Protocol
for Oil Palm Independent Smallholder
for Sustainable and Responsible Management of Peat Areas




WINROCK INTERNATIONAL

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Design & Illustration: Triana

References:

Suryadiputra, N. et.al. 2016. Protocol for Oil Palm Independent Smallholder for Sustainable and Responsible Management of Peat Areas. Winrock International Indonesia, Jakarta. vi + 64.

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About the Author Team

Winrock International is a nonprofit organization that works globally to help those in needs, promote economic opportunities and preserve natural resources. Through the guidelines, Winrock hopes to meet all the three objectives by encouraging small farmers to sustainably manage oil palm plantations in Indonesia. It is hoped that this guideline is used broadly in all oil palm sector to accelerate the realization of sustainable environment management and people's prosperity.

The drafting team would like to convey appreciation to all parties giving contribution to the completion of this protocol namely the government Siak Regency and the people and government of Teluk Masjid and Lalang Villages. Experts Dr. Nyoman Komang Suryadiputra (Wetland International), Dr Suharno (Palangkaraya University), Ramadhani Kusuma Rahman, Susanto (Perhimpunan Elang), Priyo Anggoro (FKKM Riau), Oil palm Farmers Union (SPKS) for their feedback and Triana for the design and layout. We would also like to convey our highest appreciation to Winrock International team in developing this protocol namely Dafid Pirnanda, Wiratama and Ofra, and Juliarta Bramansa Ottay, Sarah Walker and Jessica Chalmers as the editors.

Finally, we would also like to thank various organizations that support the completion of this guideline namely:

Cargill as an industry that has long been committed to the development and use of sustainable oil palm, which through this guideline is expected to provide practical guidance that is based on science for oil palm smallholders on the practice of responsible management and expansion on peatland to ensure that smallholders can remain become an essential part of a sustainable supply chain while improving their access to market.

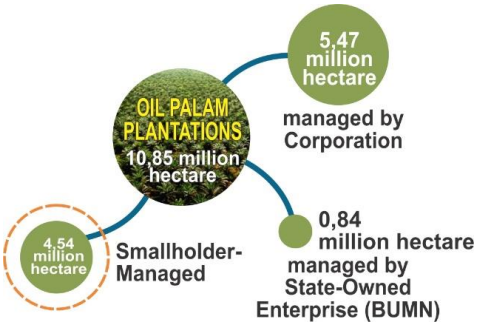
IDH Sustainable Trade as an initiative that encourages sustainable commodities and through this guideline, IDH hopes to give contribution to the promotion of sustainability of oil palm supply chain and support to the principles of MDG, namely principle 1 (To eradicate poverty and extreme famine), principle 7 (To Ensure environment sustainability) and Principle 8 (To develop a global partnership for development).

Costco Wholesale is a store network that provides a range of products for consumers that also have the materials that include oil palm as one of the composing materials. This guideline is part of the sustainability policies of Costco associated with three issues, namely integration of farmers in a sustainable supply chain, avoided deforestation and peat's best practices. Costco also supports the inclusion of gender and women's empowerment.

Guidelines Introduction

WHY IS THIS PROTOCOL / GUIDE MADE?

Smallholder or independent farmer is the owner of private plantations or rice fields with a maximum area of 25 hectares[1] and constitutes an integral part of the oil palm industry in Indonesia which contributes to 40% of the total palm oil produced.



Independent farmers are estimated to manage about 1 million hectares of peat lands, which has been a great concern on sustainability. Although it is not directly governed by the rules and standards of the market, farmers sell their products to companies that are bound by the commitment, thus smallholders are also experiencing the risk of difficulty in selling products when they cannot show sustainability.

[1]Minister of Agriculture Regulation No 98/Permentan/OT.140/9/2013.

The world's market through existing agreements such as the **RSPO** along with a number of companies has announced its commitment to sustainable palm oil trade that are traceable to its sources, avoids deforestation. This commitment is made due to the awareness and demand from consumers concerning sustainable products and business practices.

The Indonesian government has adjusted to these conditions by establishing ISPO which has been made mandatory for all companies in order to deal with the challenges of the market.

Box 1. Important Standards

These guidelines include several important standards that will affect the purchase of your oil palm

ISPO / Indonesia Sustainable Palm Oil is a certification agency established by the government of Indonesia through the Ministry of Agriculture to develop a standard that must be observed by all business entities engaging in oil palm in Indonesia. This standard is made to maintain Indonesian oil palm in the world market

RSPO / Roundtable for Sustainable Palm Oil is an international voluntary agency established and consisting of various stakeholders in the oil palm industry to agree upon the standards of sustainability and certification of the oil palm products traded.

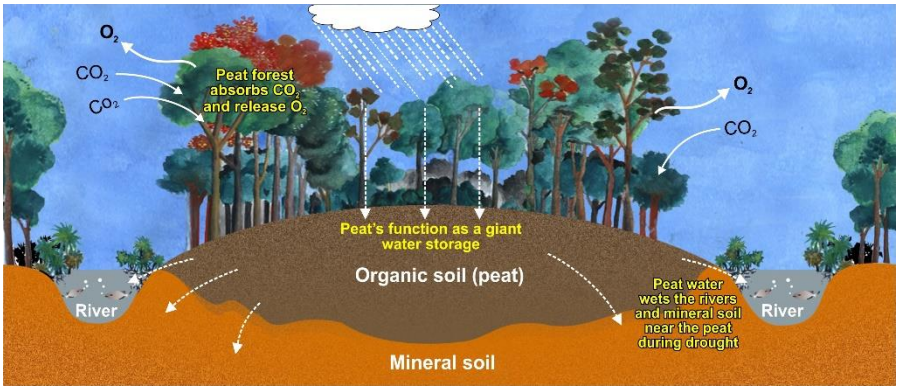
Sustainable sources commitment is a voluntary commitment made by companies to show sustainable practice of its products in order to meet the market requirements

As mentioned earlier, sustainable products are the concern of the market currently, this shows that consumers today are very critical of the sources of the palm oil they consume or used, this is driven by the awareness of the devastating impact of oil palm plantations that do not apply good management principle to people and environment.

The concern is constantly evolving and requires the efforts of the industry to show that its palm oil come from responsible sources which have been started by the government and the industry. At the same time, smallholders as the important parts of the industry also need to demonstrate the same thing.

WHAT IS PEAT AND WHY IS IT IMPORTANT?

Peat in Indonesia is generally located in the lowlands close to the shore and its estimated total area is 21 million hectares, or almost half of the total area of tropical peatlands in the world, which are located in Kalimantan, Sumatra and Papua. Peat is a type of soil derived from plant materials that partly decomposed and have been preserved in that condition for thousands of years. Figure below exhibits peat ecosystem sections that shaped like dome/basin, complete with information on its roles and functions.



Sketch of peat ecosystem sections (Illustration: Triana)

Peat has a variety of functions:

- To support various life forms by being the habitat or home for thousands of species of birds, mammals such as tigers and bears, as well as many fish species
- Peat is a gigantic greenhouse gas storage that helps to maintain the world temperature and climate
- Peat stores and regulates water to prevent flood by absorbing water during the rainy season and releasing the water during the dry season. In Indonesia, peat stores the biggest amount of fresh water which is even larger than all rivers and lakes.

HOW TO BEST MANAGE PEAT FOR OIL PALM?

Use of peat for oil palm on a large scale has been regulated by the government[2], while the best way to manage the plantations have been summarized in the RSPO Manual on Best Management Practices (BMPs) for existing Oil Palm Cultivation on Peat, which both are already included in this guideline.

However, oil palm cultivation on peatlands that owned by independent farmers have not been spelled out, and this guideline reflects from a variety of policies, standards and references, as well as the commitment of the industry to ensure the access of smallholders to markets and environmental sustainability. General problems of oil palm plantation on peat and its solutions will be described in the next section of this guideline.

[2] Regulation of the Minister of Agriculture Number: 14/Permentan/FL.110/2/2009 concerning Guidelines for the Utilization of Peat Area for Oil palm Cultivation

WHAT ARE THE BENEFITS OF THE GUIDELINES?

This guideline is expected to be used by farmers and will help to determine the best steps for managing existing or future cultivation on peatland.

By applying the protocol, the farmers can fulfill that role by having the knowledge to:

1. Determine in general, the best investment for their plantation on peatlands
2. Have clear guidelines regarding good practices in oil palm cultivation

TO WHOM THE GUIDELINES ARE DEVELOPED?

This guideline, in accordance with its title, is developed for people who owns or manages oil palm plantation on peat land. The table below will clarify the purpose of this guideline.

Table 1. Question and steps to be taken in managing (oil palm) on peat.

Questions	Answers
I own a plantation but I am not sure whether it is on peat or not	Follow the guideline to find out the type of land and the peat's depth
I have an oil palm plantation on peat land, what do I do?	This guideline is developed for you
I want to build a plantation	Follow the guideline
I want to replant my plantation	Follow the guideline
I want to sell or am now selling oil palm to a Palm Oil Mills but they request information about the sustainability	This guideline is developed for independent smallholders
I buy FFB from independent farmers	This guideline is developed for independent smallholders

Individual farmers whose size of land is more than 25 hectares are required to establish a business entity in accordance with government regulations and follow the **RSPO** Good Management Practice Guidelines for the management and rehabilitation of natural vegetation associated with oil palm plantations.

HOW TO USE THE GUIDELINES

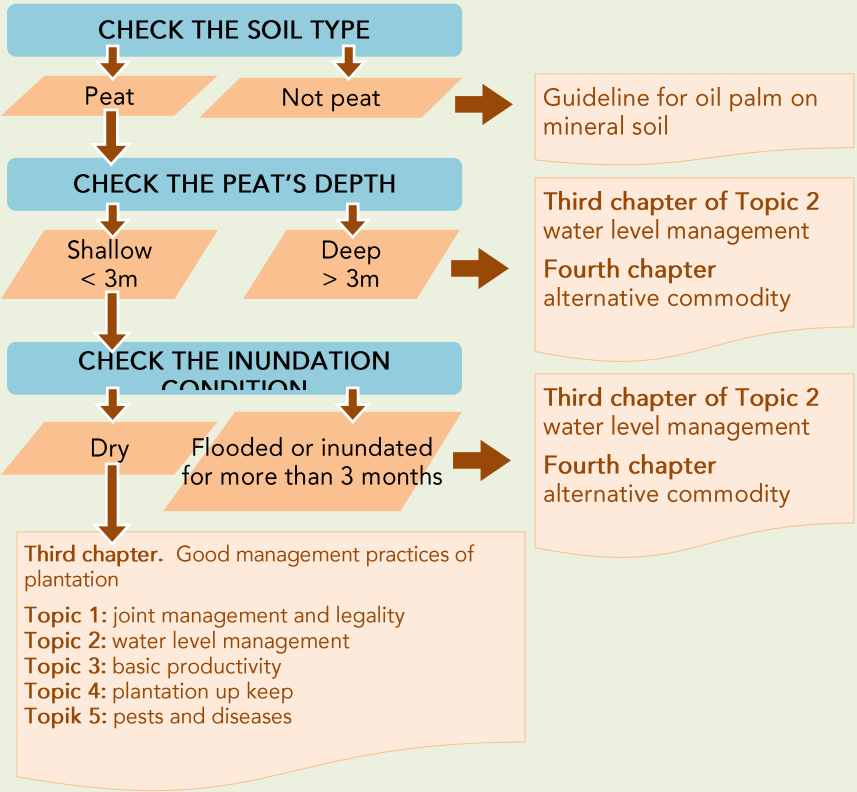
This guideline invites smallholders to optimally manage their plantation that exist on peat in order to fulfil their economic needs and environmental sustainability. Through a series of gradual processes as follows:

1. In the first chapter, the smallholders are invited to understand the general problems of oil palm plantation on peat land
2. In the second chapter, through 3 major steps, the smallholders are invited to understand their plantation condition and decides the best investment option
3. The third chapter explains the good plantation management practices for oil palm plantation on peat
4. The fourth chapter provide alternatives for the smallholders, if the land they owned are not suitable for oil palm plantation

Diagram flow chart

First Chapter — Understand the general problems of oil palm plantation on peat

Second Chapter — Understand the peat on land and decides the best investment option



Third chapter — *Good Agriculture Practice* for *Palm Oil* on peat for the people

Fourth chapter — Other option for peat, switching from oil palm

Chapter one. Understanding the general challenges in oil palm plantations on peat lands

Cultivating oil palm on peat land is not easy, as there are a lot of challenges and problems experienced by farmers that are also experienced by large enterprises until now because of the high cost and incomplete knowledge about peat.

Peat in its natural state will always be wet even in the dry season, so that only plants that tolerant with inundation, such as *Ramin, Jelutung, Sago, Shorea balangeran* and Rattan. Meanwhile, oil palm that is originally from Africa is not a plant that can live in inundated condition, therefore the drying of peat becomes crucial.

Canal is the common form of drainage made for this need and its size usually reaches 120 to 700 meters per hectare. The deeper the peat, the more canals need to be built. However, once dried, the peat will be dry and deflate similar with dough with flour which swells when added with water and deflates when dried. This causes three major problems:

1. High subsidence rates or collapse of the surface of the peat so that oil palm will be slanted and in some cases the plantation will be flooded or prone to fires

Photos of leaning oil palm tree, inundated oil palm plantations and burnt oil palm tree. Location, Kerumutan, Pelalawan, Riau (Nyoman Suryadiputra & Dafid Pirnanda, 2015)

2. Issue of pests such as beetles and termites, even diseases such as Ganoderma (boletus mushrooms) that are more risky.

Pic. (http://anash-coconutz.blogspot.co.id & http ://www .agrofarm.co.id)

3. Low productivity compared to mineral soils

Table 2. Productivity comparison (ton/ha/year) between oil palm on mineral soil and on peat

Oil Palm Age	Ideal productivity in mineral soil		Ideal productivity on peat (Dolmat *et al.*, 2002 ***	Remarks for oil palm on peat
	Soil Class S3-S1*	Soil Class S3-S1**		
> 13 years	Gradual productivity decrease	Decreasing at the age of 18 years	Rapid decreasing productivity	Productivity decreases until replanting (age 25 – 30)
13 years	26-31	27-31	24.0	Productivity decreases due to pest, diseases, leaning and collapse of oil palm trees
12 years	26-31	27-30	28.4	Plants begin to improve or recover
11 years	26-31	27-30	26.0	
10 years	26-31	26-30	24.9	
9 years	26-31	26-30	25.8	Gradual declining of productivity because many trees start to leaning or collapse
8 years	24,5-30	26-29	27.1	
7 years	22-26	25-28	28.5	

6 years	17-21,1	24-27	30.1	Peak of productivity
5 years	14,5-18	23-26	25.0	Productivity increases rapidly
4 years	12-15	21-23	20.2	Productivity increases
3 years	6,2-9	16-18	17.5	Start to be productive or harvesting
< 3 years	0	0	0	Not productive yet

S1 soil type is the most suitable soil type while s3 type is less suitable

*Lubis 2008
** Socfindo 2008
*** In compacted deep peat and having a population of 160 trees / ha

The red color indicates a decline in the productivity of oil palm which is more rapid on peat compared to in mineral soil, with the decline that has already started at the age of 7 years while oil palm in mineral soil starts experiencing productivity decrease at the age of 13 years. The harvest period is also different as oil palm planted on peat cannot be harvested before 5 years while oil palm planted in mineral soils can be harvested at the age of 3 years.

The numerous problems of palm oil on peat inhibit plant growth and result in low production of the fruit compared to oil palm in mineral soil. Good results can only be obtained if the farmers understand the problems and how to deal with them but it will require massive knowledge and cost.

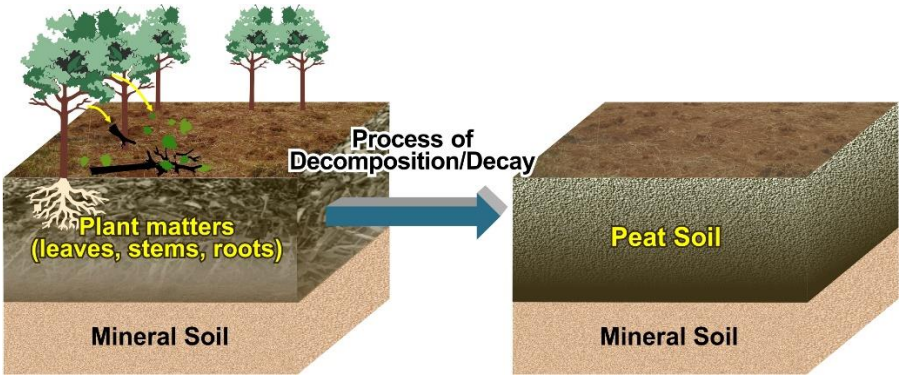
Chapter two. Understanding the peat on land and decides the best investment option

STEP 1 CHECKING IF YOUR SOIL IS PEAT

Peat Area is generally a flat area in the lowland located between two major rivers that if doesn't had outlet or drainage, will be flooded during the rainy season.

In its natural condition, peat consists of organic materials in the form of plant matters such as decomposed roots, stems, leaves and bark that are submerged in dark brown water that looks like tea or coffee with strong odor.

Peat Soil



Peat lands in general has three shapes based on its maturity level, and there is an easy way to determine the maturity of the peat is by squeezing it in your hand. Grab the wet peat by hand and squeeze it gently by clenching your fist and follow the table below to determine the maturity of the peat in your hand.

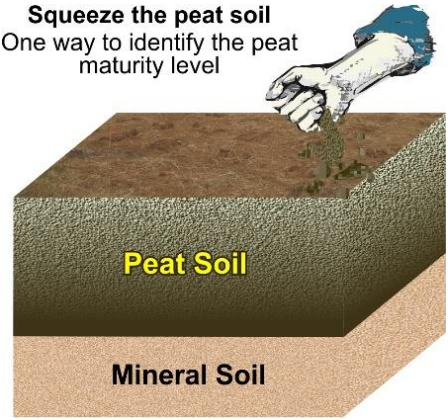
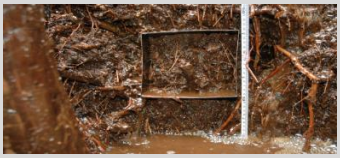


Table 3. Peat maturity level

¾ or more of the peat is left in your hand, this means young peat	**Fibric** Mostly is brown in color with numerous fibers	
Between ¾ and ¼ of the peat is left in your hand, this means that the peat is almost mature	**Hemic** Dark brown soil, partially fibrous	
Only ¼ of the peat is left in your hand this means that the peat is mature	**Sapric** The soil is very dark, almost black	

Based on a simple observation above, we can immediately know whether the land is peat or not, thus with that knowledge one can follow the below steps:

1. **If your land is peat**, then proceed to the next step which is to measure its depth.
2. **If your land is not peat,** then several plantation management practices will still be useful for you. Practices like land legality, joint management, and integrated pest management. Guidelines developed by Oil Palm Smallholders Union and APKASINDO will also be very useful for you.

Building new plantation[3] on peat with whatever depth is not recommended, since peat may shrink naturally when cultivated, which will not be able to prevent flood to happen in the future and may bring losses. In addition to that, the existing government regulation and **the future market tend to no longer wants palm oil coming from peat land,** it is better to invest to plants that is endemic to peat.

[3] PPEG

STEP 2 MEASURING THE PEAT DEPTH

Measuring the depth of the peat is generally done using a special drill for peat (Edelman Auger) as shown in the figure. The basic principle is gradual measuring by checking every 15 -50 cm to check the soil taken by the drill bit, until mineral soil is discovered.

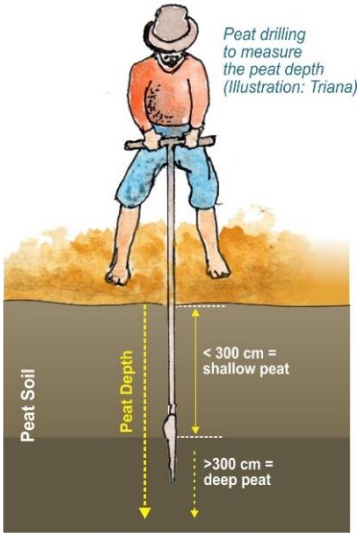
Prepare a wooden stick with the minimum length of 4 meters and one of the ends is pointed and attached with a measuring strip along the stick. On the sides of the pointy end is carved to extract soil when the stick is pulled out of the peat.

Peat depth measuring tool / drill (Winrock Int.)

The important thing to know is if the peat in your land is shallow peat (less than 3 m) or deep peat (more than 3 m).

How to find out the depth:

1. Prick the wood that has been sharpened into the soil, if it hasn't reached 3 m deep, but it cannot go further, pull the prick and check the soil. Whether it is mineral or peat soil. If the soil is mineral, then your land is considered **shallow peat,** and record the depth.
2. When it reaches 3 m and still hasn't found mineral soil, you don't have to continue to measure the depth, and your land is fall into the **deep peat** category.

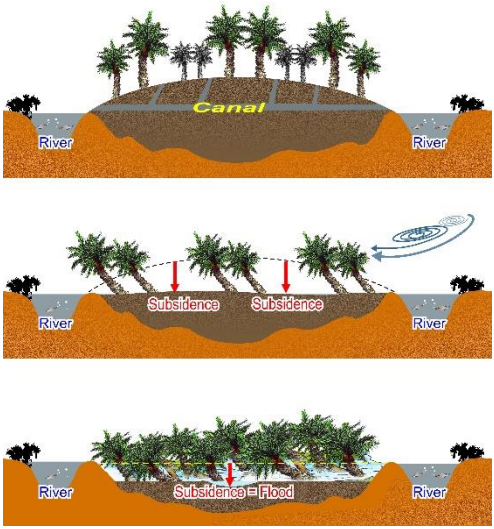


After finding out the depth of the peat, the next step is to determine the best investment for your land based on the depth of the peat and condition of your plantation. If your current plantation **is less than 3 meter,** then continues to the next step about peat management on plantation and good management practice for plantation. Flood and inundation are the consequences of peat subsidence and if it already happens, then it will be very difficult to address, thus it is crucial to have a good planning to ensure the plantation activities still profitable. This will be explained in the next chapter.

If the peat in your plantation is deeper than 3 meters, then it would be better to gradually switch to other commodity, because: (1) peat subsidence will be very significant, therefore the risk of flood in the plantation is very high and may bring losses to the smallholders, (2) the significant impact to the environment, thus in contradiction with the future regulations, and in the future it will become more difficult to market its harvested production.

STEP 3. CONSIDERING THE PEAT SUBSIDENCE AND INUNDATION IN PLANTATION

Subsidence is the decrease of peat soil's surface level due to construction of drainage (canal). Peat then experiencing compaction and dried, thus susceptible to flood during rainy season and fire during dry season.



Subsidence in oil palm plantation (top, Winrock Int.); subsidence illustration of oil palm plantation on peat (bottom: WII)

Peat subsidence is inescapable; thus, it needs to be managed properly, and otherwise the peat will be lower than the surrounding and will lead to inundation. The worst case that might happen is where the land is flooded permanently or become what similar to a lake, and the canal's function is no longer working. Below are the activities to monitor the rate of subsidence and efforts to deal with it.

The important steps that need to be taken by the oil palm plantation owner or manager is to observe the inundation and flood condition, as explained earlier, peat will shrink naturally and it would not be beneficial for smallholders, thus it requires a good planning in managing the existing plantation and in developing replanting plan, to avoid losses.

Inundation can occur in your plantation due to peat subsidence and in many cases this subsidence is not evenly distributed throughout the land, but more quickly in some places, it could be caused by a lot of activities in certain location or because of fire. From inundation history documentation, one may accurately know where the locations that often inundated and its inundation duration. It is better for smallholders to determine the next steps, which in general are:

Oil palm plantation that are inundated (WII)

1. Applying good plantation management practices, especially about water level management to reduce the risks of more land becoming inundated
2. Applying good plantation management practices to increase productivity and a better yield
3. It is better to replace the plants in the inundated area with crops that are suitable with peat which still has economic value.

Below are steps to monitor inundation in peat land:

Make a map of the plantation

Make a map or sketch of the plantation and the surrounding area including rivers and beaches, forests, hills etc. Determine a clear distance from your plantation with other features in the map, the more detailed the better.

Record the inundation

Inundation occurs in places where water recedes slower than in other area, this is very bad for oil palm development. Follow the instructions below:

1. Map the location of inundation in the plantation
2. Copy and fill out the form below.

Table 4. Monitoring of inundation in oil palm plantation on peat land

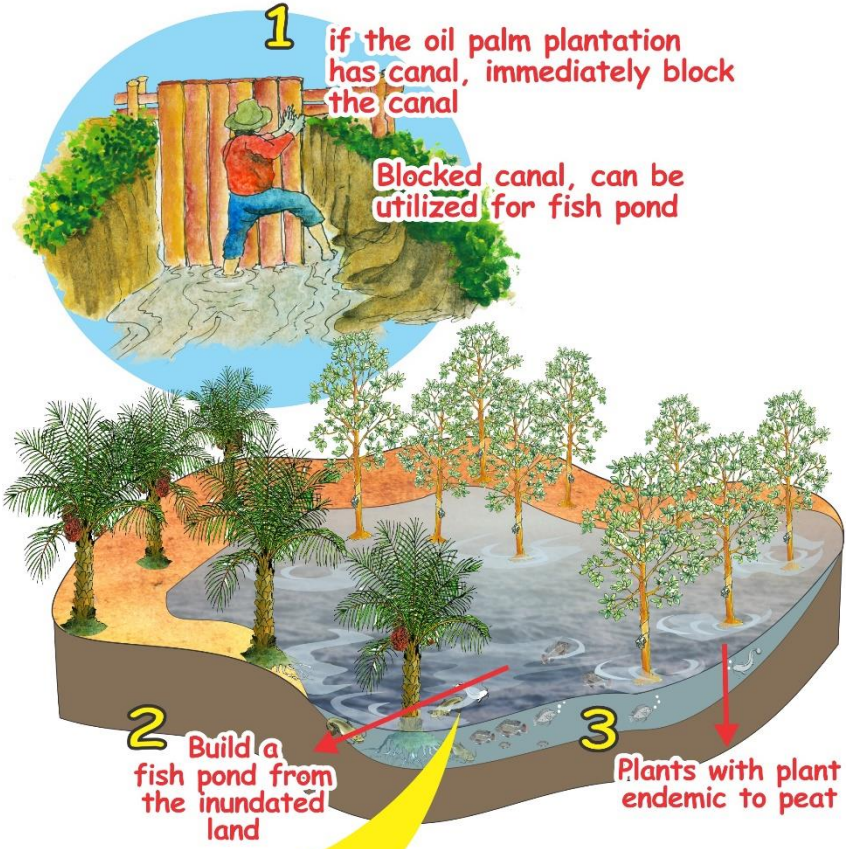
Name of Recorder: ..... **Recording Date:** ..... **Name of record location:** ..... **Weather condition during recording:**	Recording Month: ..... Remarks:												Other remarks
	Jan	Feb	Mar	Apr	May	Jun	Jul	Ags	Sep	Oct	Nov	Dec	
The size of oil palm area that are inundated (Ha) ..... mark on map													
Water height from the land surface (use measuring stick) Maximum (cm)													
Minimum (cm)													
Locations of inundation, mark on map													
When the inundation started													
When the inundation ended (has fully recede)													
Cause of inundation (river runoff, high rainfall rate, sea tidal)													
Oil palm fruit productivity													

Determine the best intervention

Below are measures that smallholders should use to best design their plantation in accordance to its condition.

There are inundated areas, but less than 3 months	Check where the water from, if it is from canal then it should be blocked to control the water level.
There are areas that are inundated for more than 3 months in one year with depth of more than 20 cm	The dry areas are still suitable for oil palm, but it may have risks where the trees leaned and collapsed. Fish ponds and suitable crops may be planted and developed for flooded areas. Crops endemic to peat may be planted in the middle of the plantation and 5 meters from each canal side, which has economic value in the future when all plantation area are permanently flooded. When the plantation is permanently inundated because the peat is no longer there, it would be better to block areas with canal or weir and make those are fish ponds.
100% or all plantation are flooded	Use the oil palm area for fish ponds and plant crops that are suitable to peat For areas that already have canal or weir, better to block those areas and use it as fish ponds.

Steps to be taken for inundated (flooded) oil palm plantation



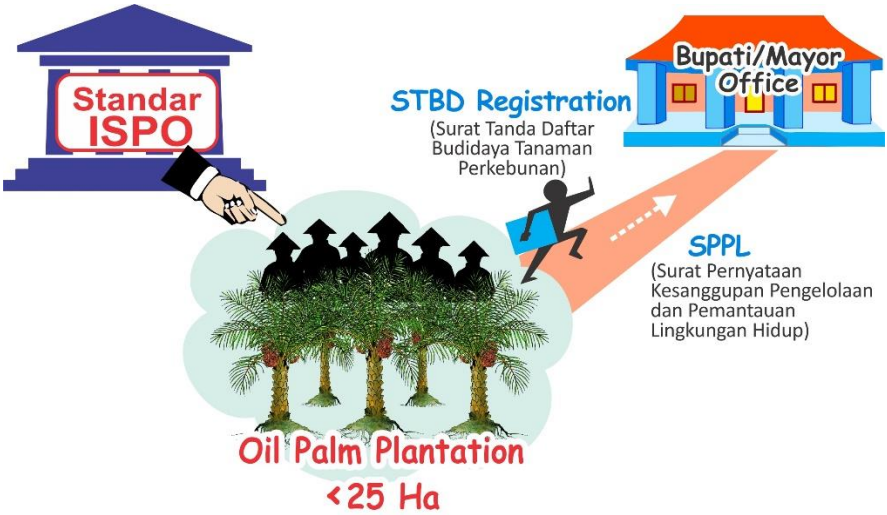
Chapter three. Good Agriculture Practice for Oil palm on peat for the People

TOPIC 1: PLANTATION LEGALITY AND JOINT MANAGEMENT

Palm oil as an export commodity is influenced by many global issues, including environmental issues, therefore the palm oil needs to be certified at the national level by ISPO and international level by RSPO. It has already been proven that smallholders in Indonesia can be certified by both standards as shown by the experience of KUD Krida Sejahtera in Lampung in 2015.

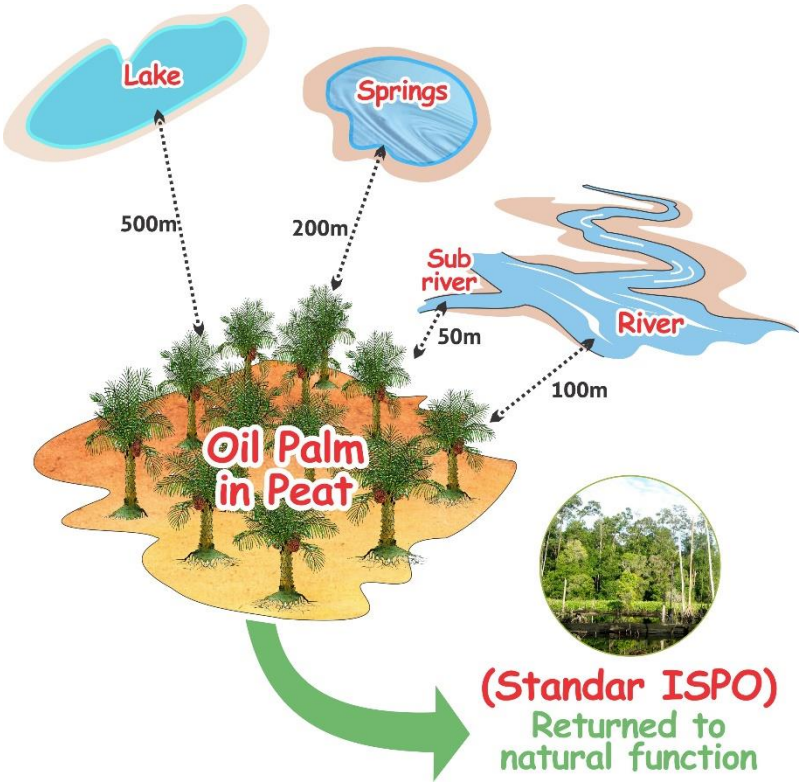
The advantages of certification is that it provides assurance that the produced palm oil is coming from a sustainable oil palm that follows the market criteria and government regulations. Several main issues that smallholders must pay attention to in relation to ISPO.

Government regulation on ISPO Standard states that for farmers who have land under 25 hectares must be registered to the Regent or Mayor. The registration is called STDB = Plantation Plant Cultivation Registration Certificate with the examples below and SPPL (Statement of Capability for Environmental Management and Monitoring), which is a statement of the ability to manage and monitor the environment issued by the local environment agency.



If parts or the entire palm trees (regardless of the depth of the peat) are in a location that is prohibited for cultivation, then in accordance to ISPO, the land must be returned to its natural function, such as:

- 500 m from the edge of lake or reservoir (dam)
- 200 m from the edge of natural springs, and rivers in the swamp
- 100 m from river
- 50 m from sub river
- 130 times the difference between the highest and lowest tides of the shore



For further information on ISPO and RSPO Standards please contact directly those organizations

Indonesian Sustainable Palm Oil Commission (ISPO)
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Jl. RM Harsono No.3
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Roundtable for Sustainable Palm Oil (RSPO) Indonesia

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email: rspo@rspo.org

Furthermore, considering the need to manage plantation properly requires intensive efforts, smallholders should work in groups and establish a joint management, because it is more effective and profitable. The costs to benefit comparison when management is done individually or in group is described below:

1. Farmers that manage their plantation area of 2 hectares on their own, need more than one and a half billion rupiahs for 25 years and it will take 12 years to repay the loan
2. Meanwhile, when 15 farmers with the respective plantation of 2 hectares, jointly manage 30 hectares, the cost needed for each farmer is only about one billion rupiahs and the loan can be repaid in just 9 years

There is some popular form of farmers' organizations in Indonesia, among others:

1. **Farmer Group Association** (***Gabungan Kelompok Tani / Gapoktan***), this group is the common government program to foster the farmers. It has several benefits:
    - Access to subsidized fertilizer and other production means such as pesticides from the government, that are given through authorized distributors as required by the government
    - The farmer group only needs to make annual fertilizer and means of production need (RDK) to be given to the Field Supervising Officers (PPL), which are generally available in every village or sub district
    - High quality seedlings are available under local government programs

- Sharing costs between members which will be more efficient for pest control, use of tools, development and maintenance of critical infrastructure such as water lines and roads which are generally very costly

2. **Cooperative** as another common type of organization with considerable success, in which its members are individuals or groups of farmers. The benefits of cooperative are:
    - It has access to fertilizers and pesticides from the government same as gapoktan
    - Although it is more complicated to establish a cooperative than a *gapoktan* as it will require statutes and registration with the government, a cooperative has valid legal entity
    - As it has a legal entity, a cooperative can apply for loan to banks, cooperate with companies for plasma scheme, as well as with the government for various programs
    - The ease in working with companies to get high-quality seeds and training related to the maintenance of the plantation, as well as FFB purchase guarantees
    - There are many schemes of cooperation undertaken by companies and independent smallholders throughout Indonesia that have been successful, such as scheme of innovation for finance and development, finance and replanting, or even for the management of water

PLANTATION CULTIVATION BUSINESS REGISTRATION FORM (STD-B)

Regency/City ..... Sub District .....

Number

A. Owner Information
   1. Name : .....
   2. Place/date of birth : .....
   3. ID Number : .....
   4. Address : .....

B. Plantation Information
   I. Plantation 1
      - Location/coordinate of the plantation (Village/SubDistrict) : .....
      - Land title status :
        - Number : *(Certificate of Ownership/Girik/SKT/lease/...)*
        - Area Size : .....
        - Type of Crop : ..... ha
        - Production per ha per year : .....
        - Origin of seed : .....
        - Number of trees : .....
        - Planting Pattern : .....
        - Type of Fertilizer : *(Monoculture/ combine with ….. crops)*
        - Processing Partner : .....
        - Type of soil : .....
        - Planting Year : *(mineral/peat/mineral-peat)*
        - Other business in the plantation area : .....

   II. Plantation 2 *)
      - Location/coordinate of the plantation (Village/SubDistrict) : .....
      - Land title status :
        - Number : *(Certificate of Ownership/Girik/SKT/lease/...)*
        - Area Size : .....
        - Type of Crop : ..... ha
        - Production per ha per year : .....
        - Origin of seed : .....
        - Number of trees : .....
        - Planting Pattern : .....
        - Type of Fertilizer : *(Monoculture/ combine with ….. crops)*
        - Processing Partner : .....
        - Type of soil : .....
        - Planting Year : *(mineral/peat/mineral-peat)*
        - Other business in the plantation area : .....

   III. (continuous)

This STD-B is no longer valid if there are changes to the information mentioned above

....., ... 20.....

Regent/ Mayor

.....

Remarks:

*) filled if ownership of more than 1 (one) location

STATEMENT OF CAPABILITY FOR ENVIRONMENTAL MANAGEMENT AND MONITORING (SPPL)

We, the undersigned, (filled according to ID Card)

Name : .....
Title : .....
Address : .....
Phone No. : .....

As the person in charge in managing the environment of:

Name of company/business : .....
Company/business address : .....
Company phone No. : .....
Type/Nature of Business : .....

with environmental impacts as mentioned by the data/information attached to this SPPL.

planning to apply environmental impact management and monitoring through: 1. As stated by the data / information attached to this SPPL.

Principally willing to apply all environmental management and monitoring as stated above, along with the attached information / existing data and/ planning according to the existing condition, that are inseparable with this statement letter, and willing to be supervised by the competent authority. This SPPL is effective since the stipulated date until the end of business and/activities or experiencing change of location, design, process, raw material and/supporting materials.

...../...../...../ Party that stating,

(.....NAME.....)

TOPIC 2: MANAGING WATER LEVEL

As discussed earlier that subsidence will happen naturally in the managed peat and will make the land inundated or flooded. To reduce the peat subsidence rate, it is crucial to monitor the subsidence rate and manage the water level. Managing the water level also may reduce the pests and diseases risks to the plantation.

Monitoring the rate of subsidence

The following steps should be taken to measure the rate of subsidence:

1. Choose a place in the middle of the plantation where there are not many activities.
2. Prick the iron pipe down to mineral soil and let it stand upright.
3. Put a sign on the pipe at the surface of peat as the "point 0", with paint.
4. Build fence around the unit to prevent intrusion.
5. Check every 6 months and record the peat subsidence from point 0 to the peat surface today

Simple instrument to measure peat subsidence

Especially for plantations that already have a canal or trench, then the subsidence risk would be enormous and ultimately harm the farmers. To reduce the risk, water management system needs to be done to keep the water at the level of around 40 cm in the plantation and in the drainage which aims to maintain growth and development of oil palm while reducing the rate of subsidence of the peat.

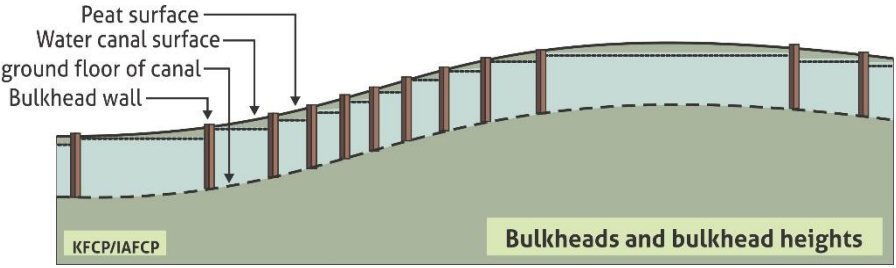
To accomplish this, water level infrastructure monitoring that needs to be built and operated will involve: (1) blocking canal dam or weir to set the water level, (2) piezometers for monitoring the water level in the plantation and, (3) observation board for observations in the trench or canal.

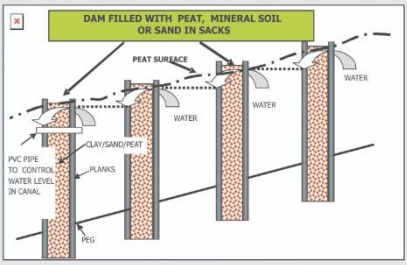
Canal dam or Weir

In a plantation, which has had a trench or canal with flowing water as shown in the figure, it is necessary to be block to keep the water moisten the peat evenly, reduce the level of subsidence and avoid the risk of drought and fires.

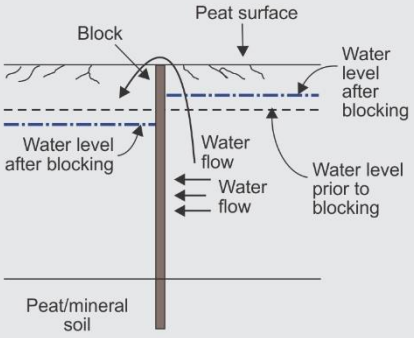
Air (gambut) mengalir di saluran/ sekat

The dam is built in the canal in such a way that the difference of the water level between the dam is 20 cm as shown in the below figure.





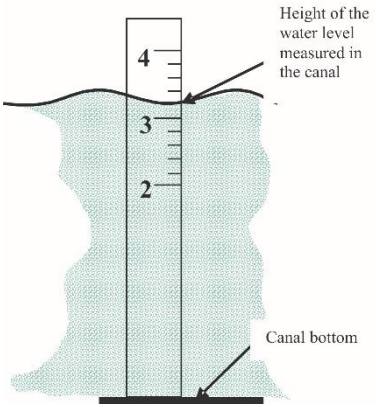
The figure below shows the basic principle of blocking canals in peatlands to raise the water level of the peat.
On the left is an example of an ideal position block (Photo: Suryadiputra 2009 and illustration Suryadiputra *et al*. 2005)



Ensuring difference in water level in the drainage

The water level needs to be monitored to ensure the water surface level is in accordance with our expectation but it is also important to know the condition of the dam. The methods are quite simple:

1. The observation board as shown in the left picture, namely a ruler attached to both sides of the dam.
2. Check the water level, in normal condition the level should be different (except maybe during the rainy season), but if it remains the same, the dam may be leaked. Check immediately and fix it to prevent collapse.

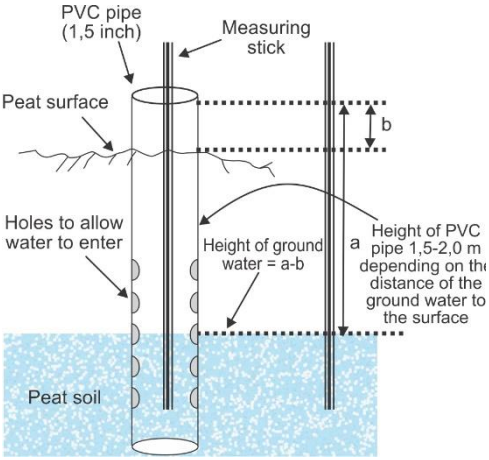


Surface water level measuring device inside the canal (Suryadiputra et al.., 2005)

Monitoring of water level in the plantation

Water level is an important information and the water level range in the soil should be 40-60 cm. For monitoring of the ground water table using "piezometers" that is substantially accurate, do as instructed below:

1. As shown in the below figure, make hole in the plastic tube (PVC) to facilitate water inlet
2. Place the PVC in several locations in the plantation
3. Fill the PVC with cement as shown in the figure to prevent it from moving
4. Measure the water level daily using a measuring tape as shown.
5. Measure the water distance in the soil from the ground surface
6. Remember that the expected water level or groundwater to the surface is around 40 cm



Sketch of the measuring tube of peat water level that made of PVC (WII)

How to measure the difference of peat water level on peat land (Suryadiputra et al., 2005)

Monitoring of water level at drainage

The water level in the plantation needs to be observed regularly, by measuring the water level in the drainage/weir located inside the plantation. Things to be done are:

1. Make a ruler made of wood or PVC pipe as shown in the below picture with the level of "0 (zero)" on the surface of the peat
2. Place the ruler in the drainage/weir that are formed naturally or man-made
3. Perform daily checks of the water level. The ideal distance of water level from the ground is around 40 cm

The ruler of water level in the drainage/weir (left); and the daily measurement activity (right)

TOPIC 3: BASIC PRODUCTIVITY

The main problem in the smallholder's plantation on peat in addition to subsidence that may cause flood, is: (1) Lean seedling and (2) Poor quality of seedling. Insertion measures will be discussed in this topic as the farmer's planning to increase the basic productivity of the plantation, because poor quality seedling will not produce an optimum yield even with a maximum treatment.

Saving leaning oil palm

Leaning and collapsing oil palm is one of the cases that most often occur in oil palm plantation on peatlands. Standard measure for saving leaning oil palm tree is by supporting it with a wooden stick and compacting the area around the oil palm tree

Oil palm supported by wooden stick

Rehabilitation of trees that have skewed a lot and collapse with roots sticking out is done by piling up the emerging roots with soil. The soil used should not be taken from the surrounding of the tree to prevent damage to the surface feeder roots. Then, it is important to make two circles weeding: one for fertilizer administration and one for harvesting.

Plants that are leaning and collapse will bring losses to the farmers. Consequently, they need to be monitored regularly as part of the monitoring of productivity. The table below which will help farmers determine the next steps.

Table 5. Data of production of oil palm fruit (FFB) in smallholders oil palm plantation on peatland

Measurement/data collected by: ..... Date/month/year of recording: Ex. December 2016 ..... Location of plantation/block name: ..... Peat thickness: ..... meter Peat size:						Lean Oil Palm		
Planting Year (example)	The Crop Age (year) during recording in 2016	Size of The Planting Area (Ha)	Jumlah pokok sawit yang ditanam	Number of lean and collapse plants	% of lean plant against total plant	% of lean plant that is still producing fruits	% of lean plant that is not producing fruits	FFB Productivity ton/ha
2007	10	.....	.....	.....	.....	.....	.....	.....
2008	9	.....	.....	.....	.....	.....	.....	.....
2009	8	.....	.....	.....	.....	.....	.....	.....
2010	7	.....	.....	.....	.....	.....	.....	.....
2011	6	.....	.....	.....	.....	.....	.....	.....
2012	5	.....	.....	.....	.....	.....	.....	.....
	TOTAL	..... (ha)	.....	.....	.....% (average)			

➢ *Data of water depth in peat soil should also be mentioned/measured*

Quality seedling

The common problem of oil palm farmers is the poor quality of seedling and massive fertilizing will not improve productivity to be the same as good quality seeds used by companies. Bad seeds are only a waste of money.

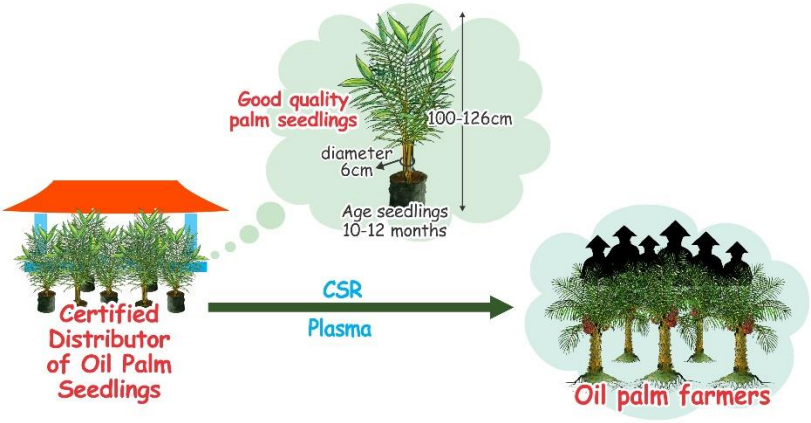
Good quality seedling is seedling from an officially certified supplier or distributor. This Protocol does not recommended farmers to buy seeds or grow their own seedlings due to the general conditions as follows:

1. Seedling suppliers only sell the seedlings in high quantity
2. Transportation of seedlings should be in a controlled environment and it is expensive

Exceptions can be made in a larger farmers groups with adequate technical capacity

To obtain high-quality seedlings, below are several recommended seedlings distributor companies:

1. Companies that have developed their own seedlings by forming collaborations for plasma or CSR programs.
2. Authorized distributor, but it needs to be assured that the seeds are certified and grown with the best breeding practices.



Your seeds still need to be selected carefully. Below are several general conditions of good quality seeds:

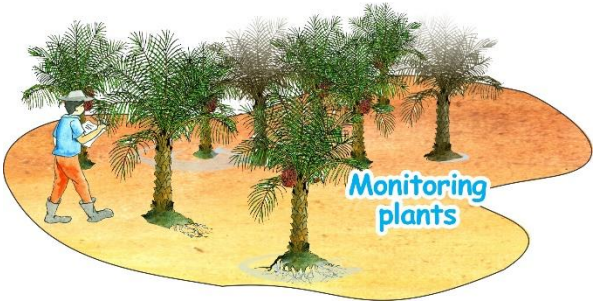
1. At the age of ready for planting or 10 -12 months. Ask for proof of age
2. The seed has a height of 100-126 cm, with a canopy that is parallel and perfectly open and the leaves are not too dense
3. The diameter of the rod is about 6 cm, with 15 to 18 firm (not soft) branches
4. The branches and leaves are dark green in color
5. They are free of pests and diseases.
6. Add 5% of the seeds amount for insertion needs, so when you are planning to have 100 seeds, add 5% more, so in total it becomes 105 seeds

Insertion

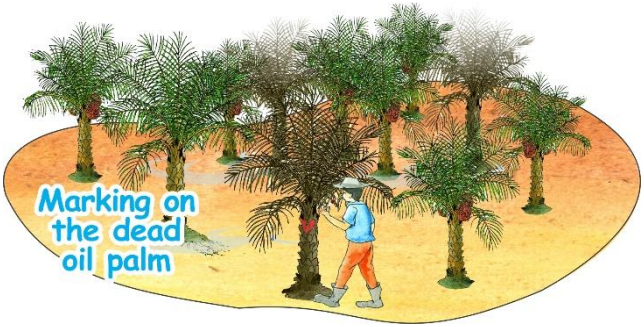
The purpose of insertion is to replace dead or non-productive oil palm trees because of low-quality seedlings or growth problems. The target for insertion is all oil palm trees is in the best condition before reaching reproductive age. To determine whether insertion is necessary, follow the inspection steps described below.

Monitoring of abnormal or dead oil palm trees

1. Monitor the plant or do census at months 6, 14, 17, 20 and 23 after planting



2. Mark the oil palm trees that do not grow well with paint to be replaced with new seedlings



3. Insertion is done in month 26 after planting

Monitoring for non-productive plants

1. Monitor the plant or plan a census in months 17, 20, 23 and 26 after planting

Insertion steps

1. Insertion is best done in the rainy season and the seedlings should be of the same age with the seed replaced.
2. After the oil palm tree is dead, chop it into small pieces with saws and axes, then spread the pieces in every 4 rows to accelerate decomposition. Do not stack them to reduce the existence of rhinoceros beetle.

Temporary nursery

Temporary nursery is made to keep the seedlings in a safe place until planting time. Even though it is temporary, its purpose is to treat the seedlings to allow them to have relatively good standard.

Temporary nursery can be done by setting up a location near the planting area. Steps to create temporary nursery are as follows:

1. Determine and prepare the location of the temporary nursery by cleaning it up.
2. Prepare the tools and materials, such as water pumps, hoses, PVC pipe, and other tools
3. Place the seeds with path system, avoid lopsided area.

4. Arrange the seeds with the ideal distance, usually 0.5 x 0.5 cm.

Temporary Nursery (Ilustration: Triana)

Steps to maintain the seedlings are as follows:

1. Separate the seedlings that will be directly planted with the seeds stored for insertion
2. Water the seedlings the day before planting to keep them moist
3. The seedlings prepared for replacement / insertion are treated normally
4. When in need of replacement, the seedlings that have had roots inside the polybags are ready for planting

Building of planting path and compaction

At least 2 months before planting that is usually at the end of the dry season, get ready for planting:

1. Develop the planting path to make it easier to plant the oil palm trees
2. For shallow peat, the planting path shall follow the path with the spacing of 9mX 9m x 9m with equilateral triangular pattern and the total plants in one hectare are 143 seeds
3. For the media of deep peat, the total plants in one hectare is 160 seeds with an isosceles triangular pattern (6.91 m x 8.43 m x 8.43 m)
4. Mark the targeted planting holes with pegs
5. After that, compact the planting path to make the roots firmly embedded in the land and reduce the risks of weak or collapsing plants

Making planting holes

Hole in the hole is made to reduce the risks of lean plants or roots hanging on the ground:

1. Clean the area around the planting hole from mulch
2. Develop the planting of holes in the concept of hole by using a shovel and a machete to make the first hole sized 120cm x 120cm and 30cm depth, and the second hole of 60cm x 60cm x 60cm3
3. Separate the surface soil on one side, and the sub soil on the other side. This soil will be used again
4. Compact the soil around and at the bottom of the hole
5. Do the things above at least 2 weeks before planting.

Top view Side view Palm have been planted

Planting Techniques

1. Move the seedlings carefully near the seed holes, fasten the canopy if necessary
2. Seedlings should not be stacked during transport and do not throw the seeds
3. Pour evenly 500 g of phosphate fertilizer such as agrophose and phosphate rock or sp-36 into each planting hole
4. Tear off the polybag with a machete or other sharp objects and remove the seeds carefully from the polybag to be placed into the planting hole
5. Removed the torn-off polybag into the trash bin. Do not litter your plantation with plastic waste

6. Cover the seeds slowly with the surface soil, until the space around the seedlings are fully covered by soil, then carefully compact it with your hands so that the seeds stand upright
7. Make the plant surface higher than the surrounding and stack back the mulch around the seeds
8. Seedlings that tend to weather shall each be given a stick to support
9. Develop a map of the plantation and mark every plant.

TOPIC 4: PLANTATION UP KEEP

Palm tree circle weeding

Clean the palm tree and its area at a radius of 1-2 meters from weed using a machete or a machine, so that the palm tree growth and the palm circle are not disturbed.

Weeding is done before the peak of the rainy season, with six to nine rounds of weeding per year recommended for immature peat plantations (compared with 4-5 rounds for oil palm plantations on mineral soils).

Once a year the palm tree circle is examined and cleaned from weeds. Uproot weeds and each hole is filled with soil.

For mature plantation, weeding can be done for 3 to 4 rounds per year.

Soil amelioration or condition improvement

Peat is generally acidic with a pH of 4 to 5, while oil palm needs a pH of 5 to 5.5, soil conditions can be improved through neutralization of peat by giving treatment to the soil. Follow the below steps:

1. Do treatment by adding organic matters such as compost, manure from cows or chickens

2. Or use inorganic materials such as various forms of calcium (dolomite, phosphate rock and kaptan, mineral soil, sludge and ash
3. Since every material has its advantages and disadvantages, it is recommended to mix it for better results
4. This choice also depends on the cost and availability of materials. Choose what is best for you
5. Use dolomite with a dose of, for example, 0.39-0.55 tons / ha / year to 158 trees per hectare, by administering it to every line of plantation in every harvesting

Pruning

Cuts or reduction is intended to have the optimum amount of leaves in a tree to make harvesting easier. Pruning is done depending on the age of oil palm trees, (see the table below).

Table 6. Pruning or reducing palm leaves

	Age	Tools	Time	Target
early fruit pruning	16 - 28 Months	Chisel, wide and sharp end		Dry leaves First rotting fruits
Production pruning	20 - 28 Months	Chisel		Leaves grow well (toleration for 20 rotting fruits
Maintenance pruning	Post Production			Leaves that grow well (toleration for 2) are only 38-48 leaves. Leaves fronds must be as strong as possible

To avoid interruption of care and harvesting activities on productive lines, the pieces of palm leaves shall be stacked neatly on one of the lines between the rows of plants, (usually called the "dead market"). While other lines shall be kept clean for the smoothness of harvesting process (or commonly mentioned as "bearing market").

Fertilizer

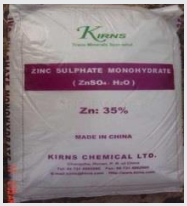
Fertilizer is an important part that makes oil palm tree healthy and productive. Below are the principles to be considered:

1. With flooding issue in the peat, be careful in administering fertilizer to prevent the weeds from benefiting from the fertilizer
2. There are 2 types of fertilizer, namely single content fertilizer such as urea and TSP or various contents
3. The quality of the fertilizer, poor fertilizer will only harm you
4. Differ the dose for immature trees (TBM) and trees that have been harvested (TM) as shown in the table below
5. The time and method for fertilization is also different.

Table 7. Dose of Fertilization on Immature Plants (TBM) and Productive Plants (TM)

Fertilizer (kg/tree/year)	TBM	TM
Urea	1.25 – 1.50	1.50 – 2.50
	Administered once a year	

Fertilizer (kg/tree/year)	TBM	TM
KCl / MOP 	1.50 – 3.50	3.00 – 5.00
	Administered 2-3 times a year	
Kiserit 	0.00 – 1.00	1.00 – 1.75
	For TBM there is no period	Administered once a year
Dolomite – optional to Kiserit  Better for peat but if xxx is shown better to use kiserit	0.00 – 2.00	2.00 – 3.50
	For TBM there is no period	Administered once a year
SP-36 	1 – 1.25	1 – 1.50

Fertilizer (kg/tree/year)	TBM	TM
Borax 	0.05 – 0.1 Administered once a year	0.1 – 0.25 Only when necessary
CuSO4 	0.1-0.15 Administered once a year	0.15 Only when needed
ZnSO4 	0.05-0.1 Administered once a year	0.05-0.1 Only when needed
Fertilized administration	All fertilizers shall be administered evenly at the circle of palm trees for a radius of 20 cm from the tree	For Urea, spread from 50 cm from the tree to the outer limit of the circle For KCL, kiserit and SP-36, spread from 1m - 3m from the tree For Borax, CuSO4 and ZnSO4, spread from 30 cm to 50 cm from the tree

Source: Kiswanto et al. 2008. Assessment and Development Center for Agricultural Technology of the Agricultural Research and Development Agency.

6. Fertilizing timing is usually linked with the climate condition, with 2 options:

   a. First Application at the beginning of the rainy season (September-October).

   b. Second Application at the end of the rainy season (March-April).

   However, climate is unpredictable right now, smallholders are also experiencing difficulties to determine the right time to administer fertilizer. The best ways is by using the rainfall rate as an indicator, when the rainfall rate of 100-200 mm/month, then it would be the right time (month) to administer fertilizer, conversely avoids fertilizing in the month with the rainfall rate of over 250 mm / month.

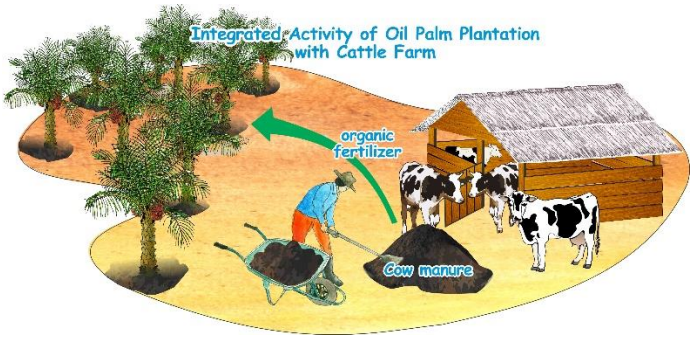
7. For everyday applications, avoid giving nitrogen fertilizer on a day where the rainfall rate is over 25 mm / day. If there are many plants in the drainage, it means there are a lot of nitrogen fertilizer flowing in the water, if that is the case, then it is necessary to spray back to the soil around the trees

Organic fertilizer

The use of organic fertilizer has the advantage to enhance soil conditions, but because of the high cost of organic fertilizers, it is usually used as a supplement to common chemical fertilizers.

For long-term sustainability, the choice of integrating oil palm with manure to produce fertilizer is an option that has been proven successful in Central Kalimantan by KUD Tani Subur, which uses cow manure for fertilizer.

For the use of organic fertilizer like *tangkos*, (oil palm waste) one must be careful when using *it*, as it may trigger the grow of rhinoceros beetle. The application of organic fertilizer is done evenly and thinly on the oil palm tree circle.



Harvesting

Collecting the harvest

In general, harvesting means gathering fresh fruit bunches (FFB) of oil palm trees for sale to other parties. Below are some important steps of harvesting:

- The early fruit, which is called "sand fruit" should not be harvested and should be removed
- The criteria of ripe fruit ready for harvest are:
  - For bunches of around 10 kg, there are at least 5 fruits that fall naturally
  - For fruit bunches which more than 10 kg, at least 10 fruits that fall
  - For trees younger than 10 years, at least 10 fruits fall
  - For trees older than 10 years, at least 15-20 fruits fall
- Harvesting time is very important as fruits that are too ripe or unripe will have lower oil content and in normal circumstances, the harvest is done every 2 weeks
- To facilitate harvesting, the frond is first cut into two or three pieces and stacked in the "Dead Market"
- Cut the fruit bunches as close as possible to the hilt - maximally 2 cm and gather them in the oil palm circle be transported to the designated place to gather FFB
- To ensure a good price because of the oil content, the FFB must be transported to the factory as soon as possible - preferably under 8 hours after harvesting
- Productivity results vary because of the soil, seed quality, climate, and on how you manage your plantation. In optimum conditions the crop can reach 20-25 tons FF / ha / year or around 4-5 tons of CPO.

Productivity monitoring

Common practice to determine productivity is by observing the fronds or branches of oil palm. The growth level and crop conditions can be seen through the observation of the fronds length at various ages.

Oil palm plantations are normally grouped into immature (TBM) and mature (TM) plants. TBM on oil palm is the period before harvest (starting from the planting to the first harvesting) which lasts 30-36 months. Productivity monitoring done with different schedules on TBM and TM plants as shown below.

TBM observation

Table 8. Observation towards palm fronds length in immature plant (TBM)

Age (Month after planting)	Fronds measure	Fronds length	
		Local seedlings(cm)	*Dami* seedlings (cm)
6	Third frond	130 - 140	150 – 160
12	Third and ninth fronds	160 - 180	180 – 220
18	Third and ninth fronds	220 - 240	240 – 270
24	Ninth and seventeenth fonds	270 - 290	290 – 320

TM Observation

For productive oil palm, monitoring is conducted every 5 years starting from the age of 36 months. However, because it is planted on peat, the greatest threat is lean trees and malnutrition resulting in non-optimum harvest, consequently, annual inspection is recommended.

Table 9. Annual observation towards fronds length in productive plant (TM)

FRONDS LENGTH OBSERVATION

PLANTATION: ..... BLOCK : Team :
DIVISION : ..... Planting year : ....
Planting month : ....
Date : ..... Plant age : ..... month .....

Tree			Fronds length		
	Row Number.	Tree Number	3rd Frond	9th frond	17th Frond
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
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31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
		Average			
		Deviation standard			

TOPIC 5: PESTS AND DISEASES

This topic discuses Integrated Pest Management and management of diseases that are commonly found in oil palm plantation on peat, that really affects the plantation productivity.

The use of natural method and materials as first measures and chemical materials as last resort is being emphasized, since the hazardous nature of chemical materials to human and environment, thus the use of chemical materials must really follow the product usage instruction and consultation with experts. Smallholders are expected cautious in using chemical materials like DDT that the government already prohibit, the same with the use of Parakuat that its usage is really limited[4] but already prohibit by RSPO[5].

Information and the availability of natural and organic pesticides, and other materials can be discussed with the local plantation agency, agronomy and companies through the representation of farmers' group, or communicating with:

OIL PALM RESEARCH CENTER
Jl. Brigjen Katamso No. 51, Medan - 20158
Sumatra Utara, Indonesia
Telephone: +62 61 7862477
Fax: +62 61 7862488
Email : admin@iopri.org
Facebook: ppks.id

[4] Minister of Agriculture Regulation Number: 01/Permentan/Ot. 140/1/2007 on List of Prohibited and Limited Pesticides Active Materials
[5] Next RSPO Criteria

Integrated Pest Management (IPM)

The best practice for pest control is integrated pest management which combines physical, chemical and biological efforts. The main thing in integrated pest management is for controlling purposes and not destroying, thus to limit the number of pests and not to create losses.

Table below will elaborate Integrated Pest Management further, and its main principles, which are:

1. Controlling number of pest is crucial in avoiding pest infestation that can be done through a good plantation management, and efforts by natural means to **prevent** pest outbreak.
2. **Routine inspection** and **rapid response** upon countering problems and the use of natural pesticides (anti-pest that come from plants), and organic pesticides that is anti-pest by using bacteria, may reduce the risk of hazardous pesticides misuse.
3. **Pesticides will become the last resort,** and when being use there should be some controls implemented.

In general, using the pesticides in accordance to the prescribed dose and administer it only in certain area will reduce the risks to the surrounding environment, and control specifically will be given based on the information below based on recommendation from Pesticide Action Network and Sustainable Agriculture Network regarding hazardous chemicals.

However, the basic principle in using chemicals, that it is mandatory to use body protection that may reduce the risk of exposure to skin such as long sleeves cloth and mask to avoid direct inhale. Pregnant woman and children are strictly prohibited come near the areas that are being treated with chemicals.

Termites *Captotermes curvignathus*

Termites are common in peat and attack the root, trunk, and canopy of oil palm tree

Termites attack mature and immature, and on immature termites may kill 8%-9% of oil palm tree in the plantation

Prevention of termite outbreak can be done by

- Ensure the remaining tree roots are pulled and the soil is compressed
- Maintain the water level
- When you find termites colony, destruct the nest and kill the queen

Regularly use EFB compost as a trap which has been administered with pathogen (*B. bassiana* dan *M. anisopliae*)

Initial symptoms and how to control it

When there is a soil lining on the rod, fronds and fruits:

1. Immediately mark the trees showing initial symptoms of termite attack
2. Use EFB compost as a trap which has administered with pathogen *B. bassiana* and *M. anisopliae* in accordance to the dose stated in the instruction.
3. Spread the EFB compost trap on the tree circle that shows the symptoms and 6 other near trees
4. Inspect the plantation and ensure there is no high pile of fronds and trash
5. Ensure the water level in the plantation and in the drainage in accordance to the water level management standard

If the condition is not improved after 3 months, and even the leaves and fronds turn brown color, use the last control measures.

Last control measures

- As the last measures, spray anti-termites like fipronil to the termite colony house, all the attacked trees and 6 other near trees.
- Mix 2.5 L of fipronil with 5 L of water, and spray around 5 L to every tree and after that don't re-spray fipronil until the next 6 months.
- Re-inspect after 7 days and every 2 months

If the trees still dry and brownish, and no new bud after 8-9 month from the initial attack, then the trees are definitely die. Immediately chop the trees to avoid another pests like rhinoceros beetle

Notes:

Fipronil has a serious impact to certain insects like bees or wasps that produce honey and or support the flower pollination process. If there are bee or wasp hives nearby the trees that will be treated with fipronil, then when possible cover the bee hives. And ensure that there are also water source near the bee hives during fipronil application.

Rhinoceros beetle *Oryctes Rhinoceros L*

Rhinoceros beetle attack immature and mature palm. Very dangerous for immature because when attacked, the point of growth will decay and kill the trees.

Prevention of rhinoceros beetle outbreak can be done by:

- Keep the plantation clean, especially around trees
- Avoid high pile of empty fronds or trash in the plantation
- Kill the larva when found
- Regularly use EFB compost as a trap which has been administered with pathogen *M. anisopliae*
- Plant land-cover-plants like Mucuna to slow the beetle development
- Chop the trash like trees trunk that exist in the plantation

Initial symptoms and how to control it

The beetle initial attack is indicated by a bite marks and holes on the fronds and other part of the trees, and make the fronds weak and easy to break. When found, immediately apply the following controls:

1. Mark the trees showing initial symptoms of beetle attack
2. Use EFB compost as a trap which has administered with pathogen *M. anisopliae* in accordance to the dose stated in the instruction
3. Spread the EFB compost trap on the tree circle that shows the symptoms and 6 other near trees
4. Inspect the plantation and ensure there is no high pile of fronds and trash

If the condition is not improved and more than 4% (four out of one hundred) of the plants attacked by the beetle then apply the last control measures

Last control measures

As the last measures, the use of pesticides can only be done to young plants that are still reachable, because the administration of the anti-beetle is applied to the bud of the tree. There are two anti-insects that commonly used

1. Insecticides (anti-insects) uses 5% *karbosulfan* sprinkle to the bud as much as 5 – 10 gram / plant,
2. Mix 2cc Cypermethrin 250 EC for every 1 L of water, and spray to all over the bud until it is wet enough

Do this every 2 weeks until there is no more beetle attack to the palm trees, by still continuously collecting larvae and spreading pathogen-compost-trap

When the attack is too severe, where there is no new bud, chop the tree to prevent it become beetle nest

Notes:

Cypermetrin and *Karbosulfan*, both has a serious impact to certain insects like bees or wasps that produce honey and or support the flower pollination process. If there are bee or wasp hives nearby the trees that will be treated with Cypermetrin and *Karbosulfan*, then when possible cover the bee hives. And ensure that there are also water source near the bee hives during Cypermetrin and *Karbosulfan* application.

Moth Caterpillar *Tirathaba mundella* and *Tirathaba rufivena*

Moth caterpillar attack immature and mature palm, by attacking the male flower and put their eggs on the fruit fronds and once it hatches the caterpillar will create holes in the fruit

Prevention of moth caterpillar outbreak can be done by:

- Maintain the cleanliness of the plantation by removing unharvest rotten fruits that trees circle.
- In immature, removing the male and female flowers at the age 1 year since planting until maximum 6 months before initial harvest may address this attack
- Maintain its natural predator which is wasp like *Braconidae* and *Ichneumonidae* that will kill the moth caterpillar by planting plants like *Tengguli* (*Cassia* spp.), *pukul delapan* flowers (*Turnera subulata*), *Orok* (*Crotalaria usaramoensis*) and *Air mata pengantin* (*Antigonon leptopus*)

Initial symptoms and how to control it

Moth initial attack is showed by bite marks from the larvae on the young fruits

When found, immediately implement controls by using bio-pesticides that contains organic agent like *Bacillus thuringiensis* bacteria. Spray 1g of Bacillus thuringiensis like Dipel WP with the mixture of 1L of water on the fruit attacked

When the condition is not improved and more than 50% of the tree attacked by the moth caterpillar then apply the last control measures.

Last control measures

As the last measures, there are two ways based on how easy to get the ingredients:

Mix 1 - 2 cc Cypermethrin 250 EC per one liter of water, and spray to the male flower until it is wet enough.

Do this every two weeks until there is no more moth caterpillar attack to the trees.

Notes:

Cypermetrin has a serious impact to certain insects like bees or wasps that produce honey and or support the flower pollination process. If there are bee or wasp hives nearby the trees that will be treated with Cypermetrin, then when possible cover the bee hives. And ensure that there are also water source near the bee hives during Cypermetrin application.

Leaves-eating-caterpillar Fire caterpillar (*Setothosea asigna* and *Setora nitens*) and ***Ulat kantung*** (*Metisa plana* and *Mahasena corbetti*)

Part that being attacked is the young leaves that may decrease its size

Prevention of caterpillar outbreak can be done by:

- Don't spray weed excessively that may decrease or erase the caterpillar natural predator that control the caterpillar population
- Maintain its natural predator which is wasp like *Braconidae* and *Ichneumonidae* that will kill the moth caterpillar by planting plants like *Tengguli* (*Cassia* spp.), *pukul delapan* flowers (*Turnera subulata*), *Orok orok* (*Crotalaria usaramoensis*) and *Air mata pengantin* (*Antigonon leptopus)* and also remove the hosts (*ulat kantung*) like *Acacia mangium.*

Initial symptoms and how to control it

The fire caterpillar eat all the young leaves and only left behind the midrib, and *ulat kantung* will create holes on the leaves that they eat

When found, immediately implement controls by:

1. Collecting the *ulat kantung* on fronds
2. Use bio-pesticides that contains natural agent like *Bacillus thuringiensis* bacteria. Spray 1g of Bacillus thuringiensis like Dipel WP with the mixture of 1L of water on the fruit attacked

If the condition is not improved and found 5-10 caterpillars in one frond, then apply the last control measures.

Last control measures

As the last measures, there are two measures based on the age of the plants:

1. For young plants (1-6 years) use mixture of 1-2 cc Cypermethrin 250 EC per one liter of water, and spray 0,5 until 1 litre of mixture to all leaves until its wet enough.

   If after 7 days, there are still many caterpillar, then re-do this until the number of caterpillar decreasing
2. For old plants with age above 6 years, use **injection system** directly to the trunk by using Asefat active materials (with concentration of 10-15 gr/100 ml/tree) and *Dimehipo* (10-20 ml/tree).

   Injection is done by creating a small hole, usually with a drill with 15 – 20 cm deep and with 45 degrees slope. Then inject the mixtures into the hole, and fill the hole with clay.

   If after 14 days, there are still many caterpillar, then redo this to the same hole until the number of caterpillar decreasing

Notes:

Cypermetrin has a serious impact to certain insects like bees or wasps that produce honey and or support the flower pollination process. If there are bee or wasp hives nearby the trees that will be treated with Cypermetrin, then when possible cover the bee hives. And ensure that there are also water source near the bee hives during Cypermetrin application.

Rattus argentiventer (**Ricefield rats**) and *Rattus tiomanicus* (**Tree and bushes rats**)

Attack the fronds of immature and male flower and fruit bunch of mature

Prevention of rats outbreak can be done by:

- Maintain the rats natural predator like snake and owl
- Creating nests and raise white owl (*Tyto alba*) in the middle of oil palm plantation

Initial symptoms and how to control it

Bite marks on the TBM trunk and bite marks on the male flower. When found immediately implement controls by:

1. Placing rat trap with salted fish as bait
2. Adding number of owls

If the condition is not improved and it is found more than 5 trees experiencing new attacks (damaged fruits and fronds) during the inspection, then apply the last control measures (rodenticide)

Last control measures

As the last measures of rat control by using *rodenticide*, but it requires extra cautious in using the toxin since it may kills other animals like owls that may increase rat population if the owls are killed.

Use *rodenticide* that uses active *warfarin* that is placed on the tree circle facing the "bearing market" so it may be easy to monitor, or placed on the tree around 40 cm from ground in the middle of the fronds.

Inspect every 7 days, replace the consumed warfarin. If the consumed warfarin is less than a quarter in 7 days, then there is no need to continue.

Notes:

Rat carcass because of the warfarin should be removed using hand gloves and buried in location that will not endanger to human health, for example far from water source.

Disease

Table 10. Common disease that attack oil palm

	Rotten Buds	Rotten Fronds Marasmius	Rotten Trunk or Ganoderma
Cause	*Erwinia bacteria* This disease is the impact of rhinoceros beetle that attacks immature and young mature palm	*Patogen fungi Marasmius palmivorus* Attack the fruit fronds of immature and mature palm	*Ganoderma boninense* or *Ganoderma zonatum* Attack the root and stem tisue of immature and mature palm
Symptoms and Impacts	The buds rot making them easy to remove The attacked buds smell bad The tree will die When survives, it will have small and thin leaves	Flower and fruit frond rotten	Decreased plant production, many broken fronds on the base, many fall and not opening, and in advanced attack, the trunks become weak, easy to break, and mushroom attached to the trunk are visible
Prevention	Keep the plantation and around the trees clean Control the bud weevil beetle and water on plant	Castrate the immature, remove all rotten flowers and fruits, Regularly prune the leaves, fronds and harvest Do not allow over ripe fronds unharvest/ left behind on trees Keep the plant clean from weed.	Plant Ganoderma-resistant seedlings, apply natural agent in planting holes like *Trichoderma* and Mycoriza during planting. Carry out census regularly every year Maintain water level in plantation per the suggestion

Treatment	When there is an attack, there are several measure can be done: - Cut and burn the attacked buds - Add N and Mg fertilizer If that still not working, then: - Sprinkle the buds with fungicides that uses active *Dyfenokonazol* of 250g/L (concentration of 1 ml/L) in the first week and bactericide using active *Streptomycyn* (1gr+1gr/1 L water) in the second week. - Do this in turn for 3 times	When there are rotten flowers or fruits, spray those with fungicides (anti- fungus) that uses active *kaptafol* or *tebukonazol* with concentration 0,1-0,2 % every two weeks until the rot stop. If it cannot be helped and the fruits or flowers are rot, then cut and removed outside the plantation, and dried under the sun to prevent infection/contagion	There are no treatment for Ganoderma yet, thus when there are trees infected, it should be cleaned immediately to prevent further infection or contagion. How: - Cut and chop the trees - Dig a hole around the trees and roots with size of 2 m x 2 m and 1 m deep - Trees, roots and bump is chopped, and dried under the sun along with the soil, and don't stack it - The plant ex hole is filled with soil from different area. Don't plant the land before 6 months

Chapter four. Other option for peat, switching from oil palm

Step 2 and Step 3 of the chapter 2 of the guidelines that bring you to this part mention about the transition to other commodity due to unsuitable soil for oil palm, which cannot grow well in inundated condition. Thus, if your land is in deep or shallow peat but inundated or flooded, then this guideline will recommend you to:

1. Reducing the land subsidence rate by closing the canal and maintain the water level to be no less than 40 cm from the surface to be planted with peat native plants in the middle and edge of the plantation. About the method to measure the rate of land subsidence and water management, refer to Chapter 3 in topic 2 on water level management.
2. Utilize the flooded area and the dammed/blocked canal as fish ponds.

Peatland Rewetting:
trapped fishes and prevent fire

Wetlands INTERNATIONAL

From the figure below, it is apparent that dammed canal can function as fish ponds and maintain the peats nearby to remain wet.

Peat swamp fish trapped in the blocked canal in Sungai Puning, Barito Selatan-Central Kalimantan (2004)

3. Switch from oil palm to plants that endemic to peat, that also have economic value

   Types of plants endemic to peat that can be planted around the canal or in the middle of the lands are, among others:

Jelutung

Ramin

Blangeran

Tembesu Rawa

Gelam

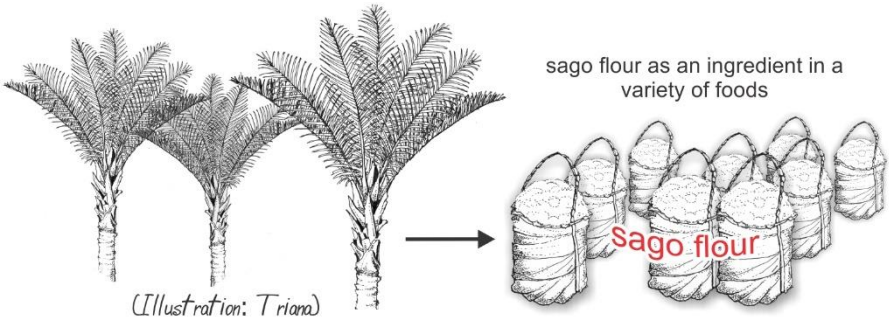
Jabon

(Figures: Dafid Pirnanda, 2015)

As commercial crops usually will take time before they can be harvested, therefore, during the waiting time to harvest, we can plant mix swamp plants that may produce early yield

A rather good strategy is by planting commercial crops from the beginning such as *tengkawang*, sagu and *jelutung* which need at least 7 years to be harvested, and nipah that can be harvested after about 4 years old. Besides, vegetable crops such as tomatoes, peppers, etc. can be made as supplemental crops by making mounds

Sagu



In Riau Province, sagu is widely planted or grows wild with good growth rate in peatlands and can be harvested at the age of 10 years to produce about 200 kg of flour, worth around Rp 4000-6000 per kg in the market, meanwhile in Papua, sagu is sold between Rp 5.000 until Rp 6.000 per kilogram (kg). Sagu cultivation is quite popular in some places in Kalimantan and the eastern coast of Sumatra.

Sagu (*Metroxylon* spp) is one of *palmae* family that produce starch, that grows naturally especially in the low lands or swamp with abundant water source.

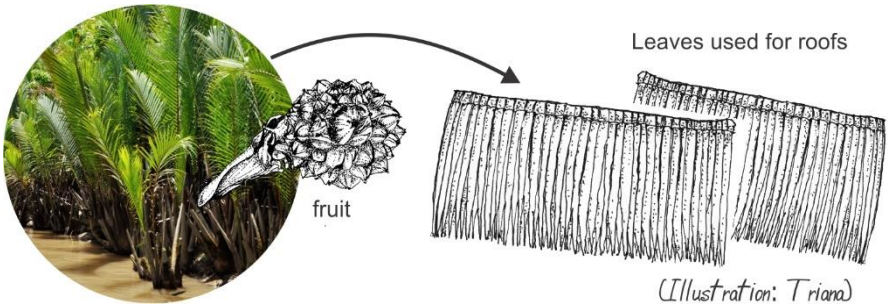
Sagu is an Indonesia endemic plant, because it has a high diversity and grow predominantly in the eastern part of Indonesia. Sagu population is concentrated in Indonesia and Papua Nugini. In Indonesia, the biggest sago plantation center is spread in Papua, West Papua, Maluku, North Maluku, Riau, Sulawesi, and Kalimantan.

Sagu is used for food, cattle feed, renewable fuel (bioetanol), and industry raw material. Industry who uses sago as material area varied, among others are liquid sugar industry, food seasonings, adhesive (glue), textile, and food industry like noodle, flour, dry/wet cookies. Sagu derivatives can also be used, derivatives like lactic acid, *destrin*, maltosa, fruktosa, cianol that can be used to produce pesticides (vegetable), film, textile, paper, ply wood, cosmetics, and food. Dregs of sagu processing can be used as fungus media and hardboard.

Sagu seedlings or seeds must come from superior sagu type, especially from the one with high starch production potential. The famous sago especially from the high starch production potential are Molat, Tuni, Ihur, Makanaru, and Rotan (in Maluku). Type of sagu in Papua are the one with thorn, which are, ara, Rondo, Wimir, Witar, and the non-thorn, like Osukulu, Yeba, Folo, while in West Papua like in Sorong, type of sago that have high starch are Iwa Binis, Iwa Muluk, Iwa Snan, and Iwa Rwo. Type of *meranti* sago in Selat Panjang. The sago superior type that are identified in several locations but with different local name probably are coming from the same species.

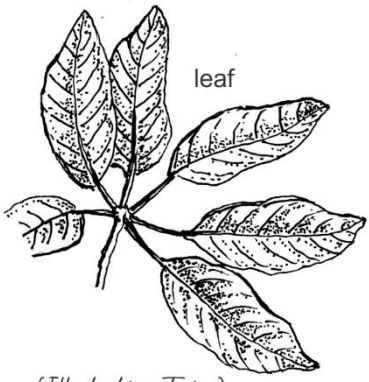
Sagu is planted with various distance, between 8 m x 8 m; 9 m x 9 m or 10 m x 10 m, depending on the variety, because it depends on its crown size, with rectangular planting system, therefore, the population per hectare is between 130 – 150 trees.

Nypa

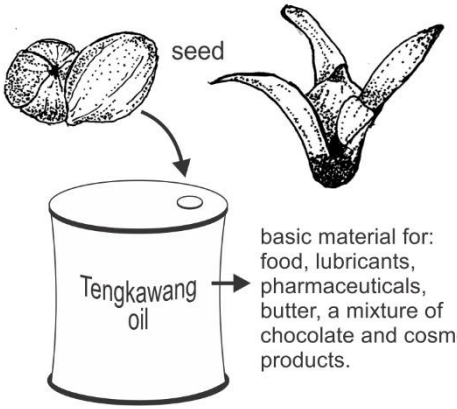


- Planting distance of 3 x 4 m with 800 trees per hectare which family can easily managed.
- Adult Nypa can be harvested for around of 1 L of sap per day, and 100 liter of sap can be converted into 15 L of sugar or around 20 kg of palm sugar. This daily production is equal to Rp 280.000, however it would be less than that in the beginning.
- How to produce sugar, quite easy, Nypa sap is boiled until it condensed like syrup and leave it until it dried.

Tengkawang/Illipe

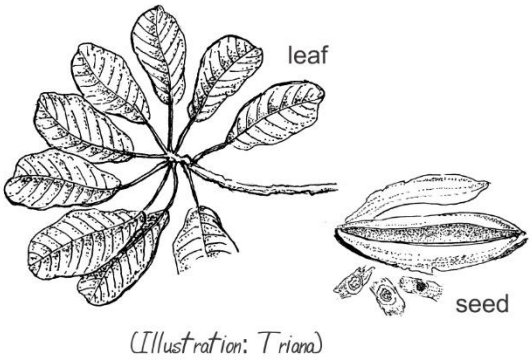


(Illustration: Triana)



This is another option of plant to be cultivated in peat areas. It is commonly grown in Kalimantan and generally used as the raw materials of cosmetics and chocolate.

Jelutung



(Illustration: Triana)

It is commonly grown in Jambi and even planted around oil palm and areca.

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