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**CLIMATE-SMART BEST PRACTICES  
FOR INCREASING YIELD AND  
PROFITABILITY IN OIL PALM FARMS**



**FOUNDATION FOR PARTNERSHIPS INITIATIVES IN THE NIGER DELTA (PIND)**





## ABOUT PIND

PIND is a non-profit organization that promotes peace and equitable economic growth in the Niger Delta region through strategic partnerships and collaborations.

Since 2010, with our partners, we have been contributing to strengthening and stabilizing the region by

- Reducing conflict and fostering peace & stability,
- Reducing poverty,
- Facilitating alternative clean energy solutions for remote coastal communities that are off the national grid,
- Enabling youth employment,
- Supporting gender equality and social inclusion for women, youth, and people with disabilities,
- Empowering local civil society organizations, and
- Influencing governments policies, programs & practices that significantly benefit the poor and marginalized.

We implement collaborative market-based, community-owned programs to mitigate conflicts and boost economic opportunities for local businesses, ensuring that economic progress occurs in a systemic, inclusive, and sustainable manner.

Our projects span all nine Niger Delta states: Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo, and Rivers, focusing on the underserved and hard-to-reach coastal communities of the region.



## Introduction

### PIND'S INTERVENTIONS IN THE PALM OIL SECTOR

PIND designed its palm oil project to catalyze economic activity in the sector by addressing specific systemic constraints faced by the millions of value chain actors. A study in June and July 2012 carried on the oil palm sector in the Niger Delta identified some of these constraints. They included the shortage of fresh fruit bunches for many millers attributed to, among other causes, low four tons per hectare yields, which is just 25% of the maximum possible yield for new plantations. Additional constraints were poor agronomical practice, limited use and incorrect fertilizer application, and low-yielding plant material, which limit farmers' ability to maximize productivity and increase profit.

PIND, therefore, created four interventions

- i. Access to improved processing technology
- ii. Access to improved harvesting technology
- iii. Increased yields and profitability for oil palm plantation (through the introduction of best management practices) and
- iv. Access to improved oil palm seedlings

PIND partnered with input companies, farmers and agro-dealers, fabricators, equipment sellers, millers, nursery operators, and farm service providers to facilitate workshops, information sharing, and field demos for smallholder farmers and processors. These activities formed the broad scale of the interventions, and this manual captures the essential information from them on how to use best practices to boost productivity and income.



## 1. CLIMATE SMART (CS) CONCEPT OF NURSERY MANAGEMENT

### CLIMATE CHANGE

Climate change has adversely affected agriculture worldwide. These changes have resulted in a rise in temperature, irregular rainfall, flooding, soil degradation, nutrient depletion, different pests' appearance, etc. Therefore, to sustain oil palm productivity in the face of changing climatic conditions, it is advisable to engage in climate-smart agriculture practices that could reduce the effects of these changes.

Farmers should adopt practical techniques that conserve soil, water, and nutrient in oil palm plantations. Such reasonable steps include intercropping, mulching, terracing where necessary, planting cover crops, integrated crop-livestock management, integrated management system for pest/disease control, irrigation, and organic manure fertilization as other water/soil conservation practices. These techniques apply from nursery to plantation management.

### 1.1. NURSERY ESTABLISHMENT

Establishing an **oil palm nursery** is necessary for growing sprouted oil palm seeds to produce healthy and viable seedlings of similar sizes /appearance for field plantation establishment. Such seedlings can only be produced under intensive management in a nursery.

Oil palm nurseries can be established at the beginning of raining season so that the seedlings will be ready for transplanting in June of the following year. The current recommended oil palm nursery technology is the **poly-bag nursery**. Use biodegradable polybags that can be planted directly and keep the ball of earth intact to ensure early and vigorous establishment.

There are two types of oil palm nursery systems: **single-stage** and **double-stage nurseries**.

### SINGLE STAGE NURSERY

In the single-stage nursery, sprouted oil palm seeds are planted directly into large black polythene bags of 500 gauges measuring 40cmx45cm laid flat or 40cmx40cm. The seedlings should be nurtured in the main nursery for about one year before transplanting into the field. A 10% to 15% prenursery should be used as a source of replacement in the main nursery.

This technique is simple and cost-effective, provided the source of **Tenera sprouted nuts** is credible and certified. Preferably, look for drought-tolerant/slow-growing and disease tolerant/resistant types.



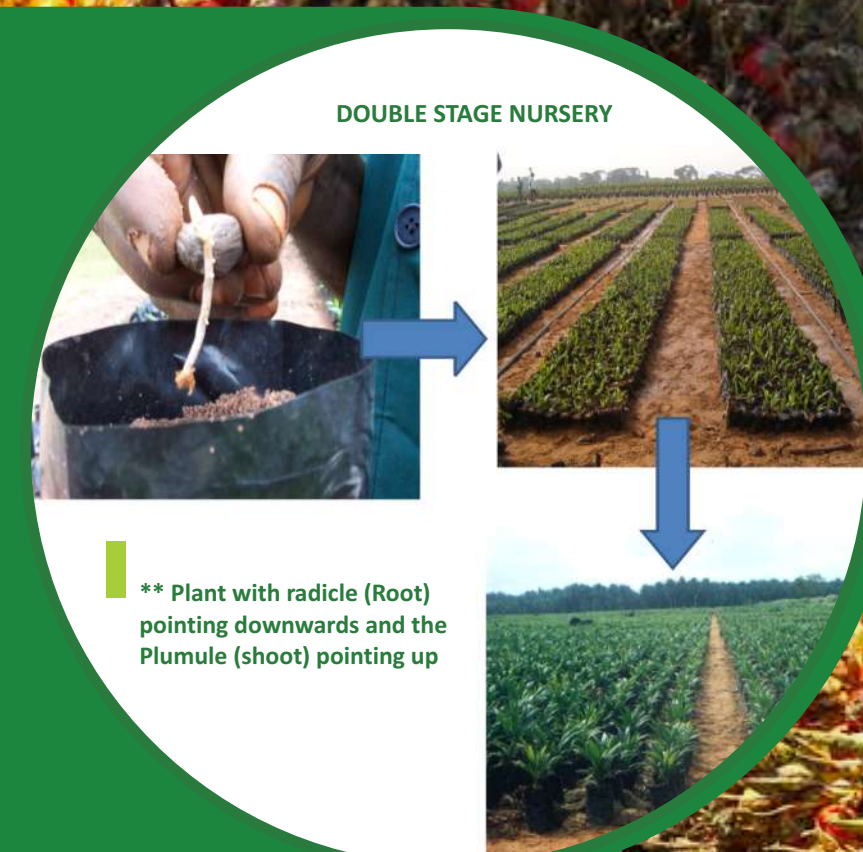
**SINGLE STAGE NURSERY:** Sprouted oil palm seeds are planted directly into nursery main poly-bags that have been properly spaced and left in the nursery until they are ready for transplanting into the field.

### DOUBLE STAGE NURSERY

Sprouted oil palm seeds are planted in small poly bags (25cmx12.5cm) at the pre-nursery stage. These are placed together in a bed and held for 10 -14 weeks. The seedlings are then transplanted into larger poly bags (40cmx45cm) in the main nursery, where they will remain until they are ready for field planting.

The double-stage nursery is practiced more on large oil palm estates. It has the following advantages over the single-stage:

- o It allows for a better selection of healthy seedlings with equal vigor.
- o Seedlings remain in the pre-nursery for up to three months, providing time for the main nursery preparation.
- o Good healthy seedlings are sustained due to high culling.



**\*\* Plant with radicle (Root) pointing downwards and the Plumule (shoot) pointing up**



## 1.2. NURSERY MAINTENANCE

Maintenance of the oil palm nursery involves the following activities:

- Mulching with suitable materials such as shredded or decomposing oil palm bunch refuse, dry grass, wood shaving, palm kernel shell, and decomposing mesocarp fiber. Mulching conserves soil moisture, suppresses weed growth, and protects the soil. The inter-rows can also be mulched to suppress weed re-growth.
- Shading with overlaid palm frond about three meters above the seedlings, especially during the dry season, to reduce evapotranspiration.
- Removal of pests like snails, crickets, grasshoppers, beetles, and caterpillars daily. In high forest areas, it may be necessary to fence the nursery with wire netting as protection against rodents.
- Weeding regularly and replenishing mulching materials from time to time.

Inter-row mulching in oil palm nursery



Climate-smart practices that increase organic fertilizer inputs should be enhanced. Use cover crops during fallow periods to help:

1. Replenish soil organic matter and nutrient supply (mainly sodium and potassium) by recycling empty fruit bunches (EFB).
2. Reduce soil erosion.
3. Improve the soil's capacity to store moisture.
4. Create a better rooting environment.
5. Regulate soil chemical and physical properties affecting nutrient storage, availability, and root growth.

If there are several years of planting, use land rotation techniques to reduce the expense of collecting topsoil from other sources. Topsoil collected from the nursery can also be used as it will have been enriched with organic matter from the mulch and cover crop.

## 1.3. PRUNING OIL PALM SEEDLINGS IN THE NURSERY

Prune seedlings often to sustain healthy seedlings with equal vigor throughout the main nursery until field transplanting.

Tips for Pruning:

- All leaves that are badly infected with freckles should be regularly cut off, removed from the nursery, and burnt or buried.
- Any older leaf should be cut off when at least one-third has become brown/black, a sure sign that the leaf is dying and useless to the seedlings.
- Prune leaves of very old seedlings 4-6 weeks before transplanting to the field.
- Observe seedlings for pests and remove them. Maintain a high level of sanitation around the nursery. For pests and removed them. Maintain a high level of sanitation around the nursery.

## 2. CLIMATE SMART (CS) CONCEPT OF BEST MANAGEMENT PRACTICES

Oil palm CS best management practices (CS-BMP) are essential for optimum and sustained returns on capital invested in oil palm production.

CS-BMP is necessary for the following reasons:

- i. To arrange oil palms for optimal and eco-friendly land use for possible intercropping with arable crops
- ii. To grow oil palm with other tree crops in an agroforestry system
- iii. It leads to early fruiting between two to three years after transplanting into the field.
- iv. At maturity, the farmer could attain 18-25 tonnes ffb/ha/year yield potentials.

### 2.1. CONCEPT OF YIELD MAKING (INCREASING YIELD)

#### 2.1.1. ESTABLISHING A PLANTATION

An oil palm enterprise, from plantation establishment/planting to processing to marketing, requires a lot of capital. A permanent crop with a long economic life of at least 25 years needs systematic and standard establishment procedures. This enables young and newly planted oil palm seedlings to establish faster, healthier, and start fruiting early. Planting into the field should start as soon as the first rains are well established in April and should be completed by the end of June to prevent moisture stress.

Polybag seedlings are best transplanted with all the soil in the bags. During planting, care must be taken in removing the bag without injuring the roots of the seedlings.

#### Oil Palm Planting Procedures:

1. Mark out the planting point at 9m by 9m triangular or 8.5x8.5 m triangular. An expert should do this.
2. Depending on the condition of the soil, planting holes may be dug with a shovel, spade, or hoe. Digging holes long before planting is usually not recommended due to the fallback of the soil and the possibility of the hole filling up with water. Holes should be slightly bigger than the polybag width.
3. Apply 500g of rock phosphate to each planting hole for root development.
4. Distribute the seedlings to the planting points.

Normal field spacing





## OIL PALM PRODUCTION IN THE AGROFORESTRY SYSTEM

In the agroforestry system, food crops are planted alongside palm trees. The food crops should be planted in the inter-row space two meters from each palm.

### This system

- Mitigates against climate change effect
- Provides food security to smallholder farmers
- Provides economics of land use
- Increases farmers revenue(income)

### Methods

- Alley cropping
- Intercropping
- Agro-silvopastoral (snailery, beekeeping)



**INTERCROPPING:**  
Three rows of banana/plantain (3x3x3m) Note: few rows of crops may be possible as the oil palm trees mature and cast more shade.



Mature oil palm at normal spacing (9x9m) and rows of cacao. Cacao can be planted under mature tropical trees that provide shade and shelter from the sun and the wind, at a spacing of 3x3x3m.

### 2.1.2. CHOOSING PLANTING MATERIALS

Oil palm products include palm (or mesocarp) oil and palm kernel oil. They are both derived from the palm fruit. It is important to know the planting material that possesses high oil and kernel content. For a profitable oil palm enterprise, use a certified Tenera hybrid seed.

The oil palm fruit is a one-seeded fruit of variable comprising a fleshy pulp or pericarp around a seed. The pericarp has an outer protective layer (the exocarp) and an inner fibrous pulpy mesocarp from which the palm oil is extracted. Inside the mesocarp is a seed coat, the shell protecting the kernel that produces the palm kernel oil.

A mistake in the choice of planting material is costly and not easily reversible. The result of the wrong choice of planting material is low or very poor yields resulting in low revenue and higher production costs. Do not collect sprouted seedlings from the ground of any farm. It is best to get seedlings from sprouted nut producers (SNPs) or certified nursery operators (CNOs).

## CHARACTERISTICS OF THE THREE FRUIT FORMS OF THE OIL PALM

Varietal Characteristics	Dura	Tenera	Pisifera
Shell Thickness	Thick	Thin	Shell-less
% shell: fruit	20 – 60	2 – 25	0
% mesocarp: fruit	20 – 60	50 – 95	95 – 100
% kernel: fruit	8 – 20	2 – 20	0 – 5
Bunch production	Large/Few Bunches	Smaller/More Bunches	Irregular/Sterile Bunches

### 2.1.3. WEEDING/CREATING PALM CIRCLES

Weeding is done after slashing and before harvest. When done well, weeding or creating palm circles makes harvesting more effortless, less costly, and prevents crop losses. A palm circle should be 1.2m to 2m wide per palm from the base of the tree, depending on age.

#### How to Create Palm Circles

- Establish circles by removing all weeds, shrubs, logs, tree stumps, rotten bunches, loose fruit, and oil palm seedlings with a hoe.
- Maintain clean circles by hand or apply herbicide with a knapsack sprayer every two to three months.

### 2.1.4. CREATING PATHWAYS

Pathways make field maintenance, harvesting, and fertilizer application easier. It also keeps the farm accessible all year round. Pathways can be created by hand or with the use of herbicides.

#### How to Create and Maintain Pathways

1. Create a 1.0m wide path every two rows of palm trees by clearing with hoes, spades, rakes, etc.
2. Clear the paths by weeding every two to three months, depending on the season
3. Do not weed slopes frequently to avoid erosion



The Three Fruits from the Oil Palm



Creating Palm Circles



Creating Pathway



A strategic pathway format for an Oil Palm farm



### 2.1.5. GROUND COVER MANAGEMENT

Ground cover can be managed in the following ways:

#### 1. Slashing

- To reduce competition for nutrients with the oil palm
- To improve field sanitation
- To reduce weed growth

#### How

- Manual slashing is done by cutting weeds on the plantation with a cutlass or machete
- A combination of manual slashing followed by herbicide application is appropriate in extreme cases with established weed vegetation like **Siam weed** or any other broad-leaf weed.

#### When

- Slash every two months for young palms and every four months for mature palms

#### 2. Elimination of woody plants with herbicides

- To reduce competition for nutrients with the oil palm
- To create field sanitation
- To enable good field supervision
- To improve productivity

#### How

- Apply herbicides with Glyphosphate or 2,4-D on the fresh-cut surface of the woody plant

#### When

- During initial field slashing



Herbicide application after Slashing

### 3. Planting Leguminous Cover Crop (LCP)

- To improve soil fertility, control soil erosion, and reduce weed growth
- To discourage insect pests like rhinoceros beetles

#### How

- Mix equal amounts of **NPK fertilizer** (nitrogen (N), phosphorus (P), and potassium (K)) and cover seeds (10 kg/ha) before sowing.
- Plant **Pueraria** cover seeds in drills or mounds of 1.0m apart between palms.
- **Mucuna bracteate** cuttings or seedlings may also be used (two seedlings per palm).

#### When

- After land preparation – at least a month before planting new plantings.
- Before palm canopy closes in matured fields.



Leguminous cover crops in between rows of palm trees

### 2.1.6 Canopy Management

#### i. Pruning

- It helps the palm tree produce more bunches.
- It makes harvesting easier, and cheaper, and prevents crop loss.

#### How

- Leave not less than one to two fronds beneath the next harvestable brunch
- Remove dead and unproductive leaves
- Remove surplus leaves

#### When

- Before and after the peak harvest, that is, two times per year

Years After Planting (YAP)	No. of Spirals	No. of Fronds	Fronds under the lower bunch	Tool
3	No fronds removal			
4	Remove basal fronds only			
5-7	6-7	48-56	2	Chisel
8-15	5-6	40-48	1-2	Chisel/sickle
> 15	4-5	32-40	1	Sickle



Pruning an oil palm

#### ii. Box Frond Stacking

- Replenishes organic nutrients in the soil
- Controls erosion and soil conservation

#### How

- Ensure to use a three-side box stacked around a palm
- Place hard and thorny parts in the interline and soft parts across the palm

#### When

- During pruning and after cutting fronds when harvesting.



Box frond stacking



### 2.1.7. FERTILIZER CHOICES (APPLICATION AND PLACEMENT)

#### A. Applying Empty Fruit Bunches (EFB)

- Replenishes soil nutrients (nitrogen and potassium)
- Creates a conducive environment for palm-feeding roots
- Controls soil erosion and conserve soil water

#### How

- Apply 30-40 tons of EFB to 1ha (280kg/palm) in between palms every five years
- Arrange the EFB in a single layer to enhance aeration and acid oryctes or beetle infestation

#### When

- After planting seedlings in immature palms
- Before the dry season in mature palms



Applying empty fruit bunches (EFB)

#### B Composting

Composting means transforming various organic wastes into products that plants can use safely and beneficially as bio-fertilizers. Humus soil makes up approximately 60 percent of finished compost.

Mature compost is an excellent organic fertilizer. It

- Serves as a good soil conditioner
- Promotes good soil structure
- Improves water and nutrient-holding capacity
- Helps to control erosion

#### Recommended compost application rate:

- 150g compost per bag of seedlings, and
- 100 g compost + 12 g NPK (20.10.10) fertilizer in a single dose complimentary application.

#### Composting EFB

In oil palm production, a significant waste generated is the EFB which is a suitable raw material for compost after mixing with Palm Oil Mill Effluent (POME). Composting EFB adds value to generated waste and addresses the issue of climate-smart nutrient replenishment in oil palm production.

Composted EFB has a yield effect of 71% on planted oil palm seedlings when solely used as fertilizer. An increase of over 100% dry matter was recorded when composted EFB was complimented with inorganic fertilizer in a single dose application.

#### C. Applying Inorganic Fertilizer

Oil palm will grow well and yield optimally if all essential plant nutrients are present in sufficient quantities and available forms. Inorganic fertilizers supply oil palms with adequate nutrients for healthy vegetative growth and help produce more bunches.

Nigeria's recommended fertilizer for immature oil palm is NPK plus Magnesium Oxide (MgO) at this rate: 12:12:17+2.

#### How to Apply

- For maturity, apply the 4R principle (right TYPE, right RATE, right PLACE, and right TIME)
- Ensure even spread of fertilizer (flick method is recommended)
- Apply at the periphery of the palm circle, between rows, and on the frond stack areas
- Apply during the rainy season. Avoid too heavy rains and very dry periods



Applying inorganic fertilizer





## 2.2. CONCEPT OF YIELD TAKING (HARVESTING STANDARDS)

As oil palm fruits in the bunch approach maturity, oil formation increases in the mesocarp. The process of bringing down the ripe fruit bunches from the oil palm tree top is called harvesting. Applying proper harvesting techniques increases palm fruit yields. The proper time to harvest bunches is when the fruits become loose and can be dislodged. The **ffbs** should be harvested at an interval of 10 days in the peak months of January to May and 14 days in the lean months of June to December, all year round.

### How To Harvest

- Use the right tools and ensure they are sharpened properly. Depending on palm height, use a harvesting chisel, Malayan knife/sickle, or a Mechanical Adjustable Harvester (MAH)
- Avoid the use of climbers
- Harvest bunches with 1-5 loose fruit shed
- Ensure that the fruit sockets are yellow
- Pick up loose fruit the same day or a maximum of two days after harvest
- Load loose fruit same day
- Load ffb same day to the processing site
- Do not keep ffb in heaps for too long in the field
- Do not overload the truck over a long period of more than 48 hours

### Ablation

It is the act of removing flowers from age 14 to 24 months. It's also called castration to help in vegetative growth.

*Harvesting with mechanical adjustable harvester*





### 3. CLIMATE SMART (CS) CONCEPT OF PROCESSING

There is a need to widen the scope of climate change mitigations by reducing overall greenhouse gas emissions and improving the environmental performance of the entire oil palm industry. This has led to the introduction of environmental management system regulations for sustainable and climate-smart oil palm processing operations, especially at the downstream side of the value chain.

**Climate-smart oil palm processing** can be described as an approach to palm oil milling that effectively supports sustainable development and food security in changing climate. These include factors that improve sustainable productivity and incomes while developing or adapting resilience to climate change by decreasing and eliminating greenhouse gas emissions.

The Roundtable on Sustainable Palm Oil (RSPO) has adopted and published a set of principles and criteria to help oil palm producers be more sustainable with emphasis on **Principle 4 (Use of appropriate best practices by growers and millers)**

#### CS Processing

- Addresses poor, inefficient, and non-eco-friendly oil palm fruit processing among small and medium-scale oil palm farmers and also considers environmental sustainability
- Deepens the adoption of oil palm fruits small-scale processing equipment (SSPE) and high-capacity mill (HCM) among small and medium-scale oil palm farmers
- Boost the income of oil palm farmers through an increase in the extraction rate of palm oil to at least 15%
- Enables sustainable palm oil milling operations
- Encourages Palm waste utilization and value addition

#### 3.1. Stages of Palm Fruit Processing:

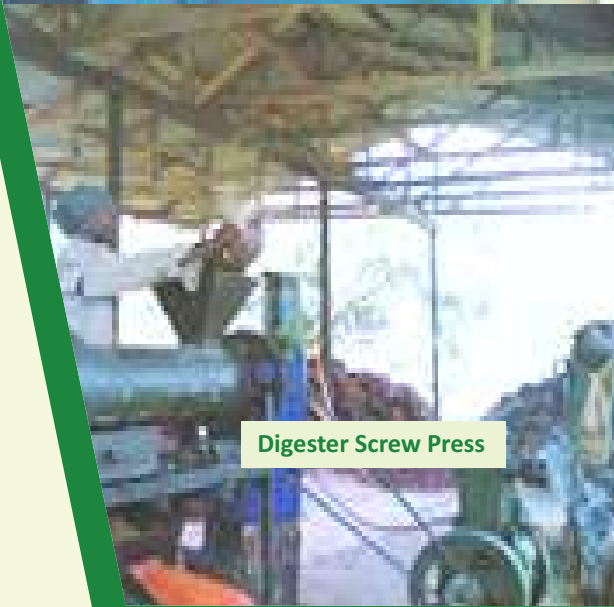
1. Bunch sterilization by steam treatment to loosen and soften the fruit
2. Bunch stripping to separate the fruit from bunch stalk and spikelets
3. Fruit digestion macerates the fruit and produces a pulp to release the oil
4. Pressing or other treatment of the digested fruit to remove or extract the oil from the macerated pulp
5. Clarification or purification separates the oil from the sludge and dries the oil
6. Separating nuts from the fiber
7. Nut drying, grading, and cracking
8. Separating kernels from shells
9. Kernel drying and packing




Sterilizer



Clarifier



Digester Screw Press



Digester Screw Press