

Where is The Next Outbreak?

A Risk Analysis of African Swine Fever (ASF) in China

All About ASF in China

ASF is caused by African Swine Fever Virus (ASFV) which is a large DNA virus that causes a high mortality hemorrhagic fever in domestic pigs (Sánchez-Vizcaíno, J. M., et al, 2015). Since the first ASF outbreak occurred in China in August 2018 (Wang, et al, 2018), there is little indication that this deadly disease has been brought under any significant control, as it continued to spread throughout China and beyond its borders. Due to the socio-economic consequences in areas where ASF circulates and where it is newly introduced, there is an urgent need to control the further spread of ASF and, hopefully, to eradicate this devastating infectious animal disease in China eventually, the largest pork market and pork producer in the world.



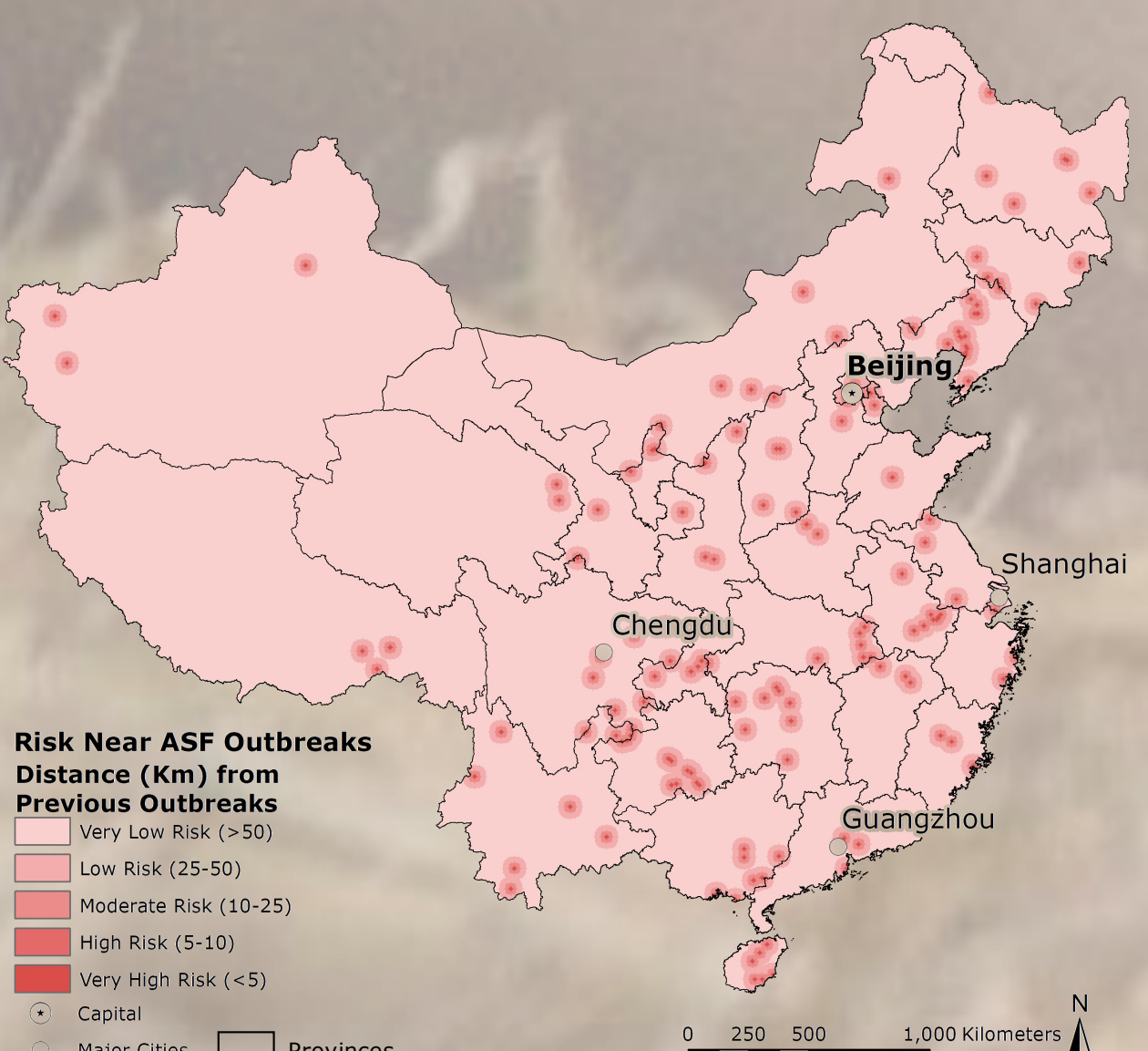
Methods

Factors contributing to the spread of ASF are identified from literature, including previous ASF outbreaks in China, wild boar, soft ticks, pig density, pig farm types in relation to pig density. The final weighted ASF risk analysis map was produced by running a variety of analyst tools such as extract by mask, zonal statistics, Euclidean distance, reclassify, and raster calculator. Weights of each factor is shown in the table below.

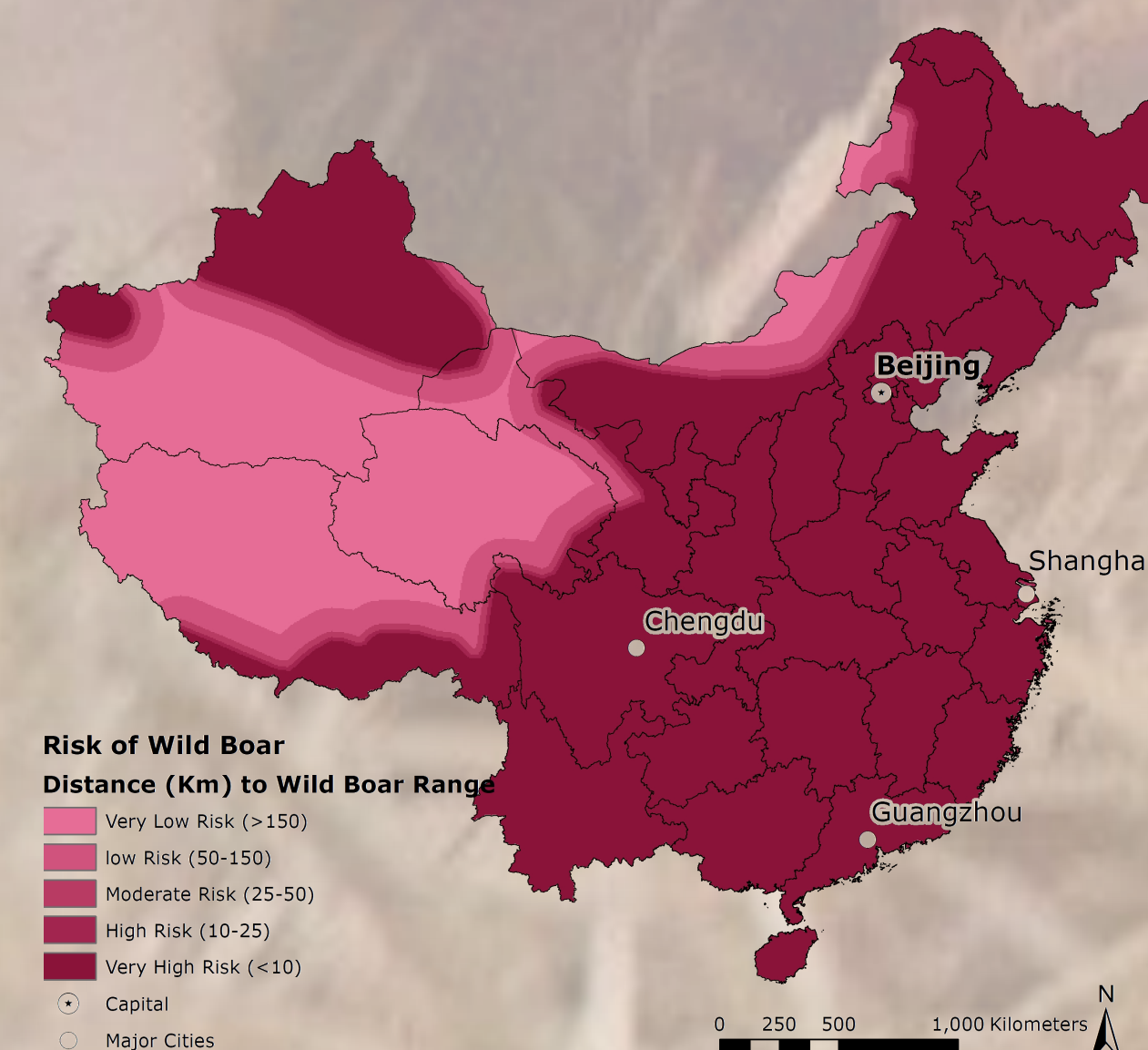
Factor	ASF Outbreaks	Wild Boar	Soft Ticks	Pig Density	Pig Farm Type
Weight	40%	5%	5%	30%	20%

Disease Transmission Factors

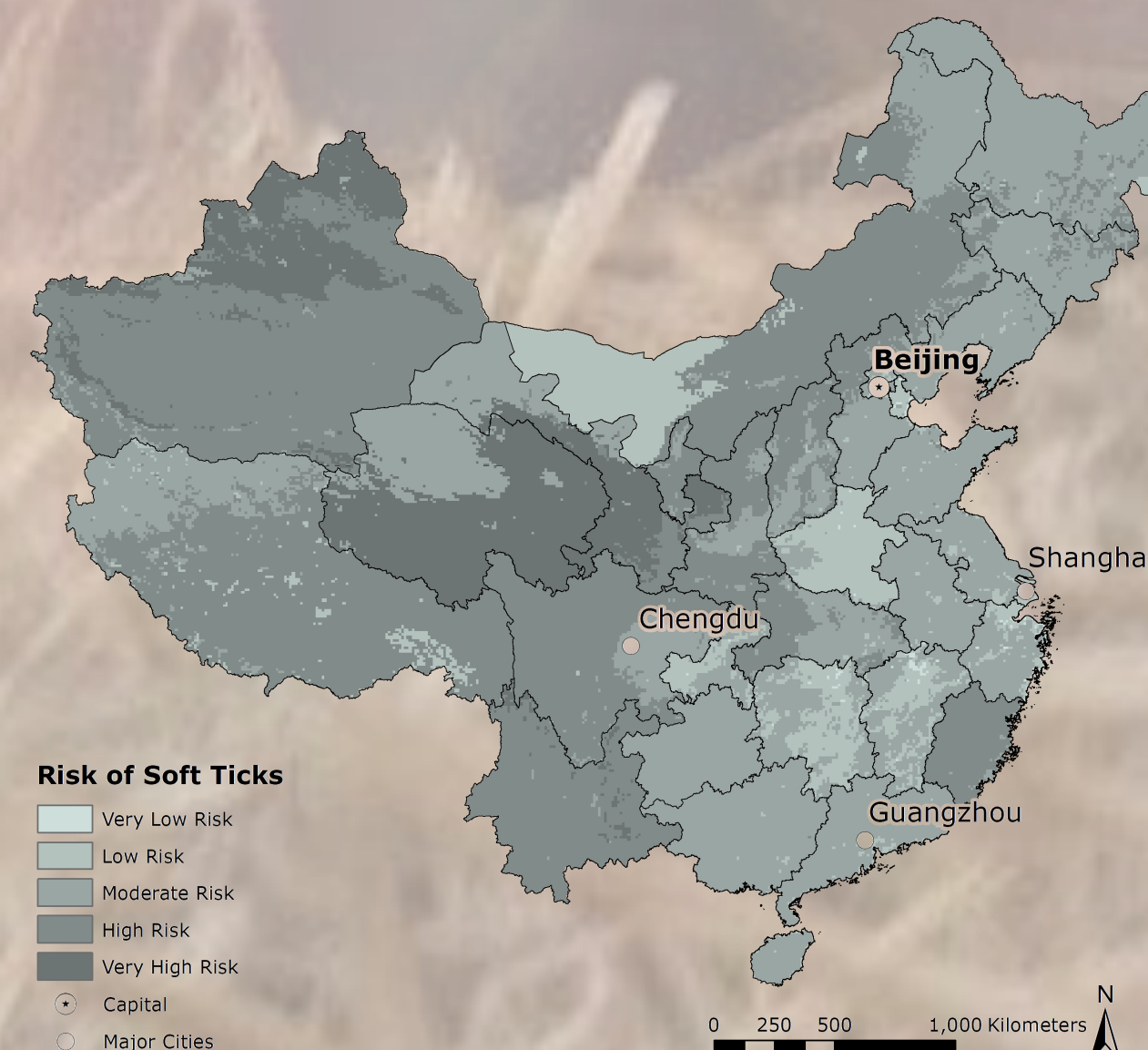
ASF Outbreaks:
An existing ASF outbreak puts its neighboring areas at high risk depending on the distance from the outbreak. As of Aug, 2019, there has been 137 ASF outbreaks reported in China alone, and the disease continues to spread within China. Currently, the government's response following an outbreak is to cull infected pigs as well as all pigs within 3 kilometers of the epidemic area, indicating the radius of high risk areas of an outbreak. Therefore, the distance from each outbreak was used to reclassify the risk score.



Wild Boar:
As a natural reservoir of ASF, wild boar plays an important role in maintaining this disease and spreading it to domestic pigs. An ASFV report has confirmed that the same strain that caused the first ASF outbreak in China was isolated from an infected wild boar. Since there is a lack of data on wild boar density in many parts of the world, distance from the range of the wild boar was used instead to reclassify the risk score based on the average daily traveling distance of wild boar from previous studies.

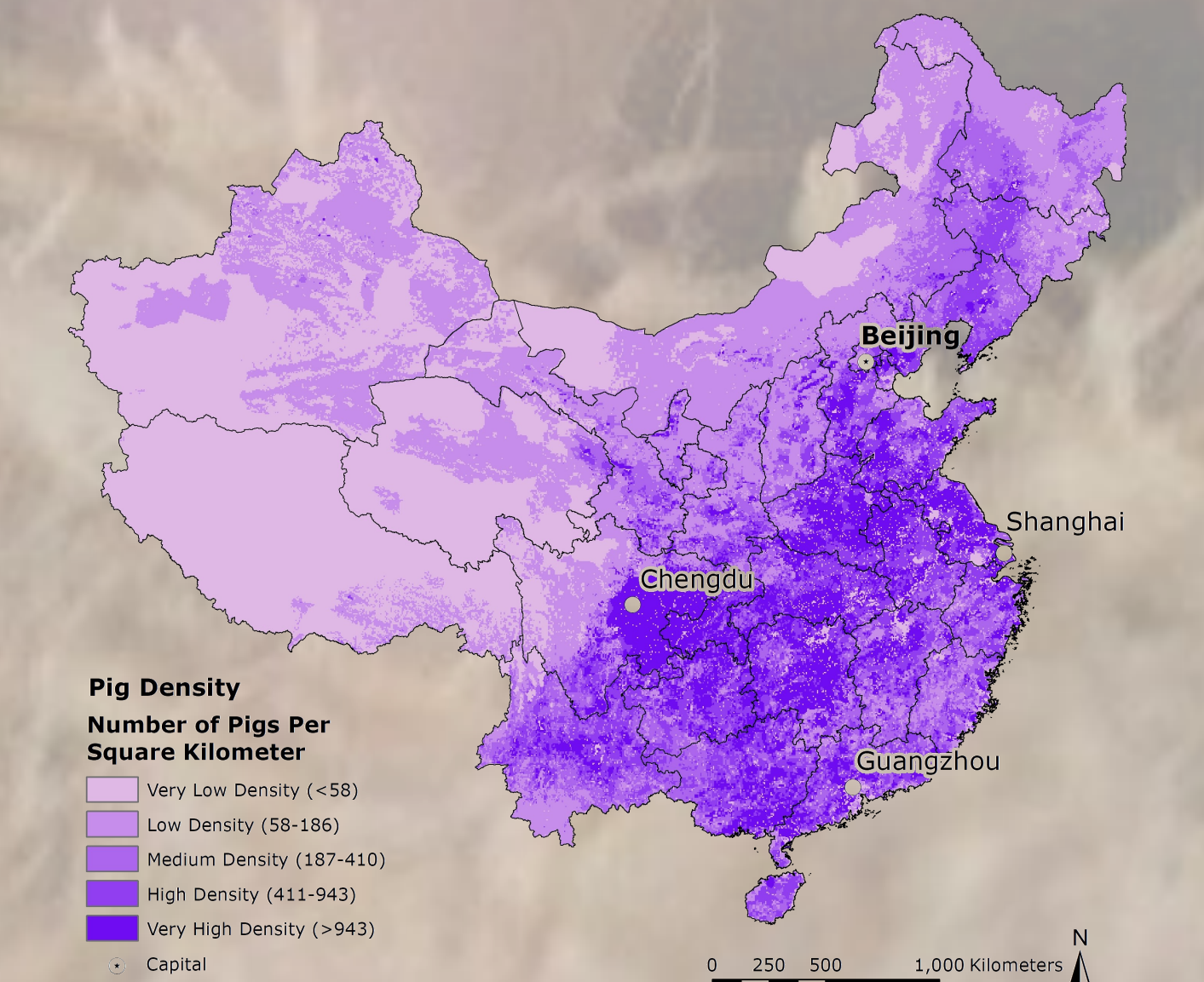


Soft Ticks:
Infected soft ticks are one of the important sources of ASF transmission. However, there is a lack of data on soft tick density as well as range. To predict the risky areas of soft ticks, the land cover data and species richness among different provinces in China according to a literature paper were utilized. Both data were reclassified and raster calculator tool was used in the end to analyze the risk of soft ticks in China with higher accuracy.

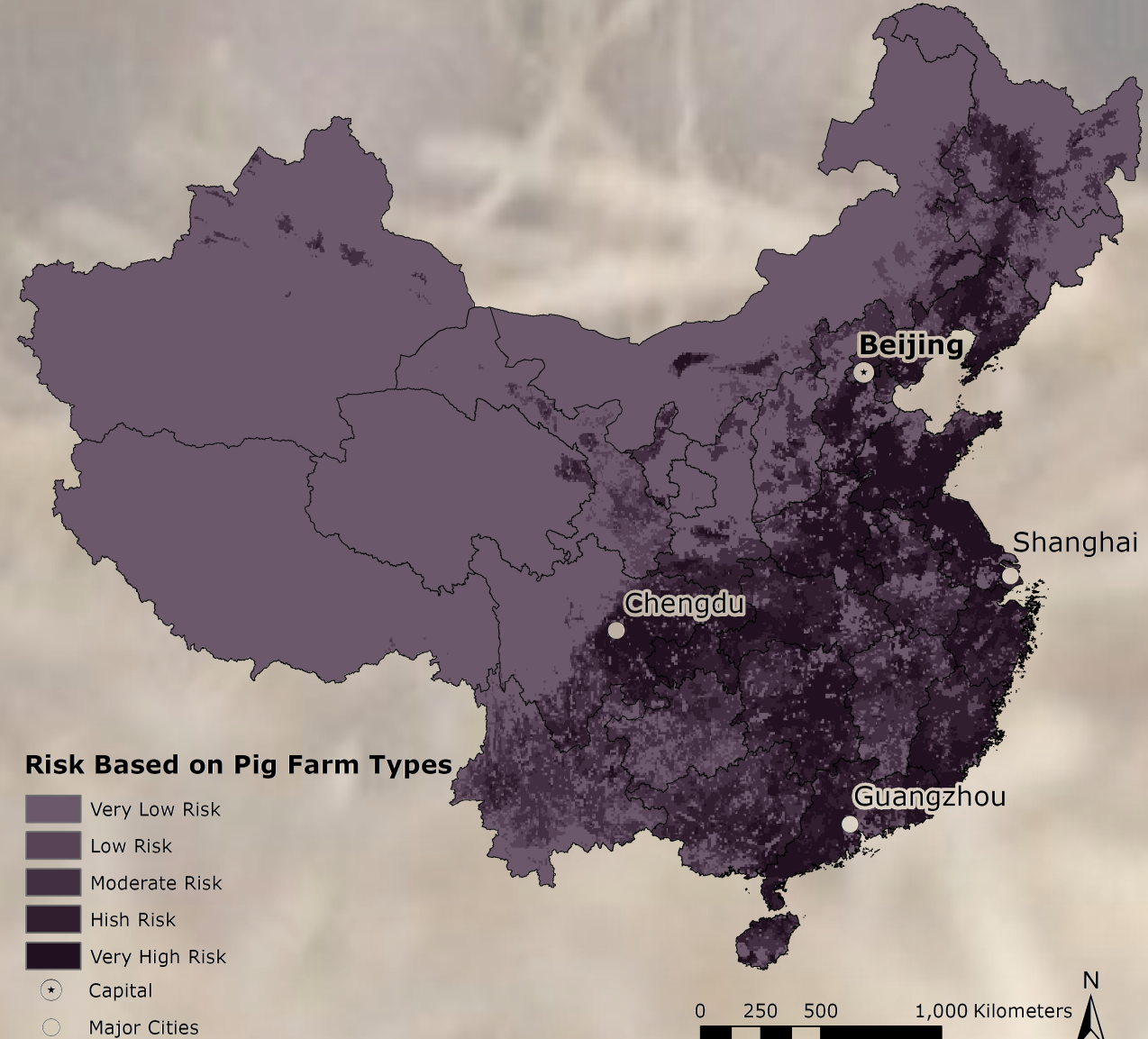


Agricultural Factors

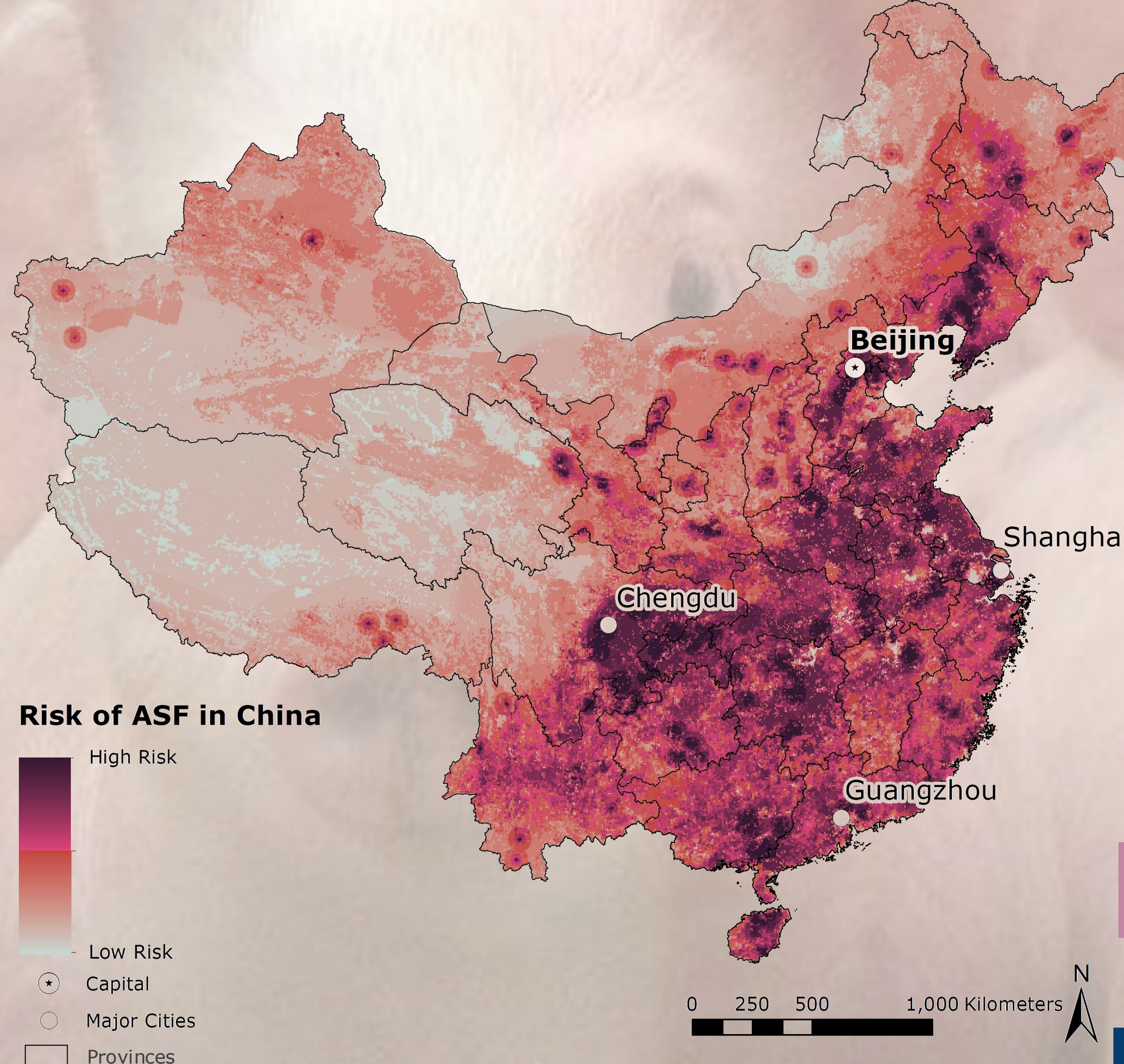
Pig Density:
China is the world's largest pig producer and pork market. More pigs are raised in eastern and southern regions of China. Since ASF is transmitted through direct or indirect contact with infected animal's body fluid, pig density is certainly an important factor when it comes to the spread of this disease. Before the final risk analysis, pig density was reclassified to five levels based on the quartiles of the statistics.



Pig Farm Types:
According to statistics of current ASF outbreaks, pig farm type also plays an important role in the spread of ASF in China. Commercial farms contribute to the majority of the outbreaks in China. Based on the chart above, pig density data from different types of farms were reclassified and then weighted by using raster calculator tool to analyze the risk of ASF based on pig farm types. The weights are shown as follows: Pig Farm Type Risk Analysis: 25.31% backyard farms + 54.32% commercial farms + 20.37% others.



Weighted Risk Analysis for ASF in China



Now What?

According to the final weighted risk analysis of ASF in China, middle eastern and south western China appear to be the most risky regions for contracting this devastating disease. Areas where multiple outbreaks have occurred in the past show particularly high risk potential compared with surrounding areas. The ranking of top five provinces with a high mean risk score was shown in the table below. As shown in the table, Chongqing, a megacity in southwest

Rank	Province	Mean Risk Score
1	Chongqing	3.14
2	Hunan	2.89
3	Jiangsu	2.87
4	Tianjin	2.87
5	Hubei	2.86

China, is shown to be at the highest risk of ASF outbreak with a mean risk score of 3.14, which is also the only province in China with a score above 3.

This spatial analysis can provide insights for government officials, public health officials, veterinarians, and farmers to be better aware of the potential high risk areas of ASF, to enhance disease preventative measures, and to improve disease surveillance accordingly.

It is also worth mentioning that limitations exist in this analysis. Factors that affect the spread of ASF are not limited to the factors that were used in this analysis. Some additional factor would be the underreported ASF cases from backyard farmers suggested in literature that might have a huge impact on the weights of the pig farm type analysis as the ratio could shift. More studies on wild boar as well as soft ticks should be conducted for a more accurate prediction of how these two factors play in ASF transmission.

Acknowledgements

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Projection: Asia Lambert Conformal Conic
Data Sources: Global Administrative Area (GADM), Tufts M Drive, International Union for Conservation of Nature (IUCN), Food and Agriculture Organization of the United Nations (FAO), <https://www.pigprogress.net/health/articles/2019/8/ASF-China-An-Underestimated-crisis-457673E/>.

ASF Outbreaks in China in Relation to Farm Types

Farm Type	ASF Outbreak	% Percentage (%)
Backyard Farms	41	25.31
Commercial Farms	88	54.32
Others	13	20.37