

## Letter to the Editor

## Mapping bovine Brucellosis in Colombia with geographical information systems, 2009–2019 – Implications for OneHealth

Dear Sir

Bovine brucellosis is a bacterial zoonotic disease of considerable impact, especially in cattle-raising countries, common in Latin America, which can cause neurological and systemic complications in humans. Multiple factors, including environmental changes, including climate change, influence its epidemiology, so it is essential to consider animal, human and environmental health (OneHealth) [1].

Multiple environmental factors, including climate change and variability, which are now recognised, may be related and social in their distribution and persistence [2]. Using geographic information systems (GIS) to characterise the occurrence of vector-borne, zoonotic, and infectious diseases is beneficial. In Colombia, as in other countries in Latin America, they have been used in different human and animal infectious diseases, such as dengue, chikungunya, Zika, giardiasis, taeniasis, and neosporosis, among others, recently including bovine rabies [3]. Not so yet for bovine brucellosis.

A cross-sectional retrospective observational descriptive study was developed in which the behaviour and temporal-spatial distribution of bovine brucellosis in Colombia was observed in its departments from 2009 to 2019, using data from the Colombian Institute of Agriculture (ICA) of Colombia.

During the study period, 510 farms were evaluated, with a median of 5 farms per department (minimum 0, maximum 129), 28 of the 33 departments or districts assessed (Bogotá, Amazonas, Guainía, Guaviare, San Andrés), there was a median of 53 farms evaluated per year (Fig. 1). Of the total properties, 271 (53.14 %) were positive, changing by year from 22.5 % (in 2009) up to 75.0 % (in 2016), a positivity ranging from 0 to 100 %, with an average of 33.37 % in those departments where it was evaluated, and an average of 49.39 % per year, finding the highest accumulated positivity in Córdoba (100 %), followed by Risaralda (77.8 %), and Valle del Cauca (74.4 %). Twenty-six maps were generated with these variables where a large proportion of positive farms in multiple departments was observed in 2013 and 2018, especially in the Andean region and Vichada (Fig. 1).

As can be seen, especially in the generated maps, the circulation of brucellosis in bovines in Colombia is still extensive. Even more, the oscillation in the annual positivity is concerning. Especially in the last five years, a wide distribution was observed in many Andean departments, including some of them, such as Nariño and Putumayo, which have international borders with Ecuador. This country is also endemic for bovine brucellosis [4], including border areas such as the province of Carchi [5] or the province of Esmeraldas, which borders Nariño (Figure).

It is worrying that departments such as Amazonas, Guainía, Guaviare, San Andrés and the Capital District (Figure), which have significant livestock activity, according to the records of farms with cattle

(2016) of the Colombian Agriculture Institute and a large number of livestock, have not had evaluations in their farms for bovine brucellosis. For example, of these five departments without evaluation, Guaviare, by 2019, according to the Colombian Agriculture Institute, had a census of 443,633 bovines in 4520 farms. Similarly, in the Capital District (35,304 cattle), Guainía (5711 cattle), Amazonas (854 cattle) and San Andrés (723 cattle).

Similarly, in 2010, 2011, 2013, 2014, 2015, and 2018, different departments bordering Venezuela (Figure), such as La Guajira, Cesar, Norte de Santander, Boyacá, and Vichada, also had brucellosis in cattle, and Venezuela is also an endemic country for this bacterial zoonosis. Unfortunately, there are few studies in Venezuela, with prevalences reaching up to 10 %. Nevertheless, the health crisis in Venezuela led to the conclusion that this zoonosis would also be under no control over the last few years. The preceding may be related to vaccination problems, and the critical situation in Venezuela, where there is no vaccination in cattle, animals, or humans, and multiple infectious pathologies have resurfaced, including foot-and-mouth disease and bovine tuberculosis, among others.

Therefore, in these departments, an evaluation of properties suspected of brucellosis should also be carried out integrally with other diseases under surveillance, especially in the Capital District, which is around Cundinamarca, where there is brucellosis, and Guainía, which borders Vichada as well, with brucellosis, and Amazonas with Putumayo.

Brucellosis is still a persistent zoonosis in Colombia through long periods of apparent epidemiological silence in specific departments, bovines, and humans [1,2]. In addition to studies in cattle, it is essential to know the behaviour of canines, which are susceptible, which has been reported in some publications from Antioquia, as well as other animals, including bats, which could have a potential role as dispersing hosts. Bovine surveillance is helpful as a predictive or sentinel indicator to prevent cases in humans.

The maps developed in this study allow us to quickly appreciate groups of neighbouring departments in different regions of the country affected by bovine brucellosis, which enables us to consider the spread of the disease associated with the mobility and transportation of cattle between various departments, including international borders, as is the case with Venezuela and Ecuador. These results have implications for public health in planning and surveillance, especially in those departments close to those historically affected in the study period.

### Author contributions

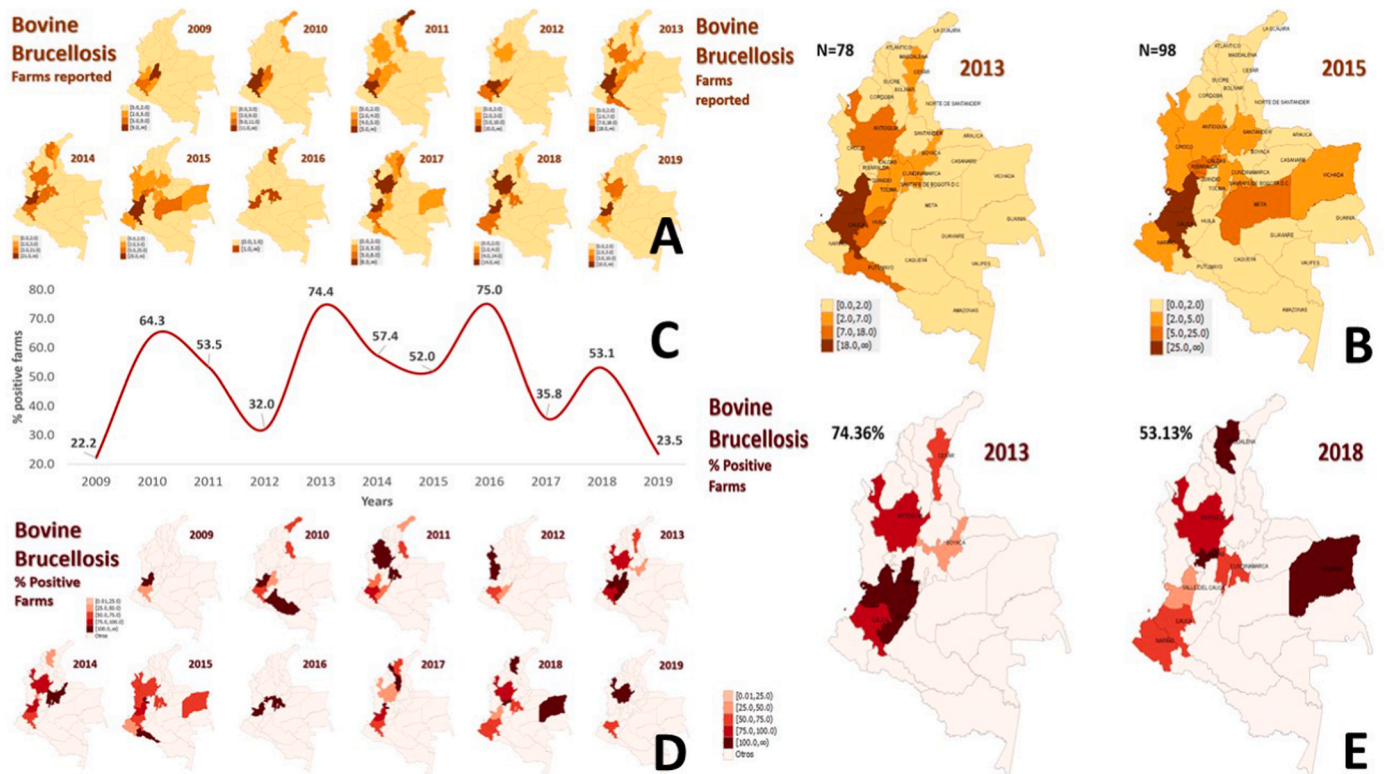
Conceptualization; methodology; software; validation; formal analysis; investigation; resources; data curation; writing—original draft

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**Fig. 1.** Bovine brucellosis in Colombia, 2009–2019. a) distribution maps by departments of farms evaluated for brucellosis in cattle. b) detail of the distribution maps by departments of farms for 2013 and 2015. c) annual variation of the positive farms (%) for brucellosis in cattle. d) distribution maps by departments of positive farms (%) for brucellosis in cattle. e) detail of the distribution maps by departments of the positive farms (%) for brucellosis in cattle for 2013 and 2018.

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#### Informed consent statement

Not applicable.

#### Declaration of competing interest

The authors declare no conflict of interest.

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