



Trends & Outlook

Oil Palm Cultivation in South East Asia





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- 130 member company; 1/3 of oil palm plantation companies are members; 2/3 are not members
- > 2750 estates in the country; 5.2 million hectares;
- > 300 mills; annual growth 1.3%; RM 60-80 bil/yr
- ca. 543 000 immigrant workers from Asean
- > 180 000 independent smallholders
- > 1 million household population in FELDA & FELCRA
- 25-30 tons/ha; 20 t FFB=4 to 5 t CPO; potential 60 tons/ha; efficiency use < 50% of fertilizer applied



- 0.3 % of world's arable land; no peatland oil palm
- produced 19.2 million tons (2013); 35 mi t(Indonesia)
- Asean produces 90.3% of world's CPO; ca. 17 mi. ha.
- Promote the cause and interest of plantation owners in policy takes, R&D priority, survey feedback, marketing & promotion; welfare of growers
- (CESS fund; RM 15/ton); worth RM 60-80 bil./yr
- Oil palm is 7 or 8 X more productive than other veg. oil crops; perennial plt of 25 yr life cycle
- Oil palm Carbon sequesters 100 tons; emits 30 tons



Palm Oil Sustainability Agenda

**Climate Change - Evolving
Cooperatives to Embrace
Sustainability**

**2. Gleaning the Spirit,
Premise and Precepts
of Sustainability**

**3. Sustainability Standards
for Palm Oil Cultivation**

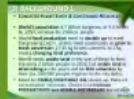
**4. Emulating the SOCIO-
BIOLOGICAL MODEL of
SUSTAINABILITY in SOCIAL
INSECTS: Quintessence of
Sustainable Living by Termites,
Ants and Bees**

1. Climate Change - Evolving Imperatives to Embrace Sustainability

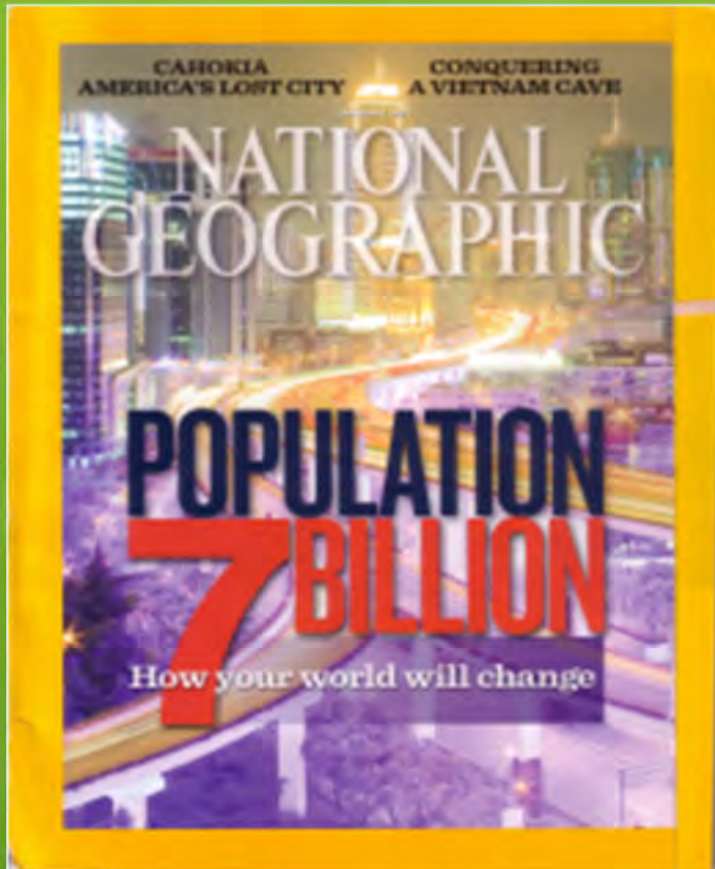
Congested & Constrained Future (1996)



Trigger Impacts of Climate Change



Congested & Constrained Future is now!



HOW OIL PALM SUSTAINABILITY INITIATIVES AFFECT CONSTRAINED RESOURCES

1. **WATER** - Hot & humid habitat origin: droughts/floods; shallow adventitious roots !
2. **ENERGY** - Palm-based fuel, Renewable Energy; carbon footprints; net sequester
3. **HEALTH**- Community Wellness (socioeconomy)
4. **AGRICULTURE** - Diminishing arable land; ILUC, NCLR
5. **BIODIVERSITY** - Genetic Conservation; HCV Compensation; Enhanced BioD



HOW OIL PALM SUSTAINABILITY INITIATIVES AFFECT CONSTRAINED RESOURCES

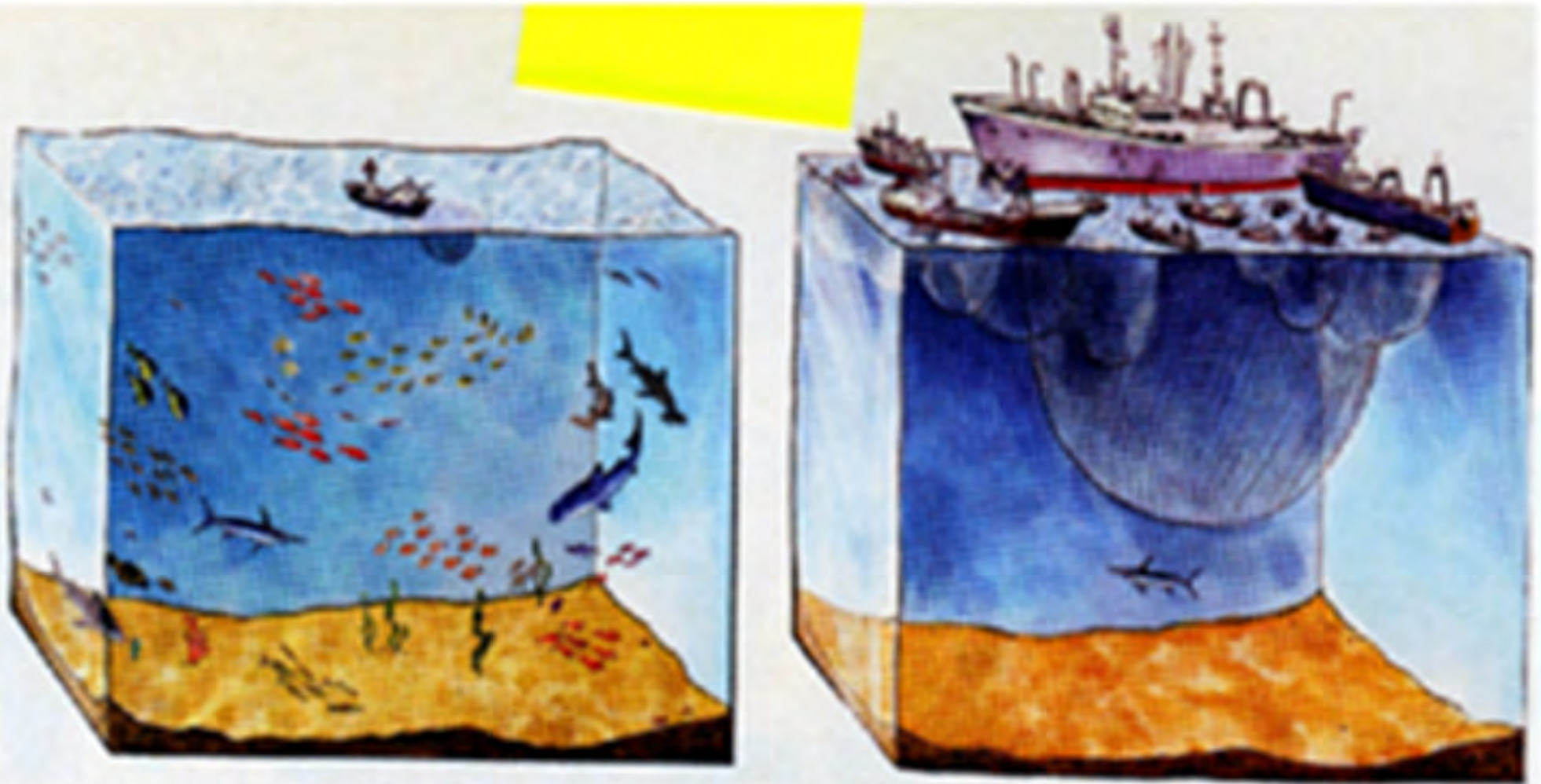
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Trigger Impacts of Climate Change

(3) BACKGROUND 1

- *CONGESTED PLANET EARTH & CONSTRAINED RESOURCES*
- **World's population** is 7 billion burgeons to 9.3 billion by 2050; increase by 2 billion people
- World **food production** need to **double up** to meet the growing pop'n. Grains need quadruples as **grain to meat conversion** (7-15 kg Grains converts to 1 kg meat); **changing food preference**.
- World needs **arable land** in the size of Brazil to feed the extra 2 billion people in 2050, but **arable land is diminishing** as the pop'n will be **80% urbanites** by then (ca. 200 000 people migrate to the city daily).
- Need for **EDIBLE/VEGETABLE OIL** shoots up. Palm oil consumption increases. Choice is to **increase PRODUCTIVITY not ARABLE HECTAREAGE** for oil palm

Sustainable Agroecosystem





2. Gleaning the Spirit, Premise and Precepts of Sustainability



Brodlundt Commision

Meeting the current societal needs without compromising the capacity of the future generations to meet their needs and demands. Life Cycle Analysis (LCA) is important to determine overlapped generations (caring, sharing, co-existence);

BRODLUNDT COMMISSION

- **SUSTAINABILITY** is captured and defined as *meeting the current societal needs without compromising the capacity of the future generations to meet their needs and demands.*



SPIRIT OF SUSTAINABLE DEVELOPMENT



SUSTAINABILITY DEFINED BRODLUNDT COMMISSION

- *Overlapping generations*; considers inter-generational **CARE & SHARE** (yongs and olds); **LIFE CYCLE ANALYSIS**
- **Co-existence** (social); we are together in the same stratosphere on planet earth (environment); *shared destiny/values/resources/accountability*
- **Cost** (economics & environmental) of maintenance/sustenance
- Currency in **CARBON** (carbonomics)



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• Sustainability Cornerstones

Economic, Social & Environment
Incomplete without the drivers

SUSTAINABLE AGRICULTURE BUSINESS PRINCIPLES (SABPs; UN Initiative)

- There are **six pivotal values** for consideration. Triple bottom lines of

- ✓ **PROFIT**
- ✓ **PEOPLE**
- ✓ **PLANET**

that are the **cornerstones of sustainability** viz.
ECONOMICS, SOCIAL & ENVIRONMENT



SUSTAINABLE AGRICULTURE BUSINESS PRINCIPLES (SABPs; UN Initiative)

- There are **six pivotal values** for consideration. Triple bottom lines of

- ✓ **SHARING**
- ✓ **CAPACITY-BUILDING**
- ✓ **GOVERNANCE**

the three other **keystone links** for long term sustenance. RSPO is bereft of these components for communal decorum



3. Sustainability Standards for Palm Oil Cultivation



Do these regulations & standards capture the essence of sustainability? RSPO is WENGOs (WWF-led) dominated that contrive rainforest sustainability ethos into palm oil sustainability. Growers uncritical & unclear on definition of sustainability. RSPO evolved into trade barriers



5 DIFFERENT SUSTAINABILITY STANDARDS AVAILABLE FOR OIL PALM

- **RSPO** - RoundTable Sustainable Palm Oil
- **ISCC** - International Sustainability for Carbon Certification
- **MSPO** - Malaysian Sustainable Palm Oil
- **ISPO** - Indonesian Sustainable Palm Oil
- **SABP** - Sustainable Agriculture Business Principles



Do these regulations & standards capture the essence of sustainability? RSPO is WENGOs (WWF-led) dominated that contrive rainforest sustainability ethos into palm oil sustainability. Growers uncritical & unclear on definition of sustainability. RSPO evolved into trade barriers

**4. Emulating the SOCIO-
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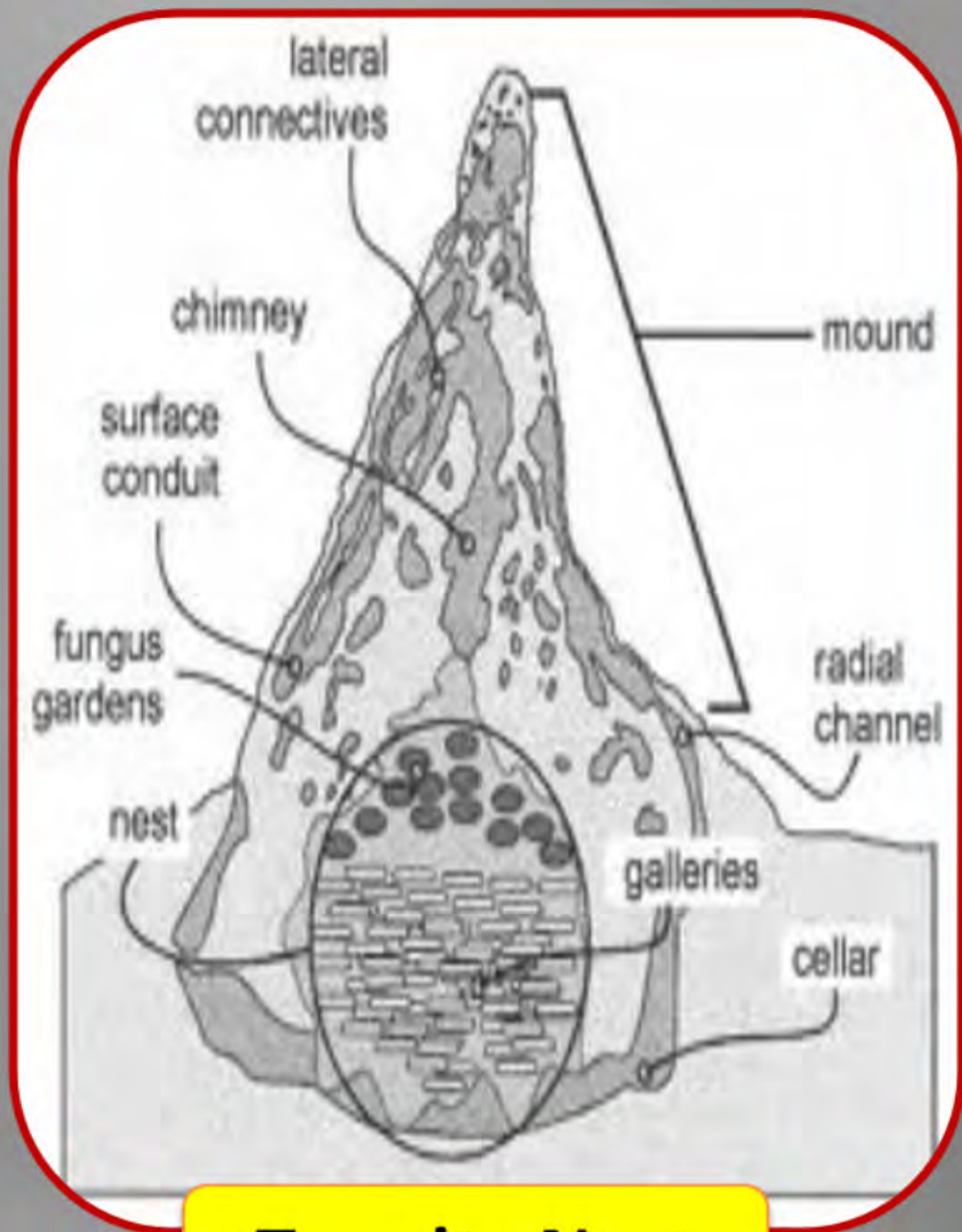


Carbon Emissions is to Human as Humidity Control is to Termites:

- Whilst planet earth is constrained by the < 400 ppm, atmospheric carbon emission to prevent global warming, the **termites** are constrained by the **5% atmospheric water regime**

BIO-INSPIRED INNOVATIONS

| Biological Algorithmn | Applications in Agriculture |
|--|--|
| <ul style="list-style-type: none">• Fungal Gardens (ants & termites) | <ul style="list-style-type: none">• Vertical Farms (optimising area&space for agriculture) |
|   |  |
|   |  |



Termite Nest

- **Parable of Sustainability:**

Termites, Ants and **Bees** have been on planet earth for ca. 400, 300 and 45 million years, respectively. Survived more than hundred times of Climate Changes. Decorum of sustainable living in social insects to emulate.



Epitomes of Sustainability Drivers in Social Insects

1 Capacity-building: to innovate and meet challenges and crisis; task specialization; recycling; getting more from less; R&D - Yield (60 t potential), fertilizer

2 Sharing, Caring & Sacrifices: Sharing the responsibility, Reduce wastage, costs and burden of communal living (altruism); compensation for sacrifices; Overlapping Inter-generational care (Business Life Cycle & Ecosystem)

3 Governance: Equitable share; Authority & Accountability; Disciplined, Fair, Strict but flexible in meeting the decorum of communal, sustainable living.

PLANTATION ECOSYSTEM



Sustainability Dynamics of the Closed-loop, Oil Palm Ecosystem

2

Shift from
INPUT-OUTPUT LINEAR MODEL
to
**CLOSED-LOOP, ECOSYSTEM,
PRODUCTION MODEL**

OIL PALM PLANTATION ECOSYSTEM



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Components of the Oil Palm Ecosystem

Oil Palm Biomass

Six types of OP biomass produced as by-products of OP Industry

- ✓ Oil palm fronds (OPF)
- ✓ Oil palm trunks (OPT)
- ✓ Empty fruit bunches (EFB)
- ✓ Palm kernel shells
- ✓ Mesocarp fibre
- ✓ Palm oil mill effluent (POME)

OP biomass available in the plantations – OPF available throughout the year during harvesting of FFB and pruning of palm

OPT – available during replanting of old palm trees (25-30yrs)

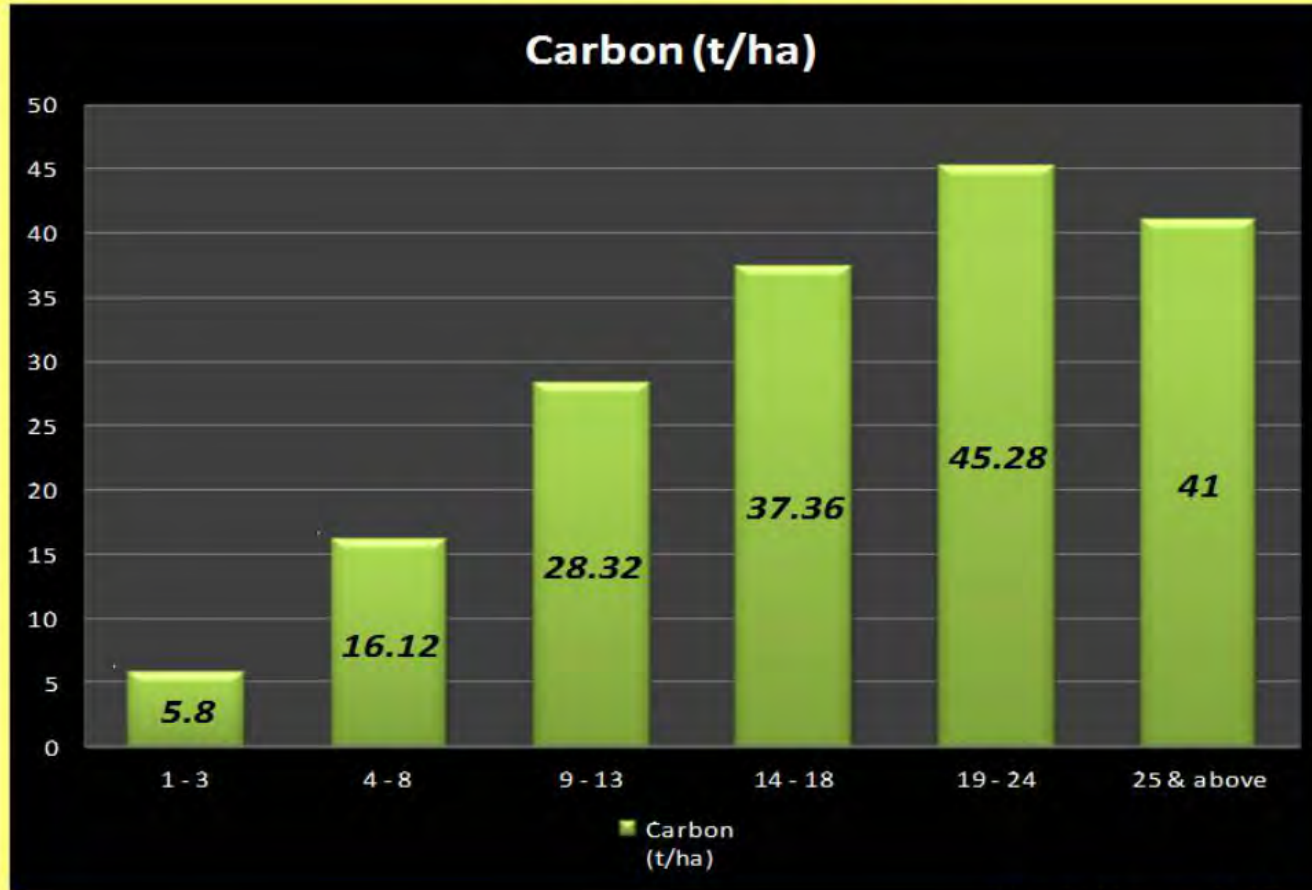
Palm Oil Mill Effluent (POME)

PRODUCTION OF COMPOST FROM EFB & PALM OIL MILL EFFLUENT (POME)



Carbon Balance of the Oil Palm Ecosystem

Estimated Carbon fixed by oil palm in t/ha/year at the six age groups.



Khalid Haron, 2013

What is the optimum life cycle of oil palm for sustainability?

Shift from
INPUT-OUTPUT LINEAR MODEL
to
***CLOSED-LOOP, ECOSYSTEM,
PRODUCTION MODEL***

Enrich the Biodiversity in the Oil Palm Plantation Ecosystem of Mono-cropping cultivation. Diversity is a source of **STRENGTH, STABILITY, ADAPTABILITY & RESILIENCE**. Mono-cropping ecosystem is fragile & vulnerable



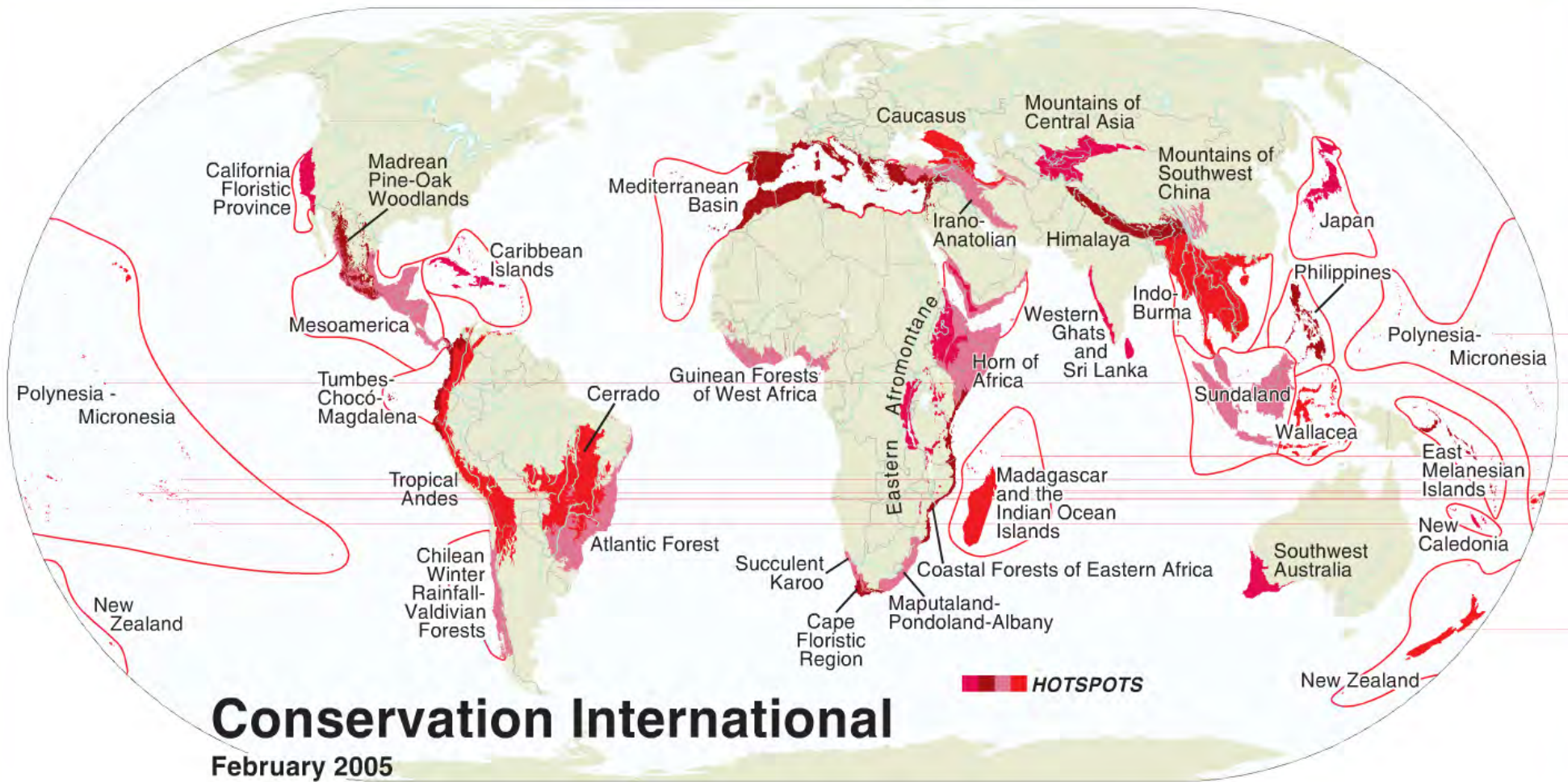
White-Bellied Sea Eagle



Oriental-pied Hornbill with a caterpillar at oil palm smallholdings.



Oriental Magpie Robin



California Floristic Province

Madrean Pine-Oak Woodlands

Mediterranean Basin

Caucasus

Mountains of Central Asia

Mountains of Southwest China

Caribbean Islands

Irano-Anatolian

Himalaya

Japan

Mesoamerica

Tumbes-Chocó-Magdalena

Cerrado

Guinean Forests of West Africa

Eastern Afrotropical

Horn of Africa

Western Ghats and Sri Lanka

Indo-Burma

Philippines

Polynesia-Micronesia

Polynesia - Micronesia

Tropical Andes

Chilean Winter Rainfall-Valdivian Forests

Atlantic Forest

Succulent Karoo

Cape Floristic Region

Maputaland-Pondoland-Albany

Madagascar and the Indian Ocean Islands

Coastal Forests of Eastern Africa

Southwest Australia

Sundaland

Wallacea

East Melanesian Islands

New Caledonia

New Zealand

New Zealand

Enhanced Biodiversity



Closed-Loop Ecosystem



Approach to the **CLOSED-LOOP, PRODUCTION MODEL?**

Trans *Bio-geographical Transplant of Oil Palm* (*Elaeis guineensis*) from the Rainforest West Africa into similar (hot & humid) habitat of the Rainforest of the Indo-Malaya archipelago. Obligate *Elaedobius kamerunicus* weevils were left out.



Re enact the **habitat of ORIGIN of Palm Tree** from the hot and humid tropical rainforest



Re enact the **habitat of ORIGIN of Palm Tree** from the hot and humid tropical rainforest ecosystem of Africa into Malaysia. Coalesced, covered canopy create the microclimate of humid conditions (viability of pollen grains). *Elaeobius* weevils & *Ganoderma* fungi thrive well.

ReConstruct the Keystone link of species in the **OIL PALM ECOWEB**



Close Up Forest Floor - initial 11 months in 2010 - 2011 of the forest

ReConstruct the Keystone link of species in the OIL PALM ECOWEB



Closed-Loop Ecosystem maintained by returning remnants of the harvest and plant parts back to the soil for soil rehabilitation via soil microbes growth. Role of keystone species in the ecoweb is enhanced for stability

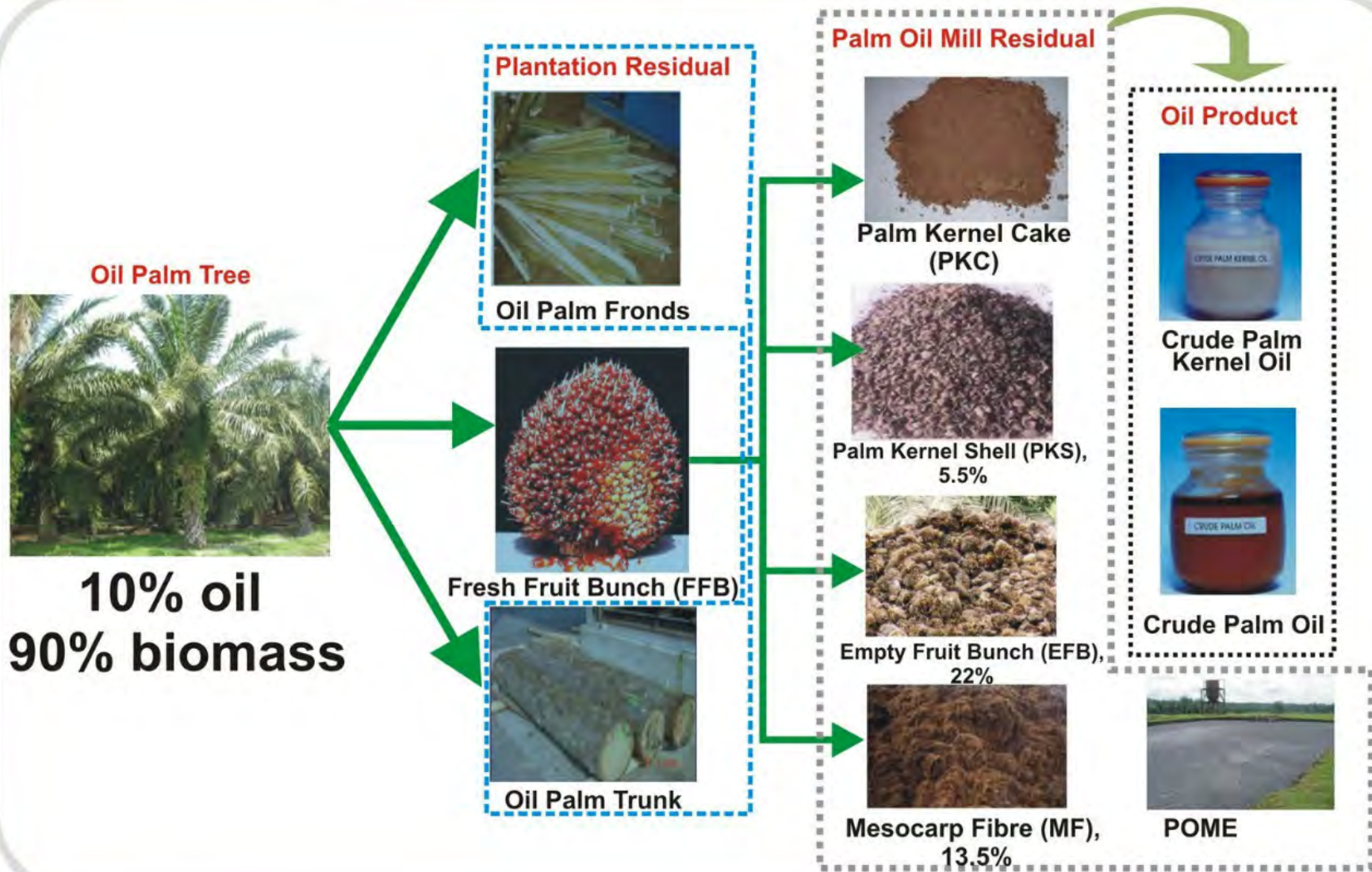


SUSTAINABILITY OF THE OIL PALM SUPPLY CHAIN



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Close the loop on BIOMASS REMOVAL (carbon, potassium, water, etc.) leakages/waste. Return the BIOMASS back to the plantation field



How will **BIOMASS REMOVAL** of the ecosystem components compromises the Oil Palm Sustainability Ethos (Carbon & Water footprints, Potassium)?



Inno Integrasi

Missing Links in Sustainability

Removal of Bio-mass from Land without Replenishment



Extraction and transportation of FFB to palm oil mill



Removal of bio-mass from the Land without replenishment.

Decrease in productivity and life span of Bio-logical Assets due to disease and degradation of soil conditions

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EFB, Decanter sludge, boiler ashes



POME



CPO
Extracted &
Shipped out



Commercial & In Confidence
Inno Integrasi

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3

Case Study on the Oil Palm Biomass Balance, Equivalents & Strategic Options

**FERTILIZER EQUIVALENTS of
the OIL PALM TREE BIOMASS
COMPONENTS**



**BIOMASS RETURNS to field
plantations will improve SOIL.**

TABLE 11. NUTRIENT CONTENTS, FERTILIZER EQUIVALENT AND MONETARY VALUE OF OIL PALM BIOMASS AT REPLANTING

| Palm Residues | Dry matter (t ha ⁻¹) | Nutrient content (kg ha ⁻¹) | | | |
|-------------------------------|-------------------------------------|---|-------------|-------------|-------------|
| | | N | P | K | Mg |
| Above-ground | 85 | 577 | 50 | 1255 | 141 |
| Below-ground | 16 | 65 | 8 | 129 | 15 |
| Total | 101 | 642 | 58 | 1384 | 156 |
| Fertilizer Equivalent | | SOA | PR | MOP | Kies |
| Tonnes ha⁻¹ | | 3.06 | 0.37 | 2.77 | 1.0 |
| * Value (RM) | | 2907 | 240 | 4709 | 800 |
| Total = RM 8656 | | | | | |



* Based on fertilizer price (June, 2012)



BIOMASS RETURNS to field
plantations will improve **SOIL**
REHABILITATION via conditions
enrichment for **SOIL MICROBES**
- **ECOSYSTEM SERVICES**

Missing Links in Sustainability

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EFB, Decanter sludge, boiler ashes

POME



CPO
Extracted &
Shipped out



Concise Production Process and Quality Control



Controlled Environment Composting

- Seal & computer controlled Composting Chambers
- Optimum composting conditions 7 X 24, via high aeration, with 14 days batch cycle
- POME application for moisture control & Bio-Formulation

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Commercial & In Confidence
Inno Integrasi

Post Composting

- Curing and additives for different blend of Bio-organic Fertilisers
- Form Factor processing – Nursery or Plantation Format
- Packaging

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Nutrient Value of Oil Palm Biomass & Case Studies



Tracing the Potassium Trail

High Potassium requirements in Palm Oil

30-60% fertilizer cost in mature palm

*OPF (Oil Palm Fronds) Biomass accounts 14.75 ton/
ha yr*

*Since potassium is costly and taken in huge amounts,,,so **retrieve the loss from plant biomass,** etc.*

K in OP ecosystem: where does it go?

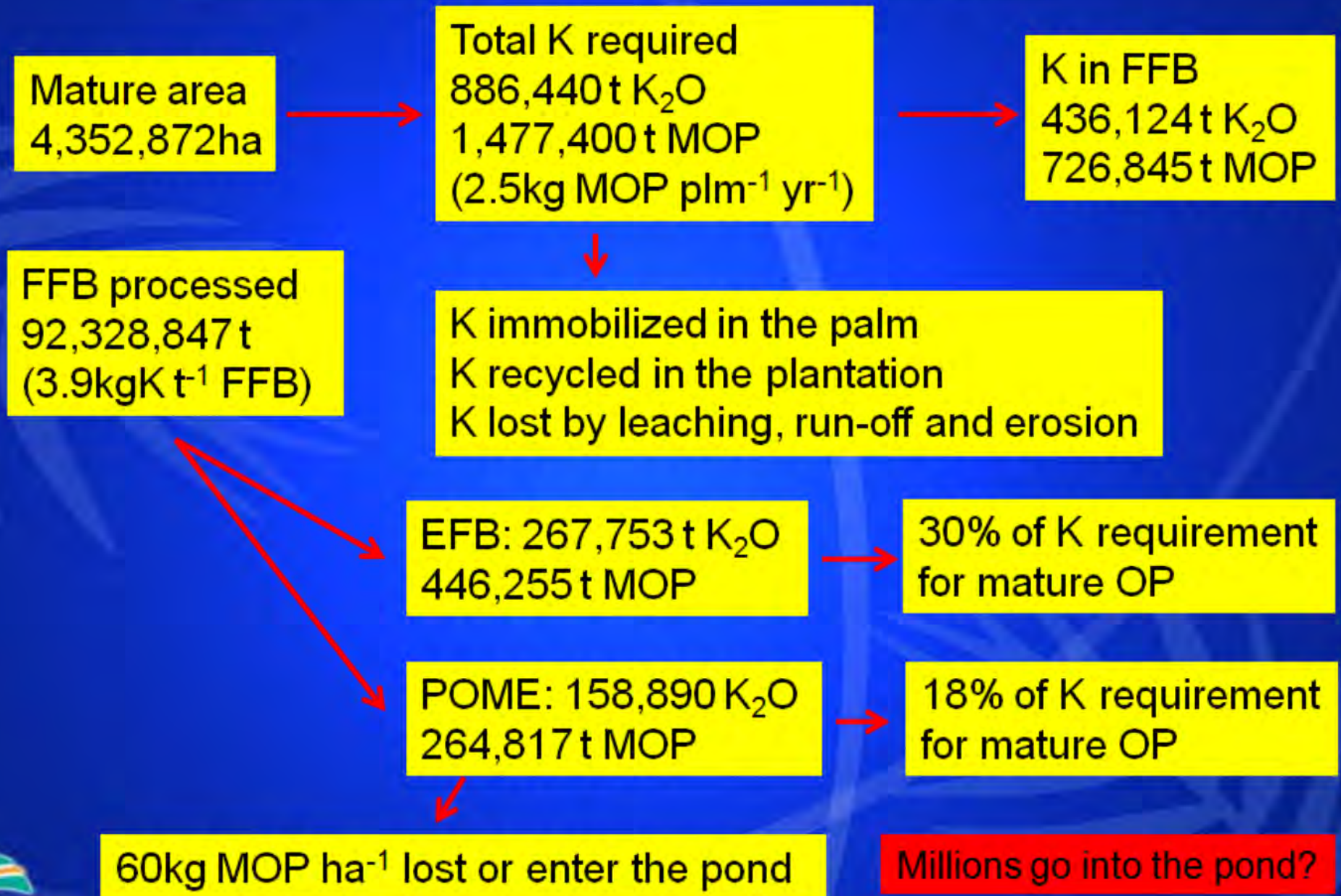
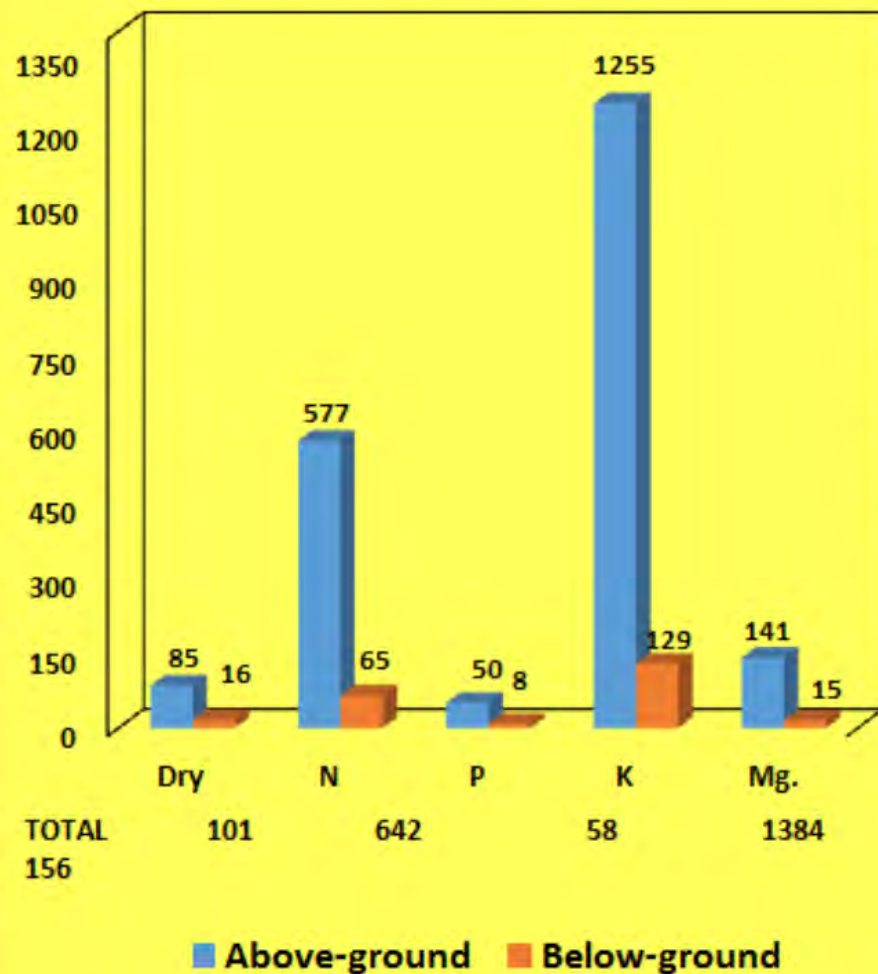
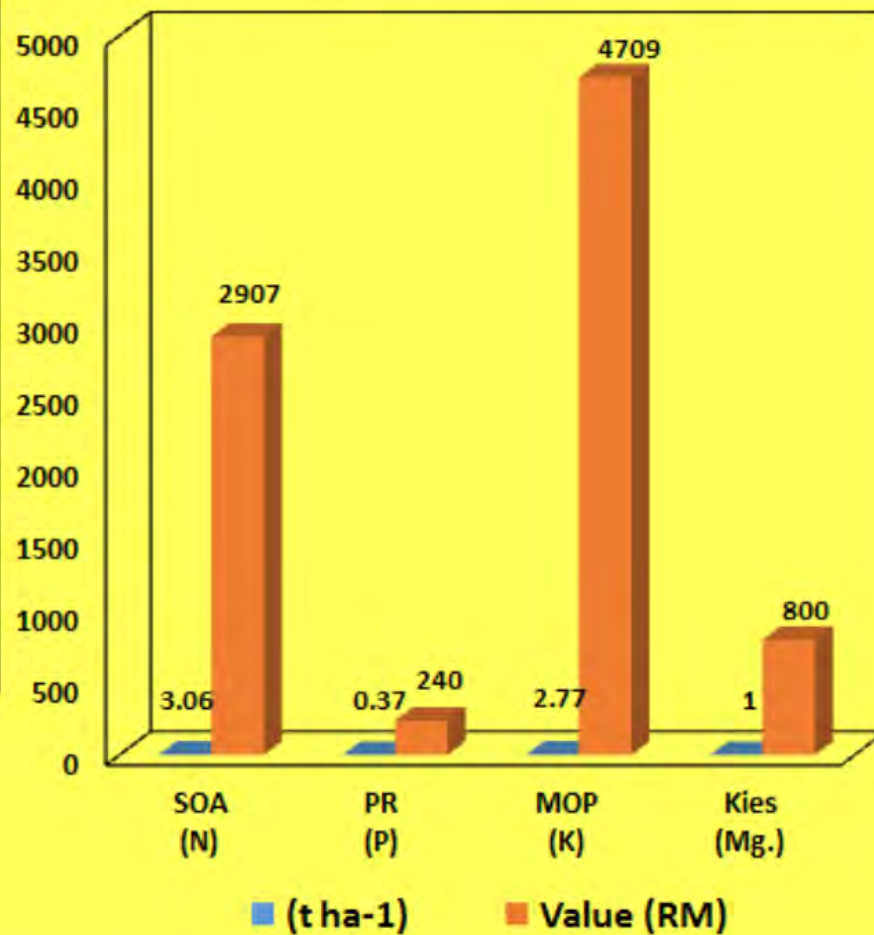


TABLE 5. NUTRIENT CONTENTS AND FERTILIZER EQUIVALENT OF OLD OIL PALM BIOMASS AT REPLANTING.

Palm Residues



Fertilizer equivalent



TRENDS FOR OIL PALM FERTILIZER

Mostly inorganic but **shift emphasis to organic sources** for sustainability

Stemming the loss of Inorganic Fertiliser, optimize utilisation
Where are the major **sources of loss/leakages?**

Identify, Trace & Trek & quantify the %age and **VALUE of losses** - Traceability Studies

Closed the loop/leakage & stem losses from Production Ecosystem

Major **Losses from POME** (Palm Oil Mill Effluent) (?)



EFB recycle



POME recycle

EXISTING NUTRIENTS RECAPTURE FOR THE FERTILIZER ECOSYSTEM

Existing RETURN, RECYCLE and CLOSE-THE-LOOP for NUTRIENTS
ZERO BURNING of plant materials during replanting



Zero burning



FERTILIZER (N,P,K, etc) Recapture: POME biomass treatment to recoup the Potassium saves a huge cost savings on fertilizers



POME recycle

EXISTING NUTRIENTS RECAPTURE FOR THE FERTILIZER ECOSYSTEM

Implementing RETURN, RECYCLE and CLOSE-THE-LOOP for NUTRIENTS
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FERTILIZER (N,P,K, etc) Recapture: POME biomass treatment to recoup the Potash
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Zero burning

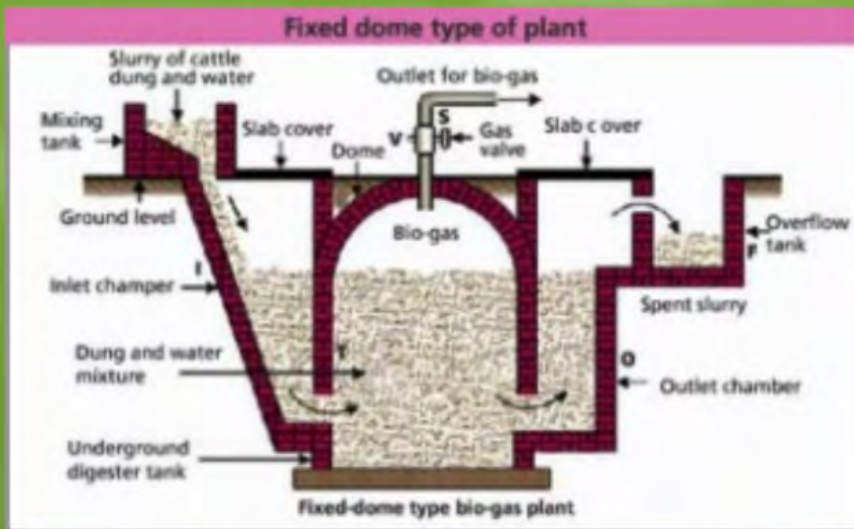


FERTILIZER (N,P,K, etc) Recapture: POME biomass treatment to recoup the Potassium saves a huge cost savings on fertilizers



POME recycle

CARBON: BioGas Methane-Carbon Capture



Biogas plants

Nitrogen-fixing legumes

NITROGEN: Cover Crops Root Nodulations (Nitrogen-fixing bacteria - Root nodules)



Cover crops



Potassium & micro-elements

Mulches & cover crops to capture moisture in the surface soil



Compost & Mulches

Examples of Closed-Loop Fertiliser Application

Opt for the **ZERO WASTE** strategy for potassium

Plant Filter: Potassium capture using **banana plants planted in clusters** between rows in cluster of fronds heaps (possible). Reconsider current planting density

Banana planted in clusters;
Thrives under moist/humid
conditions; short term crop



Redesign the POME treatment process ponds to enable the **RECAPTURE** or **RECOUP OF NUTRIENTS IN THE ECOSYSTEM**, zero waste approach

Retrieving POME in
the ponds recapture
the potassium loss
which costs
millions of Ringgits





Speaker's Quick Takes, Summary & Recommendations

**PARTIAL
FOR ENE**

SUSTAINABILITY

SUSTAINABILITY MANTRA

1 Sustainability values of the UK Palm Supply Chain has progressively been promoted and regulated into the SUSTAINABILITY PRECEPTS STANDARDS - RPO, SCC, RPPD, LABP, RPO, and including the SCPI, principles and criteria of the oil palm managers.

2 The SUSTAINABILITY MANTRA will reshape the productivity landscape of the palm oil industry. Decision on the BIOMASS UTILISATION will be considered against these newly embraced elements in sustainability.

3 However, oil palm growers will focus in the principles and criteria of oil palm sustainability (RPO, SCC, RPPD, RPO, LABP, etc.) to take or verify over biomass utilization for renewable energy. The considerable benefit of analysis will be further expanded from focusing on the incorporation in BIOMASS UTILISATION of the OIL PALM PLANTATIONS for RENEWABLE ENERGY USE to work.

1

Sustainability values of the Oil Palm Supply Chain are systematically being premised and regulated into the SUSTAINABILITY PRECEPTS (STANDARDS - RSPO, ISCC, MSPO, SABP, ISPO, etc), including the SOPs, principles and criteria of the oil palm management.

2

The SUSTAINABILITY MANTRA will reshape the productivity landscape of the palm oil industry. Decision on the BIOMASS UTILISATION will be considered against these newly embraced elements in sustainability.

3

Therefore, oil palm growers will factor in the principles and criteria of oil palm sustainability (RSPO, ISCC, MSPO, ISPO, SABPs, etc.) to take priority over biomass utilization for renewable energy. The comparative cost-benefit analysis via the fertilizer equivalents (benchmarking) on the considerations for BIOMASS UTILISATION of the OIL PALM PLANTATION for RENEWABLE ENERGY USE is weak.

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PARTIAL BIOMASS FOR ENERGY, etc.

Energy is used to produce biomass. This is done by using energy from the sun to grow crops. The energy from the sun is converted into chemical energy stored in the biomass. This energy can then be used to produce energy.

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Invariably, partial **EFBs, POME (partial), OIL PALM TRUNKS, PALM KERNEL SHELLS**, etc. are strongly considered to be returned back to the soil in the oil palm plantation first and then for renewable energy.

Nonetheless, the **BIOMASS FOR RENEWABLE ENERGY** have some level of use to serve as complement **MIX RESOURCES** for the **RENEWABLE ENERGY policy** without sacrificing or jeopardizing the sustainability of the oil palm supply chain.

MPOA council is taking a consonant policy stance on biomass utilization in that it is up to the individual company to make their own business decisions towards the **UTILISATION OF BIOMASS for RENEWABLE ENERGY.**

This policy take is not in full compliance, but partial, with the PEMANDU's target on **RENEWABLE ENERGY** from the palm oil industry.

Summary & Recommendations



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Summary & Recommendations

1 **INPUT-OUTPUT LINEAR** model shift to **CLOSED LOOP, ECOSYSTEM** production model (sustainability)

2 **CLOSE the LOOP (Reduce waste/leach & filter)**
a. Return the **PLANT BIOMASS** back to the field;
b. Recapture & Retrieve **NUTRIENTS w PLANT FILTERS** ;
c. **REPLANTING** on rows of stacked frond & plant filters;
d. Review **PLANTING DENSITY & Palm Life Cycle (<25 yr)**

3 Reduce dependence on **INORGANIC FERTILIZER** & balance the shift to **ORGANIC FERTILIZER**

4 Redesign **SOPs & Re-layout plantation infrastructure** to reduce carbon footprints;

5 **Enhance Biodiversity** of the oil palm monocropping; **enhance role of keystone species** of oil palm ecoweb



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That's All Folks!!

