



Civilian Vulnerability in the Democratic Republic of Congo



Introduction

The conflict in the Democratic Republic of Congo is one of the most devastating in the world. Civilians are constantly targets of attacks from militias, armed groups, and the government, particularly in the eastern part of the country due to presence of foreign armed groups such as the FDLR, CNDP, and ADP. It is essential to know where civilians are being targeted in order to develop effective protection strategies.



In this project, I will analyze where civilians are most vulnerable to violence in the Democratic Republic of Congo. My hypothesis is that, based on previous research conducted, violence against civilians is more likely to occur in areas close to mines, areas close to borders, areas close to population centers, areas that are forested, areas close to roads, and areas where previous battles have taken place.

Methodology

I created a vulnerability index combining data from ACLED, containing all instances of violence in the DRC from 2010 to 2014; mining data from the World Resources Institute; administrative boundaries from GADM; road and town data from the Ministry of Sustainable Development, of Forest Economy, and Environment of the Democratic Republic of Congo; and land cover data from GLCF. I created subsets of the data, including only the capital and head of districts and provinces; active mines; national roads; and battles from the ACLED data set.

Next, I used the Euclidean distance tool on the border, mines, battles, towns, and roads data, and then reclassified the data. The above chart

Classification Categories	
Most vulnerable- 1	0-10km
2	10-20km
3	20-50km
4	50-100km
Least vulnerable- 5	100+km

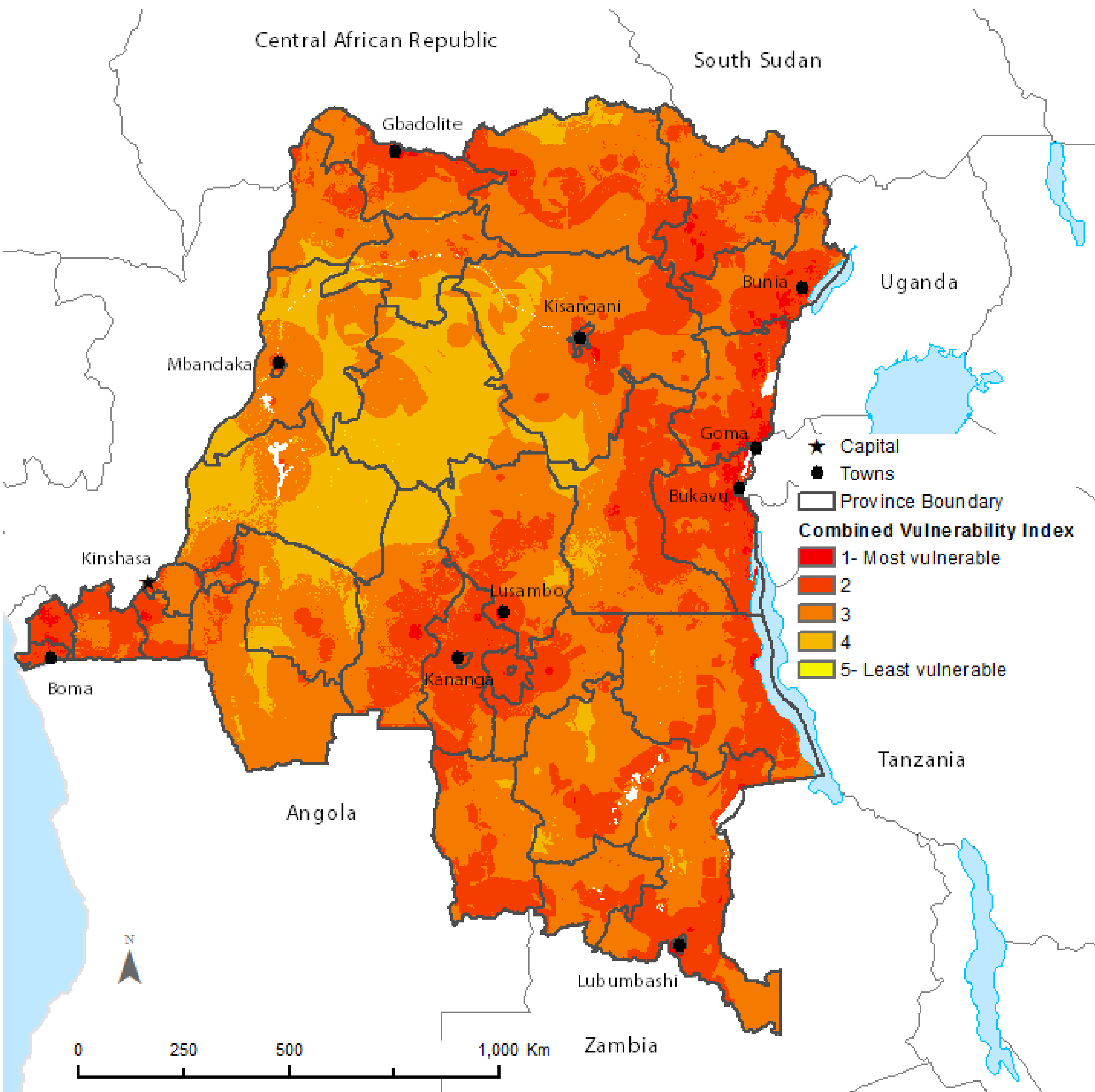
Land Cover Classification		
Old Value	Label	Vulnerability Level
0	Water	5
1	Evergreen Needleleaf forest	1
2	Evergreen Broadleaf forest	1
3	Deciduous Needleleaf forest	1
4	Deciduous Broadleaf forest	1
5	Mixed forest	1
6	Closed shrublands	2
7	Open shrublands	2
8	Woody savannas	3
9	Savannas	3
10	Grasslands	4
11	Permanent wetlands	5
12	Croplands	4
13	Urban and built-up	5
14	Cropland/Natural vegetation mosaic	4
15	Snow and ice	5
16	Barren or sparsely vegetated	5

indicates what categories I used to develop a vulnerability scale for each layer.

For land cover, I reclassified the 16 categories into five vulnerability levels, with forests as the most vulnerable areas.

Next, I used map algebra to combine the rankings of each layer. Six was the lowest score, and thirty was the highest. Then, I weighted each level. Previous battles and mines had a greater weight because those are a greater indicator of conflict. To finalize my map, I used the integer function to create five levels of vulnerability.

Combined Vulnerability Index



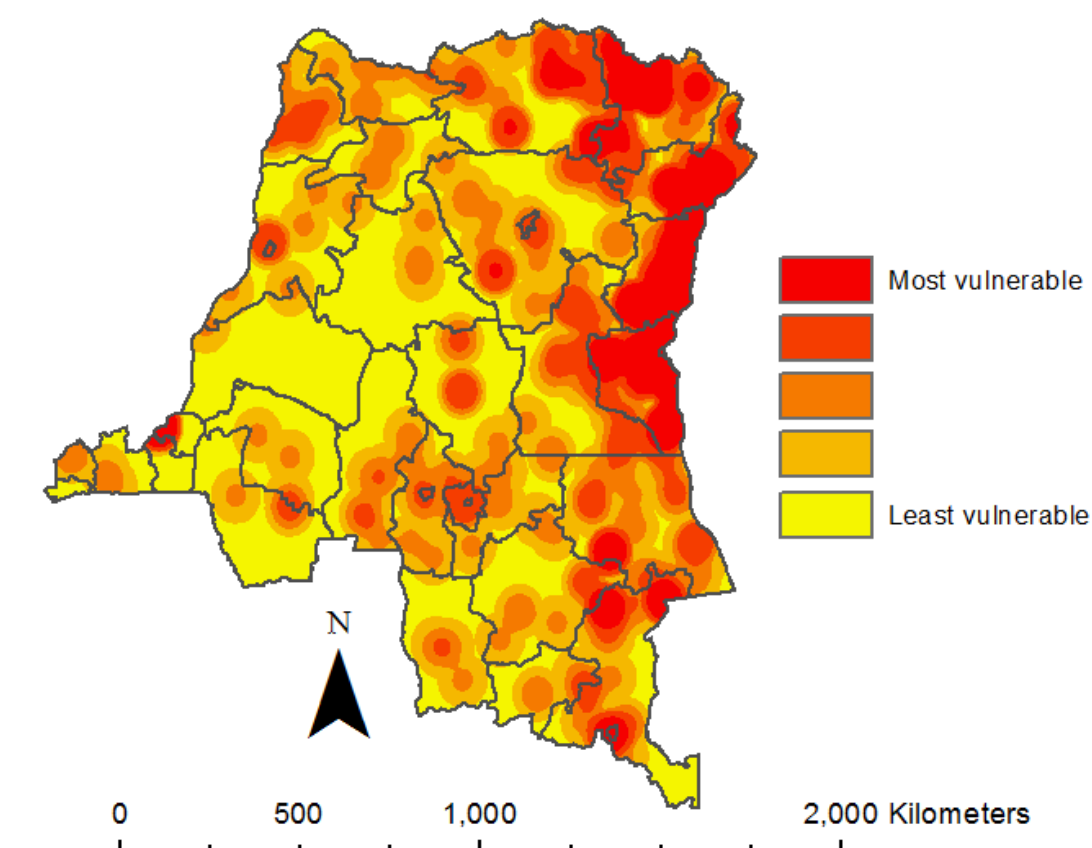
My final map shows where civilians are most vulnerable in the DRC, based on proximity to mines, proximity to the border, proximity to major national roads, proximity to population centers, land cover variation, and locations of previous battles between 2010 and 2014. Civilians are more vulnerable in the eastern part of the country, and around major population centers, such as Bunia, Goma, Bukavu, Boma, Kananga, Kinshasa, and Lubumbashi. While many of these are near the borders, Lusamba, Kananga, and Kisangani are further from the borders, while still being very high areas for civilian vulnerability. Interestingly, there are no areas that are considered “least vulnerable”, showing that civilians are vulnerable in every part of the country.

Layer	Weight
Previous Battles	0.25
Mines	0.25
Roads	0.125
Towns	0.125
Borders	0.125
Land cover	0.125

Conclusion

To finish my analysis, I created a hotspot analysis of instances of violence against civilians in the DRC from 2010 to 2014, the same period as the battle dataset used in the vulnerability index. We can see that there are some correlations between where violence against civilians is occurring and where civilians are most vulnerable. This includes in the eastern part of the country, as well as around Kinshasha, Bukavu, Goma, Kisangani, Bunia, and Kananga.

Hotspot Analysis: Violence against Civilians

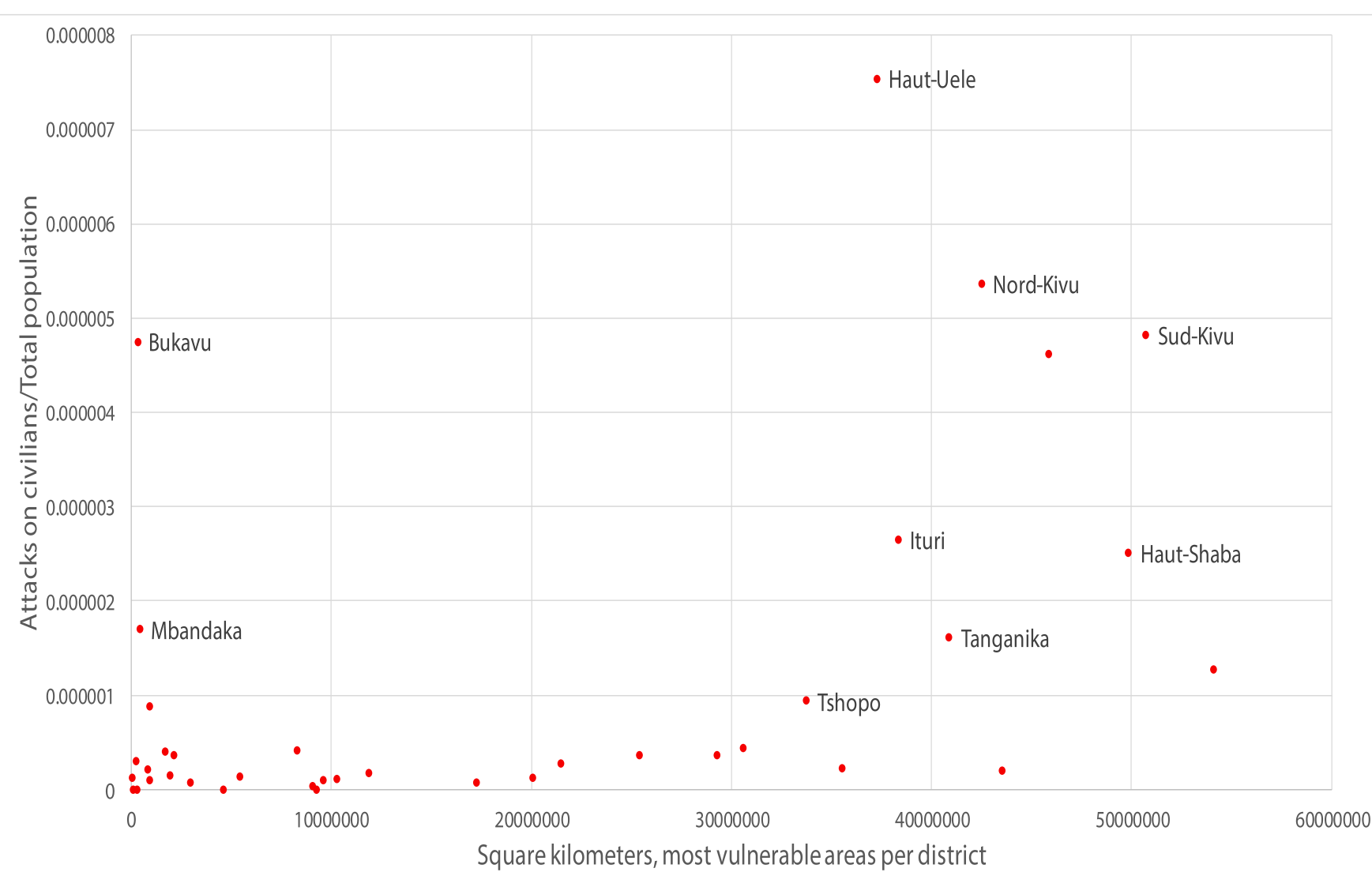


Finally, I created a scatterplot indicating civilian vulnerability by district. This chart shows area in square kilometers in the most vulnerable areas (level one and level two) per district, along with the number of attacks on civilians normalized by total population, obtained through Gridded Population of the World. This scatterplot shows that there may be an exponential relationship between area and attacks on civilians. As the area of the most vulnerable parts of each district increases, there seems to be an increase in attacks on civilians.

However, this analysis shows correlation, not causation, and it is hard to tell that there is a clear relationship between these criteria and an increased number of attacks on civilians.

There are some limitations to this analysis. The location of armed groups is going to have the greatest effect on civilian vulnerability, and geography can only show where these groups might be located. Nonetheless, this research is one step towards understanding where civilians are most vulnerable.

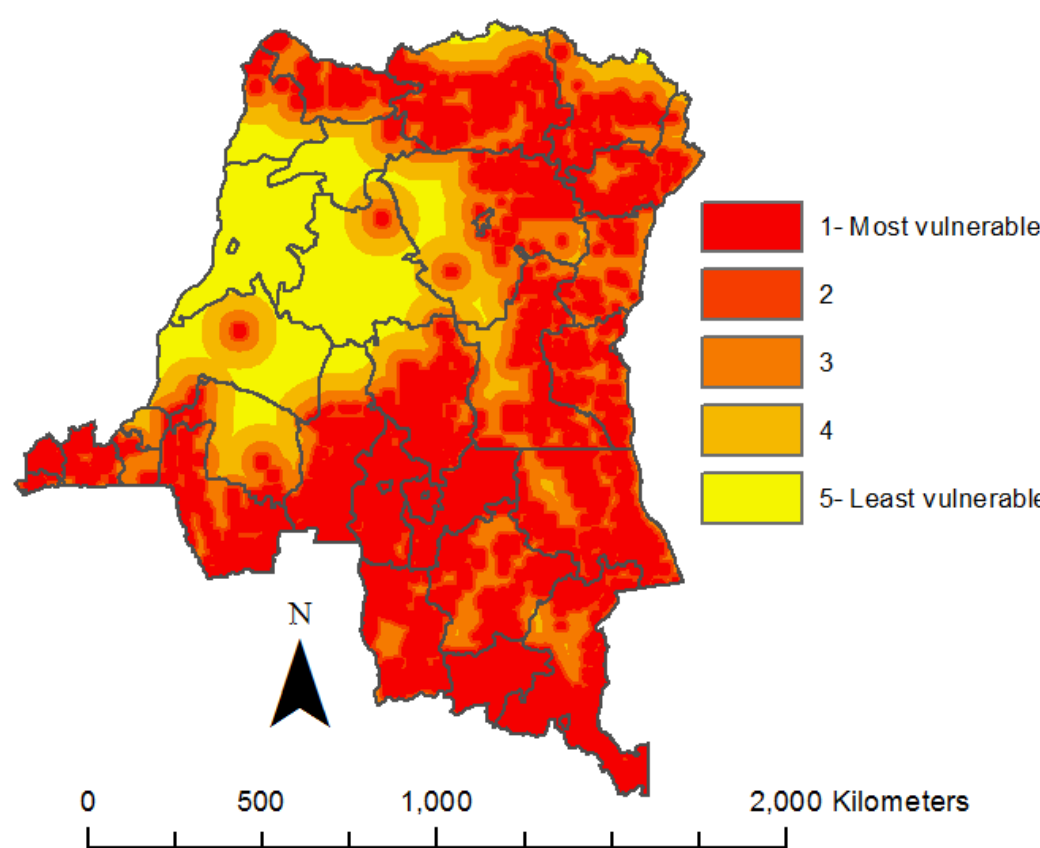
Civilian Vulnerability by District



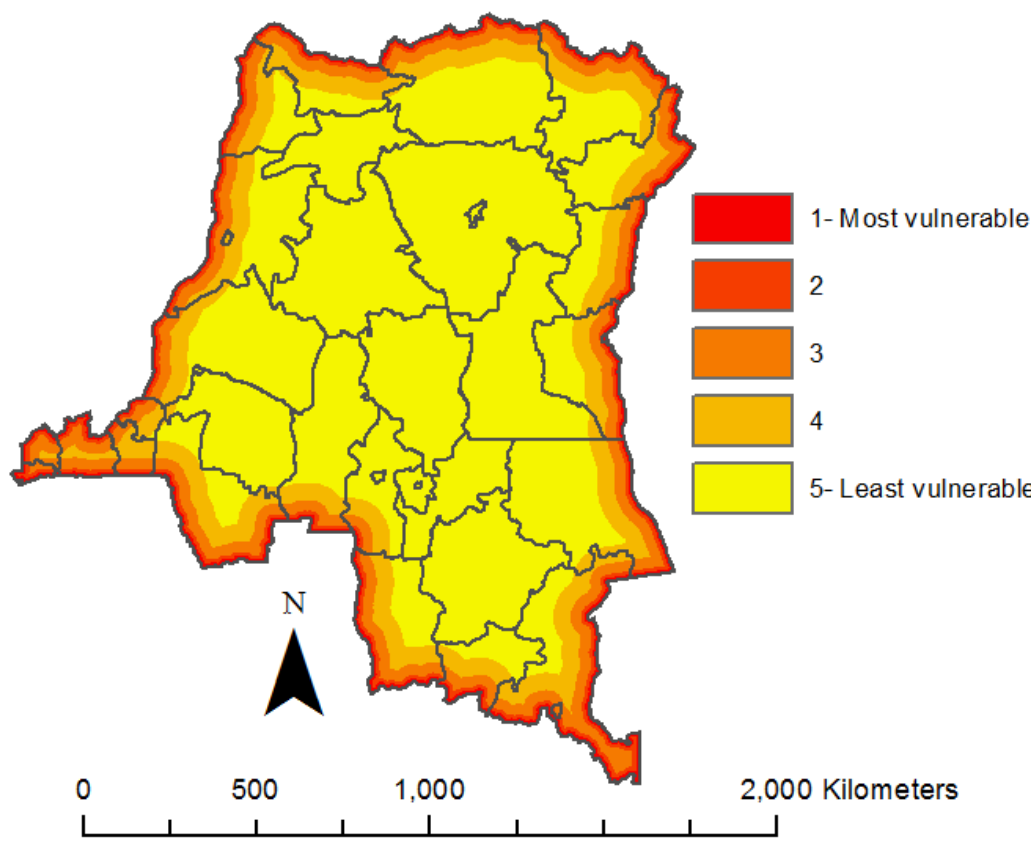
Cartographer: Michelle Kirkman
Class: DHP-P207
Date: May 2016
Projection: Africa_Albers_Equal_Area_Conic
Sources: GADM, GCLF, Gridded Population of the World, ACLED, Ministry of Sustainable Development, of Forest Economy, and Environment of the Democratic Republic of Congo, World Resources Institute



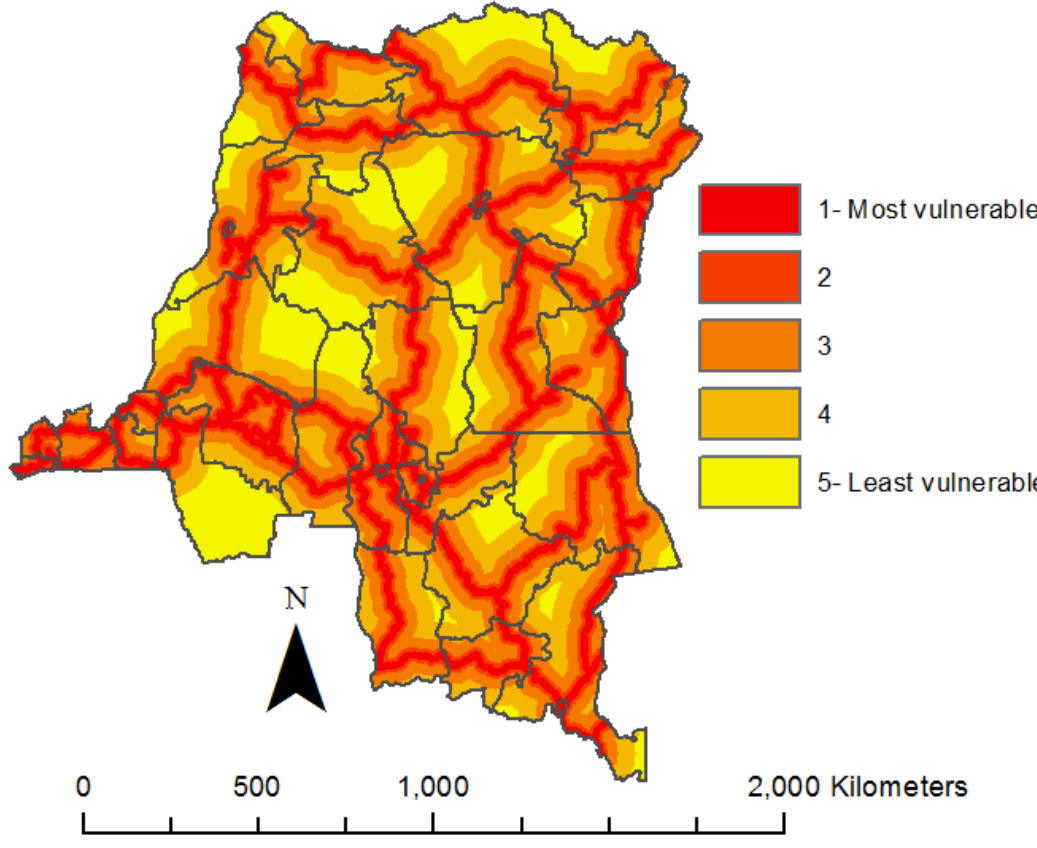
Proximity to Mines



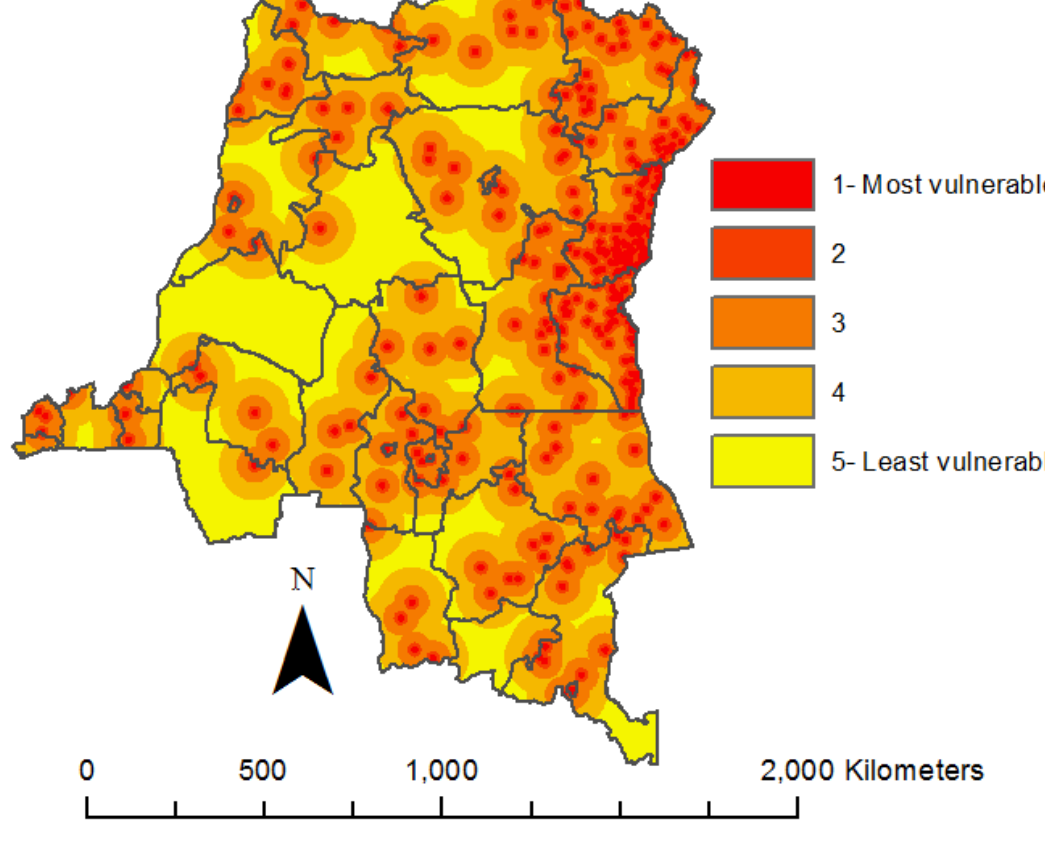
Proximity to Border



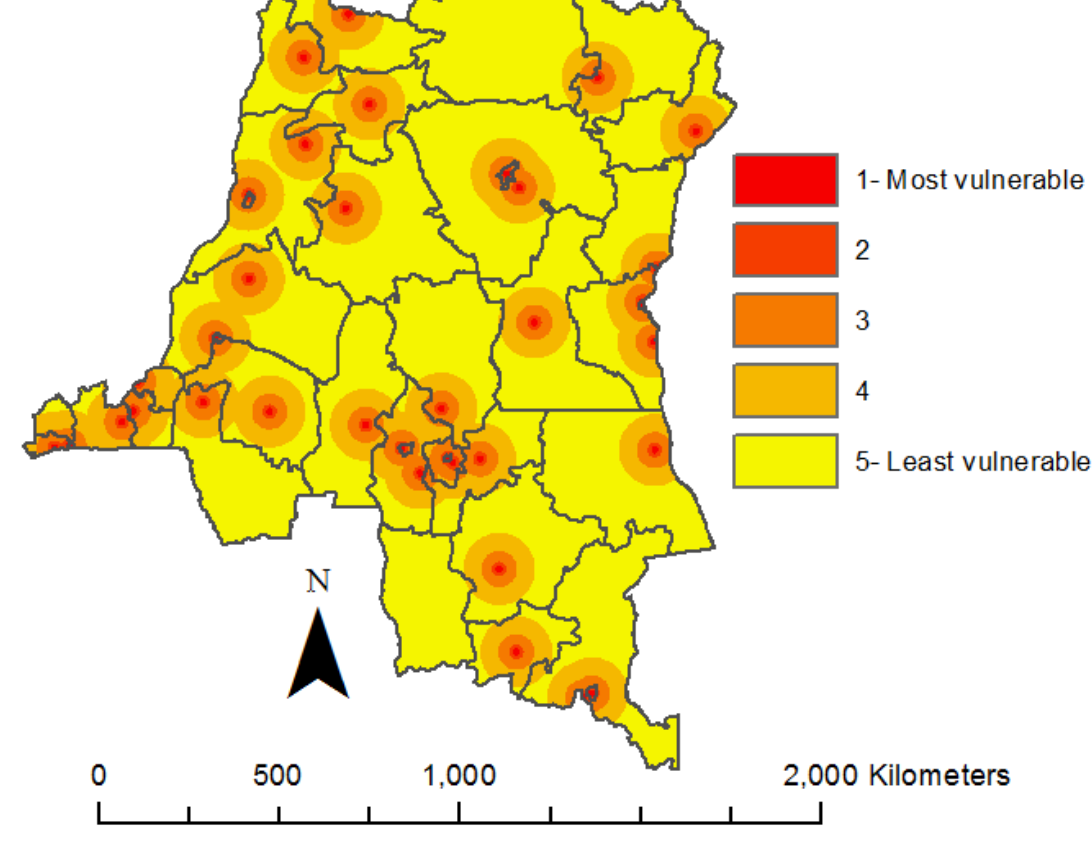
Proximity to Roads



Previous Battle



Proximity to Towns



Land Cover Variation

