ENGINEERING NEEDS IN AGRO-BASED INDUSTRIES

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1. INTRODUCTION

The performance of the Malaysian agricultural sector has been one of the most commendable in modern times. Although we are still importing various food-stuffs from our neighbours, we are the world's leading producer and exporter of rubber and palm oil. Malaysia is also a leading producer of pepper and, in the coming years, of cocoa as well. Table I shows Malaysia's major agricultural produce and its percentage of the world output based on the 1985 estimates.

TABLE I: PRODUCTION OF MAJOR AGRICULTURAL PRODUCE IN MALAYSIA

Produce ('000 tonnes)	1984	1985e	Percent of World Output
Rubber	1529.2	1540	36%
Palm oil	4138.4	4292.8	55%
Cocoa	85.2	103.5	NA
Pepper	15.0	17.0	20%
Padi	1713.5	1773.5	NA
Coconut oil	68.7	103.1	NA
Pineapple	155.7	150.0	NA
Meat	284.4	294.9	NA
Fish	656.5	666.4	NA
Tobacco ('000 kg)	6863	8456	NA

e = estimates; NA = Not available
source: Ministry of Primary Industries, Malaysia
Ministry of Agriculture, Malaysia

However, although we are pleased with our achievement, we have to face the realities of international trade. The primary commodities that we produce are not insulated from the destabilising impact of volatile prices and are subject to the vagaries of fluctuating demand in consuming countries.

Our agricultural sector is presently at a crucial stage . Slowly we are losing our grip on the competitive edge to our two neighbours, Indonesia and Thailand. They have more land and their labour costs are much lower. It is time for us to develop a new strategy - one which can enable us to maintain the upper hand, while also taking advantage of the raw materials that they produced. This can be achieved through the use of modern technology to attain a higher productivity and emphasizing on production of processed goods rather than supply of raw materials. The time has come for the engineers to play a more prominent role in agricultural production.

The contribution of engineers in our agricultural production has been very limited; normally in the form of services rendered. Those who are directly involved are few in numbers and quite often are unsure of their job specifications or role in agricultural production.

While our country is striving towards industrialization, our agricultural sector is still very much dependent on manual labour. The production of our primary commodities, namely rubber

and palm oil, is very labour-intensive. Mechanization of agriculture and building of factories should, at least, go hand in hand. In the U.S.A and other developed countries, farm mechanization has been considered as the critical factor in their industrialization process. It has released millions of agricultural workers to other industries, thus contributing to the nation's industial expansion. With farm mechanization, only a small proportion of the population is involved in food production for the entire population.

Compared to our neighbours, our farm operations are relatively more mechanized with its infrastructure more well-laid. However, our high investment into farm mechanization and its infrastructure does not really give us much advantage over our neighbours due to cheap labour costs in this region. Furthermore only certain aspects of farm operations are being mechanized while others, such as harvesting, still require an intensive labour force. At the same time, almost all of the machineries that we use are imported and their maintenance costs are high because we lack the necessary trained local staff to look after the machines. Spare parts have to be imported too. As a result, the production cost of most of our crops are comparatively higher than our neighbours. It is thus cheaper to buy our food from Thailand and Indonesia rather than to grow our own.

We can produce our crops at competitive costs if we can increase the workers' productivity and operate the farms more efficently. We should strive to find ways to adopt less labour-intensive

techniques in harvesting our crops. This can only be achieved with the full involvement and commitment of our engineers.

2. ENGINEERING NEEDS

Engineering input into agro-based industries are needed at all phases of production, i.e. from the land preparation stage to the marketing of the processed products. Technically, the engineering needs can be broadly classified into the following categories: (1) Power and Machinery (2) Soil and Water (3) Process Engineering and Environment and (4) Food (and Other Resource-based) Engineering.

2.1. Power and Machinery

The change from muscles to motors was perhaps more than any other, the single event that revolutionized agricultural production. The power delivered by the farm tractors together with the accompanying machineries have removed the drudgery from farm operations. It has enabled better usage of labour and made farm life more pleasant.

Fully mechanized agriculture involves the use of machinery at all phases of crop production. Usually different machines are needed to do specific farm operations. Thus a farm has to be equipped with different types of implements such as ploughs and harrows, seeders and planters, cultivaters, harvesters and so forth. To

own all these machineries is beyond the means of our farmers. Even plantation companies do not have many of these machineries because it is cheaper to use manual labour. The problem arises when there is a shortage of labour or the labour cost becoming too expensive.

Presently, there is a shortage of labour force in the plantation industry. Life in the estates is still very demanding. Mechanization of this sector is of utmost priority. More engineers are needed to modernize this sector. We are too dependent on imported machineries so that when these are not available, we are left with some crude implements to harvest our commodities. This is the case with our rubber tapping and oil palm harvesting, resulting in 60% of the production cost going to labour.

Research into the development of such implements needs to be carried out professionally. The government and the private sector have to provide the necessary support, while engineers are needed to make this effort a success. With a concerted effort from both parties, the growth of a local farm-equipment manufacturing industry can be encouraged.

2.2. Soil and Water

The field of soil and water engineering involves the control and proper utilization of our two main natural resources - land

and water. These two resources need to be controlled and utilized efficiently so that farming can be carried out under less hazardous conditions while achieving better production.

A proper understanding of the soil-plant-water relationship is essential for a better production of a crop. Too much or too little water is not healthy for the plant. A deficiency of soil moisture can affect the photosynthetic rate of a plant by impeding the uptake of carbon dioxide and reducing the hydration of protoplasm. An excess of soil water will displace air from the pore space in the soil, thus affecting the aeration of the roots and their ability to absorb nutrients.

The water requirement of a crop varies at the different stages of growth, with some stages being more critical to its availability. Timely delivery and removal of water as required is essential for a good harvest of the crop. A properly designed drainage and irrigation system should be able to do the job.

There are various methods of irrigation. In Malaysia though, irrigation is always associated with the flooding irrigation of rice. Of the total cultivated padi area, about 54% or 340000 hectares are estimated to be equipped with irrigation canals. About 30% - 40% of these lands can be double-cropped yearly. However, despite our heavy investment into the development of irrigation and other infrastructural facilities, our rice production remains low. This is one area where engineers have contributed quite a lot, mostly in the form of services rendered

such as in the construction of irrigation canals and farm roads. However, engineers should participate in the production aspects of the rice crop as well. At the same time, we should restudy the present rice policy which is dictated by short-term economic considerations and can be detrimental to our resources in the long run.

There is another type of irrigation that need to be developed. This is the irrigation of the upland crops. Presently, the Department of Irrigation and Drainage Malaysia (DID) does not give any emphasis towards its development, so much so that we are lacking behind Thailand in this respect. If we are serious with the National Agricultural Policy (NAP) and determine to improve our fruit and vegetable outputs, something has to be done to develop the upland irrigation systems.

2.3. Process Engineering and Environment

This field covers a wide range of engineering activities on the farm, such as processing of farm produce, building of farm structures, and utilization of agricultural by-products and wastes.

Processing of crops and other produce are necessary to improve and retain their quality. Improved methods of handling, storage, ventilation, refrigeration, pasteurization and grading are some of the engineering activities involved in agricultural processing.

It was estimated that about 15% of the total loss in padi production in Malaysia occured during the post-harvest handling and milling. Taking an average loss of 3.1 tonnes per hectare, the total loss in monetery term for the MADA area alone can reach $33 million.

In principle, all farm buildings are for one of the three basic functions, i.e. storage, processing (which may be combined with storage) and production (basically livestock). The environmental needs of the animals or the behavior of crops in storage need to be taken into account when designing a farm building.

The progress in structural and building technology has resulted in the production of various new building components and better use of construction materials. At the UPM, research has been concentrated on the production of low-cost materials for farm building purposes. Some of the materials being tested are (1) lightweight concrete using palm oil shell and klinker, (2) rubber timber, (3) bamboo as an engineering material, (4) ferrocement for farm structures and (5) soil-cement for farm roads.

Many agricultural by-products and wastes can be processed and utilized in many forms such as fertilizer, animal feed, building material and energy source. If left untreated, these agricultural wastes can be harzardous to our environment, since their discharge will pollute the water sources and the air we breathe.

The waste products from our palm oil industry, consists mainly of palm oil mill effluent (POME) and the ligno-cellulosic wastes such as empty fruit bunches, palm trunk, pressed fruit fibres, fronds, shells and kernel cake. The production of POME alone was estimated to vary from 10 - 18 million tonnes per year. The total agricultural wastes were estimated to be about 52 million tonnes per year.

2.4. Food (and Other Resource-based) Engineering

Food engineering is the application of enginnering principles and concepts to handling, processing and distribution of food. The field emphasizes the design of processes and systems for the food industry rather than the products themselves. A person in this profession should have a clear understanding of the processes and equipment involved, as well as an adequate knowledge of the chemical, microbiological and biochemical characteristics of food products.

The Industrial Master Plan (IMP) has singled out the Food Processing Industry as one of the priority sectors for expansion and development. It is proposed that a modern food processing sector should be developed and industries utilizing more local raw materials should be encouraged. Part of the strategies include designating cocoa products, animal feeds and fruits and vegetables as priority products and intensifying research and development in these sectors.

For the primary commodities sectors such as rubber and oil palm, the IMP recommends a strong emphasis on product development and making inroads into new markets. Presently, only 4% of the total natural rubber produced is being consumed by the local manufacturing industry. The IMP development objectives are to increase the local consumption of rubber by 5-folds by 1995, and to develop the industry into an export oriented one. The development strategies for palm oil products industry include the development of further downstream palm oil based products, establishment of a palm kernel oil based industry and the rationalisation of the refining and fractionation sub-sector to enhance processed palm oil production efficiency and competitiveness.

3. EDUCATION, RESEARCH AND DEVELOPMENT

It has often been said that R & D activities in Malaysia thus far has only concentrated on solving the problems of the agricultural sector. This unfortunately implies lesser emphasis need be given to agricultural research. However within the wide spectrum of agricultural activities which include agronomy, horticulture, soil science, plant protection, animal science and agricultural engineering, there has not been an even distribution of R & D activities.

Clearly, much is left to be done in the area of agricultural engineering - the area where involvement of engineers is needed.

The Faculty of Agricultural Engineering at Universiti Pertanian Malaysia was established in 1975 for the purpose of fulfilling this need. Agricultural engineers and agricultural engineering technical assistants are presently being trained at the university to meet the nation's demand for specially trained engineers to serve the agricultural sector. Unlike engineering graduates who followed the traditional engineering streams such as civil and mechanical engineering and require postgraduate retraining or pre exposure to agricultural practices before they can design and build systems for agricultural production, agricultural engineering graduates could be absorbed into the agricultural sector immediately.

While the IMP has identified the need for vigorous R & D in the area of food processing, it fails to see the same need for greater engineering input into agricultural production itself. The IMP has proposed the establishment of a bio-technology research division to help in the development of the food processing industry. However for the sector to develop, a sound R & D programme in the field of agricultural engineering is necessary.

Malaysia should give priority to the establishment of a testing center for agricultural machinery. All advanced (industrial and agricultural) countries have established such a center, for example the NIAE in United Kingdom, Nebraska Testing Center in USA, Institute of Agricultural Machinery Overseas Technical Cooperation Agency in Japan and also the RNAM in the Phillipines.

A center is needed to provide useful information on agricultural mechanization, and to compile and distribute information on agricultural implements. It should serve as the testing and evaluating center on machines' performances and set standards for agricultural machineries in Malaysia. The establishment of such a center would facilitate the development of a local farm-implements industry.

In the same light, a center for post harvest technology should be established together with a research station to test and evaluate, under actual field conditions, the performances of the various machineries, pilot plants and irrigation and drainage systems. Besides improving the agricultural production, the manufacturing sector should also benefit from the establishment of these R & D and testing centers and the station.

4. SUMMARY AND CONCLUSION

As our country strives towards industrialization, we have caused considerable labour migration from the agricultural sector to the factories. There is no glamour in agriculture. The sector simply cannot compete for the labour.

In order for the agricultural sector which is important to our nation to survive, it has to be mechanized. This calls for the full involvement of engineers in agricultural production. Agricultural engineers are needed in the field of power and

machinery, soil and water, process engineering and environment and food engineering.

The importance of this newly introduced engineering field has not been fully recognized. There is a brief statement on mechanization and processing in the NAP, but there are no stated targets or new elements in the overall development strategy. The IMP identifies the food processing industry as one of the priority sectors but has no mention for the production of the raw materials which originates from the agricultural sector.

It is our firm belief that, a successful industrialized nation always has a strong agricultural sector.

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