A STUDY ON EFFECT OF SWAT'S NON-POINT SOURCE POLLUTION ESTIMATION USING THE ROAD CLASSIFICATION

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ABSTRACT: SWAT (Soil and Water Assessment Tool) is used to estimate the generated non-point source pollution in unspecific space. It is based to soil, landcover, terrain information and weather, which are built with the GIS (Geographic Information System). Landcover data is importantly operated to estimate of non-point source pollution using the SWAT. Because of landcover has much change in process of time than other data sets. And, landcover is concerned in directly release of pollutants. Several studies of non-point source pollution using the SWAT had been estimated it using generally large-scale landcover. Therefore, the road has included for just urban area. The road in the urban area is the very highest impervious area. So, non-point source pollution (concentrated pollutant, dust, heavy metals, etc.) on the road is easily bound to be release into the river. Thus, the road needs to classify in the urban area.

In this study, case of using the classified landcover by the road compares with case of existing large-scale landcover in order to analyze how much effect of the classified landcover by the road to SWAT's non-point pollution estimation. And, estimations be compared with observed water quality data. The road was classified by small-scale in the urban area through overlap of landcover and road layer.

The results of this study, case of using the classified landcover by the road have a more positive relatives than large-scale. They proved necessary of the classified landcover by small and about especially the road. This study is still underway. And, future studies will proceed to find the way that is estimate of the SWAT model is a way to improve the accuracy. Also, we will operate SWAT by high resolution for detailed analysis.

1. Introduction

During the last several decades, and in spite of considerable efforts to reduce point source pollution, water quality often has no improved significantly (Wei, O et al., 2010). This may be due to the contribution of non-point source pollution in both developed and developing countries (Leone et al., 2009). Non-point source pollution exists at the unspecific wide space. And, it emits the irregular pollutants by rainfall and snowfall. Therefore, the management and prediction about non-point source pollution are very difficult. Non-point source pollution of total water pollution in Korea was 42 ~ 69% in 2003. But it is expected to increase about 65 ~ 70% in 2015. Accordingly, Ministry Of Environment in Korea that has been supervised point sources pollution is becoming concerned about non-point source pollution lately. However, they still not enough studies related to predict and analysis of non-point sources.

Mainly, it is used to SWAT (Soil and Water Assessment Tool) to estimate the non-point source pollution. It estimates water, sediment and pesticide that is generated pollutants in soil and landcover. These models could be applied to predict future and to quantitative analysis through change of the variable or coefficient (Choi, 2009).

Especially, non-point pollution of the road is an important target that needs to supervision, because of it has very heavy accumulation and releases (Kim, 2003). Also, several advanced countries have been supervising the highway as non-point source pollution(John and Steven, 1997). According to report that research the pollution of the road, if rainfall within 2mm, COD appeared 800ppm. And, the road has more particulate matter 20 ~ 80 times, Cu and Pb 3~10 times than non-road area(Gyeonggi-do Institute of Health and Environment Reaserch, 2001). Thus, the road and transportation facilities emerged as a major problem of non-point source pollution. But, several studies don't be considered enough the road's it. Because, they used large-scale or middle-scale landcover to operate the SWAT.

In this paper, SWAT was applied to large-scale landcover and the classified landcover by road. And they are compared with observed water quality data. This study was using the ArcSWAT2009 that is based ArcGIS 9.3.

2. Materials and methods

2.1 Study area

Study area is Nak Dong Kang Haguun basin of Korean River that is included in Busan, Kimhea, milyang and yangsan city. It is N 35° 15´ ~ 35° 27´, W 128° 49´ ~129° 07´. Wide and high are 26.6 km x 23.3km and total area is 619.78km$^{2.}$ There are two National rivers (Nak Dong Kang, Yang San Cheon) in the study area. And, local rivers are 18. This area is distributed 42 subbasins by the stream and DEM (Fig.1.).

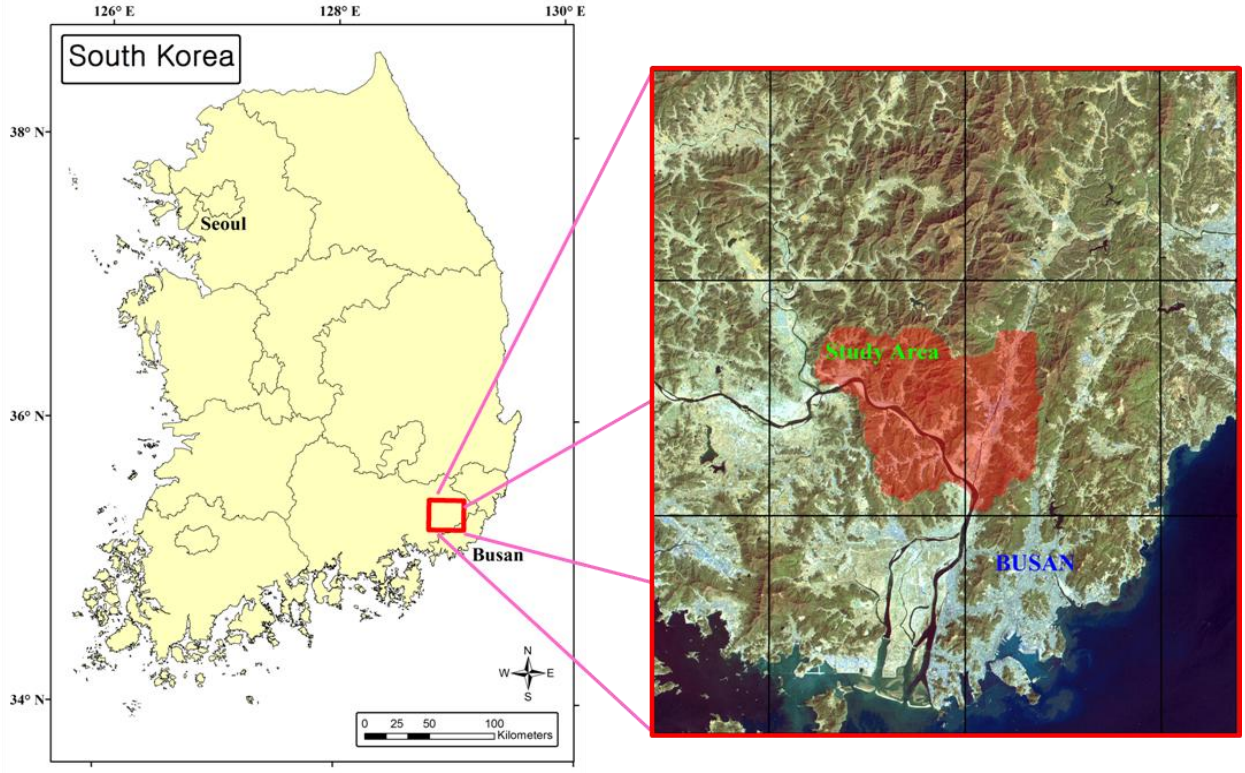

Fig. 1. Study area(Nak Dong Kang Haguun basin)

2.2 SWAT

The SWAT(Soil and Water Assessment Tool) model was developed by US Department of Agriculture – Agriculture Reserch Service (USDA-ARS). It is a conceptual model that functions on a continuous time step. Model components include weather, hydrology, erosion/sedimentation, plant growth, nutrients, pesticides, agricultural management, channel routing, and pond/reservoir routing. The SWAT model predicts the influence of land management practices on constituent yields from a watershed(Neitsch et al., 2001a: Neitsch et al., 2001b). A watershed is divided into multiple subwatersheds, which are then further subdivided into Hydrologic Response Unis(HRUs) that consist of homogeneous landuse/landcover, management, and soil characteristics. The landcover gives SWAT's estimations the greatest effect among others. Because of it is changed easily following the time and its material is being influence by urbanization.

SWAT's input data is

1) Terrain data : Landuse/Landcover, Soil, DEM(Digital Elevation Model)
2) Weather data : Location of weather station, Precipitation, Temperature, Wind speed, Solar irradiation, Relative Humidity
3) River data : Stream, Stream channel, Watershed

When created watershed and stream by SWAT, if river data is inaccuracy, could be used reference data to calibrate them.

2.3 Method and Apply model

In this study, it applied as two cases in SWAT model to estimate non-point source pollution. First case is applied large-scale landcover in the SWAT. The other case used the landcover to classify the road from the large-scale. The road and existing the large-scale landcover was overlap and added value through the raster calculation tool. That is added the transportation of the Urban-Database in ArcSWAT. The classified road types are impervious layers likely tunnel, bridge, highway and main road. Fig. 2. is flowchart about this study.

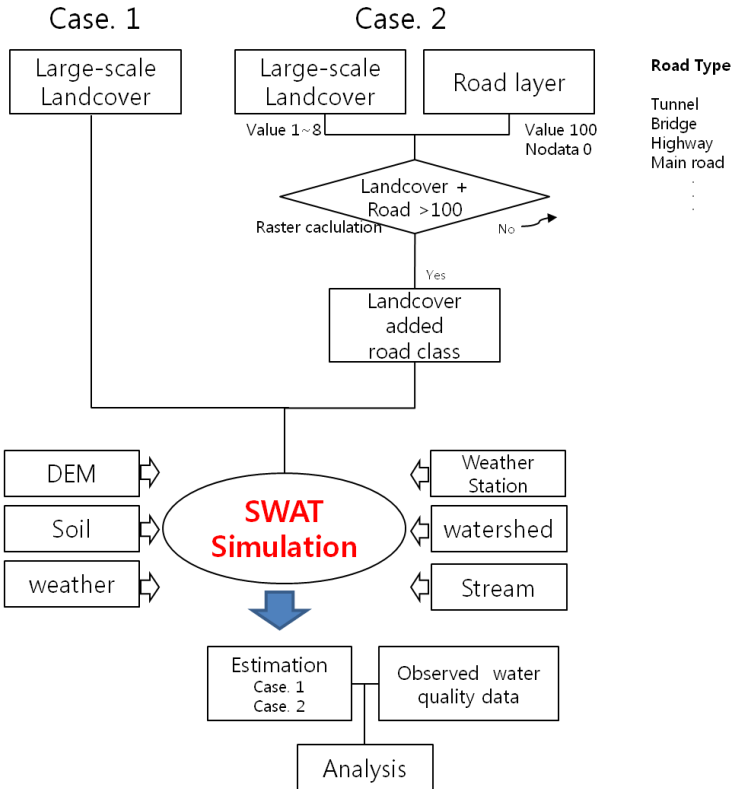

Fig. 2. Flow chart

The DEM in the study is 30m by 30m GRID data that is built through the digital map (Fig. 3.). The soil data was used to 1:25,000 soil map and 1:50,000 soil map (Fig. 4.). Two cases were applied same soil that was classified SCS.

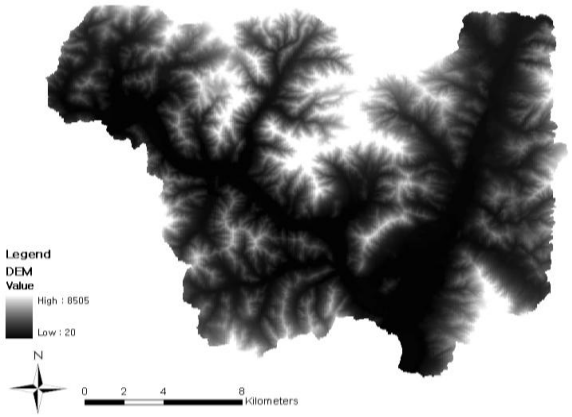

Fig. 3. DEM(Digital Elevation Model)

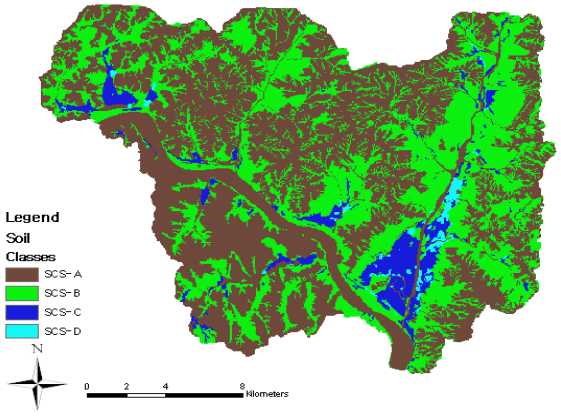

Fig. 4. Soil map

The landcover is used to large or middle scale. It is 30m by 30m raster data (Fig. 5). Fig. 6 is the classified landcover by the road. The weather data is used to daily data in 2007 that is offered from manned stations and automatic weather stations. It is applied 4 stations in study area (Fig. 6).

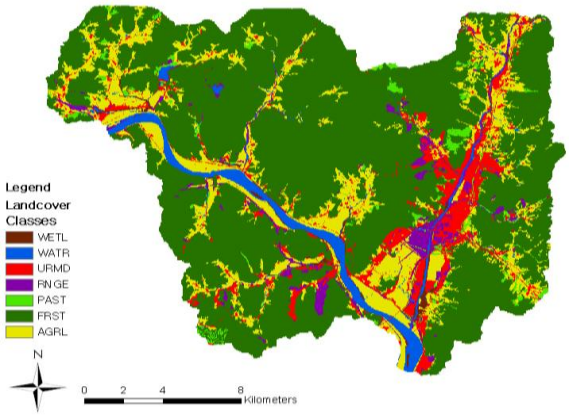

Fig. 5. Large-scale landcover

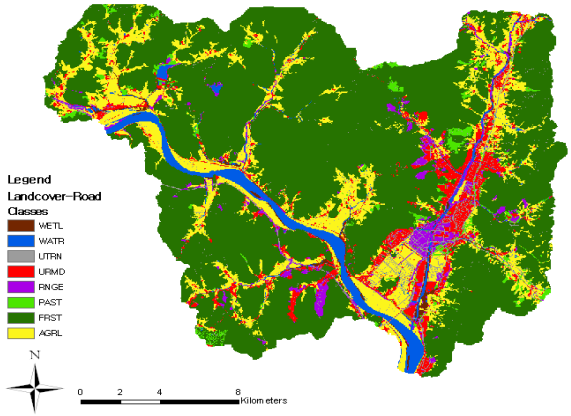

Fig. 6. Classified landcover by the road

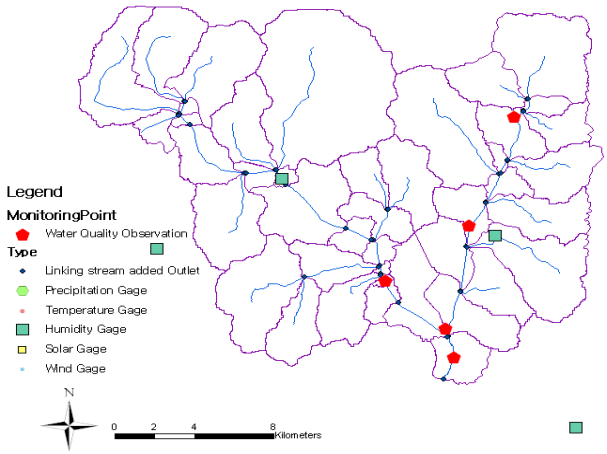

Fig. 7. Water and Weather stations.

3. Results

The weight of the reclassified road from the landcover appeared 2.79% and the others have some change. The road is classified almost from urban area. It is applied transportation of Urban-Database in ArcSWAT. The transportation is a very impervious area as 98% impervious (Table. 1., Table. 2.).

Table. 1. Classification table of large-scale landcover in the study area

SWAT Land Use Classification Table

VALUE	Area(%)	LandUseSwat
1	7.17	URMD
2	15.91	AGRL
3	67.33	FRST
4	2.15	PAST
5	0.70	WETL
6	2.97	RNGE
7	3.76	WATR

Table. 2. Classification table of classified landcover by the road in the study area

SWAT Land Use Classification Table

VALUE	Area(%)	LandUseSwat
1	5.94	URMD
2	15.22	AGRL
3	67.00	FRST
4	2.06	PAST
5	0.68	WETL
6	2.59	RNGE
7	3.72	WATR
8	2.79	UTRN

Estimates non-point source pollution through the ArcSWAT2009 were performed using the large-scale landcover[1)] and classified landcover by road[2)]. And then, the results compared with observed monthly water quality data in 2007. Two results and observed data were performed the analysis about total-nitrogen (T-N). NO3 of SWAT's estimation is added after multiply the CN(Curve Nunmber) factor and compare with T-N of observed water quality data (Fig. 8.). This method is used to the only relation between 1) and 2).

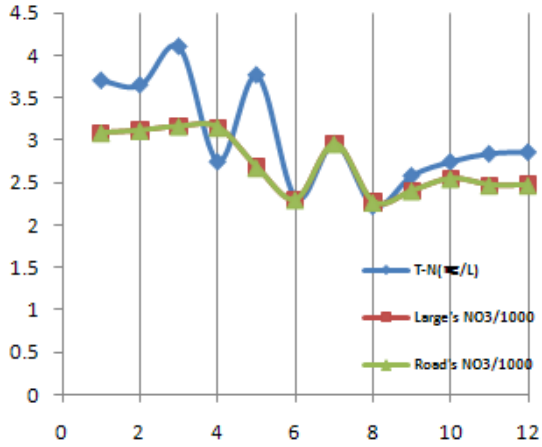

Fig. 8. Neighboring degree between NO3 and observed T-P

4. Conclusion and future

In this study, case of using the classified landcover by the road compares with case of existing large-scale landcover in order to analyze how much effect of the classified landcover by the road to SWAT's non-point pollution estimation. Case of using the classified landcover by the road appeared similar values more than the observed water quality datas. But, the gaps were very a low. This study is still underway. And, future studies will proceed to find the way that is way to improve accuracy of SWAT estimation. For example, we will operate SWAT using the high resolution and will consider to several various factors.

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