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Understanding the effectiveness of measures aiming to stabilize urban mega gullies in Kinshasa

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Kinshasa, the capital of the D.R. Congo, is strongly affected by urban mega gullies. There are currently hundreds of such gullies, having a total length of >100 km. Many of these gullies (typically tens of meters wide and deep) continue to expand, causing major damage to houses and other infrastructure and often claiming human casualties. To mitigate these impacts numerous efforts are being implemented. The type and scale of these measures varies widely: from large structural measures like retention ponds to local initiatives of stabilizing gully heads with waste material. Nonetheless, earlier work indicates that an estimated 50% of the existing urban gullies continue to expand, despite the implementation of such measures. As such, we currently have very limited insight into the effectiveness of these measures and the overall best strategies to prevent and mitigate urban gullies. One reason for this is that gully erosion is typically very episodic with long periods of stability, followed by sudden expansion events. As a result, understanding the dynamics of gully expansion in urban environments requires observations over sufficiently long time periods. However, most current initiatives to stabilize urban gullies happen on a rather isolated basis and are rarely evaluated afterwards.

This work aims to improve our understanding of this issue by constructing a large inventory of measures implemented to stabilize urban gullies in Kinshasa and statistically confronting these measures with observed vegetation recovery and long-term gully expansion rates (derived from high-resolution imagery over a period of >10 years). Our preliminary results (based on a dataset of > 140 urban gullies) shows that the most commonly applied measures are revegetation and reinforcement of gully heads with sandbags or household waste material (implemented in around 50% of the cases). Also retention ponds and water storage tanks are frequently implemented (around 30% of the cases). Surprisingly, our results indicate that urban gullies with higher expansion rates tend to have more measures implemented in their upstream catchment. While this seems counterintuitive, it may point to the fact that more actively retreating gullies create a larger sense of urgency and therefore instigates a higher number of (often ineffective) initiatives.

More research is needed to confirm this. Furthermore, the stability of gullies seems to be strongly linked to vegetation cover in the gully. Nonetheless, it is not always clear if vegetation is the cause or the result of this stability. Overall, this study provides one of the first large scale assessments of the effectiveness of gully control measures in urban tropical environments. With this study, we hope to contribute to a better prevention and mitigation of this problem that affects many cities of the tropical Global South.