Diffuse pollution management in the Korean total maximum daily load management system

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The Ministry of Environment (MOE), Republic of Korea, regulates facilities installed to reduce diffuse pollutant loads and designates control areas for diffuse pollution management. Best Management Practice (BMP) for diffuse pollution is implemented through the total maximum daily load (TMDL) management system. However, local governments seem more concerned about the diffuse pollution management in the TMDL process than designating the diffuse pollution control areas. This study reviews diffuse pollution management in the Korean TMDL and suggests issues that need to be improved.

Local governments make development and reduction plans to meet the target water quality. Until now, the focus of reduction plans has been point source pollution rather than diffuse pollution. However, MOE (2006) stated it would be difficult to meet water quality targets solely by managing the point source pollution. For example, in Seoul and six metropolitan cities in 2008, 98.7% sewage was already managed. Plans to reduce diffuse pollution begin to receive attention from TMDL management system.

The BMPs for facilities such as ponds, stormwater wetlands, infiltration, filtering, hydrodynamic separators can be applied for the control of diffuse pollution. The pollutant loads reduced by a BMP is recognized as reducing the loads generated from land areas among the six pollution source groups (NIER, 2008). The reduced loads are calculated according to a set of equations suggested by Lee *et al.* (2008).

$$TPr = 0.2716 \ln(P) - 0.2425$$

$$TRL = \exp\left[-0.0184\{\ln(TPr)\}^2 + 0.6922 \ln(TPr)\right]$$

$$RL = GL \times TRL \times E$$

where the P is the design rainfall (mm), the TPr is the ratio of treatable rainfall, the TRL is the ratio of reducible loads, the E is the efficiency of a BMP, the GL is generated loads (kg/day), the RL is reduced loads (kg/day).

In the U.S. the EPA has made an effort to implement the Low Impact Development (LID) and the Green Infrastructure (GI) to mitigate diffuse pollution within urban ecosystems. Novotny (2008) also emphasized the integration of the diffuse pollution abatement, urban landscape architecture and engineered drainage in the future cities. The awareness of issues such as eco-city concepts, LID has been raised in Korea, recently. Keeping pace with the trends, the NIER and the MOE (2010) have developed the BMPs guideline to include some LID techniques.

The basic driving force is an institutional strategy that will implement diffuse pollution management in TMDL. However so far, the BMPs actually used are limited to manufacture systems as these are relatively easy to purchase and use less area. Na *et al.* (2009) indicated that manufactured filtering systems accounted for 53%, porous pavements 23% of the diffuse pollution BMPs in development plans made within the Geum-river watershed during six months (from May to Oct. in 2009). The LID techniques such as rain gardens or planters can be used in TMDL development plans (NIER and MOE, 2010). However, some local governments and associated

institutes seem regard this type of facility only as a means to reduce diffuse pollution and ignore the benefit of sound LID approaches. In addition, the benefit is likely to be underestimated because the water quality within the TMDL management is evaluated for BOD and TP (adding TP from 2011). The biased diffusion pollution management in the TMDL process may hinder more effective and rational diffuse pollution management.

On examination, the legislation and regulation should be revised in cooperation with the associated Ministries. LID techniques need to be developed and applied to other watersheds in Korea. Other diffuse pollution management programs should be expanded in order to supplement the TMDL process. Since 2010, the MOE has prepared a Comprehensive Non-point Source Pollution Management Measures (II) in the Four Major Rivers (2011~2020) by revising the Comprehensive Measures (I) (PMO *et al.*, 2004).

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