AGRICULTURE AND MAN  PRT 2008
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PERJUMPAAN BERSEMUKA II

Golden Rice!
- Milled rice does not contain beta-carotene
- Vitamin A deficiency afflicts over 200 million children and woman
- About 500,000 children go blind (60 every hour)
- 2 million children under 5 years die each year

Ingo Potrykus (Switzerland) and Peter Bayer (Germany)
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

• 30 Objective Questions
FINAL EXAMINATION
• ALL Chapters with emphasis on Chapters 6-9 (40 questions)

• Format of the examination is the same as that of the Mid-Semester examination (English, objective choice questions)

• Use of a dictionary is NOT allowed
CHAPTER 6A
Sustainable Agriculture

CHAPTER 6B
Agricultural Practices in Malaysia

CHAPTER 7
Economics of Agricultural Development (Agriculture and the Malaysian Economy)

CHAPTER 8
Innovation & Challenges in Agriculture

CHAPTER 9
Approaches to Agricultural Development in Malaysia
CHAPTER 6A

SUSTAINABLE AGRICULTURE

- Economic development (E)
- Environmental conservation (E)
- Socio-political benefits (S)
What is Sustainable Agriculture?

• Latin *sustinere* (*sus*-, from below and *tenere*, to hold)
• to keep in existence or maintain
• implies long-term support or permanence.
• Conventional 20\textsuperscript{th}/21\textsuperscript{st} C agriculture takes industrial production as its model.

• Together with big government subsidies, food is abundant and cheap in developed countries.

• Agriculture treated as manufacturing not biological systems, without social considerations

• Degrades soil and water, reduces biodiversity and cripples small, rural communities
Sustainable farming systems are capable of maintaining their productivity and usefulness to society indefinitely.

They must be:

1. Economically competitive (E)

2. Environmentally sound (E)

3. Socially supportive (S)
1. Economically Competitive
1. Selecting Profitable Enterprises to Ensure Economic Sustainability

Explore income opportunities other than traditional crops and practices such as:

Growing alternative crops like herbs and mushrooms
– Mixed plant and animal farming

– Contract growing of seeds for vegetable, rice and specialty crops

– Organic farming

However some of these involve niche markets
2. **Financial planning**

An overall sound financial plan with capital resources, expenditure and income projections must be made.
3. Marketing plan

- Marketing ranges from passive marketing to a commodity chain all the way up to direct marketing of a retail product to consumers.

- Market research is essential for big enterprises to gauge competition, consumer trend and prices.

- Specialty and direct markets such as organic, GMO-free, and other "green" markets yield more income but require more marketing by the producer.
2: Environmentally Sound
• Farms become environmentally sustainable by imitating natural healthy ecosystems.

• Nature tends to function in cycles, so that waste from one process or system becomes input for another.

• Industrial agriculture, in contrast, tends to function in a linear fashion similar to a factory: inputs go in one end, and products and wastes (such as suspended soil, nitrates, pesticides) come out the other.

• In Sustainable Agriculture, a farm is a nature-based system, not a factory.
ENVIRONMENTAL conservation involves keeping in good condition the 4 ecosystem processes:

- Energy flow  (E)
- Water cycle    (W)
- Mineral cycle  (M)
- Ecosystem dynamics (E)
Energy Flow

- **Energy flow** is the non-cyclical path of **solar energy** (sunlight) going into any biological system.

- The natural world runs on **sunlight**. Our management decisions affect how much of it is **captured** and put to good use on the farm.

- Sunlight is the ultimate energy source
Energy Flow:

1. Sun → Corn
2. Corn → Poultry/Hogs/Cattle
3. Poultry/Hogs/Cattle → Meat Products

Heat Loss at each stage.
Water Cycle

An effective water cycle is typified by:

1. little soil erosion
2. fast water entry into the soil
3. the soil's capacity to store large amounts of water.

Goal is to get as much water as possible into the soil during each rainfall.
Ground cover

- A surface mulch layer speeds water intake, reduces evaporation and protects the soil from erosion.

- Minimizing tillage (ploughing), growing high-residue crops and cover crops, and adding compost (manure) maintains ground cover. These also add to organic matter.
Soil organic matter

- Raising the percentage of organic matter from 1% to 2% in sandy soil (Hudson, 1994) increased available water content by 60%.

- Such an improvement in a soil's water-holding capacity will have a beneficial effect on crop growth, especially during droughts.
The Water Cycle
Mineral Cycle

• In nature, minerals needed for plant and animal growth are continuously recycled within the ecosystem and there is no need for added fertilizer.

• Conditions and practices that inhibit the natural mineral cycle - erosion, nutrient leaching, organic matter depletion reduce the farm's sustainability.
The Mineral Cycle

Diagram showing the cycle of minerals in agriculture, including:
- NPK minerals
- On-farm consumption
- Minerals lost through commodities sold
- Nutrient uptake
- Manure
- Erosion loss
- Leaching loss
Ecosystem Dynamics

An effective ecosystem dynamic is indicated by high diversity of plants and animals (BIODIVERSITY) above and below ground.

Examples of increasing biodiversity: intercropping and crop rotation
Intercropping

• Increases crop species and therefore biodiversity eg strip cropping of wheat and soybeans, bananas and pineapples

• Added advantage: Some insects recognize rows of green plants separated by brown soil but not one uniform green expanse of plants and intercrops;

• or onions intercropped with carrots mask smell of carrots from flies.
Crop rotation

- Increases biodiversity
- Added advantage: breaks weed and pest life cycles
Effect of practices on biodiversity

<table>
<thead>
<tr>
<th>Increased Biodiversity</th>
<th>Intercropping</th>
<th>Crop rotation</th>
<th>Cover crops</th>
<th>Multispecies grazing</th>
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</thead>
<tbody>
<tr>
<td>Decreased Biodiversity</td>
<td>Monocropping</td>
<td>Tillage</td>
<td>Herbicides</td>
<td>Insecticides</td>
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</table>
Zero Burning

• This approach has been acknowledged by the world as an environment-friendly one that is sustainable.

• Zero burning is currently implemented in oil palm and rubber plantations.

• Upon felling, old oil palm and rubber trunks are not burned, but sliced thin and left to decompose.

  - Nutrients such as N,P,K and Mg are recycled leading to 50% reduction in fertilizer cost.

  - The rubber trunk can be marketed whole for the furniture industry.
SOCIO-POLITICAL BENEFITS
• Social benefits are provided for the farm family and community in terms of:

• food security
• land tenure
• good health
• maintaining the fabric of rural communities.
• keeping money within the local economy
• Decisions made on the farm affect local community.

• Eg, expanding your farm requires taking over your neighbour’s farm. Therefore might not want to expand.

• Other examples of social decisions are:
  - buying supplies locally rather than from outside
  - networking with local consumers
  - relaying information on sustainable food production to neighbourhood.
• Marketing strategies involving direct marketing through farmers markets or road side stalls have a positive impact on the local community.

• People will choose to support local producers or their neighbours by paying a little more compared to overall market price.
CHAPTER 6B

AGRICULTURAL PRACTICES IN MALAYSIA
• Major development in pre-independent Malaya: Introduction of rubber by H.N. Ridley and the development of plantation agriculture.

• Malaysia became world’s top rubber producer
• Rubber plantations: Dunlop Plantations (now part of IOI), Guthrie Plantation (now part of Sime Darby) and Harrisons and Crossfield (later forming Golden Hope which became part of Sime Darby)

• Malaysia became world’s top rubber producer
• Apart from rubber, tea plantations such as Boh Tea, were also established on Cameron highlands.

• Later on, other crops such as cocoa and coffee were also grown.

• However most locals then were still practising subsistence agriculture producing rice, fruit and other food crops
• Post independence (1957-1970): Government set up the Federal Land Development Authority (FELDA) and the Federal Land Consolidation and Rehabilitation Authority (FELCRA).
• Enabled huge tracts of land to be cultivated with plantation crops by settlers.
Smallholders were encouraged to switch from subsistence crops to cash crops such as rubber and oil palm.
• 1984 onwards: Agricultural development was driven by the National Agricultural Policies (NAPs).

• 1\textsuperscript{st} NAP (1984-1991)

• 2\textsuperscript{nd} NAP (1992-2010)

• 3\textsuperscript{rd} NAP (1998-2010)

• 4\textsuperscript{th} NA-FP (2011-2020)
• Malaysian agricultural land use dominated by perennial industrial crops, chiefly oil palm, rubber, coconuts, cocoa, coffee and tea.

• Oil palm and rubber alone occupies more than 80% of the agricultural land area.
CHARACTERISTICS OF MALAYSIAN AGRICULTURE

The estate and smallholder subsectors:

Estate:
- Highly commercialized and efficiently managed by professionals.
- Larger than 40 ha (or 100 acres).
- Usually owned by private or public-listed companies
- Monoculture production of industrial crops such as oil palm, rubber or cocoa.
Smallholder:

• Less commercialized, average farm size is 1.45 ha.

• Estimated smallholdings operated by 1,033,065 farmers

• Crops grown include industrial crops, rice, fruits and vegetables
1. OIL PALM

• Oil palm (*Elaeis guineensis*) occupies the largest area (≈ 60%) among crops in Malaysia and palm oil is the top foreign exchange earner among all agricultural commodities.

• Malaysia accounts for 39% of the world’s palm oil production.

• Oil palm can be harvested 25-30 months after planting. Economic life of the oil palm tree is about 20 years.
• Each palm can produce between 8-15 fresh fruit bunches (FFB) a year, each one weighing 15-28 kg.

Oil is extracted from the pulp of the fruit (palm oil) or from the kernel (palm kernel oil).

For every 100 kg of FFB, typically 22 kg of palm oil and 1.6 kg of palm kernel oil can be extracted.
Area of Oil Palm in Malaysia in the Last 30 years.

Percentage of oil palm grown by estates and other entities
2. RUBBER

- Rubber (*Hevea brasiliensis*) was the 1st major plantation crop introduced into Malaysia in 1877 with seedlings brought in from Brazil.

- Rubber was then mainly planted by plantations including Harrison & Crossfield, Boustead, Sime Darby and Guthrie.

- Rubber was the dominant plantation crop for eight decades up to 1989, when oil palm (1.59 million ha) overtook rubber (1.55 million ha).

- Some factors causing the change from rubber to oil palm:
  (a) declining price of rubber brought about by competition from synthetic rubber
  (b) increasing cost and declining availability of labour.
3. RICE

- Rice is the staple food of most Malaysians.

- Total area: Rice is the 3\textsuperscript{rd} largest agricultural crop in area planted after oil palm and rubber.

- Currently, rice growing is concentrated in eight granary areas in Peninsular Malaysia, the most productive in Tanjung Karang.
• The eight main granaries contribute about 70% of national rice production.

• Together with secondary areas, they account for 85% of total rice cultivated areas.

• The remaining 15% of planted area represents the non-irrigated rice, which include rain-fed rice fields and hills or upland rice mainly concentrated in Sabah and Sarawak.
• Rice is a highly subsidized crop.

• Rice growers are given subsidies for purchase of seeds, fertilizers, herbicides and insecticides. Prices are guaranteed for growers and controlled for consumers.

• Currently, Malaysia produces around 72% of rice consumed but targets for full sufficiency by 2015.

• Average yield per ha of rice is 3.6 tonnes.
4. COCONUT

• Coconut ranks the 4th fourth most important crop in terms of area planted after oil palm, rubber and rice.

• Rise of oil palm as the major cooking oil is one factor that caused a decline in coconut planting.
• A new value-added product that is currently enjoying good demand worldwide and could rejuvenate the coconut industry is “virgin coconut oil” or VCO. Prices range from RM40-150 per kg.

• VCO is processed using fresh coconut flesh without using chemicals and high heating in refining. This natural, pure coconut oil is very stable with a shelf life of several years and very high level of antioxidants. Used in skin and hair care as well as for general good health.
5. COCOA

- Most plantations are in Sabah but most of the processing in Peninsula Malaysia.

- Over the years, planting area has been reduced nearly 90% because of pests and poor cocoa price.

- However the processing sector has seen tremendous growth.

- Malaysian cocoa products (such as cocoa powder and chocolate) are exported to over 80 countries.
Hectarage of Cocoa in Malaysia
• Currently, Malaysia is the fifth largest cocoa processor in the world.

• A majority of cocoa is grown in mixed planting with coconuts.

• Continuous reduction in local production of cocoa beans resulted in the need to import raw cocoa beans to support the processing industry.
OTHER INDUSTRIAL CROPS

• Besides the five crops mentioned there are other crops that occupy a smaller planted area, namely coffee, tea and sugarcane.

6. COFFEE

• Coffee is mainly grown by smallholders particularly in Johor and Selangor.

• The major type of coffee grown is the Liberica coffee which is favoured by the local consumers. Only about 5% of the coffee grown is from the Robusta and Arabica types
7. TEA

• The main tea growing areas are located in Cameron Highlands, Pahang. Here, tea is grown at an elevation of 1000-1700m above sea level.

• The favourable physical conditions present in the Cameron Highlands for tea - abundant rainfall, lots of sunshine and well-drained acidic soils.

• Remaining tea growing areas are found in lowland areas, mainly in the states of Selangor and Perak.

• The main type of tea produced in Peninsula Malaysia is black tea.
8. SUGAR CANE

- Sugarcane is planted for processing into sugar only in Perlis and Kedah.
- Suitable because distinct dry seasons enable sugarcane to mature and accumulate sugar.
- Local sugar production satisfies about 10% of domestic demand.
Over 375,000 ha. planted with various tropical fruits, excess of which is exported. We import temperate fruits.
Overall, Malaysia is still a net importer of fruits and fruit products.

The major fruits being exported by Malaysia are watermelon, papaya, star fruit and durian.

Most of raw materials for processing outsourced from other producing countries due to lower cost.

Prospect for fruit and vegetable production bright due to expected increase in demand for domestic food.

Per capita fruit consumption expected to increase from 49.9 kg in 1995 to 65.1 kg in 2010, representing an annual increase of 1.8 %.

Area under orchards is expected to increase from 257,000 ha. in 1995 to 373,200 ha. in 2010.
10. PINEAPPLE

• Pineapple industry is the oldest agricultural export crop.
• For economic reasons, pineapple farmers have changed to other crops particularly oil palm, which brings more income and use less labour.
11. VEGETABLES

- Vegetables are smallholder crops in Malaysia, with average farm size less than one hectare.

- Johor is the largest supplier of tropical vegetables while Cameron Highlands is the traditionally supplier for temperate vegetables.
12. FLORICULTURE

• About 50% of floriculture production is located in Johor

• Orchid is the flower most commonly grown
13. LIVESTOCK PRODUCTION

• Malaysian livestock production is characterized by two subsectors: Non-Ruminant and Ruminant

• **Non-Ruminant** comprises **Poultry** and **Swine** production:
  – highly commercialized with total supply more than enough to meet domestic demand, excess exported
• **Ruminant** subsector is operated by **smallholders** with self-sufficiency levels for **beef** and **mutton** at 28% and 10%, respectively.

To reduce importation, the government has targeted to increase beef production to 40.6% self-sufficiency by 2015.
14. AQUACULTURE

- Aquaculture sector is an important supplier of animal protein.

- Aquaculture is the farming of aquatic organisms including fish, mollusks, crustaceans and aquatic plants.
• Subsets of aquaculture include:
  
  – fish farming (raising of fresh water and brackish water fishes, lobsters and prawns in ponds)

  – mariculture (aquaculture in the ocean which includes raising of mollusks)
- **algaculture (production of algae and seaweeds)**

- **growing of cultured pearls.**
NEW SOURCES OF GROWTH FOR MALAYSIAN AGRICULTURE: Herbs & Spices, Pharmaceuticals, Natural Products

Some common species include tongkat ali (*Eurycoma*) and misai kucing (*Orthosiphon*)
Government has embarked on large scale herbal planting with a East Coast Economic Regional Herbal Plantation Project. A plantation area of 406 ha. has been planted in Dungun, Terengganu and another 327 ha. planted in Lipis, Pahang as the initial herbal plantation projects.

- Some of the common species of herbs that are grown in Malaysia include tongkat ali (*Eurycoma*), hempedu bumi (*Andrographis*), kacip fatimah (*Labisia pumila*), misai kucing (*Orthosiphon*) and pegaga (*Centellia asiatica*)
MARKETING

• Retail shops and hypermarkets

• FAMA (Federal Agriculture Marketing Authority)
CHAPTER 7

ECONOMICS OF AGRICULTURAL DEVELOPMENT (AGRICULTURE AND THE MALAYSIAN ECONOMY)
• Contribution of agriculture to Malaysian economy

• International trade in agriculture
• Contribution of Agriculture to GDP has declined from 31% in 1965 to 9% in 2010.

• However continued importance:
  1. earn foreign exchange through exports of palm oil, rubber and fruits
  2. contribute to employment
  3. ensure food security.

• 9th Malaysia Plan emphasizes agriculture as the third engine of growth
Characterized by a dualistic system:

- **Plantation (estate) sector** and
- **Smallholder sector**.
• Plantation: single crop with land area of more than 40 ha.

Crops such as rubber, oil palm, coconuts, cocoa, pineapples and tea are planted.
• **Smallholdings** are small areas below 40 ha, typically between 0.4 - 4 ha.
• **Production capacity** is **low** due to **limited technology** and **poor management practices**.
Two types of smallholders:

1. Subsistence farmers who cultivate their land for their own consumption or sell produce in the marketplace or to middleman.
   Practice mixed cropping systems of vegetables and fruit trees or mixed cropping combined with livestock farming (chicken, goats or cows)

2. Farmers that practice monocropping type of subsistence farming similar to plantations, cultivating rubber, cocoa, or oil palm
• In the past, emphasis given to production of primary commodities for export earnings.

• However, agriculture now expanded into secondary downstream processing for value-added products.
• Malaysia’s agricultural development is guided by the National Agricultural Policy (NAP).

• Development programmes are aimed at:
  1. expanding food production to improve food trade balance
  2. increasing export of primary commodities, and
  3. ensuring supply of raw materials for local downstream industries
## Agricultural land use (hectares)

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<th></th>
<th>1995</th>
<th>2000</th>
<th>2005</th>
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### Total agricultural imports (USD million).

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## Total agricultural exports (USD million)

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</table>
• Over the years, *agricultural trade* has consistently generated trade *surpluses*

• In 2002:

  **Exports:** USD 7,375 million *(palm oil, 52%)*
  
  **Imports:** USD 4,300 million
  
  **Surplus:** USD 3,075 million
Do we have enough?

The good news is that we are pretty self-sufficient in producing most of the basic foods that we consume. But many of these items are price regulated or subsidised, making the cost unrealistic. Can the Government continue to subsidise our food and fuel?
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• Research and innovation technology

• Future challenges in agriculture
Oil Palm

- Malaysia’s golden crop contributing RM30 billion to GNP annually. Equals to petroleum (Star, 17 Sept 2007)

- Malaysia is currently one of the major world producers of palm oil
• Research improved yield of oil palm to **35 tonnes fresh fruit bunches/hectare/yr**, using the Tenera hybrid (bred from the crossing of Dura and Pisifera varieties in early years)

• In the near future, the yield is expected to reach **40 tonnes with newer hybrids from biotechnology research**
Sime Darby claims major R&D breakthrough in Oil Palm - 9 May 2016 (The Star news)

Genome-selected high-yield oil palm after 7 yrs R&D

16% increase in oil yield (11.6 tons/hect) over current best (10 tons/hect)

Identify best genes in breeding materials and advance this to field

Double rate of increase in half the time
Major milestone for Sime Darby

Genome Select high-yield oil palm the result of seven years R&D

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CAREY ISLAND: Sime Darby Group's palm oil yield increase from its new Genome Select plant will be equivalent to output from an additional 50,000 hectares of land - more than 1½ the size of Penang Island.

The group says this tremendous increase in yield will be achieved by 2023, when its entire 316,000 hectares of oil palm land is planted with its latest R&D breakthrough.

According to Sime Darby Plantation's Research and Development Centre head Dr K. Harikrishna, all this will be achieved using the company's existing planted area, and will not require a higher amount of fertiliser either.

The Genome Select story began in 2003, when Sime Darby hired biotechnologists to conduct a feasibility study on the matter.

Five years later in June 2008, the company made the decision to invest in the project, and a month later, successfully sequenced the genome.

In May 2009, Sime Darby announced its success as the first company in the world to completely sequence, assemble and annotate the genome with 93.8% completeness.

And last month, seven years after successfully decoding the oil palm genome, the company commenced its first large-scale planting of the Genome Select high-yielding oil palm - marking a major milestone for the company as well as the industry.

The Genome Select palm is capable of delivering up to a 16% increase in oil yield over Sime Darby's current best planting material, the Calix 600.

The company usually produces between eight and 10 tonnes of palm oil per hectare, but with Genome Select, output is expected to rise to 11.5 or 11.6 tonnes per hectare, under good growth conditions.

This will result in an average yield of above 6.1 tonnes per hectare across all environments in the group's plantations, compared to the average of 5.3 tonnes per hectare yield from the Calix 600.

The new crop will also have better resistance to diseases, and tolerance to drought and salinity.

The group's plantation arm, Sime Darby Plantation, conducts replanting on 5% of the company's total planted area of 316,000 hectares each year. It expects a significant impact on the company's bottom line by 2023, when it has enough Genome Select material for its entire annual replanting exercise.

For the moment, Genome Select will only be grown in Sime Darby's plantations on local soil, due to restrictions in other countries.

The company is currently planting the first Genome Select palms on 50 hectares of its Dusun Durian plantation on Carey Island, in Banting, Selangor. The next batch will be planted on another 50 hectares at the Diamond Jubilee estate in Malacca, in September.

Dr Harikrishna says the research team spent the past seven year studying the components in the oil palm genetics that allow it to produce oil, and then developed tools to exploit this discovery on a commercial basis.

"The Genome Select is not genetic modification. Neither is it tissue culture cloning. It is basically a means for us to pick the best of the best, and plant those materials. So we are able to identify the best genes in the pool of our breeding materials, and advance this to the field," he says.

He describes the company's success as a "quantum leap in oil palm genetics".

Sime Darby, Dr Harikrishna says, has been investing in oil palm breeding since the 1920s.

"On average, a breeding cycle lasts between 10 and 14 years, and you will get an increment of 8% to 10% for every breeding cycle. But what we have managed to achieve today is to double the rate of increase, in half the amount of time. And this, we believe, is a quantum leap," he says.

Sime Darby sets aside about 2% to 3% of its annual revenue, or about RM120mil per year, for R&D expenditure, and about 10% of this goes to research on the oil palm genome.

For the first 100 hectares to be planted in Carey Island and Malacca this year, the research team sampled 80,000 seedlings, and conducted 80 million genetic tests.

"For these 100 hectares, we have made the best crosses. This was possible due to the teamwork between the R&D and operations departments as well as our collaborators, who are some of the most renowned companies in the world in this area," says Dr Harikrishna.

Although the breed is significant, he says, it is opening the surface of possibilities for the future.

"We are going to introduce other traits over time, and this will make oil palm more sustainable," he adds.
• Palm oil is processed for food, oleochemical or biofuel

• ‘Zero waste industry’:

  1. Trunk used as biocomposite material, pulp and paper, or decomposed for fertiliser

  2. Leaves used for cattle feed

  3. Palm oil mill effluent (POME) used as an organic fertilizer.

• Integrated farming with livestock in oil palm plantations also practised
Rubber

• Malaysia is the third largest rubber producer in the world with 1.7 million ha. trees.
Many technological innovations have been developed in the rubber industry by MRB:

1. High yield and disease resistant clones producing >3500 kilo rubber ha-1 yr-1.

2. In the 70s it introduced a high grade rubber named Standard Malaysian Rubber (SMR) in the form of heveacrumb which is internationally recognized as high quality raw material.

3. New tapping method called puncture tapping or microtapping, with increased latex production.

   It produces yields, with hormonal stimulation (etheral), comparable to conventional excision tapping.
Puncture or micro-tapping
Rubber can be turned into many manufactured goods and used for many purposes:

1. Conventionally, rubber can be made into tyres, gloves, shoes, condoms, mats, insulators, erasers, etc.

2. New latex-timber clones (LTC), RRIM 200 series have been introduced of which the trunk can be used for timber
1.3 Cocoa
- Cocoa production: 131,000 tonnes (1995)
  70,000 tons (2000)

Reduction due to:

1. reduction in planted areas (1989: 400,000 ha; 2005: 33,313 ha)

2. low market price

3. adverse weather conditions

4. labour shortage and

5. high production cost due to pests and diseases

- Malaysia imports cocoa beans from Indonesia to fulfill the requirement of the many processing factories.
1.4 Padi

- **Malaysia** currently achieves only **70% self-sufficiency** in rice. Target is to achieve **90% self-sufficiency** in near future.

- Among the **eight granary areas**, the major production centres (rice bowls) are:

1. **MADA** (Kedah-Perlis) **Muda**
2. **KADA** (Kelantan) **Kemubu**
3. **Sawah Sempadan-Tanjung Karang** (Selangor).
• In 1995, the average national production: 3.8 tons per ha

Some areas in MADA: > 5 tons ha⁻¹

Some areas in Tanjong Karang: > 10 tons ha⁻¹

• Government aims to raise the yield to 10 tons ha⁻¹ with new technology.
• Specially formulated chemical fertilizers in trials doubled padi yield and improved quality:

1. **Vita-grow®** is a foliar fertilizer developed by **UPM** that contains complete and balanced plant nutrients

2. **Zappa®** is another **UPM** product that enhances rapid germination and tillering.
Livestock

- Livestock industry:
  - 1995: RM953 million
  - 2000: RM 1.1 billion (3.1% growth/yr)
• **Integration of livestock** rearing in oil palm and rubber plantations increased greatly beef and mutton production.

• Integration reduces management cost by allowing **livestock to eat away weeds** and having **animal dung distributed all over as fertilizer**.

• **Land development agencies**, namely FELDA, RISDA, FELCRA and State governments have participated in this integration programme.
• Cattle have also been raised in feed-lots in Malaysia has developed new breed of beef cattle named Brahmas, a cross-breed between imported Brahman and local Kedah-Kelantan breed.

• Buffaloes are also now selected for meat purposes.
• A sheep named Malin, a cross between Australian and Indonesian breeds was also developed to increase local supply of mutton.

• The Boer goats, a South African breed, are raised in large numbers for the same purpose.
• Our Malaysian poultry industry is very advanced

• We are able to produce broilers (meat) and eggs to meet not just the nation’s demand but also for export
VACCINES

[Image of Fowl Pox Vaccine and a chicken's head]
• Researches on deer and ostrich have been undertaken by UPM and MARDI to provide alternative meat resources.
Fisheries

- Aquaculture (aquafarming) is the cultivation of natural produce of water such as fish, shellfish, prawns, crabs, algae and other aquatic organisms.

- Distinguished from fishing by the idea of active human effort as opposed to simply taking them from the wild.
• **Aquaculture** includes:

1. **Fish farming** - raising of **fresh water** (carp, catfish, prawn, tilapia) and **brackish water** (sea bass, tiger prawn, crabs) fishes in ponds, net cages on land or river

2. **Mariculture** - aquaculture in the **ocean** which includes raising of mollusks (oysters, clams), cultured pearls, algae and seaweeds.
Fruits, Flowers and Vegetables

• Much research conducted on fruits such as: banana, pineapple, papaya, starfruit, mango, durian, guava, watermelon, jackfruit, rambutan, citrus, duku langsat, cempedak, ciku and mangosteen.

• Flowers such as orchids is a growing industry. Tissue culture is now used for mass-production of orchid seedlings which are even exported.
1.9 Precision Agriculture

• This is a new innovation in agriculture. Also known as “site specific management”. Initially attracted the interest of the plantation sector.

• Utilises ICT and electronic tools to determine specific amounts of fertilizer, pesticide, etc. required in specific localities (micro-niches).

• In the long run saves management cost and increases yield.

• Precision agriculture is being practiced partly in oil palm and padi growing areas.
TOPIC 2

FUTURE CHALLENGES IN AGRICULTURE
2.1 Labour

• There is a great shortage of labour with cost rising steadily in Malaysia. In agriculture there is great dependence of foreign labour with some estates employing 100% foreigners particularly those from Indonesia and the Philippines.

• However, as a transitional measure, the government still adopt a liberal policy on the recruitment of foreign workers for the agricultural sector.
2.2 Price

- Increase in the **price** of fertilizers, seeds, tools and equipments has affected the cost of agricultural production.

- **Market price** is also **elastic and problematic** at times especially when there is a **sudden drop in commodity price**.
2.3 Crop Choice

• Big conglomerates are not interested in agriculture other than planting oil palm and rubber.

• Not many large companies are involved in food crops.
2.4 New Agricultural Technology

Research on new frontier technologies although most still experimental include use of:

1. **Cell, tissue culture** and **genetic engineering** techniques to develop **new crop** varieties

2. **Plant cell cultures** to develop new products in **pharmaceuticals, nutraceuticals and food additives**

3. **Embryo manipulation technology** and **genetically engineered vaccines** to increase **animal productivity**

4. **Robotics, computer modeling** and **microprocessor control** in **machinery and automation equipment** to reduce **labour**

5. **Advanced processing and packaging systems** to strengthen better **post-harvest handling** and **shelf-life** of agricultural products.
2.5 Resources

- There is keen competition for resource use in future between agriculture, industry, residential buildings, wildlife, recreational establishments, and water catchments.

- The main challenge in the future is to enable continuous crop production with high yield per unit area. Unfortunately, excessive agrochemical inputs needed lead to soil degradation. Land development adds to the degradation.
- **Water resource management** is important as only **2.1%** of the country’s heavy rainfall is being used currently. This low rate is due to seasonal distribution of rainfall.

- **Excess water** causes **flooding** and need to be drained. More **water storage dams** should be constructed to reduce water losses.

- **Water resources** should also be managed at the **national level** as presently it is under individual state jurisdiction.
• Land development therefore has to be properly managed which involves multiple objectives decision making.

• An environmental impact assessment (EIA) has been made mandatory to anyone who intends to develop land commercially, including large scale agricultural development.
In summary, agricultural practices on arable soils must be productive, environmental friendly and sustainable. This calls for efficient water, fertilizer, soil conservation management and new technologies such as precision farming and biotechnology.
CHAPTER 9

APPROACHES TO AGRICULTURAL DEVELOPMENT IN MALAYSIA
• NATIONAL AGRICULTURAL POLICY (NAP)

• EDUCATION, RESEARCH AND DEVELOPMENT INSTITUTIONS, AND EXTENSION SERVICES

• LEGISLATIONS, POLICIES AND STANDARDS
The agricultural sector has contributed significantly to the Malaysian economy. The following has provided for the policy framework for growth of the agricultural sector in Malaysia:

1. 3rd National Agricultural Policy (NAP 3) and NAFP
2. National Development Policy
3. Industrial Master Plan
4. Science and Technology Policy
5. National Biodiversity Policy
National Agricultural Policies and National Agro-Food Policy

• Malaysia has witnessed three agricultural policies:
  – NAP 1 (1984-91)
  – NAP 2 (1992-2010)
  – NAP 3 (1998-2010)

And

On-going National Agro-Food Policy (2011-2020)
• **NAP3** covers the period from 1998-2010. It is largely guided by the National Development Policy.

• NAP3 retains the objective of NAP2 to maximize income through optimal utilization of resources in the sector.

• This includes maximizing agriculture’s contribution to national income and export, and income of producers.

• A new policy named the **National Agrofood Policy** has been formulated for 2011-2020. It emphasizes on food quality, safety, nutrition, functionality and environmental sustainability.
EDUCATION, RESEARCH & DEVELOPMENT INSTITUTIONS, AND EXTENSION SERVICES
Education

• There are centres and institutes that cater to the acquisition and dissemination of knowledge and skills in agriculture.

• These establishments include Universities, Colleges, Vocational Institutes, In-service Training Centres in various Ministeries (MARDI, FELDA, RISDA, FRIM) and Societies such as Incorporated Society of Planters.

• A degree, diploma or certificate will be issued on successful completion of the course pursued.
Research and Development Institutions

Agricultural R & D institutions can be found in both the public and private sectors.

1. **Public Sector**

   Institutions within the public sector engaged in R & D include:

   1. MARDI
   2. MPOB
   3. MRB
   4. MCB
   5. Farmer’s Organisation Authority (FOA)
   6. Federal Agricultural Marketing Authority (FAMA)
   7. Fisheries Development Authority of Malaysia (LKIM)
   8. Muda Agricultural Development Authority (MADA)
   9. Kemubu Agricultural Development Authority (KADA)
   10. Forest Research Institute Malaysia (FRIM)
   11. Federal Land Development Authority (FELDA) (Sungai Tekam)
   12. Malaysian Rubber Development Board (MARDEC)
   13. Veterinary Research Institute (VRI)
2. Private Sector.

Organisations include:

1. Golden Hope (OPRS, Banting)
2. Applied Agricultural Research (Sungai Buloh)
3. FELDA Tun Razak Agricultural Services (Jerantut, Pahang)
4. United Plantation Research (Teluk Intan, Perak)
5. Guthrie Research Chemara (Negri Sembilan)
6. Agricultural Chemical (Prai, Penang; Selama, Kedah)
7. Applied Agricultural Research (Sungai Buloh)
8. KLK & Boustead
9. DUPONT Malaysia Research (Prai, Penang)
10. Sime Darby EBOR Research (Klang, Selangor)
3. **Non-Government Organisation (NGO)**

Among the active organisations are:

1. Centre for Environment, Technology and Development Malaysia (Cetdem Organic Farm, Selangor)

2. Malaysian Environmental NGO (MENGO, Selangor)

3. Malaysian Nature Society (MNS, KL)

4. Southeast Asian Fisheries Development Centre (SEAFDEC, Terengganu).
Extension Services

• Extension services are provided for transfer of technology (TOT) in agriculture from research institutions to farmers.

• TOT is mainly the duty of the Department of Agriculture (DOA)

• However other Research Institutes also provide such service directly through training and outreach programmes. Such institutions are Pusat Latihan dan Pembangunan Pengembangan (Telok Chengai, Kedah), MARDI, MRB, MCB, FELDA, RISDA (Rubber Industries Smallholders Development Authority), MADA, KADA, LKIM, FAMA, and NASH (National Association of Smallholders)
LEGISLATIONS, POLICIES AND STANDARDS
Legislations and Policies

• Legislation is formulated to regulate the agro-forestry sector with respect to the environment and health of human, plants and animals.

• There are several Acts which have been enacted such as:

3. Poison Act (1952)
4. Food Regulation (1985)
6. Quarantine Act (1976)
There are several other policies and legislations subscribed by Malaysia:

- **Malaysia** is a signatory to the [Cartagena Protocol](https://en.wikipedia.org/wiki/Cartagena_Protocol) (May, 2000), concerned with **biosafety**

- **Biosafety Bill** (2005) governs release of genetically modified organisms (GMO) into the environment

- **ASEAN Policy on Zero Burning** (2003) that promotes zero burning by plantation and timber companies

- **Biological diversity policy** (1998) that governs conservation, research and utilization of tropical biological diversity

Standards

For quality assurance and control in agriculture, several guidelines have been laid down in accordance with CODEX Standards.

A few examples of such standards, guidelines and certification agencies:

1. Good Agricultural Practices (GAP)
2. Best Management Practices (BMP)
3. Skema Akreditasi Ladang Malaysia (SLAM)
4. Skema Pensijilan Perladangan Organik (SOM)
5. Good Fumigation Practices (GFP)
6. Hazard Analysis Critical Control Point (HACCP)
Reports must be handed in on time to UPM, usually two weeks before the beginning of the final examination.
BEST OF LUCK !