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*Supplement of*

## **Greenhouse gas emissions from natural ecosystems and agricultural lands in sub-Saharan Africa: synthesis of available data and suggestions for further research**

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## Supplementary Information (SI)

Table S1 Summary of greenhouse gas carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) emissions and N<sub>2</sub>O emission factor (%) in natural ecosystems. More detail information is available in 'Soil greenhouse gas emissions in Africa database' (<http://ghinafrica.blogspot.com/>).

Ecosystem type	Quality check†	Location	Temp	Rainfall	CO <sub>2</sub> (Mg CO <sub>2</sub> ha <sup>-1</sup> y <sup>-1</sup> )	CH <sub>4</sub> (kg CH <sub>4</sub> ha <sup>-1</sup> y <sup>-1</sup> )	N <sub>2</sub> O (kg N <sub>2</sub> O ha <sup>-1</sup> y <sup>-1</sup> )	Reference
Forest/ plantation/ woodland	-	Benin	27	1200	57	*	*	Lamade et al., 1996
Forest/ plantation/ woodland	-	Botswana	*	*	13.8	*	*	Thomas et al., 2014
Forest/ plantation/ woodland	-	Cameroon	23.8	1513	*	-4.8 to 0.2	*	Macdonald et al., 1998
Forest/ plantation/ woodland	+	Ethiopia	15	1200	15.7 to 19.4	*	*	Yohannes et al., 2011
Forest/ plantation/ woodland	*	Ghana	25	1750	*	*	3.6	Castaldi et al., 2013
Forest/ plantation/ woodland	+	Kenya	23.3	1662	20.2	-2.9	4.1	Werner et al., 2007
Forest/ plantation/ woodland	?	Republic of Congo	24.4	1875	11.4 to 15.2	*	*	Maldague and Hilger, 1963
Forest/ plantation/ woodland	-	Republic of Congo	25	1200	*	-3.7 to 3.4	-0.1 to 0.1	Castaldi et al., 2010
Forest/ plantation/ woodland	-	Republic of Congo	25.3	1400	*	*	4.6	Serca et al., 1994
Forest/ plantation/ woodland	*	Republic of Congo	25	1200	13.3	*	*	Epron et al., 2004
Forest/ plantation/ woodland	*	Republic of Congo	25	1400	9.1 to 15.7	*	*	Epron et al., 2006
Forest/ plantation/ woodland	*	Republic of Congo	25	1274	23.9 to 24.3	*	*	Nouvellon et al., 2008
Forest/ plantation/ woodland	*	Republic of Congo	25	1266	17.2 to 27.1	*	*	Nouvellon et al., 2012
Forest/ plantation/ woodland	*	Republic of Congo	25.7	1430	50.6 to 74.1	*	*	Epron et al., 2013
Forest/ plantation/ woodland	*	Republic of Congo	25	1350	29.3 to 130.9	*	*	Versini et al., 2013
Forest/ plantation/ woodland	*	Rwanda	21	1246	11.8 to 14.8	*	*	Nsabimana et al., 2009
Forest/ plantation/ woodland	-	Rwanda	17	1660	*	*	6.4 to 13.7	Gharahi Ghehi et al., 2012
Forest/ plantation/ woodland	-	Zimbabwe	*	*	*	-1.2 to 2.0	*	Mapanda et al., 2010
Savannah/grassland	-	Botswana	*	*	8.0	*	*	Thomas et al., 2014
Savannah/grassland	+	Botswana	21.0 to 23.5	331	3.3 to 6.4	*	*	Thomas, 2012
Savannah/grassland	+	Burkina Faso	29.5	926	14.1 to 21.3	2.8 to 3.5	*	Brümmer et al., 2009
Savannah/grassland	-	Ghana	26.5	787	*	-1.1 to 0.3	*	Prieme and Christensen, 1999
Savannah/grassland	-	Mali	27.6	1100	*	-0.2	*	Delmas et al., 1991
Savannah/grassland	*	Republic of Congo	25	1200	32.5 to 39.7	*	*	Caquet et al., 2012
Savannah/grassland	-	Republic of Congo	23.6	1600	3.7 to 4.3	-2.2 to -2.3	*	Delmas et al., 1991
Savannah/grassland	*	South Africa	17.9	740	*	0.3 to 2.5	*	Zepp et al., 1996

Savannah/grassland	*	South Africa	*	550	12.9 to 24.2	*	*	Fan et al., 2015
Savannah/grassland	-	Zimbabwe	17.5 to 18.5	760 to 840	*	*	0.3 to 0.8	Reese et al., 2006
Streams/rivers	nd	Okavango Delta, Botswana	*	*	*	2741.9	*	Gondwe and Masamba, 2014
Streams/rivers	nd	Nyong basin, Cameroun	*	*	54.5 to 66.0	*	*	Brunet et al., 2009
Streams/rivers	nd	Oubangui River (Congo River basin)	*	1500	5.7	5.7	0.2	Bouillon et al., 2012
Streams/rivers	nd	Ivory Coast	*	*	7.9 to 27.3	58.6 to 97.4	*	Kone et al., 2009; Borges et al., 2015
Streams/rivers	nd	Ivory Coast	1500 to 1800	*	*	8.8 to 16.4	*	Koné et al., 2010
Streams/rivers	nd	Gabon	*	*	*	123.5 to 272.6	2.1 to 4.5	Borges et al., 2015
Streams/rivers	nd	Kenya	*	*	29.9 to 49.1	33.2 to 80.2	1.0 to 4.5	Borges et al., 2015
Streams/rivers	nd	Madagascar	*	*	31.2 to 84.0	76.2 to 265.0	0.6 to 1.9	Borges et al., 2015
Streams/rivers	nd	Congo River	*	*	49.5 to 228.9	29.3 to 1082.4	0.6 to 3.1	Wang et al., 2013; Mann et al., 2014; Borges et al., 2015
Streams/rivers	nd	Zambezi River	*	1450	39.6 to 67.6	97.3 to 793.0	0.3	Teodoru et al., 2015; Borges et al., 2015
Wetlands/floodplains/lagoons /reservoir/lake	nd	Zambezi River	*	1450	-4.8 to 9.9	6.8 to 125.6	*	Teodoru et al., 2015
Wetlands/floodplains/lagoons /reservoir/lake	nd	Okavango Delta, Botswana	*	*	*	1480.4 to 1787.0	*	Gondwe and Masamba, 2014
Wetlands/floodplains/lagoons /reservoir/lake	nd	Ivory Coast	*	*	-11.9 to 161.7	*	*	Koné et al., 2009
Wetlands/floodplains/lagoons /reservoir/lake	nd	Congo River	*	*	*	246.4	*	Tathy et al., 1992
Wetlands/floodplains/lagoons /reservoir/lake	nd	Mali	*	*	*	3.1	*	Delmas et al., 1991
Wetlands/floodplains/lagoons /reservoir/lake	nd	Zimbabwe	*	*	65.0 to 232.0	-26.3 to 1235.2	0.5 to 3.5	Nyamadzawo et al., 2014
Wetlands/floodplains/lagoons /reservoir/lake	nd	Lake Kivu	*	*	1.7 to 85.8	2.1 to 6.0	*	Borget et al., 2011 and 2014
Wetlands/floodplains/lagoons /reservoir/lake	nd	Lake Kariba	*	*	*	11 to 7665	*	Delsonro T et al., 2011
Wetlands/floodplains/lagoons /reservoir/lake	nd	Ivory Coast	*	1500 to 1800	*	4.4 to 19.3	*	Koné et al., 2010
Termite mound	+	Burkina Faso	29.5	926	13.5 to 21.3	3.0 to 3.7	*	Brümmer et al., 2009
Termite mound	-	Zimbabwe	18	850	0.002	0.1	0.01	Nyamadzawo et al., 2012
Salt pan	-	Botswana	*	*	0.7	*	*	Thomas et al., 2014

Symbols: +: methods are *good*; \*: methods are *marginal*; -: methods are *poor to very poor*; ?: methods are unclear; nd: cannot comment due to no available criteria

Table S2 Summary of *in situ* carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) fluxes and N<sub>2</sub>O emission factor (%) in agricultural ecosystems. More detail information is available in 'Soil greenhouse gas emissions in Africa database' (<http://ghginafrica.blogspot.com/>).

Ecosystem type	Quality check†	Location	Temperature (°C)	Rainfall (mm)	CO <sub>2</sub> (Mg CO <sub>2</sub> ha <sup>-1</sup> y <sup>-1</sup> )	CH <sub>4</sub> (kg CH <sub>4</sub> ha <sup>-1</sup> y <sup>-1</sup> )	N <sub>2</sub> O (kg N <sub>2</sub> O ha <sup>-1</sup> y <sup>-1</sup> )	N <sub>2</sub> O emission factor (%)	Reference
Croplands	+	Burkina Faso	29.5	926	9.2 to 16.5	-0.9	*	*	Brümmer et al., 2009
Croplands	+	Kenya	*	1750	*	*	1.0 to 1.3	*	Hickman et al., 2014
Croplands	+	Kenya	*	1750	*	*	0.2 to 0.5	0.01 to 0.1	Hickman et al., 2015
Croplands	+	Madagascar	16	1300	*	*	0.4	0.47	Chapuis-Lardy et al., 2009
Croplands	+	Malawi	24	930	15.0	*	*	*	Kim, 2012
Croplands	-	Mali	27.6	1100	*	*	0.9 to 2.4	0.3 to 4.1	Dick et al., 2008
Croplands	-	Republic of Congo	23.6	1600	1.7 to 3.7	-1.3 to -1.8	*	*	Delmas et al., 1991
Croplands	-	Senegal	29.7	670	*	*	0.05 to 0.1	*	Dick et al., 2006
Croplands	+	Tanzania	24.5	626 to 905	3.4 to 14.8	*	*	*	Sugihara et al., 2012
Croplands	+	Tanzania	*	*	17.6 to 20.2	-1.7 to 5.6	0.6 to 1.1		Kimaro et al., 2015
Croplands	*	Uganda	21.9	1224	111.1 to 141.2	*	*	*	Koerber et al., 2009
Croplands	*	Zimbabwe	19.1	940	*	*	0.5 to 1.4	*	Rees et al., 2012
Croplands	*	Zimbabwe	*	*	*	*	0.9 to 7.1	*	Chikowo et al., 2004
Croplands	*	Zimbabwe	19.1	940	*	*	0.3 to 0.8	*	Rees et al. 2013
Croplands	-	Zimbabwe	*	*	*	*	0.5	*	Mapanda et al., 2010
Croplands	-	Zimbabwe	18.6	750	19.0 to 44.9	13.4 to 66.7	0.3 to 112.0	*	Nyamadzawo et al., 2014b
Croplands	-	Zimbabwe	18.9	748	1.9 to 10.4	-0.04 to 49.1	0.2 to 3.9	*	Mapanda et al., 2012
Croplands	*	Zimbabwe	21	725	*	*	0.5 to 2.7	0.3 to 1.0	Masaka et al., 2014
Croplands	-	Zimbabwe	*	*	*	3.2 to 11.9	0.8 to 3.5	*	Mapanda et al., 2010
Rice paddy	-	Zimbabwe	18.6	750	6.5	12.5	0.2	*	Nyamadzawo et al., 2013
Vegetable gardens	*	Burkina Faso	27	900	80.7 to 132.0	*	125.7 to 177.6	*	Lompo et al., 2012
Vegetable gardens	*	Niger	30.3	542	73.3 to 100.8	*	53.4 to 176.0	*	Predotova et al., 2010
Agroforestry	-	Senegal	25.8	370	*	*	0.2 to 2.7	*	Dick et al., 2006
Agroforestry	*	Sudan	28.2	698	*	*	23.6 to 26.7	*	Goenster et al., 2014
Agroforestry	+	Kenya	24	1880	*	*	0.3 to 6.4	*	Millar et al., 2004
Agroforestry	+	Malawi	24	930	38.6	*	*	*	Kim, 2012

†Symbols: +: methods are *good*; \*: methods are *marginal*; -: methods are *poor to very poor*.