



Jockey Club College of Veterinary
Medicine and Life Sciences

香港城市大學
City University of Hong Kong
in collaboration with Cornell University

Use of spatial information and Geographic Information Systems in Risk Assessment

Webinar #2

African Swine Fever (ASF) Cross Border Risk Assessment - South East Asia

World Organisation for Animal Health (OIE)/City University of Hong Kong (CityU)

Lisa Kohnle - 9 October 2020



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What is spatial information?

- Any data with reference to a specific location or geographical area
- Composed of **spatial data** (e.g. latitude and longitude) and **attribute data**

	__OBJECTID *	Lat	Long	Site	Geologic Age	Number of rock samples collected	Number of students and fieldworkers	Total cost for fieldwork (RM)	Shape *
▶	1	4.690239	102.020673	Merapoh	Late Permian	120	10	1000	Point
	2	4.194655	101.965741	Gua Bama	Middle Permian	110	10	800	Point
	3	4.274089	102.070111	Kechau	Middle Permian	150	14	800	Point
	4	3.898764	102.369489	Jerantut	Late Triassic	150	12	500	Point
	5	3.834367	102.339276	Kuala Krau	Late Triassic	85	7	500	Point
	6	3.709668	102.64552	Jengka	Late Triassic	75	7	400	Point

<https://support.esri.com/en/technical-article/000022371>

- Can be displayed on a map

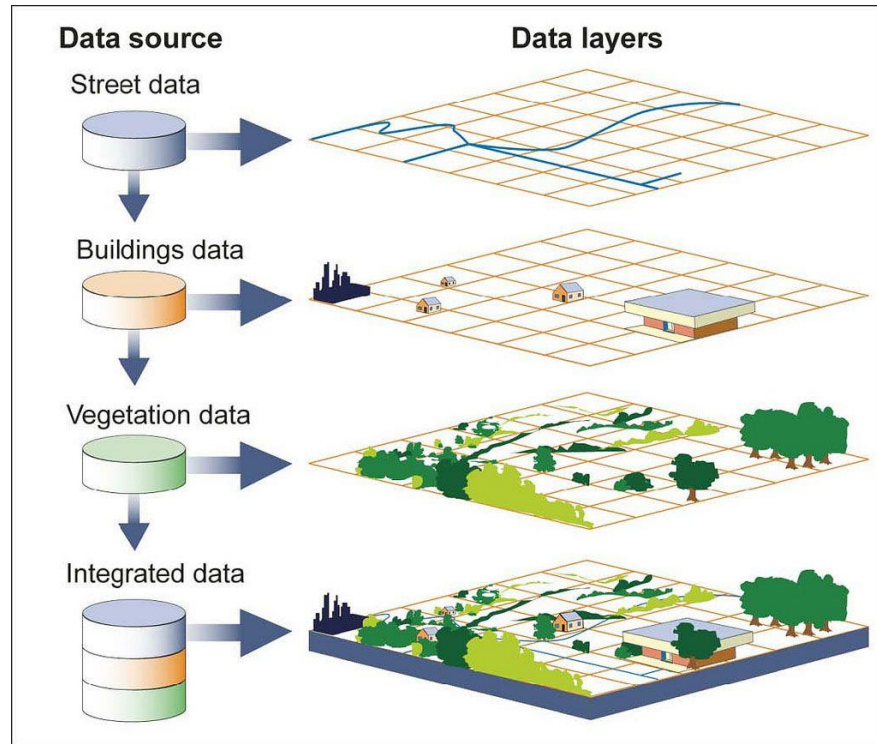


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Geographic Information System (GIS)



Source: GAO.

<https://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/>

- Computer system
- Capture, store, query, manipulate, analyse and display information related to a specific location or geographical area
- Layer-based approach
 - Collection of **thematic layers that are linked by their spatial location**
 - Spatial location is the key index variable to compare different data sets



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Geographic Information System (GIS)



ArcGIS

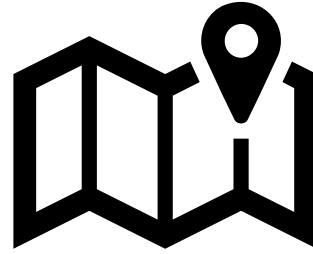


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Mapping



- Easy way of storing and displaying **large amounts of information**
- Can be used to identify and examine **spatial patterns**
 - **Distribution of disease and other features (e.g. risk factors)** over space, time and in relation to each other
 - **Relationships** between spatial location, environment and disease
- Effective **presentation** and **communication**
 - Extent
 - Intensity
 - Development and change



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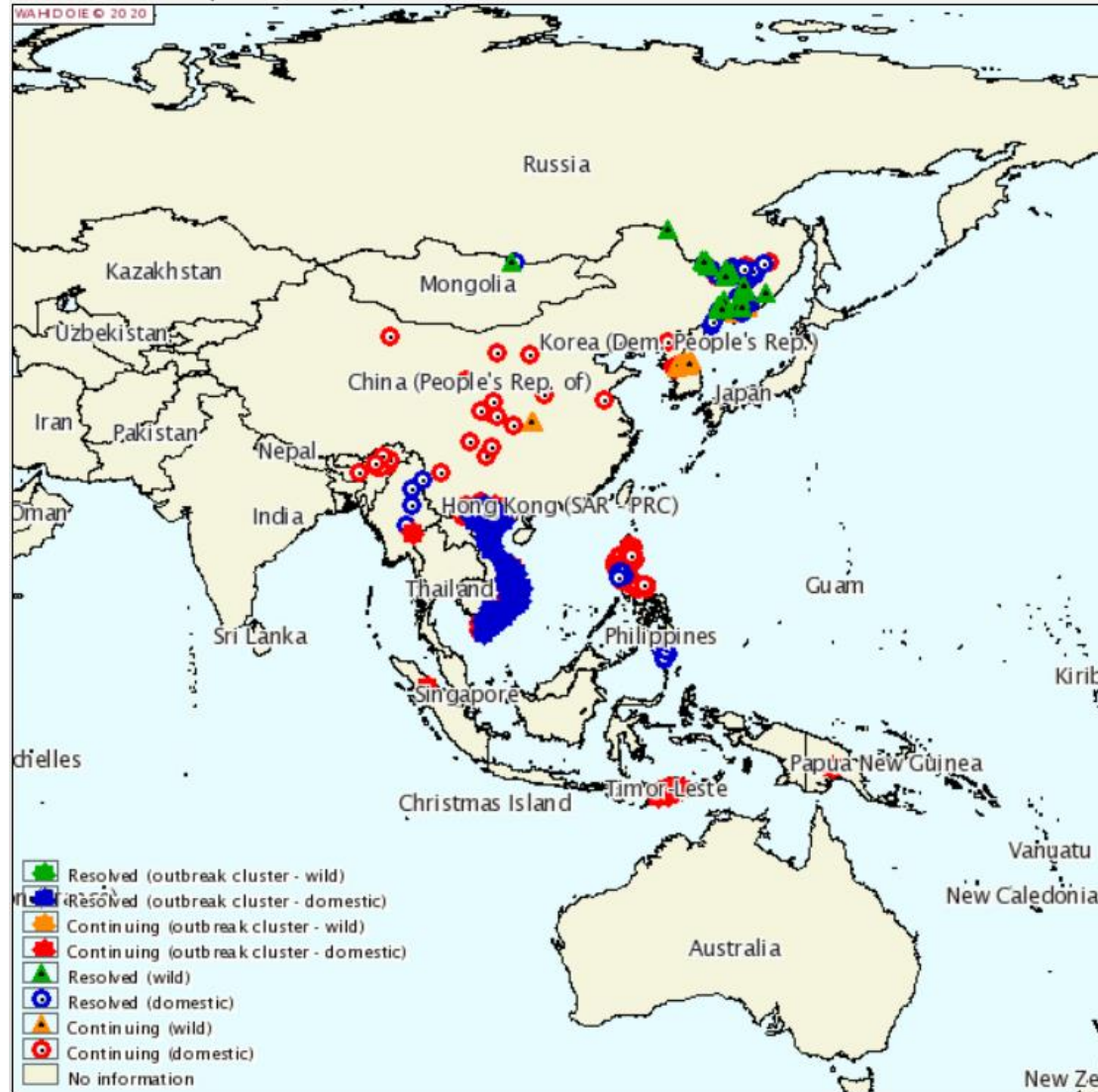
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Mapping: disease outbreaks

World Animal Health Information System (WAHIS)
of the OIE

https://www.oie.int/wahis_2/public/wahid.php/Diseaseinformation/Diseaseoutbreakmaps
https://www.oie.int/wahis_2/public/wahid.php/countrymapinteractive



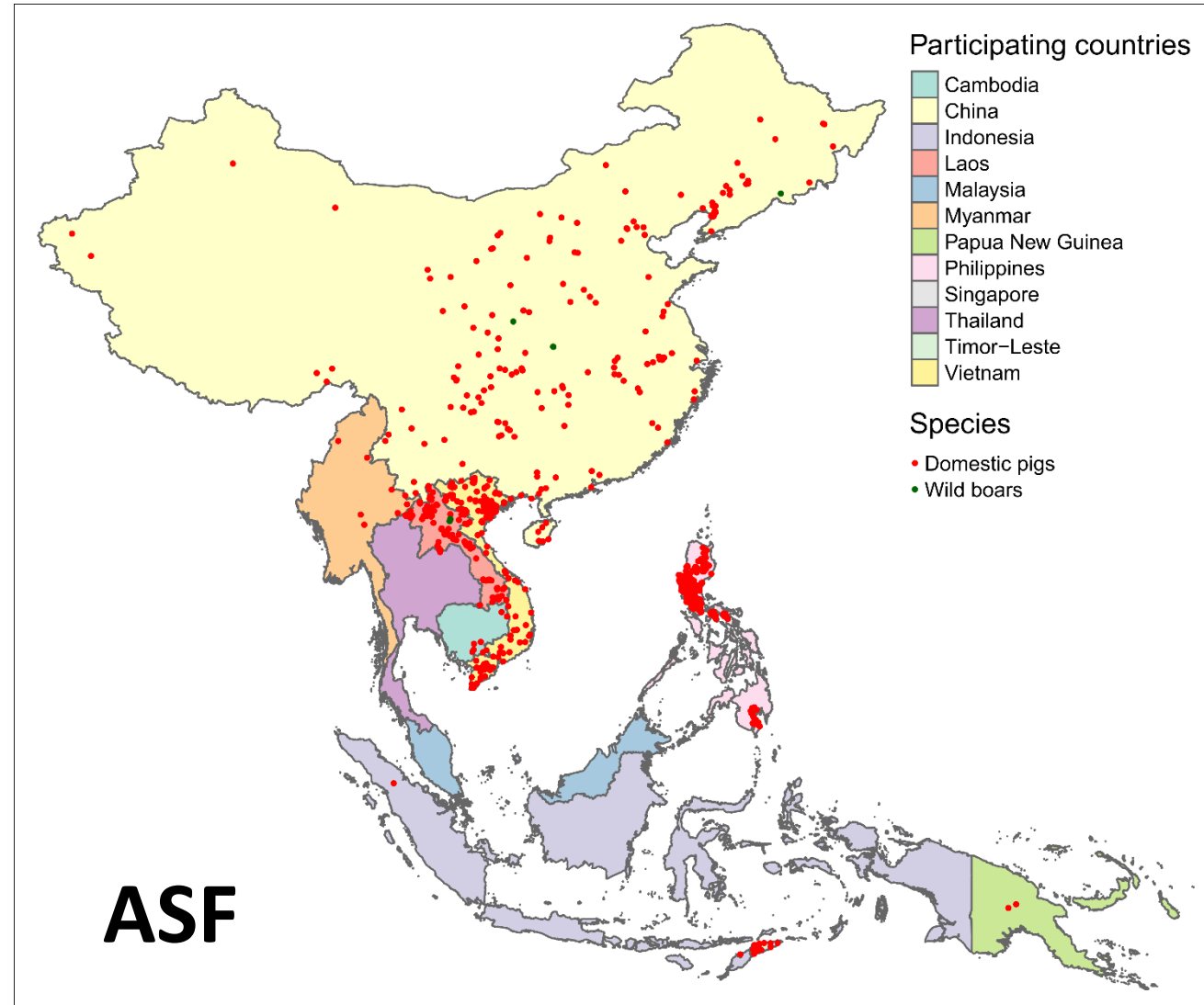
ASF

1 January - 7 October 2020



1 January - 30 June 2020

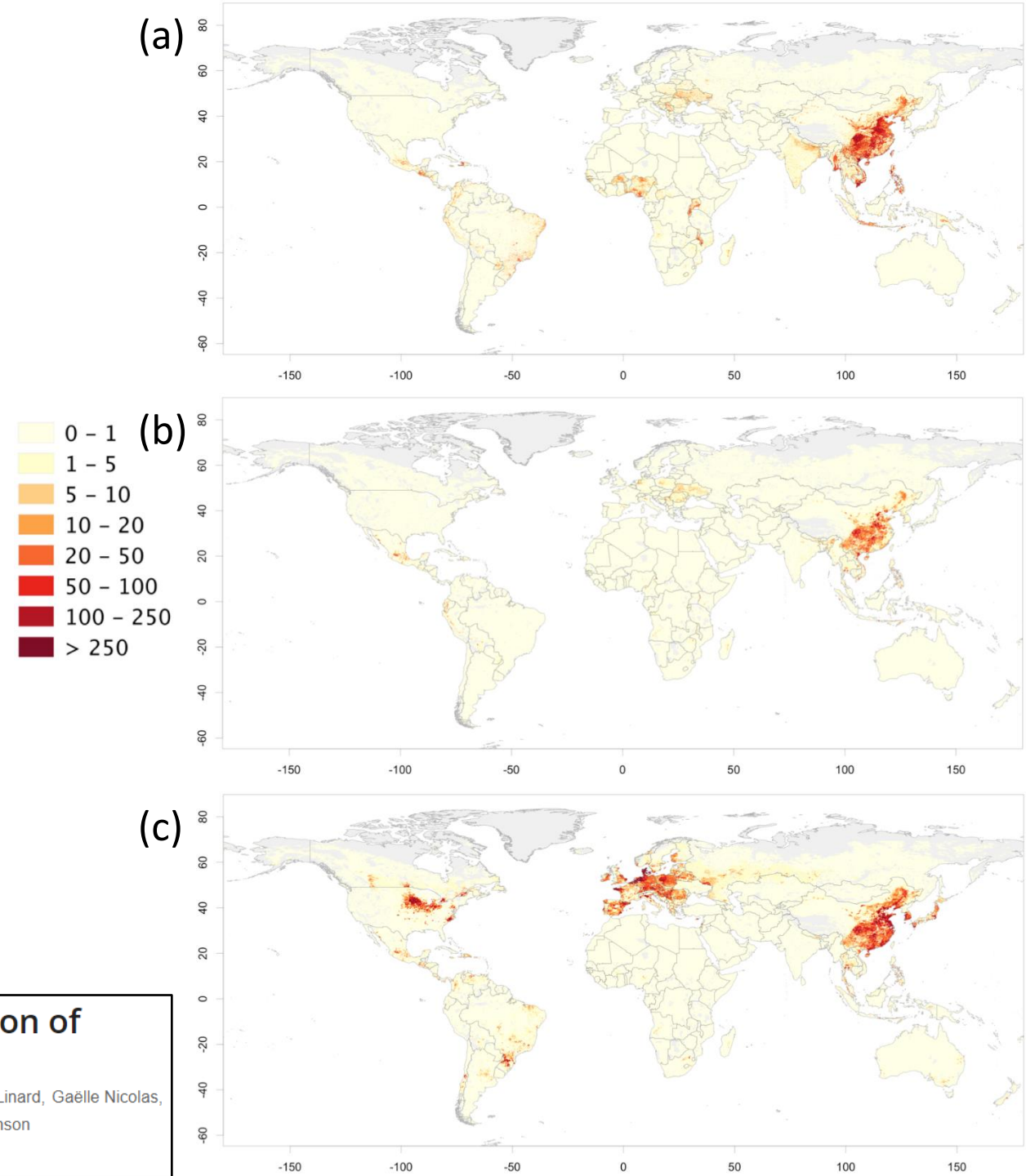
Mapping: disease outbreaks




1 August 2018 – 30 September 2020

Mapping: population densities

- Distribution of **pigs** (head per square kilometre) raised under **extensive** (a), **semi-intensive** (b) and **intensive** (c) production systems

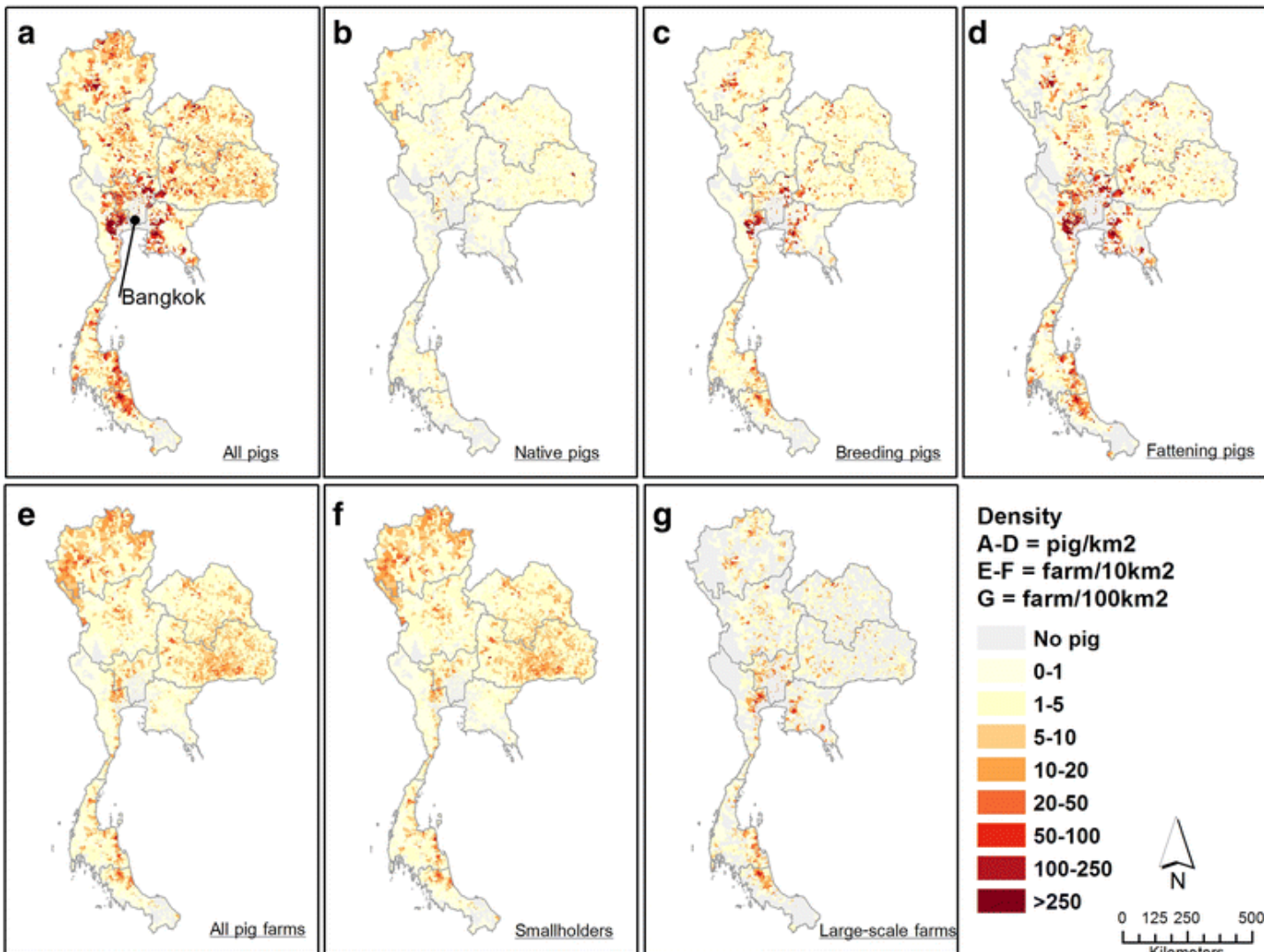


Income Disparities and the Global Distribution of Intensively Farmed Chicken and Pigs

Marius Gilbert , Giulia Conchedda, Thomas P. Van Boeckel, Giuseppina Cinardi, Catherine Linard, Gaëlle Nicolas, Weerapong Thanapongtharm, Laura D'Aiotti, William Wint, Scott H. Newman, Timothy P. Robinson

Published: July 31, 2015 • <https://doi.org/10.1371/journal.pone.0133381>


Mapping: population densities



- Distribution of **pigs** (a-d) and **pig farms** (e-g) in Thailand in 2010

Research article | [Open Access](#) | Published: 06 October 2016

Spatial analysis and characteristics of pig farming in Thailand

[Weerapong Thanapongtharm](#) , [Catherine Linard](#), [Pornpiroon Chinson](#), [Suwicha Kasemsuwan](#), [Marjolein Visser](#), [Andrea E. Gaughan](#), [Michael Epprecht](#), [Timothy P. Robinson](#) & [Marius Gilbert](#)

[BMC Veterinary Research](#) 12, Article number: 218 (2016) | [Cite this article](#)

Mapping: land cover and use

- Vegetation
- Forestry
- Soil
- Water
- Elevation
- Agriculture



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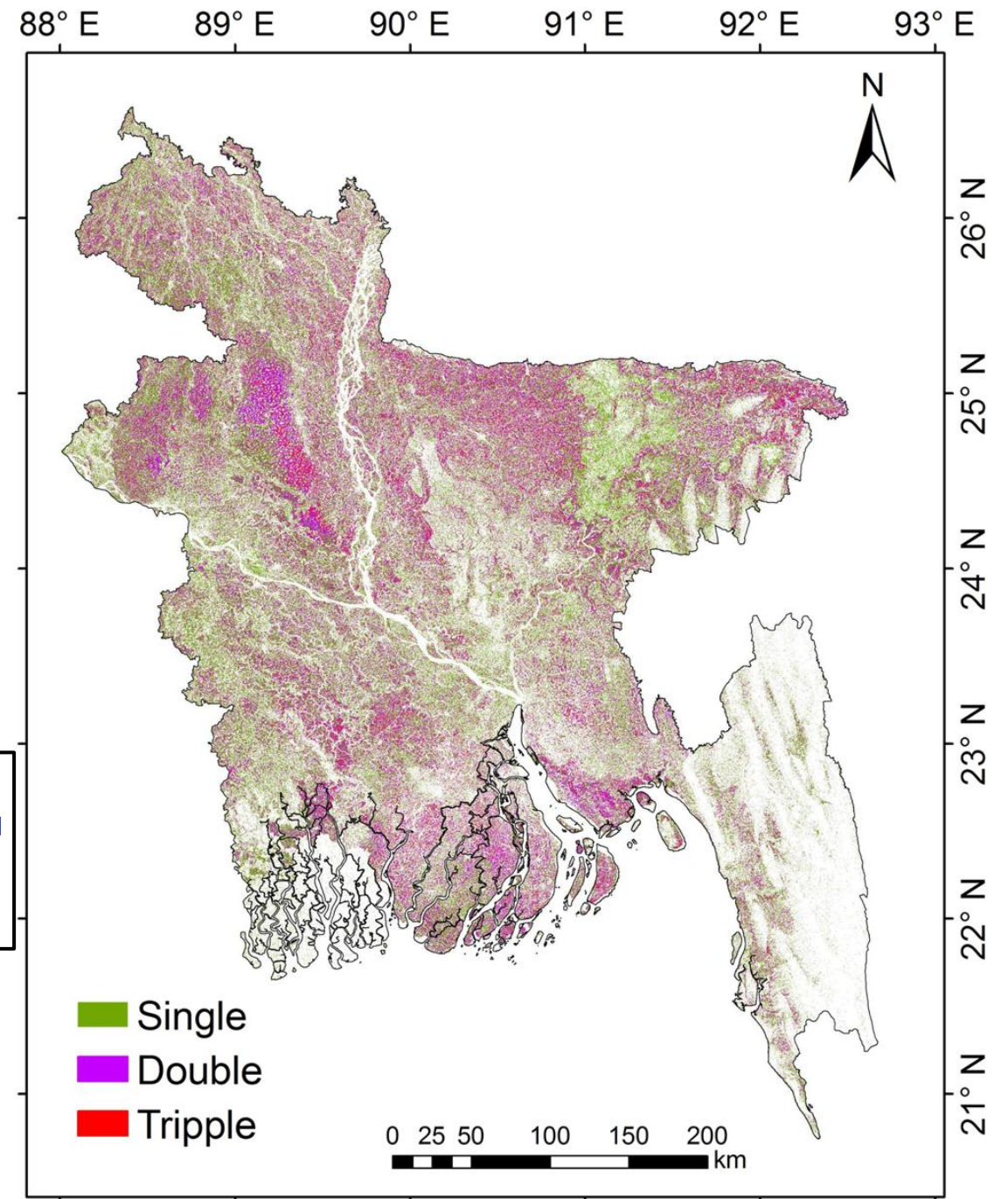


Mapping

- Vegetation
- Forestry
- Soil
- Water
- Elevation
- Agriculture

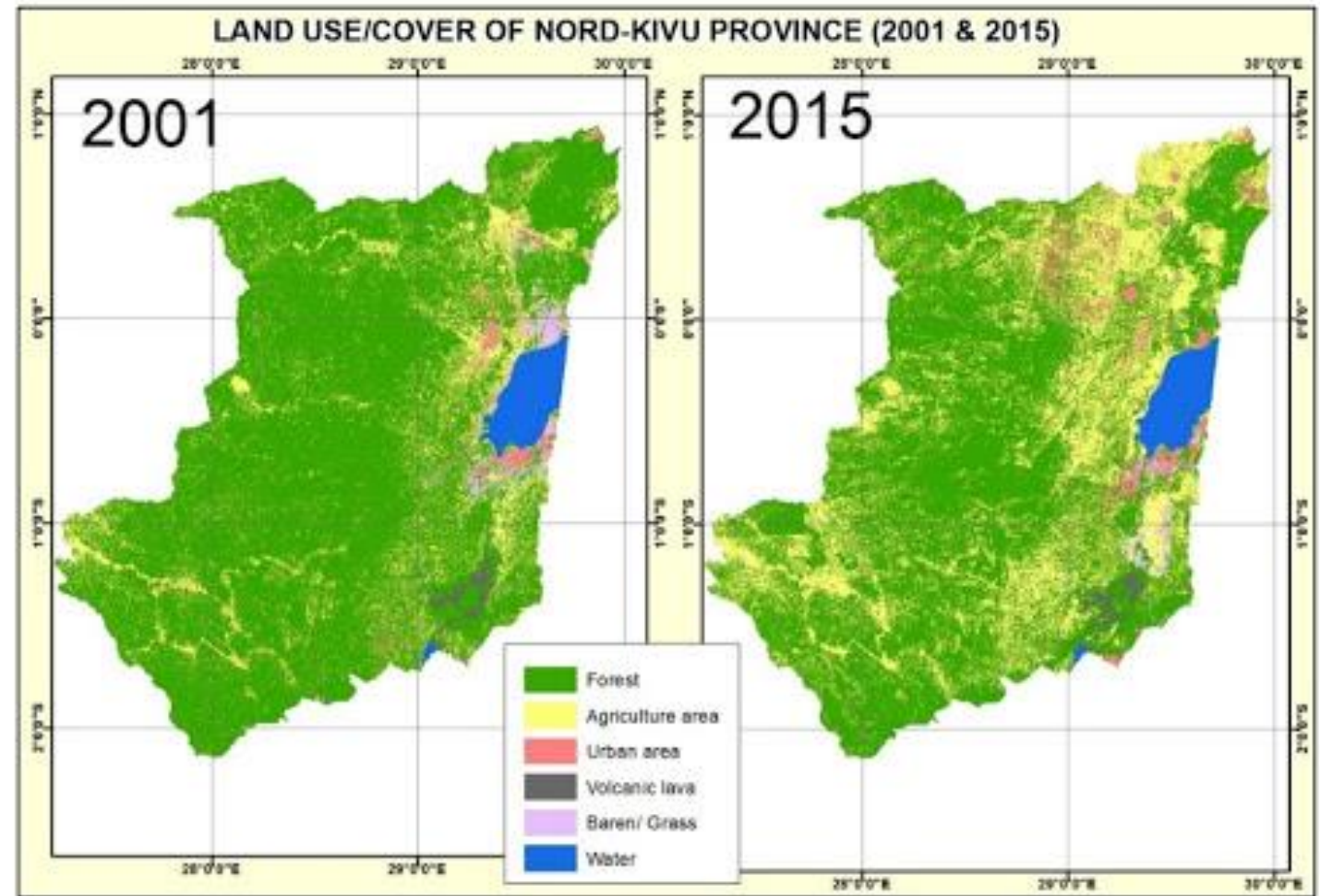
[Data Descriptor](#) | [Open Access](#) | [Published: 11 April 2019](#)
High resolution paddy rice maps in cloud-prone Bangladesh and Northeast India using Sentinel-1 data
[Mrinal Singha](#), [Jinwei Dong](#) , [Geli Zhang](#) & [Xiangming Xiao](#)
Scientific Data **6**, Article number: 26 (2019) | [Cite this article](#)

Paddy rice cropping intensity in Bangladesh in 2017



Mapping

- Vegetation
- Forestry
- Soil
- Water
- Elevation
- Agriculture



Deforestation and agricultural expansion

American Journal of Geographic Information System

p-ISSN: 2163-1131 e-ISSN: 2163-114X

2019; 8(1): 11-25

doi:10.5923/j.ajgis.20190801.02

[Open Access](#)

Key Factors Driving Deforestation in North-Kivu Province, Eastern DR-Congo Using GIS and Remote Sensing

Musumba Teso Philippe¹, Kavira Malengera², Katcho Karume³

Mapping

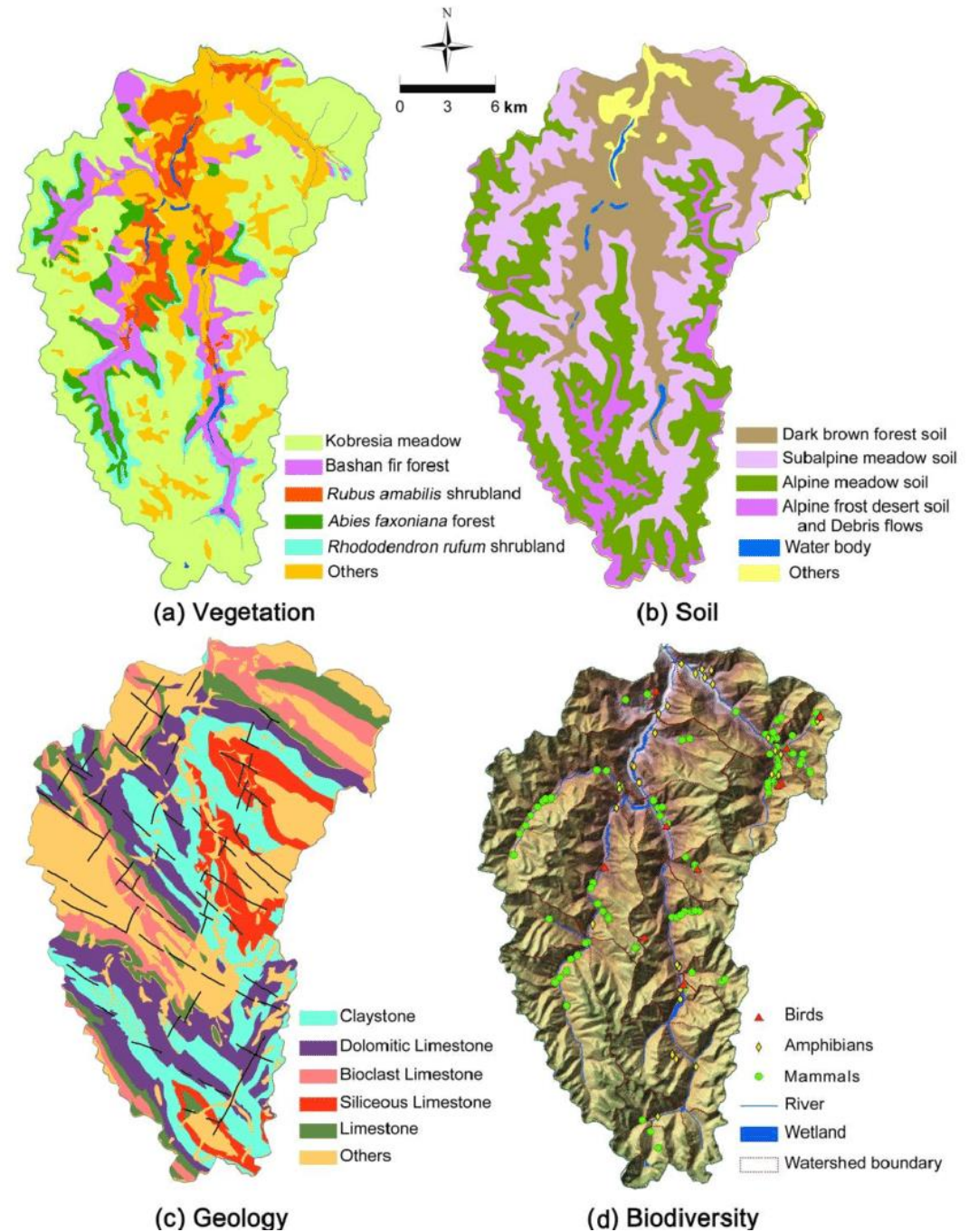
- Vegetation
- Forestry
- Soil
- Water
- Elevation
- Agriculture

Published: 25 May 2013

The development of a geographic information system (GIS) database for Jiuzhaigou national nature reserve and its application

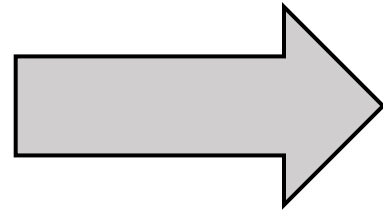
Bao-feng Di, Kai-shan Zhang , Ya Tang, Ming-hua Zhang & Susan L. Ustin

Journal of Mountain Science 10, 398–409(2013) | [Cite this article](#)



Mapping: land cover and use

- Vegetation
- Forestry
- Soil
- Water
- Elevation
- Agriculture



Habitat suitability
(e.g. wildlife, insects)

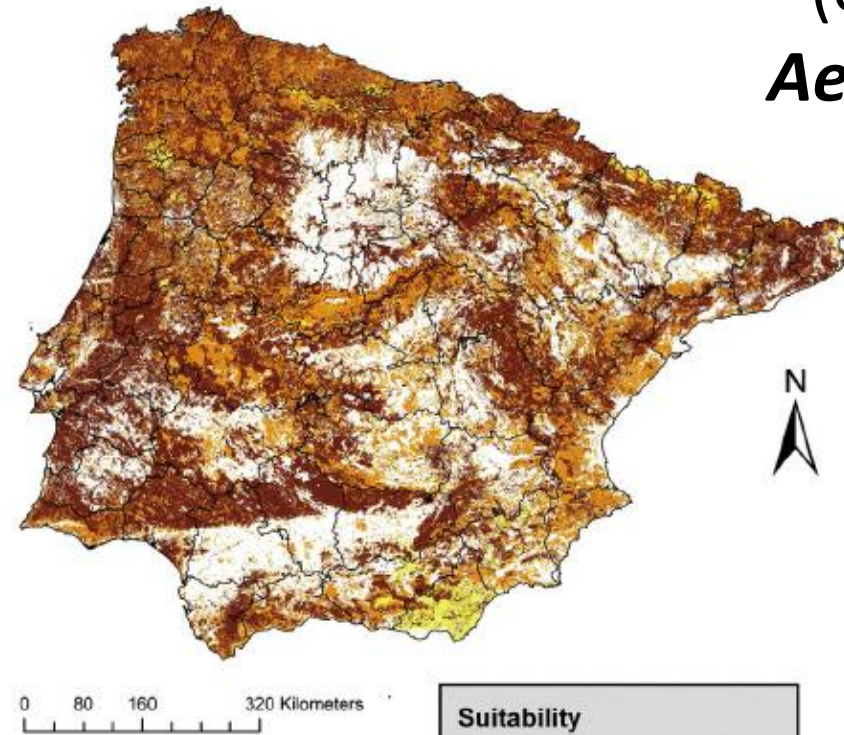


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Mapping



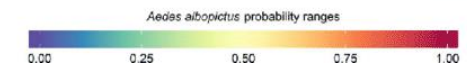
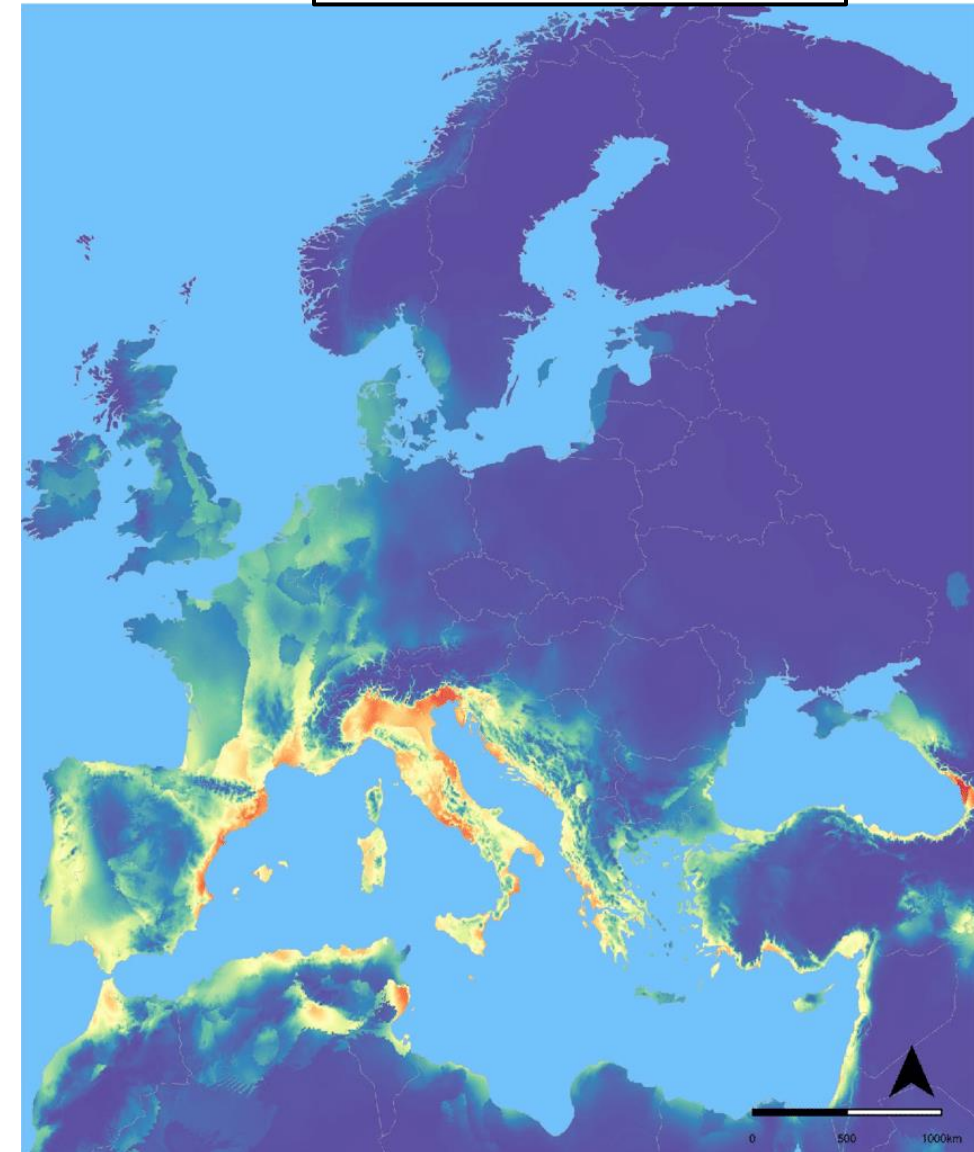
Habitat suitability
(e.g. wild boar,
Aedes albopictus)

Research | Open Access | Published: 26 April 2020

Habitat suitability modelling to assess the introductions of *Aedes albopictus* (Diptera: Culicidae) in the Netherlands

Adolfo Ibáñez-Justicia  Juan Diego Alcaraz-Hernández Ron van Lammeren Constantianus J. M. Koenraadt Aldo Bergsma Luca Delucchi Annapaola Rizzoli & Willem Takken

Parasites & Vectors 13, Article number: 217 (2020) | [Cite this article](#)



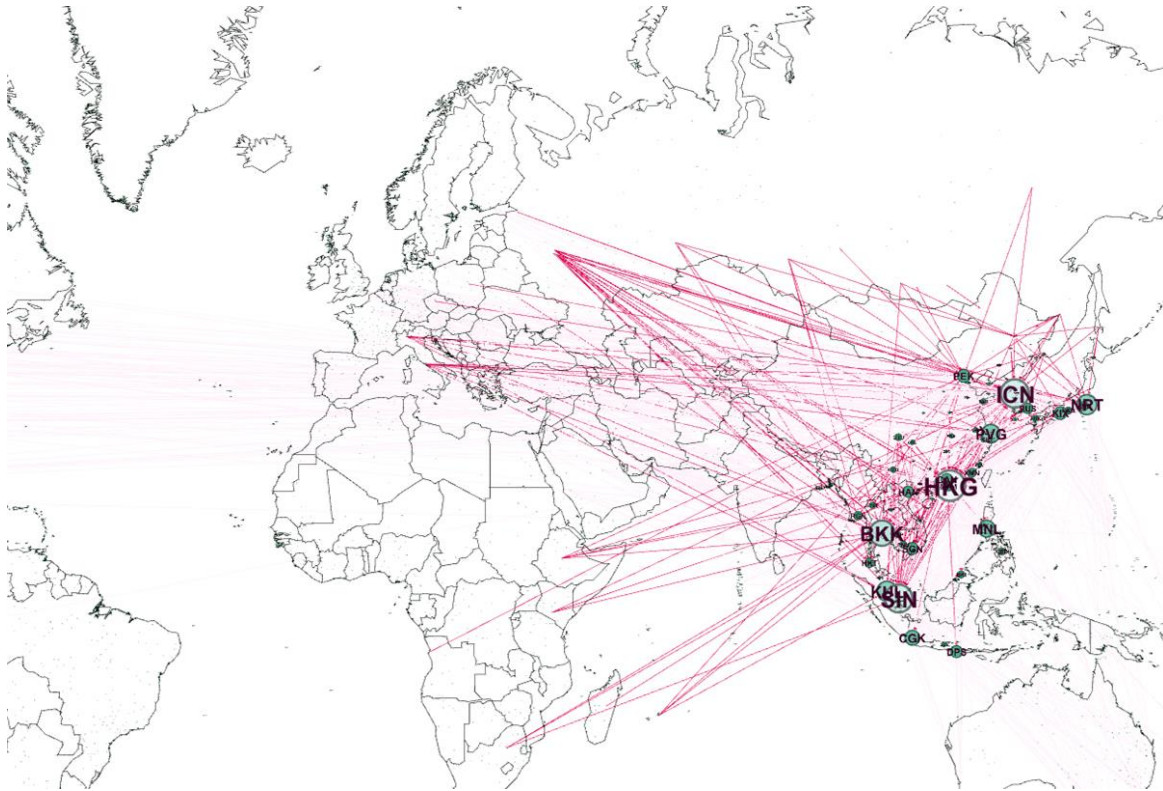
Open Access
1 June 2012

Distribution, abundance and density of the wild boar on the Iberian Peninsula, based on the CORINE program and hunting statistics

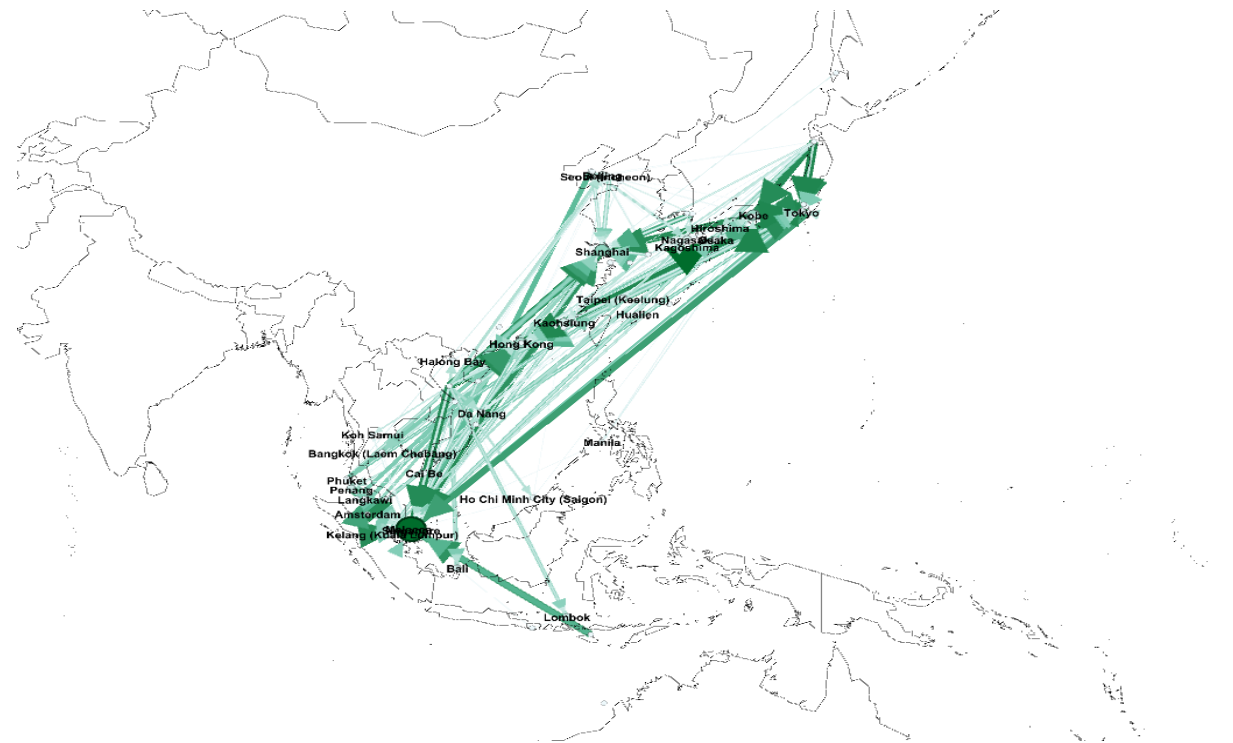
Josune Bosch, Salvador Ferris, Carlos Fonseca, María Martínez, Ana De la Torre, Irene Iglesias, María J. Muñoz
Author Affiliations

J. of Vertebrate Biology 83(2):109–151 (2012) | <https://doi.org/10.25255/jovb.0112.a72012>

Mapping: networks



International **flights** arriving daily from ASF-affected countries



Cruise ship paths within the region

Free GIS data sources



- FAOSTAT (<http://www.fao.org/faostat/en/#home>)
- World Bank Open Data (<https://data.worldbank.org/>)
- WAHIS (<https://www.oie.int/animal-health-in-the-world/the-world-animal-health-information-system/data-after-2004-wahis-interface/>) and EMPRES-i (<http://empres-i.fao.org/eipws3g/>)
- DIVA-GIS (<https://www.diva-gis.org/gdata>)
- WorldPop (<https://www.worldpop.org/>)
- GADM (<https://gadm.org/>)
- <https://freegisdata.rtwilson.com/>



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Use in risk assessment

- Mapping hazards
- Mapping risk factors
- Mapping sources and routes of exposure
- Making decisions
- Displaying results



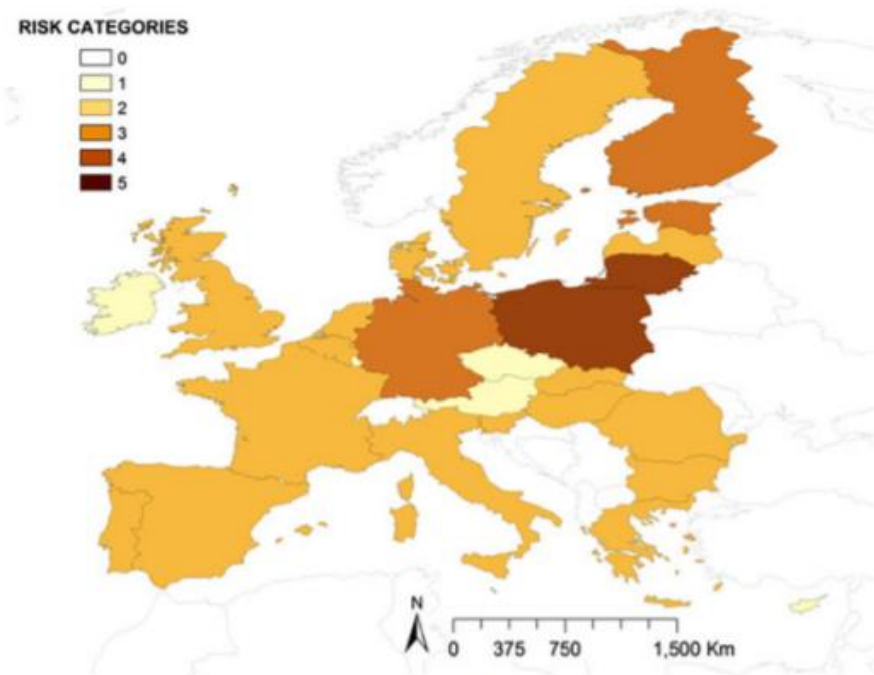
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Use in risk assessment: displaying results

- **Distribution of the risk of an event**
 - Targeted disease surveillance and control
- Colour-shaded maps to identify geographical areas at risk



> BMC Vet Res. 2012 Aug 30;8:149. doi: 10.1186/1746-6148-8-149.

Risk of African swine fever introduction into the European Union through transport-associated routes: returning trucks and waste from international ships and planes

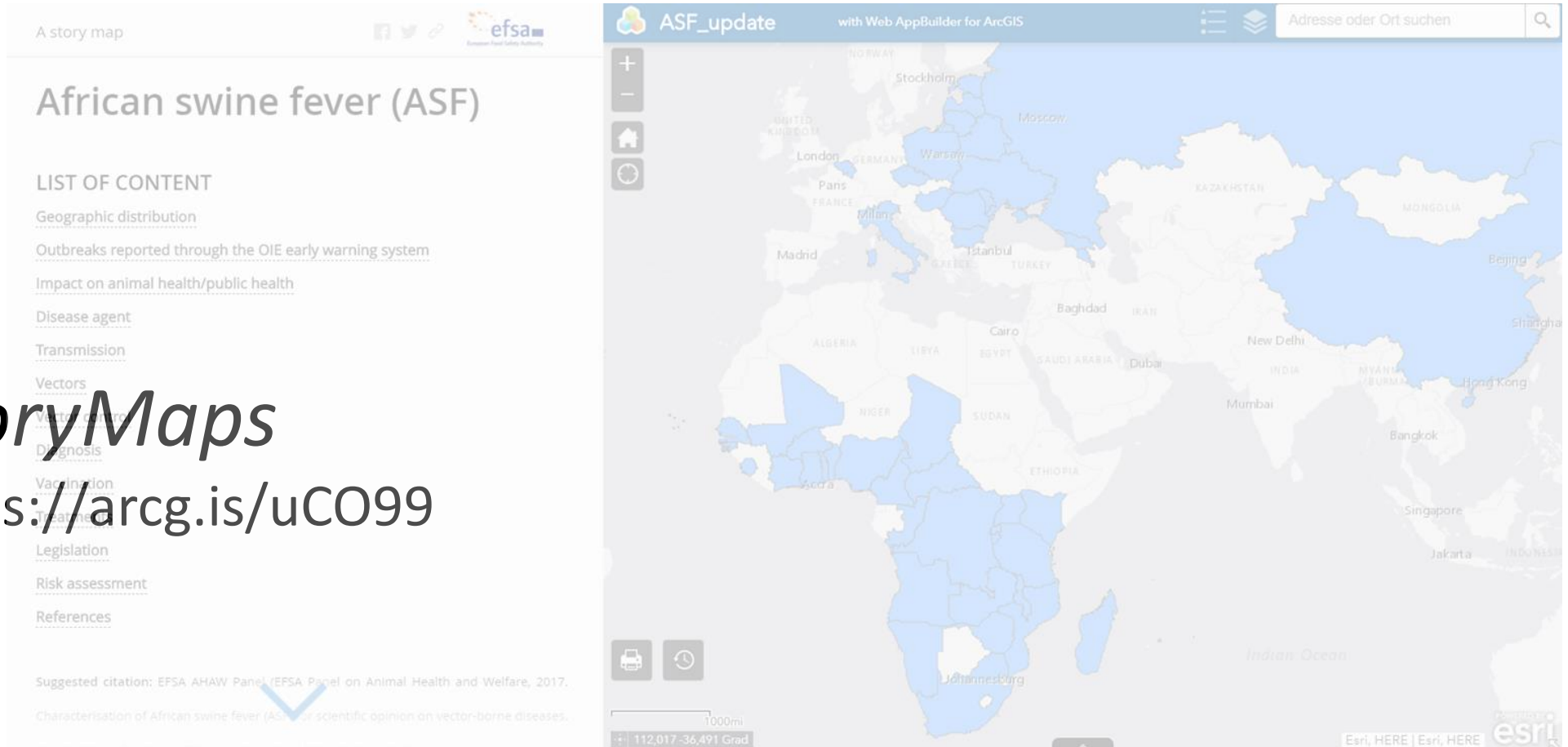
Lina Mur¹, Beatriz Martínez-López, José Manuel Sánchez-Vizcaíno

Figure 1 Distribution of the relative risk for ASFV introduction into the EU by transport-associated routes.

Use in risk assessment: displaying results

StoryMaps

<https://arcg.is/uCO99>



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Use in risk assessment: making decisions

- Spatial multi-criteria decision analysis (**MCDA**)
 - Spatial information on risk factors are used as predictor variables to estimate the probability of disease occurrence
 - (1) Identification of risk factors, (2) creation of spatial layers, (3) cartographic modelling, (4) model validation
 - Beneficial in data-sparse environments!



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MCDA

Research article | [Open Access](#) | Published: 09 January 2014

Spatial multi-criteria decision analysis to predict suitability for African swine fever endemicity in Africa

[William A de Glanville](#) , [Laurence Vial](#), [Solenne Costard](#), [Barbara Wieland](#) & [Dirk U Pfeiffer](#)

[BMC Veterinary Research](#) **10**, Article number: 9 (2014) | [Cite this article](#)

(1) Identification of risk factors

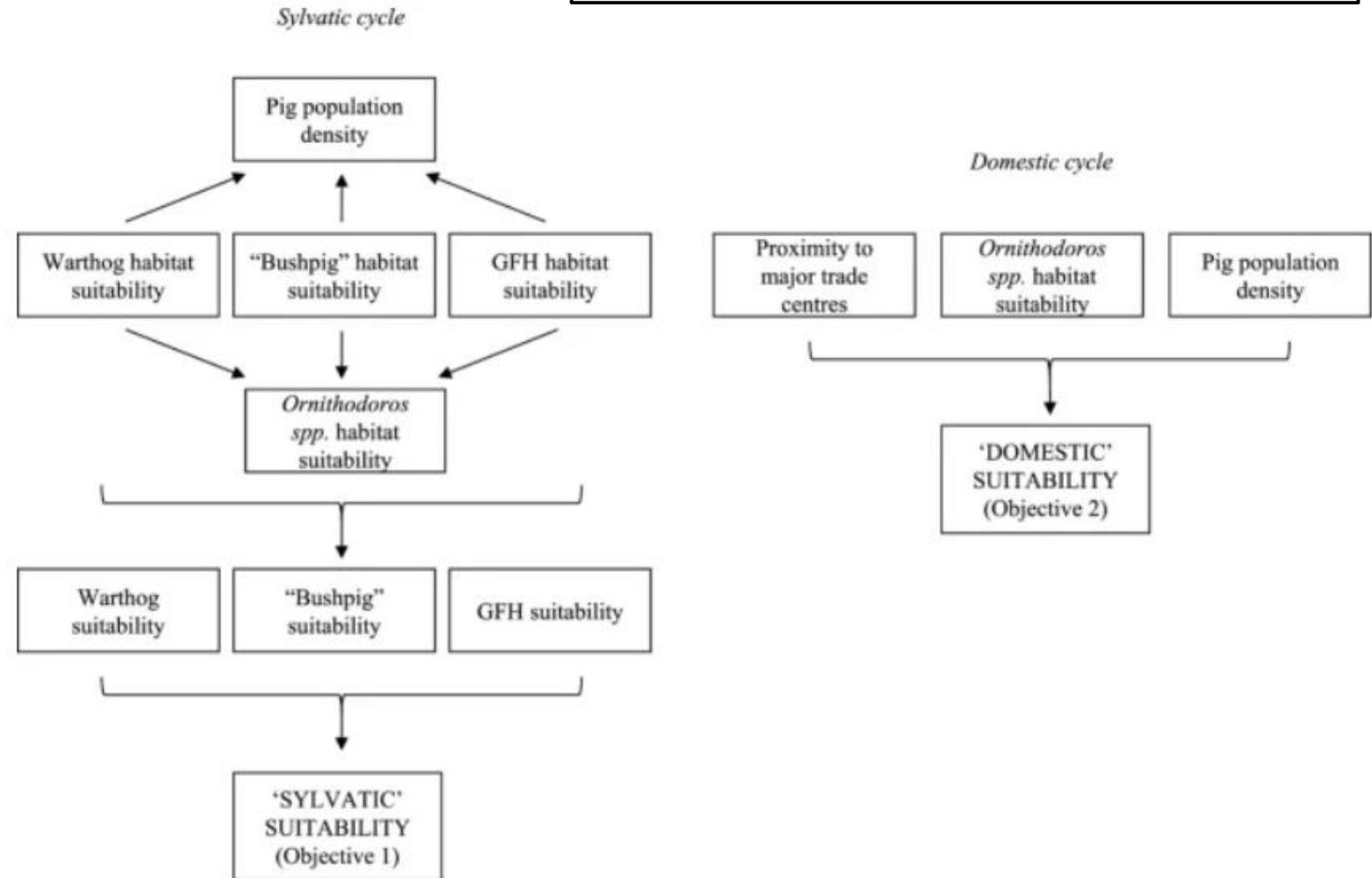
- **Sylvatic cycle**: occurrence of wildlife reservoirs, occurrence of *Ornithodoros* tick spp., pig population density



- **Domestic cycle**: proximity to major market centres, trade in pigs and their products, pig population density, occurrence of *Ornithodoros* tick spp.

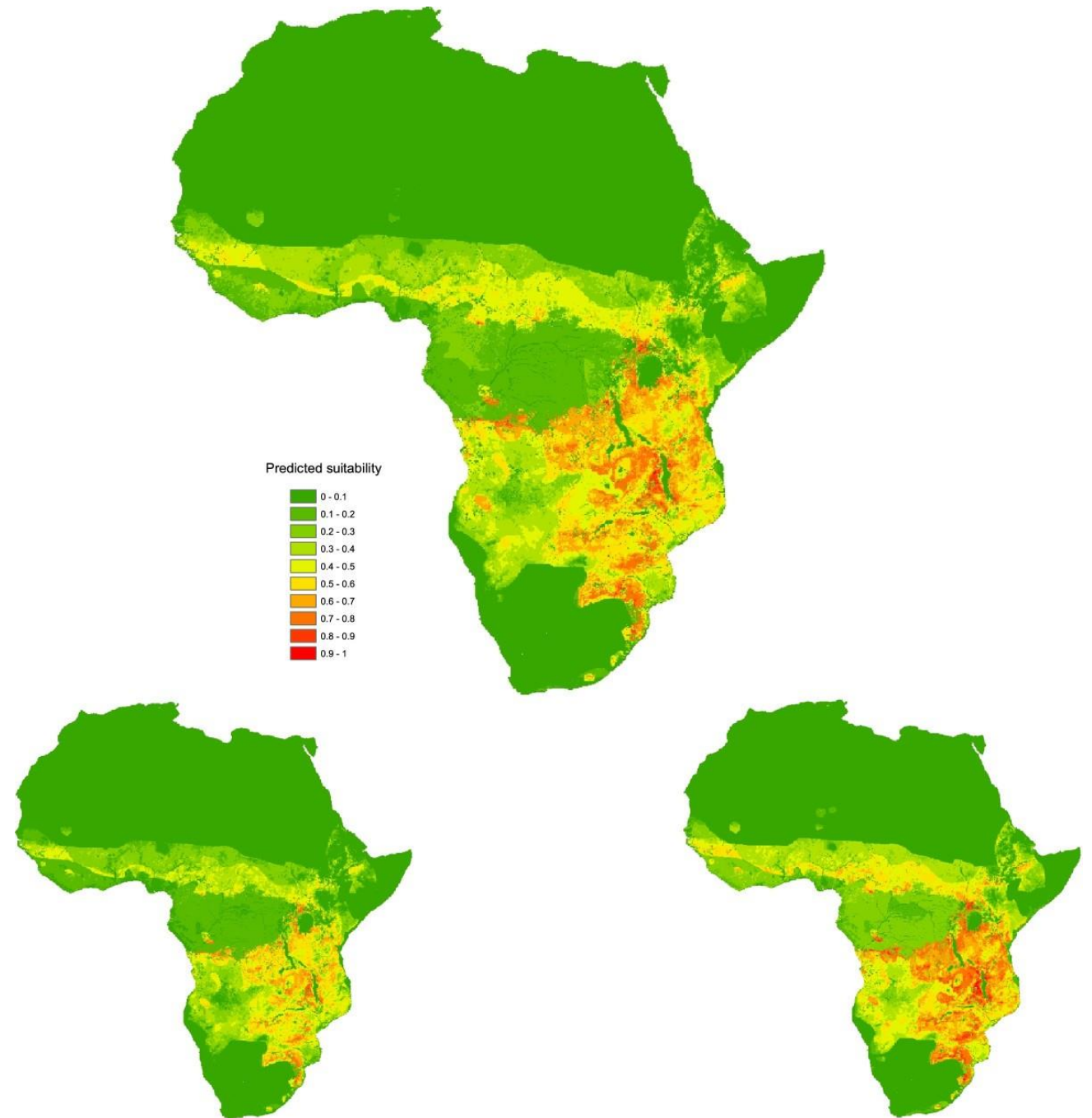
MCDA

(3) Cartographic modelling




MCDA: results

- Suitability for African Swine Fever **persistence** in domestic pig populations as part of **sylvatic cycles**



Research article | [Open Access](#) | Published: 09 January 2014

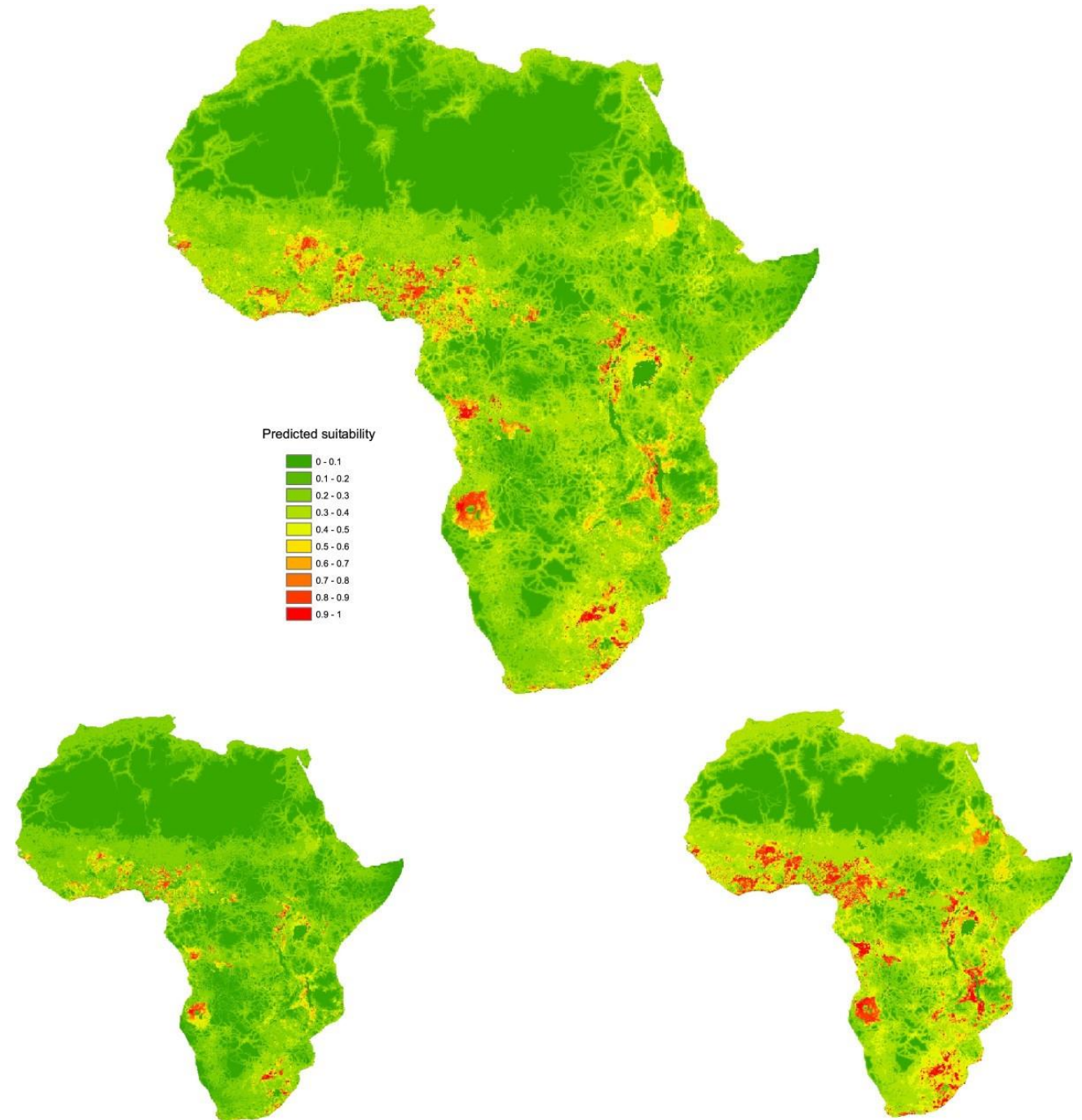
Spatial multi-criteria decision analysis to predict suitability for African swine fever endemicity in Africa

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[BMC Veterinary Research](#) **10**, Article number: 9 (2014) | [Cite this article](#)


MCDA: results

- Suitability for African Swine Fever **persistence** in domestic pig populations as part of **domestic cycles**



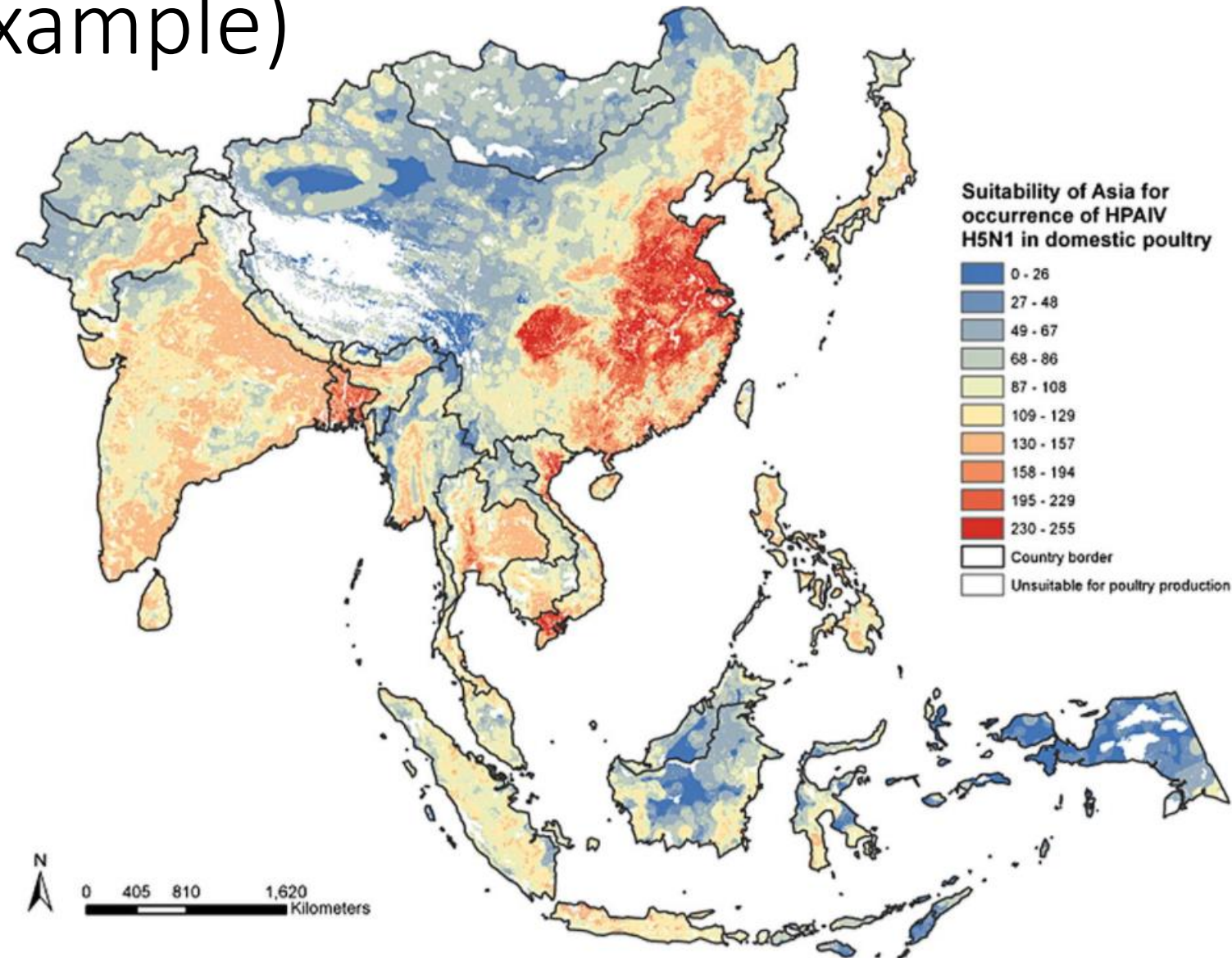
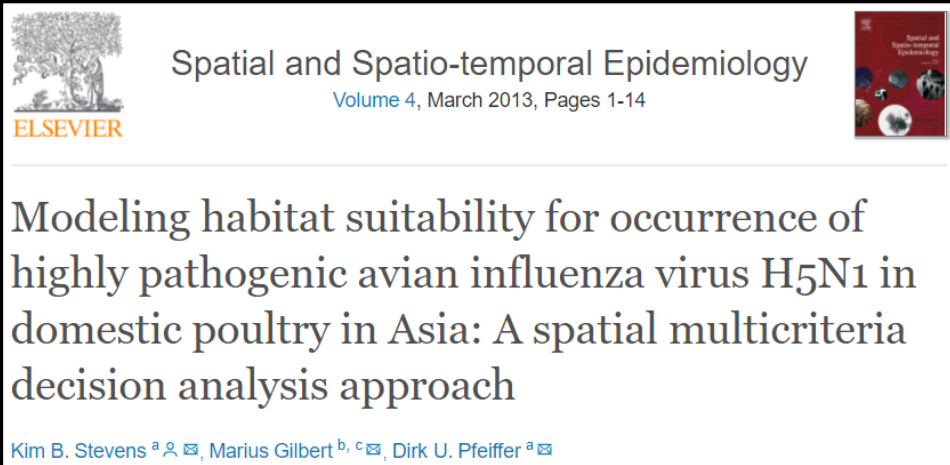
Research article | [Open Access](#) | Published: 09 January 2014

Spatial multi-criteria decision analysis to predict suitability for African swine fever endemicity in Africa

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[BMC Veterinary Research](#) **10**, Article number: 9 (2014) | [Cite this article](#)

MCDA (another example)



What can we do?



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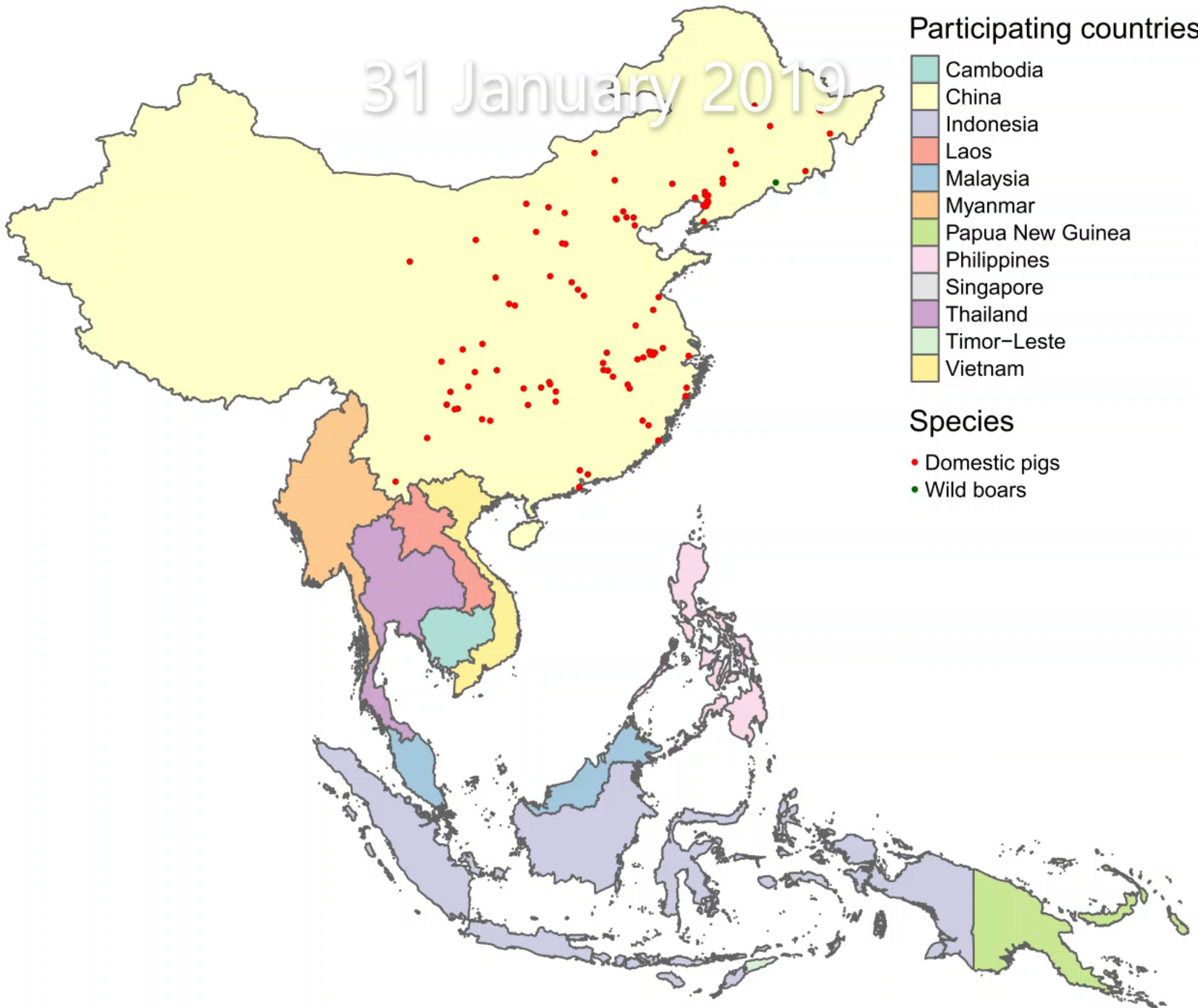
31 January 2019

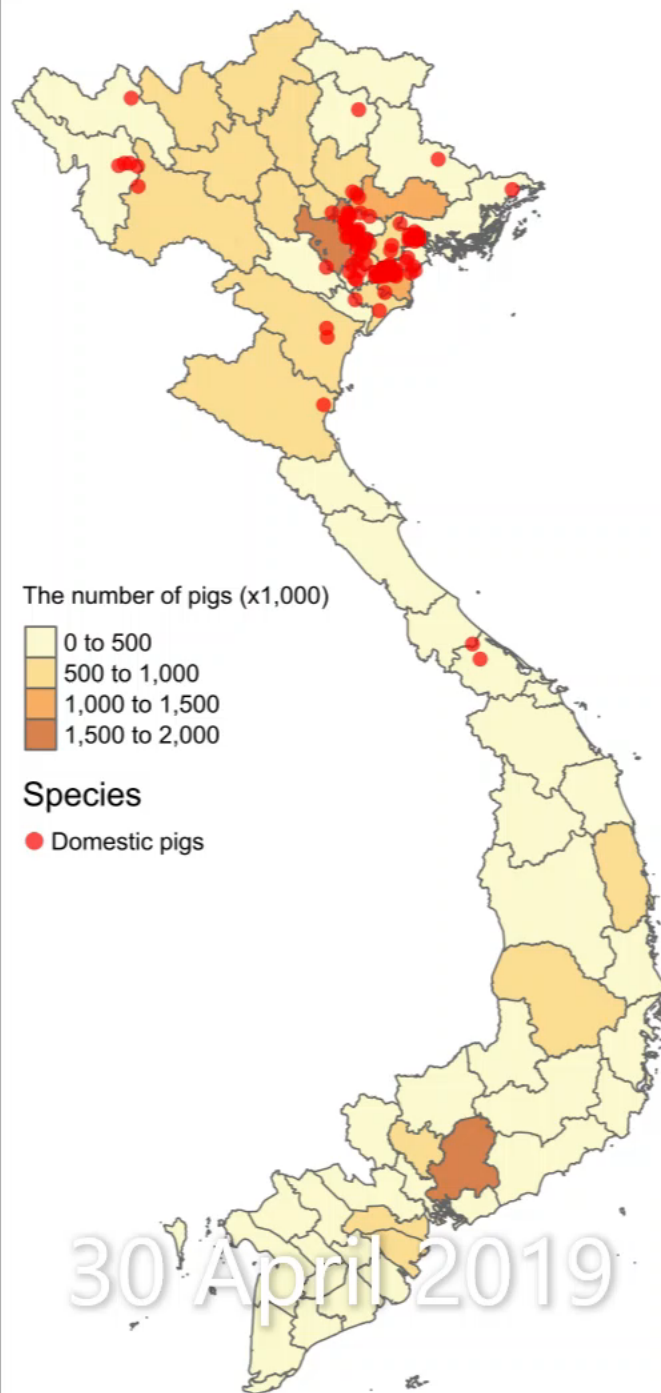
Participating countries

- Cambodia
- China
- Indonesia
- Laos
- Malaysia
- Myanmar
- Papua New Guinea
- Philippines
- Singapore
- Thailand
- Timor-Leste
- Vietnam

Species

- Domestic pigs
- Wild boars





30 April 2019

Summary



- Effective presentation and communication
- Understanding trends and forecasting
- Better planning and monitoring
- Setting of priorities
- Facilitated decision-making



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