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Supplementary Information

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

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Table of Contents

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 Tetracyclines – Predicted Environmental Concentrations Pore Water

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)									
8.75	66.86 37.75	Equ.3 Equ.2	0.0007 5958.22	0.45	0.1	21.54 2.56E-05	21.54 2.57E-05	0.02	4.31 5.14E-06	4.31 5.14E-06
8.75	66.86 37.75	Equ.3 Equ.2	0.0007 5958.22	0.16	0.036	7.71 9.18E-06	7.71 9.19E-06	0.007	1.54 1.84E-06	1.54 1.84E-06
8.75	66.86 37.75	Equ.3 Equ.2	0.0007 5958.22	12.1	2.74	579.08 6.9E-04	597.08 6.90E-04	0.55	115.82 1.38E-04	115.82 1.38E-04
8.75	66.86 37.75	Equ.3 Equ.2	0.0007 5958.22	16	3.62	765.73 9.13E-04	765.73 9.13E-04	0.73	153.15 1.83E-04	153.15 1.83E-04
8.75	66.86 37.75	Equ.3 Equ.2	0.0007 5958.22	43.5	9.86	2081.82 2.48E-03	2001.82 2.48E-03	1.97	416.36 4.96E-04	416.36 4.96E-04
8.75	66.86 37.75	Equ.3 Equ.2	0.0007 5958.22	300	68.0	14357.41 1.71E-02	14357.41 1.71E-02	13.6	2871.48 3.42E-03	2871.48 3.42E-03
8.75	66.86 37.75	Equ.3 Equ.2	0.0007 5958.22	227	51.45	10863.77 1.29E-05	10863.77 1.30E-02	10.29	2172.75 2.59E-03	2172.75 2.59E-03
8.75	66.86 37.75	Equ.3 Equ.2	0.0007 5958.22	5.9	1.34	282.36 3.36E-04	282.36 3.37E-04	0.27	56.47 6.73E-05	56.47 6.73E-05
Oxytetracycline (OXY)										
8.75	74.67 32.89	Equ.3 Equ.2	0.0002 6172.00	40.78	9.24	6770.30 0.0023	13540.60 4.49E-03	1.85	1354.06 4.49E-04	2708.12 8.99E-04
8.75	74.67 32.89	Equ.3 Equ.2	0.0002 6172.00	4.82	1.09	800.05 0.0003	1600.10 5.31E-04	0.22	160.01 5.31E-05	320.02 1.06E-04
8.75	74.67 32.89	Equ.3 Equ.2	0.0002 6172.00	770	174.53	127835.45 0.0424	255670.89 0.085	34.91	25567.09 8.48E-03	51134.18 0.017
8.75	74.67 32.89	Equ.3 Equ.2	0.0002 6172.00	75.29	17.07	12499.65 0.0042	24999.30 8.30E-03	3.41	2499.93 8.30E-04	4.999.86 1.66E-03
8.75	74.67 32.89	Equ.3 Equ.2	0.0002 6172.00	34.23	7.76	5682.87 0.0019	11365,73 3.77E-03	1.55	1136.57 3.77E-04	2273.15 7.54E-04
8.75	74.67 32.89	Equ.3 Equ.2	0.0002 6172.00	183.5	41.59	30464.68 0.0101	60929.36 2.02E-02	8.32	6092.94 2.02E03	12185.87 4.04E-03
8.75	74.67 32.89	Equ.3 Equ.2	0.0002 6172.00	211	47.82	35030.23 0.0116	70060.47 2.33E-02	9.57	7006.05 2.32E-03	14012.09 4.65E-05
8.75	66.86 37.75	Equ.3 Equ.2	0.0002 6172.00	58.27	13.21	9673.99 0.00321	19347.98 6.42E-03	2.64	1934.80 6.42E-04	3869.60 1.28E-05

SI Table 4 Fluoroquinolones– Predicted Environmental Concentrations Pore Water

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 5	70.79 2.24	Equ.3 Equ.2	0.26 5038.76	0.48	0.11	0.63 3.24E-05	10.55 5.40E-04	0.02	0.13 6.48E-06	2.11 1.08E-04
8.7 5	70.79 2.24	Equ.3 Equ.2	0.26 5038.76	0.06	0.003	0.08 4.25E-06	1.38 7.09E-05	0.003	0.02 8.50E-07	0.28 1.42E-05
8.7 5	70.79 2.24	Equ.3 Equ.2	0.26 5038.76	8.8	1.99	11.60 5.94E-04	198.38 9.88E-03	0.04	2.32 1.19E-04	38.68 1.98E-03
8.7 5	70.79 2.24	Equ.3 Equ.2	0.26 5038.76	34	7.71	44.83 2.29E-03	747.16 8.83E-02	1.54	8.97 4.59E-04	149.43 7.65E03
8.7 5	70.79 2.24	Equ.3 Equ.2	0.041 5038.76	90	20.4	118.67 6.07E-03	1977.79 1.01E-01	4.08	23.73 1.21E-03	395.56 2.02E-02
Enrofloxacin (ENRO)										
8.7 5	92.9 3.82	Equ.3 Equ.2	5.73 6434.84	0.31	0.07	0.02 1.63E-05	0.31 2.73E-04	0.01	3.68E-03 2.28E-06	0.06 5.46E-05
8.7 5	92.9 3.82	Equ.3 Equ.2	5.73 6434.84	0.142	0.03	0.01 7.5E-06	0.14 1.25E-04	6.44E-03	1.69E-03 1.5E-06	0.03 2.50E-05
8.7 5	92.9 3.82	Equ.3 Equ.2	5.73 6434.84	60.21	13.65	3.57 3.18E-03	59.57 5.30E-02	2.73	0.71 6.36E-04	11.91 1.06E-02
8.7 5	92.9 3.82	Equ.3 Equ.2	5.73 6434.84	53	12.01	3.15 2.8E-03	52.43 4.67E-02	2.4	0.63 5.6E-04	10.49 9.34E-03
8.7 5	92.9 3.82	Equ.3 Equ.2	5.73 6434.84	4.7	1.07	0.28 2.48E-04	4.65 4.14E-03	0.21	0.06 4.97E-05	0.93 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)										
8.7 5	97.10 50	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*
8.7 5	97.10 50	Equ.3 NA	8.57 NA	0.46	0.1	0.018 NA	1.14E-03*	0.021	0.004 NA	2.27E-04*
8.7 5	97.10 50	Equ.3 NA	8.57 NA	3.0	0.68	0.119 NA	7.43E-03*	0.136	0.024 NA	1/49E-03*
8.7 5	97.10 50	Equ.3 NA	8.57 NA	4.9	1.11	0.194 NA	1.21E-02*	0.222	0.039 NA	2.43E-03*
8.7 5	97.10 50	Equ.3 NA	8.57 NA	7.3	1.65	0.289 NA	1.81E-02*	0.331	0.058 NA	3.62E-03*
8.7 5	97.10 50	Equ.3 NA	8.57 NA	4.6	1.04	0.182 NA	1.14E-02*	0.209	0.036 NA	2.28E-03*
8.7 5	97.10 50	Equ.3 NA	8.57 NA	8.0	1.81	0.317 NA	1.98E-02*	0.363	0.063 NA	3.96E-03*
8.7 5	97.10 50	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)										
8.7 5	22.7 0.01	Equ.2 Equ.2	7818.34	0.36	0.08	1.57E-05	7.83E-06	0.016	3.13E-06	1.56E-06
8.7 5	22.7 0.01	Equ.2 Equ.2	7818.34	1.77	0.4	7.68E-05	3.84E-05	0.08	1.54E-05	7.68E-06
8.7 5	22.7 0.01	Equ.2 Equ.2	7818.34	227	51.45	9.87E-03	4.94E-03	10.291	1.97E-03	9.87E-04
8.7 5	22.7 0.01	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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