Supplementary Information

A framework to assess the terrestrial risk of antibiotic resistance from antibiotics in slurry or manure amended soils.

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SI Table 1 Predicted No Effect Concentrations (1)

Antibiotic	PNEC environment (µg.L-1)	PNEC resistance (µg.L-1)
Tetracyclines		
Tetracycline (TET)	3.2	1
Oxytetracycline (OXY)	18	0.5
Fluoroquinolones		
Ciprofloxacin (CIPRO)	0.45	0.06
Enrofloxacin (ENRO)	1.9	0.06
Sulfonamides		
Sulfamethoxazole (SMZ)	NA	NA
Lincosamides		
Lincomycin (LINCO)	1.8	2

SI Table 2 Literature Concentrations of Antibiotics in Farmyard Manure (FYM)

Antibiotic	Slurry Conc. (mg Kg^{-1})	FYM type	Reference
Tetracyclines			
Tetracycline (TET)	0.45	Calf slurry	Huygens et al, 2021(2)
	0.16	Pig slurry	Rasschaert et al, 2020 (3)
	12.10	Pig slurry	Qiao et al, 2012(4)
	16.00	Pig slurry	Gros et al, 2019(5)
	43.50	manure	Hu et al, 2010(6)
	300.0	Pig slurry	Widyasari-Mehta et al, 2016 (7)
	227.0	Pig slurry	Widyasari-Mehta et al, 2016 (7)
	5.90	Pig slurry	Widyasari-Mehta et al, 2016 (7)
Oxytetracycline (OXY)	40.78	Calf slurry	Huygens et al, 2021(2)
	4.819	Pig slurry	Rasschaert et al, 2020 (3)
	770.0	Pig slurry	Gros et al, 2019(5)
	75.29	Pig slurry	Gros et al, 2019(5)
	34.23	Pig slurry	Gros et al, 2019(5)
	183.5	manure	Hu et al, 2010(6)
	211	Pig slurry	Widyasari-Mehta et al, 2016 (7)
	58.27	Pig slurry	Huygens et al, 2021(5)
Fluoroquinolones			
Ciprofloxacin (CIPRO)	0.48	Calf slurry	Huygens et al, 2021(2)
	0.06	Pig slurry	Huygens et al, 2021(3)
	8.80	Pig slurry	Gros et al, 2019(5)
	34.00	Pig slurry	Gros et al, 2019(5)
	43.00	manure	Hu et al, 2010(6)
Enrofloxacin (ENRO)	0.31	Calf slurry	Huygens et al, 2021(2)
	0.14	Pig slurry	Rasschaert et al, 2020(3)
	60.21	Pig slurry	Gros et al, 2019(5)
	53.00	Pig slurry	Gros et al, 2019(5)
	4.70	Pig slurry	Widyasari-Mehta et al, 2016 (7)
Sulfonamides			
Sulfamethazine (SMZ)	0.03	Calf slurry	Huygens et al, 2021(2)
	0.458	Pig slurry	Gros et al, 2019(5)
	3.0	Pig slurry	Van den Meersche et al, 2016(8)
	4.9	Pig manure	Ji et al, 2012(9)
	7.3	Pig manure	Hu et al, 2010(6)
	4.6	Cattle manure	Ji et al, 2012(9)
	8.0	Chicken manure	Ho et al, 2014 (10)
	5.8	Chicken manure	
Lincosamides			
Lincomycin (LINCO0	0.36	Calf slurry	Huygens et al, 2021(2)
	1.767	Pig slurry	Rasschaert et al, 2020(3)
	227	Pig slurry	Gros et al, 2019(5)
	97.8	Pig slurry	Kuchta and Cessna, 2009(11)
	3.8	manure	Hu et al, 2010(6)

SI Table 3 <u>Tetracyclines – Predicted Environmental Concentrations Pore Water</u>

Equ.2 – Droge and Goss (2013)(12)

Equ.3 – Franco et al (2009)(13).

Soil pH	% Ionised	Model	K_d (L.Kg^{-1})	FYM conc (mg.kg-1)	Non-Ploughed			Ploughed		
					PEC soil (µg.kg-1)	PEC$_{PW}$ (µg.L-1)	RQ	PEC soil (µg.kg-1)	PEC$_{PW}$ (µg.L-1)	RQ
					Tetracycline (TET)					
8.7	66.86	Equ.3	0.0007	0.45	0.1	21.54	21.54	0.02	4.31	4.31
5	37.75	Equ.2	5958.22			2.56E-05	2.57E-05		5.14E-06	5.14E-06
8.7	66.86	Equ.3	0.0007	0.16	0.036	7.71	7.71	0.007	1.54	1.54
5	37.75	Equ.2	5958.22			9.18E-06	9.19E-06		1.84E-06	1.84E-06
8.7	66.86	Equ.3	0.0007	12.1	2.74	579.08	597.08	0.55	115.82	115.82
5	37.75	Equ.2	5958.22			6.9E-04	6.90E-04		1.38E-04	1.38E-04
8.7	66.86	Equ.3	0.0007	16	3.62	765.73	765.73	0.73	153.15	153.15
5	37.75	Equ.2	5958.22			9.13E-04	9.13E-04		1.83E-04	1.83E-04
8.7	66.86	Equ.3	0.0007	43.5	9.86	2081.82	2001.82	1.97	416.36	416.36
5	37.75	Equ.2	5958.22			2.48E-03	2.48E-03		4.96E-04	4.96E-04
8.7	66.86	Equ.3	0.0007	300	68.0	14357.41	14357.41	13.6	2871.48	2871.48
5	37.75	Equ.2	5958.22			1.71E-02	1.71E-02		3.42E-03	3.42E-03
8.7	66.86	Equ.3	0.0007	227	51.45	10863.77	10863.77	10.29	2172.75	2172.75
5	37.75	Equ.2	5958.22			1.29E-05	1.30E-02		2.59E-03	2.59E-03
8.7	66.86	Equ.3	0.0007	5.9	1.34	282.36	282.36	0.27	56.47	56.47
5	37.75	Equ.2	5958.22			3.36E-04	3.37E-04		6.73E-05	6.73E-05
					Oxytetracycline (OXY)					
8.7	74.67	Equ.3	0.0002	40.78	9.24	6770.30	13540.60	1.85	1354.06	2708.12
5	32.89	Equ.2	6172.00			0.0023	4.49E-03		4.49E-04	8.99E-04
8.7	74.67	Equ.3	0.0002	4.82	1.09	800.05	1600.10	0.22	160.01	320.02
5	32.89	Equ.2	6172.00			0.0003	5.31E-04		5.31E-05	1.06E-04
8.7	74.67	Equ.3	0.0002	770	174.53	127835.45	255670.89	34.91	25567.09	51134.18
5	32.89	Equ.2	6172.00			0.0424	0.085		8.48E-03	0.017
8.7	74.67	Equ.3	0.0002	75.29	17.07	12499.65	24999.30	3.41	2499.93	4.999.86
5	32.89	Equ.2	6172.00			0.0042	8.30E-03		8.30E-04	1.66E-03
8.7	74.67	Equ.3	0.0002	34.23	7.76	5682.87	11365,73	1.55	1136.57	2273.15
5	32.89	Equ.2	6172.00			0.0019	3.77E-03		3.77E-04	7.54E-04
8.7	74.67	Equ.3	0.0002	183.5	41.59	30464.68	60929.36	8.32	6092.94	12185.87
5	32.89	Equ.2	6172.00			0.0101	2.02E-02		2.02E03	4.04E-03
8.7	74.67	Equ.3	0.0002	211	47.82	35030.23	70060.47	9.57	7006.05	14012.09
5	32.89	Equ.2	6172.00			0.0116	2.33E-02		2.32E-03	4.65E-05
8.7	66.86	Equ.3	0.0002	58.27	13.21	9673.99	19347.98	2.64	1934.80	3869.60
5	37.75	Equ.2	6172.00			0.00321	6.42E-03		6.42E-04	1.28E-05

SI Table 4 <u>Fluoroquinolones– Predicted Environmental Concentrations Pore Water</u>

Equ.2 – Droge and Goss (2013)(12)

Equ.3 – Franco et al (2009)(13).

Soil pH	% Ionised	Model	K_d (L.Kg^{-1})	FYM conc (mg.kg-1)	Non-Ploughed			Ploughed		
					PEC soil (µg.Kg-1)	PEC$_{PW}$ (µg.L-1)	RQ	PEC soil (µg.Kg-1)	PEC$_{PW}$ (µg.L-1)	RQ
Ciprofloxacin (CIPRO)										
8.7	70.79	Equ.3	0.26	0.48	0.11	0.63	10.55	0.02	0.13	2.11
5	2.24	Equ.2	5038.76			3.24E-05	5.40E-04		6.48E-06	1.08E-04
8.7	70.79	Equ.3	0.26	0.06	0.003	0.08	1.38	0.003	0.02	0.28
5	2.24	Equ.2	5038.76			4.25E-06	7.09E-05		8.50E-07	1.42E-05
8.7	70.79	Equ.3	0.26	8.8	1.99	11.60	198.38	0.04	2.32	38.68
5	2.24	Equ.2	5038.76			5.94E-04	9.88E-03		1.19E-04	1.98E-03
8.7	70.79	Equ.3	0.26	34	7.71	44.83	747.16	1.54	8.97	149.43
5	2.24	Equ.2	5038.76			2.29E-03	8.83E-02		4.59E-04	7.65E03
8.7	70.79	Equ.3	0.041	90	20.4	118.67	1977.79	4.08	23.73	395.56
5	2.24	Equ.2	5038.76			6.07E-03	1.01E-01		1.21E-03	2.02E-02
Enrofloxacin (ENRO)										
8.7	92.9	Equ.3	5.73	0.31	0.07	0.02	0.31	0.01	3.68E-03	0.06
5	3.82	Equ.2	6434.84			1.63E-05	2.73E-04		2.28E-06	5.46E-05
8.7	92.9	Equ.3	5.73	0.142	0.03	0.01	0.14	6.44E-03	1.69E-03	0.03
5	3.82	Equ.2	6434.84			7.5E-06	1.25E-04		1.5E-06	2.50E-05
8.7	92.9	Equ.3	5.73	60.21	13.65	3.57	59.57	2.73	0.71	11.91
5	3.82	Equ.2	6434.84			3.18E-03	5.30E-02		6.36E-04	1.06E-02
8.7	92.9	Equ.3	5.73	53	12.01	3.15	52.43	2.4	0.63	10.49
5	3.82	Equ.2	6434.84			2.8E-03	4.67E-02		5.6E-04	9.34E-03
8.7	92.9	Equ.3	5.73	4.7	1.07	0.28	4.65	0.21	0.06	0.93
5	3.82	Equ.2	6434.84			2.48E-04	4.14E-03		4.97E-05	8.28E-04

SI Table 5 Sulfonamides and Lincosamides– Predicted Environmental Concentrations Pore Water

Equ.2 – Droge and Goss (2013)(12)

Equ.3 – Franco et al (2009)(13).

*RQ calculated using PNECr for sulfamethoxazole.

Soil pH	% Ionised	Model	K_d (L.Kg^{-1})	FYM conc (mg.kg-1)	Non-Ploughed			Ploughed		
					PEC soil (µg.Kg-1)	PEC$_{PW}$ (µg.L-1)	RQ	PEC soil (µg.Kg-1)	PEC$_{PW}$ (µg.L-1)	RQ
Sulfamethazine (SMZ)										
8.75	97.1050	Equ.3 NA	8.57 NA	0.45	6.8E-03	0.001 NA	7.43E-05*	0.001	0.0002 NA	1.49E-05*
8.75	97.1050	Equ.3 NA	8.57 NA	0.46	0.1	0.018 NA	1.14E-03*	0.021	0.004 NA	2.27E-04*
8.75	97.1050	Equ.3 NA	8.57 NA	3.0	0.68	0.119 NA	7.43E-03*	0.136	0.024 NA	1/49E-03*
8.75	97.1050	Equ.3 NA	8.57 NA	4.9	1.11	0.194 NA	1.21E-02*	0.222	0.039 NA	2.43E-03*
8.75	97.1050	Equ.3 NA	8.57 NA	7.3	1.65	0.289 NA	1.81E-02*	0.331	0.058 NA	3.62E-03*
8.75	97.1050	Equ.3 NA	8.57 NA	4.6	1.04	0.182 NA	1.14E-02*	0.209	0.036 NA	2.28E-03*
8.75	97.1050	Equ.3 NA	8.57 NA	8.0	1.81	0.317 NA	1.98E-02*	0.363	0.063 NA	3.96E-03*
8.75	97.1050	Equ.3 NA	8.57 NA	5.8	1.31	0.230 NA	1.44E-02*	0.263	0.046 NA	2.87E-03*
Lincomycin (LINCO)										
8.75	22.70.01	Equ.2 Equ.2	7818.34	0.36	0.08	1.57E-05	7.83E-06	0.016	3.13E-06	1.56E-06
8.75	22.70.01	Equ.2 Equ.2	7818.34	1.77	0.4	7.68E-05	3.84E-05	0.08	1.54E-05	7.68E-06
8.75	22.70.01	Equ.2 Equ.2	7818.34	227	51.45	9.87E-03	4.94E-03	10.291	1.97E-03	9.87E-04
8.75	22.70.01	Equ.2 Equ.2	7818.34	3.8	0.86	1.65E-04	8.26E-05	0.172	3.31E-05	1.65E-05

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