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The response of sediment source and transfer dynamics to land use (change) in the Lake Manyara catchment

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The Lake Manyara basin in the East African Rift Region of Tanzania is considered to be an important driver for sustainable development in northern Tanzania in terms of biodiversity conservation, ecotourism, fisheries, pastoralism and (irrigation) agriculture. Besides local conservation, Lake Manyara National Park and its surroundings also have a vital function as a wildlife corridor connecting the Tarangire and Maasai steppe ecosystem with the entire northern Tanzania and Southern Kenya collective of national parks and ecosystems. However, driven by population pressure, increasing number of farmers are establishing agricultural operations in the catchment, causing a shift of the natural vegetation towards agricultural land. Furthermore, pastoralists with ever growing cattle stocks are roaming the grasslands, causing a decrease in soil structure due to overgrazing and compaction of the soil. We hypothesize that these processes increase the vulnerability to erosion, which presents a credible threat to ecosystem service provision, on the one hand the agricultural- and rangelands where loss of this finite resource threatens food security and people's livelihoods and on the other hand the water bodies, where siltation and eutrophication threatens the water quality and biodiversity. Knowledge of sediment source and transfer dynamics in the main tributaries of Lake Manyara and the response of these dynamics to land use (change) is critical to inform sustainable management policy decisions to maintain and enhance future food and water security. Using geochemical tracing techniques and Bayesian unmixing models we were able to attribute the lake sediment proportionally to its contributing tributaries. Furthermore, we were able to identify differences in erosion processes in different tributary systems using gamma spectrometry measurements of surface-elevated fallout radionuclides (137Cs and 210Pb). In our results we found that almost half of the sediment in the lake could be attributed to the Makuyuni river system, while it only covers about 15 percent of the total catchment area. Comparing these results to our land use data, it is striking that this system has the lowest percentage of protected area and forest cover, while having large areas of agricultural, grass- and shrub land. It thus seems that the erosion dynamics in the Manyara catchment are linked with land cover, however further research into historical changes in sediment fluxes and land use is needed to infer the human impact on these dynamics.