CHAPTER 4
BASIC AGRICULTURAL RESOURCES

1. Climate (Temperature, Rainfall)
2. Water
3. Soil
4. Human resources (Labour)
5. Genetic resources
BASIC AGRICULTURAL RESOURCES AND ENVIRONMENT
• Agricultural industry includes crop production, animal rearing and aquaculture.

• Dependent on basic resources and environment.
Crop production is suited in areas with moderate climate and substantial water.
1. Climate

- Climate in a narrow sense is usually defined as the “average weather”, over a period of time ranging from months to thousands or millions of years.

The classical period is **30 years**, as defined by the World Meteorological Organization (WMO).

Quantities measured are **temperature**, **precipitation** (rainfall), and **wind**.
Climatic Zones

- World can be divided into 4 climatic regions:
  1. Tropics
  2. Temperate
  3. Tundra
  4. Deserts
Climatic zone: Tropics

- Non-arid (dry) in which all twelve months have mean high temperatures above 18°C

- Lots of rainfall, non-uniform, falling in rainy (wet, monsoon) season; the other season is dry.

- Suitable for crops like rubber, oil palm, cocoa, coconuts and sugarcane.
Climatic zone: Temperate

- Not too warm nor too cold; not too wet nor too dry

- Four seasons are recognized: spring, summer, autumn (fall) and winter

- Crops planted in spring and harvested in summer, example wheat and maize. However, crops (vegetables) can be grown in the glasshouse during winter
Climatic zone: Tundra

- Low temperatures and short growing seasons
- Little water and sunshine
- Three types of tundra: Arctic, Antarctic and alpine
- Dominant vegetation is grasses, mosses and lichens; crops can hardly be grown
- Livestock and crops raised can only be in enclosures with water supply
Arctic tundra on [Wrangel Island](https://en.wikipedia.org/wiki/Wrangel_Island), Russia

Antarctic tundra on the Kerguelen Islands

Typical alpine tundra
Climatic zone: Deserts

- Extreme temperature range and very little water, less than 250mm annually

- Very little vegetation; crops can be cultivated only with proper irrigation
The Thar Desert near Jaisalmer, India
Plastic sheeting reduces evaporation for desert agriculture. Northern Baja California.
Greenhouse at the Experimental Farm
Ramat Negev

Desert Sweet tomatoes
Kamhin greenhouse
2. WATER

Agriculture depends on the presence of water

- Water could be supplied through rain (rain-fed agriculture) or by irrigation
- Without water, crops cannot be grown even on fertile land
- Water is required for seed germination and plant growth
- Earliest human civilization started along river banks, example Nile valley (Egypt) and Tigris & Euphrates (Iraq), Indus river (India), Yangtze and Yellow River (China)
In Malaysia, the type of crops planted in a particular area is based on the availability of water

- For example, in Southern Peninsular Malaysia, the average rain fall exceeds 3000 mm/year which is suitable for oil palm
- In Kedah-Perlis, the average rain fall is less than 2000 mm/year which is not suitable for oil palm but good for rubber and mango
- Paddy requires a lot of water. A proper irrigation system is needed if there is not enough water. Examples of properly irrigated paddy in Malaysia; MADA (Kedah), KADA (Kelantan) and Tanjung Karang (Selangor)
Irrigation system provided by Kemubu Agricultural Development Authority (KADA)
3. SOIL

• is the complex body on the surface of the earth comprised by mineral and organic matter, as well as living organisms.

• are vital to all life on Earth because they support the growth of plants, which supply food and oxygen and absorb carbon dioxide and nitrogen.
• Rain water will seep into soil and dissolve the nutrients in fertilizer

• Plants absorbs water through their roots along with the nutrients for growth.

• Nutrients translocated to rest of the plant like stem and leaves

• Evapo-transpiration occurs where some water is lost and recycled.

• Plant growth results in defoliation of older leaves which fall, decompose to organic matter, and nutrient cycle is repeated
The type of soil present in an area is based on 5 factors of soil formation:

- Core (parent) material
- Climate
- Topography
- Vegetation
- Time
This diagram describes the soil type in the West Coast of Peninsular Malaysia (from the beach to the Titiwangsa ranges):

- **A** - acid sulphate (coastline) soil
- **B** - peat soil
- **C** - coastal, alluvium soil
- **D** - weathered soil, the soil profile here is deep, red and heavily weathered.
- **E** - eroded shallow soil
- **F** - highlands, less weathered, sometimes contain peat soil

Legend:

- A: Soils affected by the sea
- B: Peat swamp
- C: Riverine Alluvium, flooded soils
- D: Leaching, eluviation, illuviation and weathering active
- E: Eroded soil
- F: Highlands
Soil type is also identified by its profile. As shown here, an ideal profile consists of 5 horizons (O, A, B, C and R).
• Soils can also be classified into 12 orders based on their physical and chemical compositions (according to International Soil Taxonomy).
• For example, an order known as Histosol consisting of organic matter (such as peat soil) is very fertile.
• Another example is very sandy Bris soil under the order Spodosol. In addition, in Malaysia soil can be classified into
Soil Order

• **Histosol**
  – is a soil comprised primarily of **organic materials**. They are defined as containing at least 20 percent organic material to a depth of 40 centimetres.
  – are known by various other names in other countries, such as **peat** or **muck**.
  – In Malaysia, 2.4 million ha are covered by Histosol, mainly in Sarawak.
Spodosol

- In Malaysia, this soil is very sandy (also known as BRIS)
- Found along the beaches of Kelantan, Terengganu, Pahang and Johor
- Agriculture activities are extremely difficult in this soil
• In Malaysia, soils also classified as **series**

  – More than **100 series**

  – For example, In **UPM**, there are **4 series**:
     **Serdang, Bungor, Munchong and Melaka**

Each series has its own definition and is determined by the Department of Agriculture in the Ministry of Agriculture and Agro-based Industry.
4. HUMAN RESOURCE

• **Agriculture requires a huge labour resource:**
  – Preparation of soil
  – Fertilization
  – Harvesting

• **Dependency on human labour** could be **reduced** by using **machinery** as practiced by the rich and industrialized countries of the West

• **In Malaysia**, use of machineries are limited due to the **unsuitable soil terrain**

• **Malaysia is dependent on foreign labour** especially for oil palm and rubber plantations
ENVIRONMENT

• World divided into agro-ecological zones based on:
  Climate, soil and vegetation

• Impacts occur through climate change and pollution
World’s agro-ecological zones

• Not all agricultural commodities can be produced in all areas of the world
  – Depends on climate and soil type
  – Crops and animals need specific conditions for proper growth

• Can divide earth to different agro-ecological areas: climate, soil type, and vegetation
Agroecological zones

• **Tundra**: very cold climate, low biotic diversity, mosses, grasses, dwarf trees (Artic, Antarctic, alpine)

• **Grasslands**: Low fertile land, mild climate, field crops like soybean, wheat, maize, and livestock (American prairies, Russian steppes, African savannah, Argentinian pampas)

• **Deserts**: very little rainfall, extreme diurnal temperature, barren, plants are xerophytic (African Sahara and Kalahari, Asia’s Gobi, Arabian desert)

• **Tropics** (rain and sunshine all year round, hot and humid, rainforests, rubber, oil palm, cocoa, coconut)
Impact of climate change

- **Affects the type of plants present**
- **Global warming**
  - Fossil fuels usage as power for industries and transport releases greenhouse gases such as carbon dioxide, nitrous oxide and methane. This increases earth temperature and climatic instability.
  - Hurricanes, floods and droughts result.
  - Polar ice caps melt, sea water rises, and flooding occurs in low-lying and coastal areas, damaging agricultural lands.
- **Desertification**
  - Desert area increases due to climatic changes that cause drought and agricultural mismanagement.
Shrinking Ice Cap
Impact of pollution

• **Acid rain**
  – occurs in industrialized countries due to gases *sulphur dioxide and nitrogen oxides* emitted by industry
  – rain waters are *acidic* (low pH)
  – affects *forest, fresh water, soil, crops, livestock*

• **Heavy metals**
  – Occurs in industry especially automobile. Metals are *zinc, copper and lead*. *Unbound soluble form dangerous* as easily transported and made available to plants and animals. Damage cells.
  – *Cadmium* present in phosphate rocks also pollute soil and render crops *toxic*. 
• **Pesticides and herbicides**
  Excessive use exceeding permissible levels for example, in vegetable farms in Cameron Highlands have undesirable health effects.

• **Nitrates**
  Increase use of chemical fertilizers and solid wastes from livestock industry results in higher levels of nitrates washed into water ecosystem. Causes excessive enrichment of water (eutrophication) leading to rapid algal growth. That creates an oxygen deficit, killing off aquatic life.