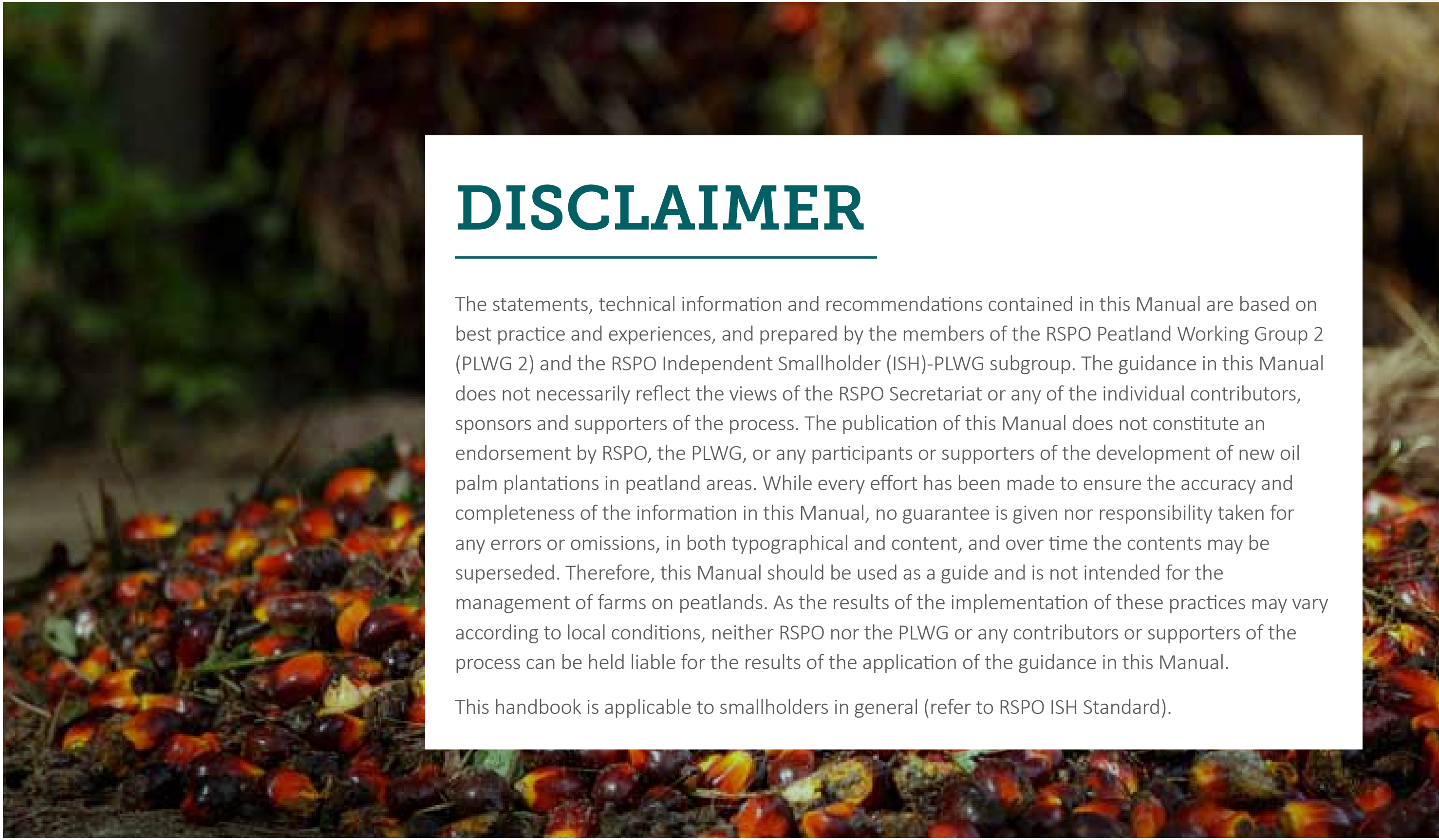
RSPO Smallholder Best Management Practices Manual

for Existing Oil Palm Cultivation on Peat



DISCLAIMER

The statements, technical information and recommendations contained in this Manual are based on best practice and experiences, and prepared by the members of the RSPO Peatland Working Group 2 (PLWG 2) and the RSPO Independent Smallholder (ISH)-PLWG subgroup. The guidance in this Manual does not necessarily reflect the views of the RSPO Secretariat or any of the individual contributors, sponsors and supporters of the process. The publication of this Manual does not constitute an endorsement by RSPO, the PLWG, or any participants or supporters of the development of new oil palm plantations in peatland areas. While every effort has been made to ensure the accuracy and completeness of the information in this Manual, no guarantee is given nor responsibility taken for any errors or omissions, in both typographical and content, and over time the contents may be superseded. Therefore, this Manual should be used as a guide and is not intended for the management of farms on peatlands. As the results of the implementation of these practices may vary according to local conditions, neither RSPO nor the PLWG or any contributors or supporters of the process can be held liable for the results of the application of the guidance in this Manual.

This handbook is applicable to smallholders in general (refer to RSPO ISH Standard).

ACKNOWLEDGEMENT

RSPO would like to thank the members of the RSPO ISH-PLWG subgroup and PLWG 2 for their continued support and contribution to the successful completion of the RSPO Smallholder Best Management Practices (BMPs) for Existing Oil Palm Cultivation on Peat.

Our special appreciation also goes to Koperasi Sawit Jaya and Koperasi Beringin Jaya from Indonesia, and Pertubuhan Tani Niaga Lestari (PERTANIAGA) from Malaysia who participated in pilot testing these BMPs. Their constructive feedback has been a great help in developing the content of this BMP Manual.

Funding for the printing of this manual has been provided by the International Fund for Agricultural Development (IFAD)—Measurable Action for Haze-Free Sustainable Land Management in Southeast Asia (MAHFSA) through the ASEAN Secretariat and Global Environment Centre (GEC).

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HOW TO USE THIS BMP MANUAL

This BMP Manual was developed with seven Chapters that focus on topics relevant for existing oil palm cultivation on peat.

Along with this BMP, an extract from the RSPO ISH Standard Auditor Checklist is provided in Annex 1 as a guide for certification bodies and it may also be used by Group Managers (GM).

Non-compliances issued to an Independent Smallholder (ISH) group shall be for the non-compliance to the requirement of the RSPO ISH Standard and not against this BMP Manual.

HOW A GM CAN BENEFIT FROM THIS BMP MANUAL

(Across all chapters)

The objective of this Manual is to provide a set of practical guidance on BMPs for GM and/or smallholders to manage existing oil palm cultivation on tropical peat in line with Criteria 4.4 and 4.5 of the 2019 RSPO ISH Standard.

APPLICABILITY OF THIS BMP DURING AUDIT

This BMP Manual was produced as a recommended guidance for ISH with existing oil palm cultivation on peat. This is not to be taken as a compulsory practice and used against certification since ground conditions may vary according to location. It is the role of the GM or smallholders to evaluate the condition of the farm before the implementation of these BMPs.

CHAPTER 1: INTRODUCTION

This chapter covers some of the basic information that a GM and/or ISH needs to know about planting oil palms on peat.

01

1.1 WHAT IS PEAT?

A peatland is an area with a layer of naturally accumulated organic matter[1]. Most tropical peat soils belong to the soil order Histosols (organic soil) and the sub-orders Fibrists and Hemists. Soils are classified as peat soils when they reach an accepted threshold (e.g. host-country, FAO, or Intergovernmental Panel for Climate Change (IPCC)) for the depth of the peat layer and the percentage of organic matter composition. Some classifications adopt a minimum organic matter percentage of 35% in a minimum accumulated organic layer of 30 cm, others specify an organic content of 65%, while some require an accumulation of at least 40 cm or even 50 cm to be qualified.

> Simple definition: A peatland is an area of land with layers of semi decomposed organic matter such as plants residues, mainly roots, leaves, twigs, etc.

1 Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of breakdown (decomposition). Agronomy Fact Sheet Series, Cornell University

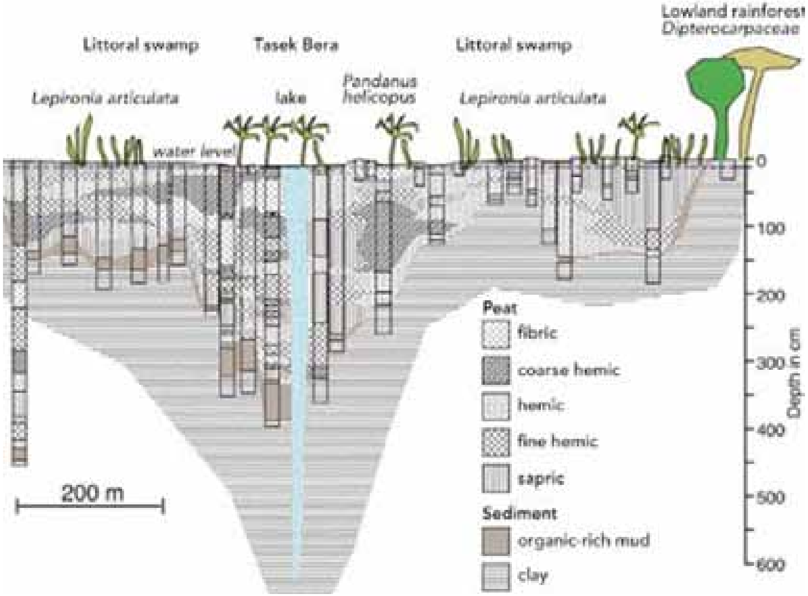


Figure 1.1: Cross section diagram of basin peat in Tasek Bera in Malaysia (Source: Wüst, R. A., & Bustin, R. M. 2004)

For example, some countries have already made classification, i.e. National Interpretation:

Malaysia – Peat is defined as soils with an organic layer of more than 50 cm in the top 100 cm of soil containing more than 65% of organic matter[1] (more than 65% loss on ignition) or 35% or more organic carbon (Leamy and Panton 1966, Paramananthan 2016, drawing on IUSS 1930).

Indonesia – Peat is defined as soils with an organic layer of more than 50 cm in the top 100 cm of soil containing more than 65% of organic matter.

Countries that do not have a clear definition of peat should refer to RSPO, or the National Interpretation.

Definition adopted by RSPO – Histosols (organic soils) are soils with cumulative organic layer(s) comprising more than half of the upper 80 cm or 100 cm of the soil surface containing 35% or more of organic matter (35% or more loss on ignition) or 18% or more organic carbon (FAO 1998, 2006/7; USDA 2014; IUSS 1930).

The percentage of organic matter is used in determining the types of peat. Peat samples need to be sent to the laboratory for loss on ignition (LOI) test to determine organic matter, refer to **Section 1.3**.

1.2 MEASURING PEAT DEPTH

In their natural condition, peatlands generally have a high-water table and are invariably waterlogged. When peatland is drained, this results in the decomposition and mineralisation of the organic matter, hence it is common to see the soil profile of drained peat consisting of three horizons differentiated by sapric (mostly decomposed), hemic (partially decomposed), and fibric (raw, undecomposed). Deeper peats tend to be less decomposed (woodier), but as peatlands are drained and developed, decomposition increases.

For peat depth, the use of peat auger is recommended (Figure 1.2). The main section (sampler) of a peat auger consists of a hooked blade (fin) and a half-cylindrical tube (gauge) that has one sharp edge to cut the peat. The sampler can be easily connected to the extension rods and auger handle. Simple procedure to measure peat depth is as follows:

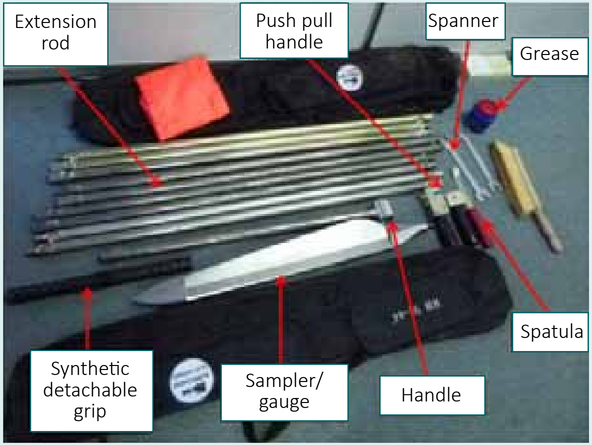


Figure 1.2: Peat auger tools and method to use this auger (Credit: Global Environment Centre, GEC)

1. Attach the handle and the extension rods
2. Connect the main sampler/gauge of the auger to the extension rods
3. Turn the fin to have the concave part facing the outside of the tube
4. Push the auger vertically into the peat without turning
5. Collect the sample by turning clockwise at least 180° (preferably a full 360° cycle) to ensure the gauge is filled with peat and the fin closes so that no additional peat enters the gauge
6. Pull the auger slowly out and lay on the ground to check samples
7. Extend the length of the rods until they reach the mineral layer
8. Measure peat depth using the formula below:

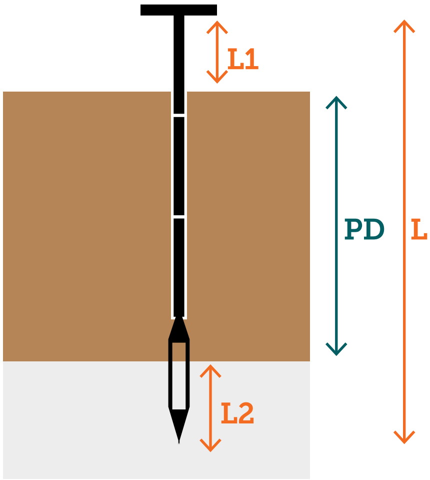


Figure 1.3: Cross section showing auger depth (Credit: Global Environment Centre, GEC)

Peat depth = L – L1 – L2

L = Total length of the peat sampler used = Length of the handle + Length of the sampler + Length of extension rods

L1 = length from the top of the handle to ground surface

L2 = length of the sampler with mineral layer

1.3
DIFFERENTIATION OF ORGANIC CONTENT AND LOSS ON IGNITION

Loss on ignition is determined by collecting samples of soil that will be heated at a specified temperature, allowing volatile substances to escape, until its mass ceases to change.

Table 1.1: Type of soil and its percentage of organic matter

Type	Percentage of organic matter	Loss on Ignition
Organic clay	20-35%	20-35%
Muck	35-65%	35-65%
Peat	> 65%	> 65%

1.4
TYPES OF PEAT

There are three main types of peat classification as shown below:

Table 1.2: Peat classification
(Image courtesy: Malaysian Palm Oil Board, MPOB)

Type	Fibric	Hemic	Sapric
Reference			
Fiber content	Fibric > 66%	Hemic 33-66%	Sapric < 33%
Description	Fibric (immature) peat is peat at early maturity stage with the original materials still recognisable, brown to light brown in colour, and when squeezed, more than two-thirds of the original amount remains on your hand.	Hemic (medium) maturity is half-decomposed peat with some of the original materials still recognisable, brown in colour, and when squeezed, between one-third and two-thirds of the original amount remains on your hand.	Sapric (mature) peat is at an advanced stage of decomposition with the original materials not recognisable, dark brown to black in colour, and when squeezed, less than one-third of the original amount remains on your hand.

1.5 IDENTIFICATION OF PEATLAND LANDSCAPE

Many tropical peatlands, especially in Indonesia and Malaysia, are formed in the lowlands in between rivers in areas that may have been swamp with water as a result of slow drainage, flooding or sea level rise. In these conditions marshy vegetation formed, which built up layers of peat over time (see Figure 1.4). The high-water level and acidic conditions prevented the breakdown of plant material and the peatland grew to 10 m or thicker in the center (at a rate of 0.5-2 mm/year). Many of these tropical bogs are dome-shaped with a rise in elevation of the peat in the areas in between adjacent rivers.

It is the landowner's responsibility to identify the type of land before conversion to oil palm plantation.

The second main type of tropical peatland is basin or topogenous peatlands, which formed depressions in the landscape or in lake basins, oxbow lakes, or river flood plains (see example in Figure 1.4). They may also be formed when drainage is impeded in the riverine systems due to reasons such as siltation, longshore sediment drift, or rising sea levels. The high water table in existing peatland requires drainage for conversion.

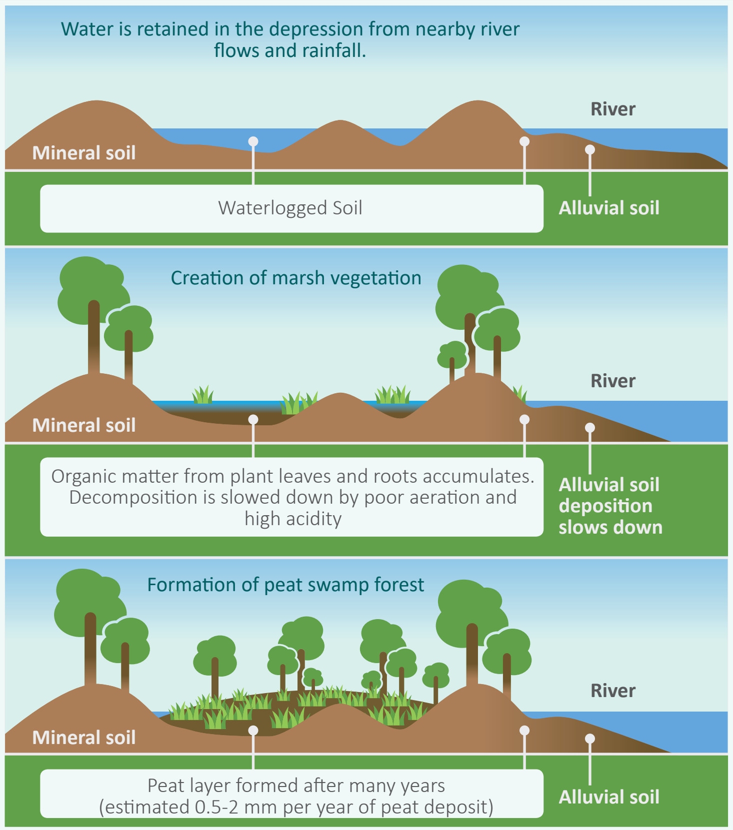


Figure 1.4: Formation of peat

In relation to Criterion 4.4 of the 2019 RSPO ISH Standard – 'New plantings of independent smallholders, since November 2019: ....are not on peat areas of any depth'. It is important to smallholders to understand peatland landscape to prevent violation of RSPO Standards. The following are some measures to be taken:

1. Be aware of areas demarcated as peatlands by referring to government demarcation regulations.

   Some examples are:

   i. Forest gazettement by Forestry Department
   ii. Any areas demarcated in Indonesia's forest moratorium order
   iii. Fall in legal boundaries and mapping made by local legal government agencies

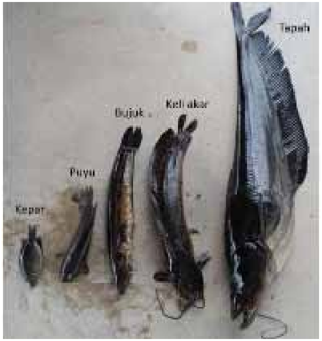
2. Conduct assessment to verify the existence of vegetation, hydrology/ water section and fauna in the peatland. Typical evidence is as follows:

Table 1.3: List of vegetation, hydrology/water section and fauna for different types of peatlands

Type	Either Fibric, Hemic, Sapric	 *(Credit: Global Environment Centre, GEC)*
Hydrology / water	• Areas with high water table/ flood consistence for years. • Water colour - brown/black • Acid water - pH <4 *Note: The high water table in existing peatland requires drainage for conversion.*	 *(Credit: Global Environment Centre, GEC)*

Vegetation	1. Forest Plant with special character, can prolonged in high water table condition. • Stilt root • Knee root 2. Basin area, lake • Emergent plant • Floating plant • Submersed plant	 (Credit: Global Environment Centre, GEC)  (Credit: Global Environment Centre, GEC)  (Credit: ASEAN Peatland Forests Project)  (Credit: ASEAN Peatland Forests Project)

Fauna	In big landscape areas, mammals can possibly be found. Example in Peat Swamp Forest (PSF).	 (*Credit: elements.envato.com, lightpoet*)  (*Credit: elements.envato.com, anankkml*)  (*Credit: elements.envato.com, Edwin_Butter*)

Fauna (Continued)	Endemic Fish – a variety of fish can be found in peat swamp.	 *(Credit: IMP NSPSF 2014-2023, SSFD, 2014)*  *(Credit: Global Environment Centre, GEC)*

CHAPTER 2: WATER MANAGEMENT

This chapter explains the importance of water monitoring and management for existing plots of cultivation that are on peat.

02

2.1 OBJECTIVES OF WATER MANAGEMENT ON PEAT

Water management is critical to the management of existing oil palms on peat. The objectives of water management on peat are:

- To remove excess surface and subsurface water quickly during wet seasons and retain water for as long as possible during dry spells.
- To improve growth and yield of oil palm.
- To minimise greenhouse gas (GHG) emissions and environmental and social impacts.
- To minimise the risk of accidental peat fire.
- To minimise peat subsidence and increase the lifespan of a farm that could over time reach an undrainable situation or an acid sulphate soil.

2.2
IMPLICATION OF POOR WATER MANAGEMENT

Too little or too much water in the oil palm rooting zone as a result of poor water management will adversely affect nutrient uptake and consequently fresh fruit bunch (FFB) yield.

Higher water levels (e.g. <40 cm from peat surface) or waterlogged/flooding conditions may severely reduce yields of oil palm (crop losses), have detrimental effect on farm operation, and incur higher cost to repair damage. Fertiliser input will go directly into the surface or groundwater instead of being taken up by the oil palms. Flooding will increase methane/nitrogen oxide emissions.

When the water level is too low, it can cause irreversible peat dryness, which in turn causes water stress, reduces its fertility, and increases the risk of peat fire.

2.3 RECOMMENDED WATER LEVEL

Most oil palms' feeder roots are concentrated in the top 0-50 cm of the peat; hence, water level needs to be near this zone.

A good water management system for oil palm on peat is one that can effectively maintain an average water level of 60 cm (range 50-70 cm) below the bank in collection drains or 50 cm average (range of 40-60 cm) as measured by a groundwater monitoring well reading.

Figure 2.1: Water measured at collection drain needs to be in a range of 50 – 70 cm (Credit: Global Environment Centre, GEC)

During droughts, water level can drop 0.5-1 cm per day. In drought-prone regions, water level tends to fluctuate severely and may often fall more than 60 cm below peat surface. It may dip 15-30 cm over a one-month drought, if there is no water input from surface or subsurface flow.

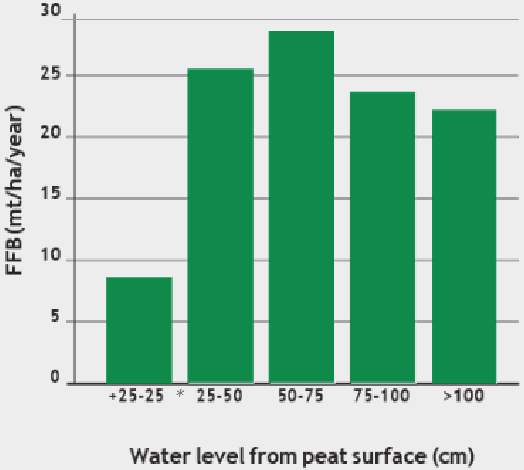


Figure 2.2: FFB yields (1998 planting) in relation to water levels in a peat estate in Riau Sumatra, Indonesia (Source: Peter Lim, TH Farm 2011)

**Note: This figure refers to water level below peat surface, except the first bar range from 25cm above surface to 25cm below surface.*

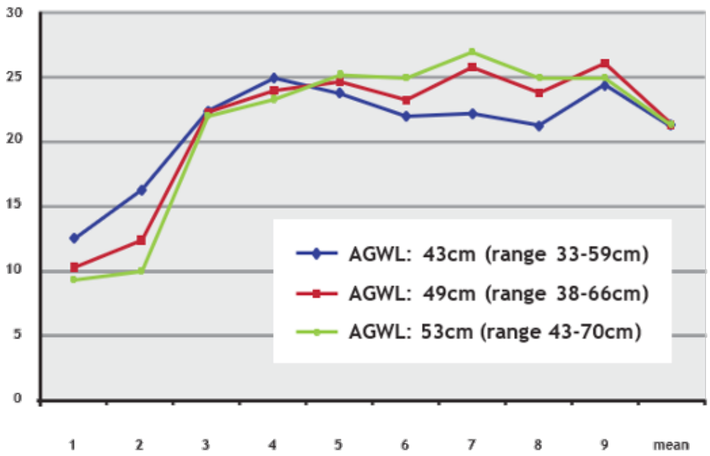


Figure 2.3: Relationship between average ground water level (AGWL) and yield for three different shallow water tables (Source: Hasnol, et al., 2010)
**Note: that for younger palms (yr1-4 of harvest) the higher water level generates a better yield.*

With good implementation of water management, yields between 25 and 30 tonnes of FFB/ha/year[2] are possible. Simultaneously, GHG emissions and subsidence can be minimised, and the life of a farm can be extended.

2 Along with other best management practices in place

2.4
SOPS TO MAINTAIN AND MEASURE WATER LEVEL

A well-planned and executed water management system with water control structures should be used for drainage and effective water management in peat areas. Water gates and/or sand bags should be installed/placed at strategic locations along the main and/or collection drains for effective control of the water table at an optimum level.

A cascade of closely spaced control structures is needed to maintain relatively constant, high water levels in the drain during the dry season (Ritzema *et al.*, 1998).

Figure 2.4: Water control structures
(Credit: Left photo courtesy of Ministry of Environment and Forestry, Indonesia and right photo courtesy of United Plantation Berhad)

It is most appropriate to use natural materials such as wood or sandbags for constructing weirs/stop-offs (Figure 2.4) and not hard structures like concrete, which will likely sink or fail in peat areas. Weirs or stop-offs should be placed at appropriate intervals to ensure that the drop-off across each weir is about 20 cm (i.e. 5 weirs are needed for a drop of 1 m – with a spacing of 200-400 m between the blocks – depending on the slope (see Figure 2.5).

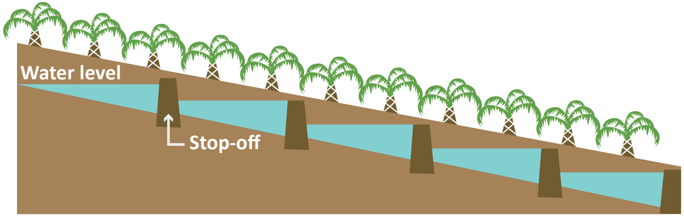


Figure 2.5: Along each collection drain a cascade of weirs is required with one stop-off or weir recommended for every 20 cm drop in level

The in-field water level is maintained at an average of 40-50 cm below the surface. In order to achieve the water level, water in the collection drain needs to be maintained at 50-70 cm below the peat surface (see Figure 2.1). To monitor the water table, the setting up of monitoring well in the field and measurement pole at the roadside drains are required.

Figure 2.6: Optimal water level management at 40-60 cm (in collection drain) results in a yield potential of 25-30 tonnes FFB/ha/year (Credit: Global Environment Centre, GEC)

Drain maintenance must be carried out regularly or when required to keep the drainage system working properly. Poor maintenance of the drainage system can be a cause of flooding in farms in peat area, although it is often a consequence of subsidence relative to the surrounding landscape.

Desilting of drains to required depths is best carried out prior to the rainy season. However, care needs to be taken to avoid cutting drains too deep in peat areas. It is also essential to check and repair all weirs and drop-offs regularly.

Water gates and flap gates need to be maintained at a minimum of every six months to ensure smooth operation.

Bunds are important protective structures in coastal areas to prevent the in-flow of excess or saline water into the fields. Suitable bunding materials are loamy or clayey soils. Clay originated from acid sulphate soil is not recommended as leaching of the acid from acid sulphate soils can have serious environmental impacts. Regular maintenance will minimise bund breakage that will result in flooding and crop losses.

Figure 2.7: Acid sulphate soil with yellowing due to oxidation of sulphur

Regular maintenance will minimise bund breakage that will result in flooding and crop losses.

Figure 2.8: Bunds used to prevent in-flow of water into the field. A flooded field will also hinder all estate operations and add to methane/nitrogen oxide emissions.
(Credit: Global Environment Centre, GEC)

2.5
FLOODING RISK ASSESSMENT

2.5.1 DEFINITION

Term	Definition
Flood rephrased from (Mandych, A. F., 2009):	Flood is commonly defined as an overflow of water onto lands that are used or are usable by humans, and are not normally covered by water. Floods have two essential characteristics: the inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, lake, or ocean.
Flood in peat (Parish. F *et al.*, 2019):	Intact peat swamps forest stores water and contributes to maintaining the water level in rivers that run through them during dry and wet periods. Intact peatlands can diminish peak flood flows mainly by reducing water velocity and also by providing large areas for storage of flood waters in terms of spatial area, and to a limited degree (depending on how waterlogged the peat already is) through the water-holding capacity of the peat. Drain peat swamps forest/peatland disrupts the hydrology functions and the surrounding ecosystem. Promoting subsidence in the long term and making these areas prone to flooding and no longer become productive land.
Flood in Oil Palm Cultivation on Peat:	Plantations are vulnerable to flooding, which seriously affects productivity. This is partly because of drainage and disruption of peat hydrology systems. Water and flood management is required to maintain natural water regimes and to manage water levels in dry and wet seasons. In the 2018 RSPO Principles and Criteria (P&C), for plantations planted on peat, drainability assessments are conducted following the RSPO Drainability Assessment Procedure, or other RSPO recognised methods, at least five years prior to replanting. The drainability assessments are related to determining the risk of flooding due to reaching the natural gravity drainability limit for peat.
Risk:	A probability or threat of damage, injury, liability, loss, or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through preemptive action.

Term	Definition
Risk Assessment adopted from ISO 9001 (Quality Management System) and ISO 31000 (Risk Management)	The risk assessment for a certain issue will form the foundation for making a decision about future actions. The decision may be to perform additional analyses, to perform activities that reduce the risk, or to do nothing at all. Risk can be presented in a variety of ways to communicate the results of an analysis to make decisions on control risk. For analysis that uses likelihood and severity in a qualitative method, presenting the result in a matrix is a very effective way of communicating the distribution of the risk throughout the work process, activity, or any areas of interest. **Risk formula** **L X S = relative risk** L = likelihood S = severity

2.5.2 INTRODUCTION TO FLOODING RISK ASSESSMENT

Example of Risk Matrix (adapted from ISO standard)

To use this matrix (Table 2.1), first find the severity rating (Table 2.4) that best describes the outcome of risk. Then, determine the likelihood row to find the description that best suits the likelihood (Table 2.3) that the severity will occur. The risk level is given in this matrix in the box where the row and column meet.

Table 2.1: Matrix on risk calculation

	Severity (S)				
Likelihood (L)	**1**	**2**	**3**	**4**	**5**
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

High	
Medium	
Low	

The relative risk value can be used to prioritise the necessary actions to effectively manage risk (flood).

Table 2.2: Description of risk level

Rating	Risk Level	Action
15 - 25	High	A HIGH risk requires immediate action to control the risk as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment form, including the date of completion.
5 - 12	Medium	A MEDIUM risk requires a planned approach to control the risk and apply temporary measures if required. Actions taken must be documented on the risk assessment form, including the date of completion.
1 - 4	Low	A risk identified as LOW may be considered as acceptable and further reduction may not be necessary. However, if the risk can be resolved quickly and efficiently, control measures should be implemented and recorded.

Suggestions for Criteria

I. Likelihood

Table 2.3: Suggestions for descriptions on likelihood

Level	Likelihood	Description
1	Rare	Will probably never happen/recur/ extraordinary case
2	Unlikely	Do not expect it to happen/recur but it is possible to do so
3	Possible	Might happen or recur occasionally
4	Likely	Will probably happen/recur but it is not a persisting issue
5	Almost Certain	Will undoubtedly happen/recur, possibly frequently

II. Severity

Table 2.4: Suggestions for descriptions on severity

Level	Severity	Description
1	Insignificant	No interruption in operation
2	Minor	Operational interruption for 3 days or less
3	Moderate	Operational interruption between 3 days and 1 month
4	Major	Operational interruption between 1 and 12 months
5	Catastrophic	Permanent loss of service

2.5.3 STEPS TO CONDUCT FLOODING RISK ASSESSMENT

Peat land may be continuously subsided after drainage. When the peat surface gets closer to the natural drainage limit/drainage base, drainage by gravity is not possible and flooding may occur.

Consequently, flood risk of farms needs to be assessed. A simple flood risk assessment can be conducted using the **RSPO ISH Flood Risk Assessment Template (excel file).**

The steps are as follows:

i. Overview and guidance:

- Fill in the details of the group and area on peat (Column A – E). Column F is formulated to generate the total size of plots by group members on peat (hectares).

ii. Risk Assessment Template:

- Fill in the details as required from Column A – H.
- For Columns I and J, refer to the next sheet labelled as 'Risk Profile'. There is information on Likelihood and Severity. Please select the score based on the description that best matches the situation.
- Column K refers to risk score and is formatted with formula to calculate risk score.
- Based on the risk score calculated, Columns L and M will auto populate with 'Description on Risk Level' and 'Proposed mitigation/contingency' for information on action and outcome of risk.

iii. Risk Profile

- There are four tables provided for descriptions on risk level, likelihood, severity and an example of situation with calculation.

2.6
EXAMPLE OF RISK ASSESSMENT EXERCISE AND PROPOSED MITIGATION MEASURES

The assessment should be done on the present situation in order to anticipate risk to happen or already happening. This will allow group managers to create a mitigation plan with measures for present and future directions of the management's decision. Table 2.5 below shows the proposed mitigation measures to be undertaken according to risk level **(Low, Medium and High)** at three different situations that may be found on the ground.

Table 2.5: Proposed mitigation measures according to rating

Process	Rating	Risk	Proposed Mitigation/Contingency
Oil Palm Cultivation on Peat	1-4	Low risk Flood/saline intrusion in plantation during wet/dry season. **or** Known flood/saline intrusion in plantation without following seasonal trends for consecutive years.	• No action • Continue replanting programme* • Maintain BMP
	5-12	Medium risk Flood/saline intrusion in plantation during wet/dry season. **or** Known flood/saline intrusion in plantation without following seasonal trends for consecutive years.	• Enhance water management • Postpone replanting programme* • Improve BMP implementation
	15-25	High risk Flood/saline intrusion in plantation during wet/dry season. **or** Known flood/saline intrusion in plantation without following seasonal trends for consecutive years.	• Halt replanting programme* • Adopt alternate land strategy, maybe change management practices and decision to rehabilitate the area

** If there are ongoing replanting programmes.*

In summary, the three identified situations are:

i. Saline intrusion and high fire risk in plantation during dry season.

ii. Flood in plantation during wet season.

iii. Known flood/saline intrusion in plantation without following seasonal trends for consecutive years.

Suggestions for mitigation measures for flood risk assessment **(Low, Medium and High)** rating with scoring can be found in Table 2.6.

Table 2.6: Exercise on assessing flood risk and proposed mitigation measures

Process	Risk	Likelihood	Severity	Rating	Proposed Mitigation/ Contingency
Oil Palm cultivation on Peat (Operation)	Flood/saline intrusion in plantation during dry season.	1	1	1	• No action • Continue replanting programme* • Maintain BMP
	Flood/saline intrusion in plantation during wet season.	3	3	9	• Enhance water management • Postpone replanting programme* • Improve BMP implementation
	Known flood/saline intrusion in plantation without following seasonal trends for consecutive years	4	4	16	• Halt replanting programme* • Adopt alternate land strategy, maybe change management practices and decision to rehabilitate the area

** If there are ongoing replanting programmes.*

2.7 ALTERNATIVE LIVELIHOOD PLANNING/ SUSTAINABLE LIVELIHOOD OPTIONS

The concept of sustainable livelihoods has a wide generic meaning, encompassing the protection and assurance of the means of livelihood (Singh *et al.*, 2010) for people and society, and the current concerns and policy requirements pertaining to sustainable development. This chapter will provide some relevant alternative livelihood options for smallholders to adopt if there is a necessity to plan alternate land development strategies. The examples of a variety of paludiculture species, fruits, and vegetables can be adopted in the strategies.

PALUDICULTURE

Productive land use on rewetted peatland with crops that are adapted to the high water levels in peatlands is called 'paludiculture'. The Peat Swamp Forest (PSF) species are being used traditionally and there are over 400 species known which have productive use (Giesen, 2015). For centuries, the local populations have used paludiculture techniques to cultivate crops that are native to peatlands, such as *sago* (starch for noodles and cookies), rattan (for furniture), "*gelam*" (for pole-wood and medicinal oil), "*jelutong*" (for latex), "*tengkawang*" (illipe nut, for vegetable oil), and purun grass (for thatching and basketry).

(Credit: Global Environment Centre, GEC)

Example 1: Sago Plantation

Sago or *Metroxylon sagu* is an example of potential plant for paludiculture activity. The sago palm can be harvested and its spongy centre or pith of the palm stems can be extracted, grind, and knead in water, and washed a few times before sent to the dryer for extracting starch for flour. Sago flour is used for many food items.

Sago needs periodical inundation for better performance, so it can be planted on slightly drained or even undrained peatland. Sago palms require only negligible maintenance, which makes sago plantations among the most productive systems that can be operated at almost no maintenance cost.

Small-scale sago cultivation without drainage results in a high sago self-propagation rate and high starch content. However, young sago palms require an open canopy, which may increase peat temperatures and could increase carbon dioxide (CO_2) emissions. When grown on tidally influenced deep peat, sago produces less starch and takes longer time to mature, approximately 12–17 years, compared to cultivation on shallow peat, where mature trunks are produced within 8–12 years after planting. The poor growth of sago palms on deep peat is likely caused by the lack of nutrients in the peat strata rather than low pH.

Example 2: Jelutong

"Jelutong Paya" or *Dyera polyphylla* is a native forest tree species in peat and able to grow up to 60 m tall. Jelutong latex is an important substitute for rubber latex for specialised moulding and also for electrical insulation. In the past, it was also an important source of chewing gum.

"Jelutong" wood has fine texture and creamy white in colour, suitable for panelling and in the manufacture of products such as pencils, matchsticks, model carvings, and other wooden accessories. The latex is obtained by tapping the trunk after 10 years, once a week. The production of latex increases with the maturity of the trees. It can be harvested for its wood after 30 years with a diameter of more than 40 cm.

The community in Kalampangan Village, Indonesia, practises intercropping and rotation of agricultural crops that are planted between Jelutong. They plant various vegetables such as chillies, long beans, eggplants, green leafy vegetable [e.g. *"sawi"* and corn].

VEGETABLES

To plant crops on peatlands, proper planning is needed and guidelines are to be strictly adhered to, in particular water management and fire prevention. Cultivation of shallow rooting crops such as ginger, beans, lettuce, tomatoes, cucumber, taro and turmeric that can tolerate acidic and wet environment made planting vegetables crop on peatlands possible to be achieved.

Example 3: Vegetables and fruits

Tomato (Growing Vegetables: Tomatoes. UNH Cooperative Extensions)

A perennial plant in its native tropics, tomato belongs to the nightshade family (Solanacae) and is native to Central and South America. Tomato plants will grow well in well-drained sites that receive full sun for most of the day. The soil pH should be slightly acidic. Excess nitrogen can result in plants with lush, vigorous foliage but little fruit production. Although it is best to determine lime and fertiliser needs from the results of a soil test, a rule of thumb for gardeners lacking test data is to apply 1.13 kg of a complete fertiliser such as 10-10-10 (or the equivalent) per 100 square feet of garden area. Work the fertiliser into the soil about two weeks before planting.

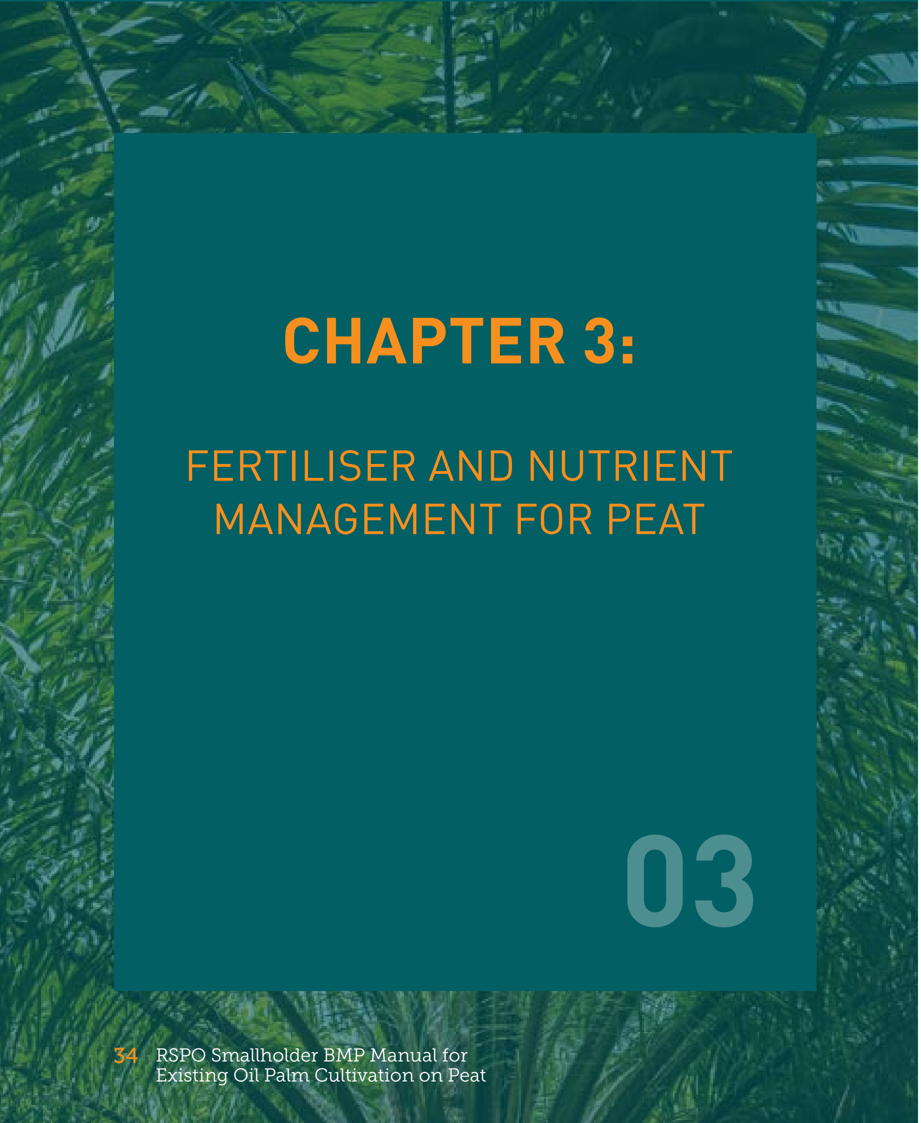
(Credit: Samrizal)

Turmeric[3]

Turmeric is a member of the Curcuma botanical group, which is part of the ginger family of herbs, the Zingiberaceae. Turmeric is widely grown both as a kitchen spice and for its medicinal uses. All curcumas are perennial plants native to southern Asia. They grow in warm, humid climates and thrive only in temperatures above 60°F (29.8°C). The turmeric plant is identifiable by both its characteristic tuberous root and leaves that extend upward from erect, thick stems arising from the root. Turmeric root is actually a fleshy oblong tuber 2-3 in (5–10 cm) in length, and close to 1 in (2.54 cm) wide.

(Credit: Tuti Sarinum)

3 https://www.encyclopedia.com/plants-and-animals/plants/plants/turmeric



CHAPTER 3:

FERTILISER AND NUTRIENT MANAGEMENT FOR PEAT

03

The fertiliser requirement in palms planted on peat is not the same as that of mineral soils. Unlike mineral soils, retaining the applied nutrients in peat (depending on the type of peat) is difficult due to low bulk density, high infiltration rate, and high porosity. Under certain situations, the chances of nutrient loss from the applied fertiliser through surface runoff and leaching are high. Retention of nutrients, especially potassium from recycled fronds, may also be difficult in peat due to the high water levels. Therefore, it is important to ensure that appropriate balanced fertilisation and agro-management practices are properly executed to obtain optimum yields in peat.

Table 3.1 summarises the common deficiencies in oil palm, how to identify them, and what are the possible remedies that can be used to overcome them.

3.1
OPTIMUM FERTILISER APPLICATION GUIDANCE

Adequate fertilisation is essential to successful palm oil production on peat areas. The main premise for the importance of fertilisers is that healthy palms will produce optimum fresh fruit bunch (FFB) yield, which is the primary commodity of most plantations.

3.1.1 FERTILISER MANAGEMENT ON PEAT

Table 3.1: Fertiliser management by stages

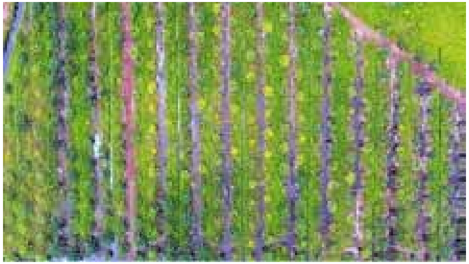
Nursery stage in general	Foliar and compound fertilisers are used with regular spraying of copper sulphate ($CuSO_4$) at 0.5-1.0 gm/litre of water and iron (II) sulphate ($FeSO_4$) at 3- 5 gm/litre of water.
0 - 10 months	Controlled release fertiliser in planting hole + copper (Cu) and zinc (Zn) fertilisers.
12 - 28 months	Compound fertiliser with boron (B), Cu, and Zn.
More than 28 months	Muriate of Potash (MOP), urea, borate, rock phosphate (RP), Cu, and Zn (mature) (dosage based on foliar analysis, trial results, and visual observations).

3.1.2 GENERAL FERTILISER REQUIREMENTS FOR MATURE PALM ON PEAT

Table 3.2: Fertiliser application frequency by type and amount

Fertiliser	Amount (kg/palm/year)	Application (round/year)
Muriate of Potash	4.0- 5.0	3
Urea	0.75 – 1.25	2
Rock Phosphate	1.0	1
Copper sulphate ($CuSO_4$)	0.1 – 0.15	1
*Zinc sulphate ($ZnSO_4$) (only when necessary)	0.10	1
Borate	0.1 – 0.15	1

3.2
NUTRIENT DEFICIENCY SYMPTOMS

	Symptom	Remedies
Nitrogen (N) deficiency and multiple nutrient deficiencies due to water log	• If palms are under prolonged high water levels, the whole canopy of the palm will turn pale green to yellow.  *Figure 3.1: Severe nitrogen deficiency under prolonged high water levels.* *(Credits: IOI Group)*	• With adequate drainage and at the desired water management level, the palms will recover from nitrogen deficiency. • Ensure a maintenance water level of 40 cm to 60 cm at all times for the best water and drainage management. Regular annual application of nitrogen and phosphate fertilisers: • Peat has high nitrogen, phosphate and magnesium. In a normal situation of peat planting, the urea requirement is generally low. • Annual dressing of 1.25 kg to 1.75 kg of urea applied per palm in two rounds should be adequate. • A single round of rock phosphate at the rate of 1.00 kg to 1.25 kg per palm per year would suffice.

	Symptom	Remedies
Potassium (K) deficiency	• Yellow or orange spots with irregular shapes appear on the leaves, starting in the older leaves. If the leaves are held up to the sun, the light shines through the spots. • Later, the spots turn orange and grow until they fuse together.  *Figure 3.2: Potassium deficiency symptoms (Credits: IOI Group)*	• Usually, high rates of MOP are recommended in peat areas ranging from 4 to 5 kg per palm with a split application of three times a year.
Boron (B) deficiency	• Hook leaf on young pinnae of young fronds.  *Figure 3.3: Hook leaf (Credits: IOI Group)*	• Borate is normally applied at routine rates ranging from 100 to 150 g per palm. • For severe boron deficient palms, it is advisable to apply borate fertiliser at a rate of 200-250 g per palm.

	Symptom	Remedies
Copper (Cu) deficiency	• Unlike mineral soil, copper deficiency is usually common in peat areas only. • Early symptoms would be young fronds are generally shorter and the leaves become yellow at the tips of the leaflets, but the midribs stay green. • In severe cases, the distal end of pinnae will become necrotic. • Internodes of affected palms also appear shorter and compacted.  *Figure 3.4: Copper deficiency (Credits: IOI Group)*	• Application of copper sulphate at a rate of 250 g per palm will improve condition. • Routine annual application of 100 g of copper sulphate would represent good maintenance. • Alternatively, it is also possible to carry out foliar spraying of copper sulphate at a concentration of 200 parts per million (ppm) to be sprayed on affected palms on monthly basis till recovery.

	Symptom	Remedies
Iron (Fe) deficiency	• At an early stage, the midribs appear green while the laminae and pinnae turn pale green to yellow. • At advanced stage, the young fronds will turn completely yellow with stunted growth.  *Figure 3.5: Iron deficiency (Credits: IOI Group)*	• Foliar application of ferrous sulphate at a concentration of 1% will be able to control the deficiency symptoms (spray directly at the affected leaf area).

3.2.1 TIMING AND FREQUENCY OF FERTILISATION

- The annual average and probability of rainfall pattern should be studied in order to schedule fertiliser application at the appropriate time. Nutrient runoff by rain is minimal in rock phosphate, therefore application during high rainfall months may not cause severe effect on runoff.
- Urea needs moisture to react, hence application on the moist surface of peat helps to speed up reaction and lower loss of nitrogen through volatilisation.
- Since MOP is a major requirement in large quantities for peat, application in split form with increased frequency and lower dosage will reduce deficiency issue. Best applied during relatively low rainfall months.

3.2.2 PLACEMENT AND METHOD OF FERTILISER APPLICATION

- The effective root zone area in oil palm planted in peat is nearer to the trunk; therefore, the application of macronutrients fertilisers should be as close as possible to the trunk base ranging from 50-100 cm for palms aged 3 years and above.
- For palms below three years, fertilisers should be applied at about 30-50 cm radius, depending on the growth rate of palms.

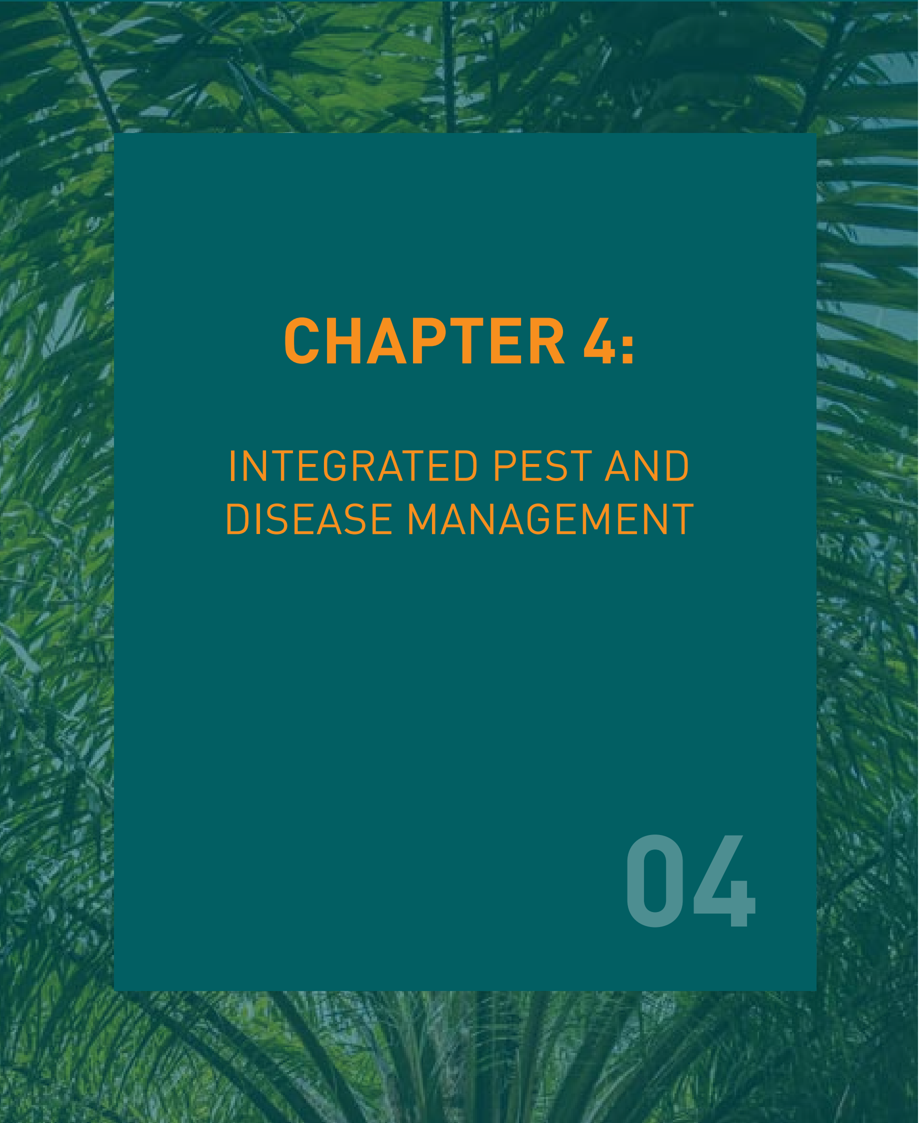
Figure 3.6: Fertiliser application ranging (dotted circle) from 50 cm to 100 cm from the base (Credits: IOI Group)

3.3
ALTERNATIVE FERTILISER

A number of organic by-products and residues are produced in oil palm plantations and mills. These materials can be recycled in the plantation as sources of nutrients, which is also another form of alternative fertiliser. The empty fruit bunches (EFB) from mills are a good example of an alternative fertiliser. The benefits are as follows:

- Can be returned to the field for mulching, and incinerated to produce bunch ash.
- Large amounts of organic matter and plant nutrients in EFB make excellent mulch.
- An application of 50 tonnes per ha of EFB provides most of the K required by mature palms.
- Applications of 15 – 30 tonnes per ha of EFB are typical in immature areas, spread in a single layer in a circle around the palm with a 1.5 m wide ring.

Figure 3.7: Empty fruit bunch (EFB)



CHAPTER 4:

INTEGRATED PEST AND DISEASE MANAGEMENT

04

The core of the Integrated Pest and Disease Management (IPDM) approach is the management to maintain and enhance the numbers of natural enemies to keep pest numbers below economically damaging levels. Within oil palm, IPDM represents a diverse range of approaches, including targeted chemical applications, the management to reduce pest numbers and transmission, and the management to increase the numbers of natural enemies and pathogens of pests.

The key success factor in IPDM is early detection by regular census and speedy treatment. In this respect, all peat estates should have permanent pest census teams. With effective implementation of IPDM, expenditures on pest control on deep peat can be greatly reduced. The amount of chemicals is also reduced to minimise the impact on beneficial and non-target organisms. Chemical treatments are only carried out by using selective pesticides at low rates and in timely manner to ensure minimum impact on biodiversity and the environment.

4.1
IPDM PROCEDURES

01. Biological Control and Cultural Practices

02. Detection of Pest Damages

03. Identification of Pest

04. List of Pest Population

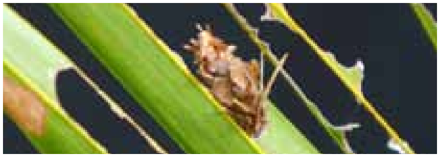
05. Selection of Chemical Control

Remark: *No Prophylactic* ***Chemical Control*** *for Pest and Diseases (of such biological control should come first;* ***only upon uncontrollable outbreak****, chemical use is recommended).*

4.2
PEST AND DISEASE IDENTIFICATION AND BIOLOGICAL TREATMENT

Pest Identification /Detection	Treatment	
	Biological Control	Chemical Control
Termites *(Coptotermes curvignathus)*  *(Credit: elements.envato.com, twenty20photos)* Monthly census on every palm (100% census) and speedy treatment is recommended. Termite infestation spreads outwards affecting the neighbouring palms in a clustered pattern; hence, identifying the origin of termite colonies is the key to effective control.	Field tests showed that the use of entomopathogenic fungi *Beauveria bassiana* and *Metarhizium anisopliae* are equally potent to control termites infesting standing oil palm.	Fipronil remains the most effective chemical for termite control. The recommended dosage - (5.0% a.i.) at 2.5 ml product per 5 litres of water. Application volumes of the above recommended chemical solution: Palms > 1 year – 5.0 litres/palm Palms < 1 year – 2.5 litres/palm Both the basal region of the spear and crown must be thoroughly sprayed. The hole or the base of the palm is to be sprayed to act as a barrier. When the mud work is thick, slightly scrape it before spraying. The mud work on the infected palms gradually dry up when the termites are killed. Application is to be repeated upon detection of re-infestation.

Pest Identification /Detection	Treatment	
	Biological Control	Chemical Control
		Alternatively, termite baiting using hexaflumuron baits applied on the mud work of infected palms seems promising. However, this treatment is not cost-effective.
Tirathaba Bunch Moth *(Tirathaba mundella)*  *(Credit: www.flickr.com, 旭宏 林)*	The Tirathaba bunch moth can be effectively controlled using the Integrated Pest Management approach. Tirathaba bunch moths may be regulated by natural predators, especially earwigs (*Chelisoches morio*) and *"Kerengga"* ants. Sanitation by removing unharvested/rotten bunches is necessary to remove the breeding sites. It is therefore important to carry out ablation from 12 to 18 months at monthly intervals and remove any rotten bunches to minimise proliferation of the pest.	The spraying of cypermethrin on infested bunches should be strongly discouraged as it will affect the population of the pollinating weevils and natural enemies such as earwigs (*Chelisoches morio*) that prey on the young Tirathaba caterpillars.

Pest Identification /Detection	Treatment	
	Biological Control	Chemical Control
Early detection of Tirathaba bunch moth damage is normally obtained by observing harvested bunches on fresh fruit bunch (FFB) platforms during routine grading. When the infested bunches on the FFB platforms in a block is more than 5%, a systematic census on 10% of palm population in the block (all palms in every 10th row) should be carried out by a team of trained Pest and Disease (P&D) workers.	Good sanitation practices on mature palms are also important as an integral part of Tirathaba bunch moth management. All rotten aborted bunches and badly infested bunches on the palms that attract the bunch moths should be harvested and taken out of the field. Spot spray infected palms and bunches selectively with *Bacillus thuringiensis* (Bt) at 1 g product/litre of water at twice weekly intervals. Use relatively clean water with low suspended dirt. Before spraying, all rotten bunches are to be removed. Ensure pruning is up to date as under-pruning will interfere with the effectiveness of spraying.	
Leaf-Eating Caterpillars The main species of leaf-eating caterpillars are: i. Bagworms (*Mahasena corbetti, Metisa plana* and *Pteroma pendula*)  *(Credit: www.flickr.com, Scot Nelson)*	Up-to-date biological controls involving natural enemies are not commonly used during pest outbreaks, but there is a real potential for managing pest population using biological control rather than pesticides.	Chemical treatment for the control of leaf-eating caterpillars to be carried out only when census figures are above threshold numbers. Threshold numbers for treatment: 10 per frond for smaller species (e.g. *Metisa plana* and *Darna trima*); 5 per frond for larger species (e.g. *Mahasena corbetti*).

<table>
<tr><th rowspan="2">Pest Identification /Detection</th><th colspan="2">Treatment</th></tr>
<tr><th>Biological Control</th><th>Chemical Control</th></tr>
<tr><td>ii. Nettle caterpillars (Darna trima, Setora nitens and Setothosea asigna)

(Credit: www.flickr.com, Forest and Kim Starr)</td><td>The establishment of beneficial plants (especially Cassia cobanensis) for biological control is effective in attracting predators and parasitoids for biological control of leaf-eating caterpillars, especially bagworms.

There have been many attempts to use viruses and entomopathogens to control outbreaks and some success was well reported.</td><td>For young palms (1-6 years):
1. Spray 0.005% cypermethrin (knapsack sprayers), fortnightly intervals, on the infested canopy until new infestations clear off.
2. When mist-blowers are used, the concentration is increased to 0.01%.
3. Ensure all the palms in an infested block are treated to minimise re-infestation.

For tall palms >8 years:
1. Trunk injection using Acephate (55%) is recommended.
2. The hole is drilled using a power drill at 45° on the lower trunk (about 80 cm from the ground) with a diameter of 1.25 cm and a depth of 15 cm.
3. Plug the hole with a mud ball after introducing the chemical with a syringe.
4. Ensure all the palms in an infested block are treated to minimise re-infestation.
5. Each injection lasts for about four weeks. Post-treatment censuses are needed to ensure that the pest is effectively controlled.</td></tr>
</table>

<table>
<tr><th rowspan="2">Pest Identification /Detection</th><th colspan="2">Treatment</th></tr>
<tr><th>Biological Control</th><th>Chemical Control</th></tr>
<tr><td>iii. Hairy caterpillars (Dasychira inclusa and Amathusia phidippus)

(Credit: www.dreamstime.com, Christopheb)

Start census when symptoms such as feeding holes on leaves and presence of caterpillars are noticed beyond normal situations. Palms should be censused at an intensity of 1% (one row in 10, one palm in 10) at twice weekly intervals. The frond of each census palm is to be taken from the middle of the crown. Threshold numbers for treatment: 10 per frond for smaller species (e.g. Metisa plana and Darna trima); 5 per frond for larger species (e.g. Mahasena corbetti).</td><td></td><td>Remarks:
1. It is often necessary to first spray a buffer zone of 5-10 palms on the perimeter of the infested block to minimise spread to neighbouring uninfested blocks.
2. It will also be useful to coordinate with neighbouring estates on treatment if they are also infested by this pest.

If trunk injection is employed, the larval growth stages must be identified.

Any trunk injection treatment must first identify the larvae and its growth stages at the time of census. Treatment is only effective when the larvae are at the feeding stage.</td></tr>
</table>

Pest Identification /Detection	Treatment	
	Biological Control	Chemical Control
Rhinoceros Beetle *(Oryctes rhinoceros)*  *(Credit: elements.envato.com, chuyu2014)* Monthly census is important for newly planted palms in areas with high rhinoceros beetle populations, especially in areas with more than two successive years of replanting (especially with "no-burn" practice) where large amounts of biomass from replanting provide excellent breeding grounds. The buildup of beetle population can result in serious repeated damage to young palms. A census should record the onset of NEW damages when symptoms such as fan-shaped cut on newly opened fronds, dieback of spear, and bore holes on the frond bases are observed.	Effective control of beetles involves the removal of potential breeding sites by mechanical chipping and pulverisation of trunk chips during replanting. The use of aggregating pheromone integrated with chemical spraying is an effective IPDM tool for monitoring and controlling rhinoceros beetles in immature and young mature oil palm fields.	At low pest levels, carbofuran (3%) or carbosulfan (5%) may be applied to the spear region and the base of new fronds at monthly intervals. Alternatively, pheromone traps can be installed at every 200 m along canals, main drains, collection drains, or roadsides of affected blocks. The height of the trap needs to be about 1 m from the top of the oil palm canopy. When the number of beetles trapped exceeds 10 beetles/trap/ week, twice weekly spraying of 0.06% of cypermethrin to the spears and new frond bases is recommended. It is important to ensure adequate wetting of the spear region, estimated about 150-200 ml solution per palm.

Pest Identification /Detection	Treatment	
	Biological Control	Chemical Control
Rats i. *Rattus tiomanicus* (Wood rat, white belly)   *(Credit: Sime Darby, En. Meor Badli Shah)*	Barn owls (*Tyto alba*) is commonly used as biological control. Nest boxes are provided at 1 unit per 5 to 10 hectares to encourage the build-up of the owl population.	Start baiting using anticoagulant baits when census results show more than 5% fresh damage. Examples of first-generation anticoagulants are warfarin and chlorophacinone, while second-generation anticoagulants are brodifacoum, bromadiolone, and flocoumafen. In new areas, start with first-generation baits, as they are cheaper and safer for rat predators (e.g. barn owls). Commence baiting block by block with the date properly recorded. For the first campaign, start with 100% baiting (1 bait/palm).

Pest Identification /Detection	Treatment	
	Biological Control	Chemical Control
ii. *Rattus argentiventer* (Paddy field rat, grayish belly)   *(Credit: Sime Darby, En. Meor Badli Shah)*	Barn owls (*Tyto alba*) is commonly used as biological control. Nest boxes are provided at 1 unit per 5 to 10 hectares to encourage the build-up of the owl population.	Place bait at about 1 m from the palm base or between frond butts if the palm circle is not weeded. Applied baits must be visible to be able to count the acceptance. Application of baits is to be timed after a harvesting round (if possible) to avoid the applied baits from being accidentally removed during loose fruit collection. Replace taken baits at 4-5 day intervals (as it takes about 6-12 days to kill rats after consuming the poison). Stop baiting when acceptance (replacement) declines to below 20%.

Pest Identification /Detection	Treatment	
	Biological Control	Chemical Control
iii. *Rattus rattus diardii* (House rat, brown belly)   *(Credit: Sime Darby, En. Meor Badli Shah)*	Barn owls (*Tyto alba*) is commonly used as biological control. Nest boxes are provided at 1 unit per 5 to 10 hectares to encourage the build-up of the owl population.	When bait acceptance is good but fresh damages continue, rat resistance to the first-generation baits is suspected. In this case, switch to the second-generation baits. For the second-generation baits, the replacement interval between two baiting is six to seven days.

Pest Identification /Detection	Treatment	
	Biological Control	Chemical Control
Damage of oil palm fruits by rats 	To carry out regular censuses based on fresh rat damage on palms or harvested bunches. For young palms, censuses should be carried out monthly in high infestation areas when their bases show signs of being chewed by rats. Fresh rat damage census should be carried out daily on the harvesting platforms on the harvested bunches. Depending on the harvesting interval, one can assess the extent of damage daily along with the crop quality control process.	

Pest Identification /Detection	Treatment	
	Biological Control	Chemical Control

Ganoderma

1. Gano, fruiting bodies, basal rot, canopy symptoms

(Credit: Sime Darby, En. Meor Badli Shah)

2. Sanitisation trenches, chipping, etc.

Three to six monthly censuses of Ganoderma infections are recommended. The strategy of more frequent censuses and speedy isolation of early infected palms is to keep Ganoderma infection levels to less than 15% till the end of the 20 to 25 years palm cycle on peat.

Control via sanitisation:

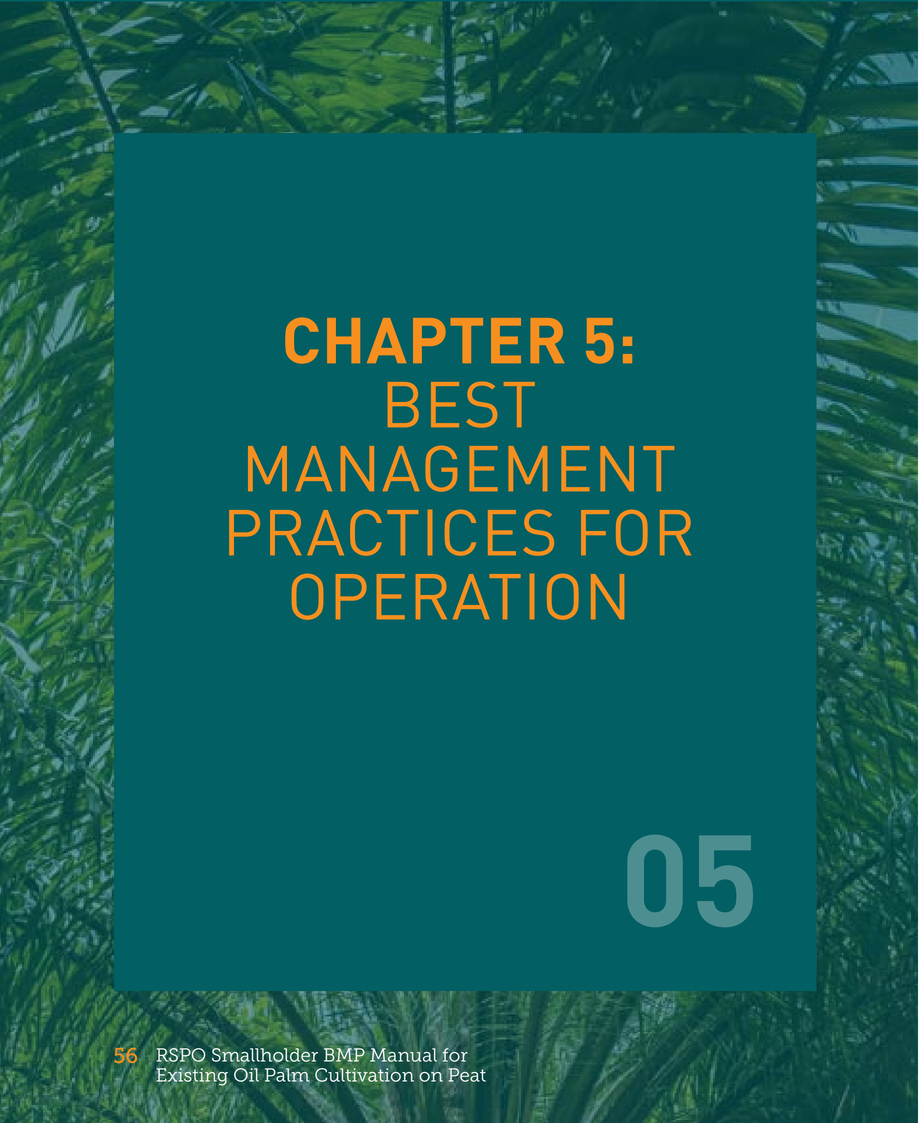
On peat areas, it is important to maintain a water level of 50-75 cm from the peat surface to minimise Ganoderma infections and the spread of this deadly disease on oil palms planted on peat.

Infected palms should be quickly isolated using a 4 m x 4 m x 75 cm deep isolation trench around the infected palm. This is to minimise the spread to neighbouring healthy palms.

It is recommended to use the soil from the trenches for mounding the base of the infected palm as the practice had been reported to prolong the productive life of the Ganoderma infected palms.

During replanting, it will be useful to excavate the infected bole and root tissues as a sanitation measure. The sanitation pit should be at least 2 m x 2 m x 1 m deep.

(Credit: Sime Darby, En. Meor Badli Shah)



CHAPTER 5: BEST MANAGEMENT PRACTICES FOR OPERATION

05

5.1 TREATMENT FOR EXISTING LEANING PALMS

A major problem with oil palm cultivation on tropical peat is leaning palms. Random leaning and in severe cases, fallen palms, are mainly due to peat subsidence. The low bulk density of peat and the less extensive root system of oil palm planted on peat are also contributory factors to leaning and fallen palms.

About 40-50% of the palms planted on peat can lean at various angles and directions at the age of about 7-8 years. The number of fallen palms increases thereafter mainly due to excessive root exposure, desiccation, and breakage caused by the weight of the palms.

Depending on the severity of leaning and fallen palms, a yield reduction of 10-30% can occur due to root damage and poor interception of sunlight for photosynthesis. The different directions and degrees of leaning palms also interfere with harvesting due to differential palm height.

Figure 5.1: Leaning palms mainly caused by peat subsidence

A practical approach to rehabilitate leaning and fallen palms is to carry out soil mounding to minimise root desiccation and promote new root development. The soil for mounding the exposed roots of leaning palms should be taken from outside the palm circles in order to prevent damage to the surface feeder roots (Lim and Herry, 2010).

Figure 5.2: Rehabilitated leaning palm after two years of soil mounding carried out on exposed roots

Good water management to maintain the water level at 50-70 cm (from water level in collection drains) or 40-60 cm (groundwater piezometer reading) is crucial to minimise peat subsidence and reduce leaning palms.

To avoid leaning palms, proper compaction should be done at the time of planting or replanting to increase the bulk density of the soil, which enhances its water holding capacity and is thought to reduce subsidence and leaning palms.

5.2
REPLANTING PRACTICES TO MINIMISE INCIDENCE OF LEANING PALMS

Leaning palms are one of the major problems of planting oil palms on tropical peat. Random leaning (in severe cases, fallen palms) are mainly due to peat subsidence, which can be avoided with proper compaction at the time of replanting. Alternatively, the hole-in-hole planting method can also be applied during replanting.

Replanting flow:		
1	Prior Replanting Assessment	• To identify risk of long-term flooding/saline intrusion and peat soil profiling (depth of peat, underlying parent materials: potential acid sulphate/acid sulphate soil, sandy soil, etc.). • Key aspect is to identify problematic areas and avoid replanting on those that are less productive (flood prone, etc.).
2	Plan out drainage system, water management structure, road system, planting density, etc.	• If assessment determines that the area is suitable for replanting and done at the same planting density as before, basic drainage can be used and replanting cost will be lower. If additional water management structures are required, it is best to plan before replanting. • A planting density of 160 palms per ha on medium to deep peat is recommended, with 148 palms/ha on shallow peat. High density 180 palms/ha is also practiced by some in anticipation of the potential loss by pests and diseases.

Replanting flow:		
3	Replanting (mechanical felling, chipping, compaction and hole-in-hole planting)	• During replanting, mechanically fell and chip the trunks to about 10 cm thick and heap on stacked rows every 4 palm rows. • Excavate palm boles and root tissue of Ganoderma infected palms. The size of excavation needs to be 2 m x 2 m x 1 m. Excavated boles and root tissues are cut into small pieces and heap on top of the stacked rows to desiccate. The excavated holes are to be filled by spoil from collection drains, levelled and compacted. • Removal or chain-sawing of protruding stumps along mechanisation paths is important to minimise risk of puncturing of low ground pressure (LGP) tyres and snapping of rubber tracks. • Surface compaction prior to planting and/or hole-in-hole planting of seedlings is important to minimise future palm leaning. • For hole-in-hole planting, the seedling bole needs to be 15 cm below the compacted peat surface after planting. It is also important to ensure that the base of the planting hole is levelled and compacted by the worker before putting in the seedling for planting. • To facilitate deep planting, it is useful to lower the water level in the collection drains to about 90 cm from the peat surface. • About 1 month after planting is completed, increase the water level in the fields back to 35 cm from the peat surface.
4	Construction of harvesting path	• After lining of planting rows, collection drains and stacking rows, now wait longer than 18 months after planting. • Elevated mechanisation path of about 3.5 m width and 50 cm height with a slight camber can be constructed using residual woody materials less than 15 cm diameter. • In areas where there are insufficient woody materials, non-elevated but compacted paths of about 3 m width can be constructed. They are constructed by removing protruding stumps, filling surface cavities followed by 1-2 rounds of compaction using a tracked excavator.

Info Box:

1. Replanting is normally carried out when the yield is below economic level and may be accelerated in the event of low productive stands caused by Ganoderma infections or other disease problems. Yield of second-generation palms on peat is generally better than the first-generation palms as peat is more compact and better decomposed.

2. When replanting, care must be taken to minimise, where possible, disturbance of the soil as this may increase greenhouse gas (GHG) emissions. Palm trunks should be chipped or applied directly to the plantations as surface mulch for reducing the direct impacts of rainfall and sunlight on the peat. Zero burning must be applied, and measures are taken to encourage rapid establishment of soft vegetation. In view of the new insights on optimal drainage levels, excessive deepening of drainage ditches should be avoided.

3. The elevated paths are useful for future mechanisation for in-field fresh fruit bunch (FFB) evacuation and to minimise the effect of subsidence on harvesting paths.

4. *Fimbristylis acuminata*, a common weed on peat areas with extensive surface root systems, should be encouraged or planted on peat roads or mechanisation paths to further strengthen the peat surface against rutting by moving vehicles.

Figure 5.3: Hole-in-hole planting on compacted peat surface.

5.3
GROUND COVER MANAGEMENT/WEEDING AND MAINTENANCE OF HARVESTING PATH

It is recommended to maintain a natural cover of soft vegetation (grasses, ferns, mosses, or leguminous cover crop):

- For soil moisture conservation and to improve soil fertility.
- To reduce direct exposure of the peat surface to sunlight, thus reducing the risk of peat fire.

Weeding flow:		
1	Chemical weeding, only palm circles (2.5-metre radius) and harvesting path	• Without delay to ensure good accessibility and crop recovery especially loose fruit collection.
2	Choice of spray equipment and herbicides.	• Based on cost-effectiveness and labour productivity. Herbicides used must be relatively safe for workers and have minimal impact on the environment. Herbicides that are quick acting and do not destroy the root system of soft weeds should be used.
3	Frequency.	• Any delay or neglect in weed control will lead to rapid deterioration of field conditions, especially in immature areas. Six to nine rounds of weeding per year are recommended for immature peat plantations due to the fast weed growth in peat areas (compared to 4-5 rounds for oil palm plantations on mineral soils).
4	Woody growth/tree seedlings	• Woody growths (tree seedlings) on the inter-rows or harvesting path can be controlled by brushing with Garlon: Diesel mixture (at a ratio of 1:19) on a 30 cm band on the basal stems. • Alternatively, woody growth can be mechanically flattened using a tracked excavator, followed by 1-2 rounds of herbicide spraying. • Where appropriate, rather than spraying the tree seedlings, they can be harvested and transferred to a nursery for rehabilitating any degraded conservation areas within or adjacent to the plantation.

Info Box:

1. With zero-burning, most of the early weed species are indigenous, mainly ferns (especially *Nephrolepis biserrata, Stenochlaena palustris, Dicranopteris linearis*), sedges (e.g. *Fimbristylis acuminata, Cyperus rotundus*), and woody species (e.g. *Uncaria* spp., *Macaranga* spp., *Melastoma malabathricum*) (Lim, 2003). Subsequently, other species are brought in by agricultural activities, road materials, wind and water, e.g. *Mikania micrantha, Merremia* spp., *Mimosa pudica, Asystasia intrusa, Digitaria* spp., *Ischaemum muticum, Imperata cylindrica, Eleusine indica*, etc.

2. *Uncaria* spp. or "*pancingan*" is a fast spreading woody creeper in many peat estates. Slashing will lead to more rapid proliferation. If not properly managed, this noxious weed can cover an entire estate within a short time. The control is by uprooting the weeds. High water table (less than 25 cm from the peat surface) and periodic flooding should be minimised as such conditions expedite the proliferation of several weed species on peat especially *Uncaria* spp.

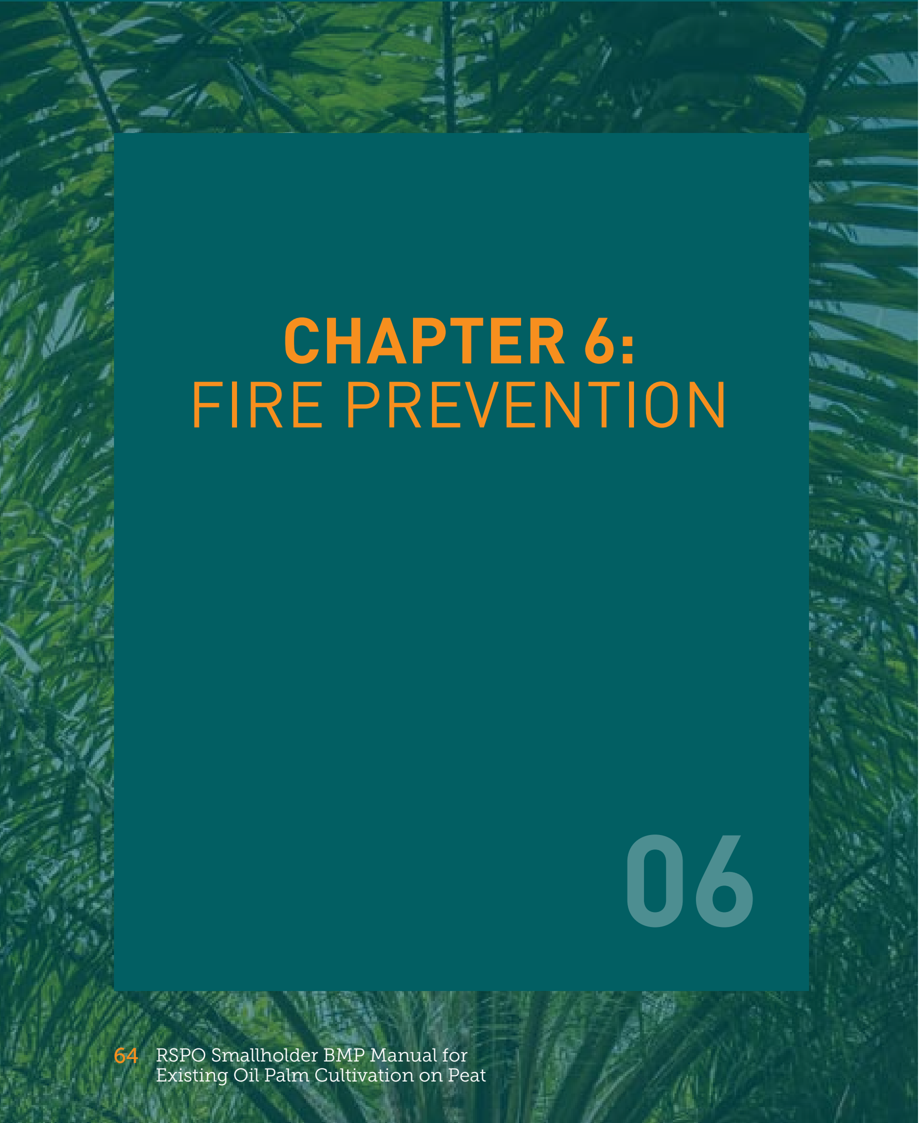
3. *Fimbristylis acuminata* with extensive surface root system is either encouraged or planted on peat roads to reduce erosion and peat degradation (Lim, 2002).

Dos

- Zero burning
- Maintain weeding at palm circles. Palm avenue, allow light vegetation to grow.
- Timely spraying of noxious weeds with selective herbicides to promote the growth of desirable ground cover is advocated to minimise the weed succession problem. The strategy is to keep the palm circles clean and inter- rows devoid of noxious weeds. (especially "lalang", *Mikania micrantha, Ischaemum muticum,* etc.).

Don'ts

- Burning for ground clearing
- Blanket Weeding – can lead to irreversible drying and increase the risk of peat fire.



CHAPTER 6: FIRE PREVENTION

Fires occur not only on dry land but also on wetland areas, such as peatlands, particularly during the dry season when these areas dry out (due to deforestation and drainage). In Indonesia, peat fires have been recorded to occur every year, even during non-El Niño (warming of the ocean surface at the Pacific Ocean) years. Therefore, plantations should be on high alert during drier months, and when ground water level drops beyond permissible level and remains low for prolonged periods. Suppressing fire on drained and deforested peatland is extremely difficult, compared to fire in other land areas. Smallholders can help in preventing peat fires by ensuring the following measures are implemented:

It is important to maintain the desired water table (40-60 cm in Malaysia and 40 cm in Indonesia) as a measure for fire prevention.

6.1
GOOD WATER MANAGEMENT

To maintain a water table 40-60 cm in plantations (40 cm in Indonesia as regulated by the Government of Indonesia). Drains are blocked to achieve the required water table.

(Credit: Global Environment Centre, GEC)

6.2
ZERO BURNING METHOD

For land clearing/replanting – palms felled, shredded, stacked, and left in-situ to decompose naturally.

(Credit: Global Environment Centre, GEC)

6.3 COLLABORATIVE FIRE PREVENTION WITH ADJACENT COMMUNITIES AND OTHER STAKEHOLDERS

It is impossible to prevent fire individually, as burning peat (especially underground) may spread beyond the smallholders' boundary. Landowners can take proactive measures to control fires in cultivated peatlands through collaborative efforts, such as effective surveillance and monitoring with daily patrol during the dry season.

High risk of fire occurrence during the dry season – prevention and preparedness measures are needed in a collaborative manner.

The leader/owner of each farm/unit/block and sub-block is responsible for the surveillance and monitoring of their area with regards to fire prevention. In case of fire, they are responsible to notify the related stakeholders and report to the relevant agency.

Figure 6.1: Landowners informing neighbouring farmers to undertake survey together
(Credit: Global Environment Centre, GEC)

Figure 6.2: Possible collaboration, first response team in the field
(Credit: Global Environment Centre, GEC)

6.4 FIRE WARNING SYSTEM APPROACH – E.G. FIRE DANGER RATING SYSTEM (FDRS)

System to notify farmers/landowners/workers in early detection of fire risk in their area. They are then able to verify ground conditions and take necessary actions.

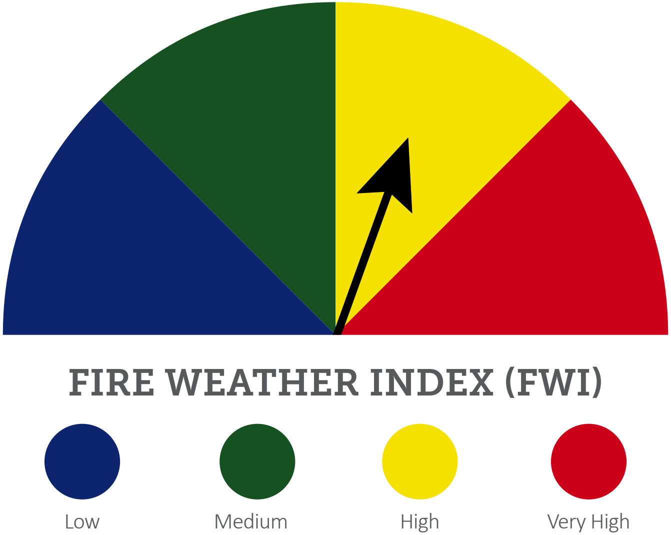


Figure 6.3: Fire Danger Rating System (FDRS)
(Credit: Global Environment Centre, GEC)

LIST OF LIGHT EQUIPMENT FOR FIRE PATROL:

1. Fire resistance boots
2. Safety helmet
3. Fire proof hand gloves
4. Appropriate field attire (e.g. long sleeve shirt, long pants, and covered shoes)
5. Backpack sprayer
6. Fire swatter (metal scraper)
7. Parang/machete
8. GPS device and logbook
9. First Aid Kit

CHAPTER 7:
CASE STUDIES OF BEST MANAGEMENT PRACTICES IMPLEMENTED

07

7.1
EXTENSION SERVICES

Training services

Various training can enhance the knowledge of smallholders and improve connections, in order to develop self-efficiency to achieve good productivity and improve farm management practices.

Training on oil palm cultivation on peat for smallholders:

1. Certification
2. Nutrient uptake
3. Water management
4. Integrated Pest and Disease Management (IPDM)
5. Fire prevention and control
6. Subsidence/greenhouse gas (GHG) emissions

1. RSPO Smallholder Trainer Academy (STA)

An initiative by RSPO to provide a wider opportunity for smallholders globally to access training. STA has been developed with a focus on improving smallholders' livelihood and sustainable practices. The approach is "Training of Trainers" and STA will work with partners from relevant sectors to expand field training capacity. Any corporate or non-corporate organisations working directly or indirectly with oil palm smallholders can become an STA Partner.

For more information, visit: http://www.sta.rspo.org

2. **TUNAS Centres (MPOB) – government agency that has been supporting smallholders in Malaysia.**

   In order to enhance productivity, smallholders need to adapt good agricultural practices and well-known knowledge on oil palm cultivation. The Centre for Oil Palm Guidance and Advisory (TUNAS Centres) under the Malaysian Palm Oil Board (MPOB) plays a key role in providing technical guidance, such as talks, short courses, hands-on classes, and on-site demonstrations.

7.2 STAKEHOLDER ENGAGEMENT

Figure 7.1: RSPO certified smallholder group in Central Kalimantan was assisted by PT Sawit Sumbermas Sarana Tbk (SSMS) to conduct hotspot fire monitoring

The ban on the use of fire for land clearing is a key criteria of the RSPO Independent Smallholder Standard adopted in November 2019. One of the RSPO certified groups in Central Kalimantan, Asosiasi Petani Kelapa Sawit Mandiri, is aware that fires in one place can spread to other places quickly, especially those close to flammable peatlands; therefore, in an effort to mitigate land fires during the dry season, the group was assisted by RSPO Grower member, PT Sawit Sumbermas Sarana Tbk (SSMS) to establish the fire prevention unit and the training on hotspot fire detection through android application. Fire hotspots can be easily monitored through the digital compass and map embedded in the phone.

7.3 GOVERNMENT LEVEL SUPPORT/AID

7.3.1 FINANCIAL AID FROM MALAYSIA

To ensure smallholder yields remain competitive and productive, the Malaysian government introduced two loan schemes of RM550 million at a 2% interest rate per year in July 2019, namely the RM500 million *Program Pembiayaan Mudah Tanam Semula (TSPKS)* and the RM50 million *Input Pertanian Pekebun Kecil Sawit (IPPKS)*. These schemes aim to ease the financial burden of independent smallholders in the process of implementing oil palm replanting and to help smallholders obtain agricultural inputs, such as certified seeds and quality breeds.

Approved applicants must show proof of replanting, replanting area, and fertilising and controlling of weeds and pests in accordance with good agricultural practices. Applicants must also apply for the Malaysian Sustainable Palm Oil (MSPO) Certification under Sustainable Palm Oil Cluster (SPOC). The schemes may benefit 15,000 smallholders nationwide who have already joined SPOC and relieve their financial burden, as well as encourage more smallholders to join the cluster of sustainable palm oil certification.

Financial aid may promote to sustainable palm oil certification.

For more information please visit, https://www.mpob.gov.my/

7.3.2 EMBUNG IN THE FIELD

Besides having water control structures in existing drains, constructing retention ponds can be one of the methods to control and prevent fire occurrence. Excess water, mainly from rain during wet season or existing drain, is stored in this structure before the dry season comes and acts as a small water reservoir for farmers. Known as 'embung' in Indonesia, the pond can be used for fire prevention on peat, irrigation, aquaculture, or even as a tourist attraction. The Indonesian government has allocated IDR200 million to IDR500 million per embung for the establishment of the Embung Desa Programme.

A simple 'embung' structure with 4 m width x 6 m length x 3 m depth can be easily made by farmers in their farm. It can be constructed using manual labour and the duration of construction depends on peat condition. For the dimensions given above, it may take 15 days, if the digging process involves heavy extraction of massive root mass.

Figure 7.2: Example of 'embung' in Kubu Raya, Kalimantan Barat
(Source: mediaindonesia.com)

Additional structures may help farmers to overcome fire occurrence, prolong peatland usage, and increase fresh fruit bunch (FFB) yields.

Structures applicable for fire prevention:

1. **Bore well**
2. **Pond/embung**

Structures applicable for yield efficiency:

1. **Enhanced drain system**
2. **Canal blocks/stop off**
3. **Weirs**

Structures applicable for monitoring water level:

1. **Water level marker**
2. **Piezometer**

7.4 ENVIRONMENTAL IMPROVEMENT

This article was taken and rephrased from the project titled 'Sustainable and climate friendly palm oil production and procurement' by GIZ. The effort, involving Indonesia, Thailand and Germany from 2018 to 2022, is commissioned by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

7.4.1 CONTEXT

Palm oil is now the most widely consumed vegetable oil worldwide. Production areas in the tropics have increased and palm oil production is an important income source for farmers and other stakeholders in rural areas.

Over the past decades, rainforests and peatlands had to give way to palm oil plantations. Forest clearing and degradation caused by small-scale agriculture and plantation, which include oil palm, keep increasing. It changes when palm oil is produced with environmental and social sustainability, which is desirable in order to avoid further deforestation, increase the supply of sustainably produced palm oil, and improve farmers' livelihoods.

Government administrations and public businesses also purchase palm oil-based products on a large scale. The majority of food products in Germany are already made with certified palm oil. However, the use of certified palm oil by public procurement bodies and in the animal feed industry needs to be further increased.

7.4.2 OBJECTIVES

To reduce greenhouse gas emissions from palm oil production.

To improve the environmental and social sustainability of smallholders in oil palm plantations.

To increase the number of farmers certified according to marketable sustainability standards.

7.4.3 APPROACH

The project focuses on the value chain – from land use and cultivation, harvesting and marketing through to the consumer. For this purpose, government authorities, companies and smallholder farmers in Thailand and Indonesia form a multi-stakeholder partnership.

The project team supports the development of land use plans involving smallholders, government representatives and private companies. Partnership agreements between actors along the value chain, such as oil mill operators, intermediaries and multinational companies, are intended to establish incentives for the transition to sustainable production.

In Germany, the project encourages public and private demand for products made from sustainably produced palm oil. Public procurement bodies and animal feed companies are advised to purchase certified products. In addition, awareness for sustainable palm oil is raised by round table talks with companies and consumer portals.

The project partners are the Thai Department of Agriculture and Department of Agricultural Extension, the Indonesian Ministry of National Development Planning (BAPPENAS), and the Provincial Government of East Kalimantan, as well as Environmental Action Germany (*Deutsche Umwelthilfe* e.V. – DUH) in Germany.

7.4.4 RESULTS

- By conserving high carbon stock forests and improving agricultural practices, greenhouse gas emissions from oil palm cultivation are reduced by the equivalent of 25,000 tonnes of CO_2. New oil palm plantations in the pilot areas are developed only on existing plots or uncultivated areas.
- More than 3,100 smallholders in Indonesia and Thailand are trained in sustainable cultivation practices and are prepared for sustainable certification.
- Jurisdictions in producer countries make use of a strategy to implement sustainability criteria and an official land use plan.
- German public procurement bodies increase purchases of certified palm oil products by at least 10%.

7.5 SOCIAL IMPROVEMENTS

This article was taken and rephrased from USAID on news from landscape on community engagement in Peatland Restoration: Free, Prior, and Informed Consent (FPIC)[1]

7.5.1 CHALLENGES

Recurring forest and land fires in Indonesia result in devastating impacts to the health and economy of local communities. This creates a huge irrecoverable loss to biodiversity and enormous amounts of greenhouse gas emissions.

According to the World Bank, in 2015, this human-induced disaster cost Indonesia $16 billion in damages. In Central Kalimantan Province, the threat is made worse by constructing large canals to drain the water from peat, leaving the soil highly prone to fire.

Recently, various government agencies, including the Ministry of Public Works, Peatland Restoration Agency (BRG), and local government, have been spurred into action to restrict water flow out of the peatlands in Pulang Pisau District, Central Kalimantan. The initiative aims to keep water levels high and peatlands moist during the dry season, provide adequate drainage to mitigate flooding in the rainy season, and enable limited access for local communities in support of sustainable livelihoods.

1 https://www.lestari-indonesia.org/en/community-engagement-peatland-restoration-free-prior-informed-consent-fpic/

7.5.2 FREE, PRIOR AND INFORMED CONSENT (FPIC)

In support of this initiative, USAID LESTARI recently completed a model stakeholder engagement activity involving the facilitation of FPIC in villages covering around 30,000 ha of degraded peatland. This peatland is part of an area that covers less than 5% of the province yet accounted for 30% of all fire impacts in 2015.

FPIC facilitation ensured that communities are well informed; have an opportunity to provide inputs; and give their willing consent to construct, maintain, and protect the dams. Notably, local communities were able to influence the design of the dams so that their small boats can pass through spillways in order to maintain their livelihoods.

LESTARI provided technical and financial support for the FPIC process mediated by the district-level multi-stakeholder forum. It adhered to both USAID and BRG social safeguard guidelines for FPIC.

Figure 3: Community engagement in peatland restoration: FPIC (Source: USAID - Lestari, Indonesia)

Landmark Achievement

The FPIC process was widely embraced by local communities and government agencies, and culminated in formal recognition (Berita Acara) that provides legal legitimacy. BRG acknowledged that this is a first for Indonesia in peatland restoration through canal blocking based upon FPIC.

Moving forward, BRG has made it clear that any party that conducts canal blocking in the area must be subject to commitments for FPIC. In order to institutionalise the approach and promote its sustainability, LESTARI obtained agreement that FPIC would become Standard Operating Procedure for canal blocking design and implementation in Public Works guidelines. The head of BRG has also decided that the LESTARI-supported FPIC process will serve a model for more sustainable and inclusive land use planning in Sumatra.

Figure 4: FPIC stakeholder being informed on canal blocking plans (Source: USAID - Lestari, Indonesia)

ANNEX 1: RSPO ISH STANDARD AUDITOR CHECKLIST

Criteria		Indicators		Checklist
4.4	Where smallholder plots exist on peat, subsidence and degradation of peat soils is minimised by use of best management practices. **Do any smallholders within the group have existing plots on peat? If no, SKIP**	**4.4 E**	Group manager confirms presence of peat on existing plots within the group and smallholders on peat commit to using best management practices and minimising subsidence and degradation of peat soils (Reference 1.1 E, Annex 2).	1. Has the group manager identified the existence of peat within the group members existing plots? 2. How many of the group members have peat on their existing plots? 3. Have the smallholders signed a declaration to commit to using best management practices and minimising subsidence and degradation of peat soils? 4. Is the group manager aware of best management practices for peat?
		4.4 MS A	Smallholders complete training on best management practices (BMPs) for peat. The group has an action plan to minimise risk of fire, to apply BMPs for plantings on peat and manage a water system in the certification unit.	1. Have smallholders participated in training on best management practices (BMPs) for peat? 2. What are the evidence of training conducted? 3. Who provided the training? 4. When was the training provided? 5. Has the group developed an action plan to minimise risk of fire, to apply BMPs for plantings on peat and manage a water system in the certification unit? 6. What are the fire fighting system available? 7. Can the smallholder demonstrate understanding on the best management practices (BMPs) for peat including the action plan to minimise risk of fire and, manage water system?

Criteria		Indicators		Checklist
4.4	Where smallholder plots exist on peat, subsidence and degradation of peat soils is minimised by use of best management practices. **Do any smallholders within the group have existing plots on peat? If no, SKIP** (Continued)	**4.4 MS B**	Smallholders implement the group's action plan based on best management practices, including fire and water management and monitoring of subsidence rate for existing plantings on peat.	1. Have the smallholders implemented the action plan to minimise risk of fire, to apply BMPs for plantings on peat and manage a water system in the certification unit? 2. What is the evidence of implementation of the action plan ? 3. What are the fire prevention and control systems available ? 4. How are the smallholders monitroing subsidence rate for existing plantings on peat ? 5. How are the smallholders monitoring the water levels for existing plantings on peat ?
4.5	Plots on peat are replanted only on areas with low risk of flooding, saline intrusion as demonstrated by a risk assessment. **Do any smallholders within the group have plans for replanting plots that are located on peat? If no, SKIP**	**4.5 E**	Smallholders commit to provide information on all plans for replanting and commit that replanting will only be in areas with low risk of flooding and saline intrusion (Reference 1.1.E, Annex 2).	1. Have the smallholders signed a declaration to commit: • to provide information on all plans for replanting and • that replanting will only be in areas with low risk of flooding and saline intrusion. 2. Has the group manager collected and compiled information on replanting by group members?

Criteria		Indicators		Checklist
4.5	Plots on peat are replanted only on areas with low risk of flooding, saline intrusion as demonstrated by a risk assessment. **Do any smallholders within the group have plans for replanting plots that are located on peat? If no, SKIP** (Continued)	4.5 MS A	Smallholders with plots on peat complete training on identification of future risks of flooding associated with subsidence and alternate land development strategies.	1. Have smallholders with plots on peat participated in training on identification of future risks of flooding and alternate land development strategies? 2. What are the evidence of training conducted? 3. Who provided the training? 4. When was the training provided? 5. Are the smallholders aware of the risk associated with subsidence? What are the identified risk associated with subsidence? 6. Have alternate land development strategies been identified?
		4.5 MS B	Prior to replanting on peat smallholders complete a risk assessment related to flooding associated with subsidence and, where there is high risk, present a plan that includes alternate land development strategies, preferencing alternative livelihood planning.	1. Is there replanting on peat by the smallholders in the group? 2. Has a risk assessement related to flooding associated with subsidence been carried out prior to replanting ? 3. What was the risks identified in the risk assessement ? 4. For high risk area, is there a plan that includes alternate land development strategies, preferencing alternative livelihood planning ? 5. Is the group manager aware of replanting activities (on peat) by group members ?

ANNEX 2:
RECOMMENDED SOP FOR FIRE PREVENTION AND CONTROL PLAN

(Adapted version courtesy of Standard Operasional Prosedur Pemadaman Kebakaran Lahan, KUD Makarti No.23/SOP-KUD-MKRSM/IV/2019)

When encountering the risk of fire, there are several steps that can be taken towards fire prevention and control:

1. Should there be fire hotspot detected, the flames should be stopped immediately with basic equipment.
2. The group members shall report to the Internal Control System of the group or Fire Emergency Unit should the basic equipment is not enough to quench the flames.
3. The Fire Emergency Unit will immediately report to the Fire Agency or related agency.
4. All group members are responsible to quench the flames and conduct the evaluation.

ANNEX 3:
RECOMMENDED TABLE/SOP FOR WATER LEVEL MONITORING

(Adapted version courtesy of ISH Group 1 Asosiasi Petani Sawit Swadaya Amanah No.022/ DOK/ SOP/ APSSA/2020 dated 12 February 2020)

1. Maintain the water level by establishing drainage channels and installing modest dams to monitor the water level.
2. Modest dam is established at specific points; specifically, main outlet and the cost will be borne by the smallholder group.
3. The high point of water level on the modest dam will be monitored every one month.
4. In order to monitor the water level, the drainage channel will be set as a water level measurement tool, which is made by PVC pipe. The length of the PVC pipe shall be 2 m (1.5 m above the collecting channel surface and the rest (50 cm) should be rooted in the soil.
5. The measurement on the modest dam will be set as 0 from the soil surface.
6. The measurements in the PVC pipe (0 cm, 10 cm, 30 cm, ...150 cm) should be marked in red with a white base color and the optimum measurements (60 cm and 80 cm) should be marked in black.
7. The material of the modest dam should be waterproofed and used as a cantilever (such as bamboo) and placed in a sand sack.
8. The High Conservation Value (HCV) team identifies the location points to establish the modest dam.
9. The modest dam will be constructed once the request has been approved by the group manager.
10. Once the modest dam has been constructed, the HCV team will evaluate the effectiveness of the dam and monitor the water level every month.
11. Install the subsidence stake from the iron pipe to monitor the decrease of water level.
12. The HCV team identifies the location points from the installed subsidence stack.
13. The result shall be reported to the group manager to get approval for establishing the modest dam.
14. The subsidence stack will be constructed once the request has been approved by the group manager.
15. Once the subsidence stack has been constructed, the HCV team will evaluate the effectiveness of the dam and monitor the water level every month.

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RSPO is an international non-profit organisation formed in 2004 with the objective to promote the growth and use of sustainable oil palm products through credible global standards and engagement of stakeholders.

www.rspo.org

Roundtable on Sustainable Palm Oil
Unit 13A-1, Level 13A, Menara Etiqa,
No 3, Jalan Bangsar Utama 1,
59000 Kuala Lumpur, Malaysia

Other Offices:
Jakarta, Indonesia
London, United Kingdom
Beijing, China
Bogota, Colombia
New York, USA
Zoetermeer, Netherlands

smallholder@rspo.org
www.rspo.org