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Effects of different N sources on riverine DIN export and retention in a subtropical high-standing island, Taiwan

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Table S1. The number and density of cattle, cows, and swine in Taiwan, US, and China (unit: million), from: http://www.indexmundi.com/agriculture

Country (area, 1000 km^2)	cattle	cows	Density (cap km^{-2})	swine	Density (cap km^{-2})
Taiwan (36)	0.03	0.11	3.8	5.5	152.8
US (9388)	89.8	9.2	10.5	118.5	12.6
China (9147)	100.6	16.6	12.8	682.3	74.6

Table S2. The arithmetic and flow-weighted means of NO_3 concentration and the mean stream discharge of 49 monitoring stations during sampling period and 2002-2012

Station	category	NO_3 conc. (uM)		runoff	Flux estimation (kg-N km^{-2} yr^{-1}) by		Relative Diff.
		Arithmetic Mean	Flow-Weighted Mean	(mm day^{-1})	AM	FWM	|AM-FWM|
1084	1	38.2	40.4	7.1	1385.9	1465.8	79.8
1109	1	36.0	29.2	3.2	1306.1	1059.4	246.7
1110	1	48.2	32.7	3.2	1748.7	1186.4	562.4
1136	1	24.8	30.8	5.0	899.8	1117.5	217.7
1238	1	22.8	24.5	6.8	827.2	888.9	61.7
1239	1	19.6	18.5	7.4	711.1	671.2	39.9
1240	1	25.2	24.8	6.5	914.3	899.8	14.5
1249	1	21.5	18.9	6.1	780.0	685.7	94.3
1250	1	15.8	15.9	8.9	573.2	576.9	3.6
1252	1	17.9	16.7	5.2	649.4	605.9	43.5
1256	1	13.0	18.2	10.8	471.7	660.3	188.7
1257	1	18.1	17.9	8.4	656.7	649.4	7.3
1327	1	23.1	18.6	6.8	838.1	674.8	163.3
1337	1	20.8	31.2	5.9	754.6	1132.0	377.3
1346	1	22.9	30.0	4.6	830.8	1088.4	257.6
1509	1	15.4	25.0	7.8	558.7	907.0	348.3
1085	2	30.6	35.8	7.7	1110.2	1298.9	188.7
1091	2	44.9	48.1	6.3	1629.0	1745.1	116.1
1106	2	84.2	92.9	3.7	3054.9	3370.5	315.6
1139	2	57.4	65.4	4.2	2082.5	2372.8	290.2
1176	2	116.2	131.8	5.6	4215.9	4781.8	566.0
1177	2	108.2	85.8	4.6	3925.6	3112.9	812.7
1201	2	70.7	79.6	7.4	2565.1	2888.0	322.9
1225	2	41.9	42.2	6.6	1520.2	1531.1	10.9
1251	2	34.9	33.4	7.3	1266.2	1211.8	54.4
1253	2	25.3	27.5	5.7	917.9	997.7	79.8
1255	2	30.4	31.5	5.8	1102.9	1142.9	39.9
1258	2	38.4	35.6	5.8	1393.2	1291.6	101.6
1262	2	21.6	26.4	9.0	783.7	957.8	174.1
1271	2	31.8	33.0	8.7	1153.7	1197.3	43.5
1654	2	17.0	21.9	10.0	616.8	794.6	177.8
1024	3	93.2	92.9	7.2	3381.4	3370.5	10.9
1042	3	58.5	78.2	5.2	2122.4	2837.2	714.7
1071	3	125.8	122.1	4.3	4564.1	4429.9	134.2
1093	3	61.6	63.2	7.1	2234.9	2293.0	58.0
1099	3	80.9	82.5	5.4	2935.1	2993.2	58.0
1118	3	81.4	73.0	7.7	2953.3	2648.5	304.8
1119	3	134.8	139.6	5.7	4890.7	5064.8	174.1

1126	3	147.3	152.5	6.0	5344.2	5532.9	188.7
1149	3	76.6	89.8	5.5	2779.1	3258.0	478.9
1150	3	87.5	94.6	4.2	3174.6	3432.2	257.6
1154	3	181.9	203.2	6.5	6599.5	7372.3	772.8
1159	3	47.9	84.8	9.1	1737.9	3076.6	1338.8
1163	3	90.3	96.9	6.5	3276.2	3515.6	239.5
1167	3	118.9	129.3	5.1	4313.8	4691.1	377.3
1186	3	41.8	65.7	5.4	1516.5	2383.7	867.1
1191	3	86.2	81.4	6.4	3127.4	2953.3	174.1
1207	3	190.9	217.1	7.8	6926.0	7876.6	950.6
1305	3	103.1	97.7	6.4	3740.6	3544.7	195.9

Riverine substance load or yield (per area load), defined as the product of concentration and stream discharge is a function of flow regimes, watershed characteristics, substance characteristics, sampling frequency, and estimation method (Ferguson, 1987; Preston et al., 1989; Lee et al., 2009). Therefore, sampling frequency and estimation methods play an important role in calculating flux, particularly for small mountainous river basins in which the storm discharge variation can surge to 2 or 3 orders of magnitude, compared to the base low. We addressed the issue of sampling frequency and estimation method in our previous studies in several mountainous headwater catchments and a nested watershed in central and northern Taiwan (Huang et al., 2012; Lee et al., 2013; Lee et al., 2014; Lin et al., 2015; Shih et al., revised). In those studies, we also conducted some high-frequency sampling works (every three hours) during typhoons. We found that the relationship between nitrate concentration and streamflow varied from hydrological enhancement to dilution along the urbanization gradient, but most watersheds showed hydrological control over nitrate loading and suggest that that nitrate loading is approximately proportional to streamflow (Lee et al., 2013). For estimation method, we calculated the arithmetic and flow-weighted mean of nitrate to investigate the potential differences resulting from differences in methods. In this table, the difference between arithmetic and flow-weighted means of all samples were less than 30 uM, except Site # 1159 which is 37 uM. In terms of yield, the mean difference between arithmetic and flow-weighted means was 271.4 kg-N km^{-2} yr^{-1}. Most of the differences were less than 1000 kg-N km^{-2} yr^{-1}, except the Site no. 1159 in which the difference was up to 1339 kg-N km^{-2} yr^{-1}. For the three categories of watersheds, the mean differences were 169.2, 219.6, and 405.3 kg-N km^{-2} yr^{-1}, respectively, for the low, moderately, and highly disturbed watersheds. Compared to the large N inputs, the differences caused by the estimation methods were ~3% and will not alter the results we presented in this study.

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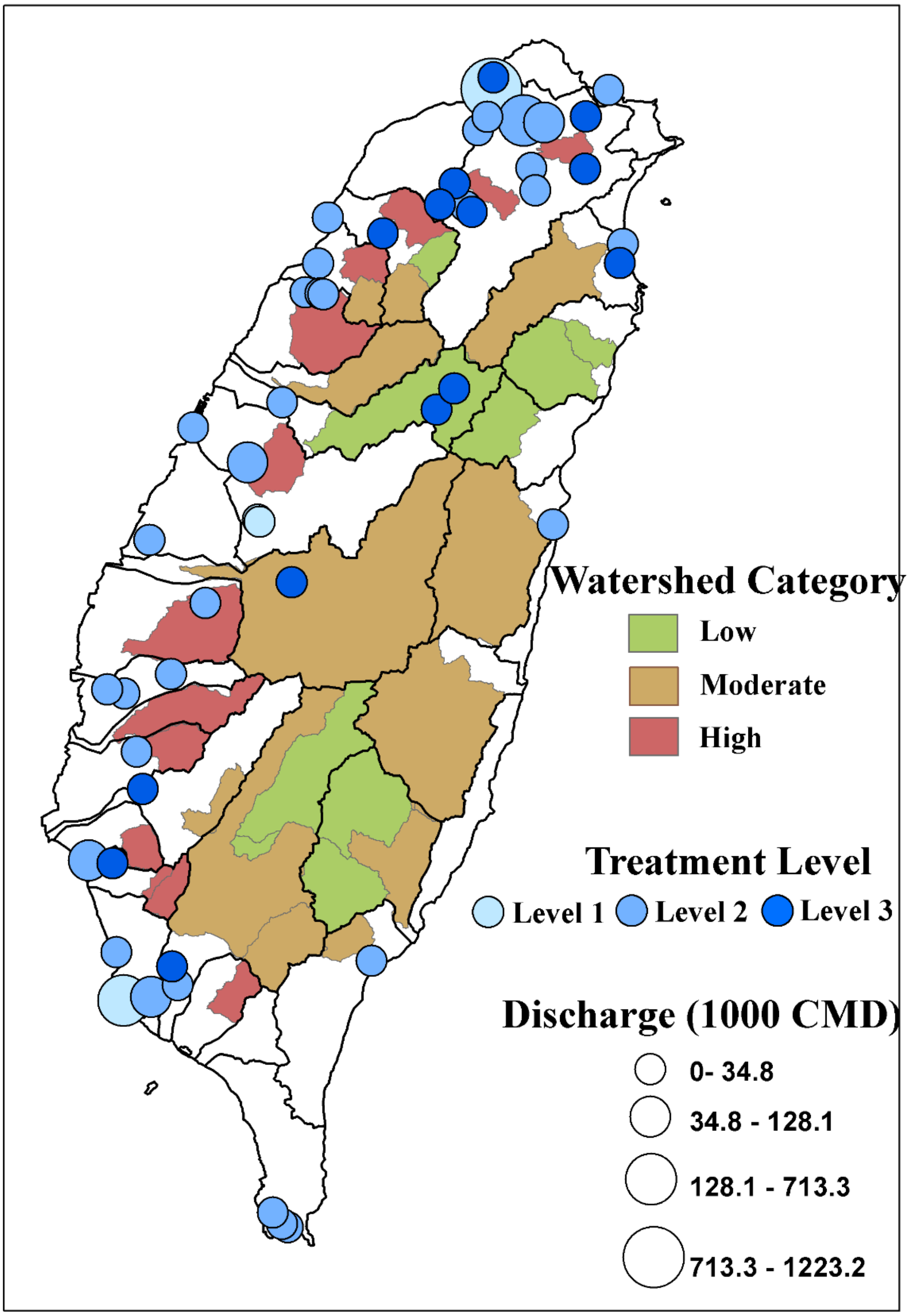

Figure S1. The distribution of wastewater treatments. The size color of circles indicate the treatment capacity and treatment levels