Development of a spatial model and risk mapping of *Fasciola hepatica* infection in dairy cattle herds from two district of the Peruvian central highlands

Poster session for Emerging GIS and data science technologies adapted to animal and human health topic

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Abstract

Fascioliasis is a major parasitic disease, affecting livestock and humans, caused by the trematode *Fasciola hepatica*, in Europe, the Americas and Oceania. The definitive hosts include several domestic animals, but is more prevalent in grass-fed ruminants worldwide. This disease produces important economic losses in animal production and is considered as an emergent Neglected Tropical Disease in human populations, especially in the Andean region. Peru have several endemic areas for fascioliasis in both animals and humans, with increasing rates of infection. This emergent has been linked to climate change. Fascioliasis transmission depends on specific environmental conditions that allows the presence of the intermediate host, an aquatic lymnaeid snail (*Galba*/*Fossaria* group). The Geographical Information System (GIS) and remote spatial sensors can be used to identify risk factors for disease and to assess endemic areas in a specific region. This risk mapping can assist decision making to design optimal control programs. The aim of this study was to develop and validate a spatial model and risk mapping of *Fasciola hepatica* infection in dairy cattle herds, using GIS and Neural networks modeling; in the districts of Matahuasi, department of Junin, and Baños, department of Huanuco, both located in the Central Highlands of Peru. Fecal samples were collected from approximately 54 animals, from 8 herds, in each district, during rainy (November to April) and dry (June to September) seasons, in 2016 and 2017. Flukefinder® test was used to detect *F. hepatica* eggs, determining prevalence of infection (p) in each herd. Prevalence were classified into low (p ≤ 20%), moderate (p = 21- 50%) and high (p ≥ 51%) risk of infection. Each grazing area was spatilly georeferenced to evaluate soil and field characteristcs, and to estimate climate variables (monthly temperature and precipitation), geographic characteristics (slope; elevation; distance to rivers, urban zone and roads).Landsat and Sentinel remote sensing imagery were used to take out the vegetation and water indexes as Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI) and Normalized Difference Water Index (NDWI) and then GIS were applied to process this information.Neural networks modeling was used to elaborate predictive models, to determine the relationship between environmental factors and *F. hepatica* prevalence. The models were validated using Kappa coefficient (k ≥ 0.6). The *F. hepatica* prevalence in Matahuasi herds ranged from 20 to 100%, and in Baños herds from 0 to 87.5%. The predictive model based on water and vegetation from Sentinel 2 satellite imagery resulted the best (k = 0.77) to develop risk maps. The most important environmental variables to predict risk of *F. hepatica* infection were slope and NDWI. Our results showed that Matahuasi district had significantly more high risk areas than Baños in both seasons during the two years of study. Baños district had a slight increase in high risk areas during dry season. These results support the use of remote sensing and predictive modeling as Neural Networks, in the development of risk maps for fascioliasis in dairy cattle which constitutes an optimal tool for efficient control programs.

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