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Composting for a more sustainable oil palm plantation

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INTRODUCTION

The new challenges of sustainability for agriculture

Before

- Food Safety
- Economic development

Nowadays

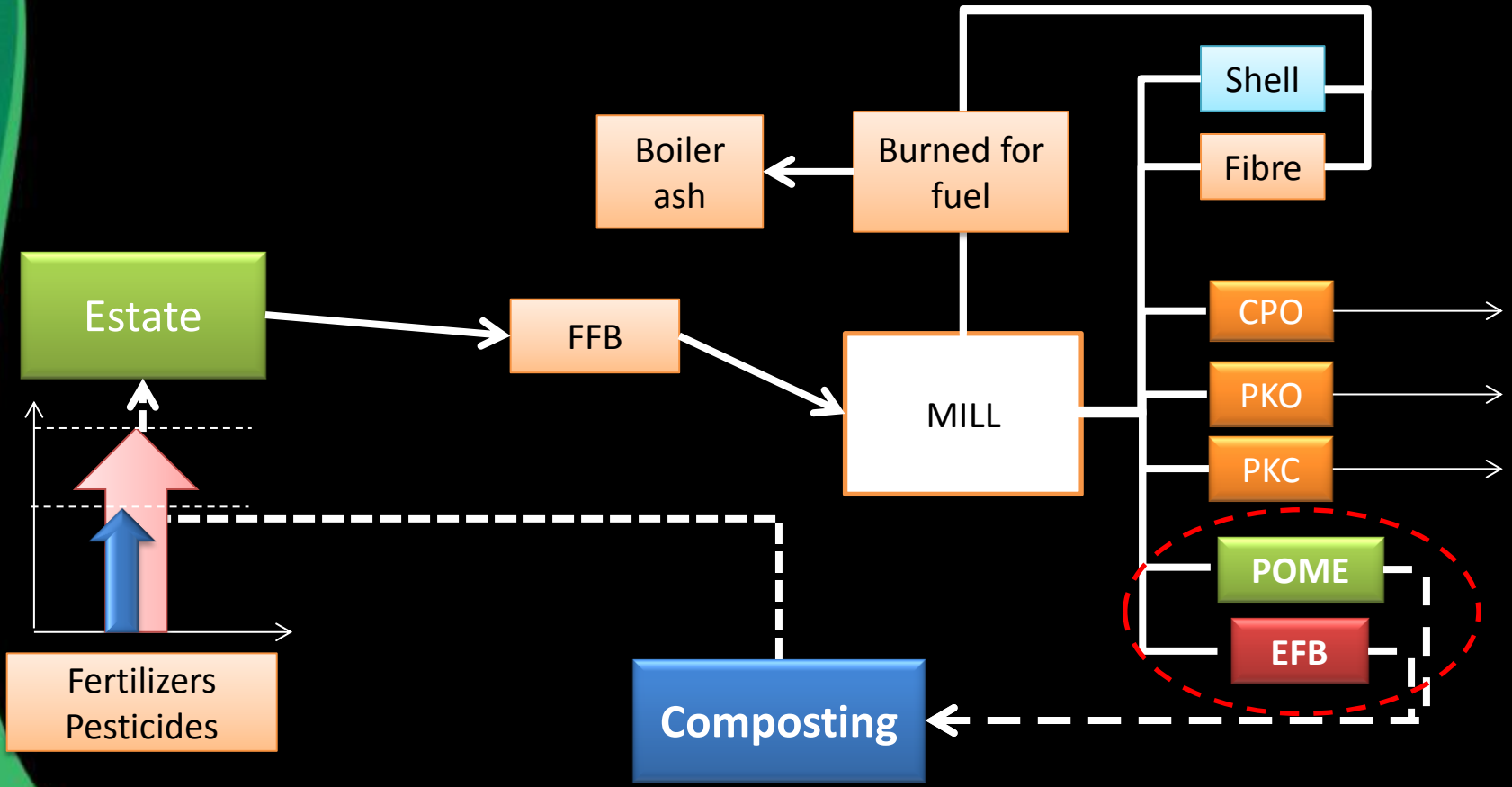
- **Food Safety**
- **Climate adaptation/mitigation**
- **Biodiversity**
- **Local Environment**
- **Working condition**
- **… Other ecosystemic services**

A case study on composting

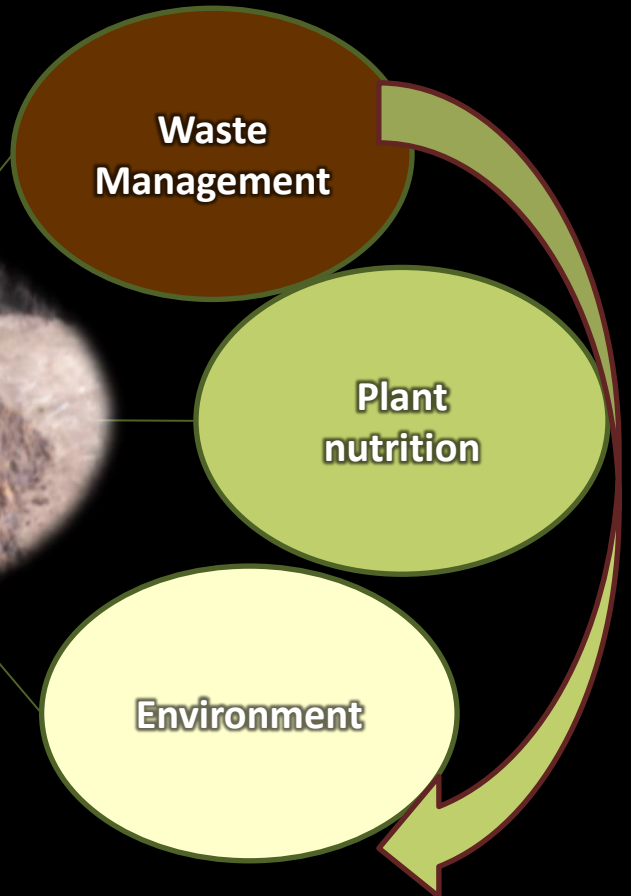
From Agriculture to Agro-Ecology:

- Particularly relevant on oil palm : high cost of imported mineral fertilizers, large amount of waste, Indonesia has the most planted area in the world.
- Decomposition of organic matter and its incorporation into soils is a key function in natural ecosystems.
- An agro-industrial solution-> Turning organic waste into a valuable resource in an effective way .
- Definition of an ecological process-> The degradation and stabilization of organic matter carried out by a succession of microbial communities under controlled conditions.

Composting in oil palm plantations



Our approach



Palm Oil Mill
- Waste management
- Logistics
- Effectiveness of the process

Estate
- Plant nutrition
- Soil quality
- Pest and disease

Global
- Pollution
- Global change mitigation

Waste Management

Location of the case study on Composting

Composting Trial

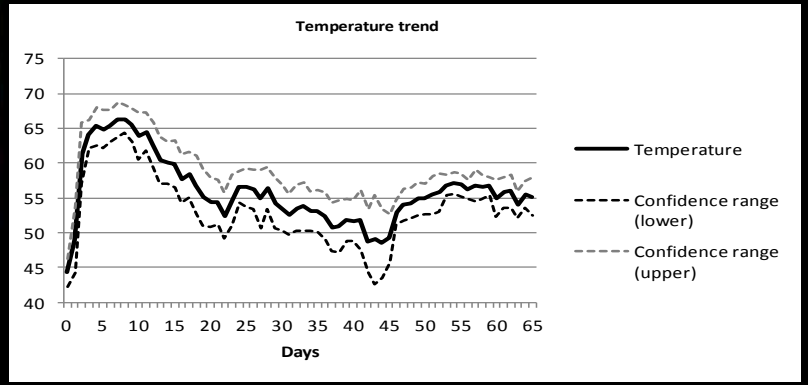
- Covered platform, aerobic process and full leachate recycling.
- Heaps of 4 tons of raw EFB from the mill
- Treated POME from methane plant
- BARformula microbial inoculation
- Daily spraying : 40 days
- Maturation period : 20 days
- POME to EFB ratio : 1, 3, 4 m^3/ton

Results :

Volume and Weight reduction

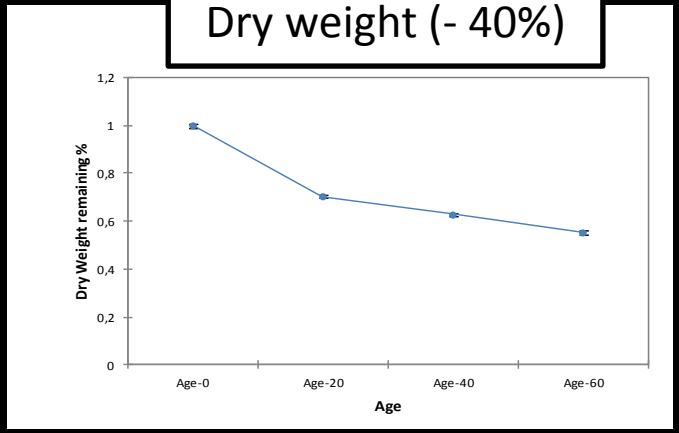
Results :

Volume and Weight reduction

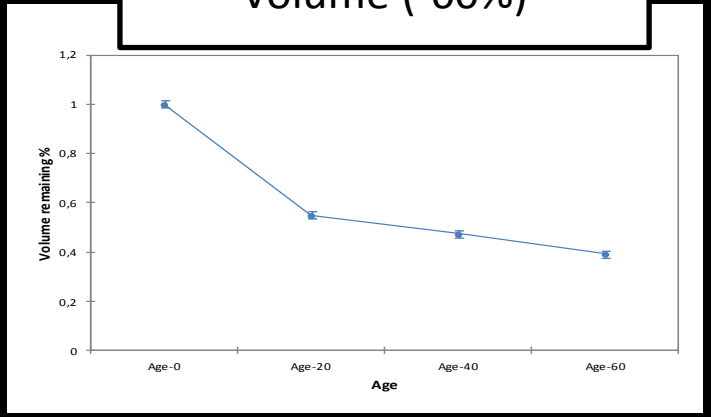


Moisture evaporation after POME application 60%

Dry weight (- 40%)



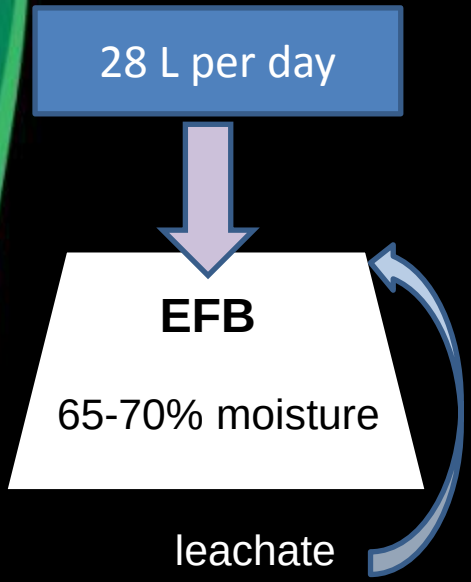
Volume (-60%)



Results :

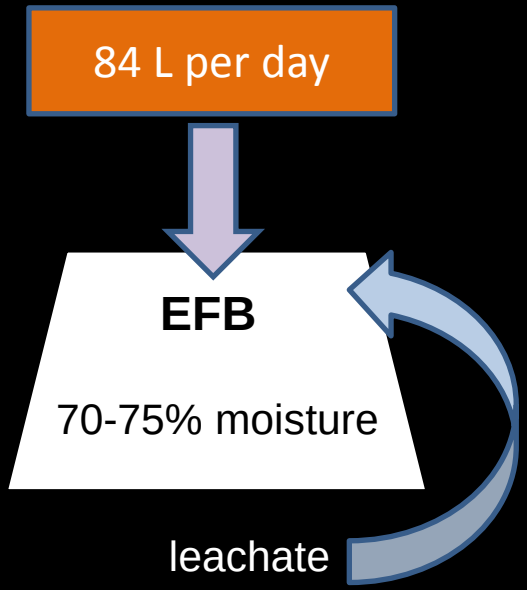
Effluent Absorption

Target 1m^3/ ton EFB



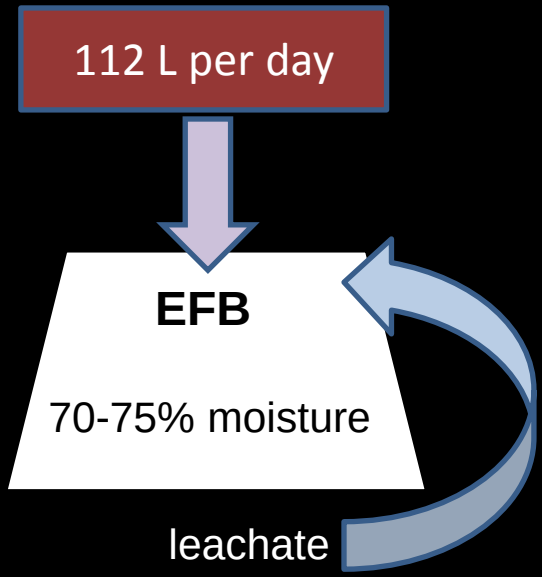
Actual ratio POME recycled: 1

Target 3m^3/ ton EFB



Actual ratio POME recycled: 1,4

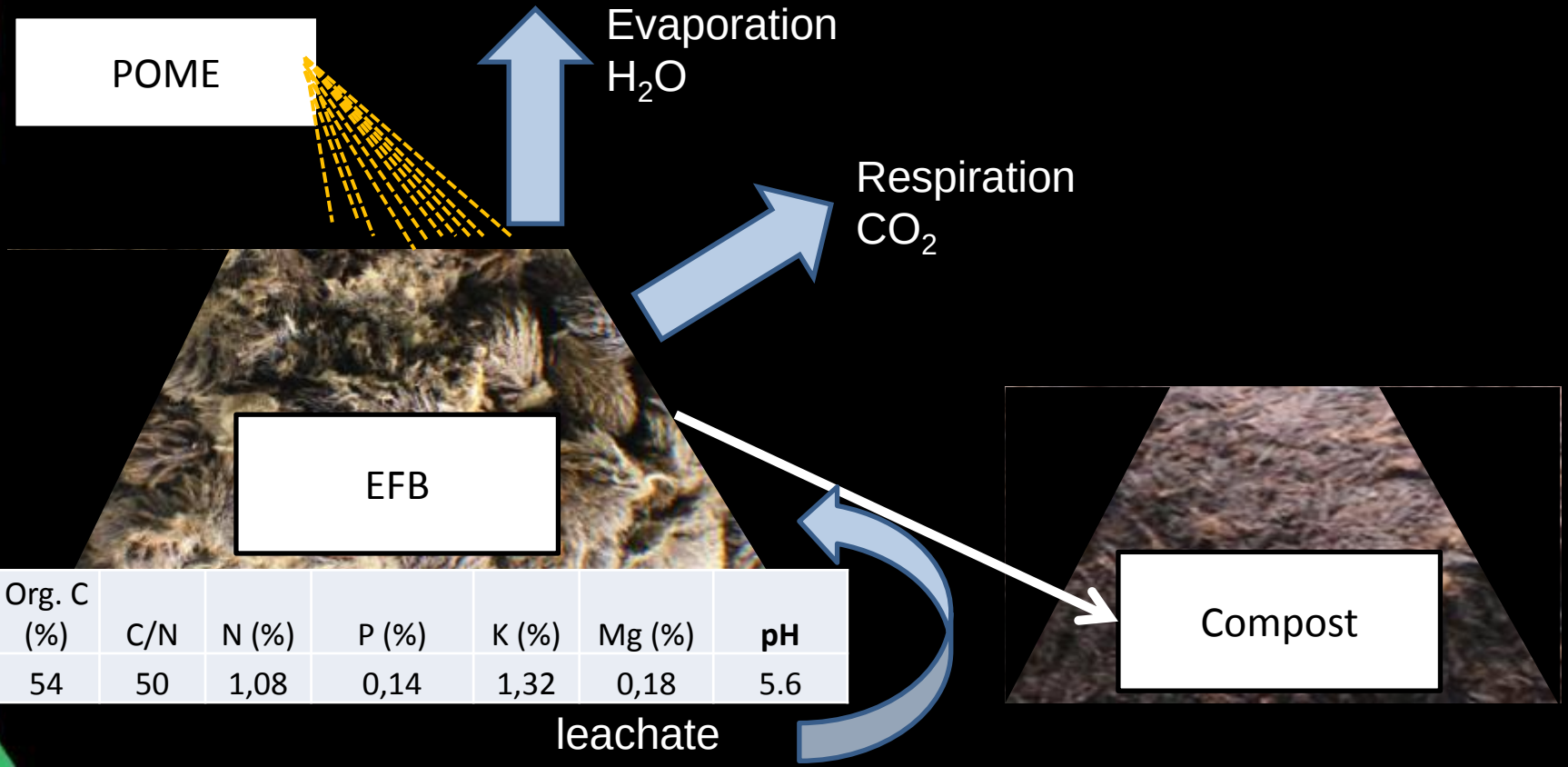
Target 4m^3/ ton EFB



Actual ratio POME recycled: 1,4

Results :

Nutrient Balance



Org. C (%)	C/N	N (%)	P (%)	K (%)	Mg (%)	**pH**
54	50	1,08	0,14	1,32	0,18	5.6

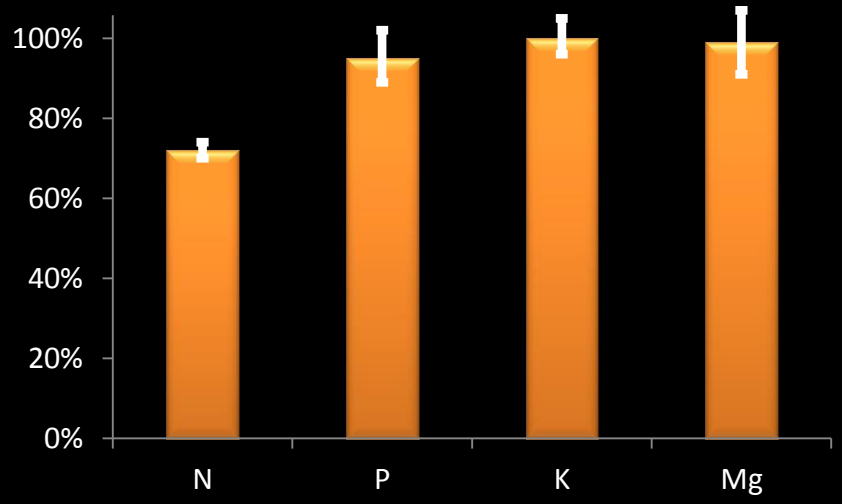
Is Composting an efficient way to recover nutrients?

Nutrient content of compost at day 60				
N	P	K	Mg	pH
1,6%	0,25%	4,5%	0,45%	8.7

Significant increase of nutrient contents during the composting process

Further improvement is required for nitrogen by minimizing the volatilization

Nutrient recovery after 60 days of composting



The error bars indicate the lower and upper bound of a 95% confidence interval for the average nutrient recovery rate during composting.

Key Learning :

Recommendations for good composting

- Controlling conditions (concrete platform and roof)
- Recycling the leachate
- Adapting the spraying program : target 1 – 1,4 m3/ton EFB, maintaining moisture around 65-70%, decreasing the dose of POME with time
- Targeting for Nutrient Content
- Challenging : How to minimize the losses in Nitrogen?

Plant nutrition

Drum trials :

Alluvial Clay

- M = mineral fertilization (once a month = 6 times)
- C = Compost (once every two months = 3 times)

  4 replicates, 32 seedlings

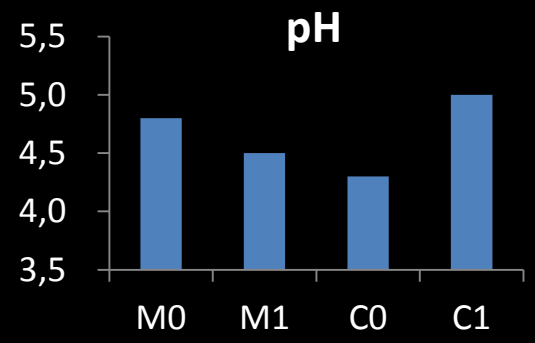
Podzol

- E low = 3 x 1,5 kg fresh EFB per drum
- E high = 3 x 3 kg fresh EFB per drum
- C low = 3 x 1 kg compost per drum
- C high = 3 x 2 kg compost per drum

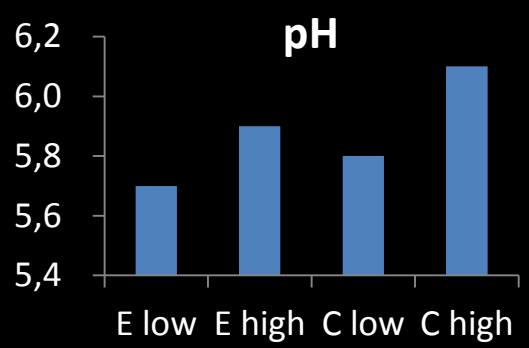
  4 replicates, 32 seedlings

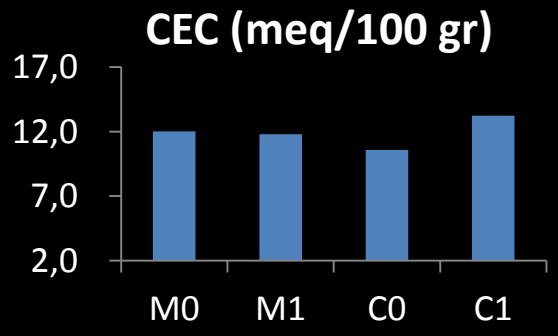
Drum Trial results

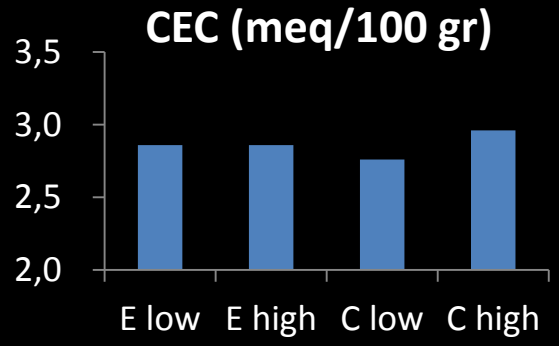
On Alluvial Clay



On Podzol

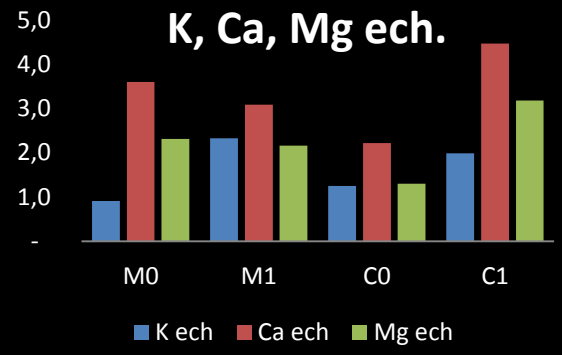


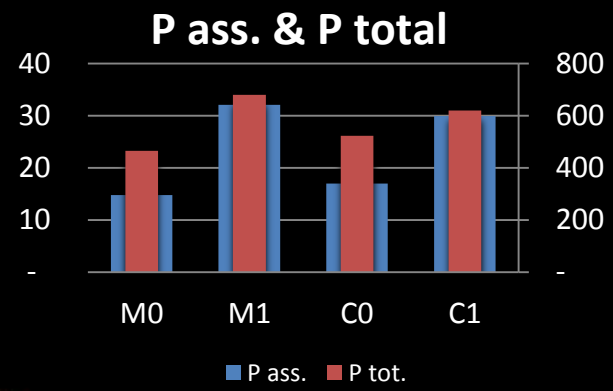




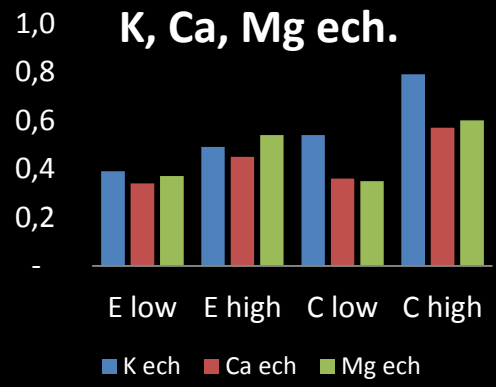
Drum Trial results

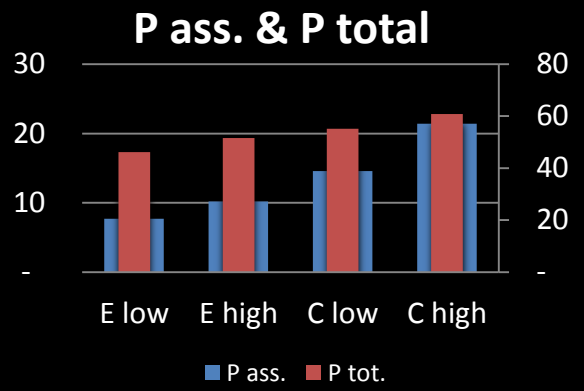
On Alluvial Clay





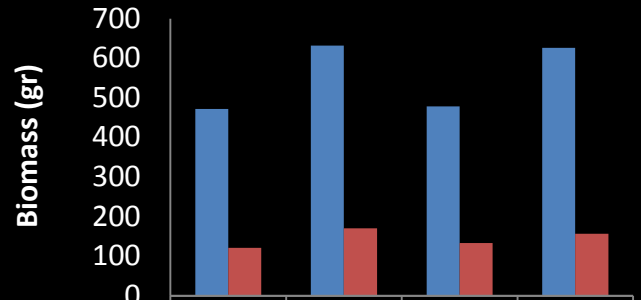
On Podzol





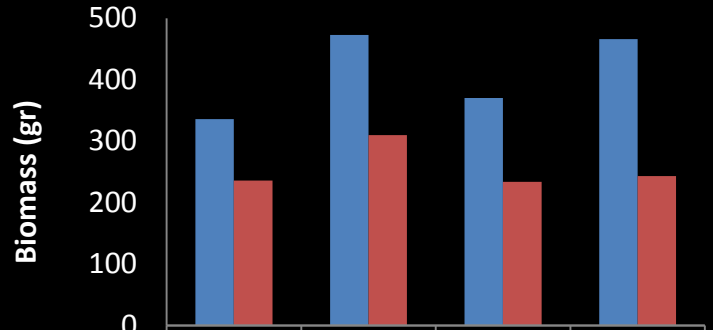
Drum Trial results

On Alluvial Clay



	M0	M1	C0	C1
Frond biomass	472	632	478	626
Root biomass	121	170	133	157

On Podzol



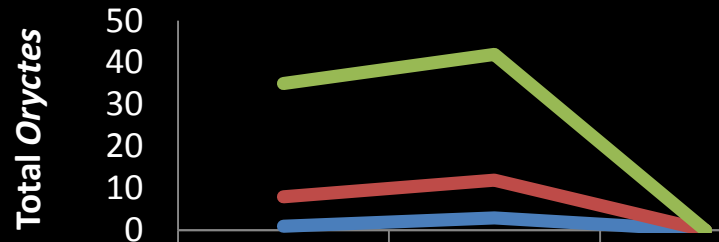
	E low	E high	C low	C high
Frond biomass	336	473	370	466
Root biomass	236	310	234	243

Foliar analysis

variable	M0	M1	C0	C1
N	3.27	**3.69**	3.47	3.49
P	0.19	0.21	0.20	0.20
K	1.72	1.79	1.82	1.69
Ca	0.50	0.51	0.50	0.51
Mg	0.27	0.27	0.26	0.28
Cl	0.58	**1.21**	0.82	0.97

variable	E low	E high	C low	C high
N	2.22	2.1	2.18	**2.82**
P	0.19	0.189	0.199	0.216
K	2.20	2.17	2.05	2.28
Ca	0.423	0.404	0.464	0.34
Mg	0.324	0.312	**0.352**	0.282
Cl	0.546	0.577	0.697	0.683

Attractivity of Compost



	Mth. 1	Mth. 2	Mth. 3
EFB	27	30	0
OP Trunk Chips	7	9	0
Compost	1	3	0

RCBD statistical design

Three (3) treatments (fresh EFB, Oil Palm Trunk Chips, compost) x 6 replicates. 18 unit plots in open land surrounded by palms, each plot being a heap of 2 m length x 2 m width x 0.2 m height.

Environment

Environmental impact

- POME ponds and nitrogen fertilizers are important contributors to the GHG footprint of CPO[1].

- Compost and methane production can be combined to reduce GHG emissions by 75%, with a target - 500 kg eq CO_2/ton CPO[2].

- Effect on soil quality : proven increase in pH and CEC, expected improvement of soil physical & biological properties.

1. Bessou, et al . 2014. « Pilot Application of PalmGHG, the Roundtable on Sustainable Palm Oil Greenhouse Gas Calculator for Oil Palm Products ». Journal of Cleaner Production 73 : 136-45.

2. Stichnothe & Schuchardt. 2010. « Comparison of Different Treatment Options for Palm Oil Production Waste on a Life Cycle Basis ». The International Journal of Life Cycle Assessment 15 (9): 907-15.

Environmental and economic benefit

- Substituting 20-30% of the mineral fertilizers (estimated).
- Saving 10,3% of the cost of fertilization in one of ANJ estate
- Improving soil properties on the long term
- Reducing drastically the attractivity to Oryctes
- Reducing the GHG emissions (needs further research)

ICOPE
enhancing sustainable oil palm

ANJ

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AGRICULTURAL RESEARCH FOR DEVELOPMENT

BPP/Agraria
THE BUSINESS OF AGRICULTURE

BICC, The Westin Resort Nusa Dua, Bali
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Thank You