AGRICULTURAL REVOLUTION

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

• Dramatic increases in food production from improved strains of wheat, rice, maize and other cereals in 1960s.

• Increased crop yield in India, Pakistan, Philippines, Mexico, Sri Lanka and other underdeveloped countries.

• Prevented large scale famine.

• Promoted integrated or organic farming techniques.
Blue Revolution

• The need to get water for drinking and crop irrigation to the many millions of people worldwide who do not have it.

• Ecologically sound and sustainable.

• 2.7 billion people face a critical shortage of drinkable water by 2025.

• Hope Green Revolution in crop productivity will soon be matched by Blue Revolution in raising water productivity in agriculture.
TOPIC 1

CAUSAL FACTORS OF AGRICULTURAL REVOLUTION
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 6 billion (Malaysia: 26 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**

• **Problems** due to:
  - **low water availability** due to low water-holding capacity characteristic of hard and silty soil
  - **soil erosion** especially on slopes
  - **acidic and poor tropical soils** (acidity causes low uptake of macronutrients like P, Ca and Mg with leaching while highly soluble micronutrients cause toxicity). Rapid decomposition. Can improve with **fertilizer and lime**
  - **salinity**
  - **waterlogging**
Percentage of arable land by country
## Arable Land Scarcity Index (ha per capita) in Asia

<table>
<thead>
<tr>
<th></th>
<th>1961</th>
<th>1990</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>East Asia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>China, People’s Rep. of</td>
<td>0.16</td>
<td>0.08</td>
<td>0.06</td>
</tr>
<tr>
<td>Japan</td>
<td>0.06</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Korea, Rep. of</td>
<td>0.08</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Southeast Asia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambodia</td>
<td>0.43</td>
<td>0.35</td>
<td>0.16</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.18</td>
<td>0.12</td>
<td>0.08</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>0.38</td>
<td>0.20</td>
<td>0.09</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.49</td>
<td>0.27</td>
<td>0.15</td>
</tr>
<tr>
<td>Myanmar</td>
<td>0.47</td>
<td>0.27</td>
<td>0.13</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.24</td>
<td>0.13</td>
<td>0.08</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.43</td>
<td>0.41</td>
<td>0.31</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>0.17</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>South Asia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afghanistan</td>
<td>0.71</td>
<td>0.54</td>
<td>0.18</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>0.17</td>
<td>0.09</td>
<td>0.05</td>
</tr>
<tr>
<td>India</td>
<td>0.36</td>
<td>0.20</td>
<td>0.12</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.19</td>
<td>0.14</td>
<td>0.07</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.34</td>
<td>0.17</td>
<td>0.07</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>0.16</td>
<td>0.11</td>
<td>0.08</td>
</tr>
</tbody>
</table>

*Source: Engelman and LeRoy (1995).*
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
CHARACTERISTICS

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
- Similarly, improved **oil palm, rubber clones, fruits and vegetables**
- **Disease resistance** varieties so **pesticide usage reduced**
- **Tissue culture** and **Genetic engineering** are other techniques
**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.
Investment in Biovalley

• Malaysia's INS Holdings and China-based Dalian Zhen-Ao Bioengineering Co will jointly produce bio-fertilizer, wheat-grass tea, bio-dynamic oil and mineral water.

• Dutch-based Inproser Technologies is embarking on the third phase of its enzymatic treatment of palm-kernel waste products.
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.
SALM Scheme

• Developed for **Fresh Fruits & Vegetable** sector

• National program initiated and managed by **Department of Agriculture**

• **Goal** of scheme is to **encourage farmers** to adopt and practice **GAP as work culture on their farm**