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Identifying sources and dynamics of eroded sediment in an East-African rift lake using erosion modelling and sediment fingerprinting.

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Unsustainable land use and cover changes (LUCC) are driving increased soil erosion and siltation of water bodies in East-Africa, threatening food-, livelihood-, water-, and energy security. Lack of long-term LUCC and sediment flux data in East-Africa's catchments impedes the development of sustainable land- and water management plans to tackle this 'wicked problem'. Using Landsat imagery this study reconstructed almost three decades of LUCC (1988-2016) in the Lake Manyara basin, Tanzania. The effects on the surface water erosion risk were modelled using the Revised Universal Soil Loss Equation (RUSLE), which highlighted notable LUCC in high risk zones, increasing the surface erosion risk substantially in these areas. In parallel, geochemical fingerprinting was applied to attribute sediment contributions from different tributaries to Lake Manyara. By unmixing the fingerprints of lake sediment mixtures against riverine sources, the proportional sediment contributions of the different sub-catchments in Lake Manyara were obtained. Additionally, sediment cores were analysed to investigate the changes in sedimentation rates and tributary sediment contributions under response of LUCC in the tributary sub-catchments. The sediment contributions from different sub-catchments matched closely, but not completely, with those sub-catchments where the model predicted big increases in surface erosion risk. Source-to-sink dynamics in the sub-catchments were explored by soil- and landscape analysis in the potential source areas and composite fingerprinting of the transported sediment. This highlighted the importance of connectivity in the source-to-sink transport of eroded sediment. While surface erosion risk is predicted to be higher in certain sub-catchments, anthropogenic micro-topographic buffers and natural wetlands decrease the connectivity. In contrast, increasing gully formation in other sub-catchments rapidly funnels the sediment to the river systems, increasing connectivity. This study highlights the importance of a multi-technique basin-wide approach to determine areas and dynamics of increased erosion and siltation to assist management authorities for targeted action.