ESTIMATION OF THE TOTAL FLOW DURING THE NON-FLOOD PERIOD USING COMPONENT SENSITIVITY

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Abstract

The dry-weather streamflow is closely related with rise and decline of groundwater table, which depends on climate, groundwater withdrawal and landuse changes. From the 1980s, the dry-weather streamflow declines rapidly due to increase of groundwater pumping for agriculture and industry utilization. These excessive groundwater withdrawals decrease the dry-weather runoff and therefore result in ecologic and environmental disasters. Therefore, analysis of influences to the non-flood (6/21~9/20) runoff and simulation of their variations are very important to water resources management and planning in the watershed.

Sensitivity analyses of climate data show that the total precipitation during the non-flood period is the most influential to the non-flood runoff and the daily solar radiation is the second among climate data. Also, the groundwater withdrawal is very sensitive and so the non-flood runoff ratio to that is about 0.6. But, the landuse changes isn't relatively critical to the non-flood total flow of the forest watershed in Korea. The summary of these input sensitivity analysis is shown in figure 1 and table1.

Therefore, the more effective alternative to secure the instream requirement during non-flood period is to regulate the groundwater pumping rather than the landuse in this study watershed. As a consequence of this study, the formula which can calculate the total flow during the non-flood period (9/21~6/20) at the Otumulgyo (bridge) was proposed as following equation.

$$y = -123.1 + 0.125x_1 - 3.427x_2 + 0.640x_3 - 0.6(x_4 - 42.43) + e \quad \text{(unit: mm)}$$

where x_1 is the total precipitation during the flood period (mm), x_2 is the daily average solar radiation (MJ/m^2/day), x_3 is the total precipitation during the non-flood period (mm), x_3 is the quantity of groundwater pumping (mm/year) and e is error term. Other factors as channel slope can influence the non-flood runoff and therefore should be found out and added to the above equation.

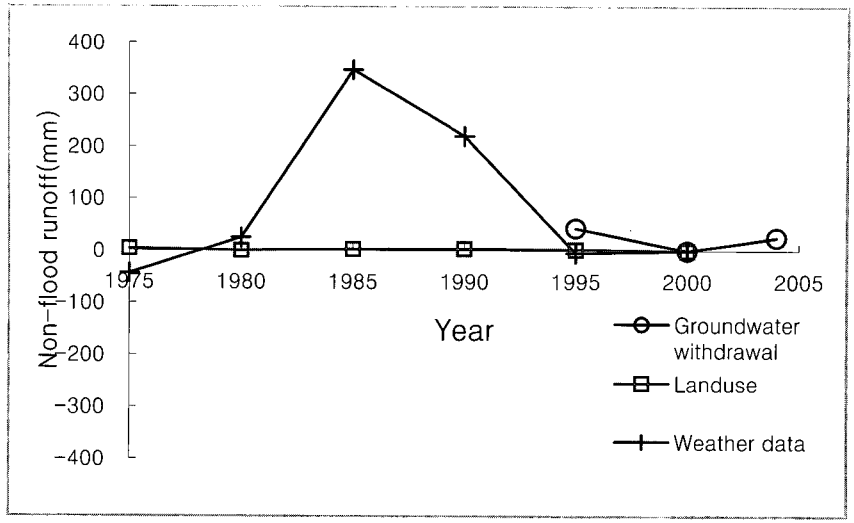

Fig. 1 Summary of input sensitivity analysis

Table 1. Summary of input sensitivity analysis

Category	1975	1980	1985	1990	1995	2000	2004
Total precipitations during the non-flood period (mm/year)	346	501	759.8	497.4	220.6	203.8	-
Non-flood runoff variations (mm/year)	92.9 (- 43%)	161.1 (+ 25.2%)	483.4 (+ 347.5%)	356.2 (+ 220.3%)	131.0 (- 4.9%)	135.9 (0%)	-
Groundwater withdrawals (mm/year)	-	-	-	-	13.92	82.41	43.31
Non-flood runoff variations	-	-	-	-	178.7 (+42.8%)	135.9 (0)	161.1 (+25.2%)
Urban area ratio (%)	3.0	5.1	7.8	6.6	10.8	17.1	-
Non-flood runoff variations (mm/year)	139.9 (+ 4)	136.1 (+ 0.2)	138.6 (+ 2.7)	139.0 (+ 3.1)	138.2 (+ 2.3)	135.9 (+ 0)	