論文の内容の要旨

論文題目：Study of future soil erosion and sediment yield considering land use and climate changes in northern Thailand（タイ北部における土地利用変化と気候変動を考慮した将来の土壌浸食と土砂生産量に関する研究）

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Soil erosion and sediment are important global problems, which are influenced by natural factors and human activities, such as climate change and land-use change. The interactions among land-use change, climate change, soil erosion, and sedimentation will continue to be a major issue for decades. Many researchers are interested in the factors that affect soil erosion, which generates sediment in rivers, and the impact of soil erosion on the environment. However, few studies have examined the impact of climate and land-use changes on soil erosion, and no research has focused on the impacts of climate and land-use changes on sediment because the measurement data are scarce.

Therefore, this dissertation 1) developed an R-factor equation for estimating soil erosion on a daily scale, 2) analyzed the impact of climate and land-use changes on soil erosion and sediments in the Nan river basin which has observation data and the potential for soil erosion and sediment yield become obvious recently, and 3) estimated the impact of climate and land-use changes on sediment inflow into reservoirs. This goal is attained using Revised Universal Soil Loss Equation (RUSLE), sediment delivery ratio (SDR) and sediment transportation model to estimate the change of soil erosion and sediment under the conditions of climate and land use changes.

Typically, RUSLE is used to estimate soil erosion on an annual scale with an R-factor equation due to a lack of rainfall data at fine temporal resolutions. The results using the daily R-factor equation in this study were similar to the observed data from the Royal Irrigation Department (RID) and the standard error of the estimates was low. Therefore, the daily R-factor equation is useful for estimating soil erosion.

The sediment yield simulated by the model using climate data for 1985–2004, and land-use data for 2000 was used to calibrate the model with observation data from the RID. Finally, the Nash–Sutcliffe efficiency (NSE) was used to check the accuracy of the

simulation. The results showed that the model was well calibrated and could be used to simulate future scenarios, given that the NSE from the calibration and validation runs exceeded 0.5.

The combined analysis of the impacts of climate and land-use changes on soil erosion and sediment suggested that the changes in both have significant impacts on both soil erosion and sediment in the river. Rainfall will likely increase in the near future, which directly affects surface runoff, an important factor related to soil erosion and river discharge that controls the sediment flow in a river. Land-use change from forest to agriculture has a greater effect on soil erosion and sediment than that from one type of agriculture to another due to the reduction in plant cover. Furthermore, the severe scenarios illustrate how land-use changes tend to affect soil erosion more than climate change, while climate change has a greater impact on sediment than land-use change.

To this end, the annual average sediment inflow into reservoirs showed that heavy rainfall could accelerate the increment in sediment in the reservoirs twice as much as land-use change from forest to agriculture. Appropriate land management can slow the sediment increase in rivers during extreme precipitation. Therefore, land-use planning for catchment areas is a good way to protect and extend the lifespan of reservoirs.

This study should help to determine the optimal land-use types for reducing soil erosion and decreasing sediment accumulation in rivers, including planning to mitigate the future impact of climate change.