SOIL DEGRADATION BY WATER EROSION AT THE REGIONAL SCALE– CURRENT AND FUTURE PROBLEMS IN BENIN, WEST AFRICA

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Despite the flat relief of the country, soil degradation is a considerable problem in Benin, because high rainfall intensities and low-input farming systems are prevalent. Soil degradation is aggravating due to a rapid expansion of cropland resulting from population growth including migration, lacking soil conservation activities and increased rainfall variability due to climate change. The traditional fallow farming systems in Benin are only sustainable for long fallow periods of at least 5 to 10 years. Soil fertilisation strategies other than crop rotation including fallows and the inclusion of the nitrogen-fixing groundnut in the crop cycle are rare. The two most important processes that lead to soil degradation are soil erosion and nutrient depletion. Both are closely connected, as the erosion of topsoil implies a loss of soil organic matter and associated nutrients leading to subsequent effects such as compaction, crusting, water-logging, and a decrease of biological activity. At the same time, nutrient depletion also enhances soil erosion due to reduced biomass and ground coverage. Both processes can heavily affect agricultural production and food security. The dominant erosion forms in Central Benin are sheet and rill erosion. To analyze the hydrological and erosive processes in the Upper Ouémé catchment (about 15,000 km^2) the model SWAT (Soil Water Assessment Tool) was applied. The model is semi-distributed, i.e. it takes into account the spatial variability of land use and soils. The model was calibrated simultaneously at the outlets of an intensively agriculturally used (586 km^2) and a less agriculturally used sub-catchment (2324 km^2) using daily discharge measurements for 1998-2001. In a second step, sediment yields were calibrated using daily suspended sediment concentrations from half-hourly continuous turbidity measurements in 2004/05. Moreover, the model was extensively validated for different time periods and sub-catchments. Subsequently, current hotspots of soil erosion could be identified. After successful validation, the SWAT model has been applied to calculate future scenarios. Two climate change scenarios derived from a regional climate model up to the year 2050 were combined with three different land use scenarios which provide the spatial distribution of land cover until 2025. The scenario analysis for the Upper Ouémé catchment indicates increasing sediment yields and decreasing water yields for the period 2001-2025 over a wide range of scenarios. However, the variability within the Upper Ouémé catchment is large. In sub-basins with a high potential of cropland expansion, future sediment yields will be driven by land use change and may therefore strongly increase. In sub-basins with low potential of cropland expansion and strong reductions in rainfall, future sediment yields may decrease. While cropland expansion in the entire Upper Ouémé catchment may slow down in the next decades, climate change impacts will increase with time and show higher variation among the scenarios.