UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"
Campus de Jaboticabal
Faculdade de Ciências Agrárias e Veterinárias

Mitigation assessment of greenhouse gas due to the conversion of sugarcane areas from burned to green harvest, considering reduced tillage and the crop-rotation

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Sugarcane Crop Area (2010/2011)

State	Available for harvest (ha)				In replanting (ha)	Total Cropped (ha)
	Ratoon	Replanted	Expansion	Total		
Espírito Santo	-	-	-	74.115	3.332	77.447
Goiás	531.334	19.130	80.189	630.653	24.548	655.201
Minas Gerais	639.060	25.409	61.877	726.346	37.491	763.837
Mato Grosso	232.196	7.443	12.777	252.416	26.314	278.730
Mato Grosso do Sul	397.403	6.227	82.620	486.250	15.813	502.063
Paraná	594.715	19.417	16.023	630.155	37.794	667.949
Rio de Janeiro	-	-	-	91.310	8.795	100.105
São Paulo	4.569.154	289.860	137.445	4.996.459	306.883	5.303.342
Total				**7.887.704**	**460.970**	**8.348.674**

Source: http://www.dsr.inpe.br/laf/canasat/mapa.html (2011)

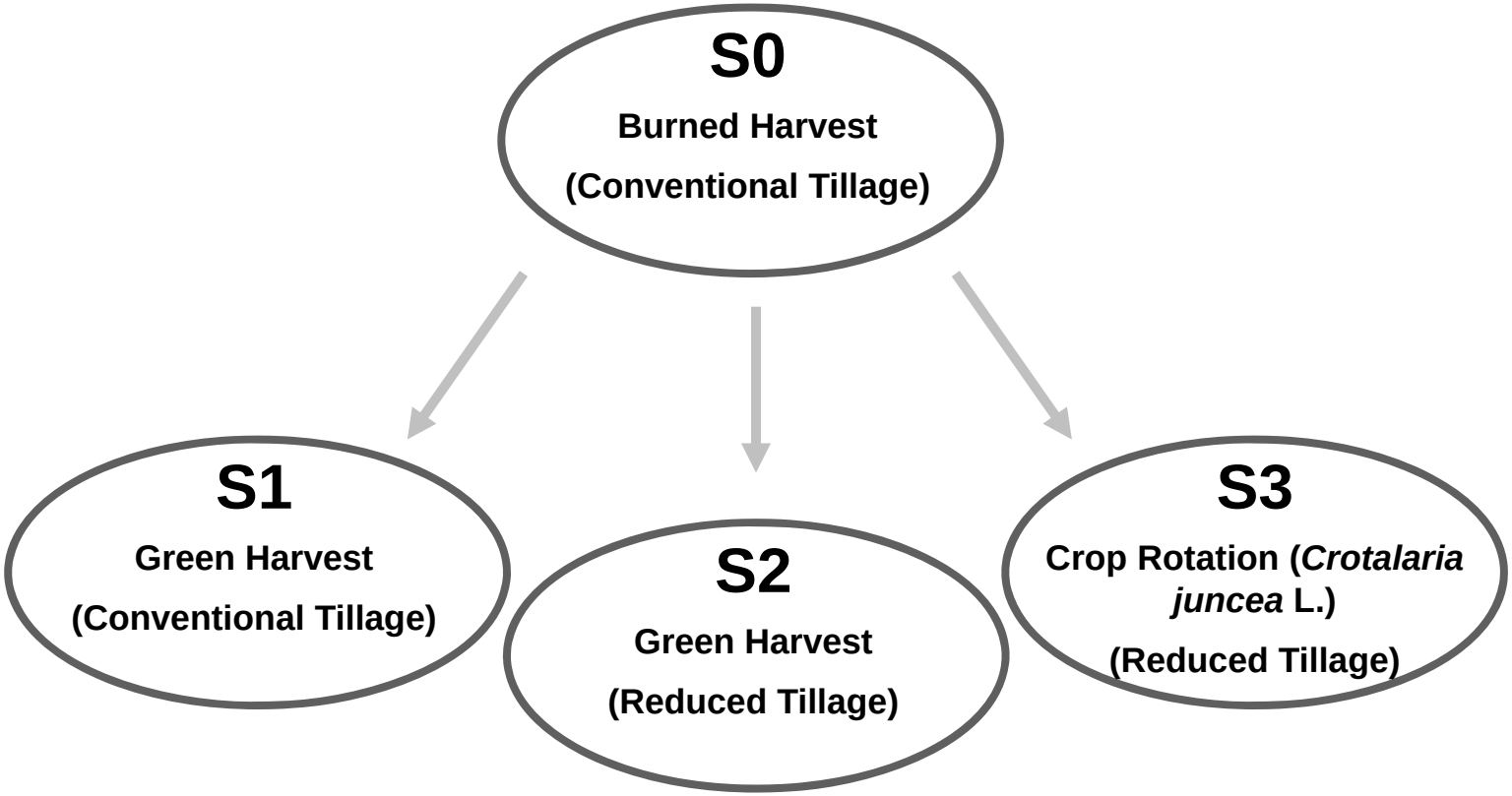
Sugarcane Harvested Area – São Paulo State (2010/2011)

Year	Burned Harvest (Hectares)	Green harvest (Hectares)	Total (ha)
2.006	2.131.989	1.110.121	3.242.110
2.007	2.023.215	1.767.049	3.790.264
2.008	1.997.630	1.924.076	3.921.706
2.009	1.792.734	2.234.331	4.027.065
2.010	2.101.110	2.627.023	4.728.133

Percentage (2010): BH: 44% and GH 56%

Source: http://www.dsr.inpe.br/laf/canasat/mapa.html (2011)

4 Scenarios considered



Inputs: Average for a sugarcane Crop Cycle of 5 years

Agricultural operations and diesel oil consumption

	Operations	S0	S1	S2	S3
		L ha^{-1} year^{-1}			
Planting	Ratoon Chemical destruction	-	-	1,60	-
	Ratoon mechanical destruction	11,09	11,09	-	11,09
	Planting systematization	30,00	30,00	30,00	30,00
	Heavy offset disk harrow	21,23	21,23	-	-
	Lime application	3,73	3,73	3,73	3,73
	Gypsum application	3,73	3,73	3,73	3,73
	Subsoiler	26,00	26,00	26,00	26,00
	Medium offset disk harrow	21,23	21,23	-	-
	Offset disk harrow	9,38	9,38	-	-
	Filtercake application	9,60	9,60	9,60	9,60
	Sunn hemp Planting	-	-	-	4,18
	Sunn hemp incorporation and Groove overture	-	-	-	9,13

Agricultural operations and diesel oil consumption

Operations	S0	S1	S2	S3
	L ha^{-1} $year^{-1}$			
Groove overture and fertilization	13,64	13,64	-	-
Seeds distribution	6,67	6,67	-	6,67
Groove closing	2,67	2,67	-	2,67
Mechanized planting	-	-	25,00	-
Herbicides application	1,60	1,60	1,60	1,60
Soil systematization for harvest	6,15	6,15	6,15	6,15
Total (1)	166	166	107	114

Agricultural operations and diesel oil consumption

(L ha^{-1} y^{-1})

	Operations	S0	S1	S2	S3
		L ha^{-1} $year^{-1}$			
Ratoon Treatment	Trash heap	-	2,67	-	-
	Fertilization	7,08	7,08	7,08	7,08
	Vinasse application	7,41	7,41	7,41	7,41
	Herbicide application	1,60	1,60	1,60	1,60
Total (2)		16,09	18,76	16,09	16,09
Harvest	Harvester	-	74,00	74,00	74,00
	Burden machine	12,70	12,70	12,70	12,70
	Towrope operation	21,20	21,20	21,20	21,20
	Sugarcane transport	82,00	82,00	82,00	82,00
Total (3)		115,90	189,90	189,90	189,90
Mean annual consumption (L ha^{-1})		162,12	238,25	224,25	225,68

Scenario S0. Burned Harvest System

Conventional tillage during sugarcane crop renovation

Scenario S1. Green Harvest System

Conventional tillage during sugarcane crop renovation

High amount of residues

Scenario S2. Green Harvest System with reduced tillage

After last harvest –

01 Herbicide application

01 subsoiler operation

Mechanized planting

Scenario S3. Green Harvest System with reduce tillage + *Crotalaria juncea* L.

<u>After last harvest:</u>

Lime and gypsum application

01 subsoiler operation

Filtercake application

Crotalaria planting

Crotalaria incorporation and groove overture

Seeds distribution

Groove closing

Methodology

Emission sources

Agricultural

GHG emissions due to the burning of agricultural residues

- *CH_4*
- *N_2O*

N_2O direct and indirect emissions from managed soils

- *N synthetic fertilizer*
- *N from organic composts (Filtercake and vinasse)*
- *N from sugarcane residues*

CO_2 emissions due lime application

Soil Carbon Sequestration

Mobile Combustion (Diesel vehicle)

Emissions due fossil fuel use (Diesel oil)

- *CO_2*
- *CH_4*
- *N_2O*

Methodology

IPCC (2006) methodologies from the Guidelines for National Greenhouse Gas Inventories

Important: Base data

- Fertilizers consumption (kg N ha^{-1})
- Varieties – Residues amount (aprox. 15 ton DM ha^{-1})
- Diesel consumption (L ha^{-1} y^{-1})
- Lime or Dolomite

Methodology

Soil carbon sequestration

Initial soil C stock (0-30 cm layer) :

Conservative amount of 28 t C ha^{-1}

Tillage (F_{MG})	Full	All	Dry and Moist/ Wet	1.00
Tillage (F_{MG})	Re-duced	Tem-perate/ Boreal	Dry	1.02
			Moist	1.08
		Tropical	Dry	1.09
			Moist/ Wet	1.15
		Tropical montane[4]	n/a	1.09
Tillage (F_{MG})	No-till	Temperat e/ Boreal	Dry	1.10
			Moist	1.15
		Tropical	Dry	1.17
			Moist/ Wet	1.22
		Tropical montane[4]	n/a	1.16

Source: IPCC, 2006

Methodology

Residue input

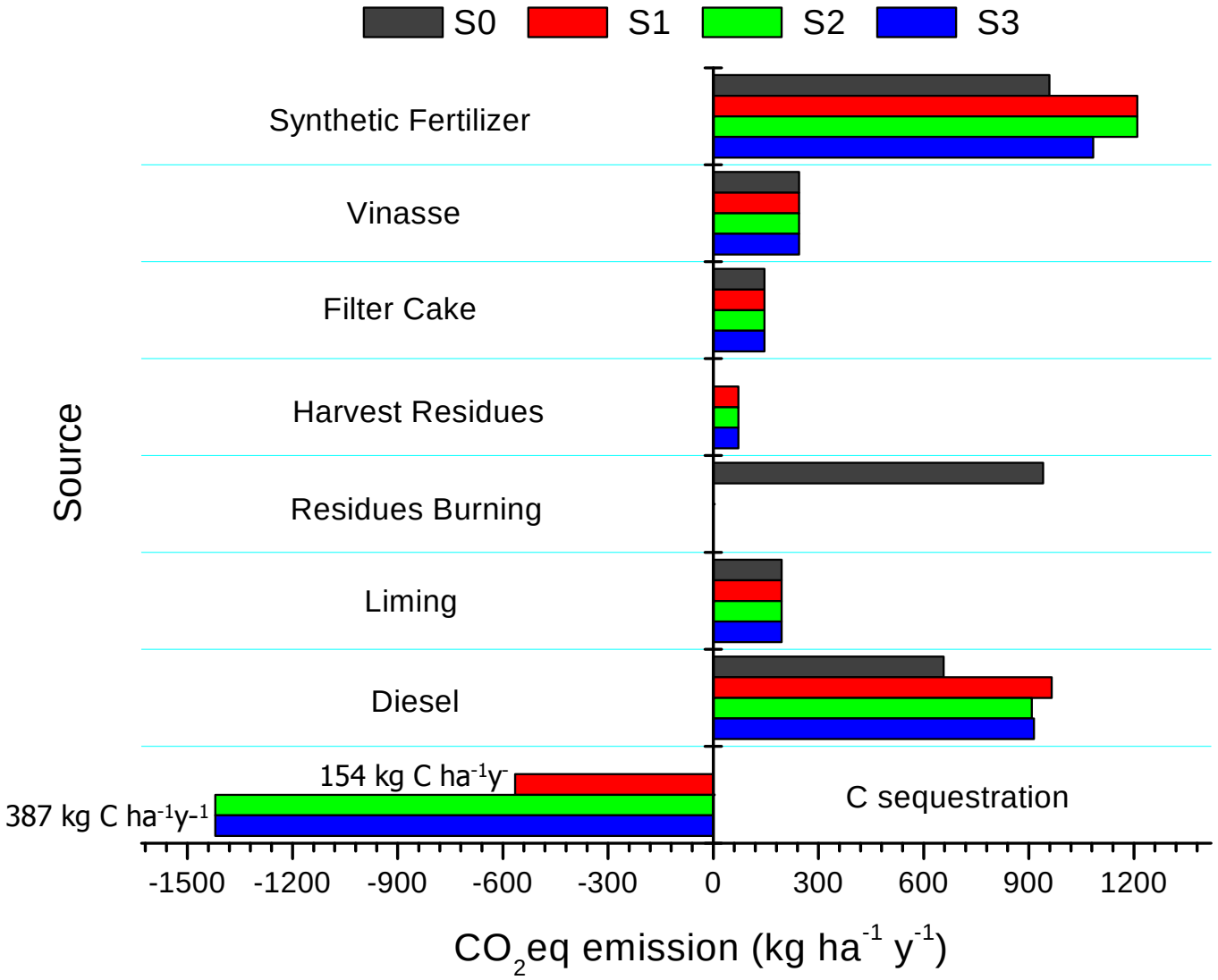
Factor value type	Level	Temper-ature regime	Moist-ure regime[1]	IPCC defaults
Input (F_I)	Low	Tem-perate/ Boreal	Dry	0.95
			Moist	0.92
		Tropical	Dry	0.95
			Moist/ Wet	0.92
		Tropical montane[4]	n/a	0.94
Input (F_I)	Med-ium	All	Dry and Moist/ Wet	1.00
Input (F_I)	High with-out manure	Tem-perate/ Boreal and Tropical	Dry	1.04
			Moist/ Wet	1.11
		Tropical montane[4]	n/a	1.08
Input (F_I)	High – with manure	Tem-perate/ Boreal and Tropical	Dry	1.37
			Moist/ Wet	1.44
		Tropical montane[4]	n/a	1.41

Source: IPCC, 2006

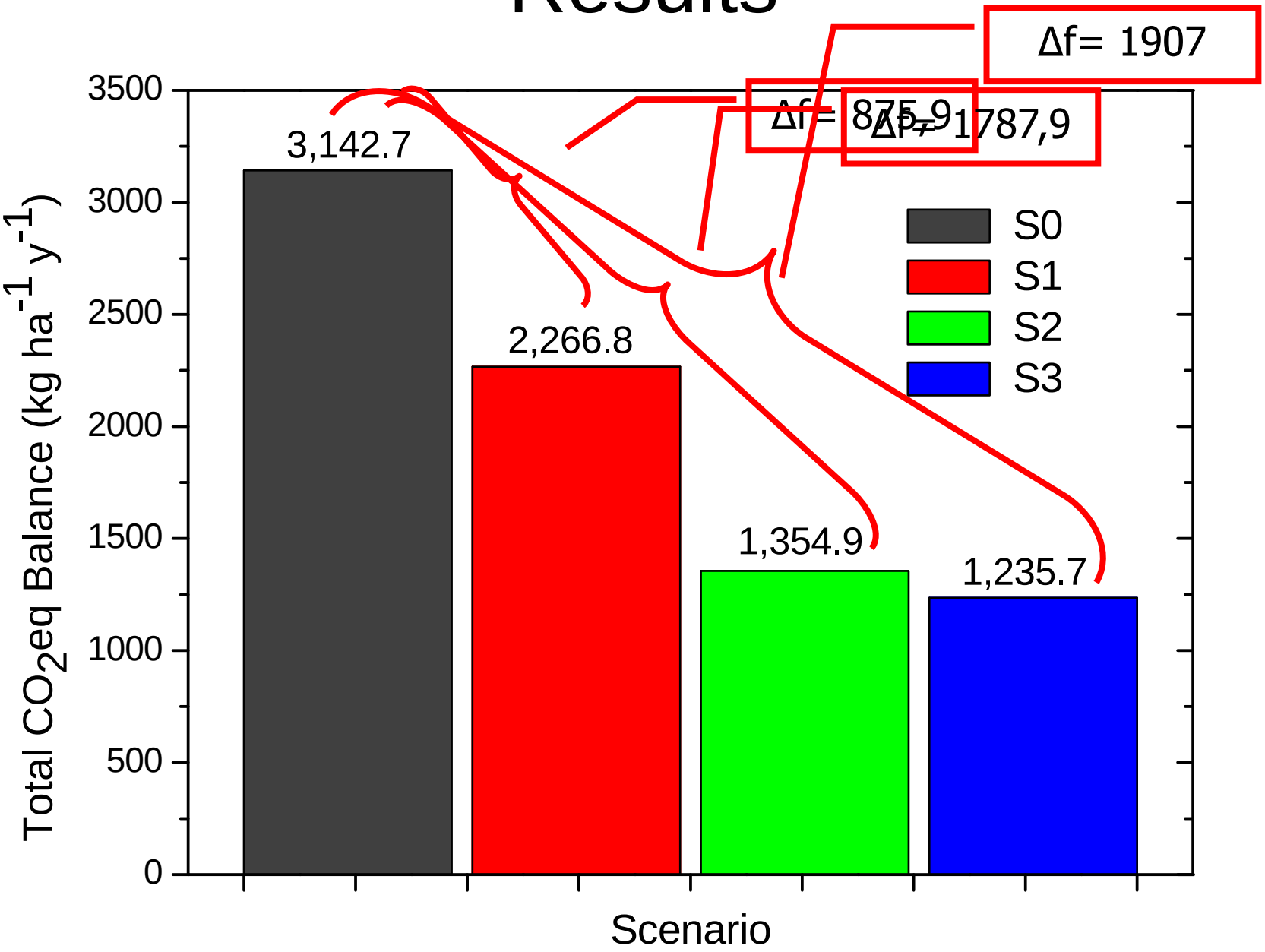
Base data – Kg ha^{-1} y^{-1} Crop cycle of 5 years

Supplies	Units	S0	S1	S2	S3
		Amounts			
Nitrogen synthetic fertilizer	kg N	92	116	116	104
Vinasse application	kg N	35	35	35	35
Filtercake application	kg N	21	21	21	21
Lime	kg	400	400	400	400
Diesel oil	liters	162	238	224	225

Results – kg CO_2eq ha^{-1} y^{-1}



Results


Δf= 1907
Δf= 875,9
Δf= 1787,9
3,142.7
2,266.8
1,354.9
1,235.7
S0
S1
S2
S3
3500
3000
2500
2000
1500
1000
500
0
Total CO2eq Balance (kg ha-1 y-1)
Scenario

Thank you very much for attention!

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