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Quantifying the direct impacts and risks of large urban gullies in the Democratic Republic of Congo

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Large urban gullies (UGs) cause major infrastructural damages and often claim casualties in many tropical cities of the Global South. Nonetheless, our insight into this new type of geo-hydrological hazard remains limited to some case studies and the overall impacts remain poorly quantified. Here, we aim to bridge this gap by making a first assessment of the number of persons affected by urban gullies at the scale of the Democratic Republic of Congo (DRC). We used Google Earth imagery in combination with local news sources and earlier research to identify 25 cities in DRC where UG occur at a significant scale (at least ten UGs). This list is likely exhaustive. Next, for each of these cities, we used Google Earth imagery and other high resolution satellite images to map all visible UG, evaluate their expansion rate and inventorize detectable damages to houses and roads. In total, >2,000 UGs were mapped across the 25 affected cities. Overall, the problem of UGs in DRC is especially acute in the cities of Kinshasa, Mbujimayi, Kikwit, Tshikapa and Kananga. Over 90% of these gullies were active during the observation period (typically from 2002 to 2020).
Next, we assessed the total number of persons that are directly affected, as well as the number of persons currently at risk. Using available high resolution population density data and taking into account the current position of urban gullies, we estimate that around 68,700 people were directly displaced due the formation and expansion of UGs over the last 15 years. This corresponds to an average of ca. 4,300 persons per year. By considering the population that lives in the direct vicinity (<100 m) of an UG, we estimate that around 1.3 million people in D.R. Congo are currently at risk and/or experience significant impacts because of UGs (e.g. reduced land value, problems with trafficability, stress). This number has doubled over the past 10 years (2010-2020) and will likely continue to increase as a result of urban expansion and climate change.
Overall, this research shows that urban gullying is a very serious problem in the Democratic Republic of Congo, but likely also in many other countries of the Global South. More research is needed to better understand this processes and, ultimately, to prevent and mitigate its impacts. The results and the database of this study provide an important step towards this.