of World population)
    - Asia 60.3
    - Africa 14.5
    - Europe 11.4
    - North America 7.6

- South America 5.6
- Oceania 0.6

Table 2.1.4
Most populated countries of the World 2015 and 2050 (projected)

| Country 2015 | Population (million) | 2050 country | Population (million) |
|---|---|---|---|
| China | 1,372 | India | 1,660 |
| India | 1,314 | China | 1,366 |
| USA | 321 | USA | 398 |
| Indonesia | 256 | Nigeria | 397 |
| Brazil | 205 | Indonesia | 366 |
| Pakistan | 199 | Pakistan | 344 |
| Nigeria | 182 | Brazil | 226 |
| Bangladesh | 160 | Bangladesh | 202 |
| Russia | 144 | Republic of Congo | 194 |
| Mexico | 127 | Ethiopia | 165 |

Source: *www.wickipedia.org*

- Factors affecting population distribution

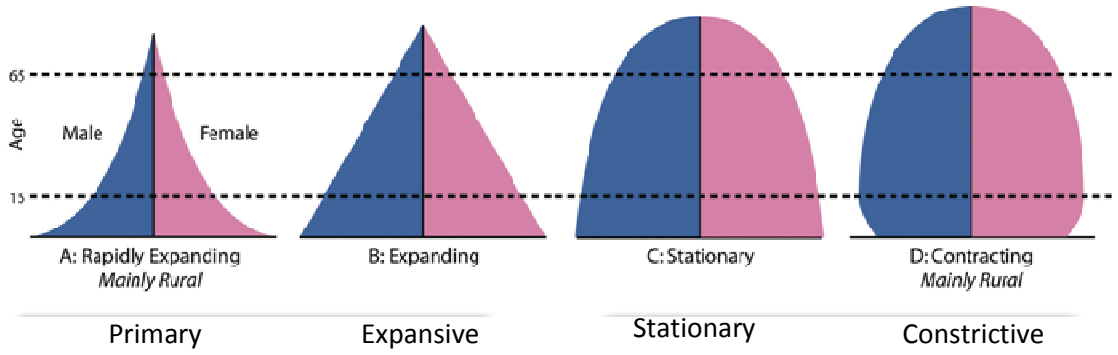
  Physical factors - climate, relief, water resources, soil, natural resources, natural vegetation

  Human factors - transportation, trade, urbanization, communication, political factors

- Structure of Population

  - The major components of the structure of population are age and sex.
  - According to data published by the United Nations, of the world population, 50.4 per cent are males and 49.6 per cent are females.
  - In the study of the structure of population age structure is very important.
  - It is possible to obtain a broad knowledge on the structure of population of a country by depicting its age and sex distribution by means of a graph. These graphs are commonly known as population pyramids.
  - Population pyramids are also known as age pyramids or age picture diagrams.
  - A clear picture of the population structure by age groups could be obtained from the pyramids.

- It is possible to arrive at conclusions on the trends and make predictions on the population by studying the shape of the age pyramid.
- The age pyramids of the countries of the world take various shapes according to the trends in population.
- According to trends in birth and death rates four types of age pyramids can be identified.




Different types of Age Pyramids

1 Primary stage: expanding/increasing

Birth rate is at a high level. Since death rate is also high the upper parts of the age pyramid is narrow. Life expectancy is at a low level.

2 Expansive stage

Birth rate is at a high level. The declining death rate of the middle parts of the age structure and a moderate increase in life expectancy result in an expanding age structure.

3 Stationary Stage

Declining birth and death rates, high level of life expectancy and a slightly higher proportion of people in older age groups are the major characteristics of this stage.

4. Constrictive Stage

The declining birth and death rates and rising life expectancy result in this type of age pyramid.

**Population Composition**

Classifying a population according to nationality, ethnicity, religion, and language could be termed as population composition.

- According to the race, humans are classified as Caucasoid, Mongoloid and Negroid.

- There are a large number of ethnic groups in the world. Many ethnic groups can be seen even within a single country.
- Population composition could be described by religions such as Christian, Islamic, Hindu and Buddhist.
- A linguistic composition could be identified as Chinese, English, Japanese and German etc.
- The composition of population could also be described in terms of economic activities such as agricultural, industrial rural or urban.

**Issues related to population composition**

- Population ageing
    - Ageing means the gradual increase in the proportion of people in the older age groups.
    - Population ageing has become a challenge faced by many countries of the world
    - Low levels of birth and death rates and increasing life expectancy of the population have resulted in ageing
    - According to the reports published by the Population Division of the United Nations the threshold age of ageing is 60 years.
    - In 2009, around 11 per cent of the world population was above 60 years of age.
    - Ageing Index is a measure that shows the level of ageing of a population.

      It is the number of persons aged 60 years and above as a percentage of the number of persons below 15 years of age.
    - In 1950, the index was 24 per cent and by 2000 it had increased to 33 percent. It is expected that this will be 101 per cent by the year 2050.
    - At present, the ageing index of the developed countries shows a higher value, but in the future the increase will be rapid in the developing countries.
    - Ageing is a demographic phenomenon. However, it affects the economy and the society of a country.
    - The elderly people of a country incline more toward consumption than production and also a group that has left the labor force. As such an increase in the aged population escalates the government expenditure.

- Disability

  - Disability is also an issue related to population.
  - It can be physiological or mental.
  - This group of population also are citizens with equal rights.
  - It is the duty of the government to take care of this group of citizens.
  - It is of importance to take caution not to offend them.
  - At present, sports activities like Olympic have been organized for them. they have been provided with education facilities also.

- **Gender issues**
  - Gender issues mean the anomalies that exist in a society between males and females.
  - The specific problems encountered by women in functioning in the society compared to that of men could be seen even today.
  - Women encountered these problems especially in confirming to the social norms of some religions and tribes.
  - However, enforcing such conservative restrictions on women are disappearing from the society.

A few problems related to gender are stated below:

- According to the data published by the World Health Organization, around 585,000 women die per year (more than one woman per minute) due to preventable complications associated with pregnancy, parturition, and abortion.
- The number of women in the age group 15-44 die due to violence is more than the number of women in that age group die due to cancer, malaria, and road accidents.

A large number of female children die due to practices like Female Genital Mutilation (FGM) espoused by some religions and cultures.

  - What was mentioned above provide information only on women who die due to gender discriminations.
  - In addition, the number of women who are the victims of social discrimination is very large.

- **Poverty**
  - Poverty means financial or material scarcity.
  - It is a complex concept associated with social, economic and political differences**.**

- Absolute poverty is the non-availability of basic human needs like food, clothing and shelter.
- This situation could especially be seen in developing countries.
- A major challenge faced by many international organizations like the United Nations and World Bank is how to reduce poverty.
- According to World Bank data, in 2015, the number of persons in poverty was 702.1 million.
- Of them, 347.1 million belonged to the African countries south of Sahara (Sub-Saharan Africa). It was 35.2 % of their total population. Another 231.3 million were in the countries of South Asia.
- According to UNICEF estimates exactly one half of the child population of the world or 1.1 billion are in poverty.
- According to the World Bank definition the International Poverty Line is:

  2008 : $1.25 per day
  2015 : $1.90 per day

- **Food Security**
  - Food security is a concept accepted at international level at present.
  - According to the definition accepted at the 1996 World Food Summit, food security is,

    "The accessibility to a sufficient amount of safe and nutritious food needed to maintain an active and healthy life at all times".

  - In order to secure food needs people should have the physical and economic capabilities.
  - Food security of a household is the accessibility for food needed to maintain a healthy and active life for all members of that household at all times.
  - Food security depends on the following three factors:

| | |
|---|---|
| Food Stability | Food stability refers to the ability to obtain food over time |
| Food Accessibility | Food access refers to the affordability and allocation of food, as well as the preferences of individuals and households. |
| Food Availability | Food availability relates to the supply of food through production, distribution, and exchange |

- **Displacement**

  Forced movement of people from their home or usual habitat involuntarily due to various reasons
  - Major factors inducing displacement
    - Natural disasters
    - Conflicts

  - Displacement occurs internally or internationally
  - Displacement leads to a number of social and economic problems

## 2.2 Factors affecting the dynamism in world population

- The continuous changes taking place in a population could be termed as dynamism in population
- The factors contributing to population dynamics could be understood from the following simple equation.

$$P = B - D \pm M$$

Where,

P = Population

B = Births

D = Deaths

M = Migration

- According the above equation, in calculating the size of population of a country the number of deaths should be deducted from the number of births and then migration gain or loss should be added.

- Due to dynamism in population changes take place in the following:
  - Population size and growth
  - Population distribution
  - Population composition and
  - Population structure

The main result of population dynamics is the change in population size.

- Three major factors contributes to the change in population size.
  - Births
  - Deaths, and
  - Migration

- The change taking place in population due to births and deaths rates is known as the natural increase in population.
- When birth rate of a population exceeds the death rate population tends to increase.
- Births and death rates are a phenomenon that vary in space and time.
- When the change in migration is added to natural increase in population it is called growth of population.
- Migration does not affect the change in world population as a whole.

- Births: (Differences between developed and developing countries)

  - The measurement that shows the number of births in relation to the mid-year population is called Crude Birth Rate
  - Crude birth rate is the number of live births in a specific year per thousand of the mid-year population in that year
  - At present, the crude birth rate in the developed countries is at a low level while developing countries having a higher crude birth rate

Table 2.2.1 - Crude Birth Rate (per 1000) – 2014

| Developed Countries | |
|---|---|
| Japan | 8.1 |
| Singapore | 8.1 |
| South Korea | 8.3 |
| UK | 12.2 |
| USA | 13.4 |

| Developing Countries | |
|---|---|
| Niger | 46.1 |
| Mali | 45.3 |
| Uganda | 44.2 |
| Zambia | 42.3 |
| Burkina Faso | 42.4 |
| Pakistan | 23.2 |
| Bangladesh | 21.6 |
| India | 19.9 |

Source: www.indexmundi.com

- **Deaths: (** Differences between developed and developing countries)

  - The measurement that shows the number of deaths in relation to the mid-year population is called Crude Death Rate.

  - Crude death rate is the number of deaths in a specific year per thousand of the mid-year population in that year

  - The difference in death rates between developed and developing countries are not that clear

Table 2.2.2 Crude Death Rate (per 1000) 2014

| Country | CDR | Country | CDR |
|---|---|---|---|
| South Africa | 17.5 | Qatar | 1.5 |
| Ukraine | 15.7 | Kuwait | 2.2 |
| Lesotho | 14.9 | Sri Lanka | 6.1 |
| Somalia | 13.9 | Malaysia | 5.0 |
| China | 7.4 | New Zealand | 7.3 |
| USA | 8.2 | India | 7.4 |
| Denmark | 9.0 | | |
| France | 8.0 | | |
| Ireland | 6.0 | | |

Source: www.indexmundi.com

- The natural increase in population of country is determined by the difference between crude birth rate and crude death rate.

Table 2.2.3 Natural Increase in Population

| Country | NI | Country | NI |
|---|---|---|---|
| Lebanon | 9.4 | Bangladesh | 1.6 |
| Zimbabwe | 4.4 | Austria | 0.8 |
| Jordan | 3.9 | Denmark | 0.02 |
| Qatar | 3.6 | China | 0.44 |
| Bulgaria | -0.83 | Sri Lanka | 0.86 |
| Ukraine | -0.64 | USA | 0.77 |
| South Africa | 0.48 | | |

Source: www.indexmundi.com

- **Migration**

  According to the definition given by the United Nations migration means the movement of people that takes place between geographical units resulting in a change in the usual residence.

  - There are two types of migrations, i.e., internal and international.
    - Internal migration
      - The movement of people between regional units within a country is called internal migration.

- Internal migration takes place mainly due to employment, education, health, industrial location, infrastructure, and relocation.
- Internal migration does not affect the size of population of the country.

• International migration

- Population movement between the countries of the world is called international migration
- International migration takes place due to various reasons:

1. For permanent residence in another country
2. For temporary employment
3. For political protection/refugees
4. Education

Factors affecting migration

- Push factors
- Pull factors

Push Factors:

- Factors inducing people to leave a place, e.g. war situations, environmental factors (disasters) and lack of employment opportunities

Pull Factors

- Factors that attract people to a place, e.g. freedom, employment opportunities, developed infrastructure facilities, favorable climate etc.

Types of migration

Immigration: arrival of people from another country to settle down

Emigration: leaving a country

Refugees

People who leave the country due to ill-treatment because of nationality, religion, ethnicity, politics, and environmental disasters

Displaced Persons (DP)

People who have lost their mother country due to political, ethnic, religious problems and environmental disasters

Migration Stream

People who are leaving a region or a country as a group, e.g. people who go to Middle East for employment

Issues and Problems associated with migration

- Positive as well as negative features could be seen in migration
- They are common to countries of origin, countries of destination and migrants.

- Countries of origin

  - Positive effects
    - A solution to the problem of over-population
    - A solution to unemployment
    - Foreign exchange could be earned
    - Helps diffusing attitudes and skills favorable to development
  - Negative effects
    - Brain drain
    - Labor drain
    - Family problems

    - Countries of Destination

  - Positive effects
    - Job vacancies could be filled
    - Economic growth could be sustained
    - Migrants could be utilized for the care of elderly people
    - Country could earn an income since migrant workers also pay taxes
    - Migrants bring new technologies and skills
    - Results in cultural diversity
    - Young labor could be brought into the country without spending on their education and health

  - Negative effects
    - Since migrant workers offer their labor at reduced salaries local workers would find it difficult to find jobs
    - Demand and pressure on public services might increase due to increase in population
    - The assimilation of migrants into the society is problematic
    - Confrontations with local people
    - Increase in crime and anti-social activities
    - Illegal migration might increase

## 2.3 Population of Sri Lanka: Characteristics, Trends and Problems

Population of Sri Lanka

- Population is the most valuable resource of Sri Lanka
- In 2016, the population of Sri Lanka was 20,864,666
- Of the total 10,2934,284 were males and 10,570,383 were females (United Nations Department of Economic and Social Affairs)

Population Growth

Table 2.3.1 - Growth of Population in Sri Lanka

| Census Year | Population (000') | Average Annual Rate of Growth |
|---|---|---|
| 1871 | 2,400.4 | |
| 1881 | 2,759.8 | 1.4 |
| 1891 | 3,007.8 | 0.9 |
| 1901 | 3,566.0 | 1.7 |
| 1911 | 4,106.4 | 1.4 |
| 1921 | 4,497.9 | 0.9 |
| 1931 | 5,306.9 | 1.7 |
| 1946 | 6,657.3 | 1.5 |
| 1953 | 8,097.9 | 2.8 |
| 1963 | 10,582.0 | 2.6 |
| 1971 | 12,689.9 | 2.2 |
| 1981 | 14,846.8 | 1.7 |
| 2001 | 18,797.3 | 1.2 |
| 2012 | 20,359.4 | 0.7 |

Source: Department of Census and Statistics, Statistical Abstract, 2014

- The growth of population in Sri Lanka could be described with the help of above table.
- During the period between 1871 and 1946 population increased at a slower rate.
- Between 1946 and 1971 it grew at a faster rate and then increases at a slower rate.
- Although the rate of growth of population is low population continues to grow.
- The spatial distribution of population growth in Sri Lanka indicates that the rate of growth of population in dry zone districts is higher than that of the wet zone districts.

Table 2.3.2 Spatial Distribution of Population Growth in Sri Lanka – 2011

| District | Average Annual Rate of Growth |
|---|---|
| Anuradhapura | 1.33 |
| Hambantota | 1.17 |
| Moneragala | 1.15 |
| Polonnaruwa | 1.11 |
| Kurunegala | 0.93 |
| Ampara | 0.81 |
| Puttalam | 0.66 |
| Kalutara | 1.23 |
| Gampaha | 1.02 |
| Nuwara Eliya | 0.05 |
| Badulla | 0.39 |

Source: Department of Census and Statistics, Statistical Abstract, 2011

- The rate of population growth in the Western Province districts of Kalutara and Gampaha has been due to the migration of people in search of employment and residence from other districts.

**Distribution and density of population**

- Distribution of population in Sri Lanka is uneven.
- Of the total extent of land of Sri Lanka 65 per cent belongs to the Dry Zone and 35 per cent to the Wet Zone. In contrast, 65 per cent of the population is in Wet Zone and 35 per cent is in the Dry Zone.
- Of the total population of Sri Lanka, 5.8 million or 28 per cent lives in the Western Province. The least populated province in Sri Lanka with 1 million people or 5.2 per cent of the total population is Northern Province.
- The population in each of the of the Western Province districts of Colombo and Gampaha surpass two million and the total population of these two districts is 22.6 per cent of the island's total.
- Kurunegala, Kandy, Kalutara, Ratnapura and Galle are the districts with more than one million people.
- The least populated district was Mulativu with 93,000 people.
  (Sea page 95 of the National Atlas, School Edition 2015 for distribution of population in Sri Lanka.)

The Table below shows the size and density of population by districts in Sri Lanka.

Table 2.3.3 Size and Density of Population at District Level (a) (b) - 2013

| District | 2012 | | 2013 | |
|---|---|---|---|---|
| | Population size (000') | Density of population | Population size | Density of population |
| Colombo | 2,316 | 3,425 | 2,326 | 3,441 |
| Gampaha | 2,300 | 1,715 | 2,313 | 1,725 |
| Kalutara | 1,220 | 774 | 1,227 | 779 |
| Kandy | 1,375 | 717 | 1,384 | 722 |
| Matale | 484 | 248 | 489 | 251 |
| Nuwara Eliya | 710 | 416 | 719 | 421 |
| Galle | 1,061 | 656 | 1,068 | 660 |
| Matara | 812 | 639 | 819 | 645 |
| Hambantota | 599 | 240 | 606 | 243 |
| Jaffna | 585 | 629 | 589 | 634 |
| Mannar | 100 | 53 | 101 | 54 |
| Vavuniya | 172 | 92 | 174 | 93 |
| Mullativu | 92 | 38 | 93 | 39 |
| Kilinochchi | 114 | 94 | 116 | 96 |
| Batticaloa | 527 | 202 | 529 | 203 |
| Ampara | 651 | 154 | 658 | 156 |
| Trincomalee | 380 | 150 | 384 | 152 |
| Kurunegala | 1,616 | 349 | 1,624 | 351 |
| Puttalam | 763 | 265 | 769 | 267 |
| Anuradhapura | 859 | 129 | 868 | 130 |
| Polonnaruwa | 404 | 131 | 408 | 133 |
| Badulla | 815 | 288 | 822 | 291 |
| Moneragala | 450 | 82 | 456 | 83 |
| Ratnapura | 1,086 | 336 | 1,097 | 339 |
| Kegalle | 839 | 498 | 844 | 501 |
| Total | 20,328 | 324 | 20,483 | 327 |

Source: Registrar General's Department

(a) Provisional

(b) The natural increase in population and net migration figures given in the Census of Population and Housing, 2012, have been based in the estimation of mid-year population.

Note: These calculations do not include the changes being taken place at district level due to the relocation of people in Northern and Eastern Provinces after 20th March, 2012.

- Factors responsible for uneven distribution of population

  Climate, Natural resources, Infrastructure facilities, Water supply, Soil, Relief

**Structure of the Population of Sri Lanka**

- The structure of a population could be presented in terms of age and gender. The table below shows the structure of population of Sri Lanka.

**Table 2.3.4TheEstimated Mid-year Population of Sri Lanka by Sex and Age Groups, 2009-2013 (000')**

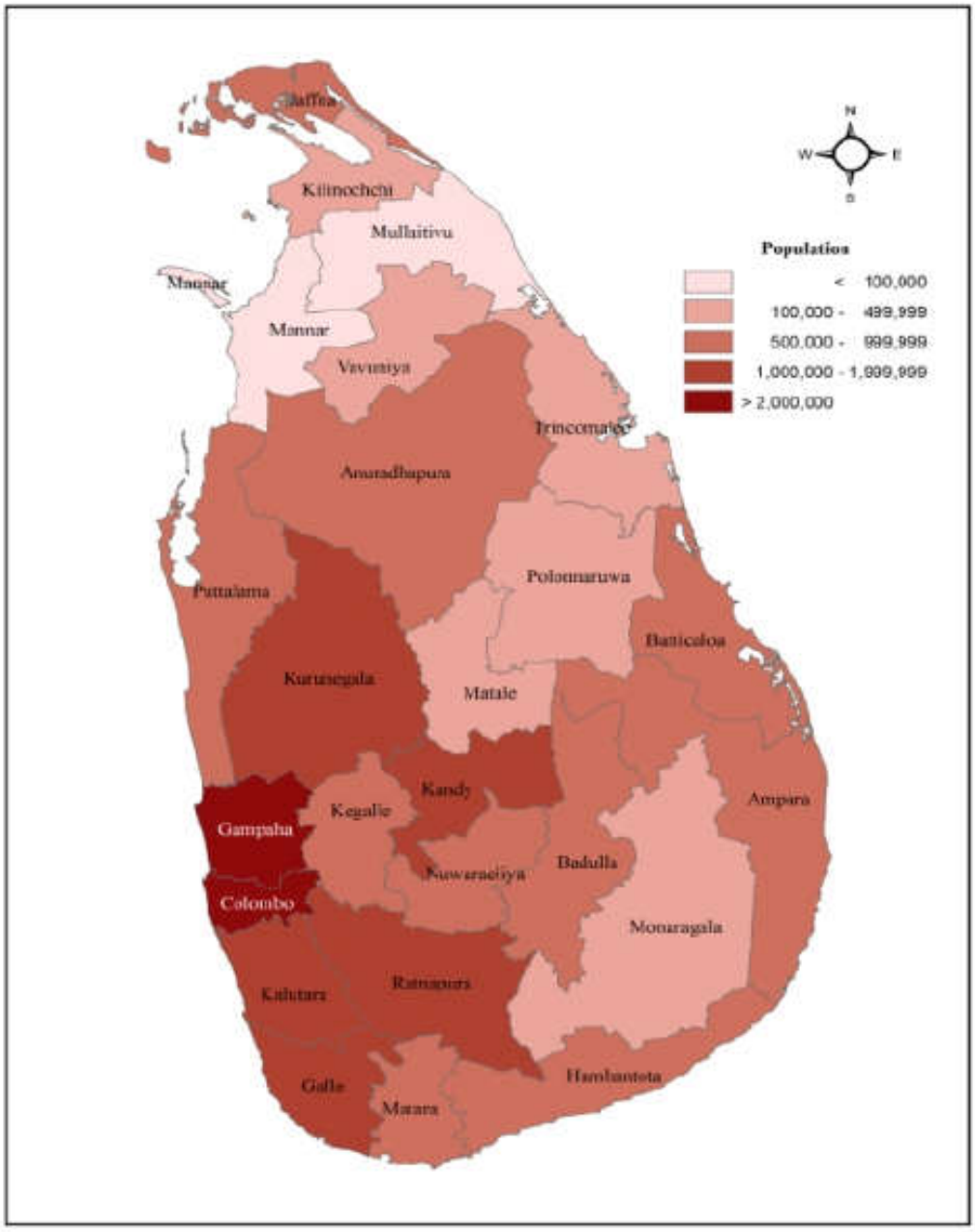
| Age Group | 2009 | | | 2010 | | | 2011 (1) | | | 2012 (1) | | | 2013 (1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males | Females | Total | Males | Females | Total | Males | Females | Total | Males | Females | Total | Males | Females | Total |
| 0 -4 | 886 | 855 | 1,741 | 895 | 864 | 1,759 | 901 | 873 | 1,774 | 884 | 865 | 1,749 | 891 | 871 | 1,762 |
| 5-9 | 911 | 883 | 1,794 | 920 | 892 | 1,812 | 932 | 904 | 1,836 | 888 | 863 | 1,751 | 895 | 869 | 1,764 |
| 10-14 | 939 | 906 | 1,845 | 948 | 915 | 1,863 | 953 | 925 | 1,878 | 829 | 804 | 1,633 | 835 | 810 | 1,645 |
| 15-19 | 1,008 | 984 | 1,992 | 1,018 | 993 | 2,011 | 1,025 | 999 | 2,024 | 813 | 832 | 1,645 | 819 | 839 | 1,658 |
| 20-24 | 964 | 960 | 1,924 | 973 | 970 | 1,943 | 984 | 978 | 1,962 | 748 | 771 | 1,519 | 753 | 777 | 1,530 |
| 25-29 | 798 | 824 | 1,622 | 85 | 831 | 1,636 | 808 | 841 | 1,649 | 745 | 800 | 1,545 | 751 | 806 | 1,557 |
| 30-34 | 769 | 791 | 1,560 | 776 | 799 | 1,575 | 787 | 809 | 1,596 | 793 | 843 | 1,636 | 799 | 850 | 1,649 |
| 35-39 | 752 | 769 | 1,521 | 760 | 777 | 1,537 | 766 | 788 | 1,554 | 683 | 727 | 1,410 | 688 | 733 | 1,421 |
| 40-44 | 705 | 711 | 1,416 | 712 | 718 | 1,430 | 715 | 725 | 1,440 | 668 | 706 | 1,374 | 673 | 711 | 1,384 |
| 45-49 | 615 | 632 | 1,247 | 621 | 638 | 1,259 | 622 | 641 | 1,263 | 620 | 661 | 1,281 | 625 | 666 | 1,291 |
| 50-54 | 546 | 563 | 1,109 | 552 | 569 | 1,121 | 559 | 578 | 1,137 | 581 | 637 | 1,218 | 585 | 643 | 1,228 |
| 55-59 | 391 | 421 | 812 | 35 | 425 | 820 | 394 | 431 | 825 | 501 | 557 | 1,058 | 505 | 561 | 1,066 |
| 60-64 | 291 | 309 | 600 | 294 | 312 | 606 | 300 | 315 | 615 | 425 | 492 | 917 | 429 | 495 | 924 |
| 65-69 | 227 | 263 | 490 | 229 | 265 | 494 | 228 | 263 | 491 | 284 | 346 | 630 | 287 | 348 | 635 |
| 70-74 | 172 | 196 | 368 | 173 | 197 | 370 | 176 | 200 | 376 | 181 | 229 | 410 | 182 | 231 | 413 |
| 75+ | 200 | 235 | 435 | 202 | 237 | 439 | 207 | 242 | 449 | 221 | 331 | 552 | 222 | 334 | 556 |
| Total | 10,174 | 10,302 | 20,476 | 10,273 | 10,402 | 20,675 | 10,357 | 10,512 | 20,869 | 9,864 | 10,464 | 20,328 | 9,939 | 10,544 | 20,483 |

**(1)** Provisional

Source: Registrar General's Department

Note:The mid-year population in 2012 has been based on primary data given in the Census of Population and housing 2012.

**Figure 2 : Population Distribution by district, 2012**




## Composition of Population

Sri Lanka's population composition could be studied in terms of ethnicity, religion, and rural and urban population.

The composition of population by ethnicity is given below:

**Table 2.3.5 Ethnic composition of Population of Sri Lanka**

| Ethnicity | 1981 (% of Total Population) | 2012 (% of Total Population |
|---|---|---|
| Sinhala | 74.0 | 74.9 |
| Sri Lanka Tamil | 12.7 | 11.2 |
| Indian Tamil | 5.5 | 4.1 |
| Sri Lanka Muslim | 7.0 | 9.3 |
| Burgher | - | 0.2 |
| Malay | - | 0.2 |
| Other | 0.8 | |

Source: Statistical Abstract 2014

**Table 2.3.6 Composition of Population of Sri Lanka by Religion**

| Religion | 1981 (% of Total Population) | 2012 (% of Total Population |
|---|---|---|
| Buddhism | 69.3 | 70.1 |
| Hinduism | 15.2 | 12.6 |
| Islam | 7.5 | 9.7 |
| Roman Catholic | 6.9 | 6.2 |
| Christian and other | 0.7 | 1.4 |

Source: Statistical Abstract 2014

**Rural and Urban Composition**

- According to the Census of Population 2012, the rural population of Sri Lanka was 15,753,322. It was 74.4 per cent of the total population of the country.
- Urban population was 3,704,470, 18.2 per cent of the total population.
- As such the urban population of Sri Lanka is low.

**Ageing**

- Ageing is a demographic process that occurs concurrently with the decline in fertility and increase in the life expectancy**.**

**Table 2.3.7 Ageing of Sri Lanka's population (%)**

| Census Year | Percentage of Aged Population |
|---|---|
| 1981 | 6.6 |
| 2001 | 9.2 |
| 2012 | 12.4 |
| 2041 (Projected) | 24.8 |

Source: Statistical Abstract 2014

- As is apparent from the table, in 2012 the elderly population over 60 years of age was 2.5 million. It was 1/8th of the total population. It has been forecast that in the coming two decades the probability is that there will be one aged person per every four persons.
- Thus the percentage of aged in the population of Sri Lanka is on the increase and it is important to pay special attention to formulate policies related to social security.

**Disability**

- In Sri Lanka attention has been paid on the disable population.
- This could be seen in the fields of education, health, sports and examinations etc.
- In Sri Lankan society favourable attitudes prevail in relation to caring the disabled persons.

**Gender Issues**

- In population studies special attention has been paid to gender issues. The number of males per 100 females is shown by sex ratio and it provide a basis for inquiring into gender issues.

**Table 2.3.8 - Sex Ratio of Sri Lanka 1981 and 2012**

| Age Group | 1981 | 2012 |
|---|---|---|
| 0-4 | 103.7 | 101.9 |
| 5-14 | 103.9 | 102.1 |
| 15-29 | 101.3 | 95.1 |
| 30-59 | 104.8 | 93.0 |
| Over 60 | - | 79.0 |
| Over 75 | - | 67.6 |

Source: Statistical Abstract 2014

- In the labor force of Sri Lanka the sex ratio in 2012 was 93.8 It is apparent that women are contributing more within the labor force. Employment policies should be formulated accordingly.

- Since life expectancy of women is higher than that of males they represent a higher proportion in the aged population. In future social security measures that care for elderly women should be broadened especially many elderly women are living without husbands.
- At present, women have been entrusted with a larger amount of work than in the past. In the past she was restricted to household work but today she is engaged in almost all occupations equally or more.
- In some fields of employment female representation is higher than that of males. A fine example is teaching profession. Females occupy a higher percentage in higher education, too. Their representation in leadership is also high. However, in politics their share is meagre.
- At household level, since income earned by males was not sufficient females also have inclined to earn money. In consequence, her role as a mother and housewife has been extended into a wage earner, too.
- However, females still needs the male's protection and owing to biological factors it is essential to act in cooperation with more attention and due respect to them.

**Poverty**

- The Central Bank Report for the year 2013 states that due to the sustainability of economic growth in recent years poverty has decreased considerably.
- In 2009/10 the household poverty was 8.9 per cent and in 2012 it had declined to 6.5 per cent.
- According to findings of the Household Income and Expenditure Survey of 2012/13 the disparities in income distribution among the people has shown a decline.
- The Gini Coefficient which was 0.49 in 2009/10 has declined to 0.48 in 2012.
- This has been due to the projects implemented targeting the low income groups.

**Displacement**

- Displacement of people could be stated as a trend in the distribution of population in Sri Lanka. This has been due to physical and human factors.
- The natural disasters took place in various parts in Sri Lanka could be stated as physical factors. Displacement of persons has resulted due to

tsunami, landslides, floods etc. These displacements may be short-term or long-term.

- The migrations from war-stricken areas to other parts of the country could be described as displacement due to human factors.
- In the decade of 1980 a large number of displaced persons migrated into India, Canada and European countries.
- Later, displaced persons due to war migrated to Colombo and other major cities.
- Accordingly, in urban areas like Colombo composition of population also has changed.
- Displaced persons have also settled in areas such as North Central Province, Mannar and Puttalam which are closed to war stricken regions.
- After the war steps have been taken to re-settle the displaced persons who are in foreign countries.
- Sri Lanka government by establishing a Ministry for Re-Settlement has given priority to these activities.
- Steps have also been taken to give priority for resettlement by re-granting land areas that belonged to the displaced persons hitherto considered as security regions.
- More than 95% of the people who were displaced due to war have been resettled. Majority of them have been resettled in their original places.
- A large number of new settlements with people displaced due to tsunami can be found in Southern and Eastern coastal areas from 100 meters from the coastline.

## 2.4 Dynamic nature of the population of Sri Lanka

### Births

- It is of importance to calculate the crude birth rate when studying births.

$$\text{Crude Birth Rate} = \frac{\text{Number of Live births in a given year}}{\text{Mid-Year Population of the given year}} \times 1000$$

The crude Birth Rate of Sri Lanka from 1992 to 2014 are given in the following Table.

Table 2.4.1 Sri Lanka: Crude Birth Rate 1992-2014

| Year | Number of Births | Crude Birth Rate |
|---|---|---|
| 1992 | 356,842 | 21.5 |
| 1993 | 350,707 | 20.8 |
| 1994 | 356,071 | 20.8 |
| 1995 | 343,224 | 19.9 |
| 1996 | 340,649 | 19.5 |
| 1997 | 333,219 | 18.8 |
| 1998 | 322,672 | 18.2 |
| 1999 | 328,725 | 18.1 |
| 2000 | 347,749 | 18.4 |
| 2001 | 358,583 | 18.9 |
| 2002 | 367,709 | 19.1 |
| 2003 | 370,643 | 18.9 |
| 2004 | 364,711 | 18.5 |
| 2005 | 370,731 | 18.1 |
| 2006 | 373,538 | 18.9 |
| 2007 | 386,573 | 18.8 |
| 2008 | 379,912 | 19.3 |
| 2009 | 376,843 | 18.0 |
| 2010 | 363,881 | 17.6 |
| 2011 | 363,415 | 17.4 |
| 2012 | 355,900 | 17.5 |
| 2013 | 365,792 | 17.9 |
| 2014 | 349,715 | 16.9 |

Source: Registrar General's Department

- As is apparent from the data given in the table the crude birth rate in Sri Lanka has been declining.
- This is further evident from the temporal change which has been taken place in the child dependents shown in the age pyramid of Sri Lanka.

- Following factors have been responsible for the decline in birth rate in Sri Lanka:
    - Tendency to practice family planning with the improvement in health sector.
    - Socialization of the concepts like two-child family
    - Decline in fertility with more and more women seeking higher education
    - Antenatal policies implemented by the government with a view to controlling population growth
- The annual average birth rate in Sri Lanka shows spatial variations, too. For example, in 2012, 53,926 births were reported from Colombo district, the highest number of births at district level. The lowest number of births in that year were reported from Mullativu district.
- The spatial variations in birth rate in Sri Lanka could be discerned from the table below which shows birth rates at district level.

Table 2.4.2 Sri Lanka, Crude Birth Rate by Districts, 2013

| Number | District | CBR |
|---|---|---|
| 1 | Colombo | 16.1 |
| 2 | Gampaha | 14.6 |
| 3 | Kalutara | 15.8 |
| 4 | Kandy | 19.6 |
| 5 | Matale | 19.4 |
| 6 | Nuwara Eliya | 20.5 |
| 7 | Galle | 17.1 |
| 8 | Matara | 16.2 |
| 9 | Hambantota | 20.7 |
| 10 | Jaffna | 17.3 |
| 11 | Kilinochchi | 25.5 |
| 12 | Mannar | 19.5 |
| 13 | Vavuniya | 20.3 |
| 14 | Mullativu | 11.9 |
| 15 | Batticaloa | 20.0 |
| 16 | Ampara | 22.6 |
| 17 | Trincomalee | 20.8 |
| 18 | Kurunegala | 17.0 |
| 19 | Puttalam | 21.1 |
| 20 | Anuradhapura | 19.3 |
| 21 | Polonnaruwa | 18.6 |
| 22 | Badulla | 18.7 |
| 23 | Moneragala | 19.6 |
| 24 | Ratnapura | 18.5 |
| 25 | Kegalle | 16.3 |

Source: Department of Census and Statistics, Sri Lanka

- The data showing the districts which had lower birth rates as well as higher birth rates in the year 2013 could be compared with that of island's average of 17.9 per 1000.
- The highest CBR of 25.5 per 1000 was reported from Kilinochchi district while the lowest which was 11.9 per 1000 was reported from Mullativu district.
- Both the highest and lowest birth rates were reported from the Northern Province.
- The crude birth rate in the Western Province districts show a low value.

**Deaths**

- According to the United Nations death means the cessation of life of a person or an organism at any time following its live birth.
- People die due to various causes:
  e.g. Health reasons
  Natural disasters
  Accidents

- A major factor that affects population dynamics of a country is deaths.
- In order to understand the deaths occurring in country it is important to compute the Crude Death Rate.

$$\text{Crude Death Rate} = \frac{\text{Number of Deaths in a given year}}{\text{Mid –year Population in the given year}} \times 1000$$

- The table below shows the crude death Rate in Sri Lanka from 1992 to 2015.

2.4.3 Sri Lanka: Crude Death Rates 1992 – 2015

| Year | Number of Deaths | Crude Death Rate |
|---|---|---|
| 1992 | 98,380 | 5.6 |
| 1993 | 96,179 | 5.5 |
| 1994 | 100,394 | 5.6 |
| 1995 | 104,707 | 5.8 |
| 1996 | 122,161 | 6.7 |
| 1997 | 114,591 | 6.2 |
| 1998 | 112,653 | 6.0 |
| 1999 | 115,330 | 6.1 |
| 2000 | 116,200 | 6.1 |
| 2001 | 112,858 | 6.0 |
| 2002 | 111,863 | 5.9 |
| 2003 | 115,495 | 6.0 |
| 2004 | 114,915 | 5.9 |
| 2005 | 132,097 | 6.7 |
| 2006 | 117,467 | 5.9 |
| 2007 | 118,998 | 5.8 |
| 2008 | 118,279 | 5.9 |
| 2009 | 120,085 | 5.9 |
| 2010 | 130,337 | 6.2 |
| 2011 | 123,261 | 5.9 |
| 2012 | 122,063 | 6.0 |
| 2013 | 127,124 | 6.2 |
| 2014 | 127,758 | 6.0 |

Source: Department of Census and Statistics, Sri Lanka

- The largest number of deaths and the highest CDR was recorded in the year 2005.

- The spatial variation in CDR in Sri Lanka could be discerned at district level and it is observed that districts where population is high the death rates are also at a higher level.

Table 2.4.4 Sri Lanka, Crude Death rate by Districts 2013

| District | | CDR |
|---|---|---|
| 1 | Colombo | 7.0 |
| 2 | Gampaha | 6.0 |
| 3 | Kalutara | 6.6 |
| 4 | Kandy | 7.1 |
| 5 | Matale | 6.0 |
| 6 | Nuwara Eliya | 6.6 |
| 7 | Galle | 7.2 |
| 8 | Matara | 6.2 |
| 9 | Hambantota | 5.5 |
| 10 | Jaffna | 7.2 |
| 11 | Kilinochchi | 3.4 |
| 12 | Mannar | 3.8 |
| 13 | Vavuniya | 4.9 |
| 14 | Mullativu | 6.0 |
| 15 | Batticaloa | 4.8 |
| 16 | Ampara | 4.6 |
| 17 | Trincomalee | 4.1 |
| 18 | Kurunegala | 6.6 |
| 19 | Puttalam | 5.5 |
| 20 | Anuradhapura | 5.4 |
| 21 | Polonnaruwa | 5.3 |
| 22 | Badulla | 6.1 |
| 23 | Moneragala | 4.7 |
| 24 | Ratnapura | 6.2 |
| 25 | Kegalle | 6.9 |

Source: Department of Census and Statistics, Sri Lanka

- In 2013, the Crude Death Rate in Sri Lanka was 6.2 per 1000, but according to the table the districts which had higher rates as well as lower rates than the island's average could be identified.

  e.g. High - Colombo, Kandy, Galle
  Low - Ampara, Trincomalee, Moneragala

Natural Increase

- Natural Increase in Population means the difference between births and deaths in a country in a given period. Increase in population is denoted by + (plus)and the decrease by – (minus).

Natural Increase in Population= Births – Deaths

$$\text{Rate of Natural Increase} = \frac{\text{Crude Birth Rate} - \text{Crude Death Rate}}{\text{Mid-year population}} \times 100$$

It is the natural increase in population, or the difference between births and deaths that have been continuously responsible for the quantitative changes in the population of Sri Lanka.

Table 2.4.5 Sri Lanka Natural Increase in Population 1997 – 2015

| Year | Population in millions | Rate of Natural Increase (%) |
|---|---|---|
| 1997 | 17.7 | |
| 1998 | 17.0 | 1.3 |
| 1999 | 18.0 | 1.2 |
| 2000 | 18.0 | 1.2 |
| 2001 | 18.0 | 1.2 |
| 2002 | 19.0 | 1.3 |
| 2003 | 19.0 | 1.3 |
| 2004 | 19.4 | 1.3 |
| 2005 | 19.6 | 1.3 |
| 2006 | 19.9 | 1.1 |
| 2007 | 20.0 | 1.3 |
| 2008 | 20.2 | 1.3 |
| 2009 | 20.4 | 1.3 |
| 2010 | 20.6 | 1.2 |
| 2011 | 20.9 | 1.1 |
| 2012 | 20.3 | 1.2 |
| 2013 | 20.5 | 1.1 |
| 2014 | 20.8 | 1.2 |
| 2015 | 20.9 | 1.1 |

Source: Department of Census and Statistics, Sri Lanka

- A period during which migration contributed conspicuously to population dynamics of Sri Lanka was from 1871 to 1881 when the British rulers brought South Indian laborers to work in the estates. During that decade the share of international migration to population growth in Sri Lanka was 67 per cent.

- It could be discerned from the following table how international migration affected population dynamics of Sri Lanka:

Table 2.4.6 International migration in Sri Lanka, 2004 -2012

| Year | Immigration (000') | Emigration (000') | Net Migration Rate |
|---|---|---|---|
| 2002 | 1,463 | 1,487 | - 1.2 |
| 2005 | 1,391 | 1,421 | - 1.5 |
| 2006 | 1,440 | 1,470 | - 1.5 |
| 2007 | 1,530 | 1,565 | - 1.8 |
| 2008 | 1,644 | 1,688 | - 2.1 |
| 2009 | 1,645 | 1,673 | - 1.7 |
| 2010 | 2,106 | 2,129 | - 1.1 |
| 2011 | 1,433 | 2,479 | - 2.2 |
| 2012 | 2,496 | 2,548 | - 2.6 |

Source: Department of Census and Statistics, Sri Lanka

- According to the table the net migration rate in Sri Lanka is a negative figure.
- The negative value of Sri Lanka's net migration rate results in low population growth rate.
- In 2012, the number of who went overseas for education, employment and other purposes amounted to 604,540 people.
- Destinations of emigrants from Sri Lanka were South Korea, United Arab Emirates, Saudi Arabia, Oman, Jordan, Kuwait, Lebanon, and Cyprus.
- Of the temporary emigrant population 65 per cent had emigrated for employment. Of them, 64 % were males and 34 % were females.
- Of the total migrant population of Sri Lanka who are living overseas 94 per cent were between the ages of 18 and 59.
- Of the migrants living abroad 1/3 belonged to the Western Province.
- According to the report of the Census of Population 2012 one person in a household per every 11 households live overseas temporarily.
- Of the total number of Sri Lankan emigrants the majority lives in the countries of the Middle East.
- According to the Census of Population 2012, of the total number of emigrants living overseas temporarily 59% were males and 41 % were females.

**Internal Migration of Sri Lanka**

- Various economic, social and political factors have affected the direction, pattern, numbers and streams of internal migration in Sri Lanka.

- According to the Census and Population and Housing, 2012, 2.7 million people (13.4% of the total population) have been recorded as inter-provincial migrants.
  Every one person out of five has changed his/her residence at least once.
- Highest amount of in-migration has been to the Western Province where the extent of land is the lowest. In 2012, the second and third highest in-migration Provinces were North-West and North-Central respectively.
- Of the districts of Sri Lanka the highest number of in-migration has been to Colombo District. In 2012, the total number of in-migrants to Colombo district has been recorded as 641,922.
- Compared with situation 1981, in 2012 migration into every district has increased.
- In Western Province one person for every five persons is an inter-provincial migrant.
- Marriage, education, displacement, re-settlement, development project, needs of the family members have been the reasons for inter-district migration.
- One migrant for every three migrants as changed his/her residential district due to marriage.
- One migrant for every five migrants has migrated due to reasons related to occupation.
- Migration into districts such as Kilinochchi, Mullativu, Jaffna, Mannar, and Trincomalee has taken place due displacement and re-settlement.
- Migration into districts such as Ampara, Polonnaruwa, Anuradhapura, Moneragala and Hambantota has been associated with development projects.
- The proportion of the working population or labor force is high among migrants.
- According to the Census of Population and Housing 2012, the highest number of out-migrants was from the Central Province. Southern and Western Provinces were second and third highest out-migration districts respectively.
- All three districts of the Western Province record a net migration gain.
- Colombo and Gampaha could be named as the district with highest migrant attraction.
- Districts of Badulla, Matara, Vavuniya and Nuwara Eliya reported a very high migration loss. In 2012 Nuwara Eliya district recorded a migration loss of-144.2 (thousand). In 2012, the highest migration loss was recorded in Vavuniya district. (-697.7 (thousand).
- The districts of Vavuniya, Mannar, and Ratnapura which recorded migration gains in 1981 transformed into migration loss districts by 2012.

| | | | |
|---|---|---|---|
| **Competency** | **:** | **3.0** | **Identifies the main settlement types and examines their characteristics** |
| **Competency Level** | **:** | 3.1 | Explains the main elements, types and patterns of settlements |
| | | 3.2 | Classifies the main settlements in Sri Lanka by their functions |
| **Periods** | **:** | 20 | |
| **Learning Outcomes** | **:** | • | Analyses what a settlement is |
| | | • | Describes the evolution of a settlement |
| | | • | Explains world settlement types |
| | | • | Explains settlement patterns |
| | | • | Describes the settlement types of Sri Lanka with examples. |
| | | • | Describes the main characteristics of settlement types in Sri Lanka |
| | | • | Describes the distribution and trends in settlement types in Sri Lanka |

**Introduction** **:** People constructed shelters to protect themselves from harsh environmental conditions and animals. In the Stone Age, men used to live in tree hollows and caves but today live in more permanent and strong houses with various facilities. The concentration of people and their houses create a settlement. The objective of this unit is to explain elements, types and patterns of such settlements.

## A guide to clarify the subject matter

### Definition of settlements

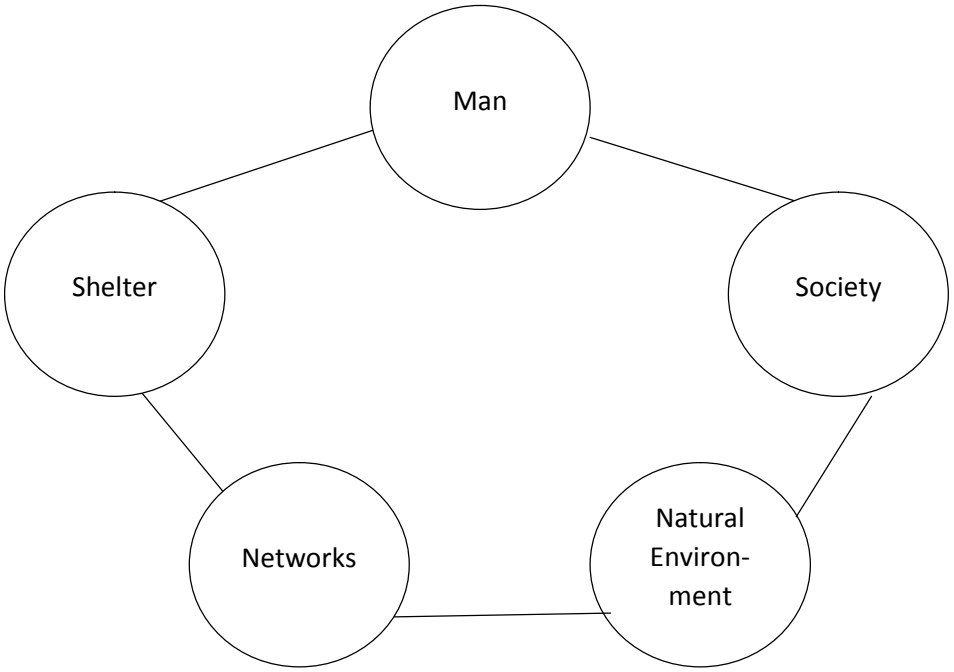
Dickinson has described settlement "as a habitat made by man on the earth's surface".

Accordingly, a settlement consists not only of houses and buildings but also with everything used by them including fences, roads, storehouses and farms. It comprises a diverse group of people.

As such, settlements could be described simply as a visual imprint made by man on the earth's surface.

- Introduction to Settlements

  A settlement may comprise permanent, semi-permanent or temporary houses. There are a few elements in a settlement.




Man : Main component of a settlement. Settlements are made by man.

Shelter : Houses and buildings

Networks : Communication networks means such as roads and Tele-communication wires that connect a place with another.

Natural Environment: Physical basis of a settlement

Society : The social environment created by all factors mentioned above.

**Factors affecting the establishment of a settlement**

- Physical and human factors affect the establishment of a settlement
- In the initial stages, settlements originated where physical factors such as water, flat land, fertile soil and climate were conducive.
- Gradually, the effects of human factors have become more important (e.g. infrastructure facilities and services)

**Evolution of Settlements**

- People display a tendency to live in groups.
- Settlements originated due to the desire of people to live in groups.
- The origin of settlements dates back to early Stone Age.
- In the early stone age, about 2 million years ago, people who were engaged in hunting and food gathering lived in tree hollows, caves and shelters made of tree branches.
- In the migratory nomadic stage tents made of animal skin were used as homes by people.
- In the late Stone Age, people engaged in permanent agriculture and animal husbandry lived in permanent houses in villages.
- Urban settlements were born with the industrial revolution.
- However, there were urban settlements in the past, too. Ur and Eridu in Mesopotamia, Mohenjo-Daro and Harappa in the Indus valley are examples.
- Later, cities like Rome, Athens and Sparta were established during the periods of Greek and Roman Empires.
- Those cities were surrounded by a moat or a rampart.
- People of Mayan, Cuzco, Zapotec, Mixtec and Aztec civilizations also constructed cities.
- The spread of settlements were accelerated with the exploration, industrial revolution and colonization.
- It is apparent that settlements are constantly changing and developing with varying needs of the people.

**Types of Settlements**

Geographers studying settlements have classified them in various ways. These classifications have been made using different criteria paying attention to how settlements are centered on particular areas and reasons behind them. Site, location, form and functions of settlements have been taken into account in these classifications.

Here, the attention is paid to identify settlements that could be classified according to their function and nature. They are,

Rural Settlements
Urban Settlements, and
Rurban Settlements.

Function of a settlement is a very important criteria. Farming, trading, transportation, resource utilization, security, cultural activities, administrative functions, sports and recreation activities are the main functions. According to the nature of these functions, they could be classified as rural, urban and rurban settlements.

These settlements could also be classified as permanent, semi-permanent and temporary, according to their duration.

The growth of settlements could also be described according to a hierarchy.

Homestead or farm ⟶ Hamlet ⟶ Village ⟶ Small Town ⟶ Town ⟶ City ⟶ Metropolis ⟶ Conurbation ⟶ Megalopolis

**Rural Settlements**

- Farmstead, farm, hamlet and village could be identified as rural settlements.
- These settlements have been based on primary economic activities.
- Farming, fisheries, animal husbandry and hunting are the primary activities.
- Road network is irregular and undeveloped.
- Rural settlements in western countries can be identified easily. The space between them is wide. Density of population is low.
- In contrast, the location of houses in rural settlements in developing countries is irregular.
- In rural settlements, farmlands and land occupied by buildings can be clearly identified.
- In rural settlements permanent and semi-permanent settlements could be seen. In rural areas semi-permanent and temporary settlements are associated with economic activities.
- Seasonal migration in search of food, migratory fishing, shifting cultivation and seasonal changes in climate have resulted in semi-permanent and temporary settlements.

**Urban Settlements**

- Small town, town, city, metropolis, conurbation, and megalopolis could be described as urban settlements.
- Large number of people live in a limited space of land. High density of population. Settlements in which industrial, administrative, commercial and educational activities are concentrated are known as urban settlements.
- These functions are concentrated in the built-up area of the city. A feature that could be seen at present is the growth in urban settlements of the world.
- People in search of high paid as well as low paid jobs are migrating into cities.
- Another facet of the urban settlements is the existence of shanties, slums and under-served houses.
- In most instances, the marginal land in urban areas are settled by these people.
- In cities of almost all countries of the world, shanties, slums and under-served houses as well as illegal settlements could be seen.

- Although the people in these settlements render a service to the city they have also created many urban problems.

**Rurban Settlements**

- These settlements are located in a transition zone between village and city.
- People engaged in primary economic activities as well as in secondary and tertiary activities in the city live in this zone.
- Although the features of a village as well of a city could be seen in this zone the urban characteristics are on the increase.
- In many developing countries, the rurban zone is settled by the migrants from the villages who have found employment in cities.
- Also, people who live in the core area of the city in order to relieve themselves from the urban congestion select the rurban zone as a residential area.

**Permanent Rural Settlements**

Settlements located in a particular locality continuously for a long period of time could be described as permanent settlements. Examples:

- Settlements associated with paddy, tea and cultivations in Asian Regions
- Wet Zone villages, Ancient Villages in the Dry Zone and villages in the valley areas in Central highland of Sri Lanka
- Mixed farming areas practicing crop cultivation and animal husbandry in the North-West Europe and fishing villages

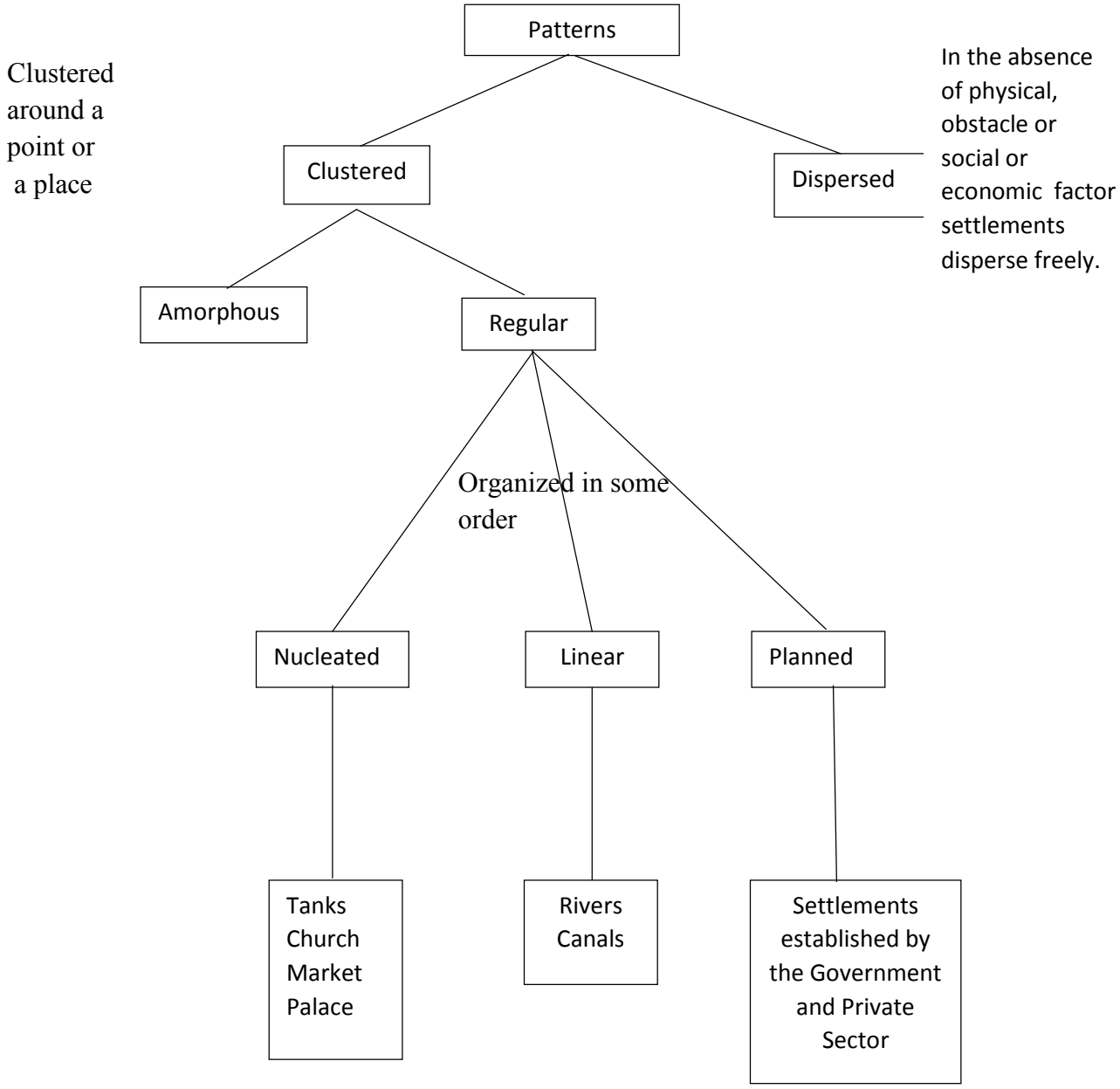
**Settlement Patterns:**

According to the pattern of distribution of dwellings and buildings in rural areas settlements could be classified.

There are two types of settlement patterns:

- Nucleated settlements
- Dispersed settlements

Settlement Patterns



Differences between Rural, Urban and Rurban Settlements

| Variable | Settlement Types | | |
|---|---|---|---|
| | Rural | Urban | Rurban |
| Population | Relatively low | Relatively high | Moderate |
| Population Density | Low | High | Moderate |
| Economic activities | Less activities mainly primary | Secondary, Tertiary, Quaternary | Gradual decrease in primary activities; increase in secondary, tertiary and quaternary activities |
| Functions | Primary; Residential | Various functions such as administrative, financial, health, education | Residential |
| Commuting | Low | Inward in the morning and outward in the evening | Outward in the morning and inward in evening |
| Migration | Low | High | High |
| Built-up Area | Relatively low | Large | On the increase |

## 3.2 History of Settlements in Sri Lanka

- It is evident that human settlements have been in Sri Lanka since the pre-historic era.
- According to the evidence found the following areas had been settled about 125,000 years ago:

  - Bundala
  - Pathirajawela
  - Minihagalkanda

- About 40,000 years ago there had been a human civilization spread in every part of the island.

  Examples: Balangoda Man
  Open settlements in the coastal areas of Bundala, Wilpattu, and Pallemalala
  Pahiyangala, Batadombalena in Kuruwita, Belilena in Kitulgala
  Alawala Lena in Gampaha, Bellanendipelessa, Alulena in Attanagoda
  Dorawaka Lena in Warakapola, Sigiriya Potana, Matota (Mannar)

- Evidence for the existence of a developed hydraulic civilization in the Dry Zone of Sri Lanka can be seen even today.

  Examples: Kingdoms of Anuradhapura and Polonnaruwa
- With the shift of kingdoms of Sri Lanka from Anuradhapura and Polonnaruwa to the Southwest, settlements also moved to the Southwest.
- During the period of the Kingdom of Kotte settlements expanded vastly.
- With the advent of the Western nations settlements were concentrated in coastal areas. The effects of this concentration could be seen even at present.

Types of Settlements in Sri Lanka

Rural
Urban
Rurban

### Rural Settlements

- Rural settlements are the abundant settlement type found in Sri Lanka. Even among them, variations could be seen.
  - Dry Zone Tank Villages
  - Wet Zone Villages
  - Villages based on traditional industries

- Traditional up-country villages
- Fisheries villages
- Estate Settlements
- Colonization Schemes
- NADZA settlements
- Youth Settlements
- Villages created as a result of disasters

- Dry Zone Tank Villages
  There are a few components in a dry zone tank village. The tank, paddy lands, highland (where houses are built) *chena a*nd forest are those components.

- Wet Zone Villages
  These villages have been originated in association with a river or stream.

- Villages based on traditional industries
  In these villages the small scale traditional industries carried out by artisans could be seen.
  - e.g. Cane products
- Fisheries villages
  These villages have originated in association with fisheries industry carried out in the coastal areas of Sri Lanka. Shows rural characteristics more than that of urban.

- Estate Settlements
  They have come into existence in association with the plantation agriculture in the up-country areas. They could be found in abundance in the districts of Nuwara Eliya, Kandy, Badulla, Matale, Kegalle, Ratnapura, Kalutara and Galle.

  The plantation, factory, houses built in a line, place of Hindu worship (Kovil), school, dispensary, and the market buildings are the salient features of this planned settlement.

Colonization Schemes

- Established in the dry zone in the 1930s.
- Later, land settlements were constructed by the River Valleys Development Board.
  e.g. Gal Oya and Walawe

Mahaweli Settlements

- The planned cluster settlement created with the implementation of the Mahaweli Development Programme are known as Mahaweli settlements. Within these settlements a hierarchy could be identified. It ranges from the nucleated villages through Village centres, Regional (zonal) centres to townships. However, with the

fragmentation of land from one generation to another the nature of settlements is changing.

**Urban settlements**

Although the majority of settlements in Sri Lanka are rural, a spread of urban settlements could also be seen. Urban settlements in Sri Lanka could be classified according to the size of population.

| | | |
|---|---|---|
| Large towns | - population more than 100,000 | Colombo Municipality |
| Medium towns | - population 20,000 – 100,000 | Kalutara Municipality |
| Small Towns | - population less than 20,000 | Kegalle Urban Council |

In Sri Lanka cities have also been classified by their function.

| | | |
|---|---|---|
| Administrative cities | - | Sri Jayewardenepura Kotte |
| Cultural Cities | - | Kandy, Anuradhapura |
| Recreational cities | - | Tourists centres, Kataragama |
| Residential cities- | | towns developed in recent times due to urbanization: Suburbs around City of Colombo – Piliyandala, Kaduwela |

- In Sri Lanka administrative criteria are used to identify urban areas.
- Accordingly, areas administered by Municipalities and Urban Councils are considered as urban.
- A larger number of urban settlements in Sri Lanka are located in Colombo and adjoining Metropolitan region.
- According to the classification of towns in 1981, main towns of all districts became capital cities. The capital city and adjoining areas have been growing.
- Although only the municipal ad urban council areas were declared as urban, there are a large number of centres providing urban services which are not considered as urban.

Characteristics of Urban settlements

- A large number of people live in urban settlements
- A diverse population composition.
- House density is also high.
- Provides various service facilities. E.g. education, health, leisure activities, infrastructure facilities, super markets.

**Rurban Settlements in Sri Lanka**

- Considered as a transition zone between urban and rural settlements. Both urban and rural characteristics could be seen in this zone.
- People migrate into this zone from rural areas as well as from urban areas. Commuting is at a high level.

- At present, many services provided by urban centres are being located in rurban area; e.g. Condominiums, health centres, educational centres and other services
- In this region, urban characteristics are superseding rural features.
- Rurban settlements are very dynamic. Outer boundary of the rurban zone is pushed toward the rural area.
- Homagama, Athurugiriya, Horana in Colombo District
  Pilimatalawa and Penideniya in Kandy District
  Koggala, Labuduwa and Karaptiya in Galle District
  Mirigama, Minuwangoda and Nittambuwa in Gampaha District could be cited as examples for rurban settlements in Sri Lanka.

**Trends**

- Settlements are changing.
- Rural settlements are on the decline; urban and rurban settlements are increasing.
- With the expansion of urban settlements the pattern of land use, too, is changing. Agricultural lands are being transformed into service provision centres.
- Urban settlements are subject to the effects of globalization.
- Houses in urban and rurban areas expand vertically; thus, pressure of population as well as the pressure on resources and services are increasing.

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**Activities**

1. Divide students into three groups.
   - Hand over the relevant assignments to each group.
   - Prepare a descriptive report on the relevant topic.
     Topics
     - Group 1 - Defining Settlements: Evolution of Settlements (stages of Growth)
     - Group 2 - Differences between Rural, Urban and Rurban settlements
       Basic features of a rural settlement
     - Group 3 - Settlement Patterns

2. Prepare a folder with pictures showing the nature of various settlements in the World.
3. Location factors of settlements
   Prepare a brief report explaining the measures used to classify settlements

**Competency** : **4.0 Studies the nature of world urbanization and examines problems**

**Competency Level** : 4.1 Explains the nature of world's urbanization
4.2 Analyses with examples the problems of urbanization in developing Countries

**Periods** : 16

**Learning Outcomes :**

- Describes urbanization
- Provides reasons for urbanization
- Explains different levels of urbanization
- Explains patterns and trends in urbanization
- Describes positive aspects of urbanization
- Analyses urbanization related social and economic problems in developing countries
- Explains with examples urbanization related environmental problems in developing world
- Describes the urbanization related health and sanitation problems in developing countries

**Introduction** : The urbanization which grew in parallel with the industrial revolution is a phenomenon that has been responsible for many socio-economic changes world over. Britain and the European countries who were the pioneers in industrial revolution were also the leaders in urbanization. In the initial period, urbanization in those countries took place at a slower rate. In 1800, the proportion of the people lived in urban areas was only 3 per cent of the world population. Of the total world population 37.2, 41.2 ad 45.2 per cent had lived in urban areas in 1970, 1980 and 1991 respectively. At present, more than half of the world population, i.e. 54 per cent, live in urban areas. According to the United Nations World Urbanization Report released in 2014, the percentage of world urban population will increase to 66 by 2050. In this unit it is expected to study the nature and problems of world urbanization.

**A guide to clarify the subject matter**
**What is Urbanization?**

Urbanization is a continuous process. It occurs when people move in large numbers for permanent residence to areas where economic and service facilities are available. The absolute increase in the size of urban population is called urban growth. It gives a

different meaning compared to urbanization. Urbanization means the size of urban population as a percentage of the total population.

Urbanization Index is used to measure urbanization.

$$\text{Urbanization Index} = \frac{\text{Urban population in a given year}}{\text{Mid-Year Population in the given year}} \times 100$$

- To identify an urban area different criteria are used by the countries in world; size of population, density of population, nature of economic activities are some of the criteria used.
- Areas considered as urban is significant in the identification of the level of urbanization of a country.
- In order to identify the level of urbanization it is necessary to compute the population living in urban areas as a percentage of the total population of the country (the urbanization index).
- There are two main factors that determine the rise in urbanization level.
    - Natural increase in urban population
    - Migration from rural areas to urban areas

  Of them, rural-urban migration plays a major role in urbanization. In urban areas normally the rate of natural increase in population is very low.

- Urban population increases due to rural-urban migration. The continuous migration from rural areas would result in the concentration of population of a country in urban areas at the expense of rural areas. This would lead to rise in the level of urbanization.
- In all countries there is a certain level of urbanization; However, to be considered as an urbanized country the level of urbanization should exceed 50 per cent.

**Urbanization Process**

The urbanization process is affected by three factors:

- Natural increase in urban population
- Rural-urban migration
- Changes in administrative boundaries

1. Urban population tends to increase due to the natural increase in its population. Although it does contribute to the growth of urban population, natural increase in urban population is very slow.
2. The factor that affects urbanization more importantly is rural-urban migration.
3. In the process of rural-urban migration people are pushed from rural areas and pulled from urban areas.
4. Poverty, unemployment etc. push people from rural areas. Conversely, they are pulled by the urban areas owing to their infrastructure facilities, higher living standards etc.

**Levels of World Urbanization**

- Levels of world urbanization could be studied from temporal and spatial perspectives.
- According to the extent of urbanization, level of urbanization could be identified as high, medium and low.
- The Table below shows the levels of urbanization from 1950 to 2014 by world regions as well as projections up to 2050.

Table 4.1.Percentage of Urban Population and Rate of Urbanization by Regions, 1950 -2050

| Region | Percentage Urban | | | | | | Rate of Urbanization | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950 | 1970 | 1990 | 2014 | 2030 | 2050 | 1950-1970 | 1970-1990 | 1990-2014 | 2014-2030 | 2030 - 2050 |
| World | 29.6 | 36.6 | 42.9 | 53.6 | 60.0 | 66.4 | 1.07 | 0.80 | 0.92 | 0.71 | 0.50 |
| Africa | 14.0 | 22.6 | 31.3 | 40.0 | 47.1 | 55.9 | 2.38 | 1.63 | 1.03 | 1.02 | 0.86 |
| Asia | 17.5 | 23.7 | 32.3 | 47.5 | 56.3 | 64.2 | 1.51 | 1.54 | 1.62 | 1.06 | 0.65 |
| Europe | 51.5 | 63.3 | 70.0 | 73.4 | 77.0 | 82.0 | 1.00 | 0.52 | 0.20 | 0.30 | 0.31 |
| Latin America & the Caribbean | 41.3 | 57.1 | 70.5 | 79.5 | 83.0 | 86.2 | 1.62 | 1.06 | 0.50 | 0.27 | 0.19 |
| North America | 63.9 | 73.8 | 75.4 | 81.5 | 84.2 | 87.4 | 0.72 | 0.11 | 0.32 | 0.21 | 0.19 |
| Oceania | 62.4 | 71.3 | 70.7 | 70.8 | 71.3 | 73.5 | 0.67 | 0.05 | 0.01 | 0.05 | 0.15 |

Source: UN, World Urbanization Prospects, 2014

With data provided in the above table salient features in urbanization in each of the regions could be analyzed.

African Region

- The urbanization level in the African region as a whole is 40.4% (2014). However, there are few countries in the region that show a higher level of urbanization (e.g. Reunion - 95% and Gabon - 87%).
- Burundi (12%) and Malawi (10%) are the countries with lowest levels of urbanization in the region.

Asian Region

- The level of urbanization in the Asian region is 47.5% (2014). Singapore (100%), Japan (93%), and South Korea (82%) have higher urbanization levels.
- In 2014, in three countries in the Asian region the level of urbanization were less than 25 per cent. Sri Lanka (18%), Nepal (18%) and Kampuchea (21%) were those countries.

North America and Europe

- In North American and European countries, too, the level of urbanization is high. By 2014, the urbanization Index for North America was 81.5%. In Europe it was 73.4%.

Latin America and the Caribbean Region

- In this region the level of urbanization was 79.5% (2014). Uruguay could be cited as country with a high urbanization level (95.2%). Trinidad and Tobago was a country with a lowest level of urbanization.

Oceania

- Oceania also is a region with higher level of urbanization. In Australia the level of urbanization was 89.4%. In contrast, the urbanization level in Papua New Guinea was only 13%.
- The ten countries with the highest level of urbanization is shown in Table 4.2.The ten countries with the lowest level of urbanization are shown in Table 4.3.

**Table 4.2 Highly Urbanized Countries of the World 2014 and 2050)**

| 2014 | | | 2050 | | |
|---|---|---|---|---|---|
| Rank | Country | Percent Urban | Rank | Country | Percent Urban |
| 1 | Hong Kong Special Administration Region, China | 100.0 | 1 | Hong Kong Special Administration Region, China | 100.0 |
| 2 | Macao Special Administrative Region, China | 100.0 | 2 | Macao Special Administrative Region, China | 100.0 |
| 3 | Singapore | 100.0 | 3 | Singapore | 100.0 |
| 4 | Qatar | 99.2 | 4 | Qatar | 99.8 |
| 5 | Guadalupe | 98.4 | 5 | Kuwait. | 98.8 |
| 6 | Kuwait. | 98.3 | 6 | Guadalupe | 98.8 |
| 7 | Belgium | 97.8 | 7 | Belgium | 98.6 |
| 8 | Malta | 95.3 | 8 | Japan | 97.7 |
| 9 | USA Virgin Islands | 95.2 | 9 | Uruguay | 97.5 |
| 10 | Uruguay | 95.2 | 10 | USA Virgin Islands | 97.2 |

Source: Source: UN, World Urbanization Prospects, 2014) Projected

**Table 4.3 Least Urbanized Countries of the World 2014 and 2050)**

| 2014 | | | 2050 | | |
|---|---|---|---|---|---|
| Rank | Country | Per cent Urban | Rank | Country | Per cent Urban |
| 1 | Trinidad and Tobago | 8.6 | 1 | Trinidad and Tobago | 10.7 |
| 2 | Burundi | 11.8 | 2 | Papua New Guinea | 22.7 |
| 3 | Papua New Guinea | 13.0 | 3 | Samoa | 23.4 |
| 4 | Uganda | 15.8 | 4 | Saint Lucia | 25.0 |
| 5 | Malawi | 1.1 | 5 | Burundi | 26.3 |
| 6 | Nepal | 18.2 | 6 | Antigua and Barbados | 26.3 |
| 7 | Sri Lanka | 18.3 | 7 | Swaziland | 28.8 |
| 8 | Niger | 18.5 | 8 | Sri Lanka | 30.2 |
| 9 | Saint Lucia | 18.5 | 9 | Malawi | 30.2 |
| 10 | South Sudan | 18.6 | 10 | Micronesia (Federal States) | 30.2 |

Source: Source: UN, World Urbanization Prospects, 2014) Projected

**Patterns and Trends in World Urbanization**

- In 2007, for the first time the number of people living in urban areas exceeded that of in the rural areas.
- A rapid urbanization is taking place world over since 1950 to date.
- Large differences could be seen in the level of urbanization by regions of the world.

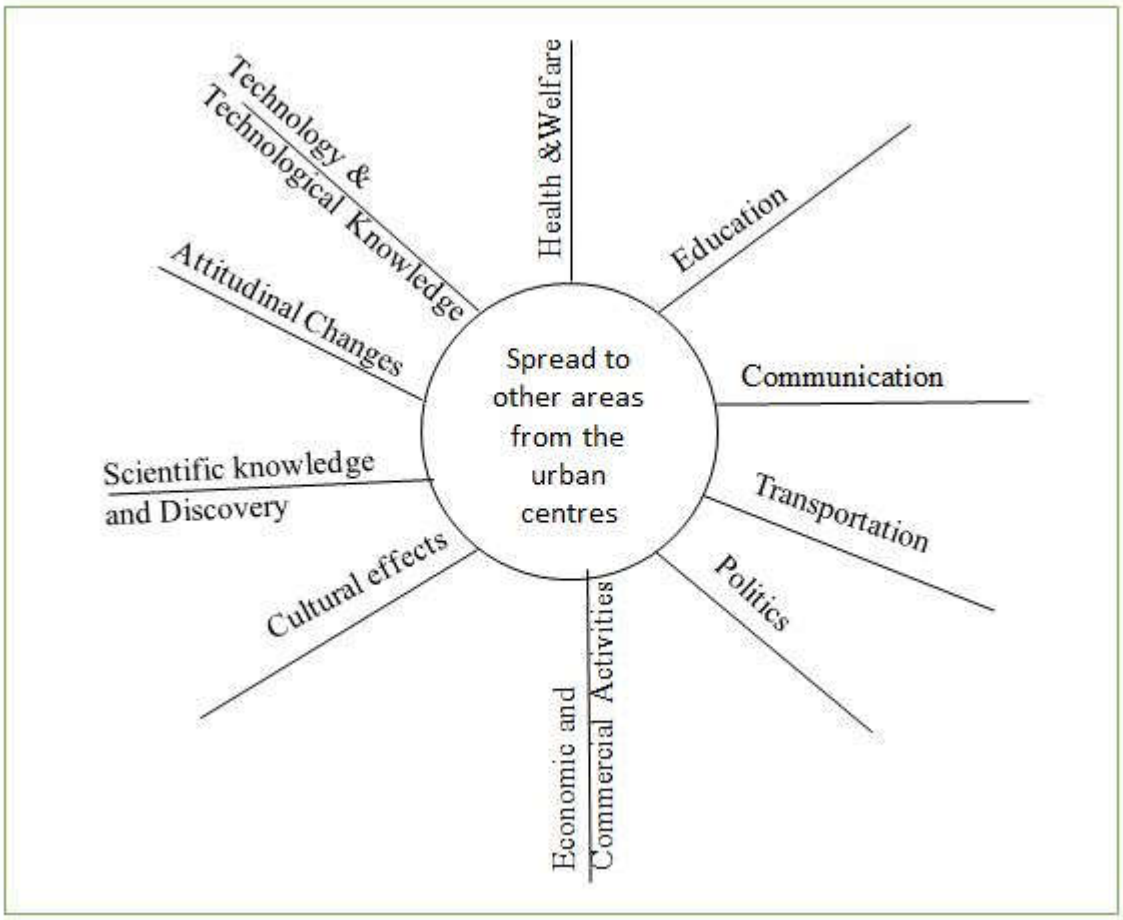
| | | |
|---|---|---|
| Europe | : | 73% |
| Latin America and the Caribbean | : | 80% |
| Africa and Asia | : | 40% - 48% |

- The rate of urbanization in African and Asian regions is more rapid than that in the other regions.
- Million cities and Mega cities are emerging largely in the developing countries.
- The rapid growth in the informal sector in the developing countries accompany urbanization.

**Positive Aspects of Urbanization**

- Cities act as the centres of development of a country Development process is spread centrifugally from the cities. This is evident from the following diagram:

**A guideline to clarify the subject content**




- As evident from the above diagram, development takes place in every field originating from the urban centres.
- As such, urban areas function as vanguard of development in every field.
- Cities are the major centres that connect various regions, countries and functions.

**Trends**

At present, the urbanization process are crossing the boundaries of the countries.

Examples: Blue Banana : The urban area that extends from Northwest England to Genova in Italy with some discontinuities

Golden Banana : Urban area extending from Genova on the Mediterranean coast to Valencia with some discontinuities

Green Banana : The urban area in the Central Europe extended with some Discontinuities

## 4.2 Problems Associated with Urbanization in Developing Countries

- A large number of socioeconomic problems have emerged due to the rapid urbanization in developing countries.
- The irregular distribution of urban areas, high pressure of population, shortage of houses, unemployment, growth of slums and shanties, congestion of traffic, water problems. sewage, urban crimes, urban environmental pollution, solid wastage are some of the commonly identified problems.
- With the rapid increase of population in urban areas, the demand for resources also escalate.
- Due to the concentration of people in a relatively small area an acute urban congestion has resulted. This could be identified in various forms like population pressure, traffic jams, and shortage of houses. For example, in 2001, the density of population in the City of Delhi was 9,340 persons per $km^2$ and it was much more in the central areas of the city.
- In 2004, 4.4 million vehicles per day had been driven on the roads of the City of Delhi alone. It has been estimated that by 2021 this number will double.
- Every resident in urban areas is not engaged in a permanent occupation and many of them are engaged in informal sector jobs such as petty trade, goods transport and taxi drivers. Another group has found employment in anti-social activities such as drug trade, prostitution, theft etc.
- As such urban environment is an area full of anti-social activities.

    - Of the population in Mumbai 31.8 per cent are the victims of crimes and in New Delhi the number is 30.5 per cent.
    - 60 per cent of the people in urban areas all over the world have become victims of crimes of various kinds.

- An acute problem associated with urbanization is the shortage of housing and construction of unauthorized settlements. The poor people with low incomes are occupying these slums and shanties with least facilities.
- The annual demand for urban housing in India is around 2.5 million but only 15 per cent of it is met.

    - In Mumbai alone 48.8 per cent of the population are slum dwellers.
    - There are 4.1 million slum dwellers in Tamil Nadu.

- These slum dwellers do not have toilet facilities and they use common toilets and water facilities.

- A large number of environmental problems also have emerged due to urbanization. They exert a strong effect on the sustenance of the atmosphere, hydrosphere, lithosphere and biosphere

- The atmosphere has been highly polluted due to the emission of smoke and various gases daily by the vehicles and industrial plants in urban areas.

    - In China, urban areas in Beijing and Tianjin rank high in air pollution. These areas are always filled with smog. In 2014, it was found that the smoke/ level of these cities has reached 35 times the highly dangerous level stipulated by the World Health Organization.

    - According to a survey on water resources carried out in 203 towns revealed that the ground and surface water in urban areas have been highly polluted.
      (China Environment Report, 2013).

- Another feature that could be identified in urban areas is social segregation. The concentration of poor low income people in urban areas has created many socioeconomic problems.

- Due to segregation of people along various cleavages such as religion, ethnicity etc. the social divisions and attendant problems in urban areas exhibit an unfavorable facet of urban life.

- The segregation in urban areas taking place due to economic factors has given rise to severe criticisms on the distribution of urban resources. The development in all sectors in areas occupied by the rich people and the underdeveloped status in areas inhabited by poor people can be easily traceable.

- The disposal of solid waste is another grave problem associated with urbanization in developing countries.

- In most developing countries an appropriate methodology or technology is not available for disposal and management of solid waste generated by large numbers of urban people every day.

- Inappropriate disposal of solid waste in urban areas has created health problems as well as environment problems.

    For example, in the cities of Rajahasi and Khulna in Bangladesh, of the entire solid waste 62.5 per cent 72.5 per cent respectively are thrown onto river and canal banks and roadsides. In the City of Manilla, about 50per cent of the solid waste is not removed. In Kampala, 80 per cent is not removed.

- About 5.2 million tons of solid waste is disposed daily from urban areas world over. Of them, 3.8 million tons are disposed from urban areas in developing countries.
- The acute environmental pollution taking place due to rapid urbanization and the unfavorable factors in urban life have resulted in the rapid spread of communicable and uncommunicable diseases in the developing countries.
- As such, many diseases such as diabetics, heart diseases, mental diseases, cancer, skin diseases, diseases associated with the respiratory system can be identified.
- Dengue, Filariasis, Malaria, Diarrhea, Cholera etc. are spreading due to environmental pollution and uncleanliness.
- Diseases like Aids are also spreading rapidly in urban areas.
- The fever diseases resulting from viruses are also spreading in urban areas.

  e.g. Influenza, $AH_1N_1$

- Many diseases that can be seen in urban areas are widely found among urban slum dwellers.
- About 2 million people in the world die annually due to various diseases resulted by environmental pollution.
- Another problem in urban areas is the supply of quality water in sufficient quantities to the community.
- The health of urban people is endangered by the scarcity of water of quality in sufficient quantities.
- In most urban areas both ground water and surface water are polluted.

  e.g. Waste generated by 150 industrial plants is disposed into river 'Kalu" flowing across two suburbs in India.

- The urban population in most developing countries do not have adequate quantities of quality water.

  e.g. The slum dwellers in the City of Mumbai receive a meagre amount of water. (they do not get at least 5 liters of water a day). Mumbai receives its water supplies from Western Ghats about 125 km away.

**Teaching Learning Activities**

- Mark and Name the most urbanized ten countries as well as the least urbanized ten countries in a World map.
- Discuss the problems of urbanization with reference to five developing countries.

**Competency** : **5.0 Studies the nature of urbanization and its problems in Sri Lanka**

**Competency Level** : 5.1 **S**tudies the nature of urbanization in Sri Lanka

5.2 Examines urbanization problems in Sri Lanka

**Time Periods** : 14

**Learning Outcomes :**

- Explains urbanization in Sri Lanka
- Describes the urbanization process in Sri Lanka
- Explains the levels of urbanization in Sri Lanka
- Examines the trends and issues of Sri Lanka's urbanization
- Discusses urbanization related social, economic and environmental problems in Sri Lanka
- Presents solutions to urbanization related social, economic and environmental problems in Sri Lanka

**Introduction** : Sri Lanka occupies the seventh place among the ten least urbanized countries of the world. As such, Sri Lanka is one of the least urbanized countries.

At Census of Population 2012, there were 64 urban areas in the country. Of them, 26 were small towns and there were less than 20,000 people in each of them. The Municipalities of Colombo, Kaduwela, Dehiwala-Mt. Lavinia, Moratuwa, Negombo, Kotte and the Urban Council areas of Kesbewa and Maharagama are the urban areas with large populations. Of the total urban population of Sri Lanka about 50 per cent are living in these urban areas. By 2012, the size of the urban population in Sri Lanka was 3,704,470 and it was about 18.2 per cent of the total population of the country (the level of urbanization).

Although Sri Lanka has attained a relatively higher level of social development compared to other South Asian countries it has lagged behind in terms of urbanization. In spite of the fact that Sri Lanka shows a low level of urbanization compared to other countries of the world, it is facing a large number of problems emerging from urban areas. It is expected from this unit to study the nature of urbanization in Sri Lanka and examine the problems associated with urbanization.

## 5.1 The urbanization Process in Sri Lanka

- Three major factors have effected the urbanization process in Sri Lanka.

    1. Rural – urban migration
    2. Natural increase in population in urban areas
    3. Re-classification of rural areas as urban areas

- Few factors have been responsible for Sri Lanka's low level of urbanization.
    - Absence of conspicuous differences between villages and towns
    - Allocation of resources to rural areas also.
    - With the development of transportation and communication facilities the country becoming smaller
    - Ability to reach any place in the island within a day
    - The disruption of urbanization process in the Northern and Eastern regions of island due to War
    - Inclusion of urban areas (Town Councils) to Pradeshiya Sabha areas
    - Extension of development programmes and industrial activities into rural areas
- Since the absence of war situation the urbanization levels of Sri Lanka would increase
- With the implementation of new urban development plans and policies the urbanization level of Sir Lanka would increase e.g. Western Province Megapolis urban development plan

Urbanization Levels in Si Lanka

- It is possible to study the urbanization levels in Sri Lanka from temporal and spatial perspectives.
- The Table below shows the temporal change in the level of urbanization in Sri Lanka from 1881 to 2012.

Table 5.1 Urban Population of Sri Lanka 1881 -2012

| Census Year | Urban Population | % of Total Population |
|---|---|---|
| 1881 | 281,065 | 10.2 |
| 1891 | 321,413 | 10.7 |
| 1901 | 414,025 | 11.6 |
| 1911 | 542,945 | 13.2 |
| 1921 | 637,870 | 14.2 |
| 1931 | 737,272. | 13.9 |
| 1946 | 1,023,042 | 15.4 |
| 1953 | 1,239,133 | 15.3 |
| 1963 | 2,016,285 | 19.1 |
| 1971 | 2,848,116 | 22.4 |
| 1981 | 3,192,489 | 21.5 |
| 2001 | 2,467,301 | 13.1* |
| 2012 | 3,704,470 | 18.2 |

Source: Sri Lanka, Department of Census and Statistics (2012)
* Estimated Value

- There has been a gradual growth from 1881 to 1971.
- The highest level of urbanization was recorded in 1971.
- The decision to consider only areas administered by Municipalities and Urban Councils as urban following the adoption of Pradeshiya Sabha Act of 1987 the level of urbanization dropped.
- When the spatial pattern of urbanization in Sri Lanka is examined a variation could be identified at Provincial level as well as at District level.

Table 5.2

Spatial Pattern of Urbanization in Sri Lanka, 2012

| Province | District | Total Population | Urban Population | Per cent of Total Population |
|---|---|---|---|---|
| Western Province | Colombo | 2,324,349 | 1,802,904 | 77.6 |
| | Gampaha | 2,304,833 | 360,221 | 15.6 |
| | Kalutara | 1,221,948 | 109,069 | 8.9 |
| Central Province | Kandy | 1,375,382 | 170,544 | 12.4 |
| | Matale | 584,531 | 60,276 | 12.4 |
| | Nuwara Eliya | 711,644 | 40,151 | 5.6 |
| Southern Province | Galle | 1,063,334 | 133,398 | 12.5 |
| | Matara | 814,048 | 96,570 | 11.9 |
| | Hambantota | 599,903 | 31,709 | 5.3 |
| Northern Province | Jaffna | 583,882 | 117,575 | 20.1 |
| | Mannar | 99,570 | 24,417 | 24.5 |
| | Vavuniya | 172,115 | 34,816 | 20.2 |
| | Mullativu | 92,238 | - | - |
| | Kilinochchi | 113,510 | - | - |
| Eastern Province | Batticaloa | 526,567 | 151,226 | 28.7 |
| | Ampara | 649,402 | 153,338 | 23.6 |
| | Trincomalee | 379,541 | 85,123 | 22.4 |
| North-Western Province | Kurunegala | 1,618,465 | 30,342 | 1.9 |
| | Puttalam | 762,396 | 66,952 | 8.8 |
| North-Central Province | Anuradhapura | 860,575 | 50,595 | 5.9 |
| | Polonnaruwa | 406,088 | - | - |
| Uva Province | Badulla | 815,405 | 69,800 | 8.6 |
| | Moneragala | 451,058 | - | - |
| Sabaragamuwa Province | Ratnapura | 1,008,007 | 99,451 | 9.1 |
| | Kegalle | 840,648 | 15,993 | 1.9 |
| **Sri Lanka** | | 20,359,439 | 3,704,470 | 18.2 |

Source: Sri Lanka, Department of Census and Statistics (2012)

- The highest level of urbanization (77.6) is reported from Colombo District.
- Three-fourth of the population of Colombo District live in urban areas.
- Of the total population of Colombo District, 44%, 20%, 15%, 13%, and 8% belong to the Municipalities of Colombo, Kaduwela, Dehiwala-Mount Lavinia, Moratuwa and the Urban Council of Sri Jayewardenepura Kotte, respectively.
- Compared to Colombo District the low level of urbanization in other districts shows an unequal distribution of urbanization in Sri Lanka.

- About one fifth of the total population in the districts of Batticaloa, Ampara and Trincomalee of the Eastern Province and Mannar, Vavuniya, and Jaffna, of the Northern Province, live in urban areas.
- According to available data the lowest levels of urbanization is recorded in the districts of Kurunegala and Kegalle.
- Of the total urban population 15 per cent live in Colombo Municipal area.

**Issues and Trends in Urbanization in Sri Lanka**

- Since urban areas in Sri Lanka are determined only on the basis of administrative criteria real urbanization level is not revealed. For example, Homagama, Beruwala, Weligama etc. have been named as Pradeshiya Sabahs. As such, the level of urbanization in the country is underestimated.
- It is assumed that the real level of urbanization of Si Lanka is around 45per cent (World Bank and Urban Development Authority of Sri Lanka sources).
- Although urbanization has sprawled outward from administrative boundaries of Colombo and other urban areas, the adjoining regions are not considered urban.
- The hidden urbanization level of Sri Lanka indicates that urbanization is on the increase.
- The criteria used to determine urbanization in Sri Lanka should be reconsidered and more broad-based criteria should be adopted to identify urbanization.
- In recent times due to the strengthening of pull factors (improvement in infrastructure facilities) urbanization has intensified.
- The new urban development policies have given priority to the Western Province e.g. Megapolis Programme
- According to the urbanization levels Western Province is followed by Northern and Eastern Provinces.

## 5.2 Problems Associated With Urbanization in Sri Lanka

- Problems associated with urbanization in Sri Lanka are severe in Colombo urban area and adjacent populous suburbs.
- In other major cities, too, these problems could be seen.
- Problems of the provision of public services
- Dilapidated roads and transport problems
- Inadequate water facilities
- Low income slum dwellers obtain their water requirements from common water provisions.
- A major problem encountered by urban people is the poor construction and maintenance of the road and gutter systems.
- Environmental pollution and disposal of solid waste are major problems associated with urbanization.

★ There are 658 industries of varying scale within the Colombo city. Of them, 427 are small scale and another 199 are medium scale. The remaining 32 are large-scale industries (Ratnayake, 2008). The urban air pollution caused by them is enormous.

★ More than 250,000 vehicles are coming into Colombo City daily. They cause air and noise pollution (the lower air layer is filled with carbon, carbon monoxide and poisonous matter like lead).

★ The accumulation of more than 1000 tons of solid waste daily in Colombo City alone is another grave problem.

★ The sewage system in the City of Colombo does not cover many of the areas where low income people live. This has resulted in urban environmental pollution and uncleanness.

★ The housing problem in the areas where slums and shanties of the low-income people are residing is another grave problem.

★ The slum and shanty dwellers do not have adequate water and toilet facilities.

★ These slums and shanties are located on the reservations of railroads, roads, river banks, lowlands subject to frequent floods and in other state lands.

★ On average a shanty is around 100-125square feet in size and its roof and walls are made of plastic sheets, tin sheets, tar sheets or wood planks.

★ In most cases six or more people live in a shanty and there are instances where a few families live in a single shanty.

★ According to a Survey on underserved settlement conducted in 1998 there were 1506 such settlements within the City of Colombo. There were 66,000 housing units in them, and at present, this number is much higher.

★ Inactivity, unhealthy food habits, smoking and drug use, and environmental pollution have led to the spread of communicable and non-communicable diseases. Ailments related to lungs, skin diseases, heart diseases, cancer, diabetics and gastritis, are some of these diseases.

★ Urban environmental pollution has also resulted in the spread of many diseases in urban areas.

e.g. Dengue, Filariasis, Cholera, Diarrhea, Worm diseases

★ In general, unfavorable health habits and life styles have been responsible for the spread of these diseases.

★ The activities of the urban residents themselves have been responsible for the spread of mosquito-related diseases.

★ There are a number of localities of slums and shanties in the city of Colombo.

★ Various diseases and other health problems are associated with these slums and shanties.

★ With the increase of low income communities in urban areas many social problems have emerged.

★ Informal trade, unauthorized trade, prostitution, pickpocketing, drug trade, begging are significant among these social problems. About 60 per cent of the youth in urban slum dwellings are unemployed.

**Measure Taken to Solve the Socioeconomic Problems Associated With Urbanization**

★ Attention should be paid to two main factors In the adoption of solutions for problems associated with urbanization.

- Development of urban infrastructure (housing, drainage, water supply, highways etc.)

- Uplifting the level of living of the urban community (health, education, security, nutrition, income sources)

★ Government has initiated many programmes in order to develop both sectors.

★ The Department of National Physical Development in its publication, "Sri Lanka 2030" has introduced plans for urban development in Sri Lanka. These proposals are implemented with revisions to suit the changing needs.

★ According to the information provided in that document, the urban poor have been provided with housing facilities under the programmes such as programmes covering the urban areas of Colombo, Gampaha and Kalutara, One million Hosing Development Programme and 15 Million Housing Development Programme.

★ Various programmes are being implemented for disposal and management of solid waste in the City of Colombo and other urban areas.

★ Various health programmes are being implemented by the Ministry of Health to improve the urban health and sanitation with the assistance of institutions like Municipalities.

★ Various programmes are being implemented by the Police, Security Forces and other civil organizations in order to prevent urban anti-social activities and reduce urban crimes.

★ Various programmes aimed at creating clean cities by minimizing the urban environmental pollution which is responsible for many communicable and non-communicable diseases are being implemented. It is expected that they will uplift the mental and physical health conditions of the urban community.

**Teaching and Learning Activities**

- Prepare a map showing the urbanization levels by Districts in Sri Lanka.

- Propose solutions for socioeconomic ad environmental problems associated with urbanization in Si Lanka.

**References**

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Ratnayake, RM.K. (2008). The Urban Poor and Environmental Heath, Colombo: S. Godage Brothers.

**Competency** : **6.0** **Analyses recent trends in World Agriculture**

**Competency Level** : 6.1 Explains the characteristics, technology and production of world Agriculture

6.2 Reviews challenges facing agriculture

6.3 Explains the nature, production, technology, marketing process, problems and trends in the agriculture of Sri Lanka

**Periods** : 36

**Leaning Outcomes** :

- Describes concisely the basic characteristics of world agriculture
- Presents facts on agricultural technology
- Accounts for the Increase of world agricultural production
- Examines the problems and challenges relating to technology used in world agriculture
- Offers suggestions to minimize problems relating to world agriculture
- Discusses briefly the origin and evolution of agriculture in Sri Lanka
- Explains basic characteristics of subsistence and commercial agriculture in Sri Lanka
- Discusses the agricultural technology practiced in Sri Lanka
- Explains the production trends in Sri Lanka's agriculture
- Describes the trends in the marketing process of Sri Lanka's agriculture
- Examines the problems and challenges facing Sri Lanka's Agriculture

**Introduction :**

A simple activity in the past, agriculture has become a complex economic activity at present. It is believed that agriculture began in the Late Stone Stage. At present, the majority of the world population are engaged in agriculture and allied economic activities. Due to various factors agriculture varies spatially from one region to another. Practiced for subsistence or commercial purposes, agriculture is significant in the supply of food and agricultural raw materials. With the increase in population the demand for food also increased. Since food supply did not increase in relation to the increase in population,

various technologies were adopted as a solution to the problem. With that food security also increased. To increase agricultural production, techniques to increase yield as well as to expand land area under crops are adopted. In this unit it is expected to study the basic characteristics of world agriculture, the technologies used, expansion in agricultural production, problems and challenges associated with agro-technology, and also the nature, production, technology, marketing process, trends and problems of agriculture in Sri Lanka.

**A guide to clarify the subject matter**

**Agricultural technology**

In order to meet the demand for food and other needs that increased with rapid growth of population improved technologies are being used in agricultural activities. It could be considered under three headings:

1. Green Revolution
2. Gene Technology
3. Organic agriculture

Green Revolution

The high yielding varieties of grain, irrigation, hybrid seeds, artificial fertilizers, pesticides, insecticides and the machinery were introduced to agriculture as a package in the Green Revolution.

Originated in 1943 in Mexico in association with the cultivation of corn, the Green Revolution was pioneered jointly by the USA, United Nations, Food and Agriculture Organization and the Rockefeller Foundation.

Although the initial programme ended in 1963, with the initiation of the World Plan for Food and Agricultural Development it was vitalized and called the Green Revolution.

The Consultative Group on International Agricultural Research established in 1980 to oversee international activities related to Green Revolution conduct research such as Agro-environmental Systems Analysis.

The agricultural technology associated with Green Revolution was executed in two ways:

1. Production of new High Yielding Varieties of Seeds
2. Application of modern technology in agricultural activities

1. Production of new High Yielding Varieties of Seeds

These are produced in many ways:

i. Crossing of Seeds

Crossing of two plants belonging to the same species but with different characteristics to produce a plant variety with desired characteristics.

- many cross bred varieties of paddy have been developed
  IR 8 –produced by the International Rice Research Institute, the Philippines

  The NERICA (New Rice for Africa) a Rice variety introduced to African regions

  IR 36 paddy variety
  TN-1 variety

These varieties are resistant to pests. Their life cycle is short and give a higher yield.

ii. Hybrid Seeds

A method to produce high yielding seed varieties. In this process, genes of two plants are cross pollinated and produce a new plant. The new plant will possess the favorable characteristics of parent plants. (Source: NIE. Grade 12 Agricultural Science Reference Manual).

Example: BG 407 H paddy variety

The NORIN 10 semi-dwarf cultivar, a hybrid variety of wheat produced in Japan, is resistant to strong winds, high rainfall and pests.

**Employment of Modern Technological Methods in Agricultural Activities**

- Use of machinery in agricultural activities

  - In land preparation, broadcasting of seeds and planting
  - Weeding, application of chemicals, irrigation, crop harvesting
  - Machinery ranges from hand tractor to large tractors
  - Use of machinery makes works easy and saves time. In some areas it is a solution to labor shortage. Maintenance and repairing of machines have created job opportunities.
    - Use of artificial fertilizers
      Application of artificial fertilizer is essential in order to obtain a higher yield from improved varieties.
  - Use of information technology in agriculture

Used to obtain information on various factors such as market situation, application of pesticide and supply of irrigation.

**Consequences of Green Revolution**

Green Revolution has resulted in favorable as well as unfavorable consequences.

- Impact on the growth in food production and food security
- Socio-economic and political impacts
- Environmental impacts

**Impact on the growth in food production**

Rapid increase in grain production in a number of developing countries after the Green Revolution

Examples: Mexico which was importing grain became self-sufficient in grain and later started to export grain

Paddy production in the Philippines increased by 30 per cent during the period 1966-77.

These developments increased the food security level, too.

**Socio-economic and political impacts**

- Since agricultural inputs (seeds, fertilizer, agro-chemicals, and machinery) were costly poor farmers were compelled to obtain loans from money lenders and in consequence they became indebtors.

- Due to indebtness poor farmers were forced to sell their farm lands.

- With no land to cultivate they were forced to work as agricultural laborers in rich farmers' lands and, some of them altogether left farming for other jobs

- Rich farmers profiteering from the Green Revolution

- Emergence of economic disparities among farmers

- Due to the increase in food production urban community was able to purchase food at cheaper rates.

- Opportunities for social mobility have been weakened

**Environmental impacts of the Green Revolution**

The ill-effects of the use of artificial fertilizer, insecticides and weedicides

- The use of insecticides and weedicides destroyed fish varieties and edible green vegetables and people were deprived of supplementary food items.

- Increase in eutrophication levels in water due to the mixing of chemicals in fertilizer

- Destruction of biodiversity

- Inputs were manufactured using depleting resources

- Destruction caused to environment as well to farmers by indiscriminate use of fertilizer, insecticides and weedicides

- Many countries became the victims of the multinational companies who produced seeds, fertilizer, agro-chemicals and machinery for agriculture
  e.g. the Philippines

**Gene Technology**

1973 could be considered as the year in which the gene technology activities were initiated. In 1994, the food developed using gene technology began to be marketed. Gene technology is used in various sectors such as agriculture, drug production, industry etc. Under gene technology by separating the DNA molecules, gene of one organism is mixed with that of another organism and produce a novel organism. This could be done with animals as well as plants.

e.g. The BT Corn variety: Genetic mixing of a corn variety with a soil bacterium

Unique characteristics of gene technology:

- Ability to produce pest- resistant plants and animals without the use of chemicals

- Opportunity for minimizing the damage caused to the environment by chemicals

- Ability to produce disease-resistant plants and animals

- Possibility of increasing plant and animal products quantitatively

- Possibility of producing plants and animals tolerant to various environmental conditions
- Increasing the nutritional value of plant and animal products
- Prevention of wastage in vegetables and fruits
- Ability to maintain the freshness of products

**Organic Agriculture**

Organic agriculture is a production process that ensures the protection of the quality of soils and environmental systems and peoples' health conditions. Instead of inputs which are harmful to the environment it consists of a process harmonizing with the natural cycles and biological processes. Organic agriculture, combining tradition, modernity and science delivers its benefits to the community (International Federation of Organic Movements). Currently, there is a tendency toward organic agriculture and it consists of practices like crop rotation, organic fertilization, and biological pest control. Since 1990 food production through organic agriculture has increased rapidly. It has been reported that in 2011 organic agriculture has covered 37 million hectares of land all over the world. A several methodologies are practiced in this process:

1. Soil Management
   The cultivation of legumes stabilizes the nitrogen content of soil. Leaves and compost fertilizers are used. Microorganism activity is fully utilized. Soil is rejuvenated through crop rotation that ensures the supply of nitrogen, phosphorous, and potassium naturally.

2. Weeding

   In weeding biological and chemical methods are used but no artificial weedicides.

   Examples:

   - Use of covers that prevent sun light to weeds.
   - Cutting off weeds and elimination.
   - Destroying weeds through application of excessive heat

3. Prevention of destruction by pests

   Use of predatory insects to control insects that destroy crops. Also, crop rotation makes pests disturbed thereby discouraging their growth.

y 4. Multi-cropping

Mono-cropping results in infertile soils, pests, deterioration in biodiversity etc. Multi-cropping is practiced in organic farming.

Benefits of Organic Agriculture

Organic agriculture produces high quality protective foods. Soil conservation, protection of bio diversity are among other benefits. In general, there are four major benefits:

1. Economic benefits
   Since organic agricultural products are of high quality they have an increasing market.

2. Food security benefits
   Foods with high nutritional value are produced. High production is also a reason.

3. Environmental benefits

   - Improving soil growth
   - Improving biodiversity
   - Absence of gene defacement
   - Minimizing climate change
   - Reducing the consumption of energy resources
   - Protection of landscape

4. Social and Cultural benefits
   - Advantageous for small scale farmers
   - Empowers women
   - Improves traditional wisdom
   - Reduces rural-urban migration

**Expansion in Production**

The growth in agricultural production is induced by the increase in demand for agricultural products. Increase in production has been necessitated by factors such as population growth, use of food crops as bio-fuel, use of grains as animal feed, a large number of people in developing countries suffering from under nutrition etc. About 45 per cent of deaths of children below 5 years of age is due to under-nutrition. Following factors have influenced the increase in production:

1. Intensification
2. Expansion in land under cultivation
3. Short-duration crops

**Intensification**

The agricultural intensification paralleling the use of agricultural technology has resulted in the increase in grain production considerably. It occurred in several ways:

- High Yielding Varieties (HYV)
  e.g. R 8 varieties; Milyang Wheat variety; NORIN 10 Wheat variety

- Use of Artificial fertilizers
  IR 8 rice variety needs four times of fertilizer than that for traditional varieties

- Use of insecticides and weedicides
  It has increased from 1.3 million to 2.9 million tons during the period 1970 – 1990.

- Application of Gene Technology
  Could minimize losses from pests; can reap a high yield - e.g. BT cotton

- Application of soil conservation methods
  Essential for a sustainable agriculture.
  Broadcasting in paddy farming; limited cultivation methods

- Use of modern cultivation methods - e.g. Green Houses; growing plants without soil

- Use of Machinery
  Use of machinery from broadcasting to harvesting is an efficient method.
  The growth in production in Wheat and Rice is given in the Table below:

(Growth in Production in million metric tons)

| Year | Wheat | Rice |
|---|---|---|
| 1995 | 545 | 369 |
| 2000 | 585 | 401 |
| 2010 | 654 | 470 |
| 2014 | 724 | 494 |
| 2020 | 756 | 538 |

**Expansion in Land under Cultivation**

- Of the total land area of the world about 38.4 per cent is used for agricultural activities. However, only 28.4 per cent is suitable for crop cultivation. In 2011, the land suitable for cultivation was about 13,962,000km$^2$.

- The land that could be cultivated has been on the decline due to the decrease in land under paddy cultivation and the use of agricultural land for other human uses. Most countries have reached the upper limit. e.g. Countries in the Western Europe and China.

- Some countries attempt to expand the land area under cultivation by using irrigation. e.g. Wheat lands in Israel, croplands in Egypt.

- Research is being conducted applying various technological methods to desalinate the land that has become infertile due to salinity. Annually, about 2 per cent of the agricultural land is lost due to salinity.

- The area under tropical rain forest is declining due to the use of land for agriculture in tropical regions.

**Short Duration Crops**

Crops that are yielding in a short period of time have been developed by improved seed varieties and the application of gene technology. As a result, it has been possible to cultivate crops that give yields a few times within a year.

e.g. IR 64 is a paddy variety yielding in 115 days.
Sundamaibarley variety in China
BARIMASVR8 lentil variety yields in 110 days.
Wheat varieties yielding in 110 days

The land area under crossed paddy varieties in a few countries of the World

| Country | Land area cultivated (ha) | |
|---|---|---|
| | 1997 | 2000 |
| India | 120,000 | 1,000,000 |
| Vietnam | 100,000 | 500,000 |
| The Philippines | 50 | 100,000 |

Source: http:/en,wickipedia.org.wiki/green-revolution

## 6.2 Challenges faced by Agriculture

Since the traditional agricultural production was not able to meet the demand for food the modern technology was employed gradually. However, it has resulted in too many problems and challenges.

- Use of chemicals
  A few instances of using chemicals in agriculture are given below"

  1 For production of fertilizer
  2 To create the suitable PH value for agricultural lands
  3 For production of pesticides
  4. Annually about 138 million metric tons of fertilizer is used globally.

  If PH value is less than 7 it is an acidic soil. If it is higher than 7 it is an alkaline soil. PH value 7 is neutral. To attain a suitable PH value for crop cultivation calcium carbonate is added to acidic soils and Sulphur to alkaline soils.

  Pesticides are used in four occasions:

  1. In Weeding - Weedicides
  2. To control fungus - Fungicides
  3. To control insects - Insecticides
  4. Other pesticides used to control other organisms harmful to crops

Environmental Impact of the use of chemicals

- Water pollution due to the mixing of chemicals in ground water
- Water poisoning by the intrusion of nitrogen in chemical fertilizers
- Deaths occurring to fish and aquatic life in lakes and rivers due to the in flowing of algae ridden water mixed with fertilizer.
- Life threat due to the accumulation of insecticides such as DDT for a number of years.
  Example: In North America millions of birds died due to Carbofuran.

- Land degradation and desertification

Degradation of land occur due to human activities as well as natural causes. Floods and wild fires are among the natural causes. It is apparent that land degradation and desertification have grown in the context of agriculture that developed after the application of technology following the Green Revolution. Desertification, drought and poverty are interrelated. According to the reports of the United Nations about 250 million people are suffering from desertification and 750 million are at vulnerable conditions.

Human activities have been restricted by land degradation and desertification. The opportunity for agriculture is also limited in these regions.

Agriculture contributes to land degradation and desertification in many ways:

- Deforestation
- Soil erosion
- Salinity caused by irrigation
- Animal husbandry that results in excessive browsing
- Mono-cropping

**A few Solutions to Land Degradation and Desertification**

- Retaining the forest cover in mountainous areas
- Popularization of the use of organic fertilizer instead of chemical fertilizers
- Practice of irrigation ensuring a minimum level of salinization
- Adoption of soil conservation methods
- Expansion of reforestation
- Practicing crop rotation instead of mono-cropping

**Disappearance of Traditional Knowledge**

With the advent of modern agricultural technology traditional customs and traditional knowledge have disappeared. This is the situation world over. Technological methods have resulted in social problems, too.

A few problems emerged due to the disappearance of traditional customs:

- Control of pests by the application of *Kem* methods are an environment-friendly methodology. It has disappeared.
- Non-use of ancient irrigation techniques that minimize salinization
- Disappearance of biological methods of pest control
  E.g. *Kurulu Paluwa* in Sri Lanka
- Distancing from the nature with the loss of respect for agriculture
- Widening gap between generations
- Engage in agriculture with commercial motives and leaving the traditional agriculture
- Increase in social distance with the loss of social bondage and mutual cooperation.

A few solutions to the problem of the disappearance of traditional customs

- Paying attention to sustainable agricultural methods instead of chemicals-oriented agriculture

  e.g. Organic farming

- Inculcating human-friendly and environment-friendly attitudes in people practicing agriculture

**Agricultural Monopoly**

It is clear that the world agriculture is controlled by a few multinational companies. It is these companies that produce inputs such as pesticides, chemical fertilizers, machinery and seeds needed by the modern agriculture initiated by the Green Revolution. Monsanto, Cargills, Syngenta, Du Pont, Do Agro science, Bayer, BASF are few such MNCs. The monopoly of modern agriculture is held by these companies. Since, Monsanto has acquired the patent rights of seeds produced by using gene technology they are the owners of the seeds market and related agricultural products world over.

Problems emerging due to agricultural monopoly

- Destruction of tropical rain forests in order to cultivate crops
- Spread of mono-cropping
- Degradation of bio-diversity
- Poisoning of soil and ground water
- Of the crops produced with gene technology a small proportion is used for human consumption and bio-fuel production, while a larger proportion is for animal feed
- Increase in the impact of pesticides
- Increase in the use of weedicides
- Large amount of money being spent on market advertising
- Discouragement of research on high yield varieties due to gene technology
- Interference in politics and social affairs of countries
- Farmers obtaining loans to purchase inputs and thereby becoming indebtors

  e.g. BT cotton farmers in India
  BT Corn farmers in the Philippines

Health Problems

- Due to the technologies employed in world agriculture many health problems have emerged. Use of pesticides and chemical fertilizer are the major causes.

A few major problems are given below:

- Emergence of the cancer threat

  Diseases such as cancer in lung, bladder and intestine, Leukemia and defacements due to the consumption food containing Glyphosate

- Skin diseases
- Mental stress
- Pain in chest and abdomen
- Development of diseases in spinal code
- Accidents occurring to people who are handling agricultural machinery
- Occurrence of kidney diseases due to pollution of water sources by agrochemicals
- Danger of deposition of agro-chemical in various foods

  E.g. Lotus roots

## 6.3 Agriculture in Sri Lanka

- Sri Lanka has been an agricultural country from the distant past. It is evident that our ancestors had maintained a self-sufficient economy through the adoption of an environment-friendly agricultural life style.

- With the advent of the western powers country's agriculture turned into cultivation of commercial crops resulting not only in the decline of traditional agriculture but also in the emergence of many other problems. Solutions to these problems were sought following the independence but still the dark shadows of the past are seen.

- In the development process attention has to be paid to produce the agricultural products that could be produced locally.

- It is the objective of this unit to study the nature of Sri Lanka's agriculture, agricultural technology used, and trends in production and marketing challenges in the above context.

**A guide to clarify the subject matter**

- Subsistence Agriculture
  - The agriculture practiced mainly for local consumption is called subsistence agriculture.
  - The cultivation of paddy, vegetables, fruits and other food crops (cereals such as green gram, cowpea, maize and onions, potatoes and other root crops in Sri Lanka can be cites examples.
  - Coconut, although considered as a commercial crop, a considerable amount of its production is consumed locally.
  - Cultivation in small and medium-sized land units, intensiveness, and mixed farming, utilization of human and animal labor are the specific characteristics of the subsistence agriculture.

- Commercial agriculture
  - Agriculture which is practiced for marketing is known as commercial agriculture.
  - Tea, coconuts, rubber and minor export crops are in this category.
  - Cultivation in large units of land, extensiveness, use of machinery, adoption of various processing methods, are the characteristics of commercial agriculture.

- **Agricultural Technology**

  - In recent times the demand for food has gradually increased with the population in our country.

  - In response, various strategies were adopted in order to increase food production. Many countries of the world use agricultural technology with a view to increasing food production.

  - There are a few areas in agricultural technology which were emphasized in our country:

    1. Irrigation technology and traditional agricultural knowledge
    2. Green Revolution
    3. Use of modern machinery
    4. Gene Technology
    5. Organic farming

- Irrigation technology and traditional agricultural knowledge
  - Sri Lanka is a country that practiced excellent agricultural techniques with a long history of irrigation technology. There were two types of irrigation:

    1. Gravity Irrigation
    2. Lift Irrigation

Gravity Irrigation

Tanks and the associated canal systems belong to this type. Sri Lanka has a wide range of tanks extending from gigantic tanks (Parakrama Samudra, 7,945 ha) to tanks with very small area (Hurulu Wewa 86 ha).

Lift Irrigation

This method is used for supplying water to highland areas. The water is drawn through Agricultural Wells and Artesian Wells.

- To lift water, sheaves, Andiya method, water wheels and various pumps are used.

- Various methods are used to provide water for crop lands.
  1. Surface irrigation : Water is provided directly along the surface.
  2. Sub-surface irrigation: The maintenance of an artificial water layer in accordance with the soil texture and depth of the plant roots

3. Micro-irrigation : Drip irrigation and sprinkler irrigation; drip irrigation is the method allowing water supplied through a tube to drop on to the plant root drop by drop. In the sprinkler system provided through a system of tubes with tiny holes, water is sprayed to the air to be dropped on plants.

- These irrigation systems are practiced in various parts of the island. They could be seen especially in dry zone areas.

Green Revolution

- In the early years of the 1960 decade, the process followed to increase the yield per unit of land in order to increase production by applying large amount of inputs is called Green Revolution.

- It affected Sri Lanka in the closing years of the 1960 decade. The effects of the Green Revolution can largely be seen in paddy cultivation. Examples for the application of high level of inputs used to increase yield are given below:

  Introduction of new methodologies
  - Mechanization
  - Use of pesticides
  - Use of chemical fertilizers
  - Practice of mono-cropping
  - Application of modern irrigation techniques

  There were many advantages of Green Revolution:
  - Ability to increase production in par with increasing population
  - Rapid increase in yield per unit of land
  - Use of machinery (to cultivate continuously) resulted in less use of human labor

  Unfavorable effects of the Green Revolution could also be seen:
  - Land degradation
  - Environmental pollution
  - Health problems (cancer, kidney diseases)
  - Emergence of insects with resistant capabilities
  - Destruction of bio-diversity
  - Extinction of some plants and animals
  - Emergence of income disparities within the agricultural society

**Use of modern Machinery**

- Compared to other crops there has been a conspicuous change in the use of machinery in paddy cultivation.
  e.g. Use of machinery ranging from hand tractor to combine-harvesters.

- There are few advantages in the use of machinery
  Work becoming easy: the work done by small machinery or human labor earlier could be done at a stretch.
  Time saving: The work that took number of days to be completed could be done in a few hours.

- There are disadvantages also in the use of machinery:
  High cost
  Problem of the removal of human labor
  Difficulty of using machinery in small plots of land
  Impact on environment and soil

**Gene Technology**

- Gene technology had to be introduced to minimize the unfavorable effects of the green revolution.
- Although various strategies were adopted to increase crop production under the green revolution, the limited extent of land available, limitations in the yield potentials necessitated to pay attention to increase in productivity. Gene technology was utilized for crop breeding with a view to increasing crop yields.
- In Sri Lanka, gene technology has been applied more on vegetables and fruits than on paddy cultivation.

  e.g. Vegetables: Ribbed Gourd, Bitter gourd, Egg fruit, Green chillies, Ladies fingers, Pumpkin, Long beans
  Fruits: Papaya, Banana, Pomegranate, Guava, Mangoes, Grapes
  Roots: Manioc
- Gene technology has increased the yield potential. Even the color and shape of food crops have been changed.

- Although Gene Technology has improved the yield potential, problems have emerged about the quality and taste of the food items.

**Organic Farming**

- Attention has been focused on organic farming with a view to minimizing the unfavorable effects on the country's agriculture caused by the artificial fertilizers and artificial pesticides.

- A measure that has been adopted at present is the use of organic manure instead of artificial fertilizers.
  e.g. Green manure, farm waste, compost fertilizer, carbonic liquids

- In place of artificial pesticides local methods are becoming popular:
  e.g Neem extract
  Liquid cow dung
  Marigold flower extract
  Various *Kem* methods (curious beliefs)

- The number of crops being cultivated under organic farming are on the increase and there is an increasing demand for its products.

- Organic farming is, on one hand, environment-friendly and, on the other, a support for the production of food crops favorable for human health.

**Production trends**

A few trends could be cited in relation agricultural production in Sri Lanka.

1. Increasing the yield
2. Post-harvesting technology
3. Use of modern machinery

- Increasing the yield
  - Various strategies have been adopted during the past.
  - Use of high yielding seed varieties
    BG 364 140-160 bushels per acre
    BG 407 H 300 bushels per acre
    At 362 150 bushels per acre (paddy varieties)

  - Old tea and rubber plantations were replanted
  - Use of fertilizers, insecticides and weedicide
  - Cultivation of land for number of times within a year (seasons)
  - Crop diversification
  - Good Management

Post-harvesting technology

- Steps have to be taken to deliver the agricultural products to the consumer with specific standards

- In our country agricultural produce is wasted in many ways.
  e.g. In production : paddy, rubber
  in transport : vegetables and fruits
  in packing and storage: paddy, tea, vegetables, fruits, other grains

- Steps which have been taken in recent times to prevent wastage
  - ❖ Use of methods to keep them for a longer period
  - ❖ Use of polythene covers to protect rubber latex from rain
  - ❖ Methods used to protect fruits and vegetables in transport
  - ❖ Use of baskets in packaging
  - ❖ Use of speedy transport methods
  - ❖ Use of vehicles with refrigeration facilities
  - ❖ Systematic storage facilities
  - ❖ Use of various methods in the market to maintain freshness (as in super markets)

Use of modern machinery

- Use of modern machinery in production, transport and storage can be identified as a new trend.

- New machinery is mostly used in the production process of plantation crops.
  e.g. New machinery used in tea factories and use new machinery in rubber and coconut production.

- Use of containers in transportation
  e.g. in exporting tea, rubber and coconut products

- Use of deep freezers for storage

**Marketing Process**

- The marketing process of agricultural produce in Sri Lanka is implemented through two major channels:

  1. Private channels
  2. Government channel

- The structure of the internal trade consists of two sectors:

    1. Wholesale trade
    2. Retail trade

- Various trading centres are also functioning in country

State sector

Cooperative shops
Corporations and state institutions
Specialized Economic Centres

Private sector

Retail shops
Groceries
Super markets
Pavement traders
Mobile traders
Weekly fairs

Specialized Economic Centres

- Provision of a reasonable price for farm products
- Opportunity for selling directly to the trader overlooking the middleman; As such the farmer could obtain higher price for his produce.
- Opportunity for the consumer to purchase farm products at a reasonable price
- Specialized Economic Centres are located at Dambulla, Meegoda, Narahenpita, Thambuttegama, Keppetipola and Welisara.

- Emphasis on quality
    - The present consumer is very particular about the quality of the products when purchasing them. He pays attention to several factors:

        - Product type
        - Institution that made the product
        - Dates of manufacture and expiry
        - Certificate of Standard
        - Healthiness
        - Correct weight
        - Nature of packaging

- As such, the manufacturer as well as the trader is required to pay attention to above factors.

    e.g. keeping food stuffs protectively in the shop and refrain from touching them at selling (bakery products)

Concern about the consumer taste and comfort

- At present, it seems that special attention is being paid to above aspects.
  e.g. Rice free of sand and stones
  Powdered coconut milk
  Processed and packeted leafy vegetable *mallung*

- Paying attention to purchasing power (ability to buy)
  e.g. Packets of varying size
  Opportunity of purchasing only the required quantity

- Attractive packaging

Super markets

- The super markets of western style that began in the 1970 decade are spreading from urban areas to rural areas at present.

- In these super markets, not only the agricultural products but also the industrial products and various services could be purchased 'under one roof'.

- Not only the private sector but also the state sector, too, maintains super markets.
  e.g. Private sector - Cargills, Keels, Arpico
  State sector - SATHOSA (CWE)

- A large number of strategies are being adopted in marketing of goods in these super markets. They have been organized to attract clients.

  Examples:

  - Availability of a range of products for selection
  - Packaging of products stimulating consumer taste
  - Provision of necessary information on the package
  - Ability to purchase the required quantity (vegetables and fruits)
  - Opportunity for selecting only the products in good condition
  - Display of goods attractively
  - Other facilities provided to clientele (for vehicle parking, games for children, trolleys and carrying bags)
  - Staff uniforms, politeness, readiness to assist)
  - Clinging of consumers using various strategies (discount cards, credit cards, promotions schemes during festival seasons)

- It is an unfavorable consequence that retail traders both in rural as well as in urban areas suffer losses because of super markets.

**Challenges facing agriculture in Sri Lanka**

- There are several challenges faced by the agriculture in Sri Lanka.
    - Loss of agricultural land and degradation

      Although paddy lands and homesteads were expanded in the Dry Zone due to the Mahaweli Development Programme, in the Wet Zone paddy lands are being used for other purposes. Also, coconut lands are being used for building construction and other development activities in urban areas.

- Importation of food products; the reduction or removal of import duties in certain periods have affected the local agriculture adversely.

  e.g. Potato and Big onion cultivation

- Unfavorable weather conditions

  Harvests have been destroyed due to drought, high rainfall, soil erosion, landslides, siltation of waterways.

    - Backward technology and techniques

      Yields have declined and wasted due to the non-development of technologies appropriate to local agriculture, soil conditions and environmental factors. It is important to introduce new technology to prevent the effects of the labor shortage created by the withdrawal of youth from agriculture.

    - Increase in the cost of production
        - In recent times cost of production has increased.
        - The increase in the cost of imported inputs has been a reason; cost of chemical fertilizers, insecticides, and agricultural implements have increased.

    - Marketing problems
        - Marketing problems in agricultural products are mostly seen in respect of vegetables, fruits and grains.
        - In the commercial agriculture, too, marketing problems can be seen.
        - These problems could be seen within the country as well in international markets.
        - If the producer fails to get a reasonable price for his product a problem arises. It is also a problem when consumers fail to purchase goods at reasonable prices. In such situations it is the middle men who reap the benefits.

**Activity**:

Writing a brief report on recent trends in the agriculture of Sri Lanka and the changes that have taken place in association with those trends.

| | | | |
|---|---|---|---|
| **Competency** | **:** | **1.0** | **Uses geographical techniques to describe, analyze and present data and information** |
| **Competency Level** | **:** | 1.1 | Examines the importance of practical geography in geographical studies |
| | | 1.2 | Describes the importance of techniques used in practical geography |
| **Periods** | **:** | 06 | |

**Learning Outcomes :**

- Describes the importance of practical geography
- Describes that geographical information could be presented by different techniques
- Explains that Practical Geography helps to arrive at informed decisions

**Introduction :** A major objective of Geography is to study the interrelationships between physical and human phenomena from temporal and spatial perspectives. It is done with the assistance of data and information collected from various field studies. It is for this reason that various practical techniques have emerged to collect and present those data and information. With the development in science and technology techniques used in practical geography also improve.

It is apparent from the study of curricula of many countries that field of geography and the subject of practical geography are interwoven. It is expected from the present unit to study the scope of practical geography and the significance of the specific techniques used.

**A guide to clarify the subject matter**

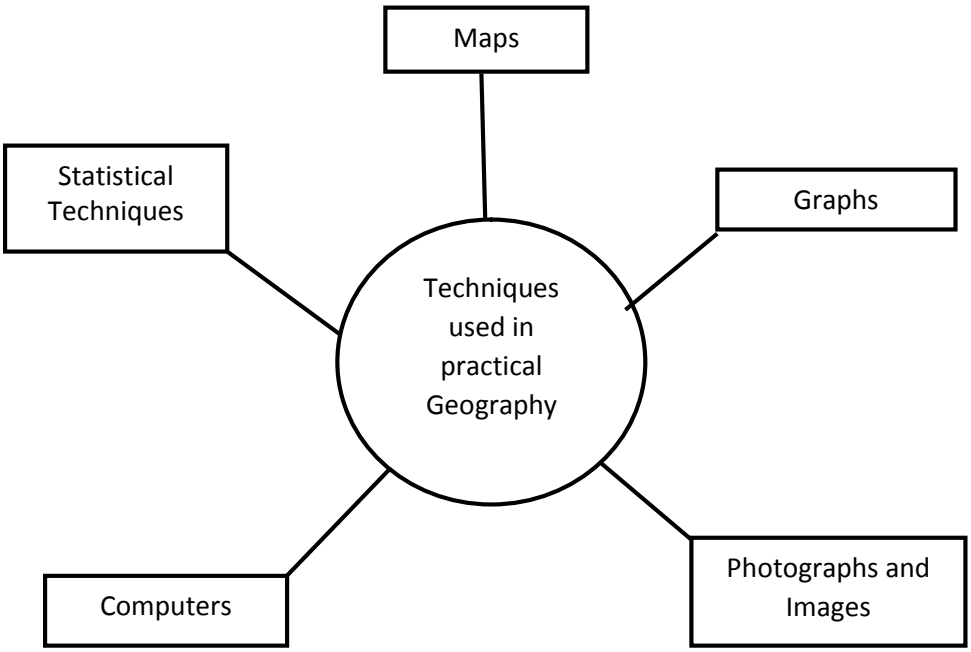
1.1 **Importance of Practical Geography**:

- In Geography various methodologies are used to grasp the complexities of human activities associated with the spatial variation and temporal change in natural phenomena.
- Geography was known from the earliest times as a subject that studies facts of practical value.

- Field work became an essential component of geography due to the necessity of collecting and presenting information on physical foundations and human activities.
- In the collection, interpretation and presentation of data and information various techniques are used in geography.
- The branch that developed with geography for that purpose is known as practical geography.
- With the current developments in technology, techniques used in practical geography have improved rapidly.

## 1.2 Various techniques used in practical geography

- The simplest method used in most subjects to present information is to provide descriptive notes.
- However, in geography, there are specific techniques to present information.




- Maps have a long history as a technique.
- Gradually, the other techniques were added to geography.
- In the modern era, too, new techniques are being added and they tend to change rapidly.

- **Physical and human geographical information that can be extracted by various techniques**

  - **Maps**
    - A long printed description of information is concisely shown by a map
    - Maps may be described as the standard picture of the Earth viewed from outside
    - Used as a technique since the era before Christ (Eratosthenes measured the circumference of the Earth; Ptolemy's map)
    - Mostly used to show spatial distributions (World's paddy cultivation area; World population distribution)
    - Maps are used to present temporal change, too. (e.g. Continental Drift from Pangaea to the present; evolution of rail roads in Sri Lanka)

  - **Graphs**
    - Graphs are used to present and understand data and information.
    - There are various graphical techniques such as line graphs, bar graphs and circular graphs etc.
    - Graphs are mostly used to present temporal data (e.g. import and export trade over the years; arrival of tourists during the past years).
    - Spatial data also are represented by graphs. (e.g. distribution of major crops in Sri Lanka by districts)

  - **Photographs and Images**
    - At present various types of photographs are used in practical geography
    - Photographs of the earth surface taken from average cameras are widely used. Photographs included in books and publications, and in visual media like television and computers are examples. (e.g., tea cultivation in highlands, area covered with snow, traffic congestion in a city)
    - Air photographs were used following the production of air planes. They were used in war fare and also for preparation of maps.
    - Satellite images could be identified as a modern cartographic technique. The data contained in satellite images are highly accurate. Also, data pertaining to different time periods can be derived from this technique (e.g. Google Earth).

  - **Computers**
    - Used in complex activities such as data storing and information, updating, analysis, processing and presentation

- Computers are used to install Geographical Information Systems and Global Positioning System

- **Statistical Techniques**

  - It is necessary to collect, analyze and present data related to geography

  - In such instances, statistical techniques are used. (e.g., Central tendency; Measures of Dispersion)

- The use of practical geographical methods is important in the synthesis of information and arriving at decisions.

  - These techniques are widely used in the analysis and making decisions based
    on the data related to physical and human geography.

  - In 1854, Dr. John Snow, an Englishman, used maps to study the distribution of cholera in the City of London. After mapping the location of pumping stations and the distribution of the number of people died of cholera, it was discovered that the water supplied from a pumping station located in a specific environment was responsible for the spread of the epidemic.

  - At present, practical geographical techniques are widely used in processing of weather data. Data derived from weather satellites are analyzed and used for prediction with the help of statistical methods and computers.

  - Modern geographical techniques are used in navigation in sea, air and land. Navigation instruments are fitted even in vehicles. These mapping techniques are incorporated into the mobile phones at present.

  - Climatic changes taking place at global, regional and local levels affect the functioning of the biosphere. Modern geographical techniques are used to derive correct information on phenomena such as El Nino, La Nina and global warming.

  - Geographical techniques are also being used to inform about disasters in advance and to take decisions in disaster management. In making early warnings about cyclones and Tsunami geographical techniques are used.

  - Also, in explaining large scale physical phenomena geographical techniques are of importance. (e.g. preparation of maps to explain geo-tectonics).

  - Data derived from satellite images are used to understand the physical environment and the problems encountered by mankind. They are of use in the management of those problems and taking decisions.

- **Use of practical geographical techniques in the communication of geographical information**

  - Information on spatial and temporal distribution of physical and human landscape can be described as geographical information.
  - At present, it is of paramount importance to communicate those information to the general public.
  - A huge amount of information has to be delivered to the public daily.
  - Some geographical information need to be communicated with special effort to make them easily understandable. In such circumstances practical geographical technical come in handy.

    e.g. 1. **Weather forecast**:

    Maps, graphs, diagrams, photographs, statistical data and computers are used.

    2. **Future development plans**:

    Map collection in the Physical Development Plan of Sri Lanka 2030.

    **3. Disaster management:**
    Early warnings, identifying the location where the disaster occurred; Locating secured places; mitigating the damage; post-management activities

    4. **In the teaching learning process** in geography geographical techniques are widely practiced. Maps, graphs, statistical data and computers are used.

    5. **The geographical information used** in lectures and presentations are explained with geographical techniques.

    6. **In the preparation of books and other documents** in geography these techniques are widely used.

    **7. Warfare**:
    Special military maps on relief. At present, GPS technology is used in the preparation of those maps.

- **Activity**

  Prepare a document with examples of geographical techniques that could be used to present geographical information in the area surrounding your school.

| | | | |
|---|---|---|---|
| **Competency** | **:** | **2.0** | **Emphasizes the importance of cartographic techniques used to present and interpret data and information** |
| **Competency Level** | **:** | 2.1 | Describes the importance of cartographical techniques used in geography |
| | | 2.2 | Identifies the modern cartographic techniques in geography and examines their importance and uses |
| **Periods** | **:** | 24 | |

**Learning Outcomes :**

- Introduces modern cartographic techniques
- Describes the common characteristics of modern cartographic Techniques
- Explains the difference between thematic and topographic maps
- Describes the uses and importance of modern cartographic techniques
- Introduces modern cartographic techniques
- Describes the common characteristics of modern cartographic techniques
- Describes the uses and importance of modern cartographic techniques

**A guideline to clarify the subject matter**

**Introduction to Maps**

2.1 Various interpretations could be presented about maps.

- 'Map is a presentation of the landscape in a miniature form. It is a summary of the real landscape.'
- 'The function of a map is the presentation of a large amount of information using symbols, color, letters and numerals.'
- In geography maps are used to present spatial and temporal dimensions.

  - Based on the information contained in maps they are categorized into two main types:
    1. Thematic Maps

2. Topographic Maps

In Thematic Maps, the selected information pertaining to a specific theme is presented in a single map. A few examples are given below:

- Relief features in Sri Lanka
- Drainage in Sri Lanka
- Distribution of Natural Vegetation in the World
- Political Divisions of the World
- District Boundaries of Sri Lanka
- Distribution of Tea land in Sri Lanka
- World Population Distribution
- Tourist Centres in Sri Lanka
- Ancient Cities of Sri Lanka

- Each and every map mentioned above have been based on a single theme. Most of the maps included in the Atlases are thematic maps.

- Thematic maps are prepared in various ways:
  - Choropleth maps
  - Isopleth maps
  - Dot Maps, etc.

- A Topographic map could be described as an attempt to represent the physical and cultural features of the real landscape in a single map according to a scale. Accordingly, a large amount of information such as relief, drainage, natural vegetation, land use, road network, administrative boundaries, tourism information, special buildings, historical places and developed regions are included in a topographic map.

  A few examples are given below:
  - 1:50,000 Map Series of Sri Lanka
  - 1:10,000 Map Series of Sri Lanka
  - 1:24,000 Map Series of the United States of America
  - 1:50,000 Map Series of Canada
  - 1:50,000 Map Series of the United Kingdom
- Uniqueness of the Topographic Maps
  - According to the scale topographic maps could be considered as medium scale or large scale maps. As far as the amount of information contained they can be represented only by a large scale map.

- As the scale is large, they are prepared in a series consisting of number of sheets. The 1:50,000 topographic map series is an example.

- In the preparation of these maps information is gathered from field visits. At present, Arial photographs and satellite images are also utilized.

- Since many geographical features are represented in these maps, various colors, symbols, letters and numerals are used to denote them. They are internationally accepted symbols and digital characters.

- A special characteristic of the topographic map is the ease of understanding the interrelationship between physical features and cultural characteristics.

- Uses of Thematic Maps

1. Speciality of a single theme
   - Road map of Sri Lanka
   - Tourist map
2. Ability to consider a single theme of a region (of a country or world).
   e.g. Political Divisions
3. Ability to compare the temporal changes of a single theme depicted by a number of thematic maps
   e.g. Changes in the distribution of population of Sri Lanka during number of years
4. Ability to depict the spatial variation of a single theme within a single thematic map.
   e.g. The variation in the extent of paddy land by districts in Sri Lanka
5. Ease of use due to its smallness
   e.g. Atlas

- Uses of Topographic Maps

1. Ease of reading the spatial distribution of physical features of the area.
2. Ability to indicate the relative and specific locations of a place.
   e.g. According to adjacent relief features, metric coordinates, latitudes and longitudes
3. Ease of understanding the relationship between topographic features
   e.g.
   - Relationship between physical features (relief and drainage)
   - Relationship between cultural features (road network and settlements)

- Relationship between physical and cultural features (relief and agricultural lands; relief and road network; drainage and irrigation canals)

4. Possibility of using for development and planning activities of a region or a country. e.g. Using the 1:10,000 map series for the development of agricultural land in Sri Lanka

**Activity**

1. Using an Atlas, prepare a document with examples for various thematic maps.
2. Classify the maps included in the document as,
    A. Thematic maps depicting physical features
    B. Thematic maps depicting cultural features

**Sources:**


- Department of Educational Publications (1995). Practical Geography
- Department of Surveys, Sri Lanka (2007). National Atlas of Sri Lanka.
- Gunasena, M. D. (2003). New Gunasena Phillips World Atlas

## 2.2 Modern cartographic techniques

Maps are used as tools to show the spatial distribution patterns of physical and human landscapes. Until recently, printed maps were widely used for this purpose. But, with the developments in modern technological equipment and methodologies, computers satellite technology and digital maps are being used for this purpose at present. As such, digital maps have become a multifunctional tool that presents geographical information in a more helpful and efficient manner.

It is expected from this unit to explain and study the uses of the modern cartographic techniques, namely, the Geographical Information Systems (GIS), Remote Sensing (RS) and the Global Positioning System (GPS).

- **The modern technological methods used for mapping and their uses**

  - The progress in current information and communication technology has impacted immensely on the development of cartography.
  - A large number of software related to this field has been developed to date and they will be further developed.
  - Owing to the use of computers and software it has been possible to construct maps more accurately and to collect, analyze and present geographical data and information easily.
  - Three modern technological methods are used for this purpose:

    1. Geographical Information Systems (GIS)
    2. Global Positioning System (GPS).
    3. Remote Sensing (RS)

- **Common characteristics of modern cartographic techniques**
  - Incorporation of various information gathered with the help of improved technological and communication apparatus.
  - Ability to show the accurate location using global and national coordinates.
  - Possibility of identifying accurately the parameters such as correct length, width and height of the spatial information mapped.
  - Possibility of acquiring spatial as well as aspatial information of a particular area from the maps
  - Possibility of using updated maps continuously due to the facility of updating the information contained in modern maps.
  - Possibility of storage, use and mobility of large amount of information

- **Geographical Information Systems (GIS)**
  Geographical Information Systems could be described as a methodology used to capture, store, manipulate and display of geospatial information using computer hardware and software.

    - There are five components in a geographical Information systems.

        1. Computer hardware
        2. Computer software
        3. Data
        4. Users
        5. Methods

## 1. Hardware in Geographical Information Systems

- Computer
  It is essential to have a suitable computer to install a geographical information system. It should possess,
  - A Central Processing Unit with high speed data processing ability (CPU)
  - High Capacity Random Access Memory (RAM)
  - Hard Disk with high storage capacity.

- Input Devices
  The following components are necessary to transform geographical data into digital data to feed them into the computer.

  - Magnetic Disk
  - Digitizing Tablet/Board
  - Scanners
  - On-screen Digitizer

- Output Devices

  - Monitor
  - Printer

**2. Software**

It is necessary to install a specific geographical information systems software in the computer. These software are used to store, analyze and display geographical data and information. A few such software are given below:

- MapInfo
- Arc View GIS
- Arc GIS
- Intergraph
- Global Mapper
- GRASS
- SAGA GIS
- ILWIS
- IDRISI

**3. Data**

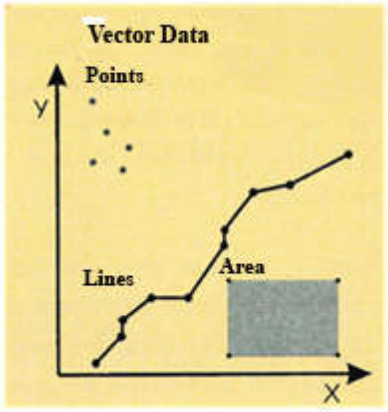
Data in a GIS are of two types.

1. **Spatial Data**:
   Data relating to geographical features that can be presented by coordinates (e.g. distribution of crops, location of a country, roads, rivers, cities)

2. **Aspatial Data**:
   Attribute data relating to spatial data (e.g. Size of population, land extent under crops, length of a road).

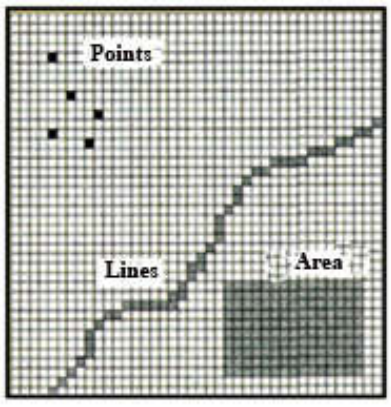
Data in a GIS can be stored in two formats.

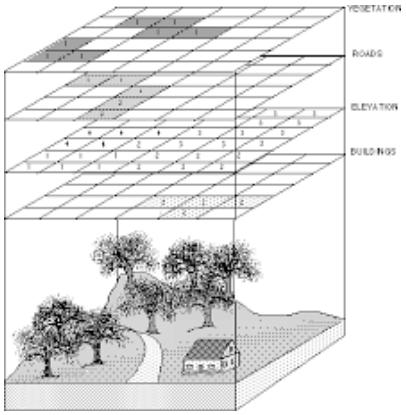
1. Vector data format
   In this format all geographical features are represented as **points, lines and polygons.**




e.g. **Points** : Buildings, a well
**Lines** : Roads, Rivers or canals
**Polygons** : Reservoir, Cropped area that possess an area

2. Raster Data format
   In this format map area is transformed into columns and rows. The squares or pixels are given numerical values.



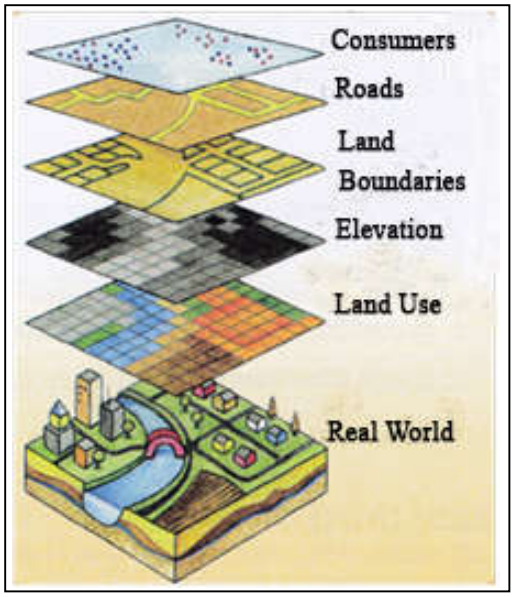
## 4. Users

The efficiency of the Geographical Information Systems depends on the availability of the persons skilled in that field. They consist of operators, technicians, data analysts, systems engineers and management personnel.

## 5. Methods

- Different methodologies could be used to operate GIS.
- As such it is important to employ a method suitable to one's objective.

## GIS: Uses and Significance




1. Ability to store various information contained in a map as data layers and use them separately.
   e.g. It is possible to retrieve only the road network shown in a map.

2. Ability to analyze information in 3D map format. A map fed into a GIS could be retrieved as a three-dimensional map. Compared to two-dimensional maps they could be analyzed more efficiently.


3. Another special feature is the ability to analyze not only the spatial data but also the non-spatial data.
   e.g. The number of wells and their distribution are spatial data but the quality of their water as well their depth are non-spatial or aspatial data.

4. Since the data could be updated instantly it is always possible to produce maps with new information.

5. Since maps constructed with GIS are made according to global and national coordinates it is possible to obtain parameters in maps such as location, scale and area accurately.

6. Since the subjective errors in vector maps are minimized in GIS maps it possible to obtain accurate perspective maps.

7. It is possible to store, use and move a large number of maps with ease.

8. Data contained in GIS are multi-disciplinary and therefore they could be used not only in geography but also in various other disciplines such as environmental science, agriculture, engineering and sociology.

- **Global Positioning System - GPS**

The navigational system comprising a satellites system launched into the earth's orbit to identify the exact location of an object or a feature on the earth according to their coordinates is called the Global Positioning System.

This is a data source for the Geographical Information Systems.

GPS consists of three segments.

1. **Space segment**: The satellite system launched into the space.

- The number of satellites launched into the space at an elevation around 22,200 km is about 31 and, of them, a minimum of 24 contribute to the functioning of the GPS. The additional 7 satellites have been placed in the orbit to be utilized in an emergency situation.

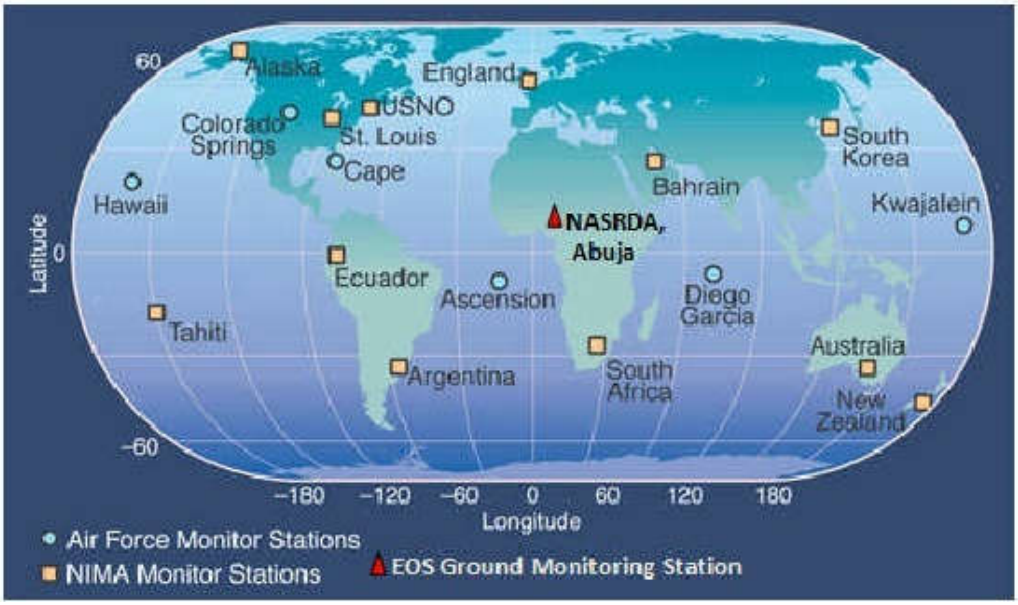
- Each satellite revolves around the earth on an allotted orbit twice a day at a speed around 11,000 km per hour.

- Generally, four satellites are placed in order to observe one orbital plane and accordingly, the earth's surface has been divided into 6 zones in this process.

- The Earth's images thus obtained indicate their exact location according to their global coordinates.

**2. Control Segment**

- The reception and monitoring of satellite information is done by a **Master Control Centre** assisted by another four **Monitoring Stations** and a number of **Antenna Stations**.




- The Master Control Centre is located in Colorado in the United States of America.

- The Monitoring Stations are located in the Hawaii Islands, Ascension Islands, Diego Garcia, Colorado Springs, Kwajalein Atoll and Cape Canaveral.

**3. User Segment**

- The users of GPS technology belong to this segment.

- In GPS, the users obtain information through an instrument called the GPS Receiver. This instrument could be carried in hand or fitted onto a dashboard of a vehicle.

- In modern mobile phones, too, GPS receivers are installed.

- Uses of GPS

  The uses of GPS extend in a wide range.

  - Ability to know exact location of a person
  - Ability to identify the exact location of a specific place related to an Incident
  - Ability to identify access roads

- Various fields in which GPS is used

  - Communication activities
  - Air travel
  - Naval transportation
  - Land transportation
  - Fisheries
  - Mineral exploration
  - Geological surveys
  - Cartography
  - Meteorological analyses
  - Cadastral surveys
  - Military and Defense activities

- Remote Sensing

- The technique of identifying, studying, understanding and analyzing an object or activity without physically approaching it is called remote sensing.

- Capturing, processing and analyzing of energy emitted or reflected by an object is done in remote sensing.

- Remote sensing provides data and information for constructing maps but does not make maps by itself.

- In the past, maps were made from data collected by visiting the field physically. But, in remote sensing technology, data are collected by an instrument placed in the distant sky or space and use them for map making.

- In remote sensing several methods are employed to collect data. They are,

    1. Remote sensing Platforms
    2. Areal Photographic technology
    3. Satellite technology

Remote Sensing Platforms

- A carrier that transports instruments needed for remote sensing process is called a remote sensing platform.

- There are three types of such platforms.
    - Ground-based platforms
    - Air-borne platforms
    - Space–borne platforms

- A remote sensing instruments kit fitted to a crane mounted on a moving vehicle or a tower is known as a ground-based platform. Their height isabout50m.

- The aero planes fitted with instruments such as cameras and films needed for capture features of the land from sky are known as air-borne platforms. Air planes, helicopters, drones, pirigibles, balloons and blimps are used in this technology.

- Rockets, satellites and space crafts are used as space-borne platforms.
  They could be classified according to their flight altitude as follows:

    - Space Shuttles (250km – 300 km)
    - Space Stations (300km – 400km)
    - Low-altitude satellites (700km – 1500km)
    - High-altitude satellites (36,000km)

The features captured form airborne platforms and satellite images captured from space-borne platforms contribute immensely to remote sensing.

**Arial Photographic technology**

- Arial photograph is a photo of a selected area of the land taken by an air plane flying along a specific path at a specific scale.
- According to the angle of the photographing they can be classified as follows:

    - Vertical aerial photographs
    - Oblique aerial photographs

- When vertical air photos are taken the optical axis of the camera is perpendicular to the earth's surface.
- When oblique air photos are taken the optical axis of the camera is not perpendicular to the earth's surface. In such photographs the features of the earth's surface could be seen be three-dimensionally.

**Satellite Technology**

- The capturing of data by the instruments mounted on the man-made satellites and sending them as digital data to the receiving stations located at various places of the earth is known as satellite technology.

- The satellite technology encompasses the analysis and interpretation of the data thus obtained.

- According to the nature of their location and orbital path there are two types of satellites.

    - Geosynchronous/Geostationary Satellites
    - Polar Orbit Satellites

- The Geosynchronous/Geostationary Satellites are located permanently at specific places in the sky. They revolve around the earth at a time corresponding to the earth's rotation time.

- The Polar orbit satellites have been launched onto the orbit in parallel to longitudes thus enabling them to revolve across the two poles

**Competency** : **3.0** **Acts with an understanding of the basic concepts necessary to interpret physical and human landscape depicted in a map**

**Competency Level** : 3.1 Identifies the peripheral information provided in a map

3.2 Identifies the physical and cultural features depicted in a topographic map

**Time Periods** : 20

**Learning Outcomes** :

- Explains the peripheral information that helps in reading 1:50,000 topographic maps
- Draws physical and cultural features depicted in a topographic map

**Introduction** : A large amount of information on the physical and human landscape of a particular region could be included in a topographic map. The physical and human geographical information such as location, relief, drainage, natural vegetation, irrigation, land use, road network, administrative boundaries, and settlements are important among them.

The 1:50,000 topographic map published by the Survey General Department of Sri Lanka is such a map with a large amount of information. Later, a series of urban maps at 1:10,000 scale was also prepared. It is apparent from these maps that as the scale of a map is increased the amount of information that could be displayed in the map also increases.

In the preparation of a map special attention should be paid to fundamentals such as location, scale and direction. Also, a legend should be included to facilitate the reading of the map. Lines, symbols, letters and colors are used to represent various information in a map.

The objective of this unit is to understand the basic concepts that helps to interpret maps by studying the information given in 1:50,000 topographic maps of Sri Lanka.

**A guide to clarify the subject matter**

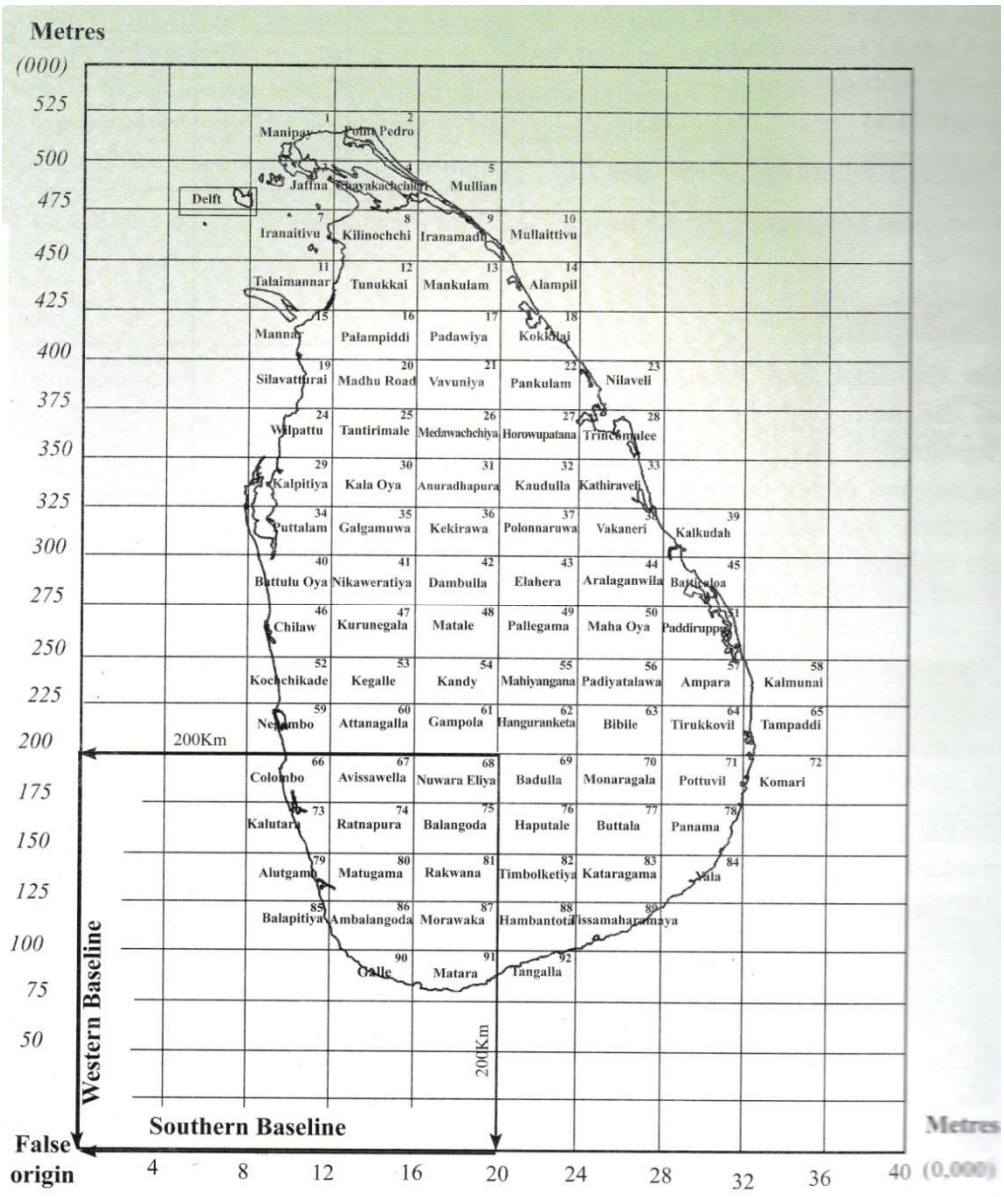
- Introduction to 1:50,000 topographic map of Sri Lanka

  - Size

    Length - 432 km x 2 cm = 864 cm
    Width - 224 km x 2 cm = 448 cm

  - Topography of Sri Lanka is presented in 92 map sheets

  - The following map sheets are combined:




57 and 58
64 and 65
71 and 72

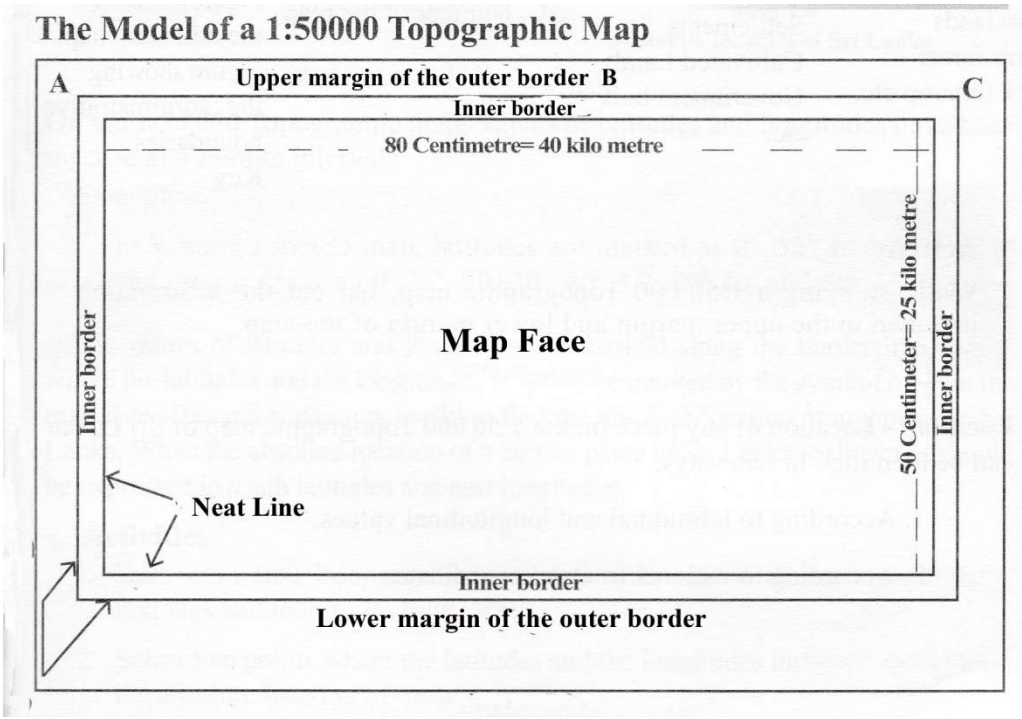
As such there are only 89 map sheets.

- **Layout of a 1:50,000 topographic map**

  A Map Title

  B Title of the map sheet

  C Map Number




- Information contained in a 1:50,000 topographic map

| | |
|---|---|
| Map Face - | Relief |
| | Drainage |
| | Natural Vegetation |
| | Administrative Boundaries |
| | Road Network |
| | Land Use |
| | Buildings |
| | Irrigation |
| | Settlements |
| Peripheral Information - | Basic Information on the map sheet (Title, Number etc.) |
| | Scale |
| | Direction |
| | Location (Latitudes, Longitudes, Metric Coordinates) |
| | Adjacent maps |
| | Legend |

- Location

  Methods that could be employed to indicate the location of a place shown in the 1:50,000 map

  Relative location: indicating the location in relation to another feature
  e.g. In relation to administrative boundaries
  in relation to adjacent maps

  Absolute location: By latitudes and longitudes
  According to the metric net

  Scale :
  - The ratio between real landscape and the map.
  - In 1:50,000 maps scale is shown in two methods
    1. Representative fraction
    2. Linear scale
  - How they are shown and their uses.

- Direction : The diagram showing the direction in 1:50,000 maps

  Grid North - The north of the grid on which the map is based.
  True North - Direction of the North Pole
  Magnetic North - North shown by the compass

  The meaning of these directions and how they are used.

- Legend : In 1:50,000 maps the legend consists of eight major headings.
  - Boundary
  - Tourist Information
  - Roads
  - Rail roads
  - Vegetation
  - Drainage
  - Relief
  - Other features
  - Symbols, colours, letters and numeral features of the area.
  - Importance of legend in reading the map to understand the information it contains.

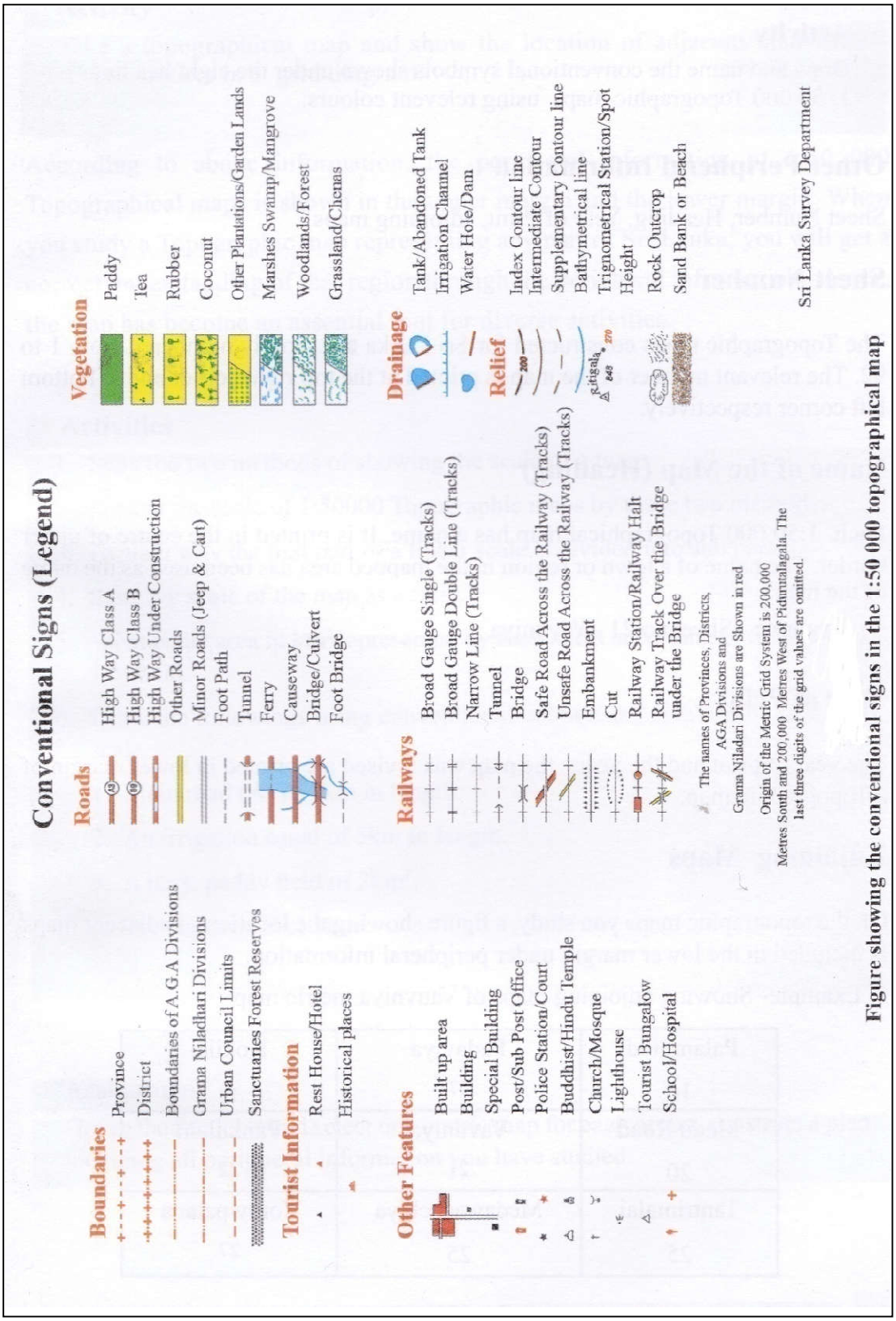



**Figure showing the conventional signs in the 1:50 000 topographical map**

**Activity**

Select one or few 1:50,000 topographic maps of Sri Lanka. Find examples for information given in the legend and prepare a table with their locations according to latitude, longitude and metric coordinates.

## 3.2 Identifies the physical and cultural features depicted in a topographic map

A multitude of information is contained in a 1:50,000 topographic map of Sri Lanka.

The large amount of information contained in the map is useful for a comprehensive study of the map area. The information could be classified as physical and cultural.

Lines, colors, symbols, letters and digits have been used in the insertion of information to the map. The information given in the face of the map could be studied using the legend.

It is expected from this unit to study the physical and cultural features contained in the map and to provide training to present them.

- In the 1:50,000 topographic maps of Sri Lanka contour lines, spot heights and trigonometric stations have been used to indicate relief.
- Among them, the contour lines could be described as a method possessing a multifunctional significance.
- By contour lines, the three dimensional landscape could be transformed into a two dimensional plane.
- There are a few types of physical features depicted in a map that could be identified and demonstrated.

1. Relief

   Plain, Highland, Valley, Spur, Gentle Slope, Steep Slope, Escarpment, Convex Slope, Concave Slope, Symmetrical Slope, Asymmetrical Slope, Mountain, Mountain Ridge, Undulating Land, Conical Hill, Isolated Hill, Gap (col,saddle).

2. Drainage Features

   River System, Catchment Area, Water Divide, Main River, Tributary, Water Fall, Main River Meander, Braided River, Marsh, distributary

3. Drainage Patterns
   Dendritic, Trellis, Radial, Annular

4. Coastal features
   Lagoon, Bay, Estuary, Point (Promontory),Island, Sand Spit

5. Natural Vegetation
   Forests, Scrubs, Marsh, Mangroves, Grasslands.

- A few cultural features that can be identified and demonstrated:

    1. Boundary
       Province, District, Divisional Secretariat Division, Grama Niladhari Division, Municipality, Protected Forests/Sanctuaries

    2. Irrigation
       Tank, Canal, Water Hole, Dam

    3. Crop Cultivation
       Paddy, Tea, Rubber, Coconut, Other Crops, Homesteads

    4. Roads and associated features
       Expressways, Highways (A and B grades), Grasslands, Other roads, cart track, Tunnel, Ferry, Causeway, Bridge, Culvert

    5. Railways and associated features
       Single Line, Double Line, Tunnel, Bridge, Protected level Crossing, Unprotected level Crossing. Embankment, Cutting, Station, Halt, Bridge Over, Bridge Under

    6. Other features
       Settlements, Built-up Area, Government Public Buildings, Religious Places, Private Buildings, Light House, Tourist Information

- **A few points for your attention when selecting 1:50,000 topographic maps of Sri Lanka**

    * Since 1:50,000 topographic maps of Sri Lanka contain information given in its legend the relevant information could be extracted easily.

    * However, some information does not appear in every map.

    * A chart showing the relevant map sheets that could be used to find specific information appears below:
        1. Coastal features
           Aluthgama, Galle, Matara, Batticaloa, Kalkuda, Trincomalee, Kokilai, Kalpitiya, Jaffna

        2. Lowland relief features
           Matugama, Matara, Awissawella, Dambulla, Kekirawa, Kaudulla, Padaviya, Polonnaruwa, Vakaneri, Buttala, Kataragama

3. Highland relief features
   Kandy, Gampola, Mahiyanganaya, Nuwara Eliya, Hanguranketa, Badulla, Ratnapura,

4. Various Drainage features
   Aluthgama, Ambalangoda, Ratnapura, Rakwana, Timbolketiya, Elahera, Kurunegala, Battuluoya.

5. Irrigation
   Anuradhapura, Polonnaruwa, Kaudulla, KalaOya, Medawachchiya, Padaviya, Iranamadu, Kataragama, Buttala

6. Railways and associated features
   Colombo, Negombo, Galle, Matara, Kandy, Nuwara Eliya, Badulla, Galgamuwa, Anuradhapura.

7. Examples for the distribution pattern of various crops could be extracted from the map sheets containing the areas specific for those crops. Likewise, information on natural vegetation also could be extracted from the map sheets containing those vegetation types (Examples: For tea cultivation and distribution of forests map sheets showing hilly areas could be used while for information on mangroves Map sheets of Colombo, Negombo or Batticaloa may be used)

8. Information on Boundaries, Tourism, Roads and Buildings could be found in many map sheets.

**Activity**

* Divide students into few groups. Provide each group with a 1:50,000 map sheet for reference.

* Allow groups to exchange map sheets and draw their attention to the physical and cultural features appear in them and ask to prepare a note on those information. The specific feature noted, the map sheet that contains it and its location should be recorded.

* Ask them to prepare a field book containing the features selected. The selection of features may be done as group work but the preparation of the field book should be an individual activity.

| | | | |
|---|---|---|---|
| **Competency** | **:** | **4.0** | **Interprets holistically physical and human landscape shown in a map** |
| **Competency Level** | **:** | 4.1 | Analyses the information contained in a map |
| | | 4.2 | Uses maps and related equipment for practical purposes |
| **Periods** | **:** | 16 | |

**Learning Outcomes :**

- Analyses the physical and cultural features in 1:50,000 topographic map
- Describes the interrelationships between physical and cultural features
- Describes how maps are used for practical purposes
- Explains mapping equipment and when they can be used

**Introduction :**

A large amount of data and information is contained in the 1:50,000 topographic maps of Sri Lanka. When maps are revised new information is also added. The topographic features depicted in the maps are represented by lines, color, symbols, letters and numerals.

According to the amount of information contained in the map, the extent of the utility of the map vary. The benefits of map reading also vary according to the level of knowledge of the map user.

According to the level of utilization, map usage could be identified in three stages as follows:

1. Map reading
2. Map analysis
3. Map interpretation

At present maps are used for various purposes. From the distant past until recently printed maps were dominant but, at present, that place has been acquired by the computer maps. Due to the increasing use of new technological instruments and methods cartography is changing fast

The objective of this unit is to attain the ability to read, analyze and interpret the information contain in a 1:50,000 topographic map.

**A guide to clarify the subject matter**

4.1 Map reading, analysis and interpretation could be stated as the three stages of understanding a map.

* Map Reading

  The identification of information in a map indicated by lines, colors, symbols, letters and numerals could be termed as map reading. The fact that all features in the geographical landscape do not appear in maps and vice versa should be borne in mind when reading a map.

* Map analysis

  Map analysis is the simple description of the information contained in a map is. (e.g .relief features, drainage pattern, distribution of roads)

* Map interpretation

  In the interpretation, it is expected to explain the relationships between features that appear in the map. Explanation of the relationship between physical and cultural features is an example. This is a creative exercise. It provides a start for further investigation. A creative exercise like finding the most suitable location to erect a tank bund would arouse creative thinking.

* Map analysis and interpretation could be carried out in two ways:

  1. Analysis and interpretation of the map as a whole
  2. Dividing the map into several parts in the analysis and interpretation

* Whatever the method followed in the analysis and interpretation of the map area attention should be paid to three factors:

  1. Physical features of the area
  2. Cultural features of the area
  3. Relationship between the physical and cultural features

  Analysis of physical features
  - Relief features
  - Drainage features
  - Coastal features
  - Distribution of natural vegetation

  Analysis of cultural features
  - Administrative boundaries
  - Agricultural land use
  - Highways and rail road system
  - Settlement pattern

- Buildings, religious places, historical sites, tourist information
- Built-up areas and cities

Relationship between physical and cultural features

- The irrigation system associated with relief and drainage
- How road system is related to relief and drainage
- Relationship between physical features and crop distribution
- Relationship between physical features and settlements

- It is essential that students should be made aware that examples must be extracted from the map area.

## 4.2 Uses maps and related equipment for practical purposes

- History of maps is old. The printed paper maps were widely in use by the end of the 20th century.
- At present, printed maps are widely used in order to make the day to day work easy. Maps have been a helpful tool to understand the total landscape. Since they have been prepared using colours, symbols, letters and numerals representing the landscape in totality.
- With the development space technology by the end of 20th century a new era in cartography also dawned.
    - Satellite Images
    - Geographical Information Systems (GIS)
    - Global Positioning System (GPS)
    - Remote Sensing (RS)
    - Digitization
- The above mentioned technological methods and instruments have been of assistance in the use of computer maps at present.
- Maps are being used to make the day to day work easy.
    - for educational purposes in planning
    - for predictions
    - in activities related to land tenure and land use
    - for communication purposes
    - in tourism
    - in disaster situations
    - in warfare
- In the preparation of printed paper maps few instruments were in use.
    - Compass
    - Theodolite
    - Chain and Tape
    - Air planes (Air photos)
- When compared to the use of printed paper maps there are few factors that have been few reasons for the wide use of computer maps.

    1. Ease of preparation of maps
        - Collection of data
        - Storage of data
        - Representation of data
    2. Ease of updating the data
       The ability to include even a small diurnal change taking place on landscape.
    3. Ability to deserve different layers by specific themes.
- Map usage has been socialized widely at present. The daily used technological instruments has been the underlying reason.

- The ability to observe the landscape of any region of the world through computerized Google map.
- Ability to find the absolute location of a place correctly through the GPS maps included in mobile phones.
- Ability to reach the destination with the help of electronically displayed of maps through the 'Navigator' facility installed in motor vehicles and mobile phones.

**Activities**

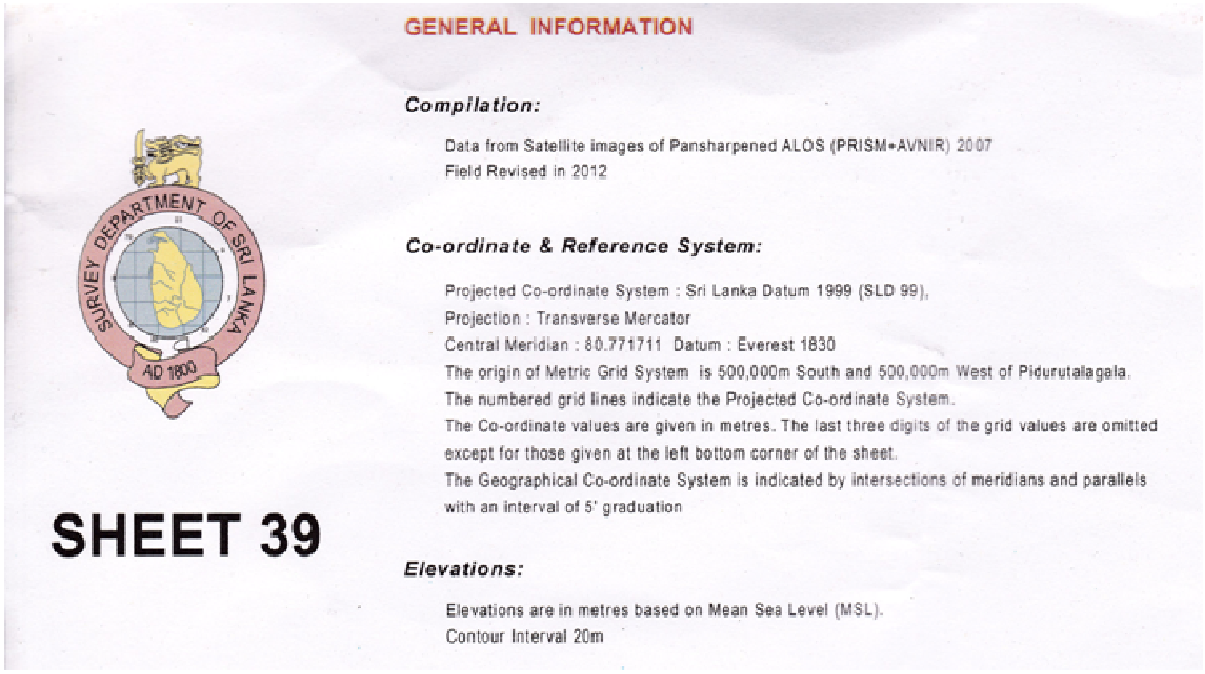
* Divide students into few groups.
  - Discuss with students how a map should be analyzed and interpreted using a selected map
  - Draw attention of the students to both methods of analyzing the map, i.e. as a whole as well by different areas of the map.
  - Draw the attention of the students to physical and cultural features as well as to the relationship between them.
  - Give each group a 1:50,000 topographic map.
  - Assign them to provide an analysis of the map area.
  - Advise them to present parts of the map area as examples when necessary
  - Provide an opportunity to present group activities.
  - Guide them providing necessary instructions.
* Find out and note the latitudinal and longitudinal location of your school using GPS technology.
* Select a town located at some distance from your school and describe correctly the route to that place use either a printed map or a computer map for this purpose.

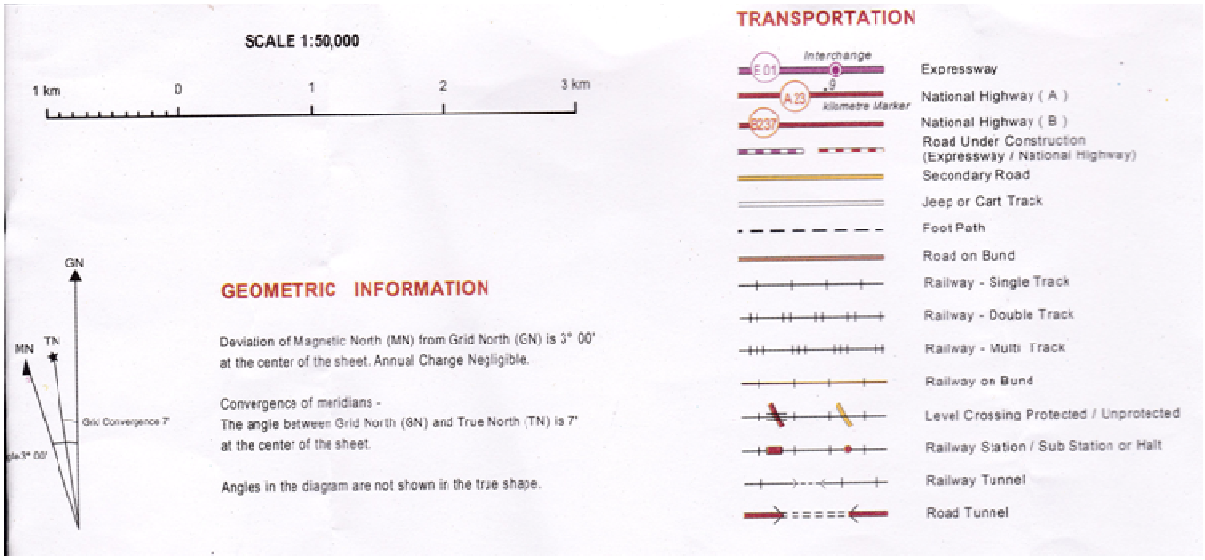
**References**

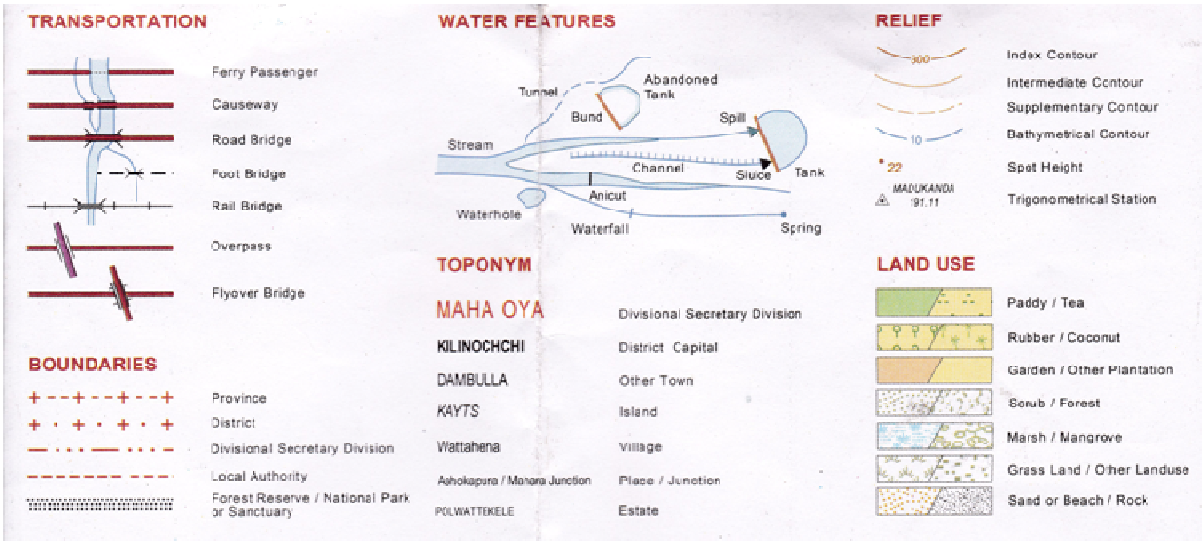
1:50,000 topographic map sheets of Sri Lanka

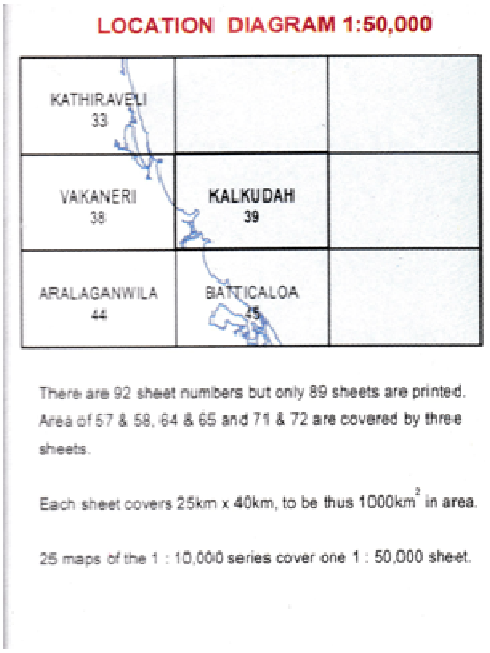
Department of Surveys, Sri Lanka, National Atlas Vol 1.

Department of Educational Publications, Practical Geography Part 1


GENERAL INFORMATION
Compilation:
Data from Satellite images of Pansharpened ALOS (PRISM+AVNIR) 2007
Field Revised in 2012
Co-ordinate & Reference System:
Projected Co-ordinate System : Sri Lanka Datum 1999 (SLD 99),
Projection : Transverse Mercator
Central Meridian : 80.771711 Datum : Everest 1830
The origin of Metric Grid System is 500,000m South and 500,000m West of Pidurutalagala.
The numbered grid lines indicate the Projected Co-ordinate System.
The Co-ordinate values are given in metres. The last three digits of the grid values are omitted except for those given at the left bottom corner of the sheet.
The Geographical Co-ordinate System is indicated by intersections of meridians and parallels with an interval of 5' graduation
SURVEY DEPARTMENT OF SRI LANKA
AD 1800
SHEET 39
Elevations:
Elevations are in metres based on Mean Sea Level (MSL).
Contour Interval 20m


SCALE 1:50,000
1 km
0
1
2
3 km
GN
MN
TN
GEOMETRIC INFORMATION
Deviation of Magnetic North (MN) from Grid North (GN) is 3° 00' at the center of the sheet. Annual Change Negligible.
Convergence of meridians -
The angle between Grid North (GN) and True North (TN) is 7' at the center of the sheet.
Angles in the diagram are not shown in the true shape.
TRANSPORTATION
Interchange
E 01
A 09
Kilometre Marker
B237
Expressway
National Highway ( A )
National Highway ( B )
Road Under Construction (Expressway / National Highway)
Secondary Road
Jeep or Cart Track
Foot Path
Road on Bund
Railway - Single Track
Railway - Double Track
Railway - Multi Track
Railway on Bund
Level Crossing Protected / Unprotected
Railway Station / Sub Station or Halt
Railway Tunnel
Road Tunnel




There are 92 sheet numbers but only 89 sheets are printed. Area of 57 & 58, 64 & 65 and 71 & 72 are covered by three sheets.

Each sheet covers 25km x 40km, to be thus 1000km$^2$ in area.

25 maps of the 1 : 10,000 series cover one 1 : 50,000 sheet.

Compiled & Published under the direction of the Surveyor General of Sri Lanka.



The Surveyor General will be grateful if any errors or omissions are brought to his notice.

**This product is available for sale at the Surveyor General's Office and District Survey Offices.**

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