CHAPTER 2

TRANSFORMATION OF AGRICULTURE – AGRICULTURAL EVOLUTION
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
TOPIC 1

PREHISTORIC ERA THROUGH THE MIDDLE AGES, and DOMESTICATION OF PLANTS AND ANIMALS
• Prehistoric Era
  – Human started farming 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**
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.
Agriculture originated from:

- Fertile Crescent of Tigris & Euphrates (now Iran and Iraq)
- Nile valley (Egypt)
- Yangtze and Yellow River valleys (China)
- Indus river valley (India-Pakistan)
- Asia Minor (now Turkey), Israel, Jordan, Syria
- Danube river and Macedonia (Europe)
- Tehuacan valley (Central Mexico)
Ancient China

Early cultures:
Xia (c. 2200 B.C.),
Shang (c. 1750 B.C.),
Zhou (c. 1050 B.C.)
Harappan/Indus River Valley: Ganges, Mohenjo-Daro

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
Sickle from chalcolithic times (2500-1800 years BCE)

Dental swing plough

Millstone for grains

Sumerian Harvester's sickle, 3000 BCE
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)

Ancient Egyptian farmer
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
Combine harvester
Information Technology

IT enables quick dissemination of knowledge
Information is a **resource** in all businesses including **agriculture**

The way it is **managed** and used for **decision making** has **major impact** on survival of the business.

In today's ever changing environment those with **information** will have a **major advantage** over those who don't.
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 and 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.
Characteristics:

1. **Short term**, planting lasts only **2-3 seasons**. Crops grown are **annuals** such as beans, root crops, maize and hill padi. Area then left to **fallow**. Community **moves** to new site.

2. Cultivation is either on **fertile virgin jungle soil** or on **hill slopes** (Niah Caves in Sarawak)

3. **Customs and taboos** play major role with **headman** making big decisions
4. Yields are poor, sufficient only for immediate family and deteriorate yearly.

5. Minimal fertilizer input resulting in loss of nutrients and fertility.

6. If planting done on water catchment areas, floods can result, disrupting ecosystem.

7. Indiscriminate clearing can damage species affecting biodiversity.
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)
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 An Nahl which reveals importance of bees in producing honey for food and medicine.

• Others on plants and domestic animals are found in Surah Al Baqarah (verse 22), Surah Al Kahfi (verses 32-41; 45), Surah Yaasin (verses 33-36) and Surah Luqman (verse 10)

• Agricultural activity placed as fardhu kifayah 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.

• In Genesis 2:8 “Now the Lord God planted a garden in the east, in Eden; and there he placed the man whom he had formed”

• Christians believe that since God created nature, agricultural practices should not damage the environment: Christian stewardship model.
• In Hindu caste system, the *vaishas* are Aryans who tended *cattle*, considered a sacred animal.

• In aboriginal and native systems, a *shaman* will perform certain agricultural rights when *opening new* agricultural land or *starting a crop* season, asking for *rain* or *good harvests*.
Among ancient cultures, the Romans, worshipped Robigus, the protector of crops and Pales, who protected shepherds and livestock.

In Greek mythology, the bull represented Zeus, the sky god.

The Egyptians believed in the goddess Hathor, that was represented as a cow.
Zeus, the sky god
Hathor, Egyptian god
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