The contributions of animal agriculture to climate change - Detailed overview of various papers

Categories \ Papers		FAO 2013		FAO 2006		Oxford 2018		LWJ 2021		WWI 2009		CLH 2019	
		14.5%		18%		28%		31%		51%		87%	
		CO2eq/ yr (Gt)	Description	CO2eq/ yr (Gt)	Description	CO2eq/ yr (Gt)	Description	CO2eq/ yr (Gt)	Description	CO2eq/ yr (Gt)	Description	CO2eq/ yr (Gt)	Description
Direct GHG Emissions	Carbon dioxide	2.0	Forest fire clearings: 0.7 Gt + Fossil fuel emissions for fertilizer production and animal transport and processing	2.7	Forest fire clearings: 2.4 Gt + Fossil fuel emissions for fertilizer production and animal transport and processing	6.6	Forest fire clearings: 1.8 Gt + Fossil fuel emissions for fertilizer production and animal transport and processing	2.8	Forest fire clearings: 2.8 Gt	11.3	Forest fire clearings: > 2.4 Gt + Fossil fuel emissions for fertilizer production and animal transport and processing + Cooking animal products + Production, distribution and disposal of byproducts and packaging + Carbon-intensive medical treatment of zoonosis, coronary heart diseases, cancers, diabetes and hypertensions leading to strokes	11.5	Forest fire clearings: > 2.5 Gt + Fossil fuel emissions for fertilizer production and animal transport and processing + Cooking animal products + Production, distribution, and disposal of byproducts and packaging + Carbon-intensive medical treatment of zoonosis, coronary heart diseases, cancers, diabetes, and hypertensions leading to strokes
	Methane	3.1	Enteric fermentation + Manure management GWP100 w/o ccfb : 25	2.2	Enteric fermentation + Manure management GWP100 w/o ccfb : 23 37% of all CH4 emissions		Enteric fermentation + Manure management GWP100 w/ ccfb : 34	17.4	Enteric fermentation + Manure management GWP0 w/ sulfate-fb, w/o ccfb : 146 33% of all CH4 emissions	7.3	Enteric fermentation + Manure management + Animal waste in landfills GWP20 w/o ccfb : 72 37% of all CH4 emissions	7.7	Enteric fermentation + Manure management + Animal waste in landfills GWP20 w/o ccfb : 72 37% of all CH4 emissions
	Nitrous oxide	2.0	Decomposition of manure and chemical fertilizer GWP100 w/o ccfb : 298	2.2	Decomposition of manure and chemical fertilizer GWP100 w/o ccfb : 296		Decomposition of manure and chemical fertilizer GWP100 w/ ccfb : 298	1.4	Decomposition of manure and chemical fertilizer GWP0 w/o ccfb : 196	2.2	Decomposition of manure and chemical fertilizer GWP100 w/o ccfb : 298	1.8	Decomposition of manure and chemical fertilizer GWP100 w/o ccfb : 298
Carbon Opportun-ity Costs (COC)	Carbon dioxide	0	not included	0	not included	8.1	Missed carbon sequestration potential: 8.1	11.4	Missed carbon sequestration potential: 11.4	11.5	Respiration by livestock: 8.8 + Land use change: 2.7	34.5	COC: 5 tons of CO2 per person per year with 6.9 billion poeple in 2010
Direct emissions plus COC (Animal Agriculture)		7.1	Contribution of animal agriculture: (7.1 Gt CO2eq/yr)/(49 Gt CO2eq/yr) = 14.5%	7.1	Contribution of animal agriculture: (7.1 Gt CO2eq/yr)/(40 Gt CO2eq/yr) = 18%	14.7	Contribution of animal agriculture: (14.7 Gt CO2eq/yr)/(52.3 Gt CO2eq/yr) = 28%	33.0	Contribution of animal agriculture: (33 Gt CO2eq/yr)/(106 Gt CO2eq/yr) = 31%	32.3	Contribution of animal agriculture: (32.3 Gt CO2eq/yr)/(63.8 Gt CO2eq/yr) = 51%	55.5	Contribution of animal agriculture: (55.5 Gt CO2eq/yr)/(63.8 Gt CO2eq/yr) = 87%
Direct emissions plus COC (All sectors)		49.0		40.0		52.3		106.0		63.8		63.8	
Main Issues (ordered by impact; direction indicated by '-' and '+', where '- - - -' means high omissions/miscalculations and '+ + + +' means high overvaluations/miscalculations)		(1) No integration of carbon opportunity costs of animal agriculture (- - - -) (2) Omission of big parts of carbon dioxide emissions caused by fire clearings (- - -) (3) Use of the Global Warming Potential for methane over 100 years and without climate carbon feedbacks (- -) (?) Omission of GHG emissions along some parts of the life cycle of animal products (-) (?) No integration of GHG emissions from side effects of animal products (diseases) (-)		(1) No integration of carbon opportunity costs of animal agriculture (- - - -) (2) Use of the Global Warming Potential for methane over 100 years and without climate carbon feedbacks (- -) (?) Omission of GHG emissions along some parts of the life cycle of animal products (-) (?) No integration of GHG emissions from side effects of animal products (diseases) (-)		(1) Use of the Global Warming Potential for methane over 100 years (- -) (2) Base (total emissions across all sectors) for calculating share of animal agriculture does not include carbon opportunity costs. (+ +) (?) Omission of GHG emissions along some parts of the life cycle of animal products (-) (?) No integration of GHG emissions from side effects of animal products (diseases) (-)		(1) No integration of fossil fuel emissions for fertilizer production and animal transport and processing (-) (?) Use of an instantaneous global warming potential for methane (+). (?) Omission of GHG emissions along some parts of the life cycle of animal products (-) (?) No integration of GHG emissions from side effects of animal products (diseases) (-)		(1) Higher GWP20 for methane is not applied to industries other than AA, resulting in a lower basis for calculating AA share (+ +) (2) Integration of GHG emissions along the life cycle of animal products and side-effects, but possibly not applied similarly to alternate products (+) (3) Use of the Global Warming Potential for methane over 20 years and without climate carbon feedbacks (-)		(1) Carbon opportunity costs were calculated by multiplying a figure for a diet of a Northern European citizen by the world population. (+ + + +) (2) Base (total emissions across all sectors) for calculating share of animal agriculture does not include carbon opportunity costs. (+ + + +) (3) Rest of calculation including issues is fully based on the 2009 WWI analysis (+ +)	
		(?) No consideration of aerosol cooling effects of emissions due to fossil fuel combustion (-), (?) No consideration of net GHG emissions of aquaculture (metabolism) (-), (?) No consideration of potential net GHG emissions of capture fisheries (metabolism) (-)											
		FAO is steered and sponsored by all global animal industries: [i] http://www.fao.org/partnerships/leap/partners/members-of-steering-committee/en/ [iii] http://www.fao.org/partnerships/leap/partners/donors/en/											
Links		[1] p.7, p.15		[2] p.113		[3] p.1 [4] p.44		[5] p.16, p.17, p.22, p.25 [6] Ref_Table8		[7] p.11		[8] p.17 [9] p.251, p.252 (fig.3)	
List of references		**[1]** United Nations Food and Agricultural Organization (20013): Tackling Climate Change Through Livestock, Rome (Italy): Food and Agriculture Organization of the United Nations (FAO) [online]. Retrieved from http://www.fao.org/3/i3437e/i3437e.pdf, accessed on 30 December 2020, **[2]** United Nations Food and Agricultural Organization (2006): Livestock's Long Shadow, Environmental Issues and Options, Rome (Italy): Chief, Electronic Publishing Policy and Support Branch, Communication Division – FAO [Online]. Retrieved from http://www.fao.org/3/a0701e/a0701e00.htm, accessed on 30 August 2020; **[3]** Poore, J., Nemecek, T. (2018): Reducing food's environmental impacts through producers and consumers. In: Science, June 2018, Number 360, Issue 6392, Erratum [online]. Retrieved from https://science.sciencemag.org/content/363/6429/eaaw9908, accessed on 26 Dezember 2020; **[4]** Poore, J., Nemecek, T. (2018): Reducing food's environmental impacts through producers and consumers. In: Science, June 2018, Number 360, Issue 6392, Supplementary Materials, Download Supplement [Online]. Retrieved from www.sciencemag.org/content/360/6392/987/suppl/DC1, Accessed on 26 Dezember 2020 **[5]** Mueller, M. (2021): The contributions of animal agriculture and major fossil-fuel-based industries to global warming, Pre-Print [online], Retrieved from https://bayern.landwirtschaft.jetzt/wp-content/uploads/2021/01/x4.pdf, accessed on 03 January 2021; **[6]** Mueller, M. (2021): The contributions of animal agriculture and major fossil-fuel-based industries to global warming, Supplementary Material [online], Retrieved from https://bayern.landwirtschaft.jetzt/wp-content/uploads/2021/01/x5.xlsx, accessed on 03 January 2021; **[7]** Goodland, R., Anhang, J. M. (2009): Livestock and Climate Change: What if the key actors in climate change are pigs, chickens and cows, Washington DC (USA): Worldwatch Institute [online]. Retrieved from https://www.industryfootprint.org/wp-content/uploads/2020/08/Goodland_2009_Livestock_and_Climate_Change.pdf, accessed on 30 August 2020; **[8]** Rao, S. et al. (2019): Animal Agriculture is the Leading Cause of Climate Change [online], Retrieved from https://www.climatehealers.org/wp-content/uploads/2020/10/AnimalAgriculturePositionPaper.pdf, accessed on 30 December 2020; **[9]** Searchinger, T.D., Wirsenius, S., Beringer, T. et al. (2018): Assessing the efficiency of changes in land use for mitigating climate change. In: Nature, December 2018, Number 564, Pp.249–253 [online]. Retrieved from https://doi.org/10.1038/s41586-018-0757-z, accessed on 30 December 2020											