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BEST MANAGEMENT PRACTICES FOR SUSTAINABLE DEVELOPMENT OF OIL PALM PLANTING ON PEAT: TH PLANTATIONS BERHAD"S EXPERIENCE

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SUMMARY

Claims were made that oil palm development on peat is not sustainable due to the impact on the hydrological balance and emission of greenhouse gases (GHG) which inevitably led to global warming. Conversely, with proper management and maintenance or cultural practices implemented, the sustainability and economic viability of the oil palm planting can be ensured.

Keywords: *oil palm, peat, management practices, sustainable, development*

INTRODUCTION

Peatlands are not only valued for their ecological services (water quality and storage, biodiversity) but, historically, have met human needs for food, energy, construction material, livestock bedding and in arts and health. Continuing unregulated and unmanaged demand for new land for cultivation and construction, along with the ongoing degradation of drained peatlands, will lead to continuous depletion of peatlands and peat resources unless concerted action is taken. Peatlands are managed for many different purposes and drained peatlands are used mostly for agriculture and forestry (Joosten and Clarke, 2002) and also for peat extraction to provide growing media and energy. Peatlands are also ‗used' or managed indirectly as a result of other landscape activities, for example, urbanization, mining, reservoir construction, mineral extraction and wind farms. Peatlands are valued for different reasons by a wide range of stakeholders (Joosten and Clarke, 2002).

CHARACTERISTIC AND CLASSIFICATION OF PEAT

Hectarage

Peat soil development will remain an important issue in the cultivation of oil palm in Malaysia and Indonesia. It is estimated that there are about half a million hectares of peatland in Sarawak developed for agricultural purposes and about 330,000 hectares are planted with oil palm. Of this about 43,000 hectares are owned by TH Plantations Berhad with approximately 75% of the land parcel is on deep peat which possess poor physical and chemical properties that requires improvement for successful cultivation of oil palm.

Depth, Horizon and Topography

It is important to determine the peat depth. Peat is considered shallow if it is less than 1.5 metres deep. The depth of peat is generally shallower near the coast and increases inwards, sometimes exceeding more than 20 m deep in Sarawak (Melling *et al.,* 2006).

Physico-Chemical Characteristics of Drained Peat

Volarovich and Churaev (1968) describe peat as a complex, heterogeneous, poly-dispersed system consisting of both true solutions of low and high molecular weight, hydrophobic sols and hydrophilic semi-colloids in a dynamic state of dispersion at equilibrium. The structure of the peat colloids is determined by the chemical composition of the compounds formed during the decomposition of vegetable matter, whereas the coarse-dispersed fraction is composed of plant remains in the form of insoluble and high co-polymers of cellular tissues. Peats can be divided into two categories:

a. High moor peat
   This peat type, comparable to most dome-shaped lowland tropical peats of ombrogenous oligotrophic nature, has a large hydrophilic humic material content (humic acids and hemicellulose). An increasing degree of decomposition results in an increase in hydrophobic components. This explains the stronger irreversible drying in sapric materials than in fibric materials.

b. Low moor peat
   This peat of eutrophic nature is uncommon in the tropics and appears to have a smaller content of hydrophilic materials. The colloid fraction mainly consists of humates of polyvalent metals forming compact coagulated aggregates.

CONSTRAINTS TO OIL PALM CULTIVATION ON DEEP PEAT

a. Low Nutrient Content
   i. Macronutrients – high K requirement
   ii. Micronutrients – Cu and Zn essential
b. Low Bulk Density
   i. Subsidence and shrinkage
   ii. Root exposure
   iii. Leaning / lodging of palm
   iv. Movement and access to palms difficult
c. High Watertable
   i. Needs to be controlled and managed
   ii. Regular desilting of drains
d. High Infrastructure Cost
   i. Drains and roads – expensive to construct / maintain
e. Water control structures (watergate, weirs, tidalgate)

NEW PLANTING FROM JUNGLE

Site Selection

It is important to assess the topography and the drainability of the site especially for planning, development and management purposes. To be successful in planting oil palm on peat based on present technology and experience, it is suggested to avoid certain peat areas such as those with salinity problem, which are difficult or problematic to manage. This will invariably increase the development cost, therefore, it is best not to develop such areas (Lim, 2006).

Perimeter Drain and Main Outlet Drains

To have systematic drainage system for draining out excess water from the field into main water course and to irrigate the field by bringing in water from the main water ways when necessary. Boundary drain is to demarcate the ownership of the property as well act as a security measure of the property. Prior to drain construction, lining should be done. The lining peg should be the centre of the drain. To ensure the right drain size and drain density. To remove all blockages during drain construction and those blockages which are not possible to be dug out should be cut and removed from the drain. To ensure all drains are inter-connected to each other. Drains are to be constructed on flat area.

Land Preparation

Once an area has been selected for oil palm planting, every effort must be made to prolong its economic life span. Peat should be considered as a precious soil resource that must be properly and sustainably managed because once it is destroyed, the damage is often irreversible.

Compaction of the Peat

Compaction has several advantages. Other than increasing the soil bulk density, it increases the soil mass per volume, thus reducing the rate of fertilizer leaching. It also increases nutrient supply (more nutrient per unit peat volume) and help to reduce early palm leaning due to better root anchorage. For effective compaction, it is very important to have a good destumping and also useful to first lower the water level in the field drains to about 90 cm. Avoid rainy seasons when carrying out compaction. The front bucket of the excavator can also be used for compaction of areas not reachable by the tracks. Compaction is done 12 months before initiation of harvesting works to help facilitate the field for mechanisation purposes.

NURSERY PRACTICES ON PEAT

One of the major constraints of raising oil palm seedlings in peat was the availability of suitable planting medium. With the scarcity of mineral soil, peat is often the preferred planting medium choice for polybag filling in every nursery established. From our experience, peat yellow incidences for oil palm seedlings raised in peat planting medium was due mainly to micronutrient deficiencies especially on Fe or iron. This was found to be effectively addressed with the additional application of ferrous sulphate (20% $FeSO_4 \cdot 7H_2O$) included in the nursery manuring regime.

PLANTING DENSITY AND PLANTING DEPTH

Water-table of 90 cm from the peat surface is required during planting. The seedlings are watered thoroughly before leaving the nursery. The root-pruned seedlings shall be lifted carefully from the ground to prevent breakage of the polyethylene (PE) bags, and transported to the designated points. Any seedlings found with damaged PE bags during transportation shall be rewrapped with plastic bag and tied to prevent breakage of the soil-bole. The seedlings should be placed in the inner planting hole of the hole-in-hole formation. The palms collar is to be at the same level with the bottom of the larger hole. The seedlings should be planted on the very same day as delivered to the field. Upon completion of planting, the palm should be in an upright position and firmly placed. Sufficient care must be taken to ensure that there is no breakage of root-bole during planting. It is important that close supervision led by an experienced executive or senior staff is provided.

PALM NUTRITION

Macronutrients and Micronutrients

Provision of essential elements required for normal growth and development of palm includes macronutrients such as nitrogen (N), phosphorus (P), potassium (K), and magnesium (Mg) and micronutrients consists of boron (B), copper (Cu), zinc (Zn). Nitrogen is the primary constituent of amino acids, proteins, enzymes and metabolic processes involved in the synthesis and transfer of energy and also part of the chlorophyll that is responsible for photosynthesis. It also increases leaf area and net assimilation rate and is taken up as NH_4^+ and NO_3^-. Phosphorous is also an essential element for photosynthesis specifically in the formation of oils, sugars, starches, etc. It also encourages blooming and root growth and transformation of solar energy into chemical energy. Potassium helps in building of proteins, photosynthesis, fruit quality and reduction of diseases and increases bunch weight but decreased oil to bunch ratio. Magnesium is a constituent of the chlorophyll in all green plants which converts light energy into biochemical energy during photosynthesis while activating many plant enzymes needed for plant growth. It increases the oil to bunch ratio (thicker mesocarp). Boron aids production of sugar and carbohydrate synthesis and is essential for seed and fruit development and also important for meristematic activity. Copper is necessary for reproductive growth. It aids in root metabolism and helps in the utilization of protein. Zinc is essential for the transformation of carbohydrates and regulates consumption of sugars. It is also a part of the enzyme systems which regulates plant growth.

Peat Acidity

The pH of organic soils is related to the presence of organic compounds, the exchangeable hydrogen and aluminium, iron sulphide and other oxidizable sulphur compounds. In contrast with mineral soils, the presence of organic acids largely determines the acidity, and the presence of mobile or hydrolysable aluminium is less important. The range of acidity in organic materials is very wide. In conditions where there has been infiltration of brackish water the pH can be as high as 7.8 as in the Maldives where peat has developed in the inner part of atolls which had strongly saline initial conditions (Hammond 1971). On the other hand, peat can be very strongly acidic where it contained pyritic materials which have been oxidized upon reclamation. The pH of such peats can reach values of less than 2. Tropical peats of ombrogenous and oligotrophic nature, which include most lowland tropical peats, are commonly acidic or extremely acidic with a pH range in water of 3 to 4.5. Variations within this range are caused either by admixtures of mineral soil which generally increase the pH, or by the specific location in the peat swamp. Surface layers of the dome-shaped peat deposits in the lowlands of Borneo have an average pH of 3.3 for the thickest peat whereas the shallow peat near the edge has an average pH of 4.3.

WATER MANAGEMENT

Water management is an integral part of oil palm cultivation which determines the degree of success of the crop. Water management is crucial in peat where subsidence and peat drying are solely dependent on water retention. Similarly water management in mineral soils would also require close attention.

Objective

a) To achieve and maintain optimum water table at 40 – 50 cm in the field.
b) To retain adequate moisture status in the soil.
c) To avoid irreversible drying and decelerate subsidence.
d) To ensure that water-gates and bunds remain steadfast even during adverse weather i.e. flooding.
e) To improve soil pH

Water management in peat requires the following course of action;

During wet seasons:

a) Main and subsidiary water-gates are to be opened to allow excess water to be drained out into the external water course.

b) Excess water in the main and collection drains must be drained out quickly but to retain at 50 cm from ground level.

c) Backflow of external water must be prevented from entering the estates.

During dry seasons:

a) Timely attention on managing the water-gates and weirs must be given before the onset of dry season to ensure the water level in the collection drain is retained at 40 cm from ground level.
b) In situation of severe water deficit, pumping in non-saline water (< 2.0 dS/m or mS/cm) during high tides may be required.

Optimal Field Water Table

The availability of soil water must be sufficient for good palm growth and high yield. During the development and six months of planting, water table in the field is to be lowered down to about 75 cm below soil surface. The average peat subsidence rate per year (cm yr^{-1}) is equivalent to 0.1 X depth of water table. Therefore, setting up water table at 75 cm resulting subsidence of 7.5 cm/ year. Due to the rapid initial peat subsidence, it is preferred to install temporary stop-offs using logs and soil bags in the initial year. As the palm grow older and to keep the feeder roots active, it is essential to maintain an optimal water table of 40-50 cm in the field. To consistently maintain the field water table at 40-50 cm, construction of stop-offs, weirs and water-gates are essential. Permanent water-gates at strategic locations are to be installed later when the subsidence rate is reduced.

SUBSIDENCE

Irreversible Drying Of Peat

Irreversible drying occurs after periods of intensive drying and is typical of many peat soils. Surface layers of organic materials in many reclaimed and drained peat swamps exhibit this behaviour. After exposure to the sun, the materials become rather like coffee grounds, and are very difficult to re-wet. This may cause severe drought stress in shallow rooting crops.

Water Holding Capacity

The phenomenon of moisture conductivity in peat is no less complex. Investigations into drying indicate that the first drying stage is characterized by the removal of free water and of water from large pores. On further drying, the forces of capillary contraction increase and weakly bound intracellular and immobilized water is squeezed out. The transfer and removal of moisture in microcapillaries brings about a change in the transport mechanism and a reduction in the drying rate.

INTEGRATED PEST MANAGEMENT ON PEAT

Tirathaba Bunch Moth

The caterpillars feed on the surface of maturing fruits causing pitting and scoring on the distal and in the form of a characteristic ring around the remains of the style. In younger bunches, they may bore into the developing fruit causing it either to fall prematurely or develop a hollow centre without a kernel. The larvae form tunnels of silk which mixed with their excreta create the frass that can be found all over the bunch during heavy infestation. The bio-insecticides Dipel ES containing the bacteria *Bacillus thuringiensis* v. *kurstaki.* was used to control *Tirathaba* both in Pusa and Beladin plantation complex. It is a safe product with no demonstrated toxicity for other non-target organism. It preserves other beneficial insects like predatory bugs, wasps, as well as parasitic flies in the plantation. The mode of action of Dipel Es is through stomach poisoning. The larvae will stop feeding and will die within several days after consuming lethal dosage of *Bacillus.*

Leaf Defoliators – Ipm

Bagworms and nettle caterpillars are opportunistic pests that can devastate large areas of oil palm if not detected and treated early. Early detection is achieved by carrying out regular inspection and counting of pest numbers in the field. Action is taken to control the pests by use of selective insecticide application. Indirect biocontrol is achieved by the cultivation of nectariferous plants like *Euphorbia heterophylla, Cassia cobanensis, Antigonon leptopus* and *Turnera subulata* in and around infested fields. These plants encourage populations of parasitoids and predators of bagworms and nettle caterpillars by providing them with nectar and shelter. The increased populations of natural enemies would in turn exert biocontrol on the pests.

Termite

For effective termite control, monthly census on all palms is required. Infested palms should be treated immediately using fipronil (5.0% a.i.) at 2.5 ml / 5 litres water/ palm (Lim and Bit, 2001). Delayed treatment will result in death of the infested palm, when the meristematic region is consumed by the termites.

SOCIAL AND CULTURAL ISSUES

Vendor Development Initiative (—Vdi")

The effort for vendor development has been in practise by THP since it ventured into plantations in the 70s. In line with the Malaysian Government‘s implementation of its Transformation Programmes and the New Economic Model, the VDI was formally implemented when THP ventured into Sarawak in realising the nation‘s agenda.

Joint Venture with Local Community

THP provides assistance in terms of financial and expertise, so as not to leave the community‘s land left undeveloped. This effort started off in Sarawak, whereby a joint venture initiative with the local community enabled the development of their Native Customary Rights (NCR) lands. This smart partnership allows the land owners to enjoy a sustainable future income and it also provides job and business opportunities to the local community.

CONCLUSIONS

Best management procedures that are vital for successful oil palm cultivation of peat specifically on land development, palm nutrition, water management and integrated pest management has led to the implementation of sustainable practices in relation of improving yield performances of oil palm planting in peat which varies with the topography and depends to a large extent on nutritional inputs and on water management. With proper monitoring and supervision, yields comparable to good mineral soil can be obtained and in this respect, overcoming constraints and challenges of oil palm cultivation on peat can be achieved by adhering to strict guidelines on sustainable agricultural practices for oil palm planting in peat.

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