Export of Organic Carbon from Agricultural Land and a Forested Watershed During Storm Events

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Introduction and Methods

While BOD (biochemical oxygen demand) has decreased in the Han River, COD (chemical oxygen demand) has increased in the last 20 years. The cause is release of non-biodegradable organic matter from agriculture and forests to the river system. Recently, the Korean EPA has tried to change the criteria for evaluating water quality in terms of organic matter content from BOD and COD to TOC (total organic carbon). But not many TOC data are available upon which to base the criteria. Therefore, we began studies in two different land use areas, and estimated export coefficients for organic matter. The study site is a bowl-shaped mountainous catchment in northern part in South Korea, Haean Catchment. About 50% of land-use was agricultural land, and its mean slope range 5~10 degrees. We investigated 22 rain events in four agricultural streams, and in a forest stream from 2009~2012.

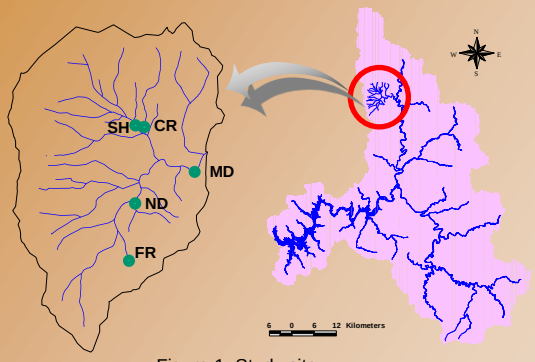
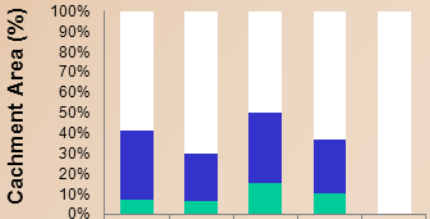


Figure 1. Study site



	ND	SH	CR	MD	FR
Forest	273	458	177	3,364	22
Dry Field	160	150	125	1,397	0
Rice Paddy	34	43	54	569	0

Figure 2. Land use of each catchment(unit: ha)

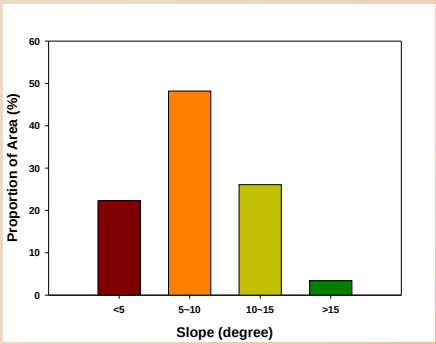


Figure 3. Mean slope of agricultural area

Results and Discussion

BOD, COD, DOC, POC increased greatly in agricultural streams during storm events. In the forest stream, COD and DOC increased, but BOD and POC did not at the beginning of the rain event. It means that much non-biodegradable organic matter is exported from forests as DOC at low flow rates. While POC remained lower than DOC during low rainfall intensity, COD and POC showed larger increases in the forest stream during storm events which have high rainfall intensity.

EMC of BOD and COD in the forest stream were lower than in agricultural streams, but TOC was similar with other agricultural streams. It means that TOC as an indicator of organic matter is more suitable than BOD and COD in forest streams. TOC export coefficients in the agricultural catchment ranged from 20 to 150 kg/ha/yr which are about 30 times higher than other studies because of croplands cultivated on steep mountain slopes. TOC export coefficients in the forested catchment ranged from 2.3 to 7.6 kg/ha/yr and are similar to other studies.

Table 1. Comparison of export coefficient with other studies in agricultural catchment

Watershed	BOD	COD	TOC	Reference
Sanno river (Japan)	-	5	5	Senichi et al. (1991)
Pandan (Malaysia)	2	16	4	Z. Yusop et al. (2005)
Mandae stream	6	36	-	Jung et al. (2012)
Kyung an River	20	35	5	Lee et al. (2001)
Naedong (ND)	37	136	104	2009
	26	82	62	2010
	21	124	37	2011
	16	74	23	2012
Seonghwang (SH)	68	201	84	2009
	30	86	28	2010
	25	108	28	2011
	21	91	26	2012
Cheongryoungangol (CR)	35	223	88	2009
	23	71	24	2010
	16	55	20	2011
	24	104	35	2012
Mandae (MD)	33	180	151	2009
	35	98	30	2010
	20	57	20	2011
	14	64	17	2012

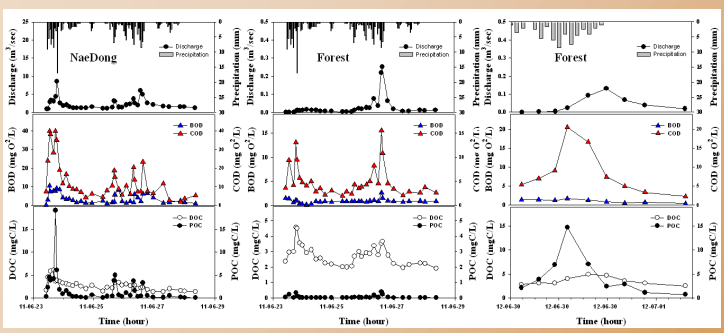


Figure 4. Temporal variation BOD, COD, DOC, POC during rain event

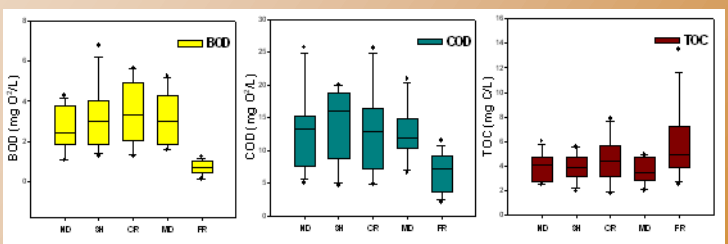


Figure 5. Comparison of EMC in agricultural and forest stream from 2009 to 2012

Table 2. Comparison of export coefficient with other studies in forested catchment

Watershed	BOD	COD	TOC	Reference
Fuji river (Australia)	8.8	19	-	S. shrestha et al. (2008)
Trinity River (USA)	-	-	10.7	Warnken et al. (2004)
Kyebank stream	5.27	0.05	-	Jung et al. (2012)
Kyung an River	3.7	7.6	1	Lee et al. (2001)
Forest(FR)	0.7	6.5	7.6	2011
	0.2	3.2	2.3	2012