

Risk map for prevalence of the Porcine Cysticercosis in Uganda

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Introduction

Porcine Cysticercosis is a zoonosis that is transmitted from human to pork through bad sanitation, and from pork to human through the meat. In order to understand where the highest risk and therefore the biggest market for vaccine is, this short report represents an approach to map this risk for this disease.

Material and method

Conceptual framework

In order to identify zones at risk for Porcine Cysticercosis three criteria have been identified. Namely, bad sanitation, high density of pigs, and high level of poverty. Widespread bad sanitation increases the chance of infection of Porcine Cysticercosis as roaming pigs have a bigger chance to come in contact with infected human faeces. High pig density reflects that more pigs are at risk. Also a higher pig density increases the chance of interaction between pigs and therefore increases the chances of spreading the diseases. Finally, high level of poverty reduces the probably of people getting treatment for diseases both in humans and in pork, and therefore increases the chance of spreading of the disease.

In order to map risk, each of the three criteria need to be mapped out and overlaid as shown in Figure 1. On locations where the three criteria are met, the risk for the disease is high. Each criteria gets a primary color, and where they overlap color the color are mixed.

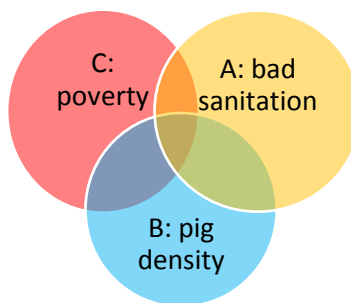


Figure 1 : conceptual framework used for the risk map

Input data used

For each criteria, a geographical data source need to be found in order to map the spatial pattern.

Bad sanitation

Bad sanitation has been mapped based on Demographic Health Survey (DHS) data from Uganda (Uganda Bureau of Statistics - UBOS and ICF International, 2012). This dataset contains data from 9033

households that can be georeferenced through 400 clusters. A cluster is constituted of about 20 households for which the geo-coordinates have shifted randomly (up to 5 km) to insure anonymity of the households. Data about sanitation (variable HV205) has been aggregated to the cluster, i.e. representing the percent of households within the cluster that have bad sanitation, defined as no facility or open facilities as shown in Figure 2.

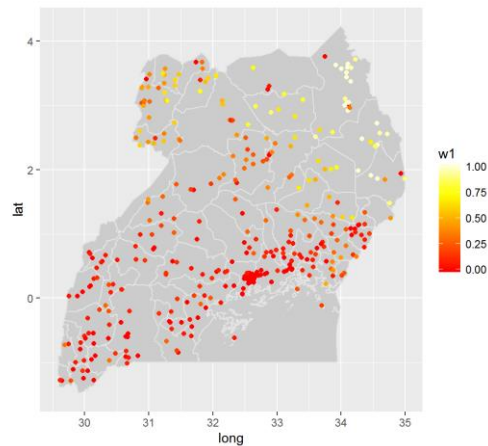


Figure 2 : percentage of household with no or uncovered sanitation facilities per cluster

As the sanitation data is in point data, it need to be interpolated in order to get a full coverage map. This was done with an ordinary kriging procedure. In a nutshell, an ordinary kriging procedure makes a weighted average between points taking spatial auto-correlation into account. This spatial autocorrelation is captured in the semi-variogram that is shown in Figure 3. It shows that spatial autocorrelation is relevant up to one kilometer and can be approximated with a spherical model.

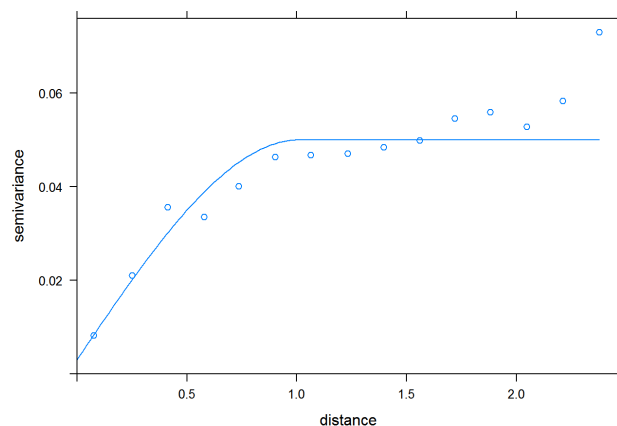


Figure 3: Semi variogram that has been used for the Kriging procedure

The resulting map that represents the proportion of people with no or open sanitation in Uganda is shown in Figure 4.

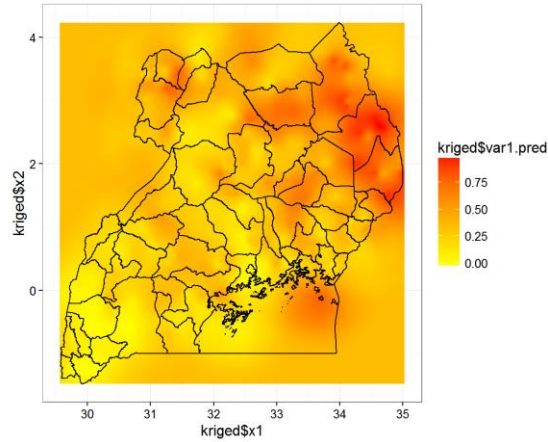


Figure 4 : proportion of people with bad sanitation map

Density of pigs

To map pig density, the FAO map of pig density was used (Robinson et al., 2014), shown in

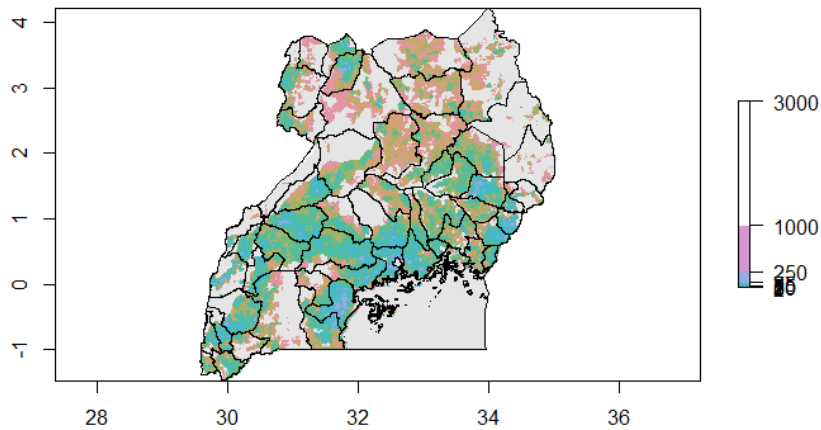


Figure 5 : pig distribution from FAO

Level of poverty

Poverty maps is also based on DHS data, which is based on the wealth index measure. All households in the dataset have been ranked based on the assets they own. The households that are among the 40% poorest have been selected, and aggregated to the cluster, representing the percentage of people belonging the category of the 40% poorest of Uganda, shown in Figure 6.

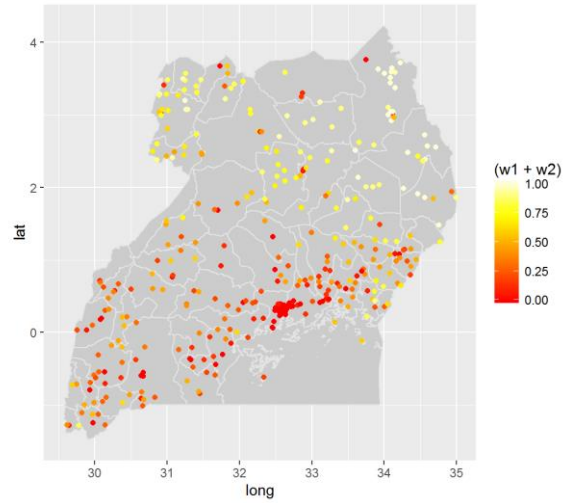


Figure 6 : percent of households in the category of the 40% poorest

The data was interpolated with a kriging procedures, making use of the variogram shown in Figure 7 resulting in the poverty map shown in Figure 8.

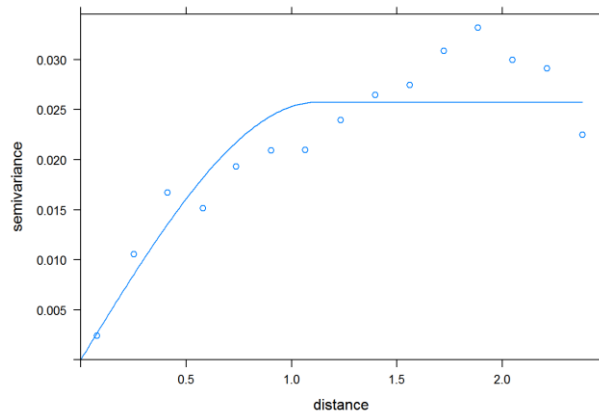


Figure 7 : variogram used in the kriging procedure for the interpolation of poverty

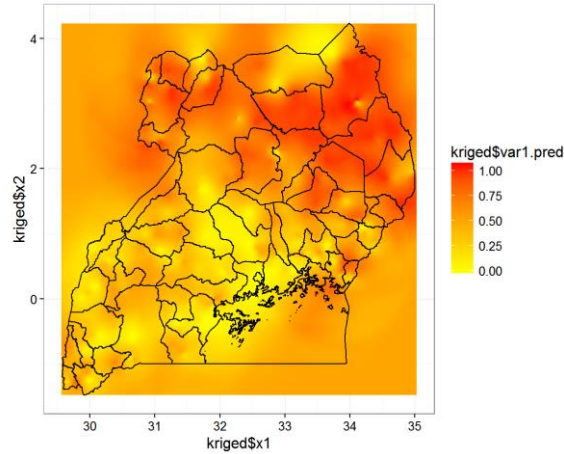


Figure 8 : poverty map representing percentage of the population belonging the 40% poorest category.

Overlay

Each criteria, percentage of the population that has bad sanitation, percentage of households among the 40% poorest and pig density, has to be classified as high and low. This categorization was based on the distribution of the data for each criteria and was based upper third of the distribution (66th centile) resulting in the thresholds shown in Table 1.

Table 1 : threshold used for the high-low definition

Variable	Threshold used
Percent of population with bad sanitation	0.666
Pig density	1
Percent of population belonging to the 40% poorest	0.666

Binary variables have been created based on these thresholds. These binary layers representing where the criteria are high.

Result

The binary layers have been overlayed as discussed in the conceptual framework shown in Figure 1 where A is yellow and represents high levels bad sanitation, B is blue and represents high pig density and C is red and represents high level of poverty. Consequently, the brown areas represent the area where all three criteria are high (ABC) and have the highest risk for Porcine Cysticercosis. This is mainly in the north in the country. As Porcine Cysticercosis is mainly driven by the interaction of bad sanitation and pigs the green area (AB) with high bad sanitation and high pig density should be considered at high risk too, and bad sanitation only in yellow area (A) remain at risk as the few pigs that might be around can easily get infected.

During an outbreak, the spreading is likely to reach quickly the green zones (AB) where high pig density and poverty are combined, as poor people are less likely to implement any measure to contain the

disease, such as access to medicine or implement animal confinement. During quick spreading outbreaks, the whole blue area (B) is at risk due to the dense pig population.

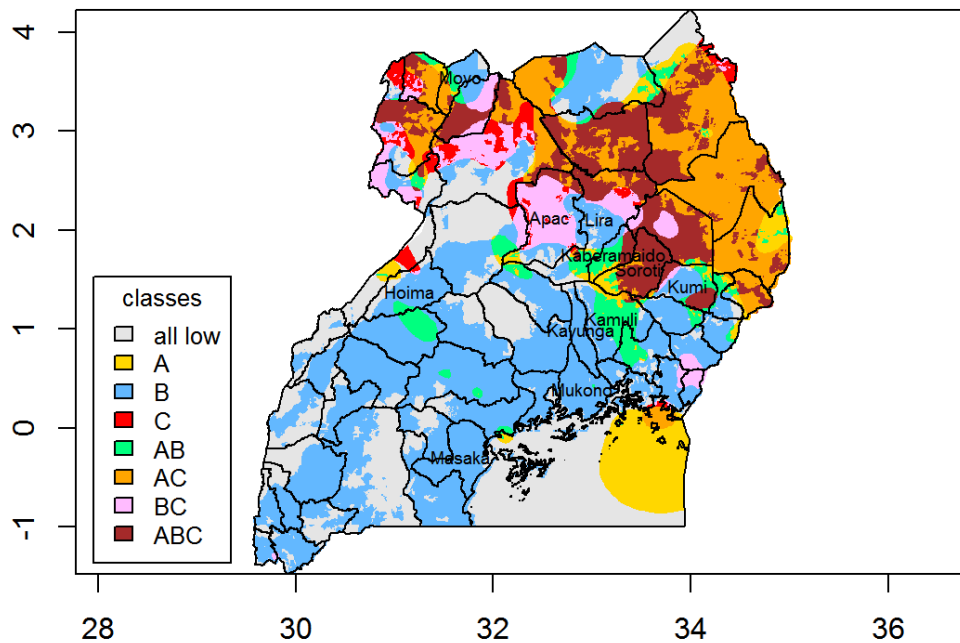


Figure 9 : risk map where A=high bad sanitation, B= high pig density, C= high poverty

Bibliography

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