Vulnerability of key urban infrastructures to geo-hydrological hazards: how endangered is the city of Bujumbura (Burundi)?

Jean Nsabimana (1-2-3), Sabine Henry (2), Aloys Ndayisenga (3), François Kervyn de Meerendré (1), Olivier Dewitte (1), Caroline Michellier (1)

(1) Royal Museum for Central Africa, Department of Earth sciences, Tervuren, Belgium, (2) University of Namur, Institute of Life, Earth and Environment, Namur, Belgium, (3) University of Burundi, Department of Geographic Sciences, environment and population, Bujumbura, Burundi

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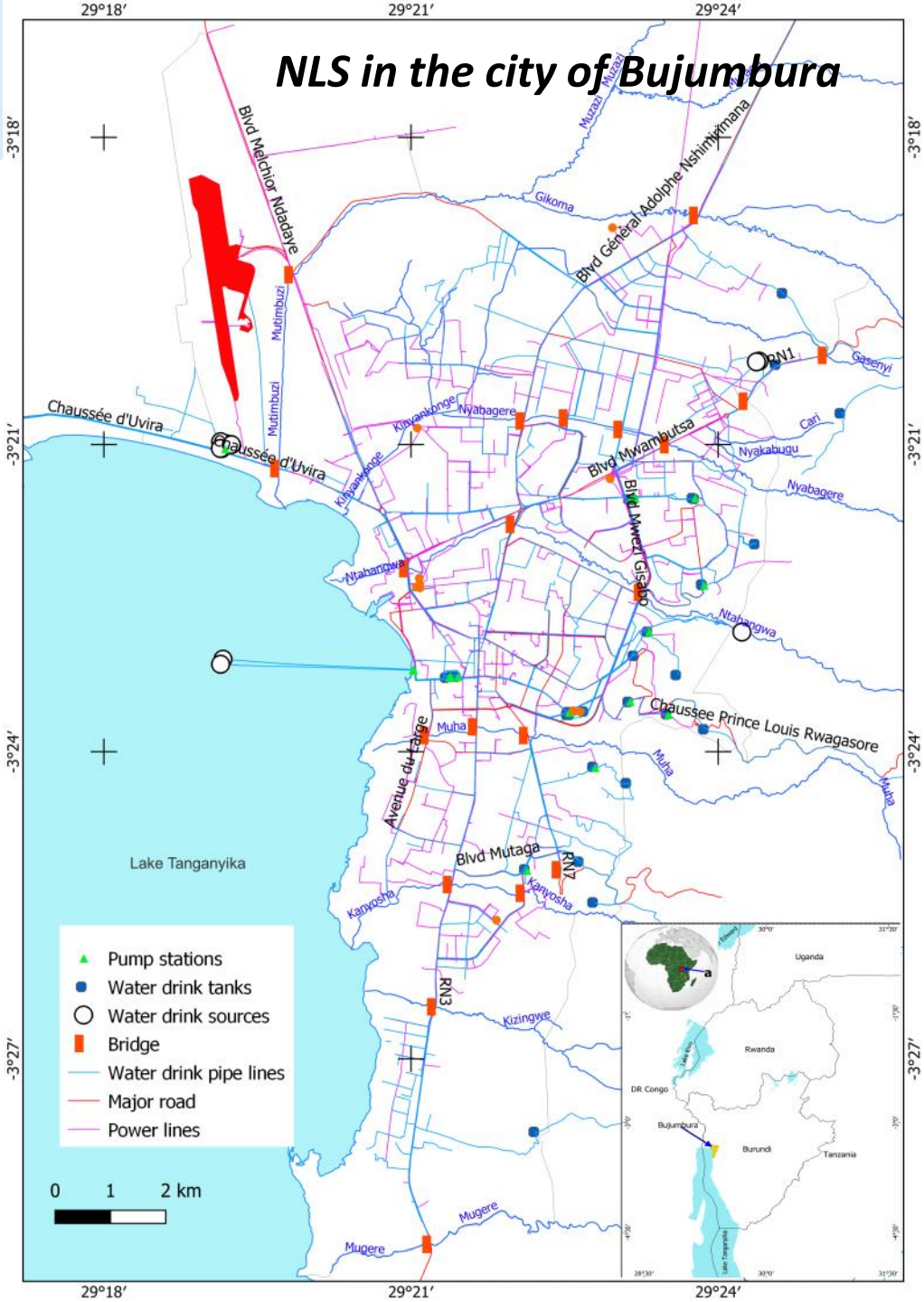
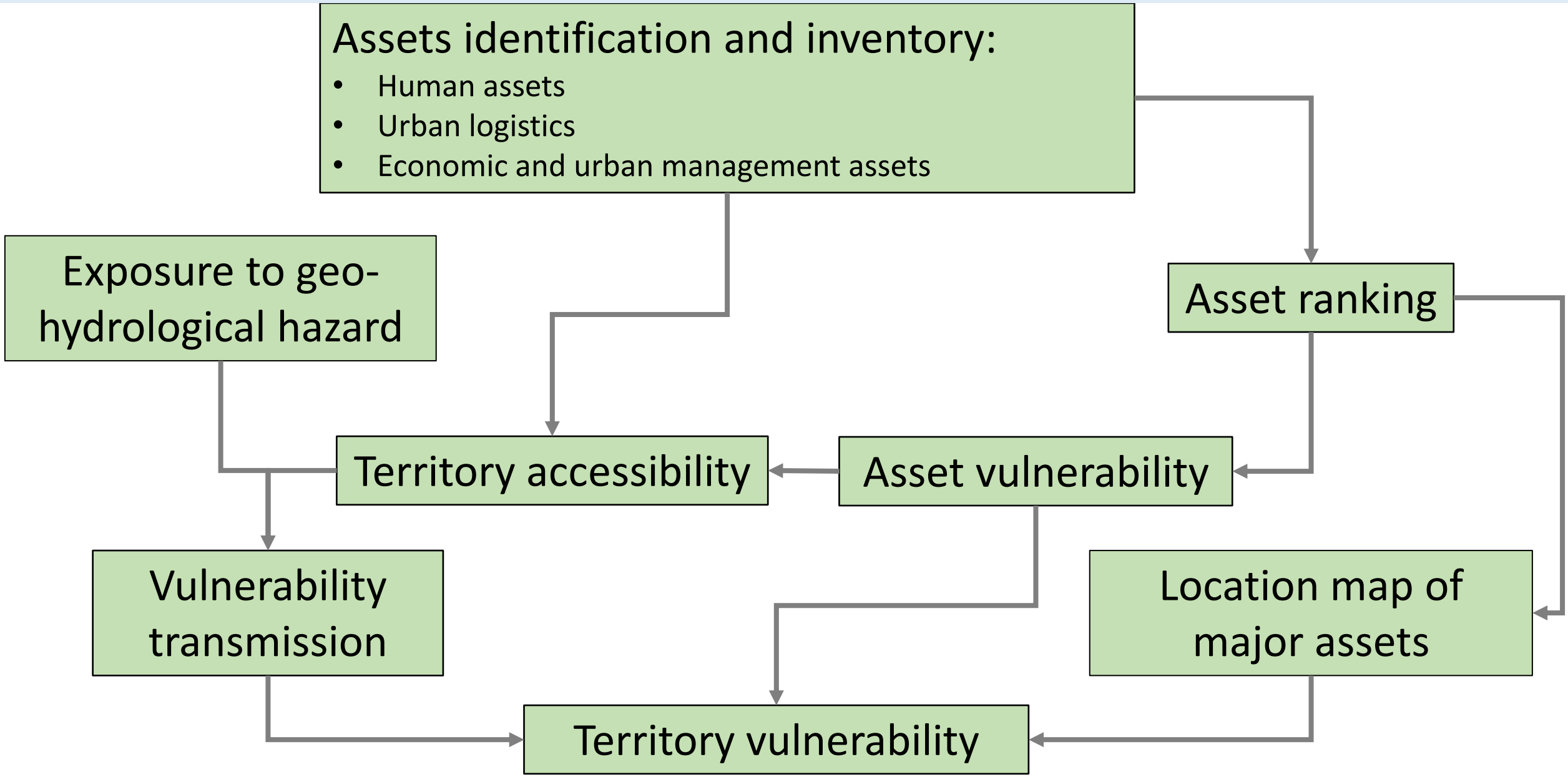
Introduction

- ❖ Networks and Life-support Systems (NLS): power lines, drinking water pipes, road
- ❖ NLS = key infrastructures contributing to the city functioning
- ❖ NLS damaging or destruction ➔ harmful consequences for the population.
- ❖ NLS = vulnerable to geo-hydrological hazards (flood, flash flood, gully, bank collapse)

➔ **How can the vulnerability of NLS to geo-hydrological hazards can lead to the weakening of a territory larger than the urban system in which they are located?**



Methodology



Methodology: data collection

- Use of available data in the institutions and the ISTEEBU reports
- Interviews with experts and field observation
- Data collection: institutions & field collection

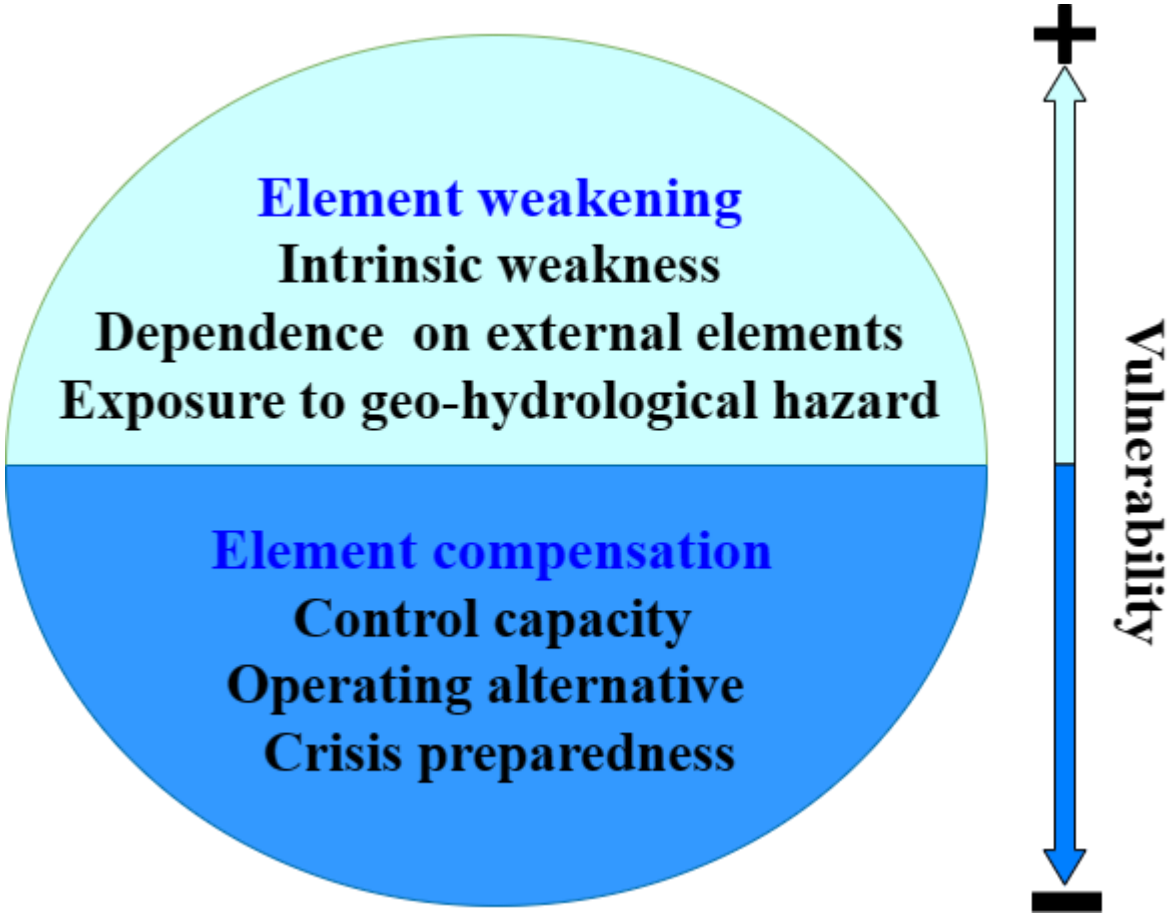
===> **Develop a database for vulnerability assessment**

- Participative approach: Local stakeholders rank all these assets

===> **Selection of key infrastructure on which to focus the vulnerability assessment**

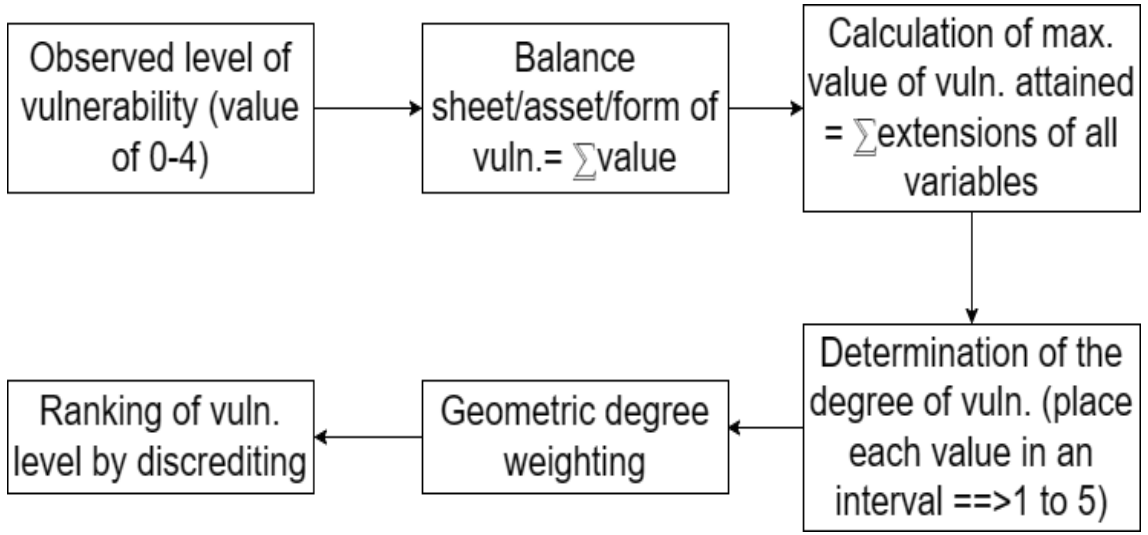
Methodology: territorial vulnerability approach

1. Vulnerability variation



Source: Adapted from Metzger & D'Ercole (2012)

2. How to measure synthetic vulnerability?



Source: Adapted from Demoraes (2004)

- Due to the data distribution ➔ Use of the natural threshold method
- The territorial approach allows us to operationalize vulnerability *(D'Ercole & Metzger, 2009)*

Results: **vulnerability analysis**

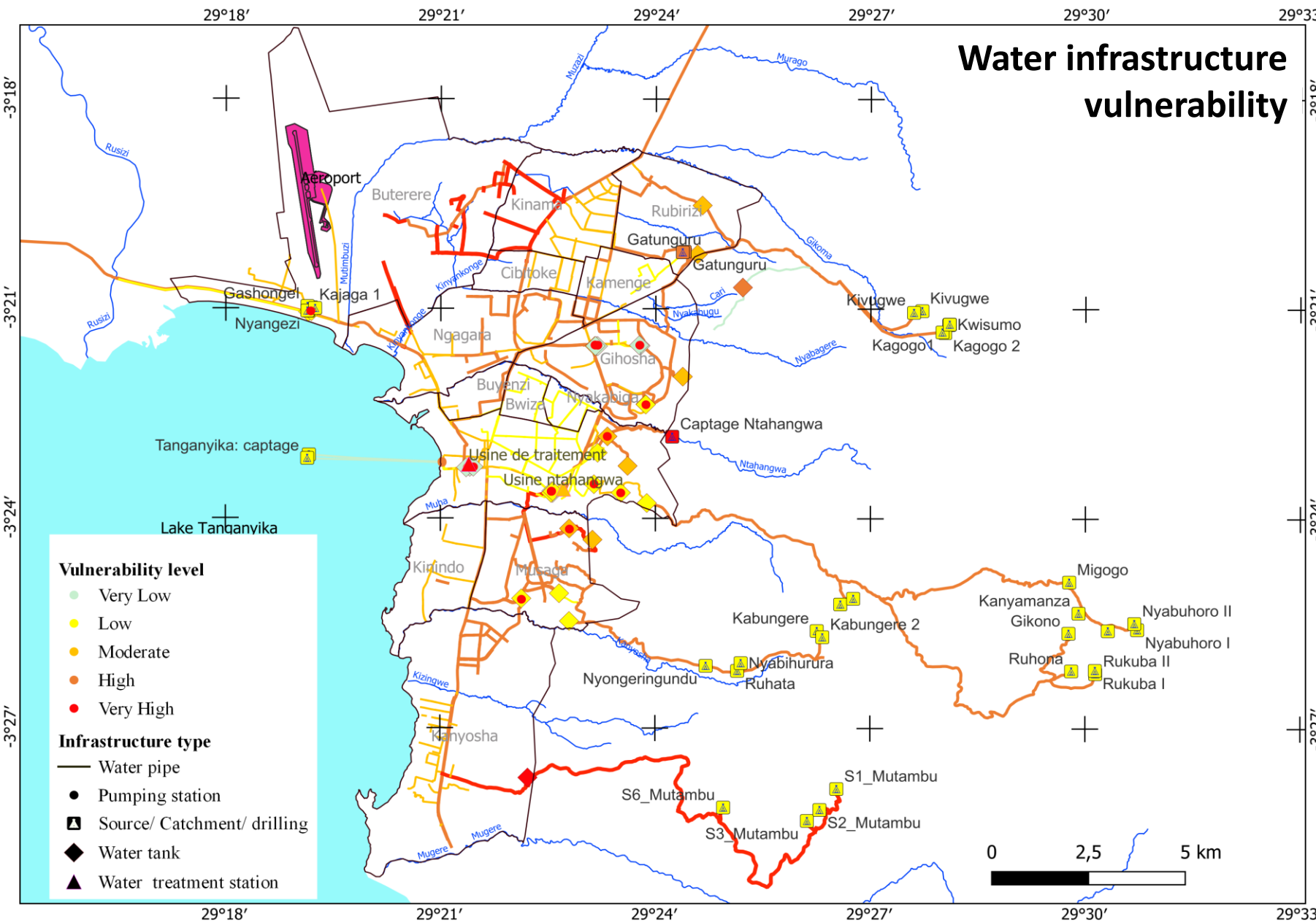
Focus on water infrastructures

- All station pumps (SP)
- Lake Tanganyika water treatment plant
- More than 52% of water pipes
- 2 of 32 water storage tanks,

==> high level of vulnerability

Vulnerability factors of water infrastructures:

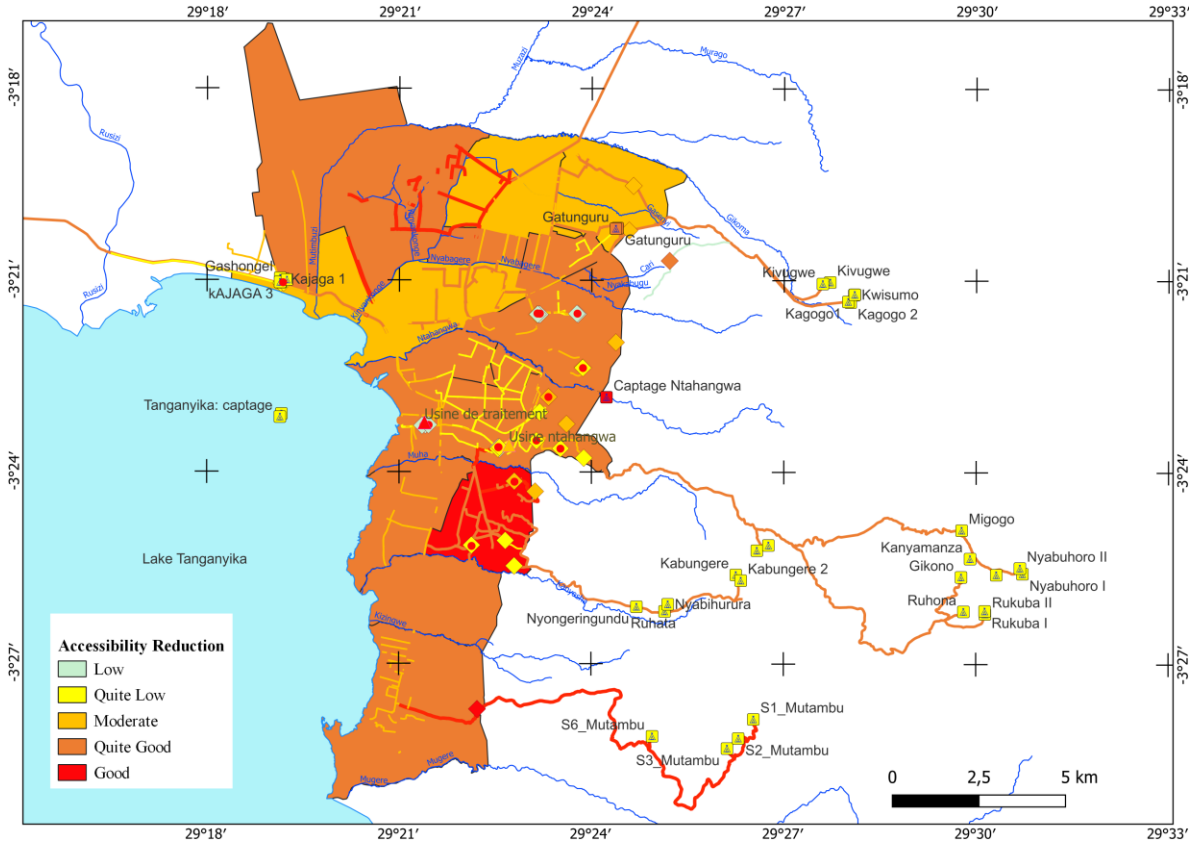
- Equipment ageing , intrinsic weaknesses, dependency, high exposure of the peripheral city to geo-hydrological hazards
- lack of preparedness, uniqueness



Result: accessibility evaluation

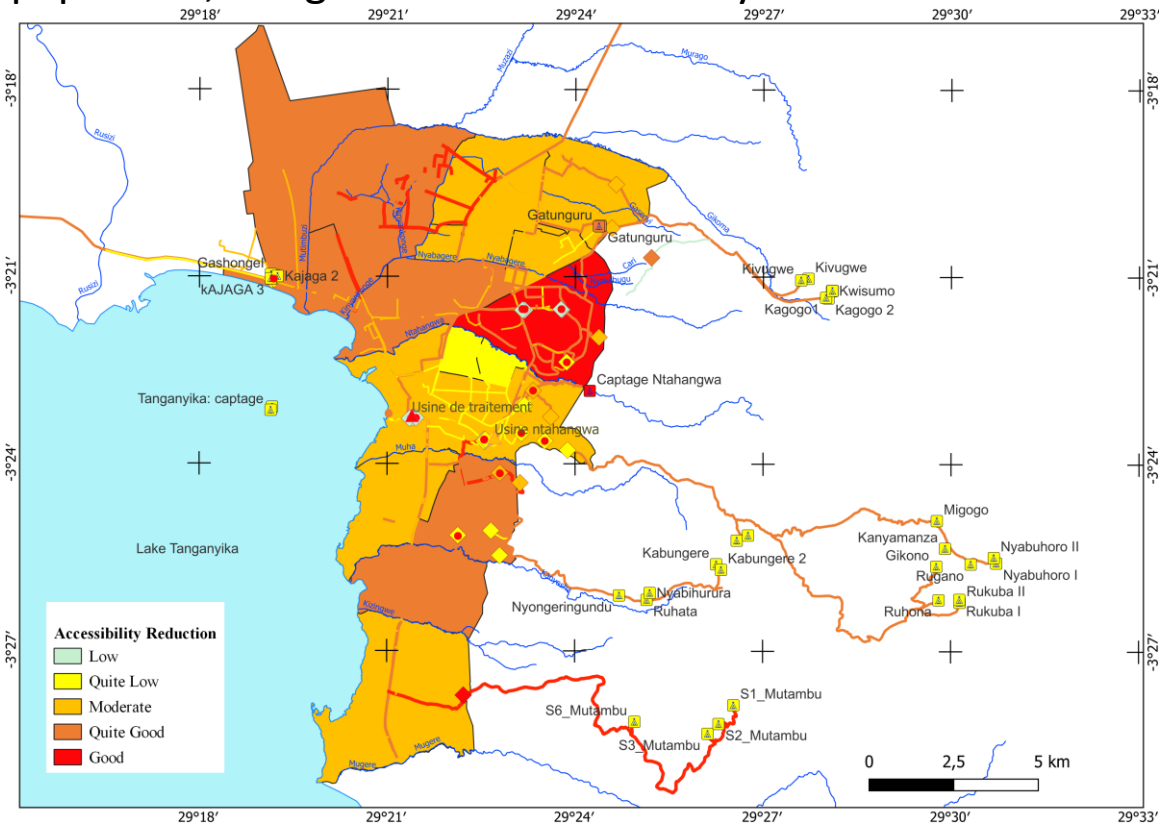
Analyze the reduction in accessibility of each area due to dependency ➔ **Vulnerability transfer and domino effect**

(1) Drink water accessibility reduction in case of malfunction of the main components of the supply: source failure, lake plant and Pump station 1



(2) Drinking water accessibility reduction in case of malfunction of other components inside the city

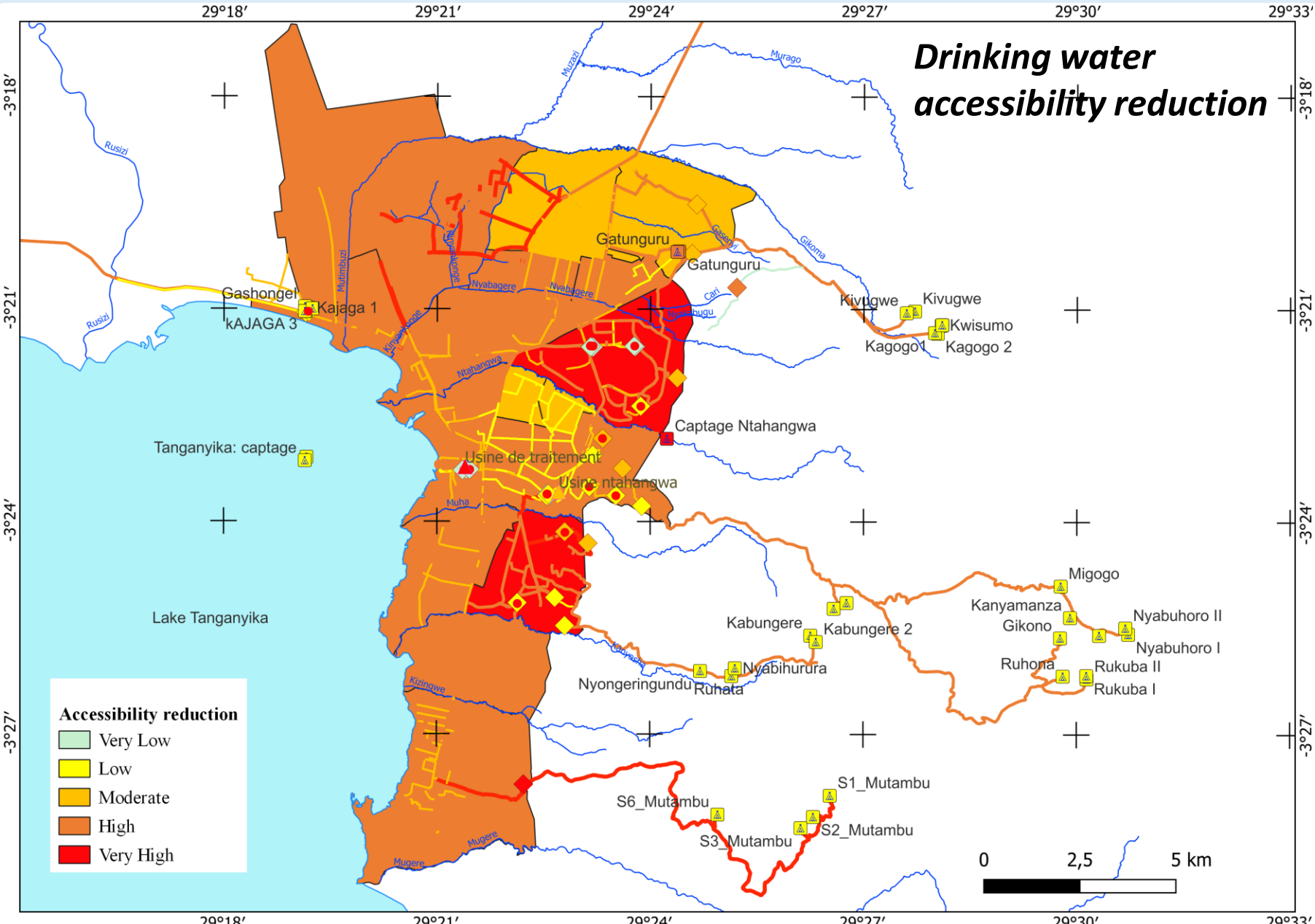
➔ The more an area depends on several vulnerable equipments, the greater its vulnerability



Result: accessibility evaluation

Water accessibility reduction

- > 90% of the city depends on the lake Tanganyika water
- Dependency of pump station on electricity
- 2 zones = very high access reduction
- > 60% of the city = high access reduction

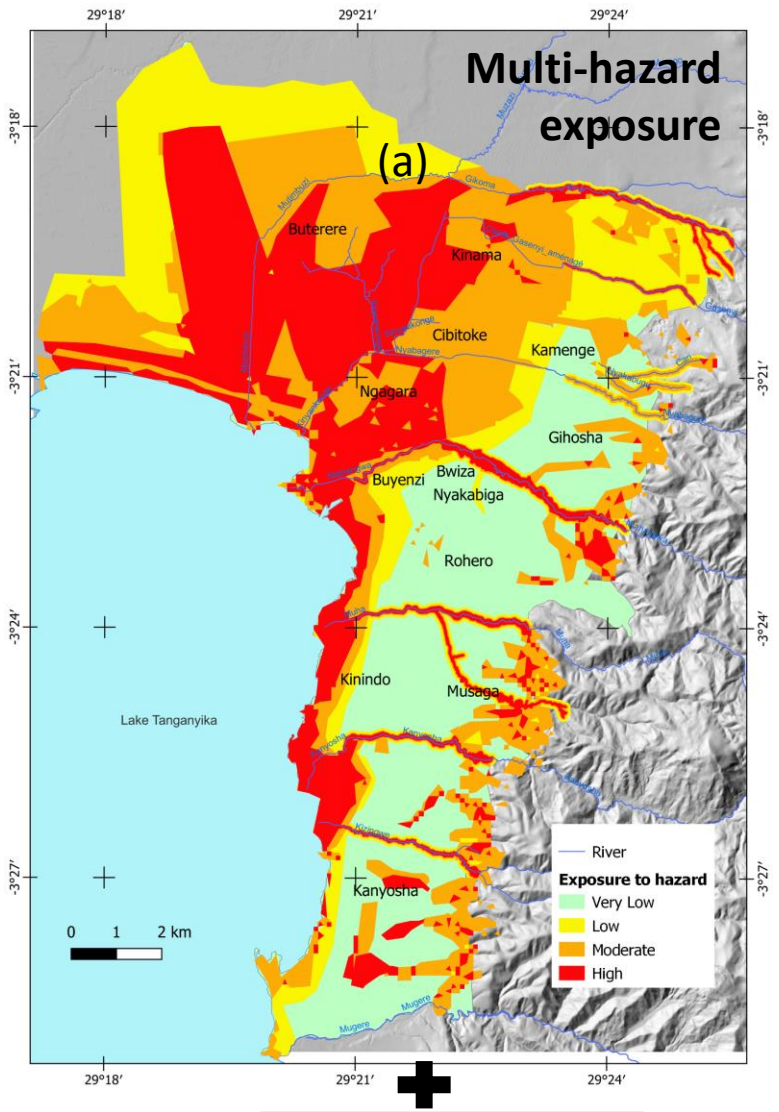


Results: From infrastructure vulnerability to the territorial vulnerability

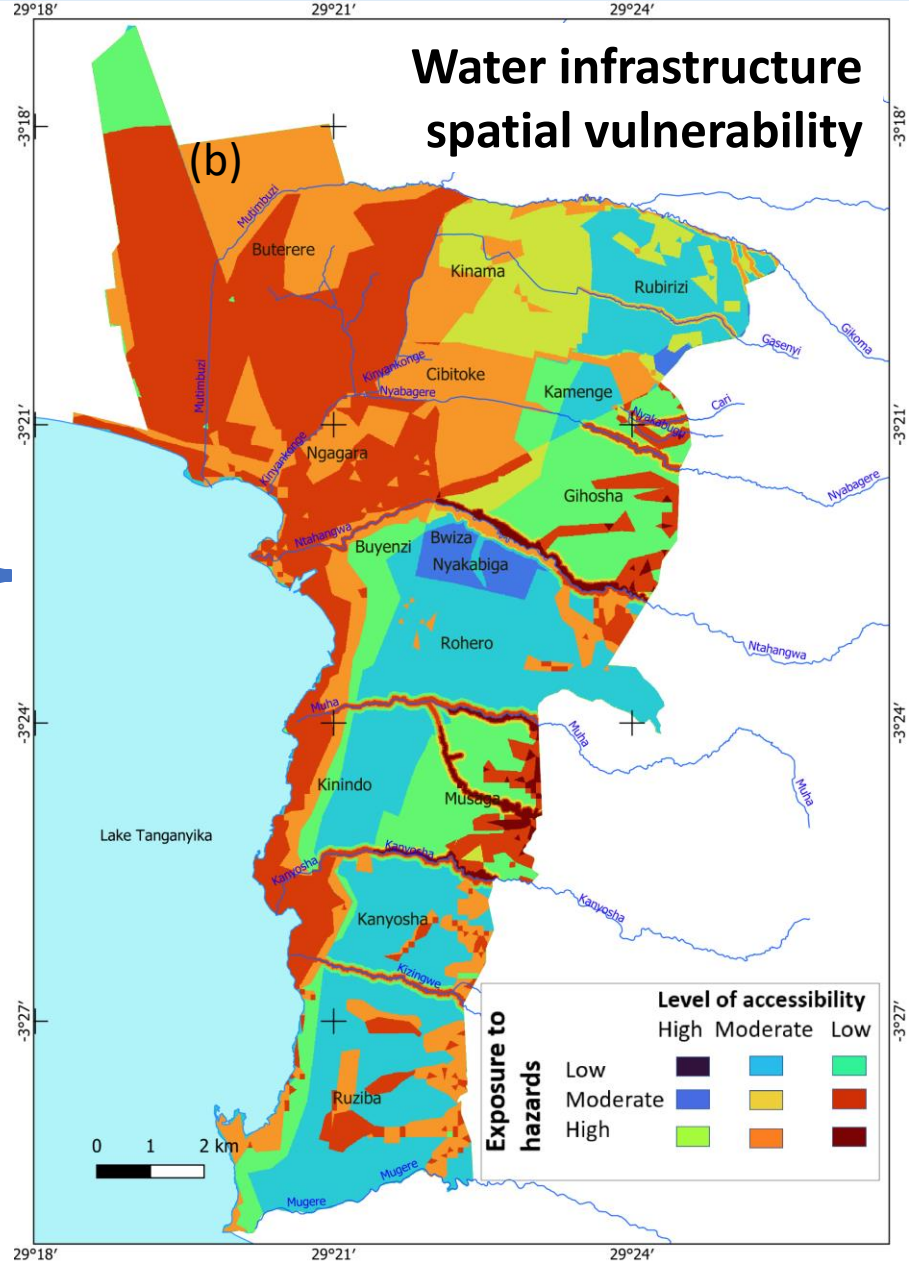
1. Spatial Vulnerability

Spatial vulnerability = vulnerability transmitted to the infrastructures via their location

Determined by two factors:
(1)hazard exposure
(2)accessibility to water



Water accessibility



Results: from infrastructure vulnerability to the territorial vulnerability

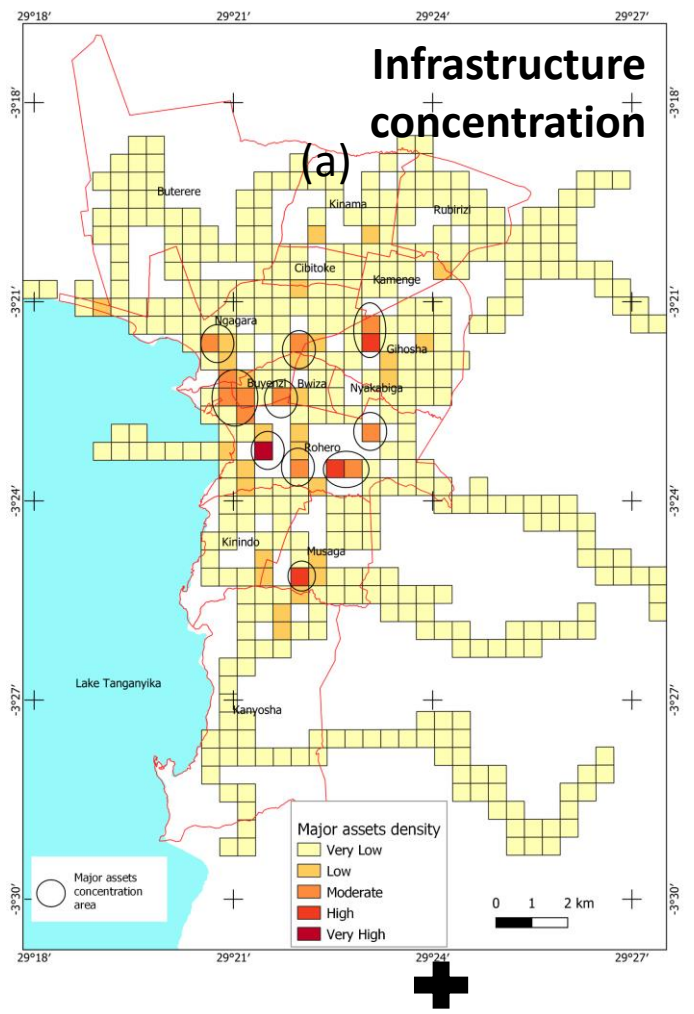
2. Territorial vulnerability

- Identify strategic areas with high density of infrastructures
- Identify areas to be protected or which should be subject to vulnerability reduction policies

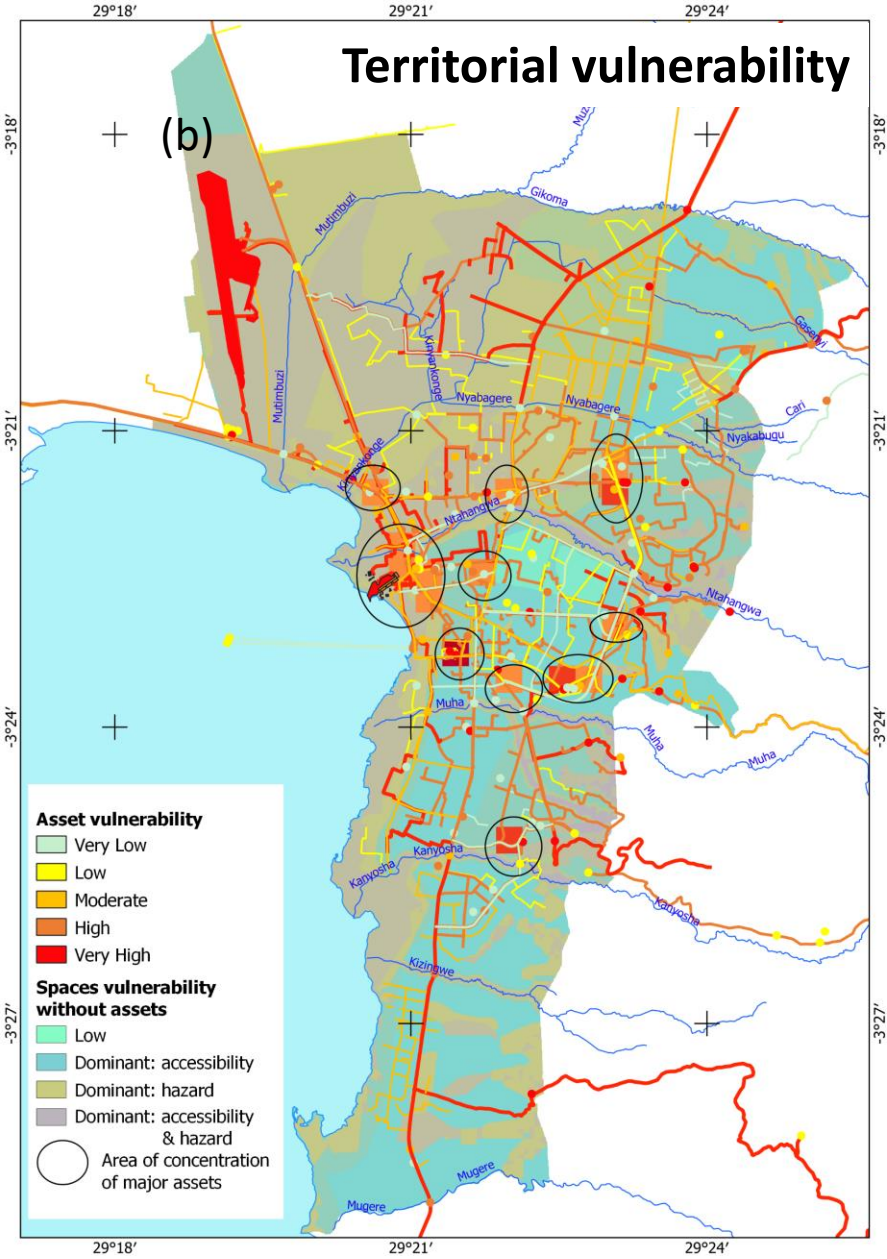
Determined by two factors:
(1) Infrastructure concentration
(2) Spatial vulnerability

Analysis of territorial vulnerability

- Difference between the center and the northeast
- Hazard and low access dominate in the north and west
- Center = less vulnerable



Water infrastructure spatial vulnerability



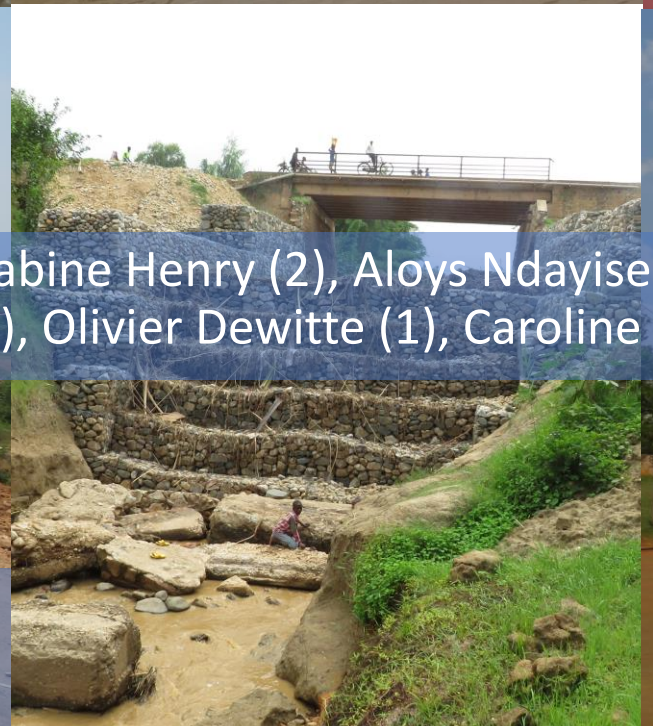
Conclusion

- We show how the NLS vulnerability can lead to the vulnerability of the entire territory
- **High exposure** of the north and west to geo-hydrological hazards ➔ high vulnerability of these areas
- The NLS vulnerability is transmitted to the territory through the **dependency** of water drink infrastructures (electric power)
- Non-exposed areas to hazard are vulnerable due to their low access to water infrastructures or NLS dependency to other infrastructures
- Areas with high spatial vulnerability (hazard + accessibility) should be the focus of vulnerability reduction policies



Thank you for your attention

Jean Nsabimana (1-2-3), Sabine Henry (2), Aloys Ndayisenga (3), François Kervyn de Meerendré(1), Olivier Dewitte (1), Caroline Michellier (1)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jean.nsabimana@unamur.be