CO_2 EMISSION UNDER DIFFERENT LAND USE AND MANAGEMENT SYSTEMS ON PEATLAND

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OUTLINES

1. Introduction
2. Activities:

   Activity 1. Land cover effect on CO_2 emission (IGP Wigena)

   Activity 2. Emission of CO_2 under Rubber Plantation (Maswar, REALU II)

   Activity 3. Spatial and Temporal Interaction of CO_2 (Setiari M)

   Activity 4. Micro variability of CO_2 emissions and effect of fertilization zoning (Ai Dariah)

   Activity 5. Carbon emission on fertilized peat soil (Husnain)

   Activity 6. Peat Respiration: Microbial dynamic and contribution (Edi Husen)

3. General Summary


MEASURING CO2 FLUX USING IRGA
Measuring Soil, Air, & Chamber Temperature
Observing water table depth
CONTROL

INTRODUCTION

- Indonesian Peatland covers about 11% (21 Mha) of Indonesian land, storing 37-55 Gt C
- The stored C rapidly emit into CO2 when the forest land is cleared and drained.
- High temporal and (micro) spatial variation. In 2011 we intensified the measurement in Riau and Jambi provinces

DISTRIBUTION OF PEATLAND IN INDONESIA

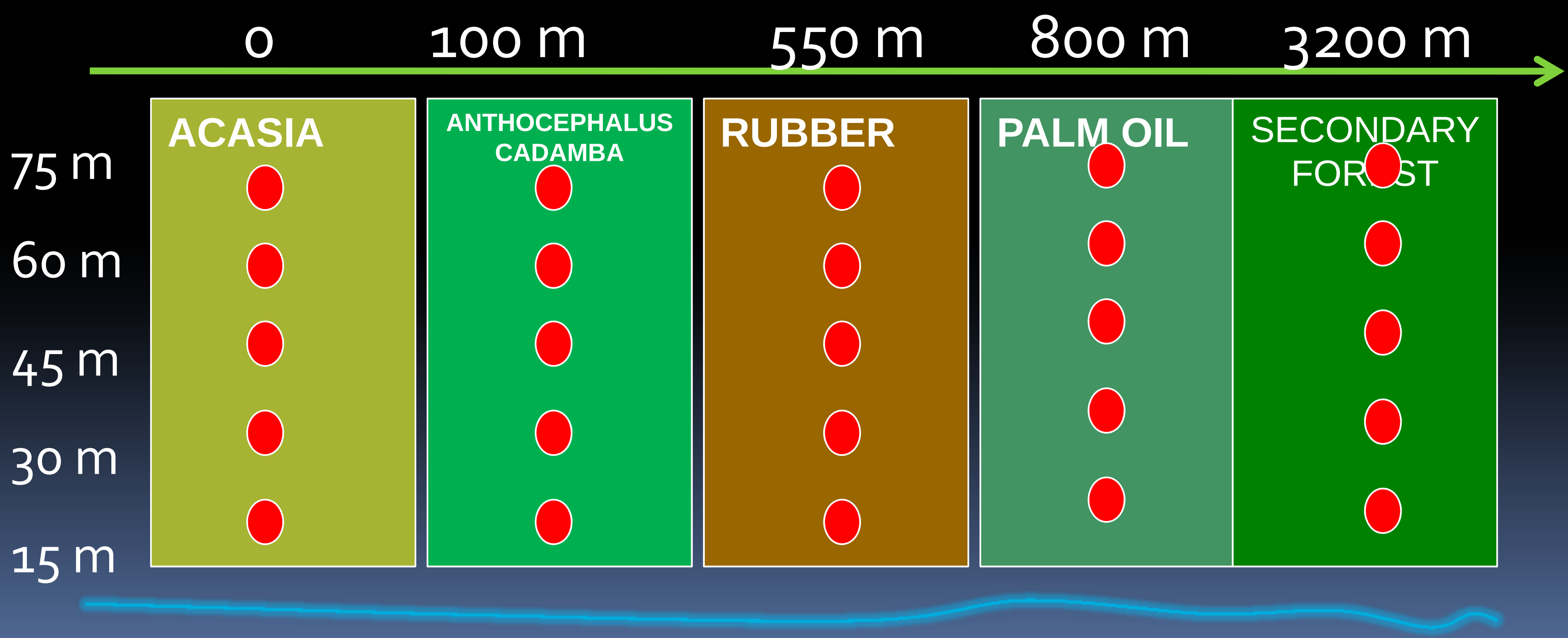
I. Land cover effect on CO_2 emission

Objectives:

To study land cover effect on CO_2 emission

Location:

- Lubuk Ogong, Riau province
- Five LU types were selected (Acacia, Anthocephalus cadamba, Rubber, OP, Secondary Forest)




ACACIA


ANTOCEPHALUS CADAMBA

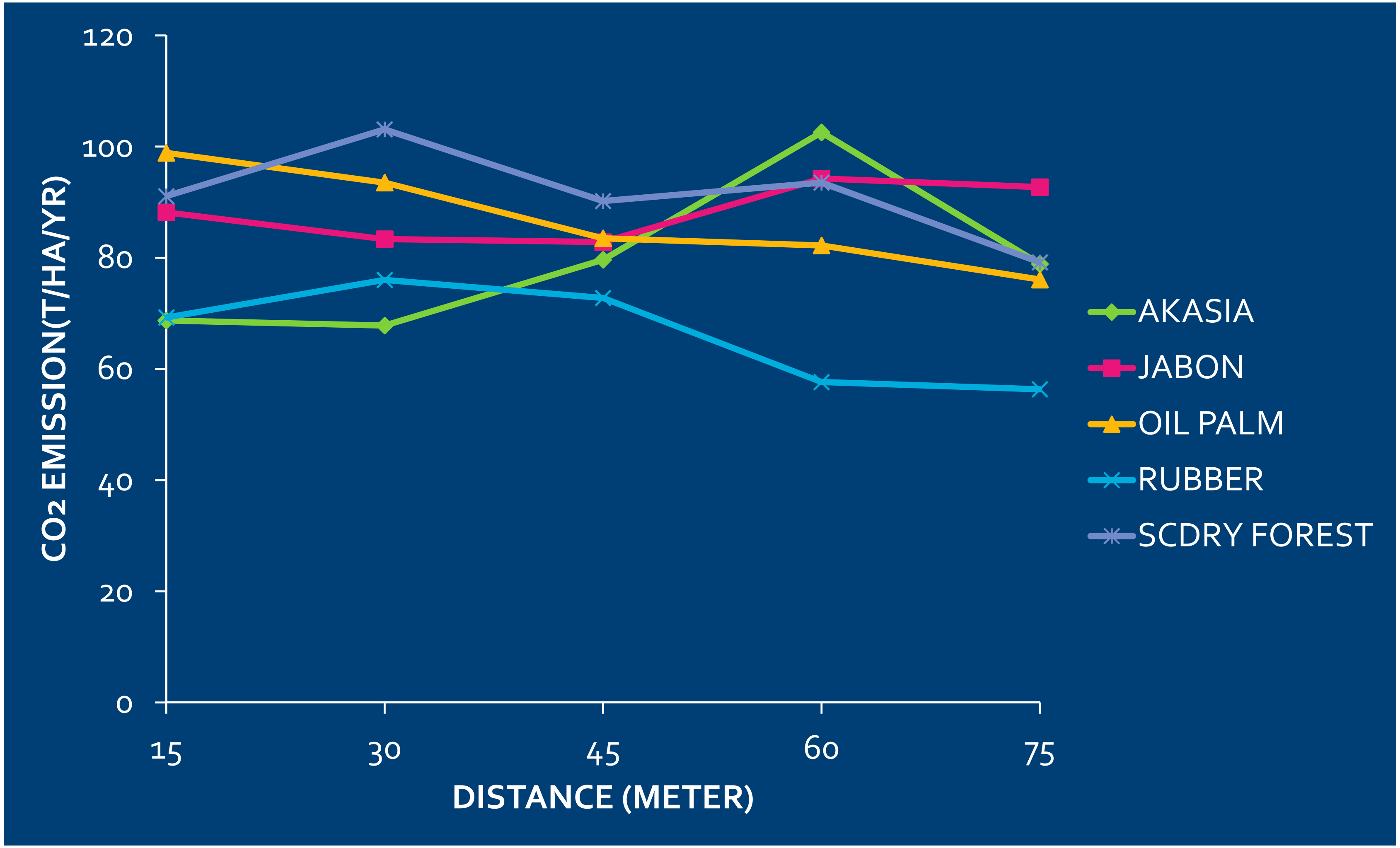

RUBBER


OIL PALM

PEAT SOIL THICKNESS AND MATURITY IN LUBUK OGONG, RIAU

Peat depth (Cm)	Distance/Maturity				
	0 meter	100 meter	550 meter	800 meter	3200 meter
	Acasia (5 Yrs)	Anthocephalus cadamba (0 Yrs)	Oil palm (3 Yrs)	Rubber (6 Yrs)	Secondary forest/Shrubs
0-20	Sapric	Sapric	Sapric	Sapric	Sapric
20-50	Sapric	Sapric	Sapric	Hemic	Sapric
50-100	Hemic	Hemic	Safric/Hemic	Hemic	Hemic
100-150	Fibric	Fibric	Hemic	Fibric	Fibric
150-200	Fibric	Fibric	Fibric	Fibric	Fibric
200-250	Fibric	Fibric	Fibric	Fibric	Fibric
250-300	Fibric	Fibric	Fibric	Fibric	Fibric
300-350	Fibric	Fibric	Fibric	Fibric	Fibric
350-400	Fibric	Fibric	Fibric	Fibric	Fibric
400-450	Fibric	Fibric	Fibric	Fibric	Fibric
450-500	Fibric	Fibric	Fibric	Fibric	Fibric
500-550	Peaty clay	Peaty clay	Fibric	Fibric	Fibric
550--600	Clay	Clay	Fibric	Peaty clay	Fibric
600-650	-	-	Hemic	-	Fibric
650-700	-	-	Hemic	-	Fibric
700-750	-	-	Peaty clay	-	Fibric/peaty clay
750-800	-	-	Peaty clay/sand	-	Clay
>800	-	-	Sand	-	Clay

CO_2 emission pattern among selected land use type at Lubuk Ogong, Riau Province



II. Spatial variation of water table depth and CO_2 emission from rubber plantation

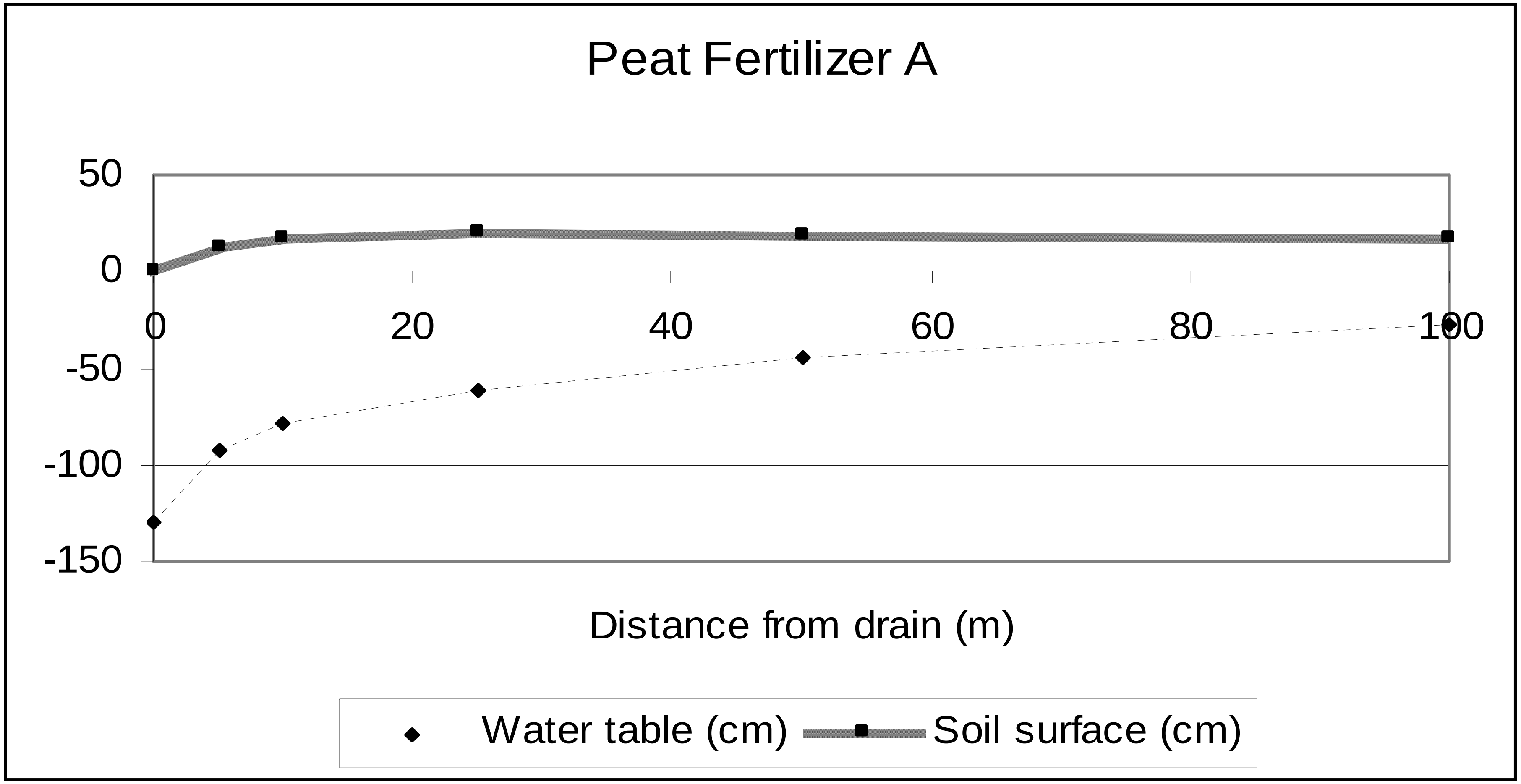
Objectives:

To study spatial variation of water table depth and CO_2 Emission from Rubber Plantation on Peat Soil

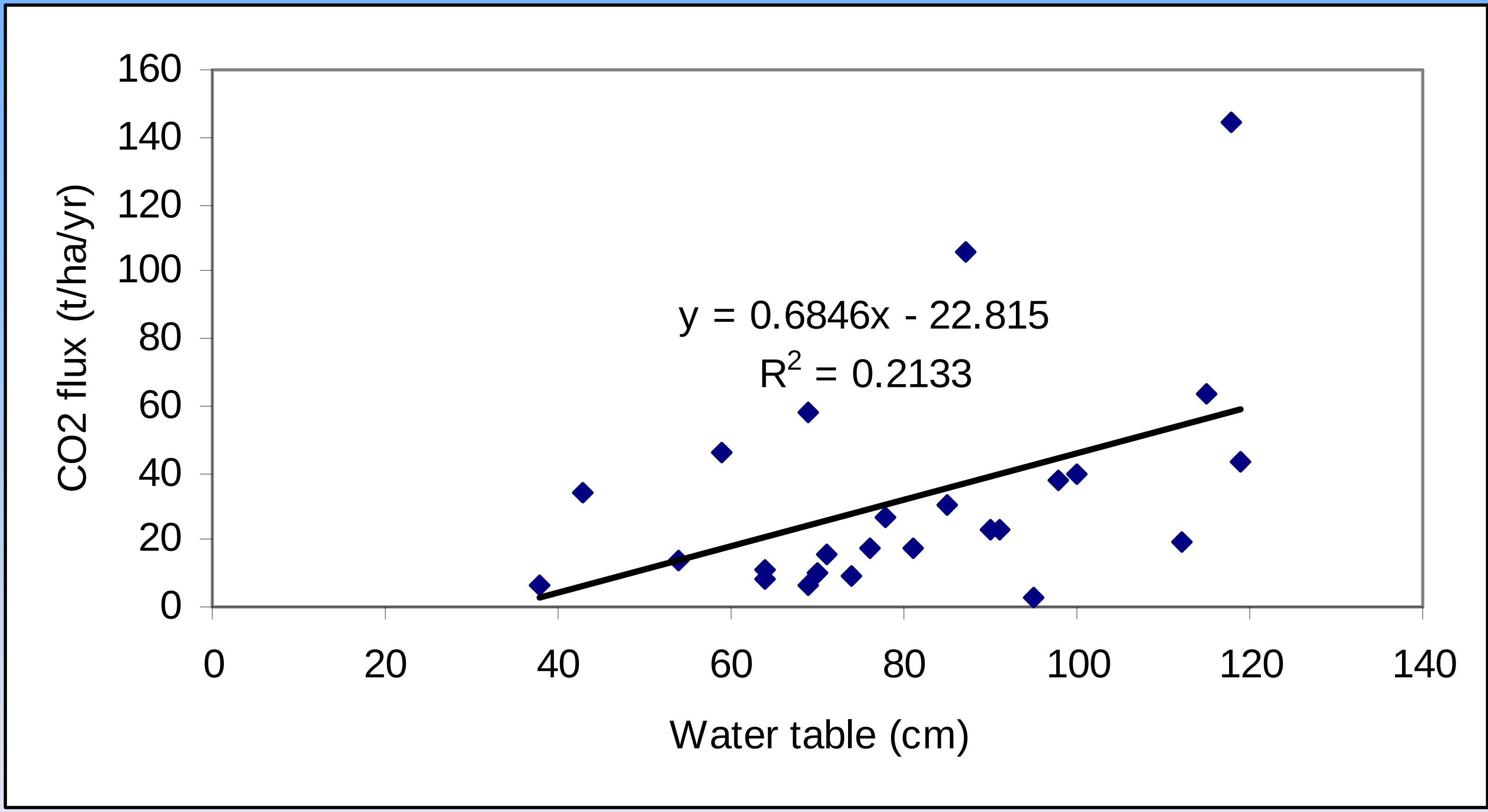
Location:

Rubber Plantation
Jabiren village, Central Kalimantan
(02^0 30' 54"S; 114^0 10' 11" E)

Water table depth (15 times observation within 3 months) and surface elevation vs distance from drainage



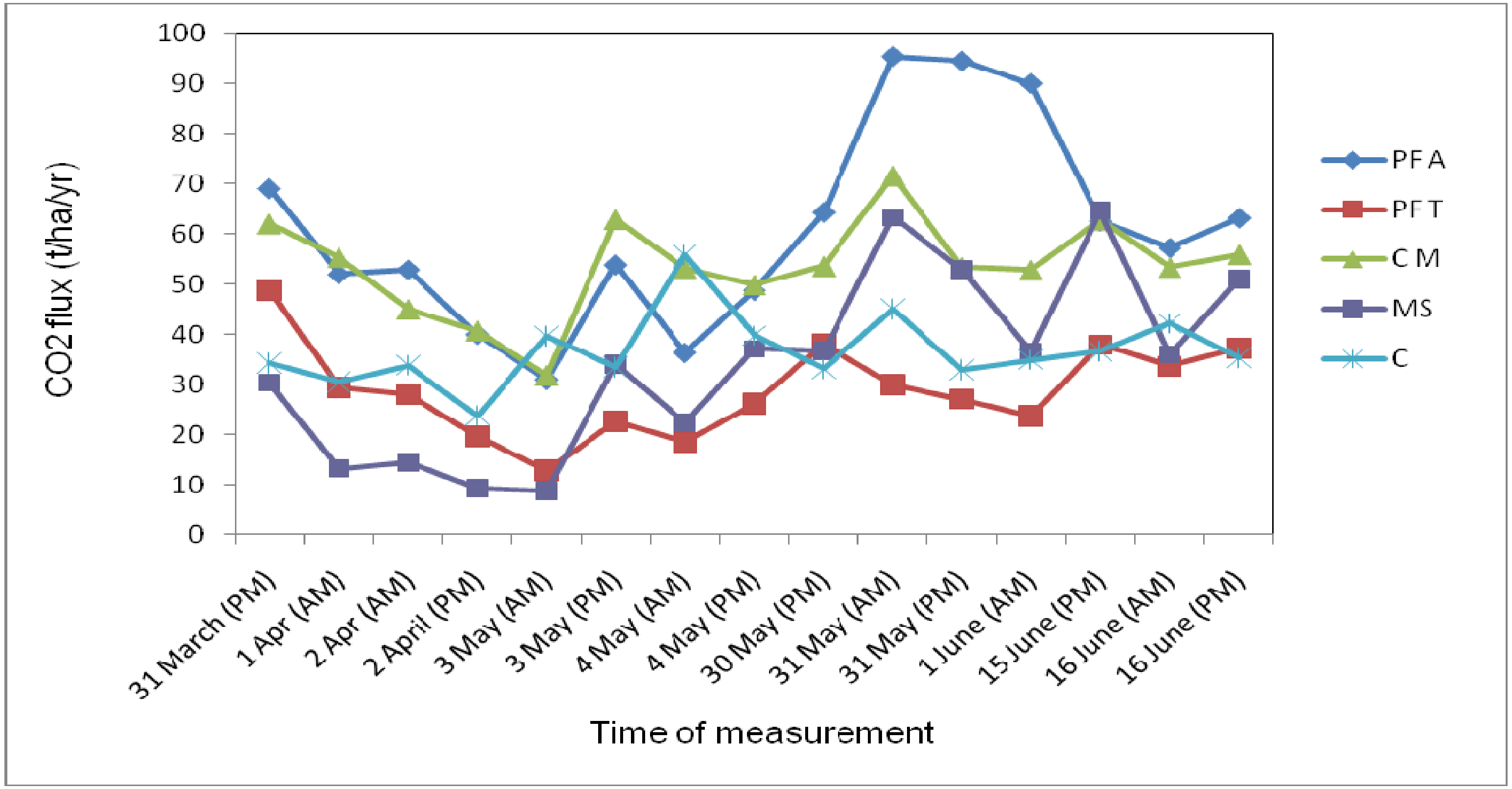
CO_2 flux and water table depth



EFFECT OF FERTILIZER AND AMELIORANT ON CO_2 FLUX IN RUBBER PLANTATION ON PEAT SOIL, CENTRAL KALIMANTAN

Treatments	N	CO_2 flux (t/ha/yr)			
		Mean	Std Dev	Minimum	Maximum
Peat fertilizer A	15	60.71	19.83	31.03	95.26
Peat fertilizer T	15	28.91	9.17	12.93	48.82
Chicken manure	15	53.61	9.63	31.80	71.58
Mineral soil	15	34.06	18.24	8.85	64.58
Control	15	36.76	7.32	23.82	55.92

CO2 FLUX BASED ON TREATMENTS AND TIME MEASUREMENT



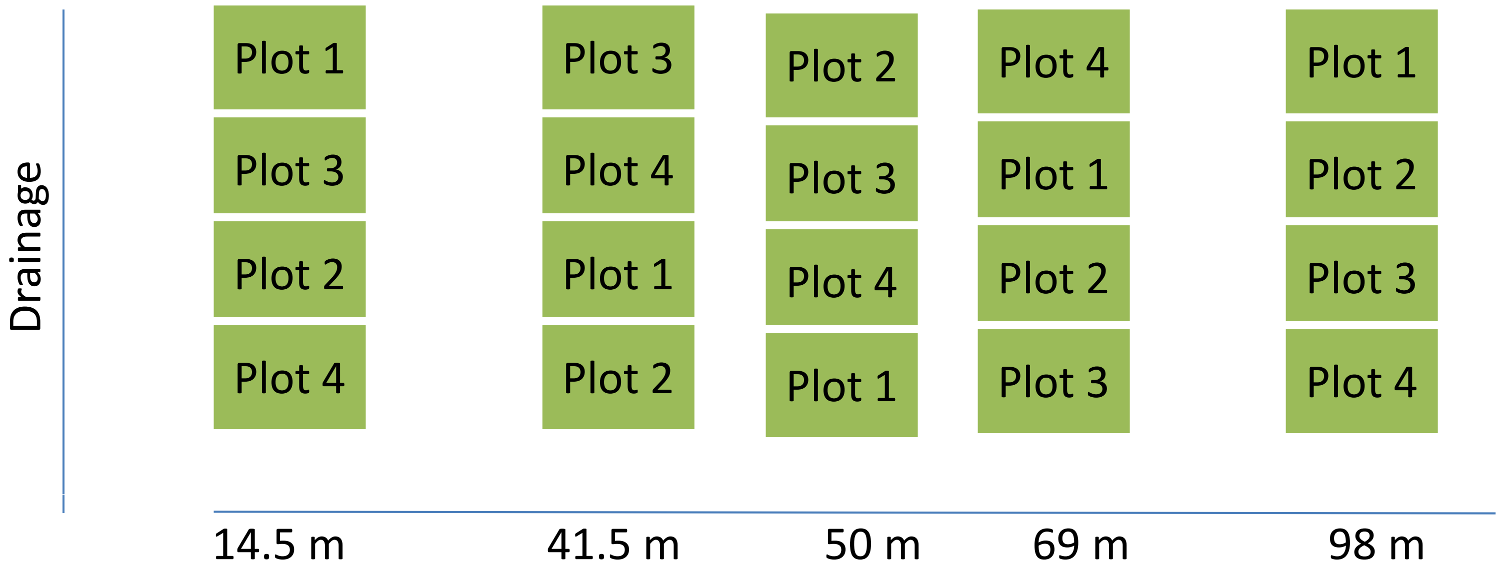
III. Emission under OP Plantation

Objectives:

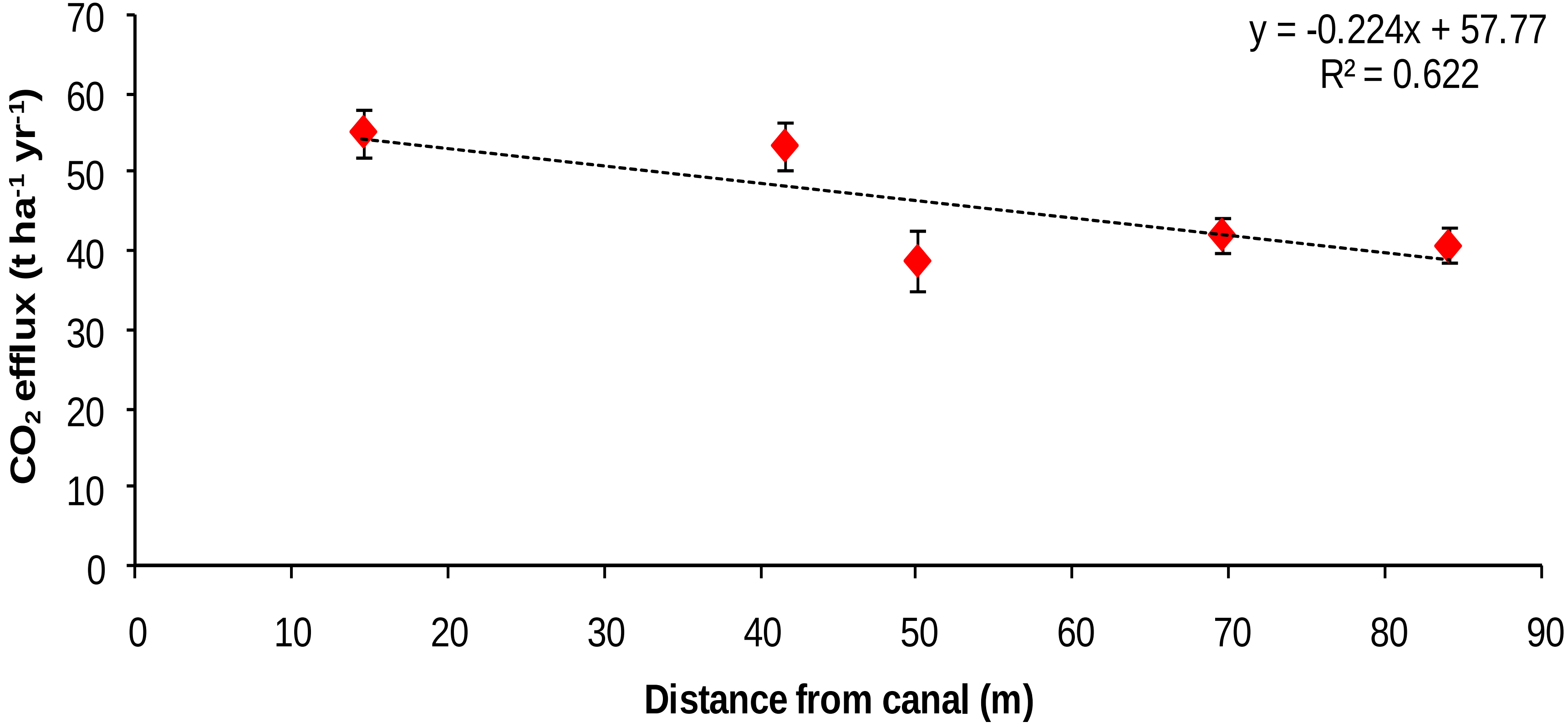
To study spatial and temporal CO_2 emission under Palm Oil Plantation

Location:

Intensified palm oil plantation (±20 years old) at Muaro, Jambi Province (10^{0}43’0.7”S;1030 52’ 56.7” E)

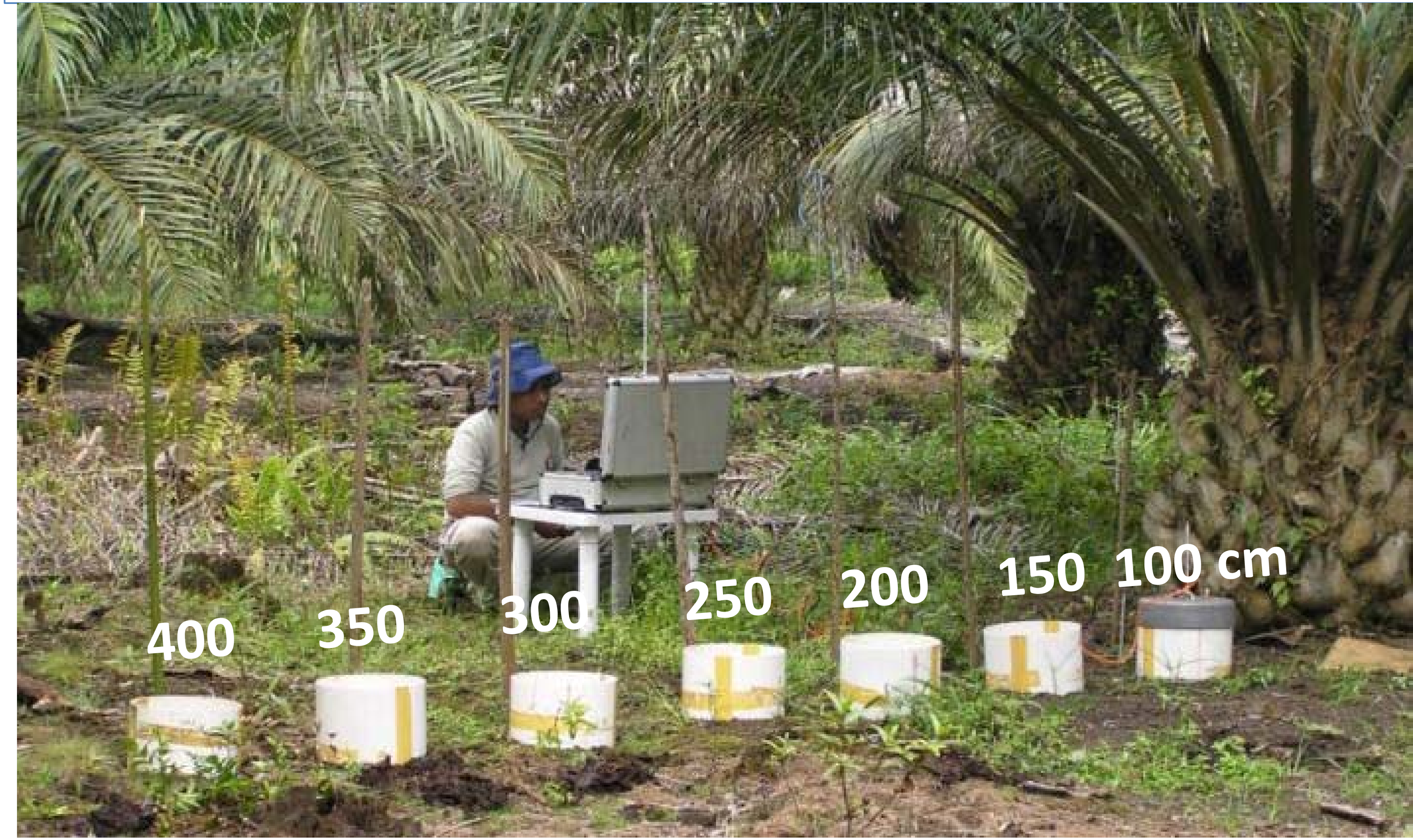


Average CO2 fluxes (t/ha/yr)

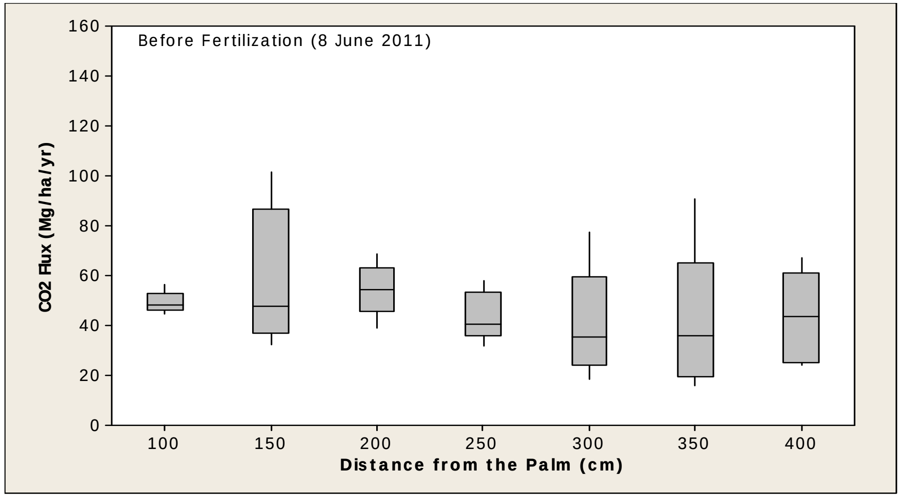


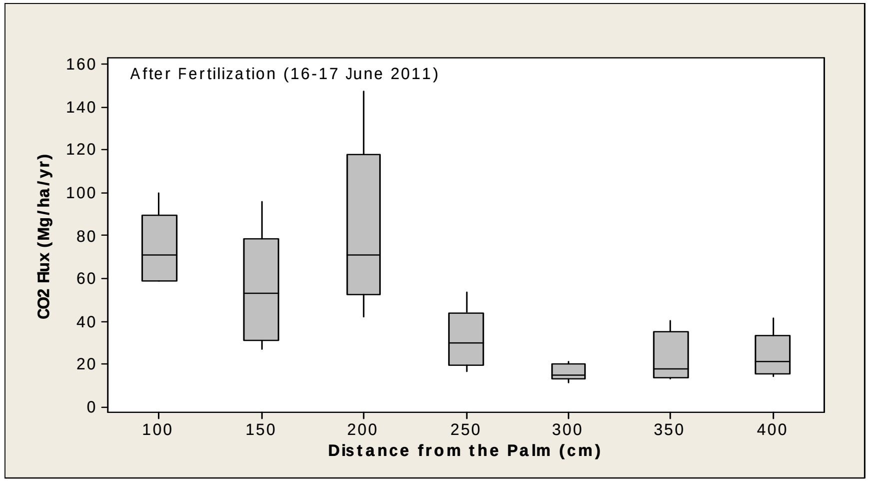
IV. Micro variability of CO_2 emissions under oil palm

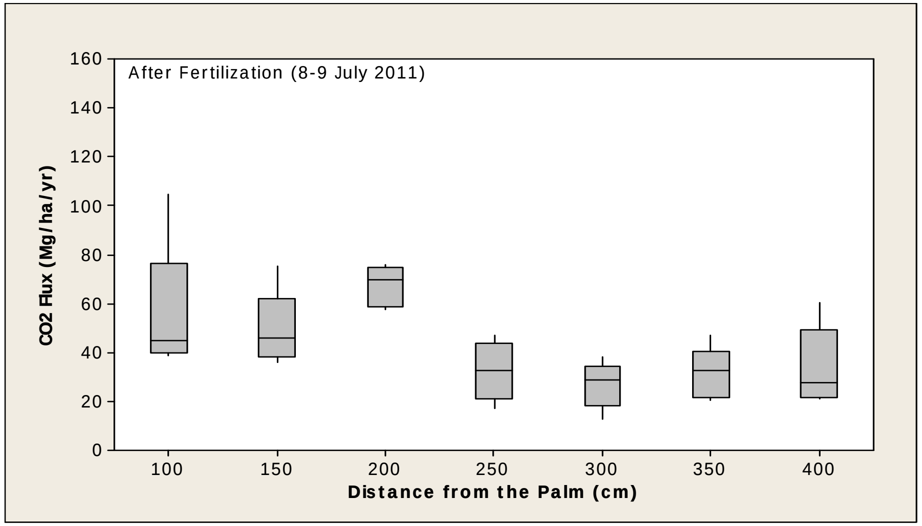
Location: Palm Oil Plantation, Arang-arang, Jambi

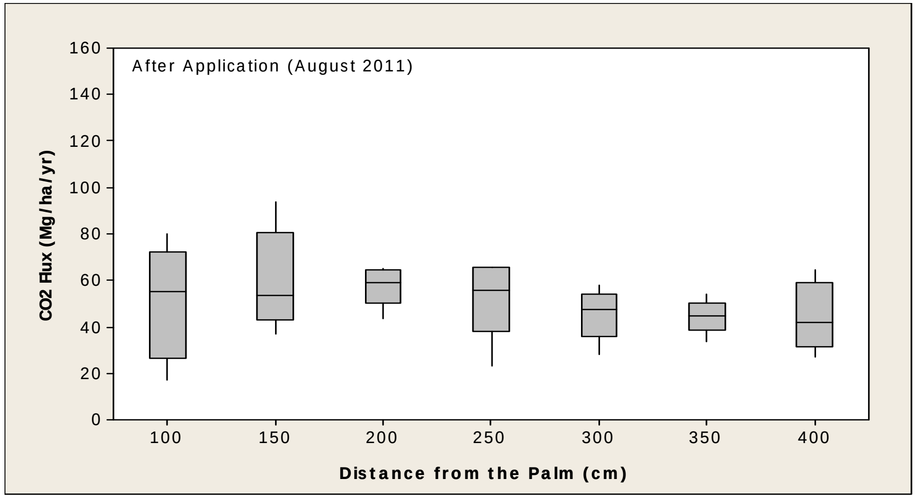


CO2 flux at different position

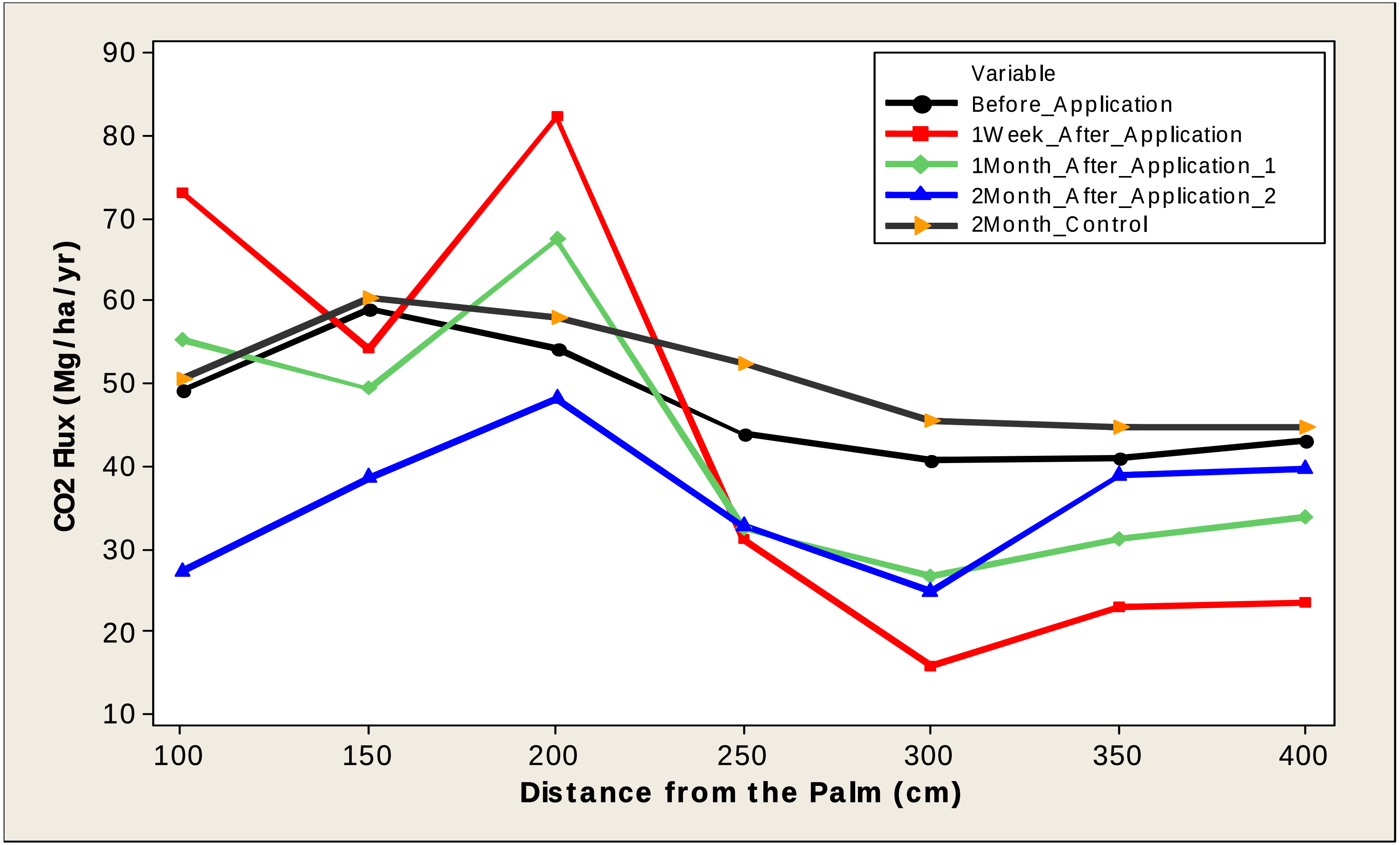








CO2 flux at different position



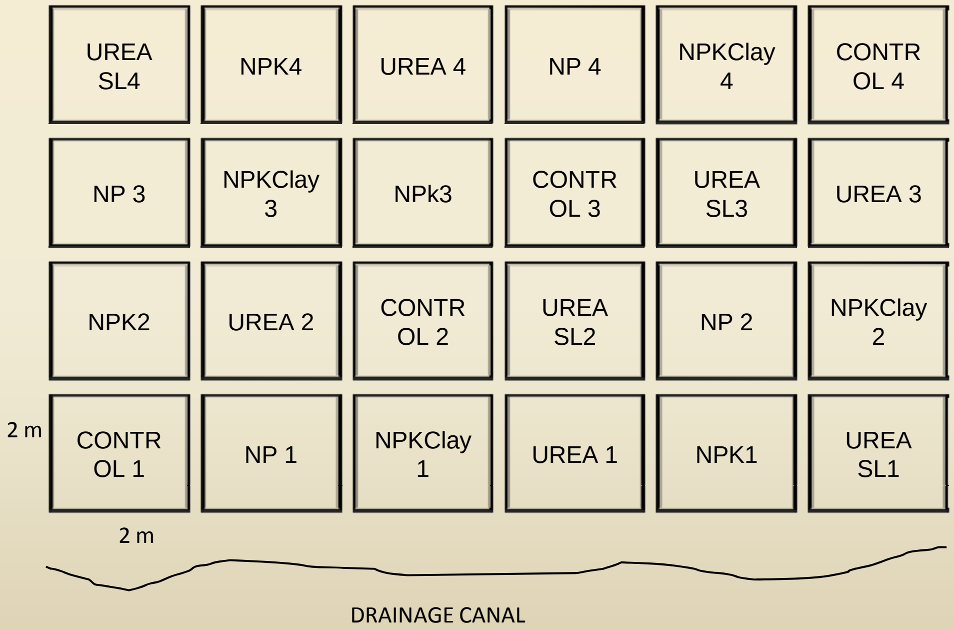
MATRIX OF CORRELATION BETWEEN CO2 FLUX AND SEVERAL VARIABLES

Parameter	Before application		1 week after application		1 month after application		2 month after application	
	Correlation	P-value	Correlation	P-value	Correlation	P-value	Correlation	P-value
Distance	-0.231	0.181	-0.649	0.000	-0.511	0.002	0.06	0.731
Water Table Depth	0.057	0.746	0.168	0.334	0.417	0.013	0.131	0.455
Soil Temperature	0.218	0.209	0.054	0.756	0.386	0.022	0.039	0.822
Air Temperature	-0.263	0.127	0.021	0.903	0.017	0.921	0.079	0.654
Soil Moisture	-0.198	0.255	-0,374	0.027	0.743	0.000	0.136	0.435

V. Fertilizer Effects

Objective:
To measure CO_2 emission on fertilized peat soil

Location:
Bareland in Lubuk Ogong, Riau Province



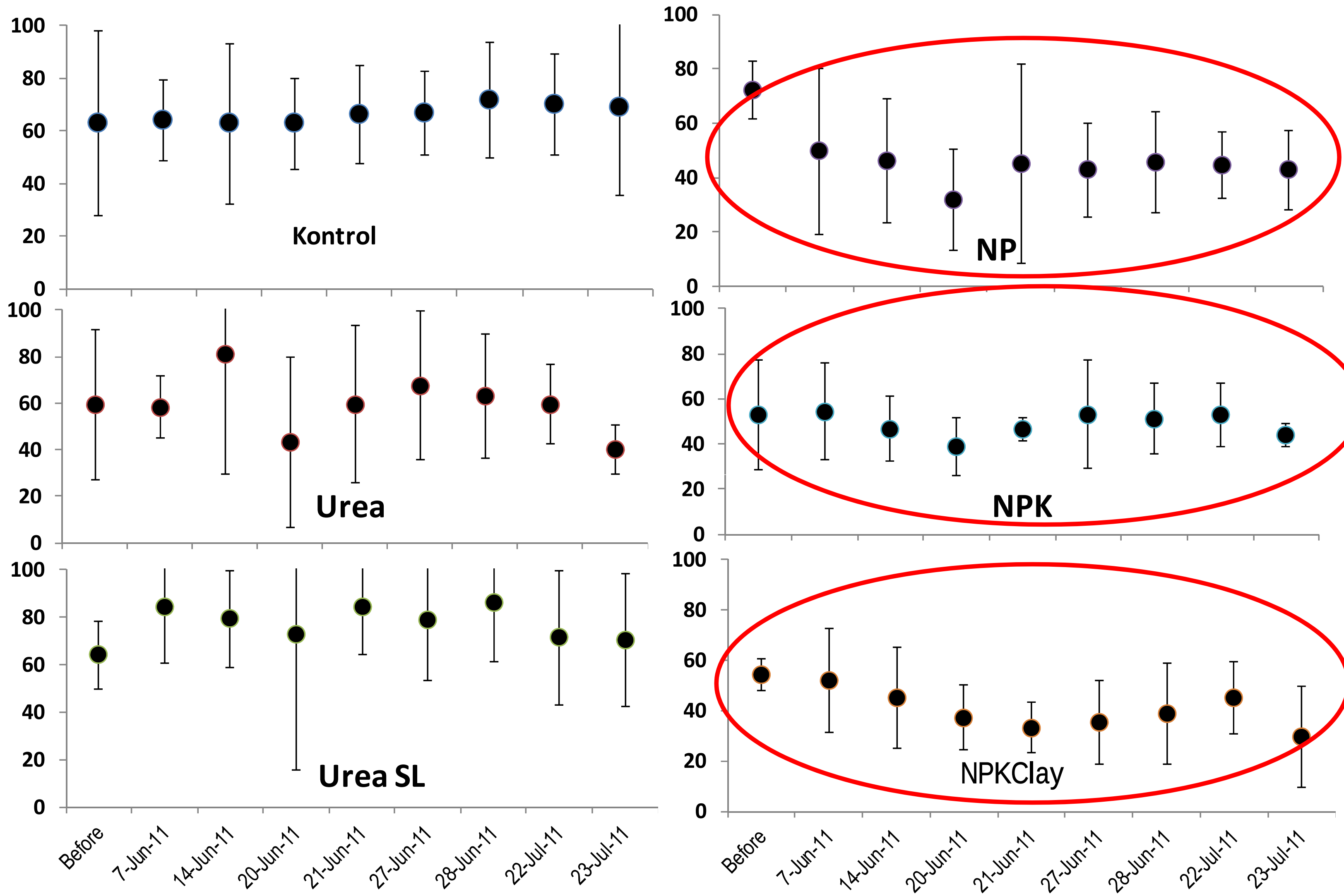
Treatment as follows:

1. Control
2. Nitrogen (Urea) fertilization
3. Slow release nitrogen fertilization
4. NP fertilization
5. NPK fertilization
6. NPK Clay fertilization

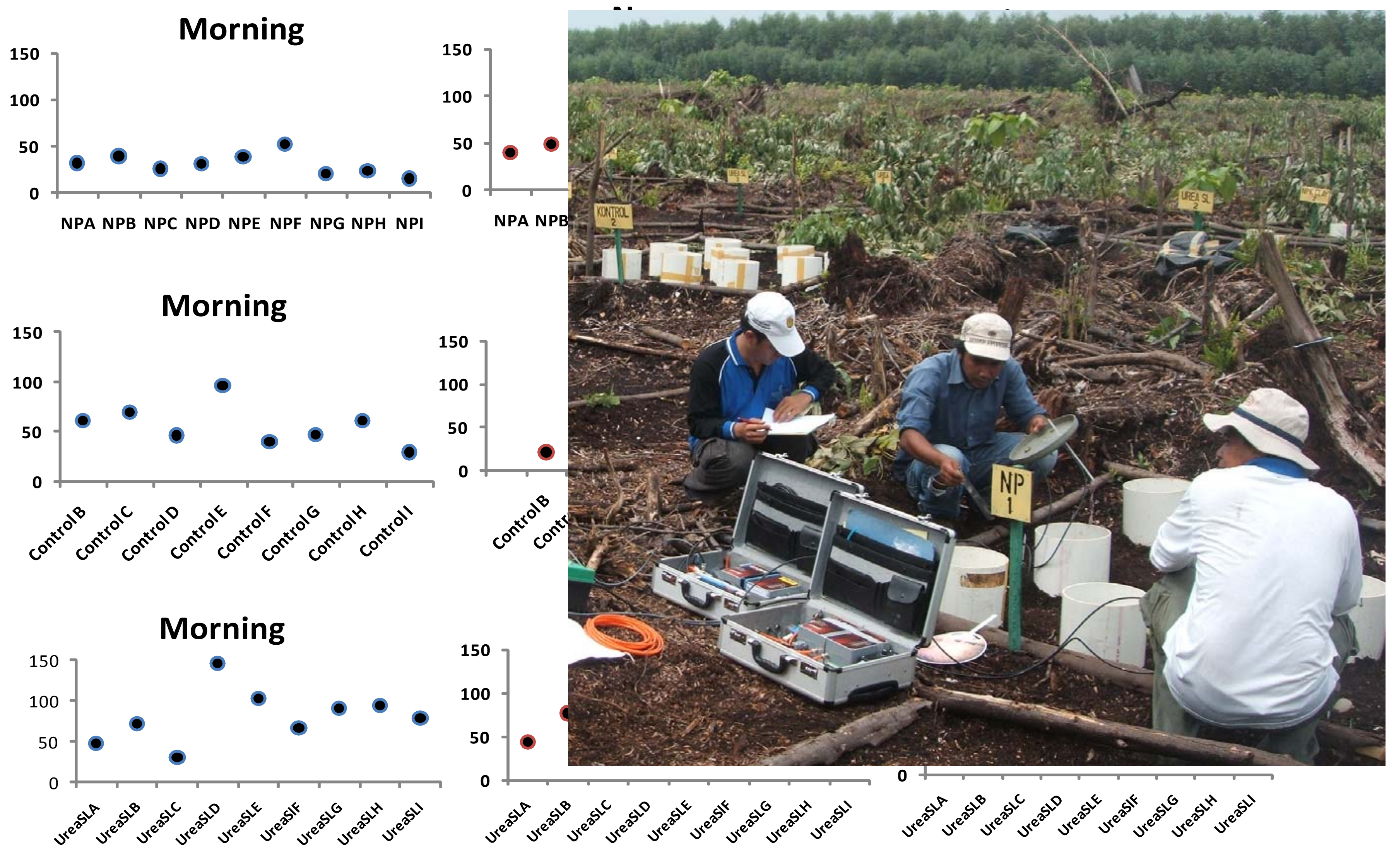

UREA
NPK CLAY
1
NP
1

RESULTS

CO_2 Flux under different fertilizer types in Riau



MICRO VARIATIONS OF CO_2 FLUX
(9 observation points on each 2 x 2 m^2 plots)



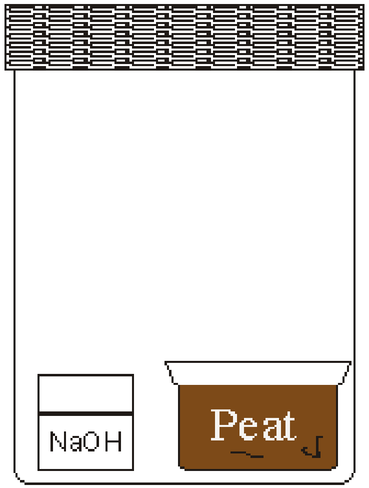
Matrix Correlation of parameter Observed After Fertilization

Parameter	CO_2 Flux	P value
Soil temperature	0.07	0.8425
Air temperature	-0.05	0.0923
Distance	-0.15	0.7318
Soil Moisture	0.02	0.0732
Water Table Depth	0.34	0.0060

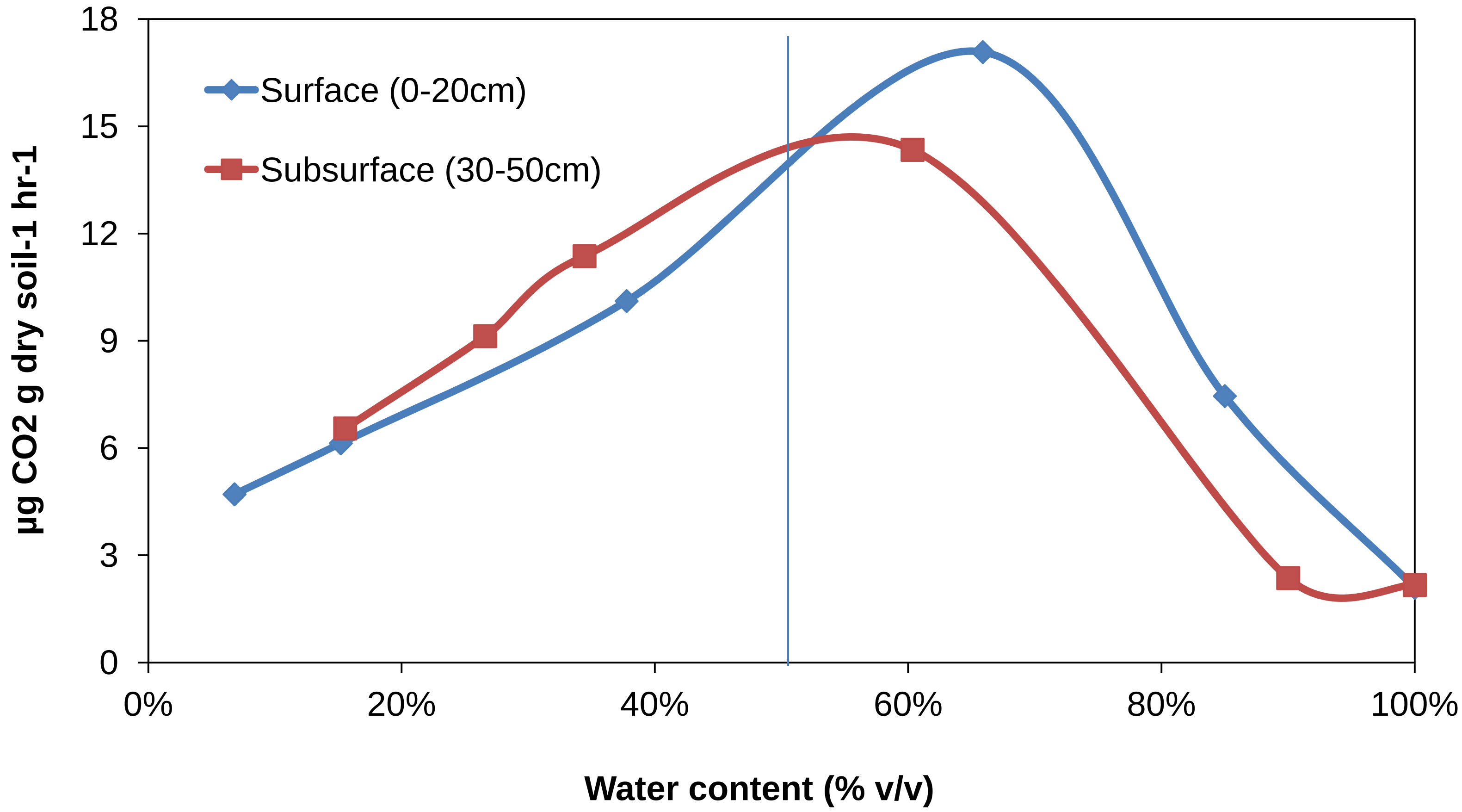
VI. PEAT RESPIRATION: MICROBIAL DYNAMICS AND CONTRIBUTION

Objectives:
To estimate microbial contribution on CO_2 emission

Laboratory experiment:
1. Measuring microbial respiration
2. Measuring total microbial population

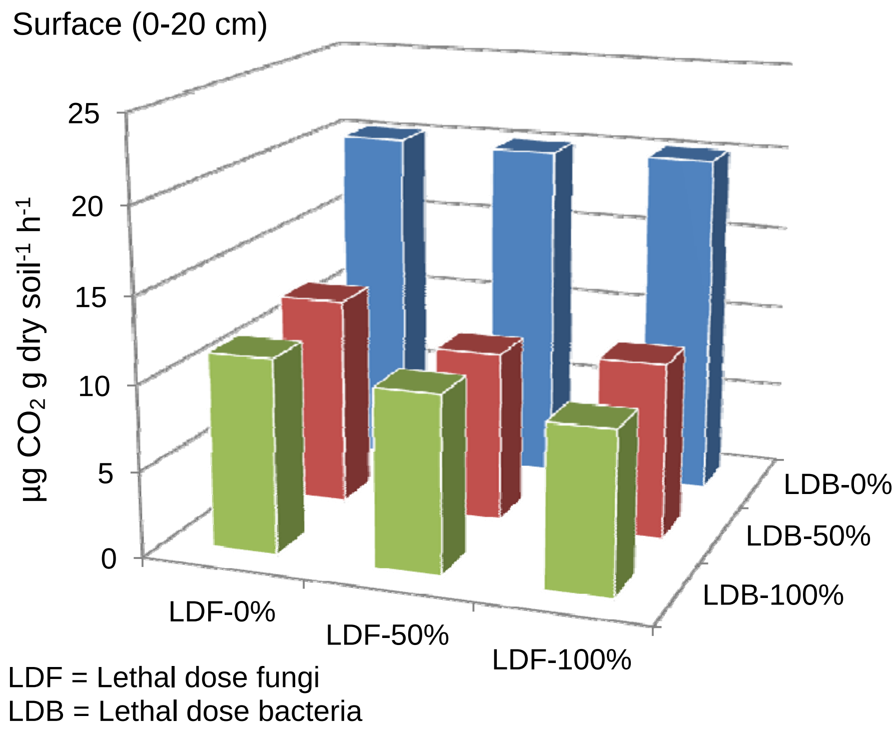


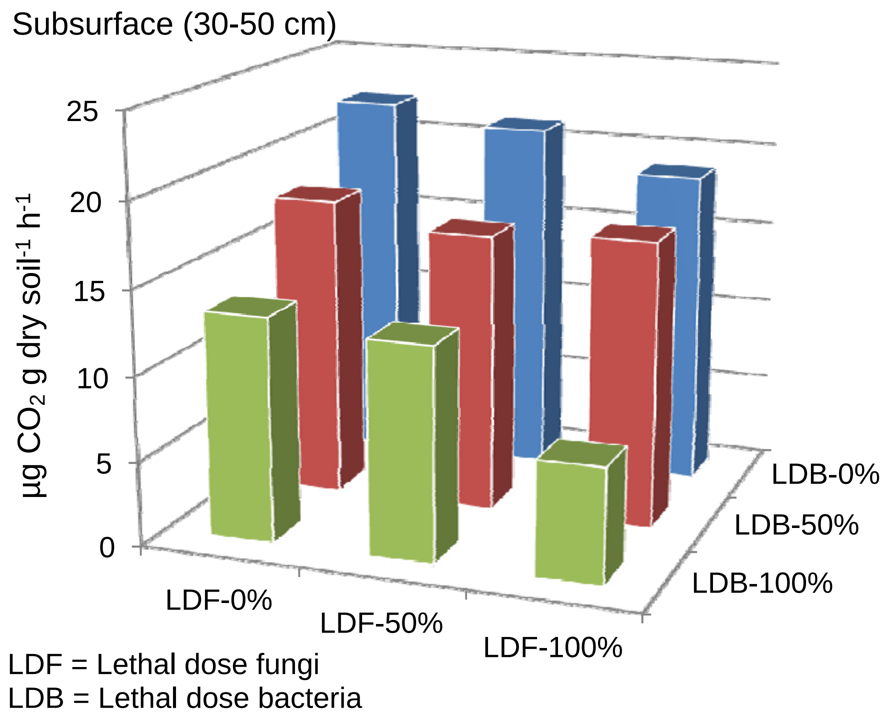
The importance of bacteria, fungi and actinomycetes and water content using peat samples of 0-20 cm and 30-50 cm depths from Jambi



✓ Respiration rates increased as SWC of peat increased up to 66% and decreased as SWC approaches saturation.

Remark: The graph was compilation of two sets of experiment; < 50% SWC and >50% SWC





- ✓ Killing bacteria by lethal dose (LDB) of chemical agents reduced sharply peat respiration. Killing fungi by LDF did not reduce peat respiration.
- ✓ Bacteria contributed to 58 to 82% of total respiration

GENERAL SUMMARY

1. CO_2 emission varied widely, spatially and temporally and seems related to land use types and management systems.
2. Water table depth is among the most consistent factor affecting CO_2 emission
3. There are many soil factors (such as peat maturity and chemical composition) that is not covered by this research design that leads to higher variation within plot compare to treatment effect
4. Bacterial activity is responsible for about 52-82% of soil CO_2 respiration
5. The optimal soil moisture condition for microbial respiration is somewhere between very dry and very wet condition.
6. There seems to be a higher CO_2 flux within active rooting zone (150-200 cm perimeter from palm trees).

Thank You