AGRICULTURAL ENGINEERING AND MECHANIZATION FOR SUSTAINABLE AGRICULTURE IN MALAYSIA

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Highlights

- Introduction to Malaysia
- Status of Agricultural Engineering
- Constraints and Challenges of Agricultural Engineering
- Expected Impact of Climate Changes Associated with Global Warming
- Agricultural Engineering and Technologies for Climate Change Mitigation and Adaptation
- Policy Implications and Strategies for Promoting Ecological and Sustainable Agriculture Development
- Demand of Advancement in Agricultural Engineering
- Strategic and Direction of Agricultural Engineering
- Conclusion









Location:

Malaysia is located in Southeastern Asia.

There are two distinct parts to Malaysia:

Peninsular Malaysia is located south of Thailand, north of Singapore Malaysia is located on the island of Borneo and shares borders with Brunei and Indonesia.

■ Geographic coordinates: 2° 30′ N, 112° 30′ E

Area:

Total: 329,750 km² Land: 328,550 km² Water: 1,200 km²



Climate: Transact all

Tropical all year-round

Natural resources:

Tin, petroleum, timber, copper, iron ore, natural gas, bauxite.

Land use:

Arable land: 3% Permanent crops: 12% Permanent pastures: 0% Forests and woodland: 68% Others: 17%



Irrigated land: 2,941 km²

Natural hazards: flooding, landslides

Environment - current issues:

Air pollution from industrial and vehicular emissions; water pollution from raw sewage; deforestation; smoke/haze from Indonesian forest fires

Environment - international agreements:

party to: Biodiversity, Climate Change, Desertification, Endangered Species, Hazardous Wastes, Law of the Sea, Marine Life Conservation, Nuclear Test Ban, Ozone Layer Protection, Ship Pollution, Tropical Timber 83, Tropical Timber 94, Wetlands

signed, but not ratified: Climate Change-Kyoto Protocol



Population: 22 million

- Ethnic groups: Malay and other indigenous 58%, Chinese 26%, Indian 7%, others 9%
- Religions: Islam, Buddhism, Daoism, Hinduism, Christianity, Sikhism; Shamanism is practiced on East Malaysia
- Languages: Bahasa Melayu (official), English, Chinese dialects (Cantonese, Mandarin, Hokkien, Hakka, Hainan, Foochow), Tamil, Telugu, Malalalam, Panjabi, Thai; in East Malaysia several indigenous languages are spoken, the largest of which are Iban and Kadazan



Malaysia (cont'd)

■ **GDP:** average 7 – 8 %

GDP composition by sector: agriculture: 13%

agriculture: 13% industry: 46% services: 41%

Population below poverty line: 15.5%

Labor force by occupation:

manufacturing 25%, agriculture, forestry, and fisheries 21%, local trade and tourism 17%, services 12%, government 11%, construction 8%

■ Unemployment rate: 2.6 %



Malaysia (cont'd)

- Agriculture products: Peninsular Malaysia—rubber, palm oil, rice; Sabah subsistence crops, rubber, timber, coconuts, rice; Sarawak—rubber, pepper; timber
- **Exports:** US\$ 74.3 billion (f.o.b., 1998)
- Exports commodities: electronic equipment, petroleum and petroleum products, palm oil, wood and wood products, rubber, textiles
- Exports partners: US 21%, Singapore 20%, Japan 12%, Hong Kong 5%, UK 4%, Thailand 4%, Germany 3%
- **Imports:** \$59.3 billion
- Imports commodities: machinery and equipment, chemicals, food
- Imports partners: Japan 27%, US 16%, Singapore 12%, Taiwan 5%, Germany 4%, South Korea 4%



STATUS OF AGRICULTURAL ENGINEERING

- Agricultural sectors involved in production, processing and waste management of crop, livestock and fishery.
- Main economy contributor for 30 years after independence 1957.
- GDP agricultural sector declining, 23 % (1980) to 2% (1995), attained an average growth rate 3.2 % per annum (1985-1995).
- Population growth 2.5 % per annum, increase demand of food and food imports



STATUS OF AGRICULTURAL ENGINEERING (cont'd)

- Agricultural engineering and mechanization input into agriculture, food and agro-based industry is very low for small holders.
- Land preparation fully mechanized, significance progress in crop maintenance, manual and semi-mechanized in harvesting and postharvest handling, rice has achieved fairly high level of mechanization.
- Most of machinery is imported amounting US\$ 70-80 million annually.
- Locally made is broad, volume is not high, component and materials dependent on import.
- Among locally manufactured machinery such as sprayers, tillers and rubber processing machines are being exported.



STATUS OF AGRICULTURAL ENGINEERING (cont'd)

Locally manufactured agricultural machines: rotary tiller, rotary slasher, rotary oil palm front mulcher, maize seeder, rice stubble slasher, fertilizer spreader, agricultural trailer tanker, oil palm fruit bunch loader, oil palm fruit bunch trailer, oil palm fruit bunch infield transporter, oil palm fruit bunch collector, manual knapsack sprayers, agricultural hand tools, and oil palm and rubber processing machines.



STATUS OF AGRICULTURAL ENGINEERING (cont'd)

- Most of the agro-based and food processing industry consists mostly of small sized firms. These small firms, which are mostly family concerns, are run in the traditional manner, often manual or semimechanized in operation and little on quality control. Typical examples are manufacturing of coffee, spices, noodle, biscuit, bakeries and fish based food.
- The few large food-processing plants are equipped with modern machinery and utilize up-to-date processing technology and they keep abreast with the latest innovation in the industry. They include the canning, sugar refineries, beverage and instant noodle industries.



STATUS OF AGRICULTURAL ENGINEERING (cont'd)

- Most of agricultural engineering machinery and technology is readily available for crop, livestock and food production. We only develop new, adopt with modification or totally adopted foreign technology.
- MARDI, MPOB, RRIM and University Putra Malaysia.
- R&D&C focus on priority research area to generate technically feasible and viable technology.
- Work in a team of multi-disciplinary area include researcher, grower, supplier and buyer.
- Agricultural engineering technology and mechanization are tested in terms of efficiency, durability, reliability, safety, mantenance, cost-effectiveness, feasible and viability.

Constraints and Challenges

High and increasing cost of production

Malaysian agriculture is operating under competitive global environment and is losing grounds due to increasing costs of production especially that of labor, machinery use and water control. They are related to the high costs of imported technology of agricultural machinery and irrigation equipments. Apart from that there is a serious shortage of agricultural workers due to competition from other sectors of the economy especially the manufacturing and the construction sector.

Intensification of production per unit area

Resources especially land and water are and will be the limiting factor in agricultural production. Therefore there is a need to optimize the use of land resource such as by intensifying the production capacity per unit area and to reduce the risk factor of water in crop production so as to stabilize yield and quality.

Competition from other sector

The input and utilization of agricultural engineering technologies is highly capital intensive investment, requiring long term commitment in the terms of resources such as finance and full management support. In such a situation, the agricultural sector has to compete for the resources with other sectors of economy.



Limiting water resources

The total fresh water withdrawal is expected to increase from the present 11.6 billion cubic meters to 15.2 billion cubic meters by year 2010 with the substantial increases expected from higher priority domestic and industrial consumers while agriculture's consumption is projected to drop from 75 to 68 %. Irrigated agriculture must therefore improve on the efficiency of water use.

Limiting land resources.

With the rapid pace of industrialization and high population growth in the country, more and more agricultural lands that are close to the urban centers are being converted into industrial lands and residential lands. Agriculture has to expand into the problem lands that have inherent constraints to the application of agricultural engineering technologies. Each has its own specific problems that are related to machine access and water control.

Uneconomic farm size

Within the smallholding sector, the farming plots, particularly those which are used for food crop production, are smaller than their respective minimum economic farm sizes to be able to enjoy economy of scale of production with respect to the use of farm machinery and other engineering technologies. Past experience in land consolidation has indicated that significant improvement in machinery usage and water control which resulted in a more efficient production capability being achieved



Concept of agricultural modernization not understood

The concept of mechanized farming is not fully understood and practiced in the agricultural sector in this country. Mechanization has always played the supporting role in agricultural development. In years to come, due to labor and cost constraints, only those crops that can be highly and effectively mechanized will be able to service and sustain in the highly competitive local and global environments.

Research and development contribution urgently needed

Agricultural engineering technologies in general are still low. The development of sufficient research facilities and training of more skilled personnel including exposure to the latest technologies that are available overseas are urgently needed to accelerate research and development efforts in the generation of innovation technologies to solve the immediate problems besetting the agriculture sector.

Import duty on machinery and equipment is high

Machinery parts and components that can be used for both agricultural and non-agricultural purposes tend to be categorized under non-agricultural purposes. Hence tax exemption is denied and this makes their use in agriculture costly and non-viable



Unavailability of suitable technology locally

Dealers in agricultural and food machinery, for example, are reluctant to supply specialized machinery that are not commonly and widely used in this country due to the uncertainties involved and the high cost of stocking spare parts. Under such situation, it would be impossible to obtain and utilize the most economically optimum agricultural engineering technology packages.

Farm setup not designed for use of agricultural engineering technologies

Most of the present farm layout and infrastructural facilities are generally not designed for efficient use of agricultural engineering technologies. Mechanization and irrigation are usually not taken into account in the initial planning stage. When the need for the technologies is realized at a larger stage, the optimum design will have to be compared within the existing layout and situation.

Formal industry linkages

Current efforts towards establishment of formal linkages between the agricultural engineering research and development centers with the machinery manufactures, dealers and the extension agencies should be intensified up for better and more efficient flow of information, technology and feedback to and from farmers. Similar linkages with international research and development centers should be developed.



Certification of agricultural machinery and irrigation components.

There is no mandatory certification of agricultural machinery before they are allowed to be used in this country. The effect of this is that inappropriate machinery that are of flow quality and detrimental to the environment, soil structure and operators safety are being marketed in the country freely.

Funding and skill technical workers

The lack of industrial extension, and difficult access to fund for pilot production and commercialization of research and development results are the factors that contribute to the slow and difficult. Process of technology transfer from local R&D centers to the industry. Technical manpower relevant to the agriculture machinery industry comprising of technicians, mechanics, and machine operators are seriously lacking in the country.

High capital investment

Mechanized agricultural and food production requires higher capital investment than the traditional manual method. But agricultural enterprises involve higher risks compared to other economic activities and they yield relatively lower returns. Strategies that ensure cost effectiveness and viability of mechanized technologies should be put in place.



- Malaysia is a tropical country that is characterized by high year-round temperature and weather is controlled by equatorial and tropical mass. The annual rainfall rain fall is often above 2000 mm and falls in almost months of the year.
- It is frequently assumed that global change will bring higher temperatures, altered precipitation, and higher levels of atmospheric carbon dioxide.
- There is little knowledge of the effects of climate change on agriculture in Malaysia, although some efforts have been made to investigate the yield dependence on seasonal mean climate and crop sensitivity to drought and heat stress periods.
- In general, temperature changes and extreme events would have impacts on agricultural production. Some study reported the relationship between climate change and rice production, where an increase of 1 oC daily temperature may result in a 10 % yield reduction.
- Rainfall would have more direct impacts on soil moisture and soil fertility as well irrigation and water supply. However there are still some uncertainties in the present knowledge on agriculture and climate, including the positive impacts on carbon dioxide enrichment and influence of climate on crop quality.



Biophysical science

Climate impacts on agriculture lies on the biophysical science. The rates of most biophysical processes are highly independent on climate variables such as radiation, temperature and moisture. What might these changes mean for the biophysical response on agricultural crop?

Interact with thermal regime.

Higher temperatures in general hasten plant maturity in annual species, thus shortening the growth stages during which pods, seeds, grains or bolls can absorb photosynthetic products. This is one reason yield are lower in the tropical country. Because crop yield depends on both the rate of carbohydrate accumulation and the duration of filling periods, the economic yields of tropical crops grown in a warmer and carbon dioxide enriched environment may not rise substantially above present levels, despite increases in net photosynthesis (Rose 1989). Higher temperatures are important to know because many crops have critical thresholds both above and below which crops are damaged. Prolonged hot spells can be especially damaging (Mearns *et al*, 1984). Critical stages for high temperature injury include seedling emergence in most crops, for example sulking and teaseling in corn (Shaw, 1983).



Changes in hydrological regimes

The hydrological regimes in which crops grow will surely change with global warming. While all GCMs predict increases in mean global precipitation (because of warmer atmosphere can hold more water vapor), decreases are forecast in some regions and increases are not uniformly distributed. The crop water regime may further be affected by changes in seasonal precipitation, within-season pattern of precipitation, and inter annual variation of precipitation. Increased convective rainfall is predicted to occur, particularly in the tropics, caused by stronger convection cells and more moisture in the air. Too much precipitation can cause diseases infestation in crops, while too little can be detrimental to crop yields, especially if dry periods occur during critical development stages. For example, moisture stress during the flowering, pollination, and grain-filling stages is especially harmful to maize, soybean, wheat and sorghum (Decker *et al.*, 1985).

The amount and availability of water stored in the soil, a crucial input to crop growth, will be affected by changes in both the precipitation and seasonal and annual evapotranspiration regimes. Some GCM predict that the rise in potential evapotranspiration will exceed that of rainfall resulting in drier regimes throughout the tropics (Rind *et al.*, 1990). Because the soil moisture processes are represented so crudely in the current GCMs, however, it is difficult to associate certainty with these projections (IPCC, 1990). Global climate change is likely to exacerbate the demand for irrigation water. Higher temperatures, increased evaporation and yield decreases contribute to this projection.



Physiological effects of CO₂

The study of agricultural impacts of trace gas induced climate change is complicated by the fact that increasing atmospheric CO₂ has other effects on crop plants besides its alteration of their climate regime. These are often called 'fertilizing' effects, because of their perceived beneficial physiological nature. Specifically, most plants growing in enriched CO₂ exhibit increased rates of net photosynthesis. The higher photosynthesis rates are then manifested in higher leaf area, dry matter production and yield for many crop (Kimball, 1983: Acock and Allen, 1985: Cure, 1985); other studies, however, have not shown such benefits (Jones *et al.*, 1985: Baker *et al.*, 1989). CO2 enrichment also tends to close plant stomates, and by doing so, reduces transpiration per unit leaf area while still enhancing photosynthesis.

The stomata conductance of several agricultural species has been observed to decrease markedly (by 36% on average) in an atmosphere enriched by doubled CO_2 (Morison and Gifford, 1984). However, crop transpiration per ground area may to be reduced commensurately, because decreases in individual leaf conductance tend to be offset by increases in crop leaf area (Allen *et al.*, 1985). In any case, higher CO2 often improves water-use efficiency, defined as the ratio between crop biomass accumulation or yield and the amount of water used in evapotranspiration. Increases in photosynthesis and resistance with higher CO_2 have been shown to occur at less than optimal levels of other environmental variables, such as light, water and some of the mineral nutrients (Acock and Allen, 1985)



Soils

Climate change will also have an impact on the soil, a vital element in agricultural ecosystems. Higher air temperatures will cause higher soil temperatures, which should generally increase solution chemical reaction rates and diffusion-controlled reactions (Buol *et al.*, 1990). Solubility of solid and gaseous components may either increase or decrease, but the consequences of these changes may take many years to become significant (Buol *et al.*, 1990). Furthermore, higher temperatures will accelerate the decay of soil organic matter, resulting in release CO_2 to the atmosphere and decrease in carbon, nitrogen ratios, although these two effects should be offset somewhat by the grater root biomass and crop residues resulting from plant responses to higher CO_2 .

Sea level rise, another predicted effect of global warming, will caused increased flooding, salt-water intrusion, and rising water table in agricultural soils located near coastlines. This particularly crucial in some tropical countries with large agricultural regions and high rural populated located near sea level.



Pests.

Pests are organisms that effect agricultural plants and animals in ways considered unfavorable. They include weeds, and certain insects, arthropods, nematodes, bacteria, fungi and viruses. Because climate variables (especially temperatures, wind and humidity) control the geographic distribution of pests, climate change is likely to alter their ranges. Insects may extend their ranges allow their survival and increase the possible number of generations (Stinner, *et al*, 1989). Consequently, a substantial rise in the use of agricultural chemicals in the country.



AGRICULTURAL ENGINEERING AND TECHNOLOGY FOR CLIMATE CHANGE MITIGATION AND ADAPTATION

- Adaptation of climate change exists at various leaves of agricultural organization. In Malaysia, farm-level adaptation include changes planting and harvest dates, tillage and rotation practices, substitutions of crop varieties or species more appropriate to the changing climate regime, increased fertilizer or pesticide applications, and improved irrigation and drainage systems.
- Malaysian government can also facilitate adaptation to climate change through water development projects, agricultural extension activities, incentives, subsidies, regulations and provision of insurance.
- Sustainable agriculture is based on the principle that 'we meet the needs of today while protecting the ability of future generations to meet their own need in the future'. Sustainable agriculture represents a broad spectrum of agricultural methodology, which supports the environment. These can range from conventional, more intensive methods or even alternative methods.



AGRICULTURAL ENGINEERING AND TECHNOLOGY FOR CLIMATE CHANGE MITIGATION AND ADAPTATION (cont'd)

- The concept of sustainable agriculture in Malaysia is still evolving and definitions and practice differ among parishioners. Essentially sustainable agriculture integrates there main objectives such as economic sustainability and profitability; environmental concerns; and social acceptability.
- The model for sustainable agriculture most preferred or practiced by local proponents of sustainable agriculture is 'organic agriculture' or 'organic farming'. Organic agriculture is a holistic production management system, which promotes and enhances biodiversity, biological cycles and soil biological activity.
- It is based on the low use of internal inputs and non-use of artificial fertilizers and pesticides. This takes into account that regional conditions require locally adapted systems.



AGRICULTURAL ENGINEERING AND TECHNOLOGY FOR CLIMATE CHANGE MITIGATION AND ADAPTATION (cont'd)

- Another model used here for sustainable agriculture is the Integrated Crop Management system. It takes into account all factors both biological and physical in the farm system. It is a more flexible and practical system using a mixture of methods and technologies, organic or otherwise to attain high yields and sustainable production.
- It incorporates the use of biodiversity to increase yield using genetic materials that adapt to the environment, are efficient producers requiring minimal fertilizer inputs, and varieties that are resistant to pest and diseases.
- It introduces integrated pest management practices that reduces the pesticide and chemical loads on the environment, encourages usage of composts, crop rotations, mixed cropping and methodology that uses both accurate amounts and placing of fertilizers, it utilizes crop management technologies that optimize usage of water and land resources



AGRICULTURAL ENGINEERING AND TECHNOLOGY FOR CLIMATE CHANGE MITIGATION AND ADAPTATION (cont'd)

- The practice of hydroponics and fertigation in soilless agriculture too offers another form of sustainable and environmentally friendly food production concept. It may be initially expensive, as it requires structures like polytunnel plastic house or glass houses and a controlled environmental system.
- It however frees agriculture from traditional environments and offers the use of less land and other resources for maximum and efficient production of food. It can be environmentally friendly given proper controls and recycling of waste water within the system.
- Control environment system also offers sustainable agriculture in intensive livestock and aquaculture production.
- All the above methods require engineering technology and mechanization to increase yield, quality, feasibility and viability to ensure sustainable agriculture.



POLICY AND STRATEGIES FOR PROMOTING ECOLOGICAL AND SUSTAINABLE AGRICULTURE DEVELOPMENT

- Agriculture is an important and essential activity for human survival and well-being. It is heavily dependent on the availability of natural resources and the physical environment. However, with the increasing population, urbanization and industrial pressures, and rising demand for food, the conflict between agriculture, the environment and natural resources will intensify.
- As a consequence, such as soil erosion, water contamination, Salinization, depletion of ground water and flooding have caused serious concern on the issue of natural resource sustainability and management.



POLICY AND STRATEGIES FOR PROMOTING ECOLOGICAL AND SUSTAINABLE AGRICULTURE DEVELOPMENT (cont'd)

- The usage of land for agricultural purposes has increased form 3.0 million hectares or 23 percent of total land area in 1966 to 5.5 million hectares or 39 percent of total land area in Peninsular Malaysia. Land utilization for Sabah and Sarawak has however, been less intense.
- Realizing the concern for developmental sustainability, the government in 1991 promulgated the National development Policy which no longer focuses on land development (or frontier development) but rather toward inset development which concentrates on existing farm and villages.



POLICY AND STRATEGIES FOR PROMOTING ECOLOGICAL AND SUSTAINABLE AGRICULTURE DEVELOPMENT (cont'd)

- The Outline Prospective Plan (1991-2000) of Malaysia and Sixth Malaysian Plan (1991-1995) marked a new era in environmental policy objective setting in Malaysia by giving priority to 'responsible and well balanced exploitation of natural resources to safeguard the requirements of future generations'. Similarly, the second National Agricultural Policy (1992-2010) contains the essence of sustainable agricultural development to maintain a well-balanced approach to natural resource utilization.
- Consciousness and awareness of natural resource and environmental conservation are epitomized by the committee of Malaysia to the global plan of action as stated in the Commonwealth Langkawi Declaration on the Environment 9n October 1989 and the Earth Summit in Rio de Janeiro 1992.



POLICY AND STRATEGIES FOR PROMOTING ECOLOGICAL AND SUSTAINABLE AGRICULTURE DEVELOPMENT (cont'd)

- To ensure a balance between development and the environment, an act called the Environmental Quality Act was established in 1974. Under powers conferred by the Act, any person intending to carry out any activities which are prescribed are required to submit to the Director General of Environmentally Quality, a report called the environmental impact assessment (EIA) report. The EIA report is a necessary perquisite to the granting of approval of the activity by the relevant approving authority. The activities prescribed include agriculture (> 500 hectares), drainage and irrigation works, Land reclamation, fisheries, forestry, waste treatment and disposal, water supply, etc.
- The EIA has proved a valuable tool for sustainable development. What is required, however at present, is the strengthening of monitoring and auditing processes to ensure thee effectiveness of the procedures in environment management as prescribed by the EIA.



POLICY AND STRATEGIES FOR PROMOTING ECOLOGICAL AND SUSTAINABLE AGRICULTURE DEVELOPMENT (cont'd)

- To preserve soil resources in order to enhance agricultural productivity, the government is preparing a new act to replace the existing Land Conservation Act 1960 which was found to be inadequate for present needs. The revised National Conservation Policy will provide comprehensive guidelines and standards to soil conservation activities.
- The use of synthetic pesticide has contributed significantly towards higher agricultural productivity in the country. However, in recent years, its usage has come under critics because of the problems related to indiscriminate and overuse. There is increasing evidence that contamination and deterioration of the environment and food are realities.



POLICY AND STRATEGIES FOR PROMOTING ECOLOGICAL AND SUSTAINABLE AGRICULTURE DEVELOPMENT (cont'd)

- The Pesticides Act (1974) was introduced to promote practices which encourage the safe and efficient use of pesticides including minimizing adverse effects on human kind and the environment, and preventing accidental poisoning from improper handling. The act also ensures that pesticides are used effectively for the improvement of agricultural production and protection of human and plant health.
- Overall, the government's policies on sustainable agriculture development have been compatible with other policies, particularly improving living standards of the rural poor and small farmers.


STRATEGIC AND DIRECTION OF AGRICULTUAL ENGINEERING AND MECHANIZATION

- In the face of labor shortage occurring in the agricultural sector, the agricultural machinery industry is a critical support industry to the sector. Befitting this role, it would be given an integrated attention in terms of direction and structural development in addition to financial incentives and other supports to ensure its accelerated growth. The dependence by the agricultural sector on unskilled foreign labor would be reduced.
- Their employment would be restricted to agricultural operations that currently cannot be mechanized. Incentives would be given for agricultural producers to adopt capital intensive mechanization and automation technologies. The introduction of high technology in mechanization and automation of agricultural production would be intensified. R&D programmed and technology transfer work in this area would be strengthened.



STRATEGIC AND DIRECTION OF AGRICULTUAL ENGINEERING AND MECHANIZATION (cont'd)

- National Committee on Agricultural Mechanization and Automation is being established to provide strategic direction and coordination on all aspects of agricultural mechanization (i.e. application of agricultural engineering inputs). Its members would comprise representatives from the public and private sectors. A technical committee and a permanent secretariat would assist the committee.
- The 'Malaysian Network on Agricultural Mechanization and Automation' is also being established to facilitate technology awareness, information sharing, and industry feedback. This government-sponsored network or information hub (iHub) would draw its membership form the general public, government agencies, and private sectors with interest in the industry.
- It set-up an Implementation Task Force, an iHub Internet Website, Mechanization Information Unit and Newsletter. It would be a program under the National Committee on Agricultural Mechanization and Automation.



STRATEGIC AND DIRECTION OF AGRICULTUAL ENGINEERING AND MECHANIZATION (cont'd)

- The Task Force undertakes national baseline technical, economic and socio-economic surveys. It would then undertake the identification and quantification of national mechanization priorities. Emphasis would be placed on land and crop adaptation for Mechanized production. They include the development of strategies and action plans in land consolidation, land leveling, input/output access, irrigation and drainage, cropping layout, adaptive plant breeding, demonstration farms and commercial farming.
- Strategies on accelerated transfer of global technologies will be implemented. They include the establishment of Technology Transfer Fund and the development of action plans in technology identification, acquisition, field evaluation, commercialization and extension.



Demand of Agricultural Engineering Advancement

To support sustainable agriculture the agricultural engineering discipline has to be sub-divided into the following specialized categories:

Biological (Agricultural) Engineering Natural Resource (Agricultural) Engineering Power Systems and Machinery Design (Agricultural) Engineering Structures and Building Environment (Agricultural) Engineering Food and Bioprocess (Agricultural) Engineering Information and Electrical Technologies (Agricultural) Engineering Forest (Agricultural) Engineering Energy (Agricultural) Engineering Aquacultures (Agricultural) Engineering Nursery and Greenhouse (Agricultural) Engineering Nanotechnology and Photonics Engineering Safety and Health in Agricultural Engineering

Other engineering disciplines must also be involved. MARDI has 600 scientists, 80 engineering scientists. (Agricultural and Biological, Mechanical, Civil, Electronics, Computer, Chemical, Mechatronics, etc). Engineers are the driving forces or future sustainable agriculture.























MARD











MECHANIZED FRUIT PRODUCTION IN SUSTAINABLE AGICULTURE



























Single row mechanical planter



Double row planters



Crop maintenance



Weed control (inter row cultivator) Fertilizer application



Crop maintenance

- Insects control (boom spray)
- Pre-mergence

MECHANIZATION IN SUSTAINABLE AGICULTURE







Vine cutting

removal



Harvester machine types

Roots Digger Harvester







MECHANIZATION IN SUSTAINABLE AGICULTURE

Land preparation Disk plough

(Rotor + ridger)



Gambar 3 : Bajak piring yang digunakan dalam penyediaan tanah









MECHANIZATION IN SUSTAINABLE AGICULTURE



Pre-mergence (boom sprayer)





Land preparation





MECHANIZATION IN SUSTAINABLE AGICULTURE

Laboratory testing of Canon Digital Camera and Sony ccd camera with Video Transmitter and Receiver On platform On the ground/tractor



Image captured by camera



7 days (Medium spot)

Image after processing



Green Area Inside the Square (3616 pixels) Green Area Outside the Square Soil or Water Square



































IRRIGATION AND FERTIGATION SUSTAINABLE AGICULTURE













Micro Drip-Fertigation System















IRRIGATION AND FERTIGATION SUSTAINABLE AGICULTURE





















IRRIGATION AND FERTIGATION SUSTAINABLE AGICULTURE







































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APPLICATION OF

COMPUTER CONTROL

SAFTWARE IN

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Development of Real Time Bulk Sampling for Padi Quality Monitoring in a Factory







Mechanism of Probe









Development of Sensory System Activities in Farm: A Soil



SOIL TILT INSTRUMENT - MECHANICAL/STRUCTURAL COMPONENT

SOILT TILT INSTRUMENT -ELECTRONIC/COMPUTER HARWARE SYSTEM





APPLICATION OF CAMERA VISION IN SUSTAINABLE AGICULTURE







Development Wireless Technology for Detection of Plant Population in the Farm



Imaging System for Prediction of Papaya Yield for Crop Regulation in Precision Agriculture







SUSTAINABLE AGICULTURE







PRECISION FARMING IN SUSTAINABLE AGICULTURE







Superimpose OpenGL Software and Video Image



Electronics sensor system for bio chemical properties in crop





ARD

New Method in murtabak processing







Product Characteristics •Regular shape •Easy to pack •Not oily

Products before packagi





Frying/Baking of Murtabak



Rack Oven used for Murtabak baking

Batch Type.

Capacity : 20 pieces/batch of 20 min

60 piecs/hr



Processing steps 3. Filling





FOOD MECHANIZATION IN SUSTAINABLE AGICULTURE

Tray Feeding Mechanism (suction pad from bottom)







Murtabak forming machine

Murtabak forming machine







FOOD MECHANIZATION IN SUSTAINABLE AGICULTURE





































FOOD MECHANIZATION IN SUSTAINABLE AGICULTURE

New Method in murtabak processing







Product Characteristics

•Regular shape •Easy to pack •Not oily

Products before packaging



Rack Oven used for Murtabak baking Batch Type. Capacity : 20 pieces/batch of 20 min.

60 piecs/hr



Processing steps 3. Filling





FOOD MECHANIZATION IN SUSTAINABLE AGICULTURE









































FOOD MECHANIZATION IN SUSTAINABLE AGICULTURE






MARDI

INSTRUMENTATION IN SUSTAINABLE AGICULTURE



Conveyor type rempeyek making machine















FOOD MECHANIZATION IN SUSTAINABLE AGICULTURE







Mechanical skewering system with six times the production capacity of manual skewering





Beef satay



Chicken satay





Mechanical continuous grilling system for commercial production of satay •better heat distribution and control, •more hygienic •less smoke FOOD MECHANIZATION IN SUSTAINABLE AGICULTURE



Development Shelf Life Prediction Model in Packaged Food





MALAYSIAN AGRICULTURAL RESEARCH AND DEVELOPMENT INSTITUTE [MARDI]

Coconut dehusker machine









MECHANIZATION IN SUSTAINABLE AGICULTURE

































SUSTAINABLE LAYER AND BROILER PRODUCTION UNDER INTENSIVE CONTROLLED/MODIFIED ENVIRONMENT SYSTEM

















Housing and System for Marine Fish Production























Naturally Ventilated Rain Shelter Greenhouse in Highlands









Micro-Drip Fertigation System





Micro-Jet Sprinkler System













Production Facilities





Proposed Integrated Data Acquisition, Monitoring ad actuating System

Artificial Lighting System













Ventilation and Misting Fan System













Slope land Greenhouse Technology

Strawberry planted on column, fertigation system, platform, aestatic, less erosion, rain water harvesting, small pump, no air, water and ground pollution.



CONTROLLED/MODIFIED ENVIRONMENT IN SUSTAINABLE AGICULTURE

Greenhouse and Cooling System









CONTROLLED/MODIFIED ENVIRONMENT IN SUSTAINABLE AGICULTURE































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CONTROLLED/MODIFIED ENVIRONMENT IN SUSTAINABLE AGICULTURE





Single-row rain shelter and fertigation system on peat lands





Design and Development of Mechanically Controlled Environment Greenhouse Production System for Temperate Crop Production









CONTROLLED/MODIFIED ENVIRONMENT IN SUSTAINABLE AGICULTURE



Modification and Improvement of Controlled Environment Greenhouse and Production System for High Value Crop Production

















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CONTROLLED/MODIFIED ENVIRONMENT IN SUSTAINABLE AGICULTURE













FOUR SEASON TEMPERATE HOUSE: Summer, Autumn, Spring, Winter



Estimated Development Costs for Highlands Production

| NO | INFRASTRUCTURES AND UTILITIES | COVERAGE AREA | COST (RM) | | |
|-----|--|------------------|--------------|--|--|
| 1 | Naturally Ventilated Rain Shelter Structure for Crop Production | 10 ha | 6,000,000.00 | | |
| 2 | Naturally Ventilated Netted Rain Shelter for Nursery | 0.5 ha | 200,000.00 | | |
| 3 | Automatic Micro Drip Fertigation System for Crop Production | 10 ha | 500,000.00 | | |
| ∠ļ, | Artificial lighting System | 10 ha | 150,000.00 | | |
| 5 | Ventilation Fan System | 10 ha | 250,000.00 | | |
| 6. | Integrated Data Acquisition, Monitoring and Actuating System | 10 ha | 200,000.00 | | |
| 7. | Total Cost | 10 ha | 7,300,000.00 | | |

Estimated Operational Costs

| NO | MATERIALS AND SERVICES | COVERAGE AREA | COST RM |
|----|---|---------------|--------------|
| 1 | Seed, pesticide, fertilizer, wrapping paper, wrapping plastic, rubber, utility, worker and management for chrysanthemum, carnation or roses production | 10 ha | 2,055,357.00 |
| 2 | Seed, pesticide, fertilizer, coco peats, utility, worker and management for tomato or strawberry production | 10 ha | 1,633,500.00 |

Cash Flow Analysis

| NO | PRODUCTION (10 HA) | CAPITAL COST (RM) | OPERATIONAL COST (RM) | TOTAL COST (RM) | NPV (RM) | IRR (%) | PAYBACK (YRS) |
|------------|------------------------|----------------------|-----------------------------|--------------------|---------------|------------|------------------|
| 1 | Chrysanthemum | 7,300,000.00 | 2,055,357.00 | 9,355,357.00 | 9,987,836.62 | 35 | 2-3 |
| 2 | Carnation | 7,300,000.00 | 2,055,357.00 | 9,355,357.00 | 1,243,832.51 | 13 | 5-6 |
| 3 | Roses | 7,300,000.00 | 2,055,357.00 | 9,355,357.00 | 7,081,193.01 | 28 | 3-4 |
| <u>∠</u> ļ | Tomato | 7,300,000.00 | 1,633,500.00 | 8,933,500.00 | 9,987,836.62 | 35 | 2-3 |
| 5 | Strawberry | 7,300,000.00 | 1,633,500.00 | 8,933,500.00 | 34,504,659.38 | 86 | 1-2 |

CONCLUSION

- Agricultural engineering is necessary to provide technologies for farm mechanization, irrigation, electrification, structures and food processing. It has contributed significantly to the industrialization of the Malaysian agriculture and it has brought Malaysian agriculture into the present sustainable agriculture and information age.
- The use of agricultural engineering inputs in agricultural production and agro-based processing is essential to overcome the various operational constraints such as climatic change, unfavorable plant growth environment, high handling losses and inefficient work rate. High technology farming, including hybrids for rice, and other grains, better methods of soil conservation and irrigation, and the use of fertilizers has led to a significant increase in the production of food in this country, particularly rice.
- Malaysian agriculture should now position and prepare itself to adopt the latest contribution from agricultural engineering which include precision agriculture, animal waste management, nutrient transport and water quality, food safety, crop bio-processing and bio-sensors.



CONCLUSION

- As the Malaysian population increases, more food, energy, and goods are required. Our natural resources are limited and while it is necessary to produce more with less input, it is equally important that the higher productivity does not degrade our environment. In the search for new ways to use agricultural products, byproducts, and wastes, our agricultural engineers should come up with viable and environmentally sustainable solutions to support sustainable agriculture agenda.
- Our agricultural engineers should ensure the sustainability of the necessities of life. They include safe and plentiful food to eat, pure water to drink, clean fuel and energy sources, and a safe, healthy environment in which to live.



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THANK YOU FOR YOUR KIND ATTENTATION

