The Use of Bio-Compost in Oil Palm Plantation– Sime Darby's Experience

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Scope of Presentation

1. Rationale of Composting
2. Overview of Sime Darby Bio-Compost Project
3. Production of Bio-Compost
4. Expected Agronomic Benefits
5. Future Bio-Compost Development

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Rationale of Composting

Two main by-products of palm oil mill
- POME
- EFB

CH_4

Issues dealing with these by-products
- Environmental pollution
- Operational problems

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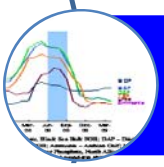
Rationale of Composting (cont)

	Common Practice	Problem Associated
POME- *Environmental concerns*	• Treated to bring down BOD • Land applied • Water discharged	• Long retention time (90-120 days) • Large area requirement • High cost for treatment • High emission of CH_4
EFB- *Operational issues*	• Mulching	• Too bulky • Difficulty in transportation • Laborious • Losses of nutrients
Bio-Compost- *New expectation for more sustainable practices*	• Manage the disposal of EFB & POME in sustainable approach • Recycle the mill waste by converting into fertiliser • Reduce dependency on inorganic fertiliser	

Rationale of Sime Darby Bio-Compost Project

Sustainable Waste Management

- Abundance biomass 5.2 million MT of POME and 1.8 million MT EFB annually
- Utilizes 100% EFB, 30-50% POME, 100% decanter and boiler ash



Risk Management i.e. Cost Savings (Long Term)

- Less dependent on costly inorganic fertilizers
- Enable effective budgeting and cost control as the buy back price is pre-determined at fixed increment annually

Greener Carbon Footprint for Palm Oil Production

- Composting process under aerobic condition, **eliminates emission of methane** (GHG), which entitles for registration as CDM project – additional revenue from carbon credits.
- Improved carbon intensity of palm oil production , 60-70% reduction of carbon emission

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Rationale of Sime Darby Bio-Compost Project (cont)

Legal Compliance

- Stricter Environmental Quality Act 1974 for wastewater discharge
- Enforcement of no waterways discharge of treated effluent

Voluntary compliance (RSPO)

- Principle 5, Waste is reduced, recycled, and disposed of in an environmentally and socially responsible manner
- Criterion 5.4, Plans to reduce pollution and emission, including greenhouse gases, are developed, implemented and monitored

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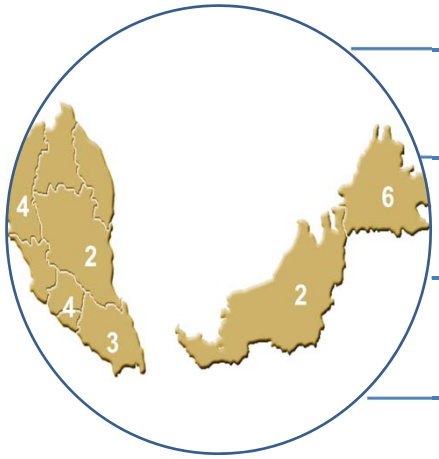
Overview of Sime Darby Bio-Compost Project



- Commenced in 2003 in Lavang Mill, Sarawak
- Todate 22 composting plants operated by 4 concessionaires
- Capacity of 600,000 tonnes Bio-Compost annually
- Potential Certified Emission Reduction 225,000 tonnes CO_{2eq}

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Expected Bio-Compost Quality

- Product quality is a fundamental requirement, the concessioners have to comply the following obligations:
- Nutrient Value :

Nutrient level(%)	N	P_2O_5	K_2O	MgO	Aggregate
GNV(%)	1.8	0.5	3.4	0.8	6.5
MANV(%)	**1.6**	NA	**3.0**	NA	NA

- Moisture Content : < 50%
- CN ratio : < 30
- Product form not meeting the specified criteria- fibrous form will be rejected for reprocessing

Expected Fertiliser Value

FERTILISER VALUE PER TONNE OF BIO-COMPOST				
Nutrient	Fertiliser Equivalent			
	Fertiliser	Quantity (Kg)	Value (RM)	Value (USD)
N	Ammonium Sulphate	42.0	38.60	12.50
P_2O_5	Rock Phosphate	8.9	5.80	1.90
K_2O	MOP	28.3	48.10	15.50
MgO	Kieserite	15.4	12.50	4.00
Total			**105.00**	**33.90**

The "Unexpected"

1. Weather-dependent
   - Open composting system is weather-dependent will result in high surface runoff & soggy conditions, thus making operation difficult

2. High Moisture Content
   - Damages to air permeable sheets, moisture content in bio-compost can increase up to 60%
   - High nutrient leaching losses
   - High variances in moisture content could lead to wide variances in the bio-compost nutrient levels

3. Low and Inconsistent Nutrient Value.
   - Poor quality of POME and the over-application of POME

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The “Unexpected” (cont)

4. Delay in Bio-Compost Application

- Lack of logistic support for field application.
- Bio-compost is not applied immediately and dumped by roadside.
- High nutrient losses (N & K)

5. Labour-intensive operation

- Manually applied at 2-3 points at the outer periphery of palm circle
- High moisture content (60%) leads to heavier bio-compost weight, lower productivity

6. Low POME uptake

- Composting plant can utilize about 30% of POME generated by the mill
- The excess 70% POME will have to be treated separately in a ETP

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Mitigating the “Unexpected”

- Closed System of Composting

- Weather independent
- Better control of moisture
- Better nutrient content
- Reduce surface runoff & soggy conditions

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Mitigating the “Unexpected” (cont)

- Mechanized Bio-Compost Application : Giltrap

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Mitigating the “Unexpected” (cont)

- Mechanized Bio-Compost Application : MTG

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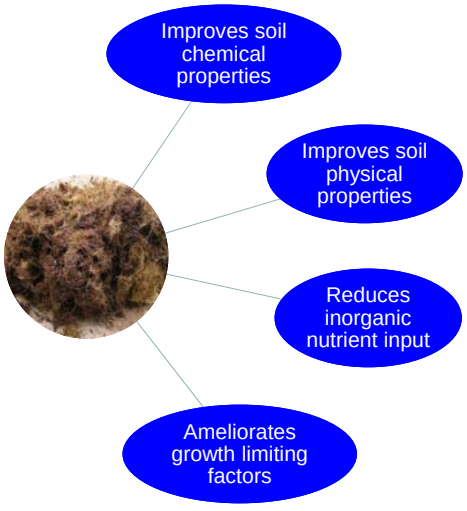
Expected Agronomic Benefits



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Expected Agronomic Benefits (cont)

Effect of Bio-compost on FFB yield in immature oil palm planting.

Treatments Bio-compost Kg/palm/year	Additional Inorganic N/K_20 Kg/palm/year	Mean FFB Yield* (Year 1 & Year 2) % Over Control
0	1.0/2.0	100
25	1.0/2.0	117
50	1.0/2.0	123
75	1.0/2.0	123

***** Harvesting commenced at 25th month from planting

Source : K.P Ong (2008)

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Expected Agronomic Benefits (cont)

- **Bio-Compost is expected to give similar benefits as EFB**
- It has been established that the application of **EFB would increase FFB yield by 7 – 75% depending on the soil type as compared to the use of inorganic fertiliser**.

Effect of EFB application on FFB yield in mature oil palm

Soil Series	Mt/ha	%	Reference
Akob	3.40	13	Gurmit *et al*., 1981 (UP)
Bungor	2.5-6.4	10-24	Golden Hope 1985
Malacca	8.27	75	Lim & Chan 1990 (Guthrie)
Rengam	3.1-4.98	7-20	Chan *et al*., 1993 (Guthrie)
Tavy	3.92-11.19	16-53	Chan *et al*., 1993 (Guthrie)
Seremban	7.36	36	Chan *et al*., 1993 (Guthrie)
Harimau	6.05	29	Chan *et al*., 1993 (Guthrie)
Prang	3.98	17	Chan *et al*., 1993 (Guthrie)

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Expected Agronomic Benefits (cont)

Effect of application of EFB

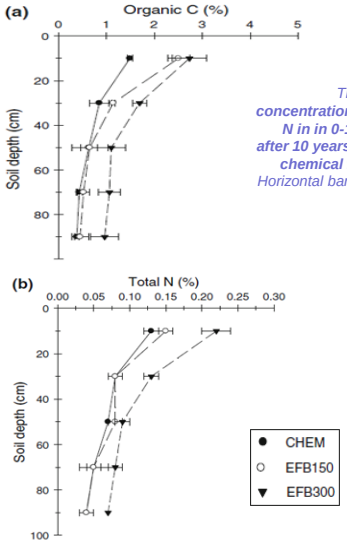
Soil Properties

Organic C

- In the topsoil, organic carbon **increased from 1.49% to 2.5% and 2.73%** when EFB was applied at **150 and 300 kg per palm per year** respectively.
- In the sub-soils, organic carbon had also increased significantly **but only with the application of EFB at 300 kg**.

Nitrogen

- There was also an **increase in total nitrogen** with EFB application .



These figures shown ***concentration of the SOC, total N in in 0-100 cm soil profile after 10 years of application of chemical fertiliser and EFB.*** *Horizontal bars indicate standard deviation*

Source: Rosenani *et. al* 2009

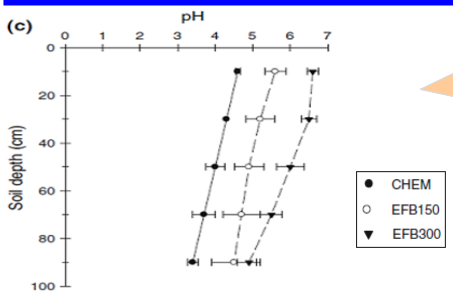
Expected Agronomic Benefits (cont)

Effect of application of EFB

Soil Properties (cont)

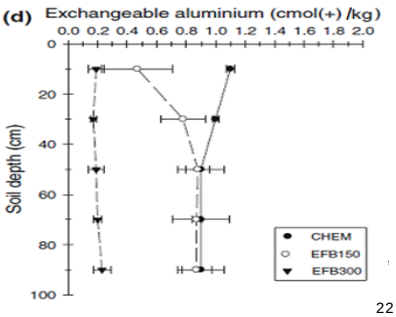
Soil PH

- Application of EFB **increased the soil pH by TWO units** with application of EFB at 300 kg per palm per year and a **one unit increase with EFB at 150 kg** in the 0-60 cm soil layer, compared to use of chemical fertilisers.



Exchangeable Al

- The application of EFB reduces **the exchangeable Al contents in soils up to 60 cm depth**.



Source: Rosenani *et. al* 2009

Field Application

1. Rates of application

- 50 – 100 Kg/palm/year
- Depending on soil, terrain and accessibility

2. Supplementary inorganic fertiliser

- Rate of application depending on the bio-compost quality, application efficiency, foliar result and observation made by Agronomist during visit.

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Future Bio-Compost Development

Bio-Compost
Moisture: 50%
Bulk density: 300 – 400 kg/m^3
Nutrient content: N - 1.8% , P_2O_5 - 0.5%, K_2O – 3.4%

Bio-Compost Pellet
Moisture : 10 - 20%
Bulk Density : 700 – 850 kg/m^3
Nutrient Content: Based on formulation

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Process Flow: Bio-Compost Pellet

Bio-Compost

Dryer

Pulveriser

Sieve

Mixer

Pelletiser

Final Product

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Future Expectation: Enriching Bio-Compost Pellet

Plant Nutrient Formulation

- Specific growing phase, nursery, immature and mature phases
- Specific environments, peat and marginal soils
- Corrective application, for nutrient deficiency symptoms

Growth Enhancement Formulation

- Phosphate Solubilizing microbes, solubilise the fixed phosphate and improve availability to the plant,
- Mycorrhizae, enhances root development, increases the absorption surface of the root
- Azospirillum and Azotobacter, symbiotic relationship for nitrogen fixation via roots

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Expected Benefits of Bio-Compost Pellet

Balanced nutrient content

- Formulated to the specific nutrient content requirements

Ease of handling and application

- Lower bulk volume for application
- Less hygroscopic
- Application rate could be reduce by half

Storage

- Requires much less storage space compared to bio-compost
- Minimal deterioration in quality if prolong storage is required

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Conclusion

The conversion of EFB and POME into bio-compost offers an attractive solution for sustainable waste management to the oil palm industry

Composting system reduces GHG emission and minimizes the risk of water pollution from POME

The use of bio-compost could reduce the use of inorganic fertiliser thus reduce the total manuring cost

Further research on enriched compost and effective application rate will add value to bio-compost.

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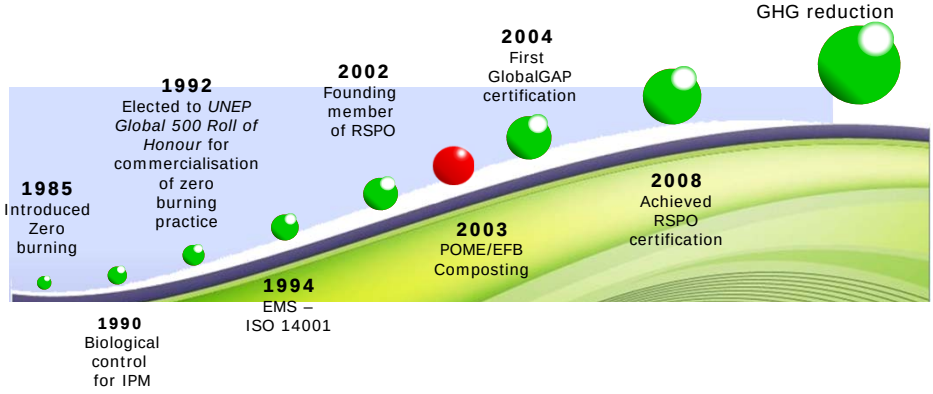
Our Sustainability Journey



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Thank You