

Quantifying the impacts of urban gullyng at the scale of the Democratic Republic of Congo

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1. Context and objective

Problem statement

- Rapid and chaotic **urbanization** in combination with the sensitive environment (erodible soils, intensive rainfall, steep hillslopes) leads to the formation of urban gullies in many tropical cities of the Global South.
- They lead to **significant impacts** (e.g. damage to houses and infrastructure, casualties, reduced accessibility). Nonetheless, these impacts remain **very poorly quantified**.
- **Urban gullies** are likely to become a more important problem in the future as a result of ongoing **urbanization and climate change**.

Our main objectives:

- To quantify how much people likely lost their house due to urban gully in D.R. Congo.
- To assess how many people are currently at risk of being impacted by urban gully.



Fig.1. Destruction of infrastructure (road, houses) due to urban gully expansion. (a) Laloux gully and (b) Livulu gully in Kinshasa (December 2019).

2. Methodology

2.a. Construction of an urban gully database

Identification of affected cities:

By systematically checking for the presence of urban gullies (using Google Earth imagery)

Urban Gully inventory :

- Constructed based on: (i) Google Earth imagery; (ii) Pléiades and IKONOS satellite images; (iii) field surveys
- Where possible, evolution of areal extent of gullies were mapped over time.



Fig.2. Urban gully digitizing (yellow polygon) on Google Earth in the city of Kikwit (image of May 2018)

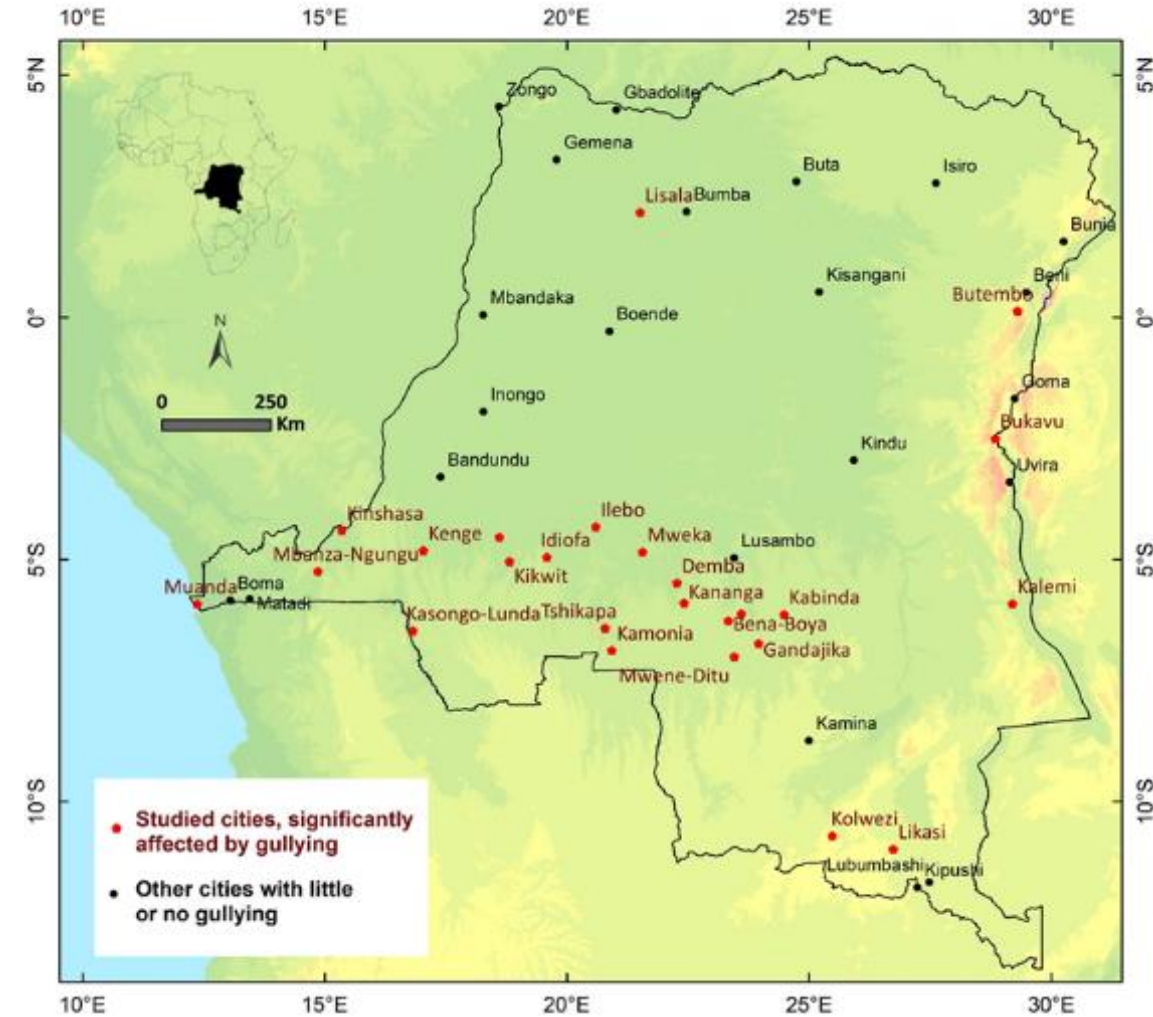


Fig. 3 Map showing cities in D.R. Congo with at least ten urban gullies detected (in red). Black point indicate cities that are not significantly affected by urban gullies.

2. Methodology

2b. Estimating the population displaced

- By comparing the areal expansion of urban gullies over time with the estimated population density in that area
- Population data derived from: WorldPop (Population counts), CENI (commission électorale nationale indépendante) and Africapolis census data

2c. Estimating the population at risk

- Based on (field) observations, we assumed that people living < 100 m from an urban gully are at risk of being impacted
- People living < 100 m from a gully head were expected to be at high risk

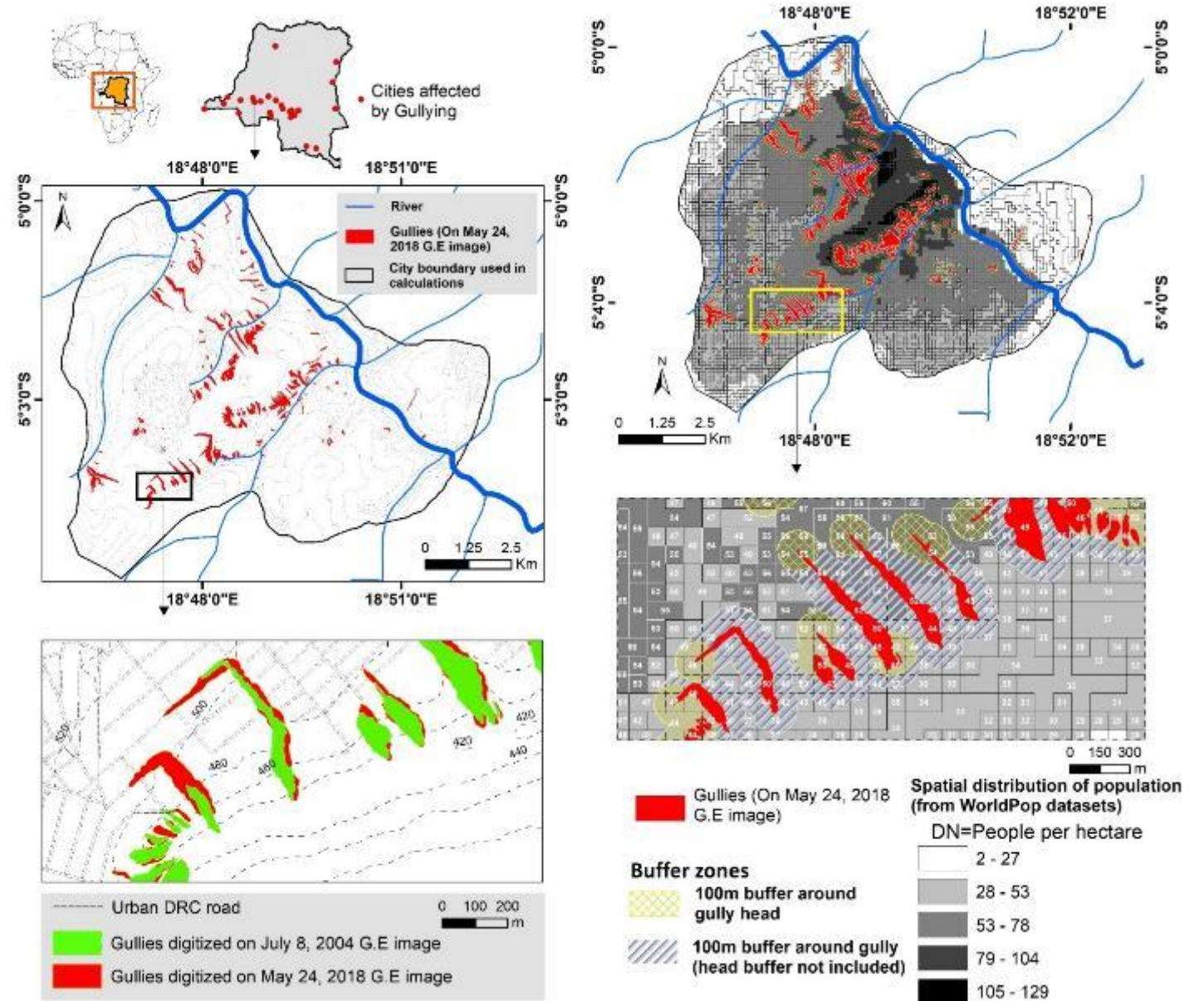


Fig.4 Geoprocessing operations to quantify population impacted by urban gully (case of Kikwit city).

3. Preliminary results

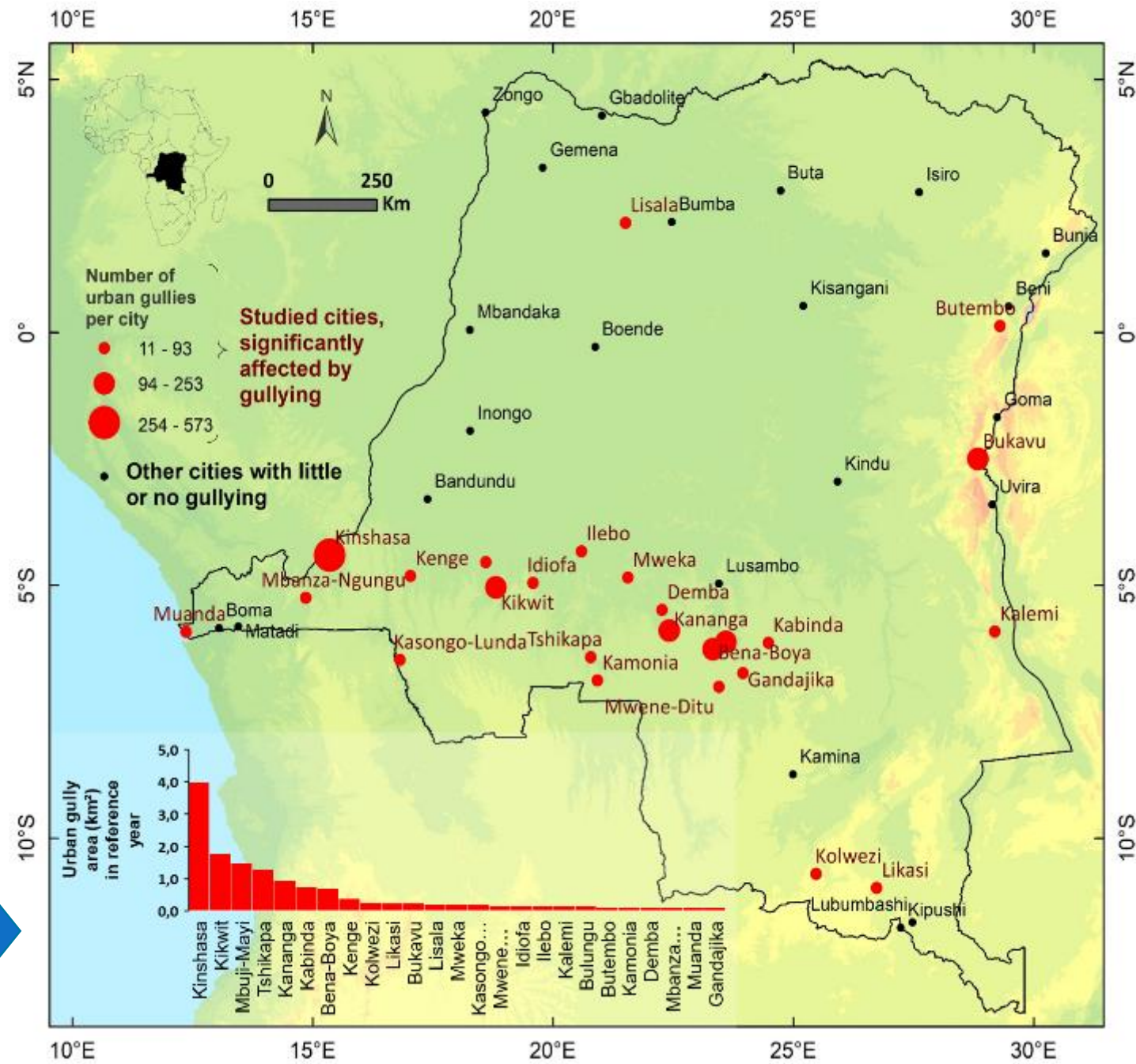
➤ Inventory of urban gullies

Around **2.000** gullies were mapped, representing a total of **14 km²** in **25** affected cities



Fig. 5 Tchad gully in Kinshasa (November 2019)

Fig. 6 Map showing cities in D.R. Congo with at least ten urban gullies detected (in red). The size of the point indicates the number of urban gullies per city. Black points indicate cities that are not significantly affected by urban gullies.



3. Preliminary results

➤ Estimate of the number of people that lost their house due to urban gulying

- Over the past 15 years, around **4.500** people per year were likely displaced due to the initiation and expansion of urban gullies in D.R. Congo.
- This figure is likely to be an underestimation

Average annual number of displaced persons

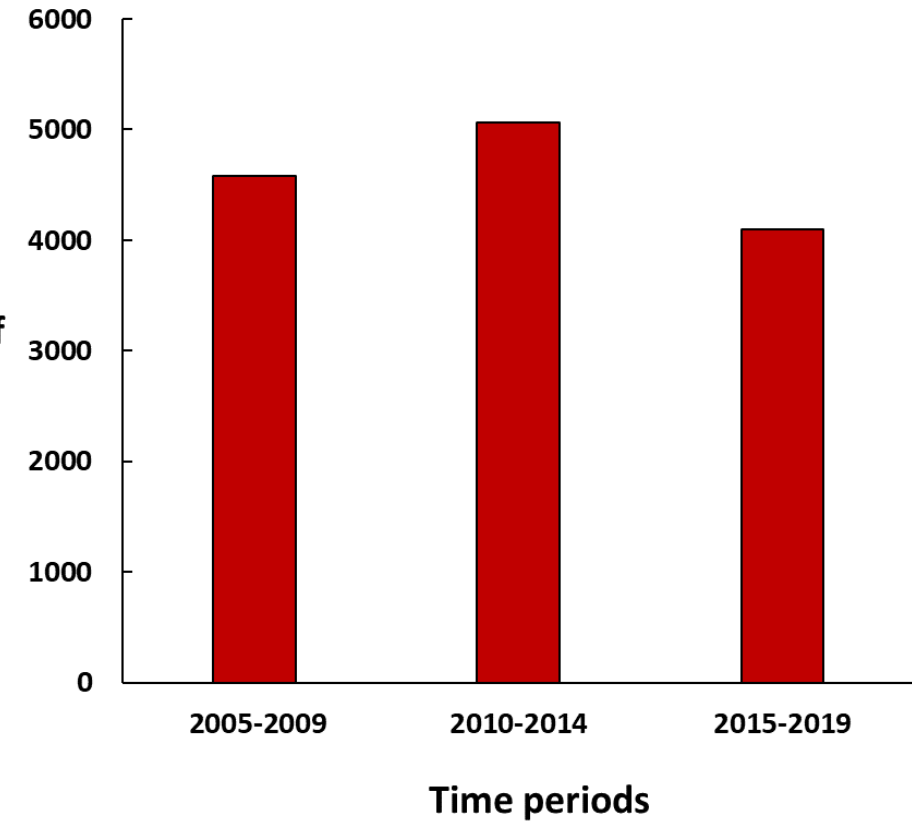


Fig.4 Average annual number of displaced people due to increasing area of urban gully

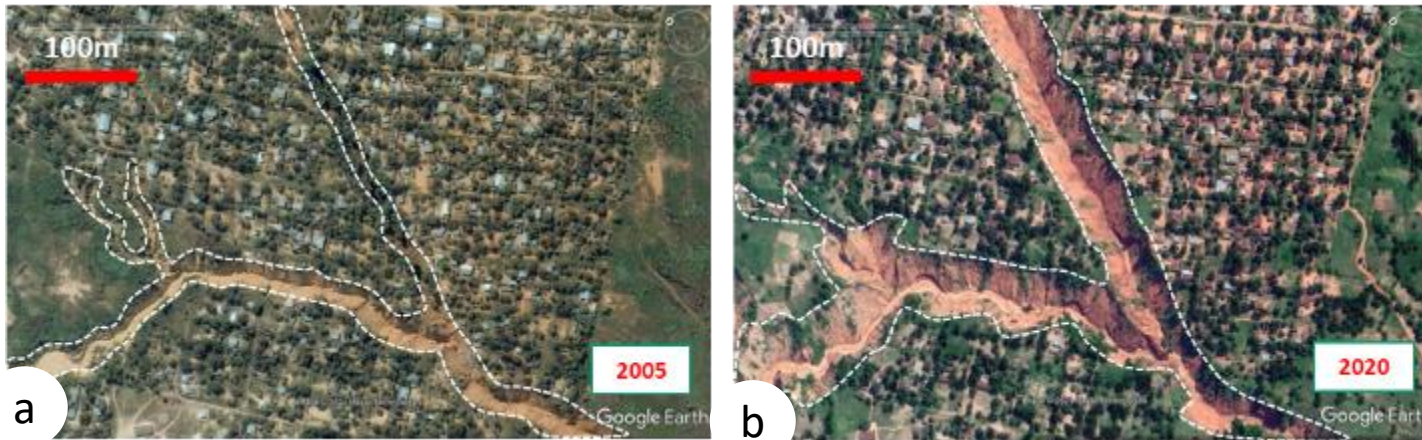


Fig.7 Lateral gully expansion in Mbuji-Mayi (a) Google Earth image of 2005 and (b) situation in 2020 : width increase. Many people at risk

3. Preliminary results

➤ Estimate of the number of persons potentially at risk in 2020



Fig.9 Houses destroyed by Funu gully (Bukavu, 2020)

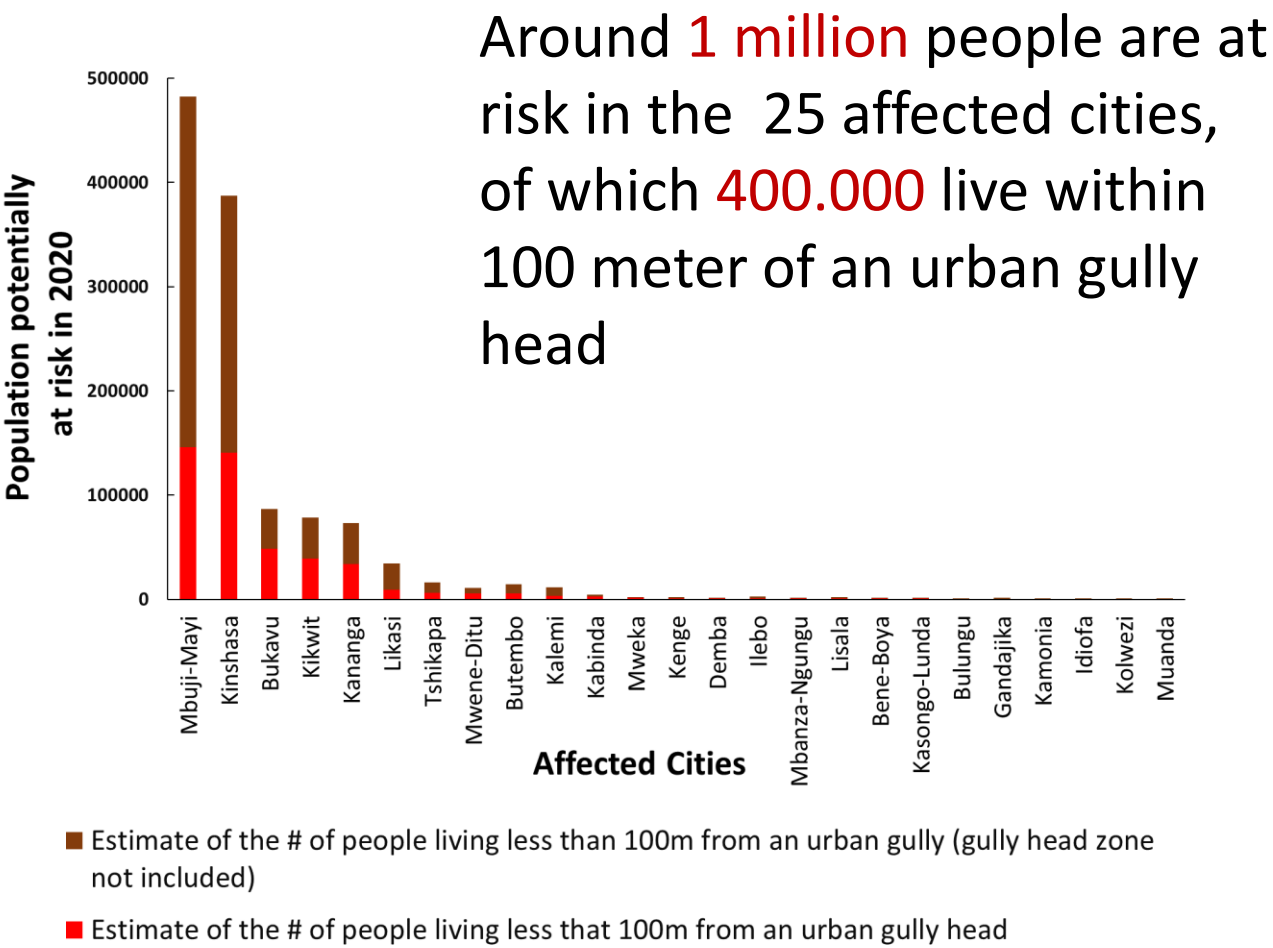


Fig.10 Total number of people at risk due to urban gully

4. Conclusions

- Overall, this research shows that urban gullying **is a serious problem** in the D.R. Congo
 - 25 cities significantly affected by gullying out of 47 cities
 - Around **4.500 persons/year loose their houses due to urban gullyng**
 - Around **1 million people** are **currently at risk** of being significantly impacted by urban gullyng.
 - These numbers may still be underestimations
- **Urban gullies** are likely to become a more important problem in the future as a result of ongoing **urbanization and climate change**
- **More research is needed** to better quantify, understand, prevent and mitigate this process and its impacts.



Thank you for your attention

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