Effectiveness of measures aiming to stabilize urban gullies in tropical cities: results from field surveys across D.R. Congo

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Urban gullies are a rapidly growing concern in many cities of the D.R. Congo, leading to many direct and indirect impacts. Hundreds of such gullies occur (typically hundreds of meters long and tens of meters wide and deep) and their expansion causes major damage to houses and other infrastructure. In several cases, this also claims casualties. Hence, numerous measures are implemented for their stabilization. These measures vary greatly in concept, location and scale: from large structural measures like retention ponds to local initiatives of stabilizing gully heads with waste material. Yet, much of these measures appear ineffective. Earlier work indicated that an estimated 50% of the existing urban gullies continue to expand, despite the implementation of such measures. However, a clear overview of the measures currently implemented and their overall effectiveness is clearly lacking. One reason for this is that most initiatives to stabilize urban gullies happen on an isolated basis and are rarely evaluated afterwards.

This work aims to help addressing this research gap by contributing to a better understanding of the different measures that are currently implemented to stabilize urban gullies in D.R. Congo and assessing their overall effectiveness. For this we conducted extensive field campaigns in Kinshasa, Kikwit and Bukavu and combined our terrain observations with data on gully expansion rates (derived from series of satellite imagery). In total, we conducted field surveys to characterize present and previous stabilization initiatives for >390 urban gullies. For nearly 80 of these gullies, the effect of a specific measure on gully expansion rates could be estimated.

Our results shows that the most commonly applied measures are revegetation and reinforcement of gullies with household waste material (implemented in around 65% of the cases). Measures based on larger engineering works were observed for only 20-30% of gullies. Small infiltration structures and vegetation at parcels are also frequently implemented (> 45% of the cases), in addition to small dams installed along roads (68%). Overall, techniques relying on vegetation are used relatively more frequently in regions with clayey soil, while techniques involving digging (e.g. infiltration pits) and topographic remodeling (e.g. gully reshaping by creation of terraces) are used mainly in sandy or sandy-clay areas.
Surprisingly, the huge amount of efforts observed strongly contrasts with their overall low impact. Among all strategies, only the reinforcement of gully channels resulted in significantly lower expansion rates after installment. The numerous initiatives based on the sparse means available seem to have limited effects. This does not imply that they are completely ineffective and should be abandoned. For example, despite possible other negative impacts (e.g. sanitation concerns), installation of organic household waste in gullies may have an indirect effect on gully stabilization by providing more suitable conditions for vegetation to develop. As such, further research is required to see to what extent such smaller measures can be improved or combined in order to stabilize urban gullies as effective and efficiently as possible. Such improved methods are badly needed as large engineering efforts are often very costly and unfeasible.