

# From traditional to specialist: village chicken production and the risk of HPAI-H5N1 release.

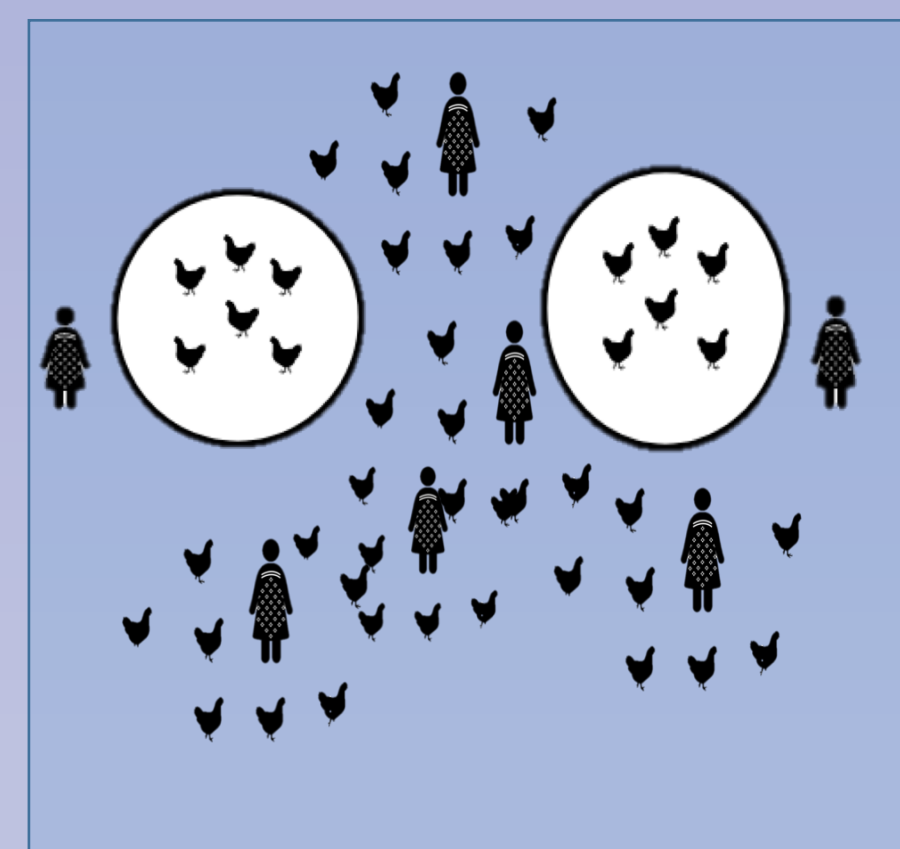
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## Background

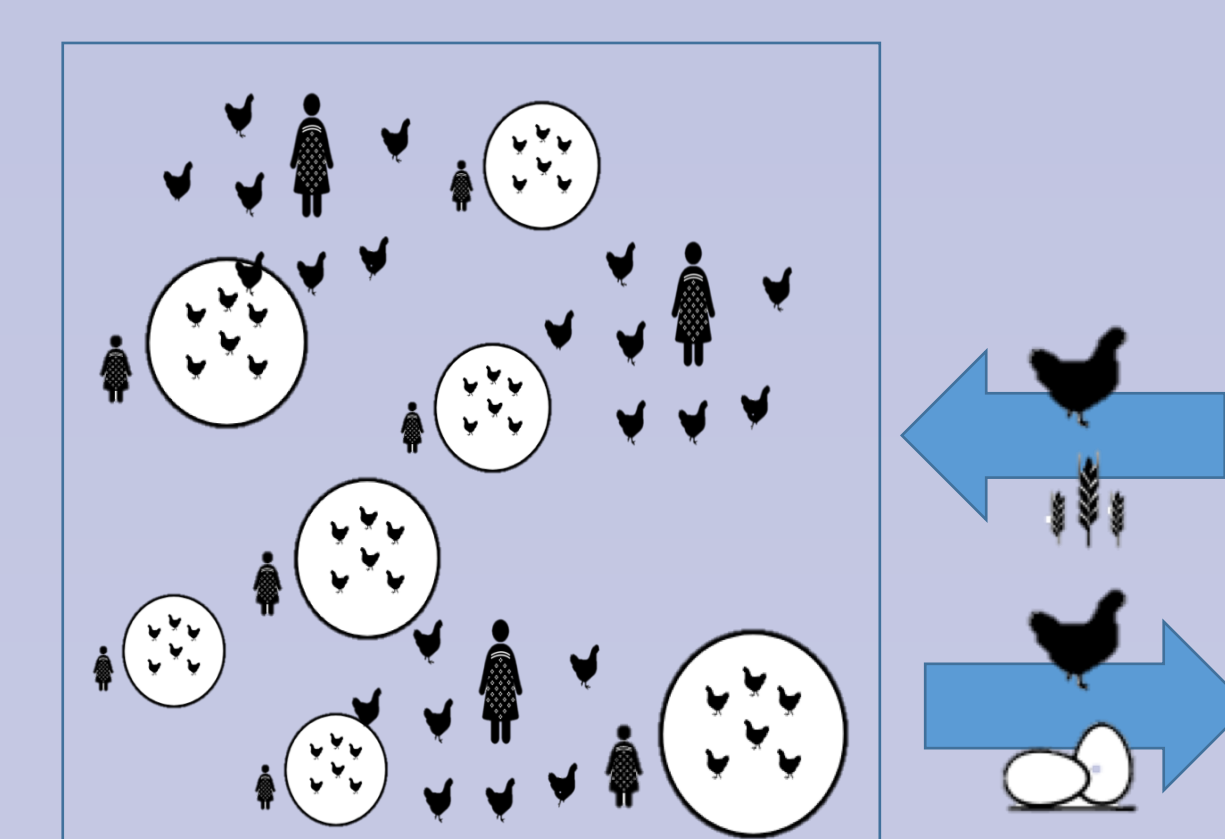
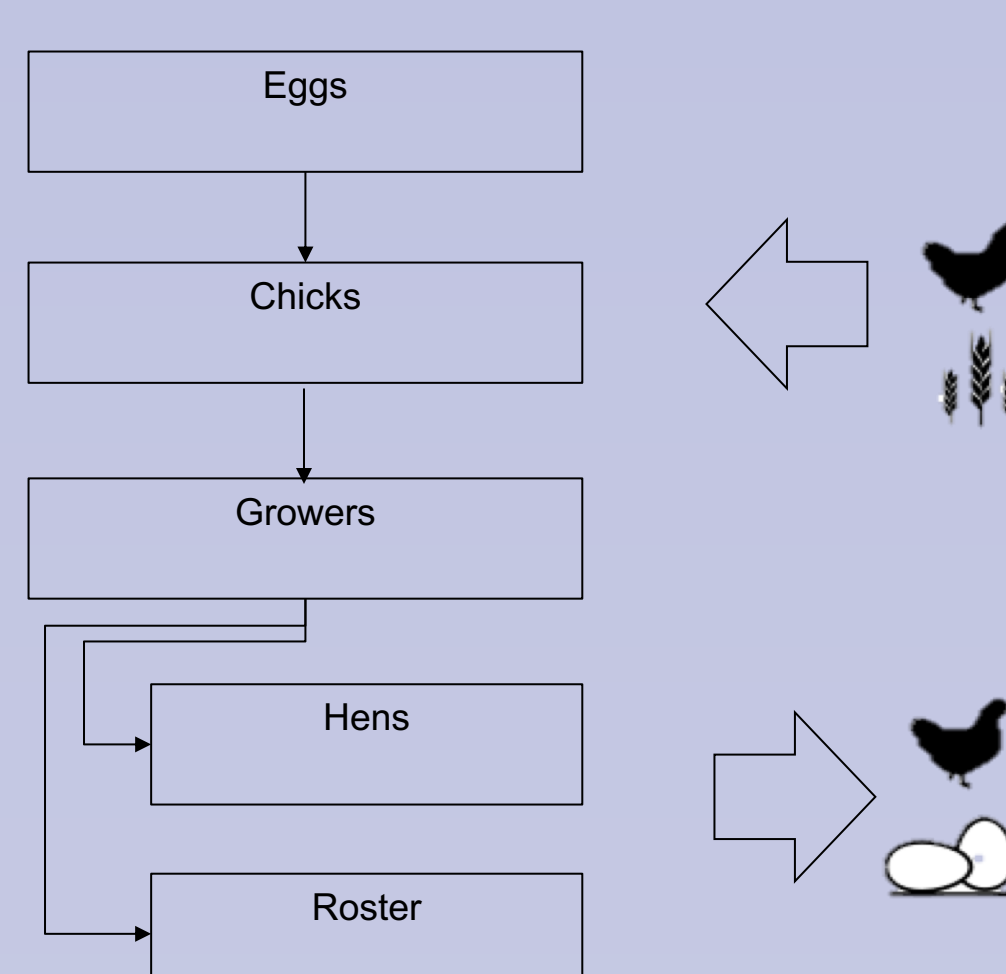
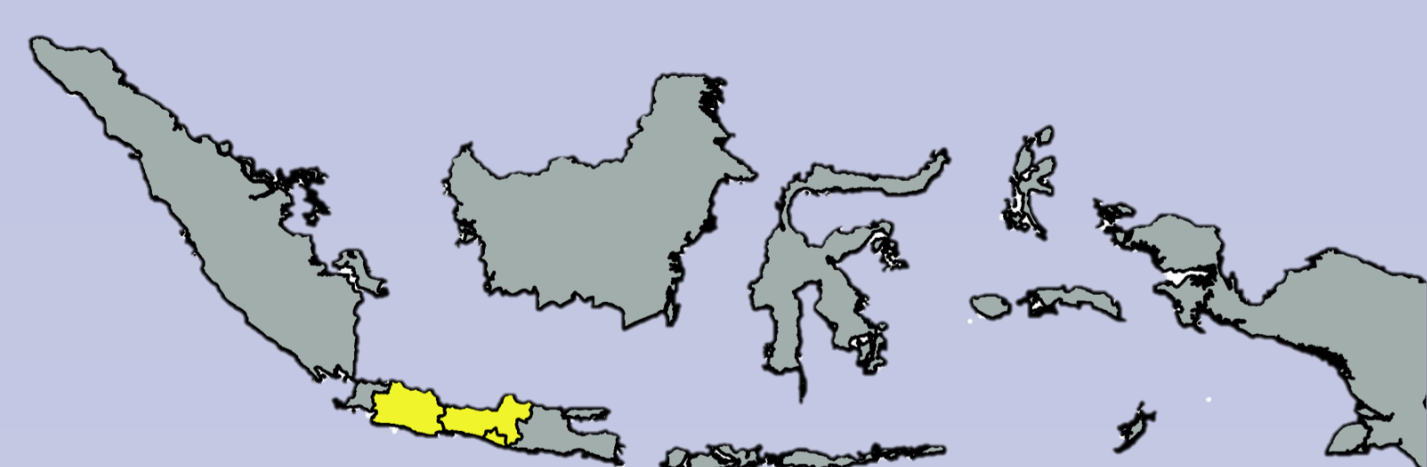


- Villages** are the *epidemiological unit* for events of highly pathogenic avian influenza H5N1 (HPAI-H5N1) in Indonesia. The most popular poultry in these settings are **village chickens**.
- Large proportion of village chickens are produced in **traditional systems**, characterized by free-range scavenging flocks, under no management and biosecurity. Less common **semi-commercial systems** source chickens to meet the demand in live poultry markets.



- Trading events** represent the main pathway for HPAI-H5N1 release in villages. Then, the **frequency and type of trading events** is a likely **proxy** to assess risk of HPAI-H5N1 release in villages. Lamentably, village trading is informal and limited data are available.
- To overcome this limitation, we explored **patterns of practice of village chicken systems**, and produced **mathematical models** that simulate **population dynamics**, to estimate the **presumed frequency of trading events in village scenarios**.

## Methods

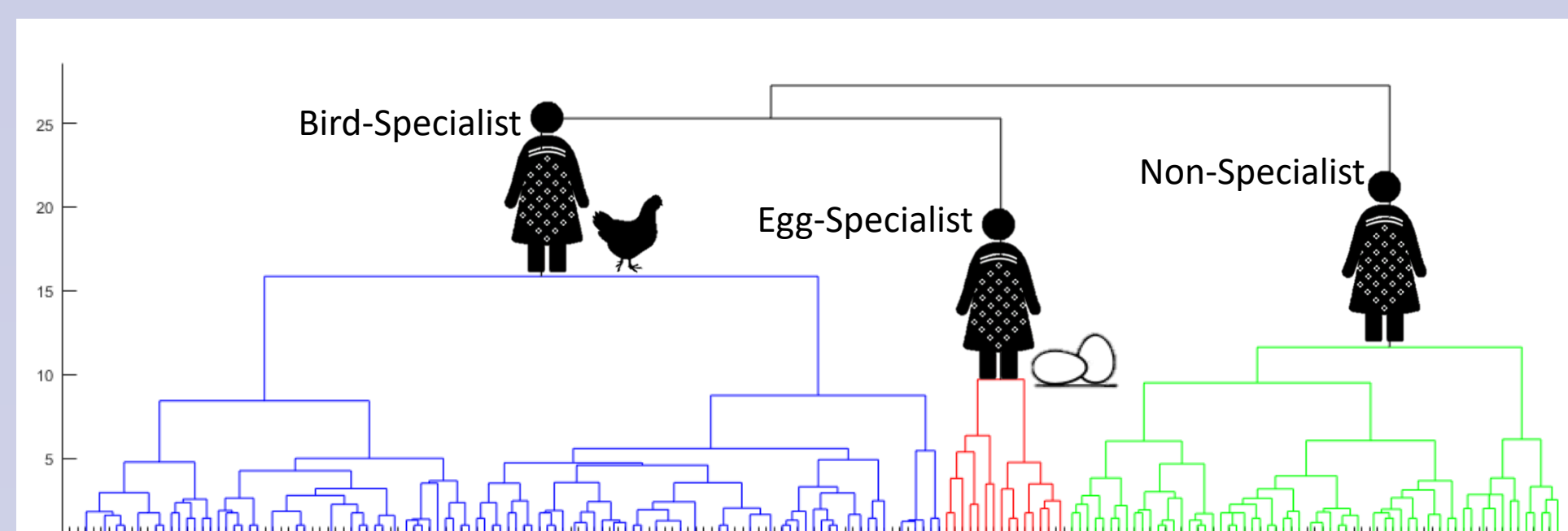


First, we explored **survey data of 191 village chicken premises** of Java, Indonesia, using **unsupervised hierarchical clustering methods (HC)** to identify patterns of **practice** among producers.

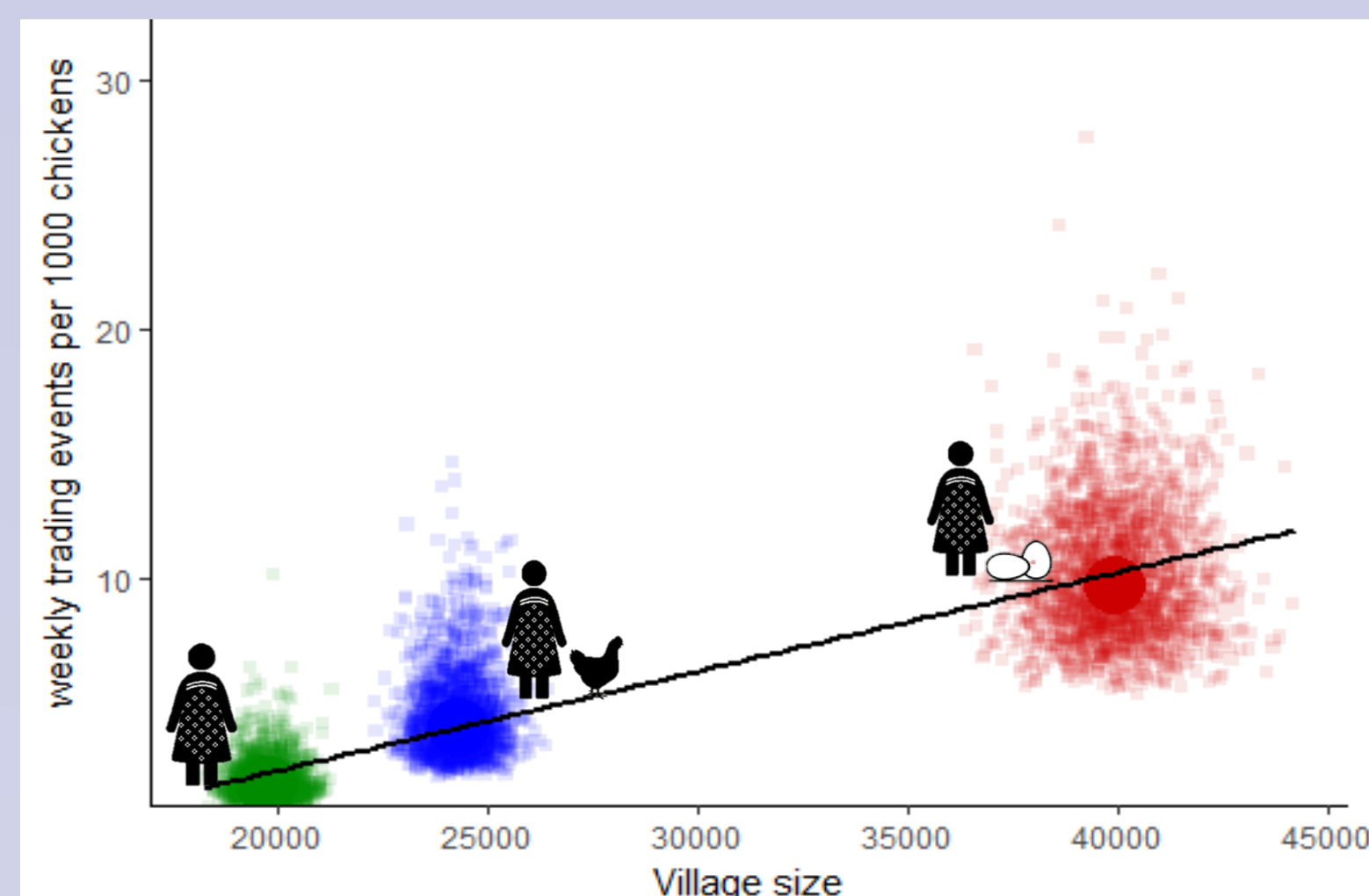
Then, we extended on previous work and produced a **demographic mathematical model** to simulate population dynamics of village chickens in each cluster. The model outputs the number of **chickens and eggs available for trading**, and **the number of birds replacements and feed needed** per unit of time.

Finally, we estimated **weekly trading events per 1000 chickens in village scenarios of size 1000 flocks** for trading of chickens (Cht), eggs (ET), importation of birds (ChI) and feed (FI). **10,000 scenario iterations** were performed to estimate the distribution of plausible trading estimates. We calculated a **release score** that represents the risk of viral release in villages. We assigned low (1), medium (2) or high (3) risk scores to the median value of trading events obtained in the scenario iterations, based on published evidence for such level of risk.

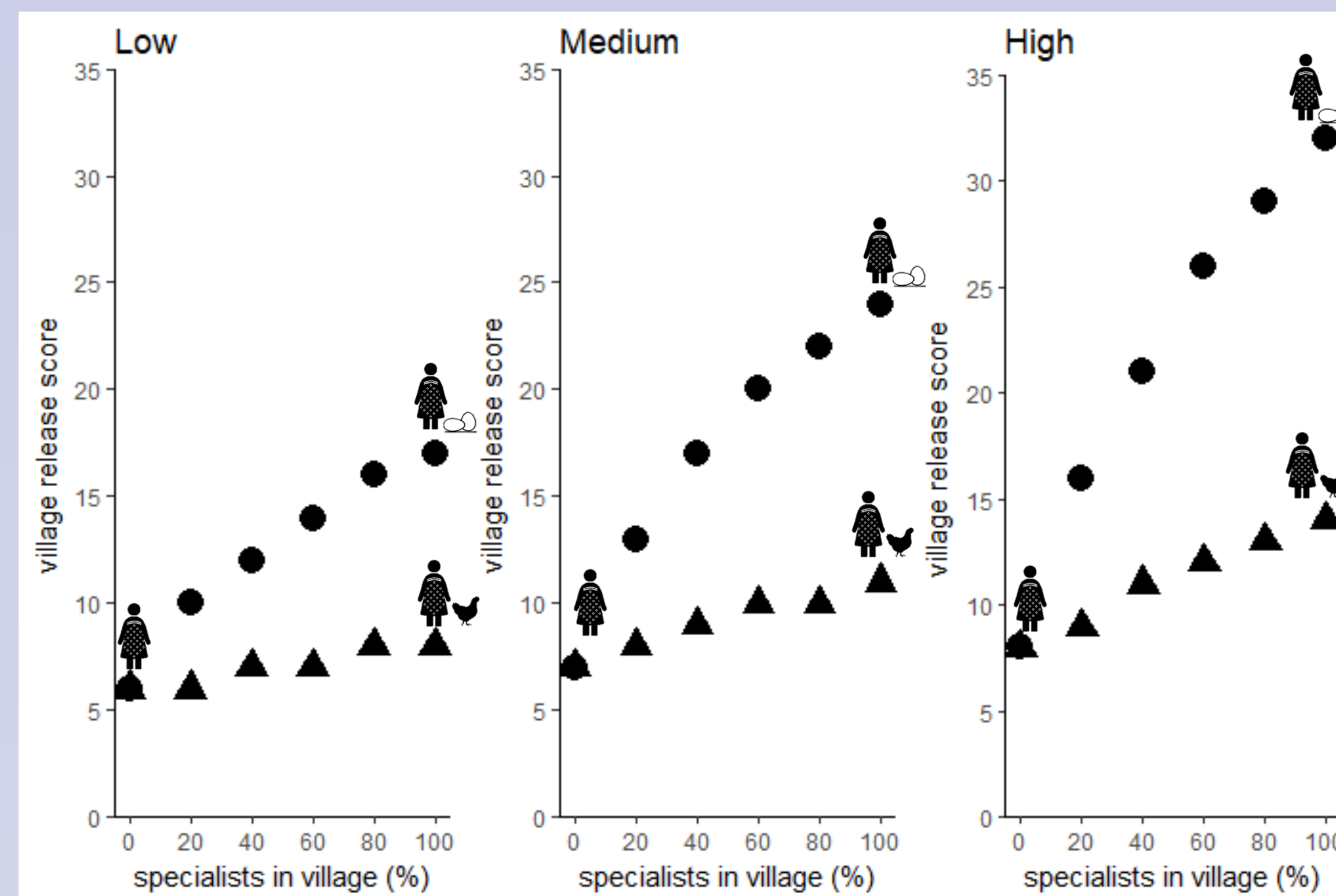
## Results



**Three cluster of producers with semi-commercial practices.** Our HC exploration found clusters of producers with a degree of produce specialization and preferred marketing strategies to trade beyond the village (F-exact;  $p < 0.001$ ). We named these clusters accordingly.

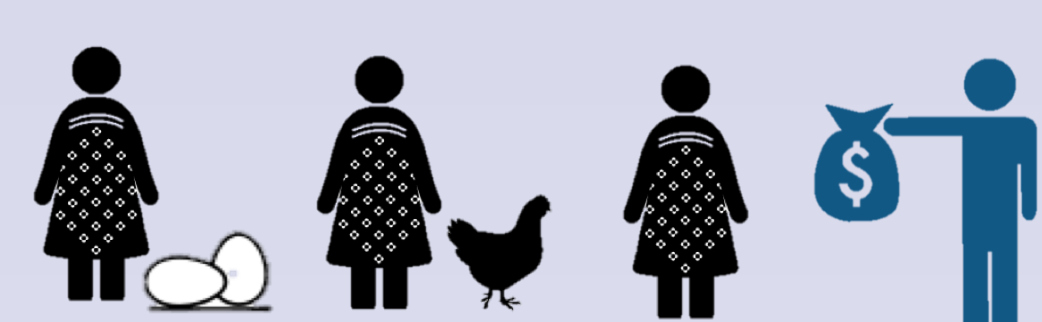


**Trading frequency: it isn't all about village size**  
 Producers that were classified as egg-specialists reported larger flocks in the original survey. This is clear in our comparison of cluster-specific scenarios of size 1000 flocks (x-axis). However, when we removed the effect of size, standardizing the trading events per 1000 chickens, we found that egg-specialist may double and triple the trading events carried by other producers (y-axis).



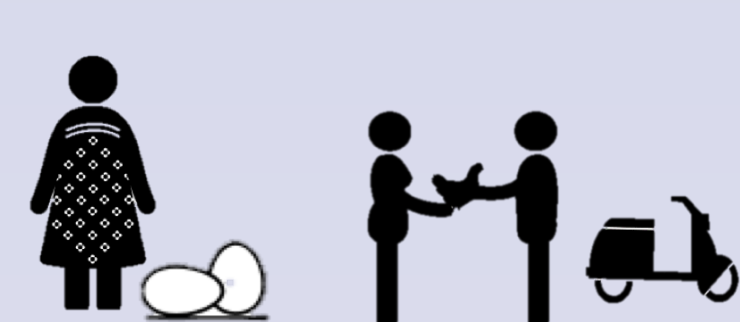
**Viral release score: non-specialist are the baseline; egg-specialists the top**  
 Among the trading events explored, field evidence is not conclusive on the risk of viral release posed by some of these. We assigned low, medium, and high risk scores to these trading events and calculated the village release score. The progressive increase in abundance of egg-specialists and birds-specialist (x-axis), raised the risk of viral release regardless of the level of release risk assumed (ANCOVA;  $p < 0.001$ ). Note, however, that the increase is sharper when egg-specialists become more abundant.

## Conclusions



### Less Traditional. More Semi-Commercial.

In contrast with most literature available, we found that most producers have adopted new farming practices, which highlights the reduction of traditional systems. Our results suggest that a classification based on trading strategies might be more sensible than current classifications based on farming practice.



### Egg-specialists: The most linked

Egg-specialists are the only producers that consistently engaged in the four types of trading activity explored. Since village chicken's eggs are highly demanded, it is expected that this group is now more abundant, increasing the trading linkages in their villages.



### Egg-specialists riskier than Bird-specialists

Egg-specialists have quicker turnover dynamics than bird-specialists. This translates into more chickens and eggs available, and higher demand for bird replacements and feed. Then, independent of the release risk attributed to trading events, egg-specialists are riskier because of the high frequency of trading, which offers more chances for a viral incursion to villages.



### More egg-specialists, more outbreaks. Right?

Well...we don't know yet. While the risk of incursion is higher with these producers, the occurrence of epidemic events in villages depends on other factors, including population size, susceptibility, biosecurity, etc. We are working on a infectious disease model that investigates these factors.