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Soil conservation risk assessment based on land use scenarios in the Nile River Basin

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Soil conservation is one of the most important ecosystem services, as it has a positive impact on soil fertility and land productivity. Soil conservation has multiple facets, while the current research on soil conservation has rarely considered combining the soil displacement conservation ability and river sediment transport conservation. On the basis of the Revised Universal Soil Loss Equation (RUSLE) and the Sediment Delivery Ratio (SDR) module of Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST), this study developed an indicator, named soil conservation risk, by introducing the soil displacement risk and the river sediment transport risk. The natural growth scenario and reforestation scenario of land use change in the Nile River Basin from 2010 to 2100 were estimated as the input parameters. Three main results were obtained. (1) From 2000 to 2010, the grassland increased by 4.34%, and the forest decreased by 4.91%. (2) From 2000 to 2100, the soil conservation presents a declining tendency in the two scenarios, and the soil conservation amounts based on soil displacement conservation and river sediment transport conservation were 1550.48±177.12 and 100.93±6.24 (t ha^{-1} y^{-1}) in a natural growth scenario, respectively, and 1576.78±63.21 and 104.41±0.30 (t ha^{-1} y^{-1}) in a reforestation scenario, respectively. (3) We compared the soil displacement risk and river sediment transport risk, and the reforestation scenario can effectively relieve the soil displacement risk in the first fifty years, while the river sediment transport risk can be relieved from 2010 to 2100. Overall, when reducing the conversion rate of the forest by 0.5 times and increasing the rate of conversion to forest by 0.5 times, the effect of land use changes to the river sediment transport risk has a longer-term effect than do changes to the soil displacement risk.