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Change of livestock trade networks during epidemic outbreaks

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Introduction

The trade of livestock is an essential risk factor in the spread of infectious animal diseases. In order to allow for efficient back tracing and forward tracing in case of a disease outbreak, all EU member states are obliged to report livestock movements to central databases. We focus on pig trade in Germany as an example of such a data set. Our aim is to investigate the impact of a disease outbreak on the network structure. In order to measure this impact, we make use of real outbreak data of classical swine fever.Being logistic hubs and responsible for large animal movements, traders play a key role in the trade network. In order to quantify network changes during a disease outbreak, it is hence strongly advisable to use information about the holding type in the pig production chain. However, in many datasets the types of the producing farms or whether the agent is a trader, is unknown.

Methods

We introduce two index numbers, that can be used to identify the position of a producing holding in the pig production chain. First, the balance of traded animals over a certain time span. This number is related to the role of the holding. Second, the trader index that counts the number of purchases that are sold directly after the purchase. Using these index numbers, we can resolve the flux of traded animals between different node types over time. This resolution is much higher than considering the total number of traded animals alone. In particular, the impact of a disease outbreak can be measured at different parts of the production chain.

Results

We resolve the number of traded animals between different holding types. After the outbreak, trade restrictions are implemented. These trade restrictions have a strong impact on the trading behavior of different farm types. In particular, we could observe behavioral changes towards higher biosecurity after the outbreak.

Conclusions

It should be noted that the technique introduced above can in particular be used to identify traders. Analyzing the pig trade network in Germany from 2005 to 2007, we demonstrate that our algorithm is very sensitive in detecting traders. Since the methodology can easily be applied to trade networks in other countries, we anticipate its use for augmenting the datasets in further network analyses and targeting control measures.

Reference

Köppel, L., T. Siems, M. Fischer, and H.H.K. Lentz. 2018. Automatic classification of farms and traders in the pig production chain. Prev Vet Med 150:86-92.