AGRICULTURE AND MAN  PRT 2008
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Faculty of Agriculture, Universiti Putra Malaysia
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PROGRAM: Bachelor
(melalui PENDIDIKAN JARAK JAUH, UPMET)

SESSION: Semester I, 2018-19

COURSE: PERTANIAN DAN MANUSIA PRT 2008
(AGRICULTURE & MAN)

CREDITS: 2 + 0

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OBJECTIVES

At the end of the course, a student will be able to:

1. explain the role of agriculture in the development of civilization and well-being of mankind

2. elucidate the importance of the agricultural sector in ensuring food security and basic industrial resources

3. discuss and evaluate the importance of agricultural resources and their management for the development of sustainable agriculture
SYNOPSIS

This course explores the evolution of agriculture from the beginning to the present as a planned activity for food security and wealth creation, driven by sustainable economic and technological advancement.

Modern agriculture is presented as a science, an art and a business, encompassing its role and impact on resource utilization and human development.
COURSE EVALUATION

1. MID-TERM EXAMINATION 30%
   based on Chaps 1-5

2. FINAL EXAMINATION 40%
   based on all Chaps 1-9, with major emphasis on Chaps 6-9

3. GROUP ASSIGNMENT 30%

TOTAL 100%
(30 Objective Questions, based on the first five chapters)

1. Introduction & Scope of Modern Agriculture
2. Transformation of Agriculture - Agricultural Evolution
3. Transformation of Agriculture - Agricultural Revolution
4. Agro-Ecological System - Basic Agricultural Resources and the Environment
5. Genetic Resources in Agriculture
(40 Objective Questions, based on all chapters with major emphasis on last five chapters, 6-9)

6A. Sustainable Agriculture
6B. Agricultural Practices in Malaysia
7. Economics of Agricultural Development (Agriculture and the Malaysian Economy)
8. Innovation & Challenges in Agriculture
9. Approaches to Agricultural Development in Malaysia
EXAMINATIONS
(MID-TERM and FINAL)

You will be examined on the contents of the power-point lectures (F2F) and the PJJ UPMET module (text), Agriculture & Man (Yusof Ibrahim & Tan Yee How, 2007). F2F lectures are available on-line.
Questions would be objective (multiple choice) in nature.

Example:

*The crop which is economically the most important in Malaysia is:*

A. rubber  
B. oil palm  
C. cocoa  
D. coconut  
E. none of the above

Answer: B
Example:
The following is (are) a good agricultural practice (s):

A. using compost as fertilizer
B. tillage (ploughing)
C. crop rotation
D. two of the above
E. all three (A, B, C) of the above

Answer: D
Example:
Most of the oil palm estates in peninsular Malaysia are found in the north:

A. True
B. False

Answer: B
GROUP ASSIGNMENT
(TUGASAN)
1. A critical review is conducted on a topic pertaining to agriculture selected from a list to reflect a grasp of the salient features and understanding of the principles involved in the subject.

Write with particular reference to MALAYSIA

You could source information for your assignment from the library, internet or on-site visits to relevant places.
ASSIGNMENT TOPICS

1. Advocating good agricultural practices
2. Impact of Asean Free Trade Area (AFTA) on Malaysian agriculture
3. Fertilizer production from oil palm empty fruit bunch (EFB) in Malaysia
4. Food safety
5. Halal hub
6. Carbon trading and Clean Development Mechanism (CDM)
7. ICT in Malaysian agriculture
8. Integrated farming in Malaysia
9. Agricultural biotechnology
10. Genetically modified organisms (GMOs) in agriculture
11. Technology transfer in agriculture
12. Environmental issues in agriculture
13. Agriculture as the third engine of growth in Malaysia
14. Mushroom cultivation in Malaysia
15. Biodiversity
16. Agrotourism
17. Recreational fishing
18. Labour problems in agriculture
19. Mechanization and automation in agriculture
20. Precision agriculture
21. Agriculture for non-food purposes
22. Aquafarming
23. Micro-organisms in the Malaysian agricultural industry
24. Entrepreneurship in agriculture
25. Hydroponics
26. Organic farming
27. Benefiting from agricultural wastes
28. Can agriculture survive against industrialization on the road towards developed nation status?
29. Agriculture as a desired profession in the 21st century
30. Agriculture in developing and developed nations
2. For this task, students will be assigned into groups based on their locality by us.

3. You will be informed on-line or as to the particular group you are assigned by around the 4th week once the registration of students has been finalized.

4. You are NOT PERMITTED to switch to another group under any circumstance. If you do so, your assignment report will not be marked even if you submit it. You will receive 0 mark!
5. Each group can select from any topic on the list.

6. The assignment has to be written in English.

7. Avoid ‘cut and paste’ and full references must be made if this is done. Try to write using your own words.

8. At the end of the review exercise, each group will submit a written report consisting of *not less than* 15 typewritten pages, font 12, 1½ spacing, inclusive of photographs and illustrations.
9. Ensure you include a ‘Contents’ page at the beginning of the report and quote your ‘References’ at the end.

10. It would be an added advantage if you could include personal experiences such as on-site visits and discussions in your report.

11. Pictures speak a thousand words so include photographs wherever relevant.
12. All members of the group must have their names on the report which is bar coded. Any student whose name is not on the report will not receive any mark.

13. Marks are group-based with all members of a group receiving the same mark. This emphasizes the importance of group discussion and teamwork.

   You should try to make contact with all your group members at an early stage.

14. The report has to be submitted to UPMET on time otherwise it will not be marked.
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**UNIVERSITI PUTRA MALAYSIA**
Pusat Pendidikan Luar (PPL)
Centre for External Education
CHAPTER 1
INTRODUCTION & SCOPE OF MODERN AGRICULTURE
TOPIC 1: GENERAL

- Definition of agriculture
- Importance of agriculture
- Agricultural systems and practices
- Downstream processing
Definition of Agriculture

• art and science of cultivating soil
• systematic production of crops for food, feed, fiber
• raising livestock
• protecting land from deterioration and misuse.
TOPIC 2:
Importance of agriculture

• At least **40%** (2002 estimate) of the world’s population is employed in agriculture, making it the most common occupation.

• Asia’s share of the agricultural labour force reaches **80%**:
  - India & China: **60%**
  - Africa: **14%**
  - Europe: **10%**
  - Latin America: **3.5%**
  - North America: **1.0%** (highly mechanized)
MALAYSIA

- Major player in *tropical* agricultural research

- Primary agro-production: *oil palm and rubber*

- **Industrialization**: downstream processing for high value-added products

- Important for *food security*

- **Private sector** participation apart from government
• Traditional farming: subsistence agriculture, the production of enough food for family needs

• This is especially the case in many underdeveloped (African continent) countries

• However, in developed and industrialized countries farming is an industrial intensive activity, producing raw materials (primary) for industrialized nations and engaging in downstream (secondary) processing

• For socio-political stability, a country must maintain a food stock-pile as a form of food security, in difficult times such as drought and natural calamities
• More recently, income is derived from transformation of agricultural wastes into feeds and fertilizers (organic farms).

• Negative aspects: environmental pollution:
  - contamination of environment with (1) nitrogen and phosphorus from inorganic fertilizers, and (2) pesticides and other biocides. All these have affected the biodiversity of plants and animals.
TOPIC 3: Agricultural Systems/Practices

Broadly categorized into:

• **Subsistence farming**

• **Commercialized farming**.
Subsistence farming

- Characterised by low input/low yield, either slash and burn (nomadic, shifting) or stationary.

- Produced only enough food to feed the family. Little surplus.

- Dependent highly on nature
Subsistence farming (cont’d)

• **Shifting cultivation** is the most primitive. Farmers typically **abandon** a plot when **soil fertility falls** and a considerable **fallow** period follows.

• **Sedentary farming** involves working on lands that have been slashed and burned; the **soil nutrient quality is inherently poor** thus offers scant yields.

• Unfortunately, under such conditions, years with poor harvests result in food scarcity and famine.
Subsistence agriculture – shifting cultivation
Subsistence agriculture – sedentary cultivation
Commercialized farming

Characterized by:

- **Monoculture** or a combination of a few crops:
- **High yielding modern** varieties
- **Large chemical inputs** (pesticides, fertilizers, feeds)
- **High technology**
- **Mechanization**
- Examples include:
1. TROPICAL PLANTATIONS (ESTATES)

- **Monocropping** - dominated by perennial plants, well known are rubber, oil palm, cocoa, coffee, coconut, tea, etc.;

- Raw material mostly exported to *industrialized nations* for value-added processing.

- However, **Malaysia** is utilizing these primary commodities for her own industry.

- **Palm oil** has been converted into *margarines* and extracted for its *carotenes*.

- **Rubber** has been used in the manufacture of *gloves, tyres, condoms, shoes*

- **Coffee** has been processed as *beverages* and **cocoa** for *chocolates*. In fact in the case of cocoa, **Malaysia** is importing raw beans from Indonesia and New Guinea for local processing.
Commercial agriculture
Commercial agriculture
2. **VEGETABLE/FRUIT/ORNAMENTALS FARMING**

- Specialized production system in **rows and blocks (beds), open or enclosed**

- Development of **ripening technologies and refrigeration** has reduced the problem of getting **fresh produce** to market.

- Apart from vegetable farms, **fruit orchards** and **flower nurseries** operate along similar lines.
3. ORGANIC FARMING

• Production system that **avoids synthetically compounded fertilizers, pesticides, growth regulators, and feed additives.**

• Relies on **crop rotations**, animal and green manures, and **biological control** measures.

• **Avoids excessive depletion** of soil **nutrients**.
Organic cultivation of mixed vegetables. Note the hedgerow in the background.
4. HYDROPONICS

- A technique of growing plants **without soil**, taking advantage of the fact that **plants absorb nutrients as simple ions in water**.

- Plants can be grown in a **more controlled environment**, and **more** can be produced since plants can be placed at a higher density.

- Produce are often of **higher quality** and harvested in a **shorter time**.

- There is **no soil-borne diseases**, weeds to pull or soil to till.

- It is a **water-efficient system** since only a small fraction of water is used compared to traditional farming.
Commercial agriculture
6. LIVESTOCK FARMING (ANIMAL HUSBANDRY)

- Raising livestock for **food, fibre, labour**

- In **sheltered enclosures** such as chicken, cattle, pigs, goats.

- **Free range** (roam freely) such as chicken, cattle and deer.
Sheltered enclosure vs free-range
7. **NEW PRODUCTS AND FUTURE INDUSTRIES**

- **Mushrooms** cultivation
  - Lowland farms: oyster, abalone, lingzhi mushrooms; **Highland** farms: **shiitake** mushroom
- **Herbal farms** and health foods
- **Speciality natural chemicals** eg carotenes
- **Recreational fishing**
Shiitake mushroom

Oyster mushroom

Button mushroom
Eurycoma longifolia – Tongkat ali
TOPIC 4: Downstream Processing

1. Food processing – sourced from plants or animals

2. Industrial processing – sourced from plants and animals
Food processing – from plant sources

- **Fruits and spread** - canned juices, cordials, jams & jellies, pickled, dehydrated fruits, margarine
- **Cereals** - rice, wheat as foods
- **Crispies** - tapioca, banana, mushroom, potato
- **Beverages** – chocolate from cocoa, alcohol from barley
- **Bottled and canned food** - tomato, chilli, oil
Food processing – from animal sources

- **Frozen ready-to-eat meals** – burgers, sausages, nuggets

- **Processed fish** – dried, salted, canned (sardines)

- **Dairy** – powders, milk, cheeses, fermented beverage (yoghurt)
Industrial processing – from plant sources

- **Palm oil** – toiletries, cosmetics, carotenes, biofuel

- **Rubber latex** – tyres, gloves, shoes, condoms

- **Timber** – furniture, building materials

- **Cotton, linen** - clothings
Industrial processing – from animal sources

Leather and silk – clothings, footwear, belts, handbags, wallets
CHAPTER 2

TRANSFORMATION OF AGRICULTURE – AGRICULTURAL EVOLUTION
TOPIC 1

Pre-historic era through the Middle Ages, and
Domestication of plants and animals
Introduction

• The world was formed 4,600 million years ago.
• Eukaryotic life forms appeared 3,600 years later (1,000 million years ago).
• First hominid hunters & gatherers recorded 4-7 million years ago, in East Africa
  – First gather wild fruits and hunt wild animals, and then later domesticated the first plants and then animals;
  – then formed social structure, sharing knowledge of cultivation of plants and raising animals
Four main civilizations termed “river civilizations”:

- **Tigris and Euphrates in Mesopotamia (7000 BC)**
- **Egypt on the Nile (6000 BC)**
- **China on the Yellow and Yangtze (5000 BC)**
- **India on Indus (5000 BC)**

Believed to be the main catalyst for the emergence of agriculture and farming.
Mesopotamia in 2500 BCE
Ancient China

Early cultures:
Xia (c. 2200 B.C.),
Shang (c. 1750 B.C.),
Zhou (c. 1050 B.C.)
Extent and major sites of the Indus Valley Civilization

Present day excavated ruins of Mohenjo-daro, an ancient city along the Indus river
Wheat was the first to be sown and harvested, using a sickle on a significant scale.
Prehistoric Era

- **Human started farming around 12,000 years ago** (pre-historic, as recorded history started 7000 years ago)

- Initially, **grain crops** like **wheat** were cultivated, then **rye** and **barley**, later followed by **peas** and **beans**

![Rye](image1)
![Barley](image2)
![Wheat](image3)
![Peas](image4)
![Beans](image5)
Sumerian Harvester's sickle, 3000 BCE

Sickle from chalcolithic times (2500-1800 years BCE)

Iron plough 200 BCE

Dental swing plough

Millstone for grains
Reasons for introduction of farming

- Climate change

- Gradual transition from hunter-gatherer to agricultural economies

- Social reasons (e.g. accumulation of food surplus for competitive gift-giving)
1.1 Global agricultural evolution

- Started 1650-850 BC (Bronze Age)

- Domestication of plants and animals was a milestone in early agriculture. Full dependency on domestic crops and animals did not begin until the Bronze Age.

- Widespread use of metal tools, large scale cultivation was started by the Sumerians. Agriculture allowed them huge territorial expansion, making them the first empire builders.

- Soon, the Egyptians, powered by effective farming of the Nile valley, with a territorial expansion more than triple the Sumerian empire in area.
Elevation map of Çatal Hüyük
Southern Anatolia, Turkey (part of Sumerian Empire)
1.2 Agriculture in the Middle Ages (500-1500 AD)

• Much of the advancement was made by the Muslims (early 9th C)

• The great cities of the Near East, North Africa and Spain were developed by the Muslims using an elaborate agricultural system that included extensive irrigation and advanced agricultural knowledge
The **Muslims revolutionized agriculture** based on four key areas:

1. **Irrigation system** with machines, dams and reservoirs

2. **Scientific approach to farming** with improved farming techniques made possible raising crops and animals **away from place of origin**.

3. **Incentives** based on **land ownership, labourers' rights, financial rewards** commensurate with their efforts.

4. **New crops** and **new cultivation techniques** introduced derived from **research**.
By 14th and 15th C, new plants and animals were shipped from the Old World to the New World.

**Agribusiness** was borne with the idea of large scale cultivation for export, including linen and silk.
1.3 Modern Agricultural evolution

1950 – present

- Agriculture so improved that yield per land unit many times more

- Rapid rise in mechanization in the 20th century, saw farm activities performed with a speed and on a scale never imaginable before, leading to tremendous efficiency

- Green revolution has begun
TOPIC 2

UTILIZATION OF HUMAN LABOUR, ANIMALS, MACHINES, INFORMATION TECHNOLOGY, TRANSPORTATION AND BIOTECHNOLOGY
LABOUR – HUMANS, ANIMALS & MACHINES

• Agriculture started with human labour, first limited to family and then hired labour

• Heavy duties were performed by animals

• Today mechanization has replaced them although some jobs such as picking fruits and vegetables, tapping rubber and harvesting oil palm fruits still done manually
Information Technology

IT enables quick dissemination of knowledge
Remote sensing, GPS and precision farming increased yields and varieties
Revolution in transportation

- 19th Century - development of railways and the steamship
- 20th century – development of automobile
- Invention of refrigerated transport – allow the long distance transport of heavy and perishable agricultural produce
- National and international markets were created
Biotechnology in Agriculture

• While most industries use mechanical devices (machines) to make things, biotechnology uses living organisms to make products of economic value.

• Genetic engineering creates transgenic life forms superior to their original version.
Teosinte (A), the ancestral native corn that existed thousands of years ago in Central America, bears little resemblance to the modern corn plant. Through selective breeding, corn with an intermediate genetic mix was obtained (B). Continued selection resulted in the modern corn plant (C). The selective breeding process takes centuries. Today, genetic engineering technology makes it possible to breed plants for specific traits within a single generation.
TOPIC 3

VALUES, CUSTOMS and TABOOS in TRADITIONAL AGRICULTURE Vs MODERN AGRICULTURE
3.1 Traditional Agriculture

Still practiced in 3rd world countries such as Africa, Asia and Latin America

Non-existent in Europe and America in the 20th century
Important characteristics of traditional agriculture

1. Local agro-ecosystem fully utilized
   Consists of man, animal and plant existing in a stable environment

2. Food production as an art passed on through generations

3. Food is survival for community – must be enough and sustainable

5. Pests and diseases controlled culturally. No chemicals.

6. Natural elements (rain and natural enemies of pests) fully capitalized.

7. Organic fertilizers, fallowing and plant-microbe symbiosis emphasized.

8. Native varieties used, as spirits believed to reside in plants.
3.2 Modern Agriculture

• Advances in science and technology transformed traditional agriculture to modern agriculture

• Utilizes biological sciences, chemistry (fertilizers and pesticides), physics (remote sensing), biotechnology, engineering (machinery), ICT (technology transfer) and economics (farm management)

• Depends on knowledge and skill

• However, disturbs local ecosystems with excessive chemicals usage
Important characteristics of modern agriculture

1. Intensive mass production seen as an agribusiness

2. Extensive use of machinery and electronics from land preparation to harvesting

3. Heavy usage of chemicals for fertilization and control of pests
4. High yielding modern varieties, clones and hybrids

5. Workers with wide knowledge and skills

6. Industrial approach with monoculture and efficient management

7. Tradition and taboos disregarded by professional management
Commercial cultivation of pineapple on peat.
TOPIC 4

THE CULTURE OF NOMADIC AND SEDENTARY AGRICULTURE
4.1 Nomadic Agriculture (Subsistence Agriculture)

Also known as:

- Shifting cultivation
- Slash & burn agriculture
- Swidden agriculture
- Still practiced in Asia (Sarawak and Indonesia), Africa and Latin America. Dates back to Neolithic (Stone Age) era.
Nomadic (subsistence) agriculture
- Slash and burn
4.2 Sedentary agriculture

- Cultivation on same piece of land for long period

- Community does not move

- Either small-scale (subsistence) or big-scale (modern commercial)
Sedentary agriculture – fixed, stationary
Small scale (subsistence) vs big scale (estate) agriculture
TOPIC 5

INFLUENCE OF RELIGION ON AGRICULTURE
• Islam and other religions give a lot of attention on agriculture.

• Many Quranic verses mention agriculture eg importance of bees in producing honey for food and medicine.

• Agricultural activity placed as very important where at least one person in a community must be involved in agriculture as a career.

• Christian biblical principles for agricultural development state that God is the first farmer and initiator of agriculture
TOPIC 6

INFLUENCE OF LIFESTYLE ON AGRICULTURE
• Modern style of living uses agriculture as a business rather than as a way of life in times of old.

• Lifestyle and size of a community influences agricultural activities.

Valentine’s Day, Mother’s Day and convocations result in demand for certain agricultural products such as flowers and chocolates.

• Healthy lifestyle requires protein and vitamins for balanced diet.

• Beautiful homes require landscaped gardens and plants.
CHAPTER 3

TRANSFORMATION OF AGRICULTURE - AGRICULTURAL REVOLUTION
AGRICULTURAL REVOLUTION

- Green revolution (1960s): Improved crop variety and yield
- Blue revolution (present): Enough water for drinking and irrigation
TOPIC 1

CAUSAL FACTORS
1. Population increase - requires food. Food production suffers from constraints

2. Resource constraints - fertile land, labour, biological diversity

3. Product choices requirement

4. Environmental-friendly practices requirement

5. Technological development requirement
1. Population Increase

• World population grows geometrically - great pressure placed on arable land, water, energy, and biological resources to provide adequate food.

• World pop: above 7.7 billion (Malaysia: 32 million)

• Malnutrition contributes to half of 12 million under-five deaths in developing countries each year.
2. Resource constraint – A. Fertile Land

Arable land decreasing so have to use less fertile and problem lands such as sandy and tin-tailing soils

Percentage of arable land by country
2. Resource constraint – B. Labour

- Youth employment low:
  - No interest
  - Low salary
  - Does not want to work under the sun

- Impetus to mechanize
In Malaysia, where to import labour?

- Indonesia
- Philippines
- Bangladesh
- India
- Vietnam, etc.

Social problems …………………
2. Resource constraint – C. Biological diversity

Diversity of living organisms are diminishing as a result of unfriendly environmental practices.
Results of Constraints

• All these constraints lead to insufficient food production in Malaysia.

• Increase in food imports in Malaysia, nearly RM 13 billion
3. Product Choices requirement

Niche demands:

1. Age bracket
2. Dietary preferences
3. Baby food
4. Fast food
5. Health food
6. Vegetarian food
7. Snacks
Causal factor: Product Diversification
4. Environmental-friendly practices requirement

Conventional agriculture often damages natural environment:

1. Removing trees (soil erosion)
2. Tilling soil (reduces fertility)
3. Chemical fertilizers (excess nitrate and phosphate fertilizers leach into soil, contaminating underground water)
4. Pesticides (danger to health)
5. Mono-cropping (diversity is eliminated whereas nature is diverse)

Environmentally-friendly approach needed
Sustainable agriculture

• A method of agriculture that attempts to ensure the profitability of farms while preserving the environment.

• Characteristics:
  • Conservation and preservation
  • Biodiversity
  • Animal welfare
  • Economically viable
  • Socially just
5. Technological advances requirement

- **Older technologies outdated** producing lower quality products and yield

- **Modern technology** needed to improve productivity and quality while reducing labour
Technological Development
TOPIC 2

CHARACTERISTICS OF AGRICULTURAL REVOLUTION
1. High-yielding and disease-resistant varieties
2. Chemicals and bioagents
3. Precision agriculture
4. Mechanization and automation
5. Biotechnology
6. Agricultural enactments and schemes
1. High yielding and disease-resistance varieties

• Breeding to improve yield with high quality germplasm

• MARDI had produced a high yielding (MR 219, MR 220) and superior quality (MRQ 50 and MRQ 74) rice varieties
**Tissue culture**

- **Technique** involves **breeding without seed** to produce **exact copies in large numbers**. Uses any **growing plant part** (e.g. leaf, shoot, meristem) cultured in tubes containing **nutrients supplemented with growth hormones**. Examples: **orchids, bananas, herbs** like “tongkat Ali” and Tahitian **noni**.

- **Maturity time is shorter** and the **plantlet is free of disease** and shares **quality of the parent**.
Genetic Engineering

- **Manipulating genes** to produce **new breeds**.
- **Examples:**
  - **New papaya** breed resistant to ring spot virus disease
  - **New maize** type that **kill stem borers** due to incorporation of **bacteria Bacillus thuringiensis** gene
  - **New potato** variety resistant to blight
2. Usage of Chemicals and Bioagents

- Used to **improve yield and quality**
- **Chemicals**: rates controlled to **minimize environmental pollution**
- **Biocontrol agents** to reduce use of chemical pesticides
Biocontrol and beneficial agents

• Parasitic insects and predators against insect pests
• Barn owl to control rats in estates and padi fields
• Microbes such as Trichoderma to control pathogenic fungi Fusarium
• Beauvaria to kill mites
• Beneficial microbes: N-fixing bacteria, mycorrhiza, probiotics
3. Precision agriculture

- Comprehensive system designed to *optimize agricultural production* through the application of *crop information, advanced technology* and *management practices*.

- Computers, sensors, GIS and satellites are used to *gather and process information*.

- Examples:
  
  **Oil palm plantation with specific climate, soil and nutrient requirements**

  **Organic farming system** has a *precise target for chemical-free products* disallowing chemical fertilizers and synthetic pesticides.

  Instead, **organic fertilizers** like compost, animal excreta and green manure are used. **Crop rotation** and **biological control** methods are used against pests and diseases.
4. Mechanization and Automation

- Use of **machines** to replace manual labour or animals
- Save **energy and time**
- Used in **irrigation, fertigation and controlled environmental systems**
5. Agricultural Biotechnology

- Employs:
  - advanced technology
  - modern processing methods
  - improved germplasm
  - genetically-modified organisms
  - environment-friendly pest and disease control techniques
to improve yield and increase quality

- Examples:
  - high yielding clones
  - fast and frozen foods, dehydrated fruits
  - health products (nutriceuticals, anti-oxidants, vitamins, “golden rice”)
  - cosmetics
  - enzymes
“Golden rice” was developed through food biotechnology. Golden rice can help deliver nutrients the body converts to Vitamin A - much needed in the developing world.
6. Agricultural Enactments and Schemes

- **Malaysian Department of Agriculture** encourages good practices based on environment-friendly concepts. Examples:
  - Good Agricultural Practice (GAP)
  - Good Manufacturing Practice (GMP)
  - Malaysian Organic Scheme (SOM)
  - Malaysian Good Farm Practice Scheme (SALM)

All the above ensure **safe, healthy food products**

- **Quarantine Act** prevents import of harmful pests
- **Permits** needed for import of plants, microorganisms, soil, composts and organic fertilizers
- **Sustainable Agriculture**
- **Biovalley**
Good Agricultural Practices (GAP)

- Collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products
- Take into account economical, social and environmental sustainability.
Good Manufacturing Practices (GMP)

Set of regulations, codes, and guidelines for the manufacture of drugs (known as medicinal products in Europe), medical devices, diagnostic products, foods products and Active Pharmaceutical Ingredients (APIs).
Scheme Organic Malaysia (SOM)

- Standards & certification requirements for the production of plant-based organic food products
Malaysian Farm Accreditation Scheme (SALM)

• SALM is a national program implemented by the Department of Agriculture to recognize and accredit farms which adopts good agricultural practices (GAP), operated in an environmentally friendly way and yielding products that are of quality, safe and suitable for human consumption.
CHAPTER 4

AGRO-ECOLOGICAL SYSTEM –

BASIC AGRICULTURAL RESOURCES AND THE ENVIRONMENT
Topic 1

- Climate
- Water
- Soil
- Human Resources
- Genetic (‘Seed’)
1. CLIMATE:

Tropics
Temperate
Tundra
Desert

Tropical forest - Malaysia
Temperate Prairie - USA
Arctic tundra - Russia
Alpine tundra - Alps
Desert - African Sahara
2. WATER

Irrigation system provided by Kemubu Agricultural Development Authority (KADA), Kelantan
• 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)
3. SOIL

The type of soil present in an area is based on 5 factors of soil formation

– Core (parent) material
– Climate
– Topography
– Vegetation
– Time
Soils can 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
Histosol

- is a soil comprised primarily of organic materials, found to a depth of 40 cm

- Also known peat or muck.

- In Malaysia, 2.4 million ha are covered by Histosol, mainly Sarawak
4. HUMAN RESOURCES
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
5. GENETIC RESOURCES
TOPIC 2

ENVIRONMENT
ENVIRONMENT

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

• Impacts occur through climate change and pollution
CHAPTER 5
GENETIC RESOURCES IN AGRICULTURE
TOPIC 1

ORIGIN and DISTRIBUTION of CROP PLANTS AND ANIMALS
• Centre of origin: Geographical area where a plant species, either domesticated or wild, first developed with special characteristics

• 6 independent centres recognized
1. Mesoamerica (Southern Mexico, and North Central America).
2. Andes and South America.

<table>
<thead>
<tr>
<th>Cereals:</th>
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<tbody>
<tr>
<td>Asian rice</td>
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<table>
<thead>
<tr>
<th>Pulses:</th>
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</thead>
<tbody>
<tr>
<td>pigeon pea, jack bean, winged bean, moth bean, rice bean</td>
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<table>
<thead>
<tr>
<th>Roots &amp; tubers:</th>
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<tbody>
<tr>
<td>yams, arrowroot, taro</td>
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<table>
<thead>
<tr>
<th>Oil crops:</th>
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</thead>
<tbody>
<tr>
<td>coconut</td>
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<table>
<thead>
<tr>
<th>Fruits &amp; nuts:</th>
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</thead>
<tbody>
<tr>
<td>bread fruit, orange, lime, tangerine, grapefruit, mango, banana</td>
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<table>
<thead>
<tr>
<th>Vegetables &amp; spices:</th>
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</thead>
<tbody>
<tr>
<td>cucumber, nutmeg, eggplant, plantain</td>
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<table>
<thead>
<tr>
<th>Fiber plants:</th>
</tr>
</thead>
<tbody>
<tr>
<td>coconut, jute</td>
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</table>
5. Africa (Sahel Region including Ethiopian Highlands).

- **Cereals:**
  - African rice, pearl millet, sorghum.
  - daf, fonio
- **Pulses:**
  - cowpea, Bambara groundnut, hyacinth bean, Kizinga’s groundnut
- **Roots & tuber crops:**
  - yam
- **Oil crops:**
  - oil palm, castor bean
- **Fruits & nuts:**
  - baobab, watermelon, melon
- **Vegetables & spices:**
  - okra, *Sesamum* sp. (leaves), *Solanum* spp.
- **Fibers:**
  - kenaf
- **Stimulants:**
  - coffee

Cereals:
- wheat, barley, rye, oat

Pulses:
- pea, chickpea (garbanzo), lentil, lupine

Root & tuber crops:
- turnip, carrot, radish

Oil crops:
- rape seed, safflower, flax, olive

Fruits & nuts:
- fig, walnut, date palm, almond
- grape, apple, pear, plum

Vegetables & spices:
- onion & relatives, lettuce, saffron, parsley

Stimulants:
- poppy, digitalis, belladonna, licorice
LIVESTOCK, POULTRY AND FISH

BEEF CATTLE

High growth rate and excellent meat quality eg:

• Angus

Originated in northern Scotland. Among finest breeds, farmed in Australia, US
Hereford

Originated in Hereford, England 300 years ago.

Farmed in many parts of world. Brown body coat and white face.
DAIRY CATTLE

Produce high milk yield. Big business as milk is important human diet

• Jersey

Originated from Jersey, Channel Islands UK, near France. Bred in many countries eg Australian Jersey, English Jersey, French Jersey,
• **Friesian**
Originated from northern Scotland.

One of finest and most popular breeds. Found all over the world eg English Friesian, Australian Friesian, Thai Friesian
GOATS AND SHEEP

• Reared for meat, skin and fibre (wool and hair)

• Originated from Western Asia
Sheep breeds

- Merino
- Dorper
- Damara
- Cheviot
- Dorset
- Border Leicester
Goat breeds

- Alpine
- Saanen
- British Alpine
- Anglo-Nubian
- Boer
- Kacang
  (local Malaysian)
POULTRY

• Refers to Chicken (Fowls), Ducks and Turkeys

• Chicken first domesticated from India for cockfighting in Asia, Africa and Europe, not for eggs or meat

• From India, fowl moved to western Asia, then Europe in 5\textsuperscript{th} Century BCE.
• Broad classes of chicken are:

➢ American
➢ Asiatic
➢ Mediterranean
➢ English
➢ Continental
➢ French
➢ Orientals
American chicken - Dominique
Asiatic chicken - Bantam
Chicken divided into:

- **Layers** - egg production. Selected for high yield of eggs

- **Broiler** - meat. Selected for rapid growth

- Both groups must be efficient in using feed. Referred to as commercial lines (breeds)
FISH

• Aquaculture (rearing of fish) started by Egyptians and Chinese around 2500 BCE

• However modern aquaculture involves species domesticated since beginning 20th Century.
Divided into:

Freshwater - catfish (keli), carp (lampan)

Marine or saltwater – grouper, mackerel, and pomfret (bawal)
TOPIC 2

GERMPLASM & BIODIVERSITY
• **GERMPLASM**: genetic resources, or more precisely the DNA of an organism and collections of that material.

• Worldwide there are collections of plant, animal and bacterial germplasm for use in breeding new organisms and the conservation of existing species.
Evolution

The first cells originated by chemical evolution on a young Earth at the beginning of time billions of years ago.

They developed from nonliving materials that became ordered into molecular aggregates that eventually could reproduce.
THEORY OF NATURAL SELECTION: Charles Darwin

• Over time, these early cells mutate to create new life forms.

• If these new forms are favoured by the environment, they will be selected and retained.

• Accumulated mutations over millions of years will result in a new species. This gives rise to the biodiversity of life we see today.
Biological Diversity (Biodiversity)

- Refers to the “variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems"
Biodiversity of life
BIODIVERSITY HOT SPOTS
To date 1.7 million species have been identified and named:

- about 1,000,000 animals (750,000 insects)
- about 250,000 plants
- about 69,000 fungi

Each species is given a binomial (double) name:

- *Zea mays* = corn
- *Homo sapiens* = humans
- *Elais guineensis* = oil palm
Techniques for conservation of genetic resources

• There are two major alternatives for the conservation of genetic resources
  – *in situ* conservation
  – *ex situ* conservation
IN SITU CONSERVATION
EX SITU CONSERVATION
REFERENCES


