

Contributions of an Agricultural Engineer in the Oil Palm Plantation

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More and more Malaysian public listed companies are expanding their oil palm plantation acreage in Indonesia. In Kalimantan, the cultivation and development of the 'green dollar tree' business is extensive, usually at the speed of 20,000ha annually. Besides tree planting, the development of an oil palm plantation includes providing engineering facilities and infrastructures to assist in oil palm fruit harvesting, production and evacuation, and also social responsibility. An agricultural engineer who applies engineering science and technology to the agricultural production and management of natural resources play a big role in this aspect.

Plantation Building and Housing

Usually, plantation companies have an in-house agricultural engineer in-charge of the planning, design and construction of plantation building projects such as the office, store, workshop, laboratory, school, executive housing and workers' quarters. The following factors should be considered when planning a building project:

- The functional requirements of the building such as space, temperature, light, physical protection, sanitation, safety and health.
- The efficiency of the building in supporting mechanisation, centralised operation, circular travel and bulk handling of materials.
- The structural design requirement that comply with the British or Malaysian Standards.
- The suitability of materials in terms of durability, fire resistance, cost, upkeep and insulation.
- Economy of construction. Costs are reduced by choosing modular dimensions, standard size materials and components, local materials and prefabricated subassemblies. The initial and maintenance costs should be weighed against the expected serviceability period.



A plantation office

- Flexibility of design that allows for future needs. For example, larger doors and extra electrical services to accommodate for future expansion.
- Available adequate supply of services such as electricity and good quality water.
- Compliance with the state and local regulation such as the Workers' Minimum Standards of Housing and Amenities Act 1990.

Farmstead (complex or housing) should be planned and designed to accommodate the development plan of the plantation. The layout should allow for the expansion of buildings and facilities. As a rule of thumb, it is advisable to look for twice as much area as required initially. The location of farmstead in a plantation should be designed by taking into consideration the labour efficiency which can be achieved by minimising the travel distance.

Besides, buildings should be located on relatively high ground with adequate surface drainage to prevent flooding. Well drained soil is essential for the

satisfactory operation of individual septic tanks. A sufficient area should be provided to cater for chemical waste and livestock effluent without polluting the stream, river and lake.

Housing location should be carefully selected in terms of prevailing wind direction and distance so that the housing will not be bothered by odours generated by the mill and livestock. Buildings that line up at the right angle rather than parallel to the wind direction will be less subjected to the spread of fire.

During the early site selection process, it is advisable to ensure a satisfactory water source from an upstream river or tubewell. Electricity supply can either be taped from the palm oil mill or generated by genset. Generally, single storey buildings with pad footings are constructed on original hard ground which provides adequate bearing capacity. The cut and fill earth volume can be estimated manually or using computer software. The buildings designed should comply with relevant standards and prepared using AutoCAD.

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The main road

Agricultural Road

Plantation roads are considered an integral part of oil palm fruit evacuation and mainline transportation system. A well planned, good quality and adequately maintained road is a prerequisite to the successful implementation of a mechanisation program and crude palm oil transportation. An agricultural engineer needs to perform a feasibility study, including the planning, design and construction of all weathered agricultural road. A gravel road in an oil palm plantation should be designed as a low impact road which minimises the cut and fill slope size, reduces the earthwork and minimises the changes to natural drainage patterns.

A good feasibility study is crucial in facilitating the management to make the right financial decision and ensuring success in the execution of projects. For instance, the management would be able to make a cost-effective decision from several possible alternative alignments of the same project. Generally, in the selection of an alignment, we must take into account the (i) topographical and hydrological data; (ii) the nature of the soils encountered and; (iii) the availability of surface materials.

Alignment studies are based on the examination of geological maps, aerial photographs and ground reconnaissance. These processes will bring out the most favourable zones in terms of contour, flooded zones, catchment areas, river flows and favourable crossing points. During ground reconnaissance, it is vital

to carry out soil investigation through trial pits and field tests to determine the nature of the foundation soils.

Basically, the surfacing material for the agricultural road can be either 75mm crusher run, lateritic soil or river gravels. The quarry dust or clay used as binder in gravels at a maximum ratio of 3:7 to provide a reasonably satisfactory running surface. The compacted thickness of surface material is usually 125-150mm. The agricultural road can be divided into three categories:

- Highway (10m wide) for crude palm oil transportation connecting the palm oil mill and federal road;
- Main road (5.5m wide) for oil palm fruit mainline transportation connecting the field and the palm oil mill or estate's office;
- Subsidiary/field road (4.25m wide) for infield oil palm fruit evacuation.

Details of agricultural road specification can be referred to the respective company technical manual or references published by FAO, TRRL, *etc.*

Water crossing is an important part of the road drainage system. An agricultural engineer is responsible for designing structures such as reinforced concrete drift, box culverts and short bridges to replace temporary log bridges which are insufficient for heavy vehicle load such as oil tanker and overloaded lorry. These crossings are designed to handle 40-tonne loads and conform to the British Standard. The design peak flow can be estimated by

examining the observed high water level at the respective cross section multiplied by the suitable factor of flood intensity. These data allow the agricultural engineer to consider the bridge size, lifespan and construction cost.

An agricultural engineer also designs the drainage system for the road. The existing ground or road attributes are acquired from detailed global positioning system (GPS) assisted road surveys and mapped in the geographic information system (GIS). Earth drains are constructed along the agricultural road and culverts are installed with the appropriate openings to facilitate the flow of surface water away from the road base. Turnouts are provided at suitable intervals (change in slopes) to dispose the runoff and sediment to a field which acts as a buffer strip. Cover crops and vetiver grasses are planted on bare slopes and the culvert's inlet/outlet to prevent soil erosion. If there is a permanent water table (for irrigation), the road should be raised at least 600mm.

Water Supply

The availability of water for the oil palm nursery, household and palm oil mill processing is of importance in an oil palm plantation. Agricultural engineers design farm ponds and tubewells to provide a reliable source of water to adequately serve the individual estates and mills. Off-stream storage ponds are designed and constructed adjacent to a continuously flowing stream and an intake, through an open channel, diverts water from the stream into the pond. The farm ponds are protected against overflow damage by providing the appropriate spillway.

Water is supplied by pump to the nursery (a minimum of one litre/polibag/day) and the water treatment plant for household uses. The storage capacity of a farm pond depends on the water needs, evaporation, seepage and sedimentation. Water losses are difficult to predict, so the minimum storage is usually computed by estimating the total needs and allowing 50% of the total storage for seepage, evaporation and other non-usable requirements.

Agricultural engineers are responsible for the procurement, budgeting, water requirement estimation, construction

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and testing of tubewell in an oil palm plantation. Tubewell supplies reliable groundwater in an oil palm plantation, especially in Kalimantan during the three-month drought period between July and September. Generally, tubewells are equipped with submersible pump and filter screen for a better quality of water supply for plantation household uses (200 litres/day/person) and palm oil mill processing ($\geq 60 \text{ m}^3/\text{hour}$).

Mechanisation

Mechanisation aims to increase the land to labour ratio in an oil palm plantation, hence reducing the dependence on foreign labour. An agricultural engineer focuses on the selection and adoption of machinery for local conditions. Imported machines from neighbouring country which are suitable for vegetable crops may not be suitable for tree crops such as oil palm fruit. Machinery or agricultural vehicles such as mechanical buffalo, mini tractor, 5- to 12-tonne bins, etc, are commonly used for infield collection and mainline transportation. In order to maximise the productivity of capital intensive machinery, their idling time must be minimised as much as possible. They must be subjected to preventive maintenance on a regular basis to avoid breakdowns. It is also important to have a central workshop with competent mechanics and replacement parts for these machineries.

An agricultural engineer evaluates the economical aspects of a machine by comparing the harvesting costs of

the machines against the conventional manual method. He or she should determine the service life and total production of the machines in order to attain a balance between the harvesting and machine costs, and productivity.

Lorries used for long distance mainline transportation to a palm oil mill must be able to deliver as many trips as possible. An agricultural engineer has to design a reinforced concrete ramp which is strategically located in the field to optimise the travelling time for both in-field collection and mainline transportation. The ramps are commonly used in estates with undulating terrain, and a 50-tonne ramp normally covers about 2,000ha of mature field.

Conclusion

It is apparent that the vital role and contribution of agricultural engineers in developing large scale oil palm plantation is important. They promote science and technology, through the use of modern engineering technology to assist in the transformation of the plantation industry towards greater commercial orientation. An agricultural engineer can work together with the planter to produce quality products which, not only benefit the plantation in terms of yield improvement and cost reduction, but also the community and towards environmental sustainability. This would be in line with the vision of the Roundtable on Sustainable Palm Oil (RSPO) of 'sustainability implies economic, social and environmental viability'. ■

QUOTES OF THE DAY

In Lighter Vein

*I'm on a committee
Oh give me your pity! I'm on a committee
Which means that from moring 'til night',
We attend and amend, and contend
and defend,
Without a conclusion in sight.*

*We confer and concur, we defer and demur,
And reiterate all of our thoughts,
We revise an agenda, with frequent addenda,
And consider a load of reports.*

*We compose and propose, we suppose
and oppose,
And the points of procedure are fun;
But though various notions are brought up as
motions,
There's terribly little get done.*

*We resolve and absolve, But we never dissolve
Since it's out of the question for us,
To bring our committee to end like this ditty
Which stops with a period.....Thus.*

Author Unknown