

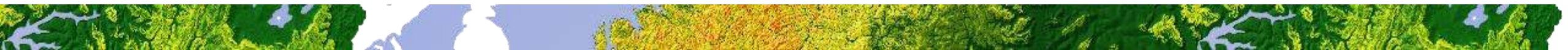
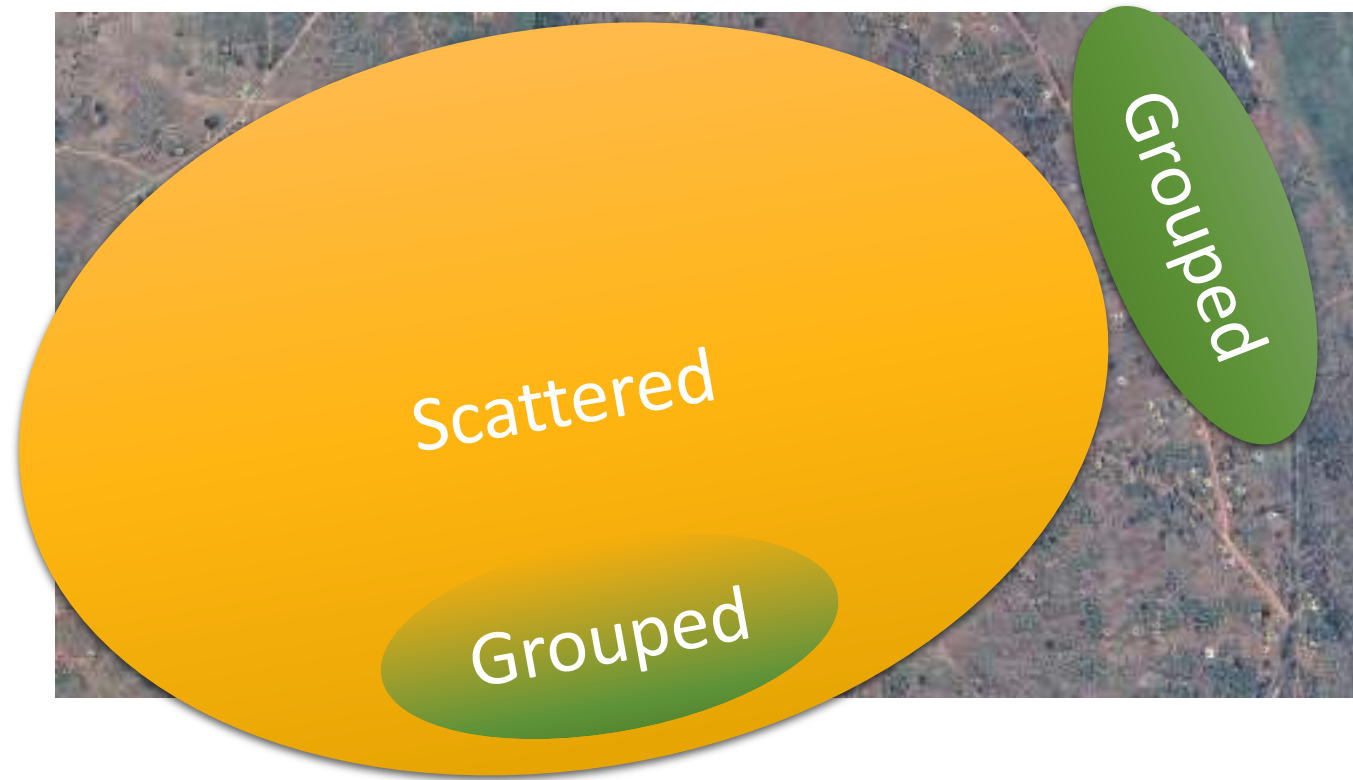
A topographic map of Rwanda is shown in the background, with colors representing elevation: green for lowlands, yellow and orange for midlands, and brown for highlands. A horizontal band across the middle of the map shows an aerial photograph of a rural settlement with blue-roofed buildings and a road.

Rural settlements in Rwanda & Associated landslide risk

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AfricaGIS 2017, Ethiopia

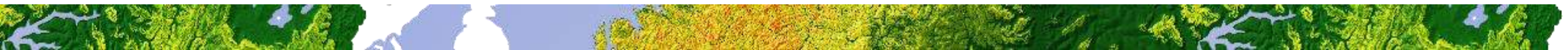


- Scattered rural settlement dominated human settlement in Rwanda
- Paysannat (colonial... independence...), villagization since 1970s (Imidugudu), IDP villages during the last decade
- 82.7% of Rwandans live in rural areas (NISR)
- 19.3 % of the national population lived in imidugudu in early 2000s.
- 62% in grouped settlements today





- Increasing landslide impacts in rural areas
- between 2011 to 2013 caused 74 deaths, 573 houses
- In 2016, landslides took 110 lives, and damaged 2674 houses
- Rural areas are the most affected
- Relocation of households in high risk zones
- High risk zone considered as areas with steep slopes



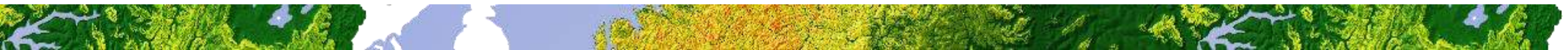
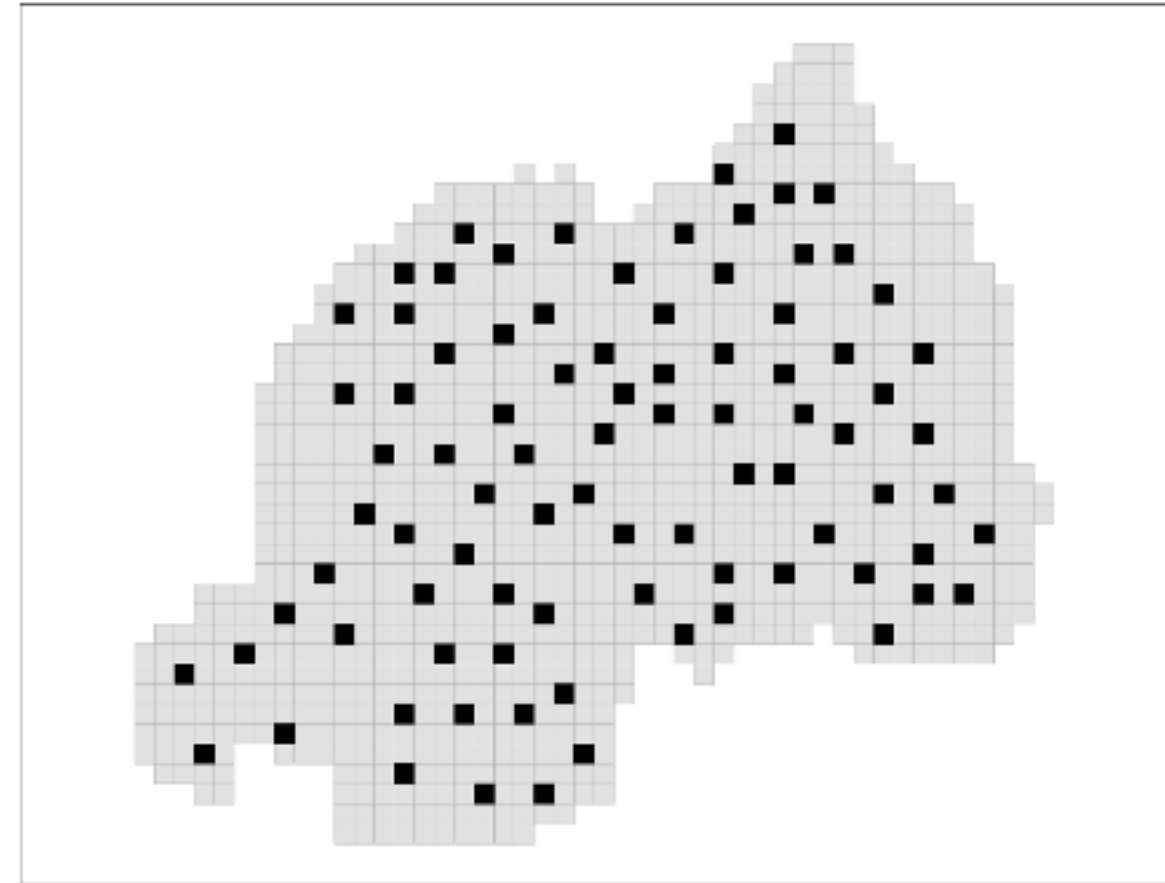


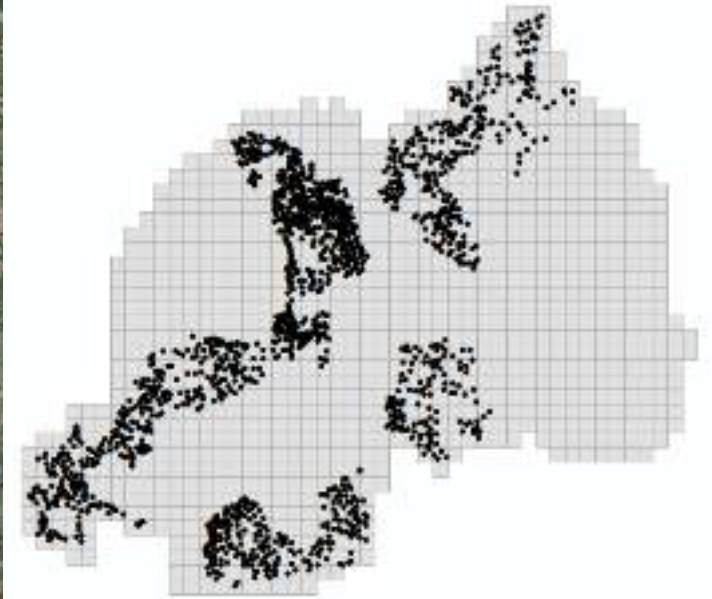
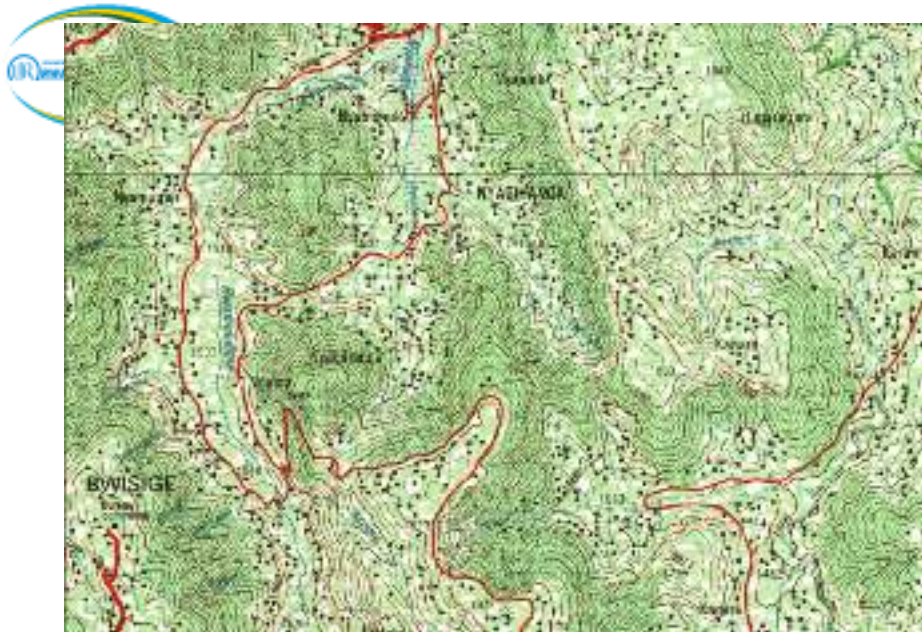
- Grouped vs scattered settlement
- Rural settlements and country topography
- Rural settlements and landslide disaster risk





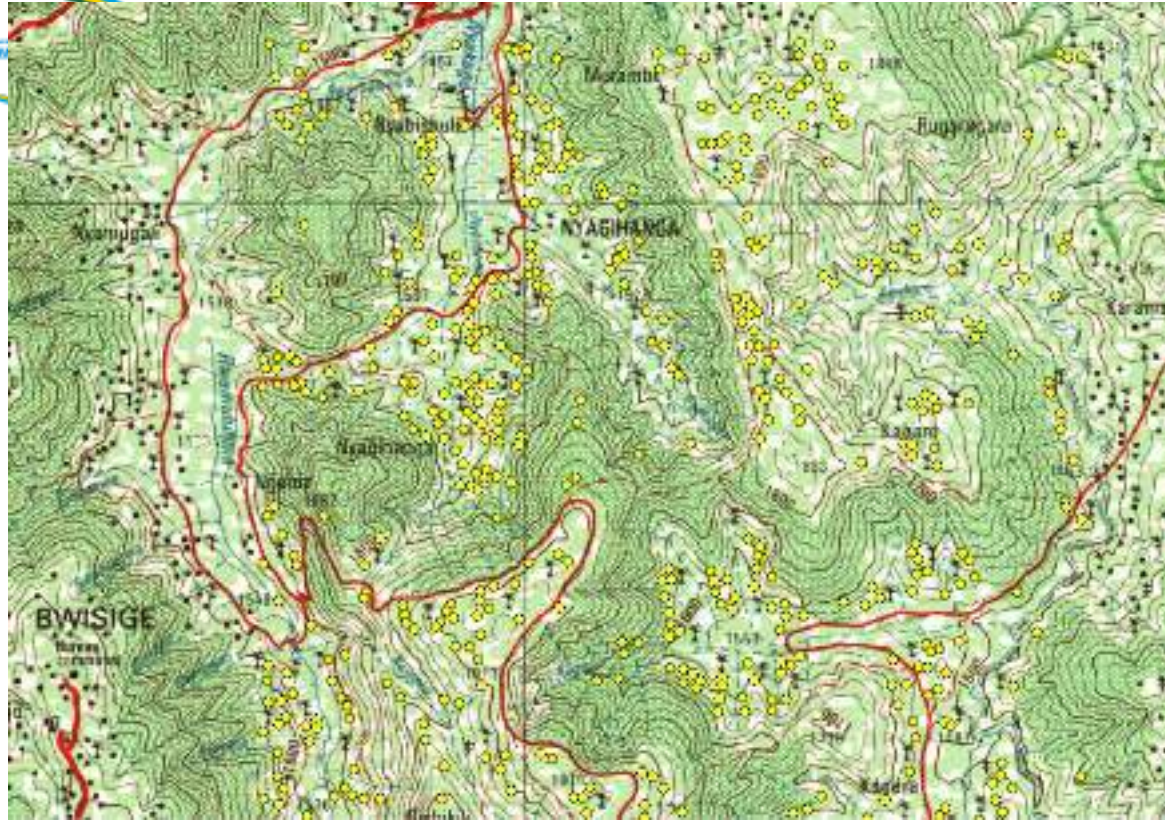
- 5x5 km
- Grid samples
- House point extracted using Object Oriented Image Analysis and Manual digitization
- Sample collected in rural sectors
- Officials and experts consulted



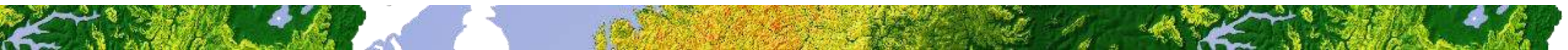


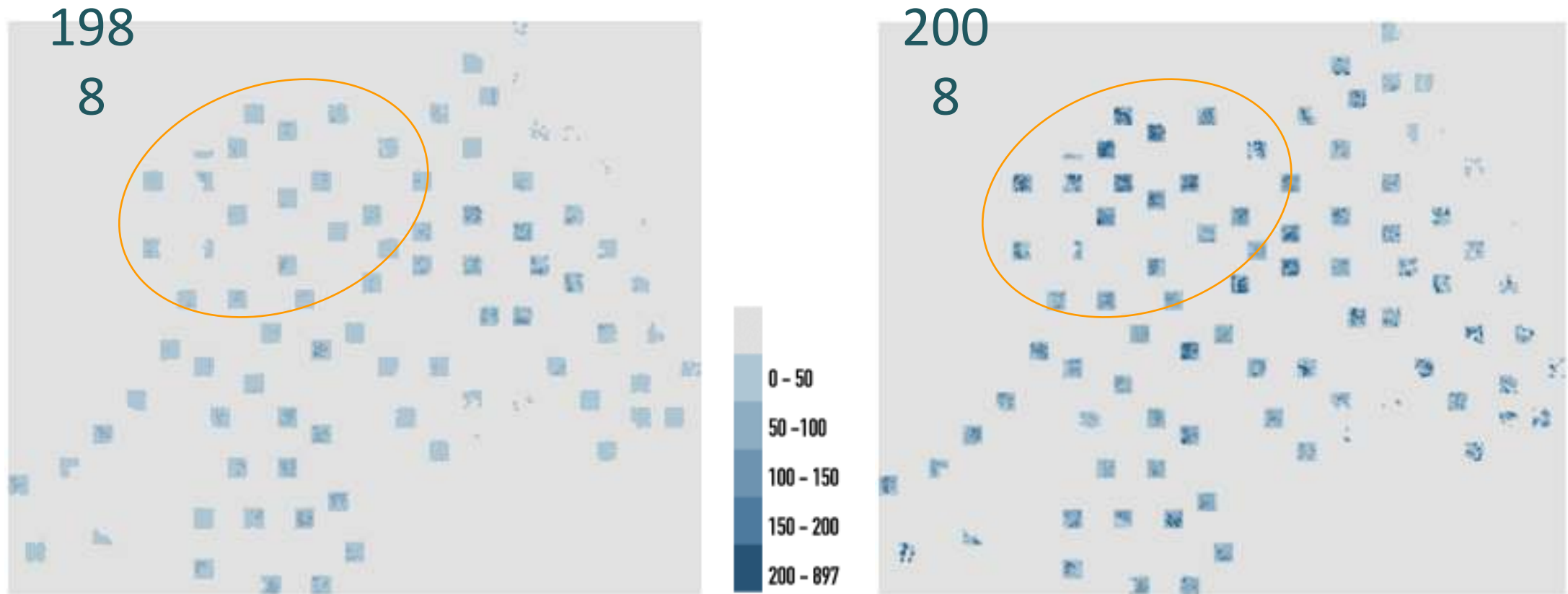
- Topo maps of 1988
- Orthophotos of 2008
- ArcGIS base layer images (later not considered due to cloud cover over some study areas)
- 1598 locations with rural layout plans



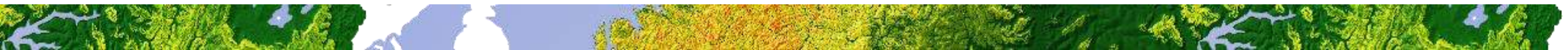


- 69065 houses in 1988 and 176854 houses in 2008
- Avg 802 houses per grid in 1988 and 1986 houses per grid in 2008 (9731 people or 389 people per km²)



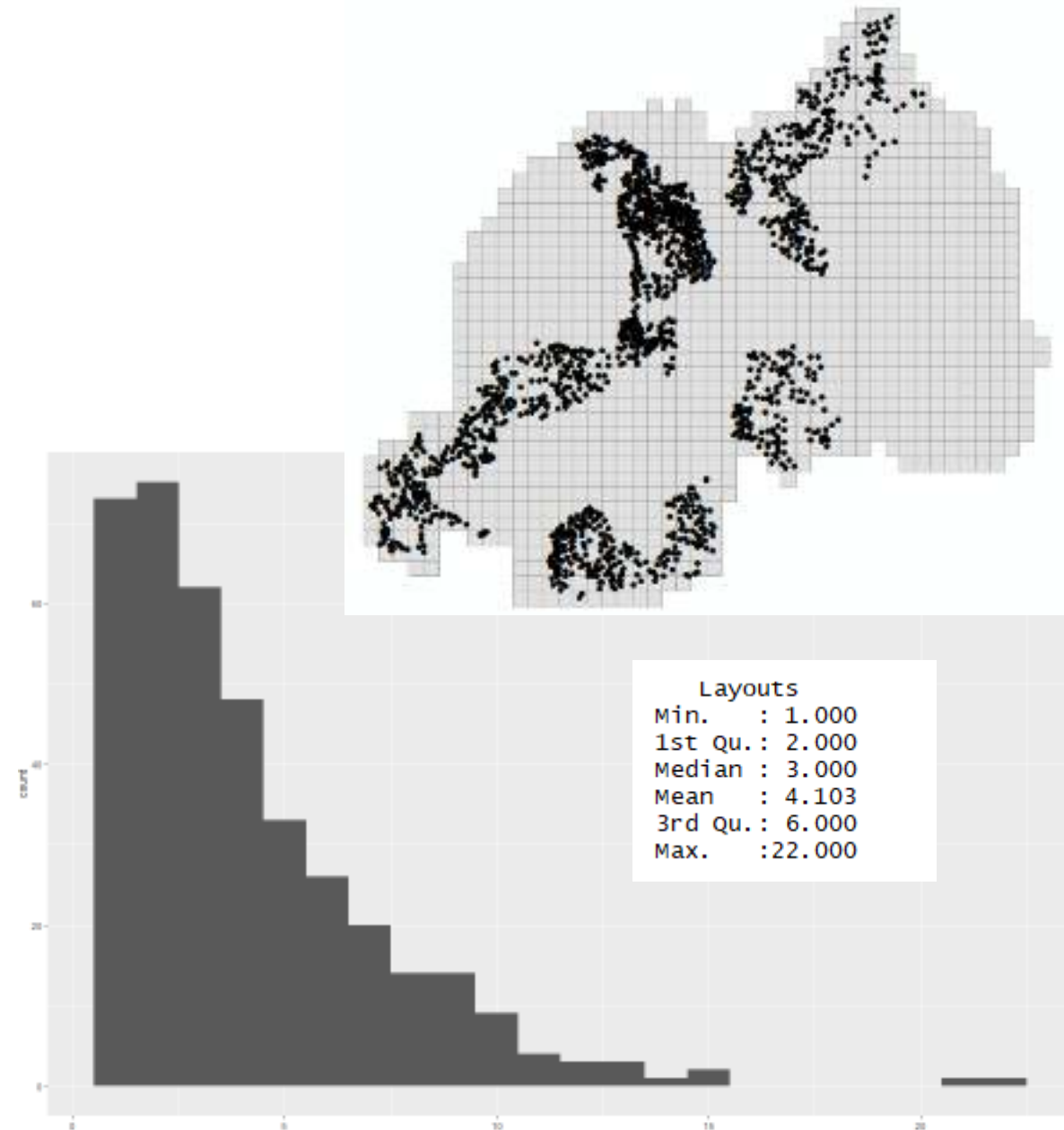


- Increasing densities
- (High densities in areas with high landslide susceptibility in 2008)



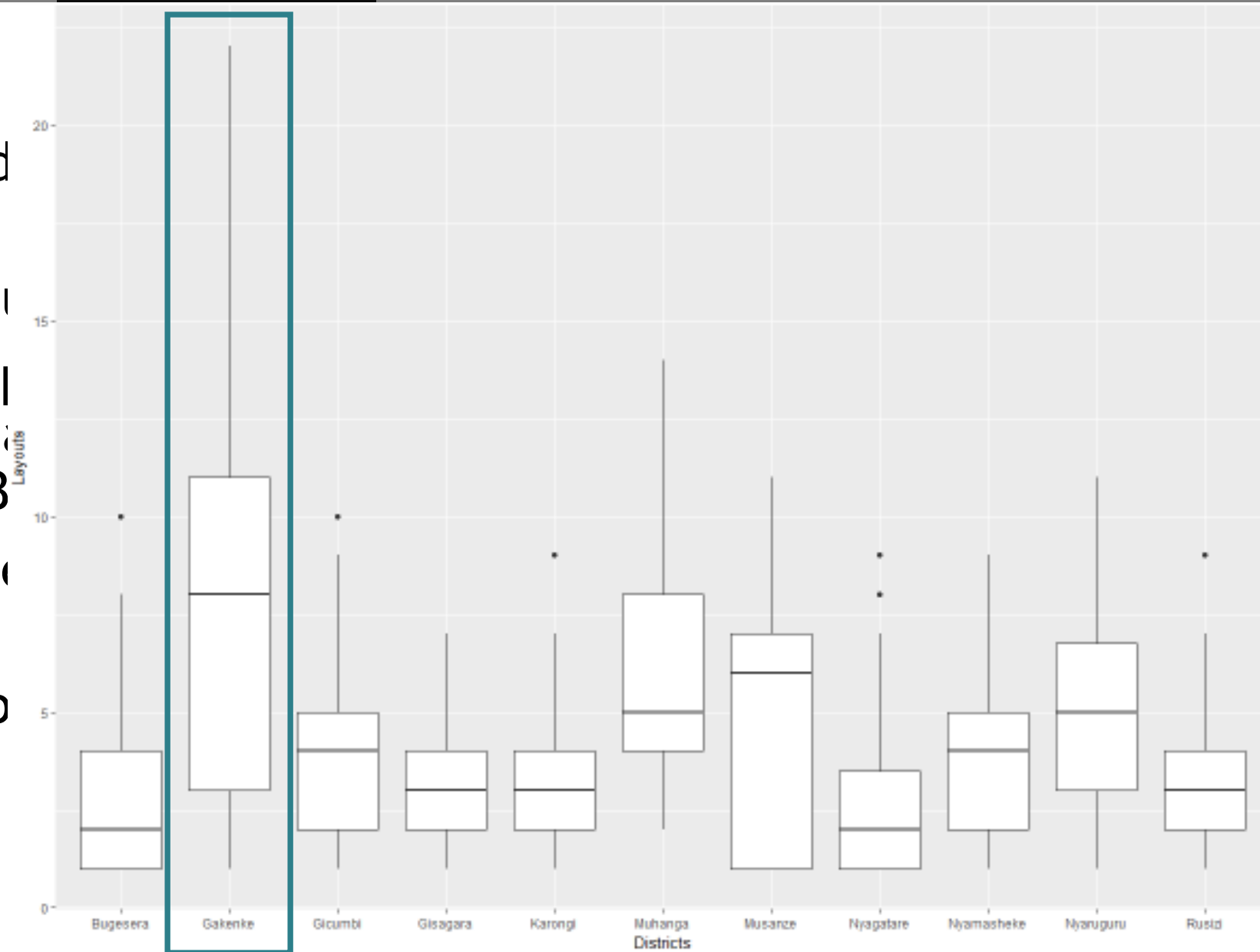


- Grouped are defined as areas with layout plans
- More than 7000 layouts planned
- 200-500 households per layout (860 - 3440 people...average household size is 4.3)
- 3525 to 14103 people per grid in average
- 141 ppsqkm to 564 ppsqkm



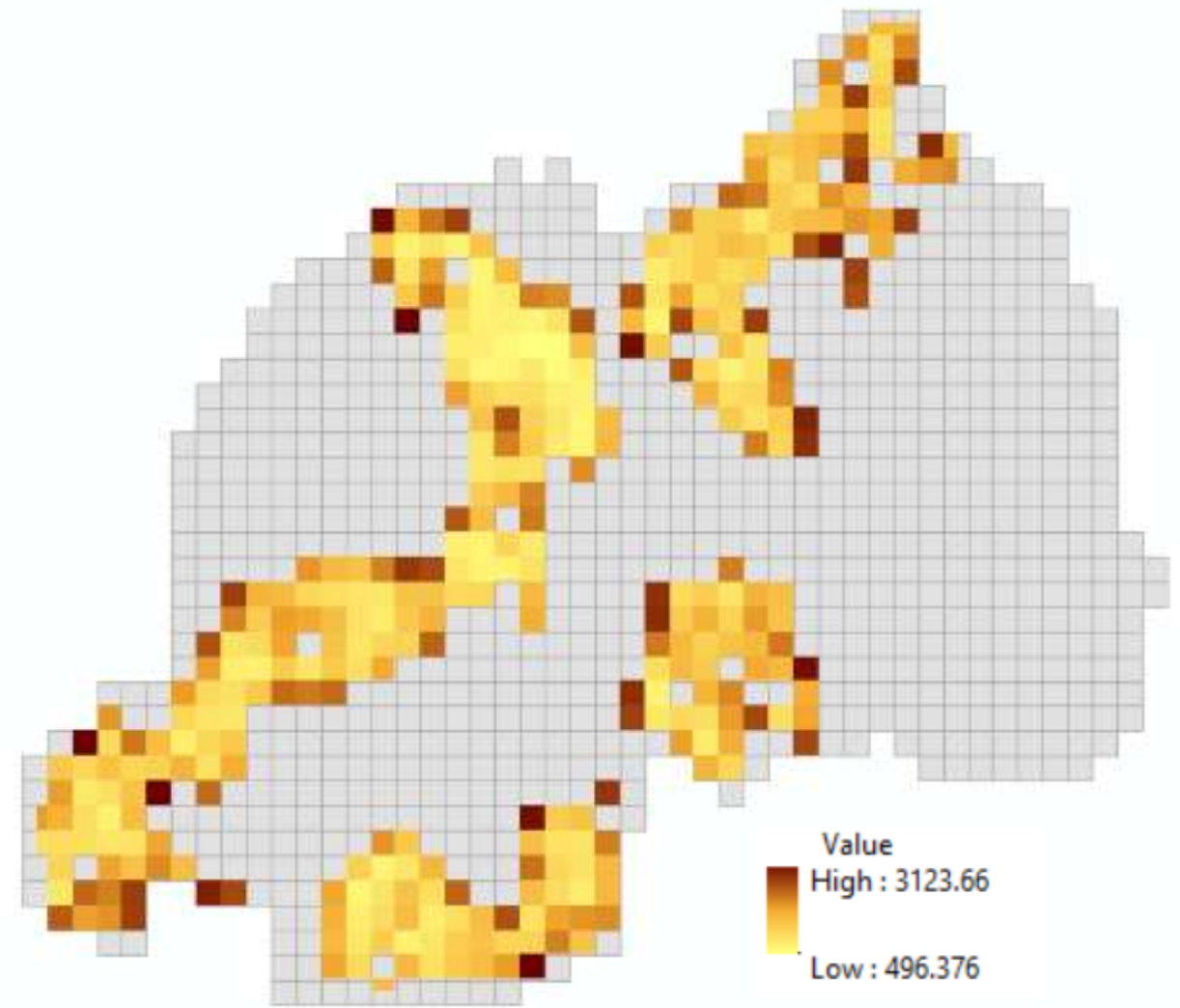


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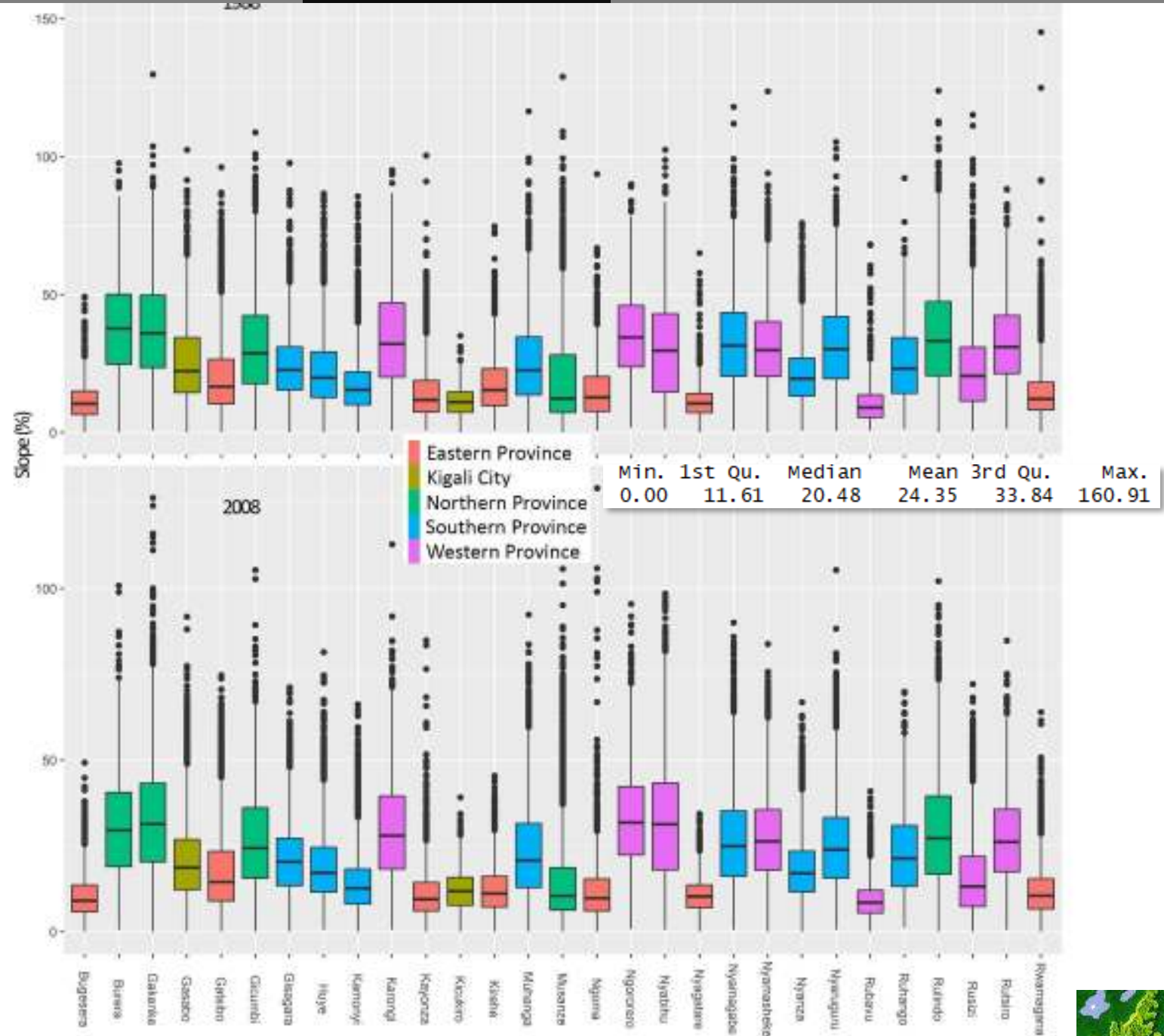
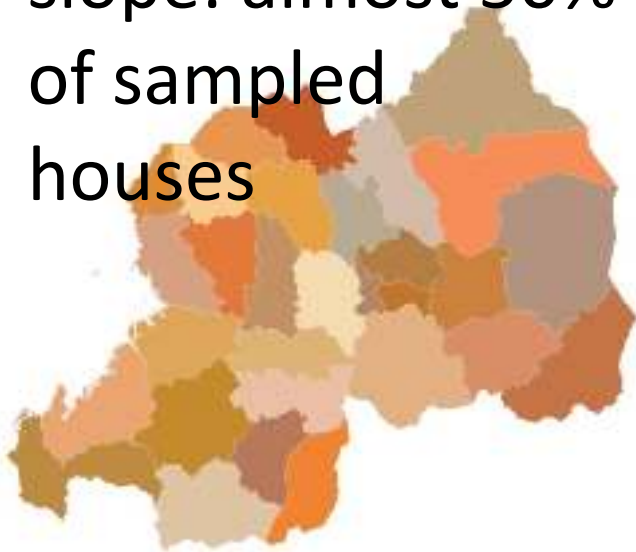
- 1 km buffer around layout (overlaps)
- “Scattered” grouped rural settlement (more than 7000 planned layouts)
- Settlement outside planned rural settlement site
- The average distance per grid was between 496.37 and 3123.6 meters





Slope

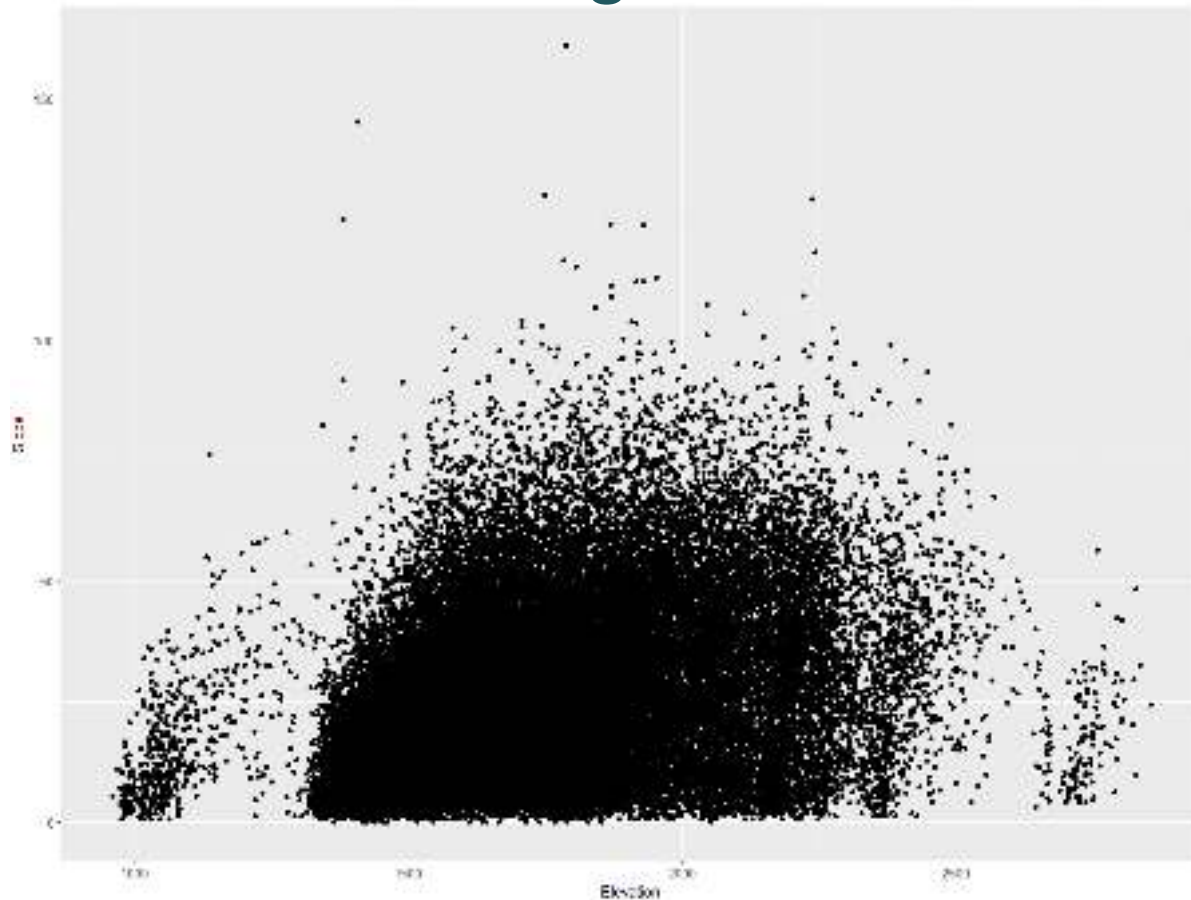
- All slopes have settlements
- Above 20% of slope: almost 50% of sampled houses



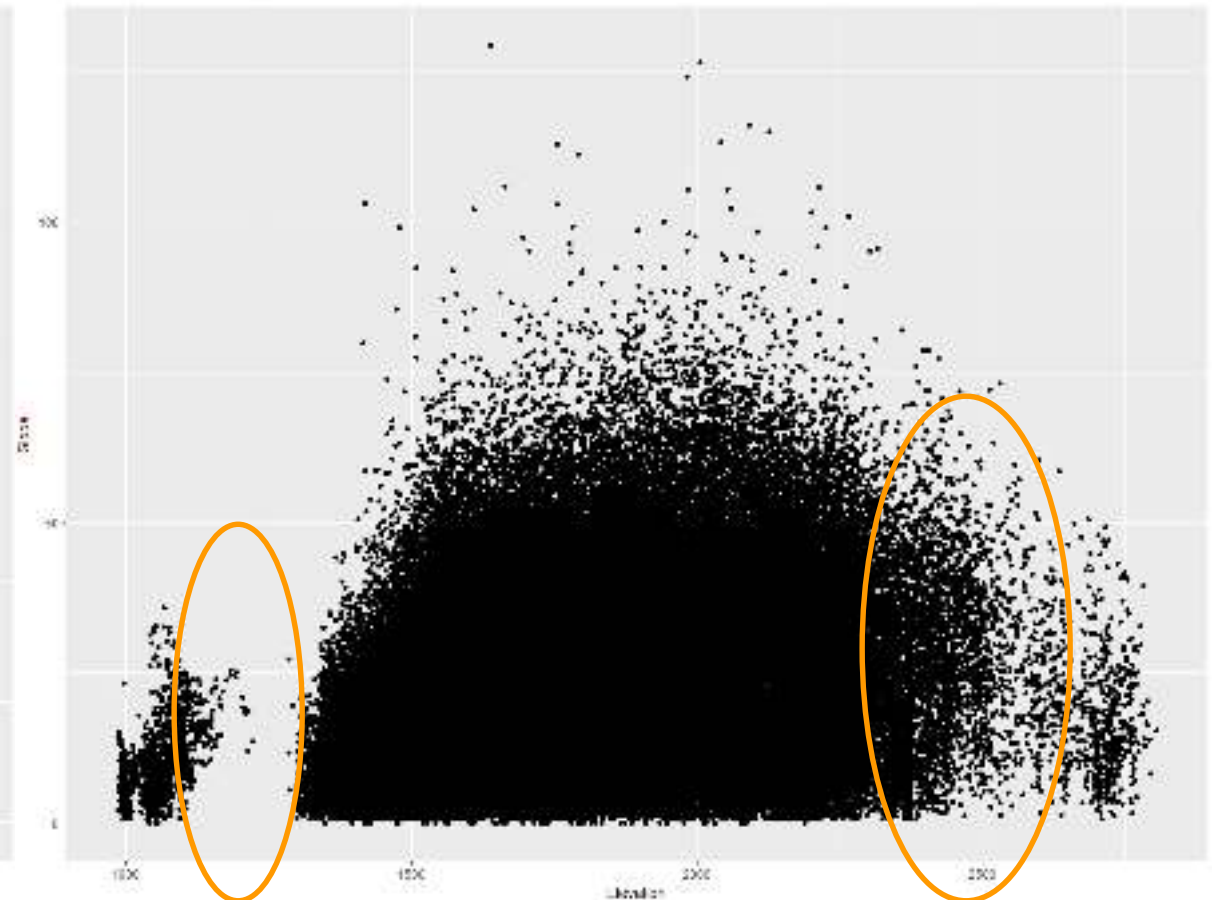


Slope vs elevation

198
8

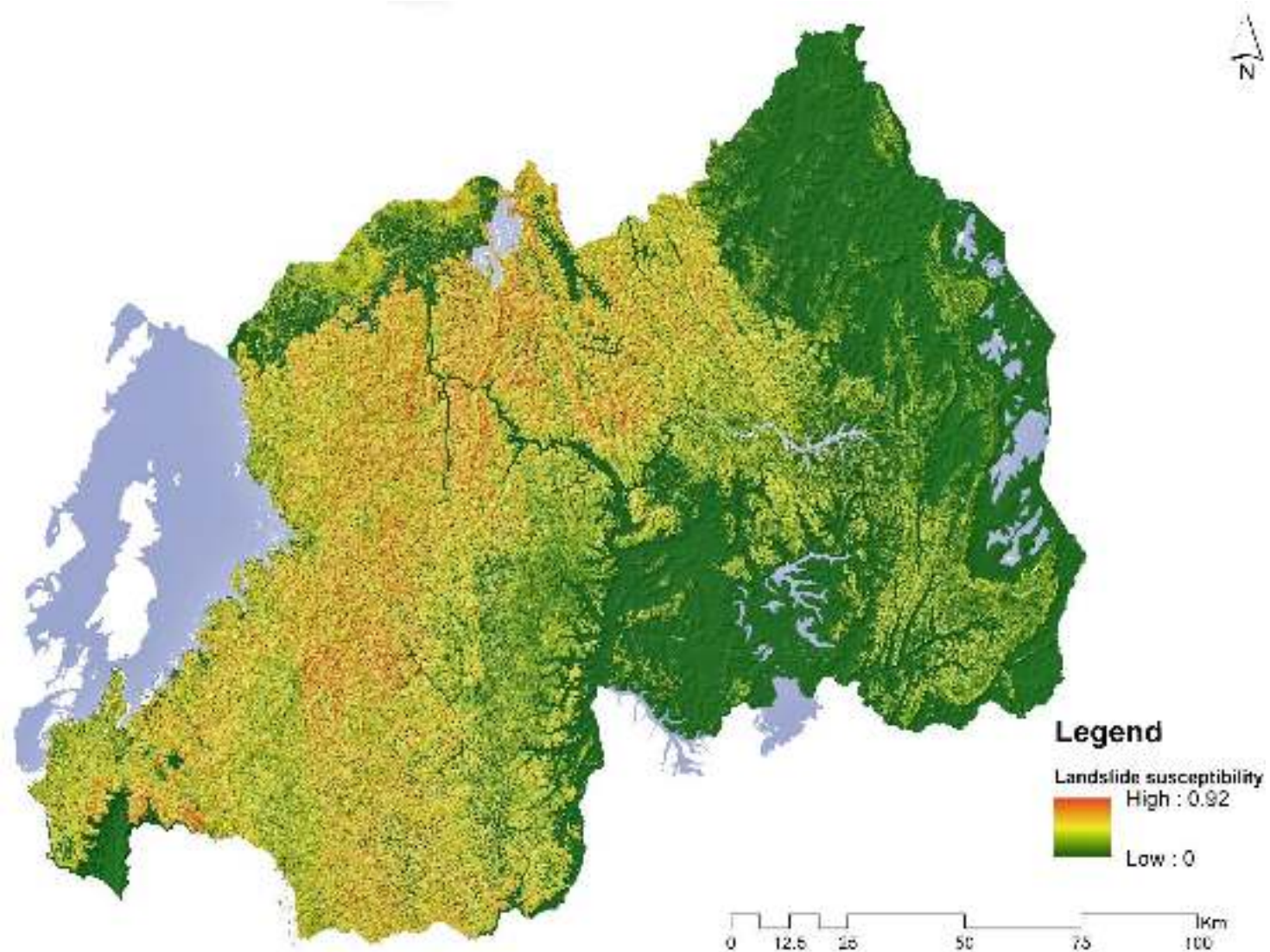


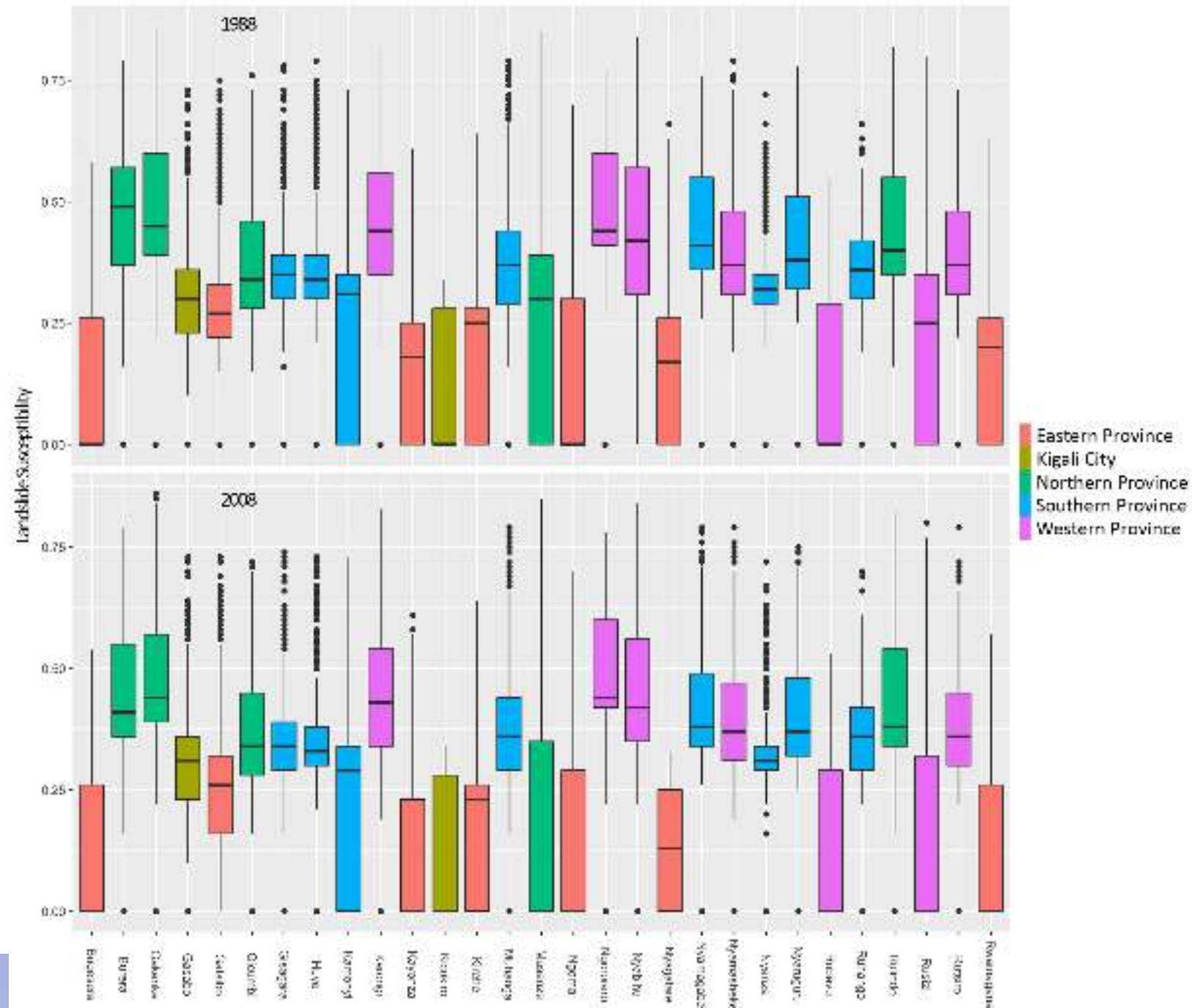
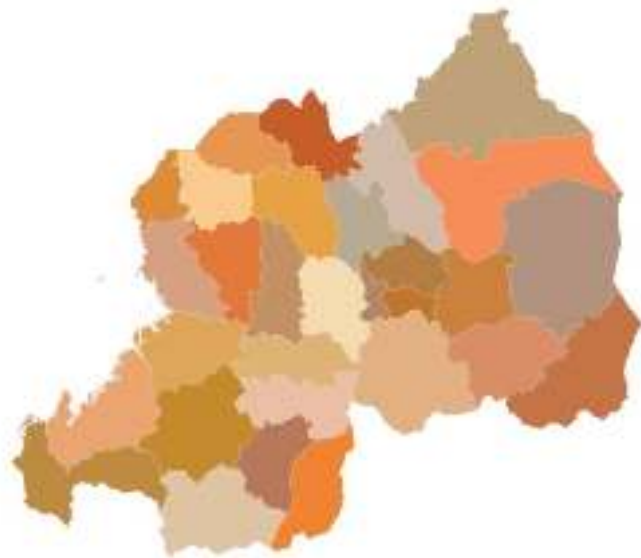
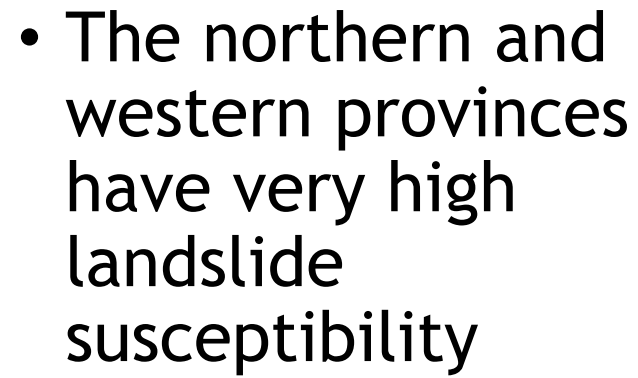
200
8





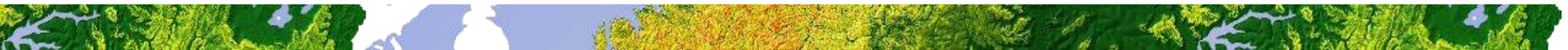
- Landslide susceptibility map of Rwanda as part of the National Risk atlas of Rwanda







- Increasing scattered settlements...scattered village
- Rural settlements were still predominantly scattered in 2008
- Increasing number of houses in high risk areas...% of houses above 20% of slope which is not allowed for construction
- No relationship between slope and altitude
- Increasing risk is the result of increasing population density





Murakoze!