Controlling Avian Flu and Protecting People's Livelihoods in the Mekong Region

Epidemiological Investigations of HPAI H5N1 in Viet Nam

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RVC London

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Aknowledgements

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Contents

- Field Investigations
  - ✓ *Patterns of farm gate trade in smallholder poultry farms of Northern Vietnam*
  - ✓ *Traceability of smallholder poultry*
- Modelling of surveillance data
  - ✓ *Within-flock transmissibility of avian influenza (H5N1) virus before and after systematic vaccination campaigns in Vietnam*
  - ✓ *Social network analysis of market traders and communes*
- Spatial Risk Modelling
  - ✓ *An analysis of the spatial and temporal patterns of HPAI occurrence in Vietnam using national surveillance data*
- Animal Health Risk Assessment
  - ✓ *Assessment of H5N1 risk and the importance of wild birds*
  - ✓ *Quantitative assessment of the risk posed by live bird imports for the introduction of HPAI H5N1*

Field Investigations

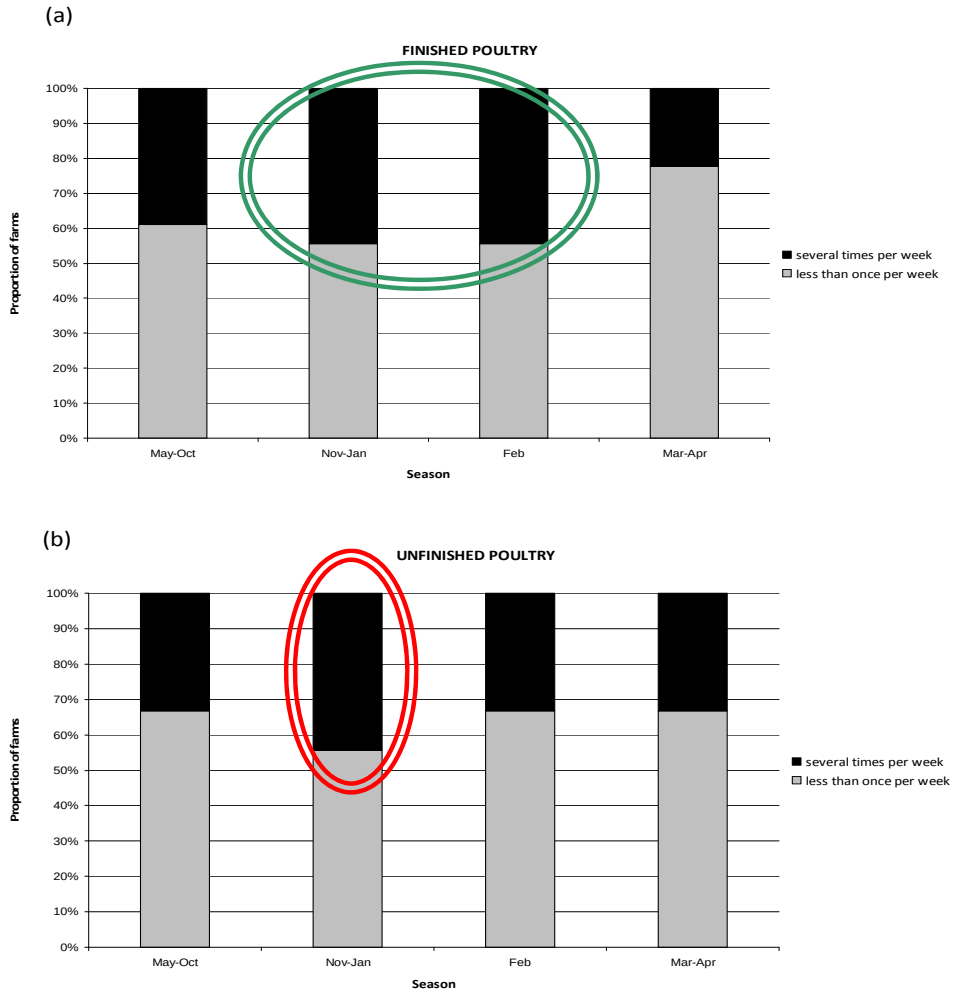
Patterns of farm gate trade in smallholder poultry farms of Northern Vietnam

Material and Methods

- Rapid Rural Appraisal of 21 smallholder commercial poultry farmers held in Phuc Tien commune, Phu Xuyen district in the Ha Tay province in Northern Vietnam.
- **AIM:** obtain baseline information regarding the trade activities of smallholder commercial poultry farms with a farm size between 100-1,000 heads.
- Information collected by the research team, through individual interview and group discussions of all farmers.

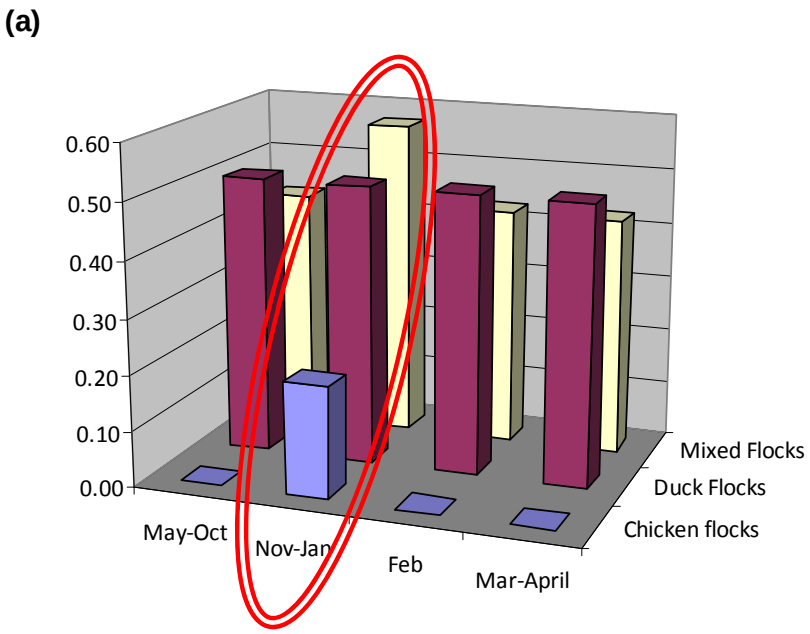
- Survey conducted at 11 markets currently authorized to trade live poultry
- **AIM:** obtain baseline information regarding trade activities of live poultry traders operating at each market.
- Individual interview based on a structured questionnaire
- Information collected by the market inspector Individual interview based on a structured questionnaire

Farm gate trade frequency of finished and unfinished poultry

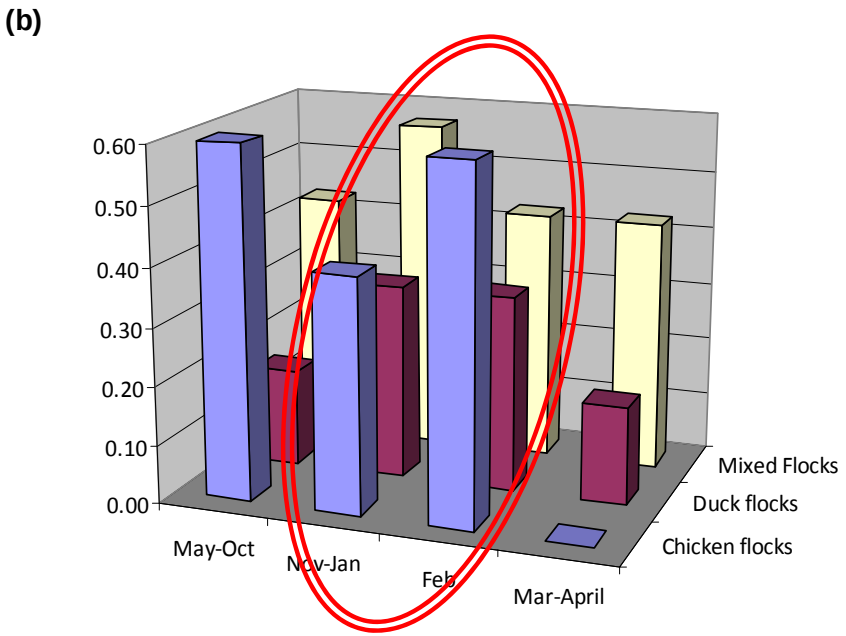


Farm Gate Trade Frequency by Farm Type

Unfinished



Finished

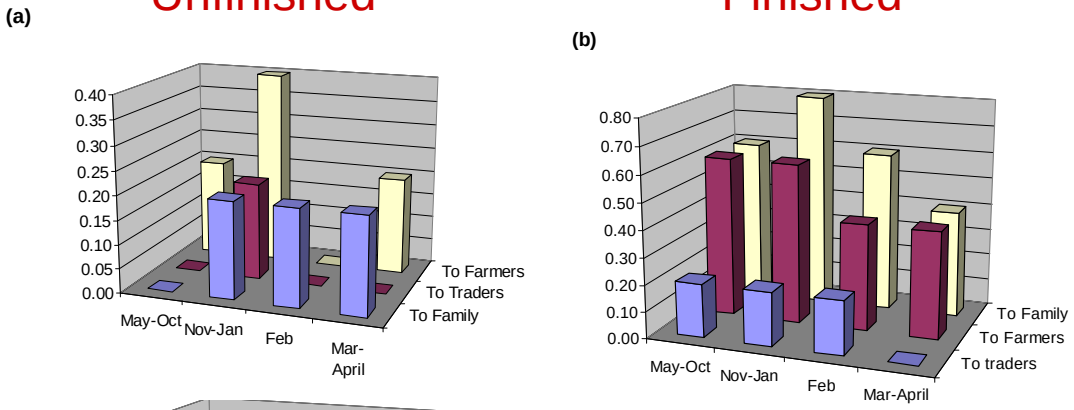


Farm Gate Destinations

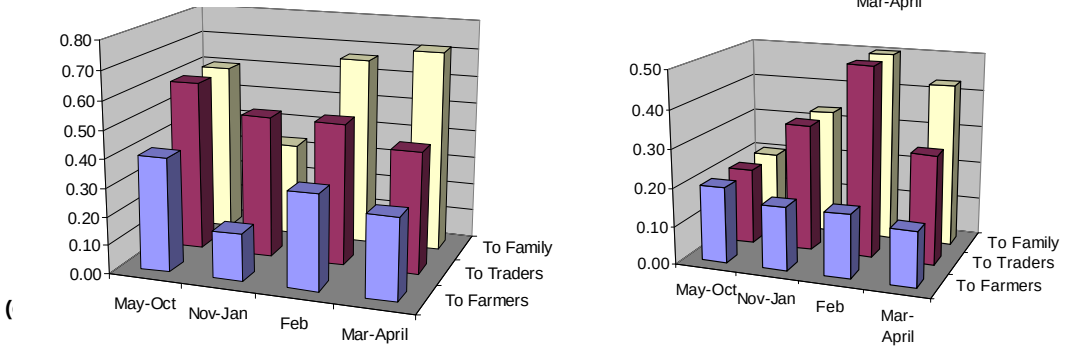
Unfinished

Finished

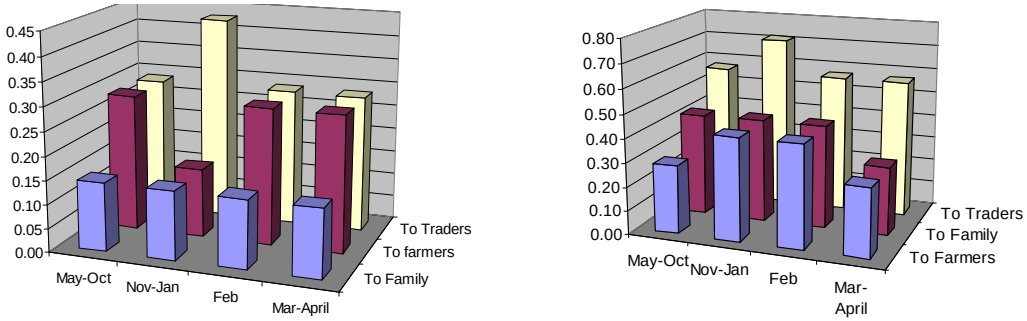
Chicken



Ducks



Mixed



Some Other Findings

- 90% of poultry into markets originating from three provinces (Ha Tay, Ha Nam and Ha Noi).
- Predominant farm size of poultry originating from Ha Tay, Ha Nam and Ha Noi is between 100 - 2,000 heads.
- Poultry types sent to markets include white chicken (commercial breed), local chicken (native breed), duck and muscovy duck farms.

Field Investigations

Traceability of smallholder poultry

Study Design

Poultry Farm

Commune animal health worker

Non-RFID poultry tags

Poultry

READER A

Poultry baskets

RFID Basket tags
Weighting of baskets

Poultry traders

Live Bird Market

Market inspector

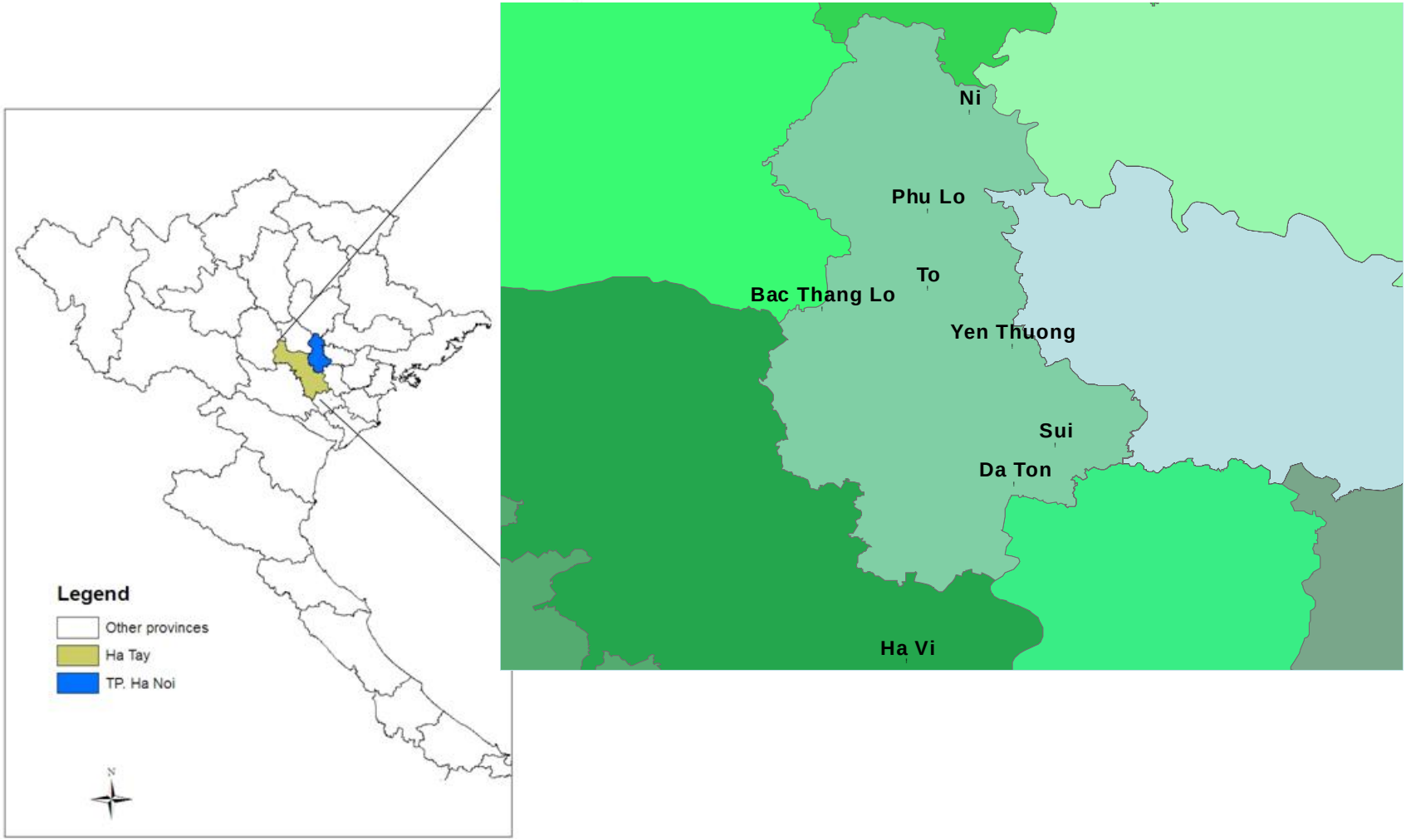
Poultry

Poultry baskets

READER B

Areas of Traceability Study

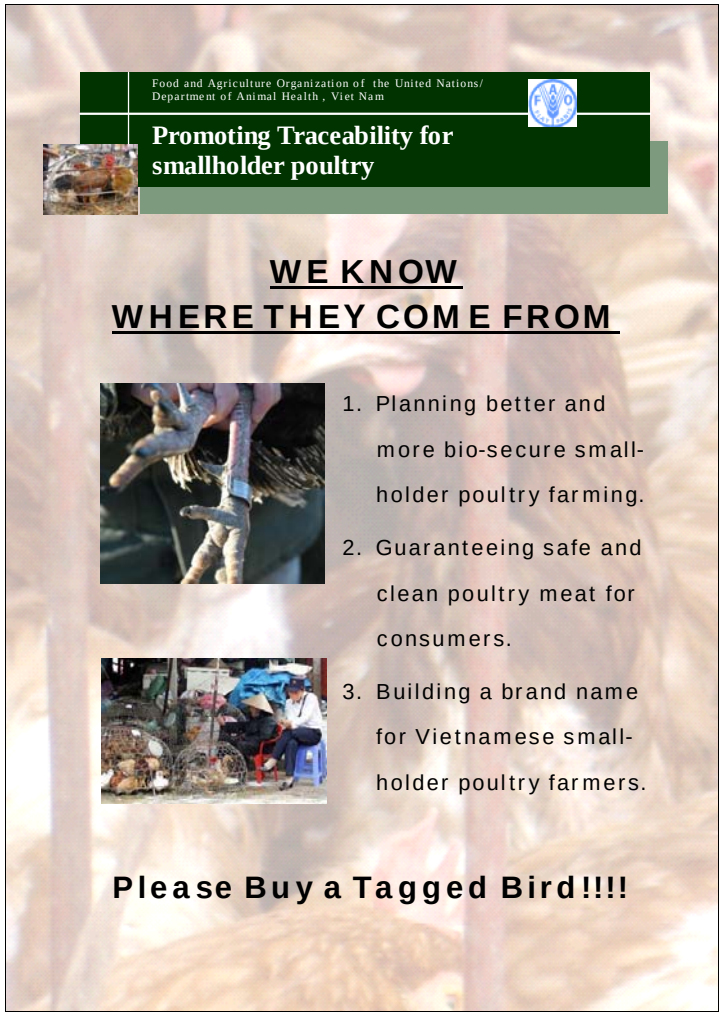
Map of districts of Ha Tay and Ha Noi provinces where Part I of the traceability study could be conduced

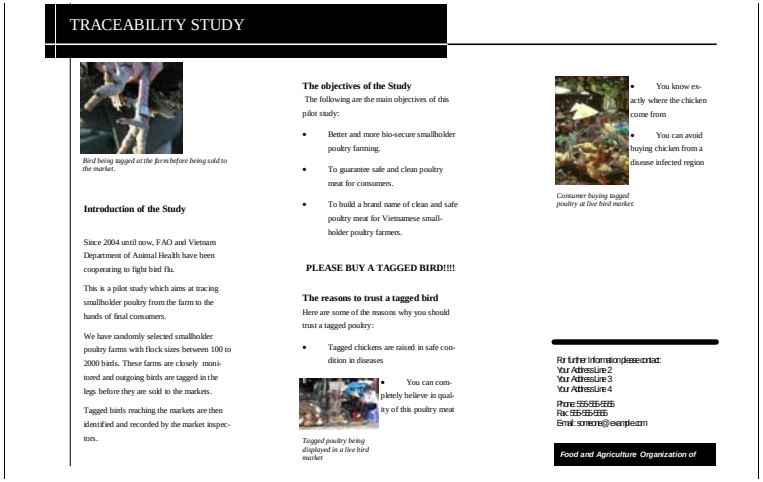


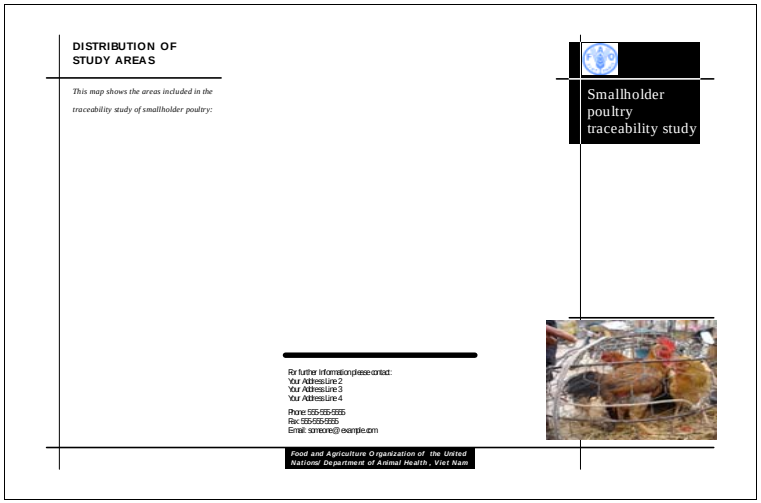
Number of Birds Tagged by Farm Type

ASSUMPTIONS	WHITE CHICKEN	LOCAL CHICKEN	DUCK	MUSCOVY DUCK
Number of farms to be enrolled in the study	36	3	14	15
Expected number of outgoing batches per farm throughout the study period	4-6	5-7	6-8	5-7
Expected number of birds per outgoing batch	300	30	200	200
Expected proportion of birds to reach the primary receptor market (%)	**5**	**1**	**10**	**10**
Required number of birds to be tagged per outgoing batch per farm	121	18	132	132
Total number of birds to be tagged	17,424 - 26,136	270 - 378	11,088 – 14,784	10,125 – 13,860

Public Awareness Campaign







Modelling of Surveillance Data

Within-flock transmissibility of avian influenza (H5N1) virus before and after systematic vaccination campaigns in Vietnam

Presented at *European Scientific Conference on Applied Infectious Disease Epidemiology* (ESCAIDE) 2007, October 18-20, Stockholm, Sweden

Material and Methods

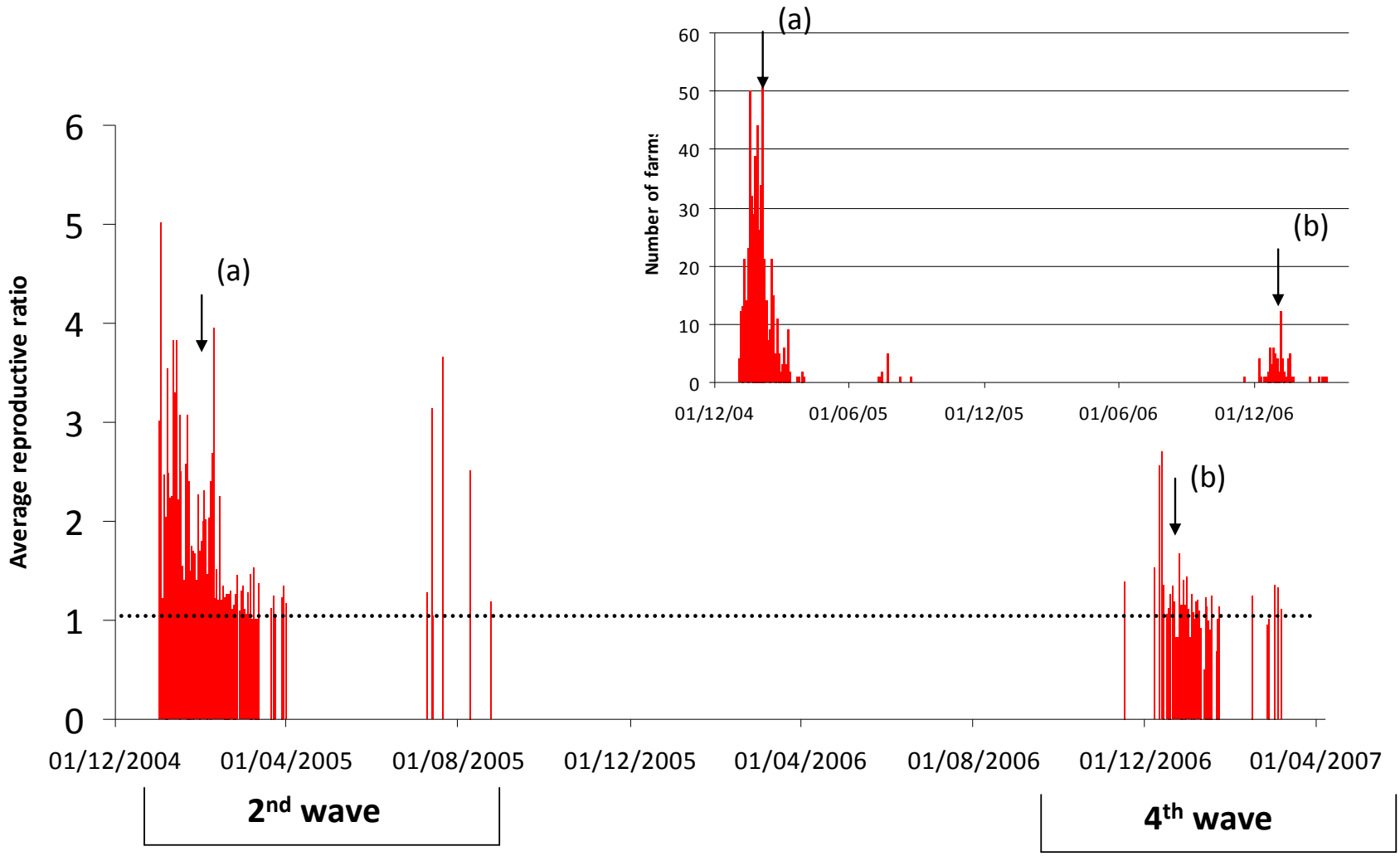
- A total of 1019 and 114 farm outbreaks where reported between 1st January 2005 – 31st August 2005 and 11th November 2006 – 7th March 2007, respectively.
- These outbreaks where reported in 32 provinces of Viet Nam.
- For all study periods considered, about 85% (968/1133) of outbreaks occurred in the southern provinces
- For the period 11th November 2006 to 7th March 2007 only 4 (3.5%) outbreaks occurred in Northern provinces.

Reproductive Ratio of Infection – R0

- The threshold conditions for disease spread:
  - Deterministic approach
    - R=1 (endemic situation)
    - R<1 – disease will not spread
    - R>1 – disease will spread
  - Probabilistic (stochastic) approach
    - R<1 – minor outbreaks may occur
    - R>1 – minor or major outbreak may occur

(Anderson and May, 1991; Diekmann and Heesterbeek 2000)

Incidence vs within Farm Reproductive Ratio



Infection Potential of Incident Farms by Farm Size

OUTBREAK TIMING	PARAMETER	POOLED	S1	S2	S3	S4
Pre-vaccination (1st Jan 2005- 23rd Aug 2005)	R_0 (Mean)	2.05	2.13	2.02	1.99	2.06
	S.e.	0.059	0.74	0.34	0.068	0.107
	95%CI	1.89-2.13	0.57-3.70	1.33-2.70	1.87-2.13	1.83-2.26
	Obs	1019	17	54	797	151
	HIT (Mean)	0.28	0.15	0.20	0.27	0.36
	S.e.	-	-	-	0.0094	0.024
	95%CI	-	-	-	0.25-0.29	0.31-0.41
	Obs	1010	17	54	797	151
During Vaccination (7th Dec 2006 – 7th Mar 2007)	R_n (Mean)	1.85	1.98	1.74	1.13	1.09
	S.e.	0.059	-	-	0.057	0.079
	95%CI	1.89-2.13	-	-	1.87-2.13	0.34-1.27
	Obs	1019	1	1	70	42
	HIT (Mean)	0.28	0.14	0.19	0.18	0.13
	S.e.	-	-	-	0.0094	0.024
	95%CI	-	-	-	0.12-0.23	0.09-0.20
	Obs	90	1	1	64	26

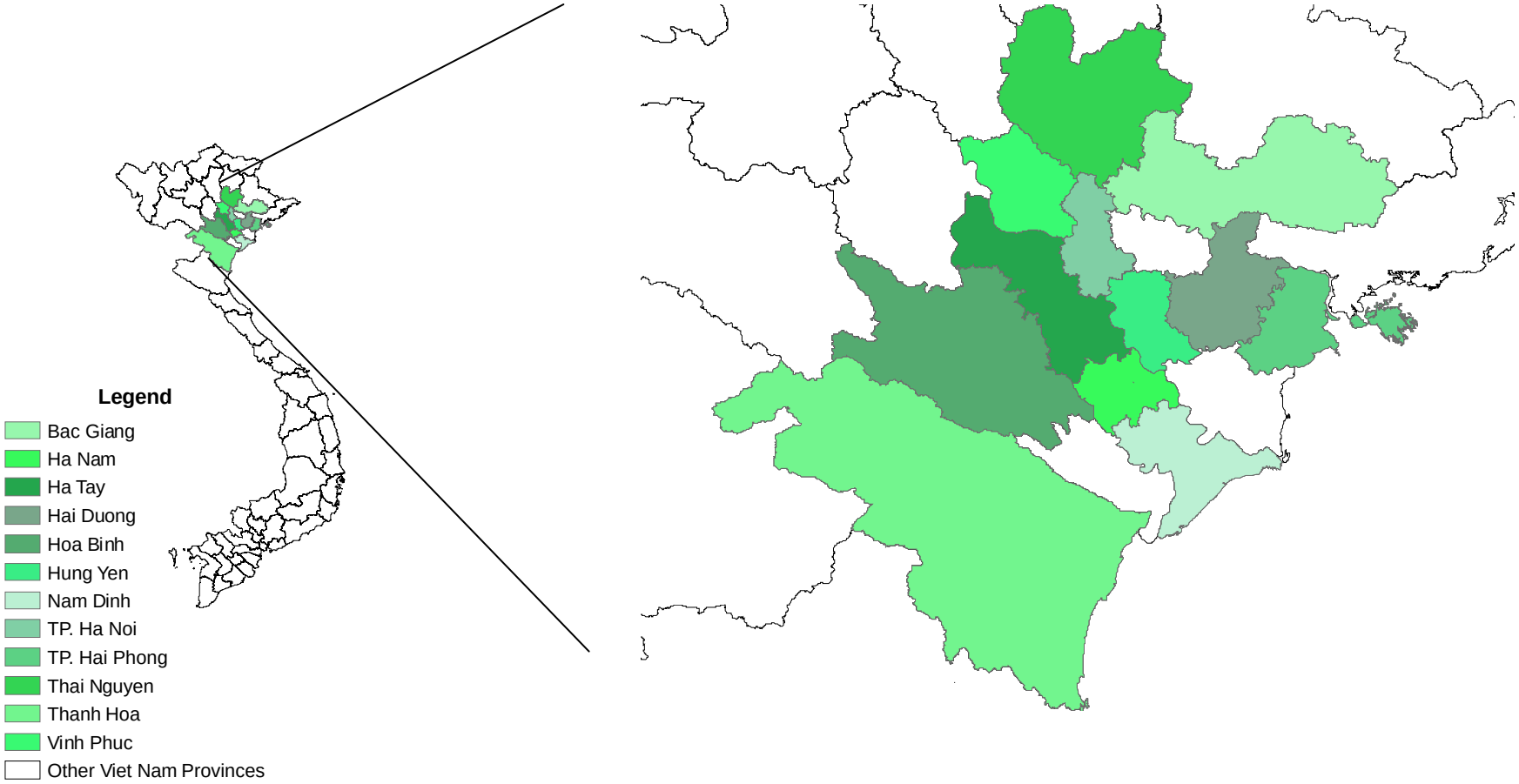
Discussion

- Outbreak farms of the initial stage of the epidemic curve have significantly higher infection potential than remainder of farms.
- Significant reduction of infection potential between pre and post vaccination outbreaks.
- Infection potential is significantly higher than unity in “vaccination era” incident farms.
- Larger farms (>3,000 heads) have significantly higher infection potential compared to smallholder commercial farms.
- Duck farms seem to have a significantly higher infection potential than chicken farms.

Modelling of Surveillance Data

Social Network of market traders
and communes

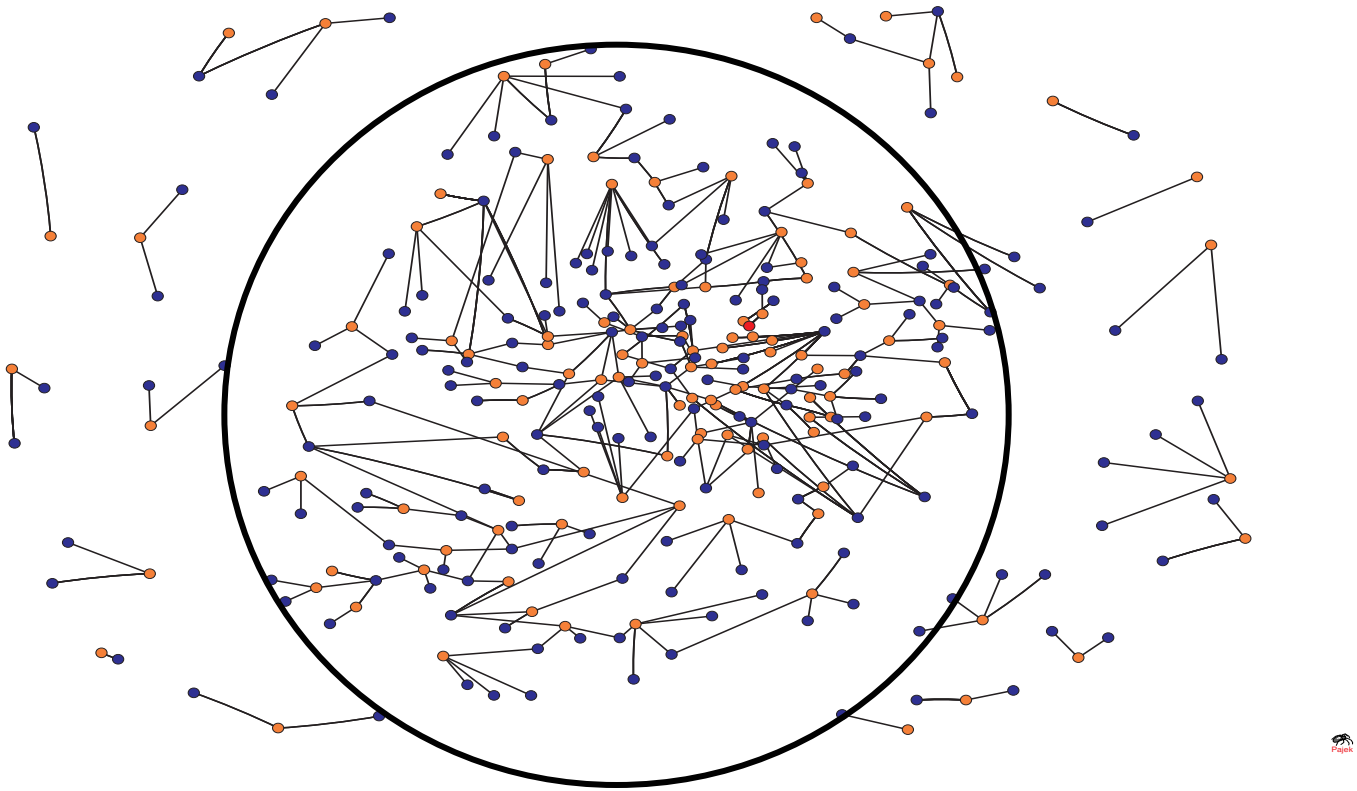
Catchment Areas of Surveyed Markets



Preliminary Findings

- 2-mode network connecting traders and communes via poultry trading
- It has 310 nodes: 117 traders and 193 communes.
- There are 474 links
- 2,45 traders per commune and 4 communes per trader on average.
- Network with clear core structure with
  - 59 components are connected to the core group
  - 18 isolated components

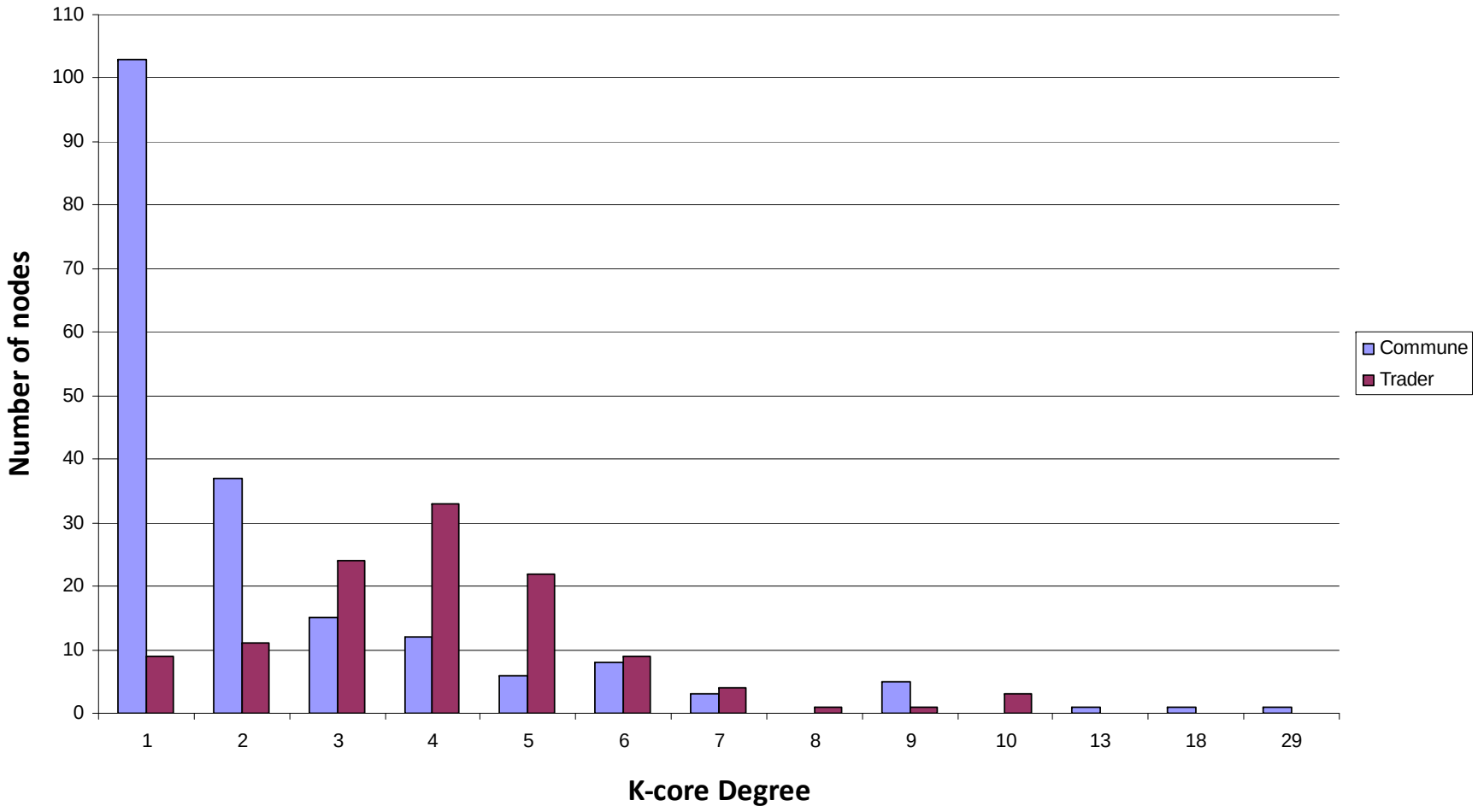
Two-mode Network of Traders and Communes



Commune

Trader

K-core Degree of Network Nodes



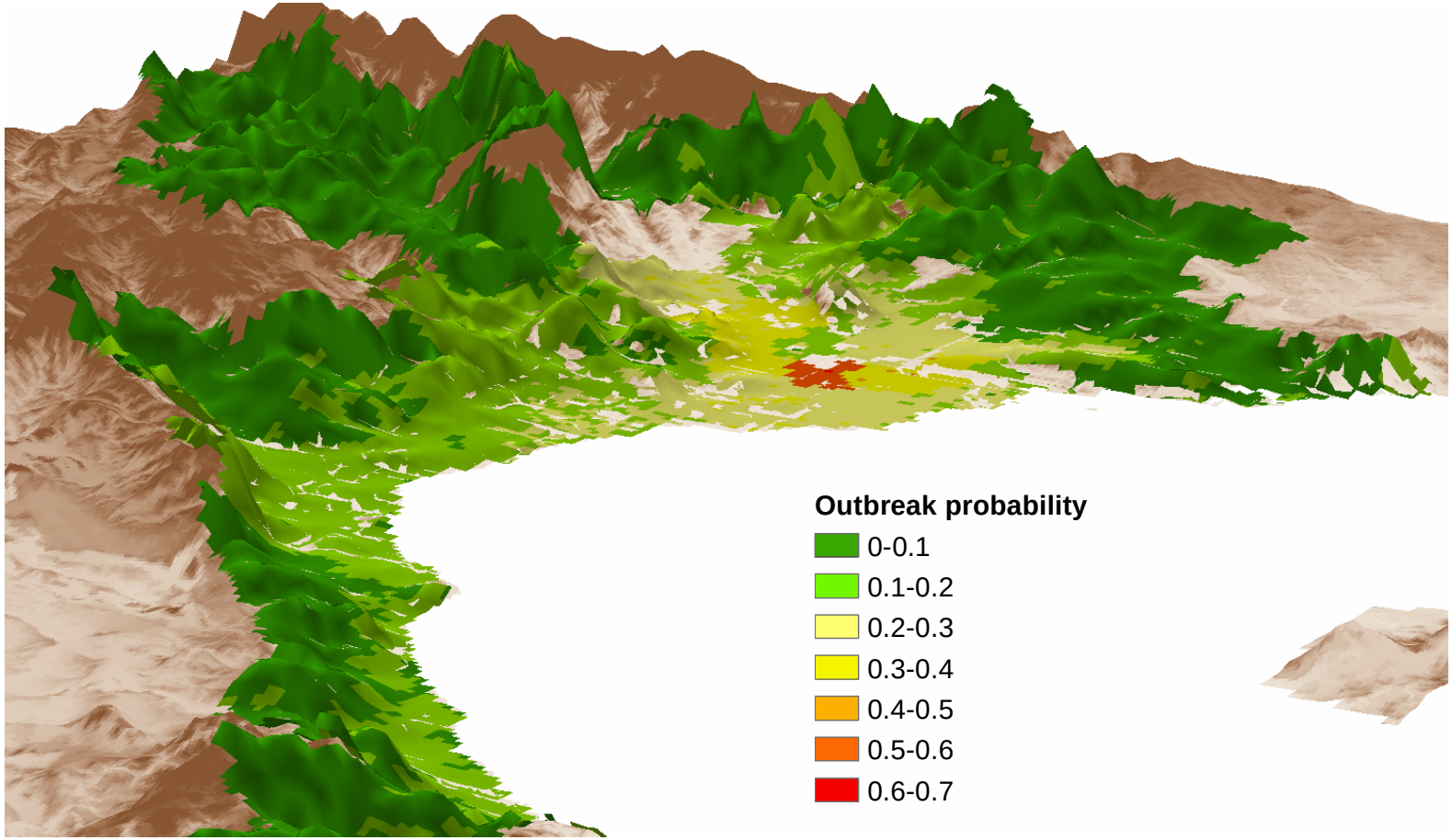
Spatial Risk Modelling

An analysis of the spatial and temporal patterns of HPAI occurrence in Vietnam using national surveillance data

Published in *The Veterinary Journal* 2007, 174 (2): 302-309.

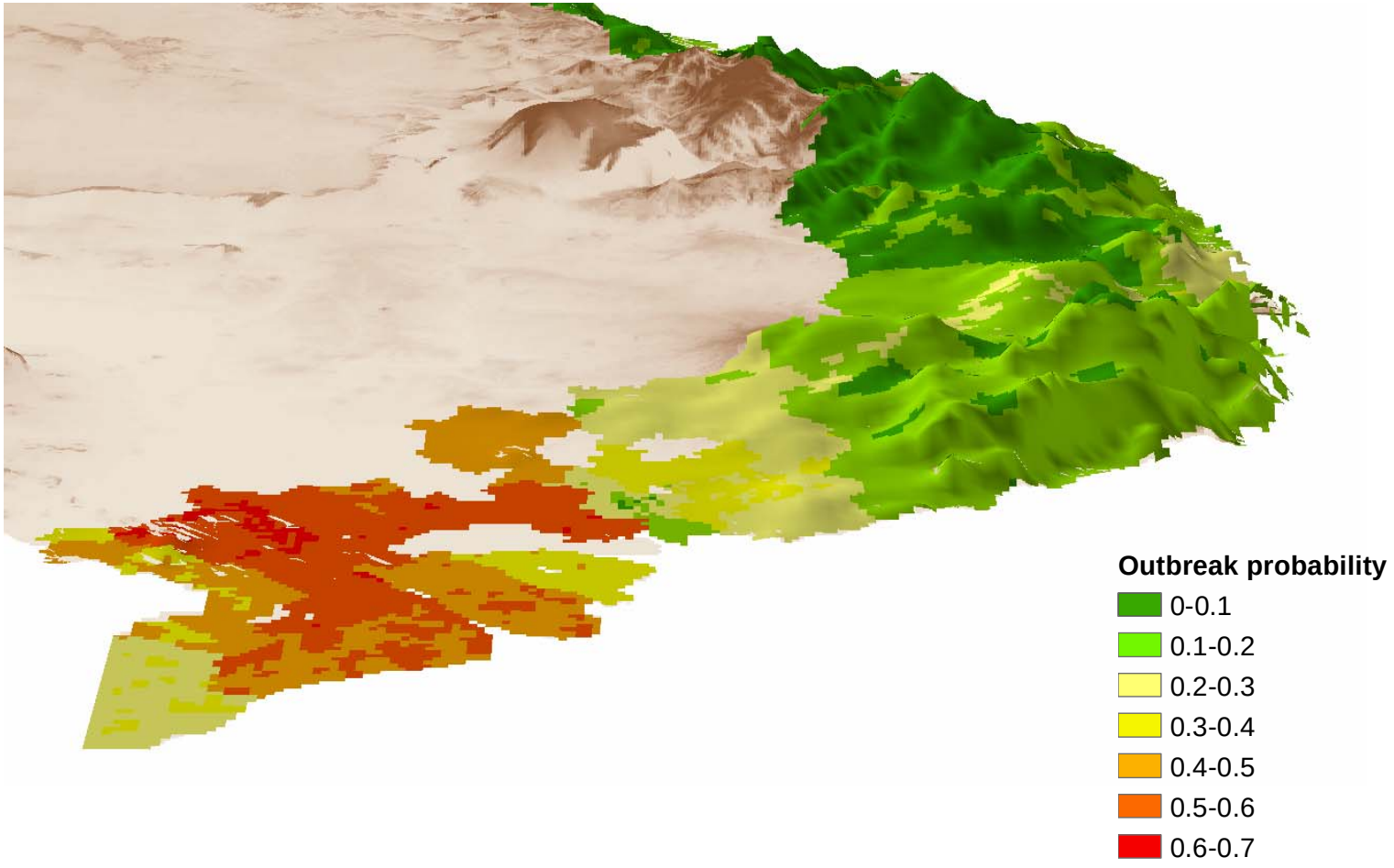
Probability of Outbreaks in Northern Vietnam

based on Logistic Regression Model for 2003/4 AI Epidemic



Probability of Outbreaks in Southern Vietnam

based on Logistic Regression Model for 2003/4 AI Epidemic



Animal Health Risk Assessments

Assessment of H5N1 risk and the importance of wild birds

Published in *Journal of Wildlife Diseases* 43, S47-S50.

OIE - Animal Health Risk Assessment

OIE, 2005 – Related to sanitary measures from animal health hazards originating from international animal trade

ACTIVITIES

- Identify hazard
- Define risk question
  - Outline pathway
  - Collect data
  - Assess risk

COMPONENTS

RELEASE ASSESSMENT

↓

EXPOSURE ASSESSMENT

↓

CONSEQUENCE ASSESSMENT

H5N1 HPAIV Exposure Assessment for EU

EFSA Scientific Panel for Animal Health & Welfare

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Ilaria Capua
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David Stroud
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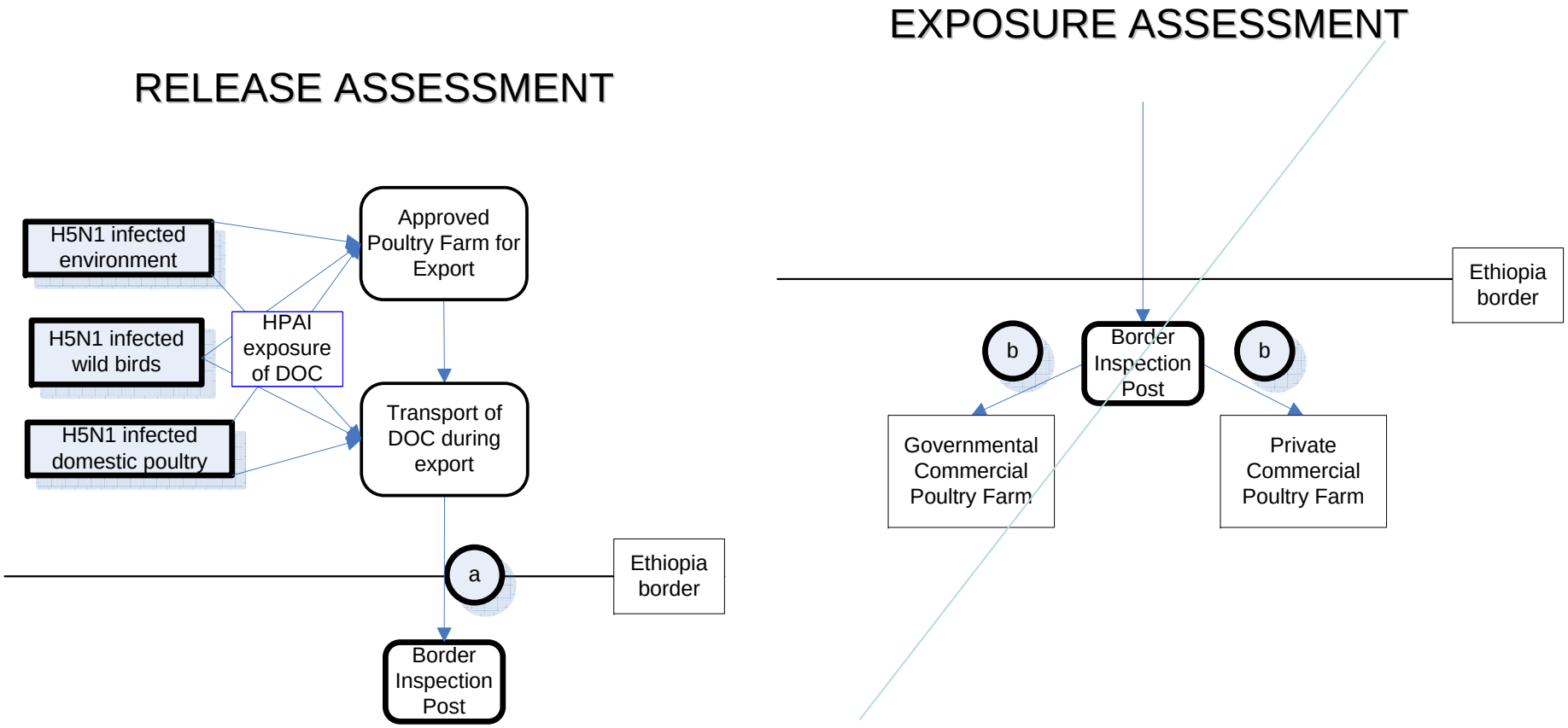
Jonas Waldenström

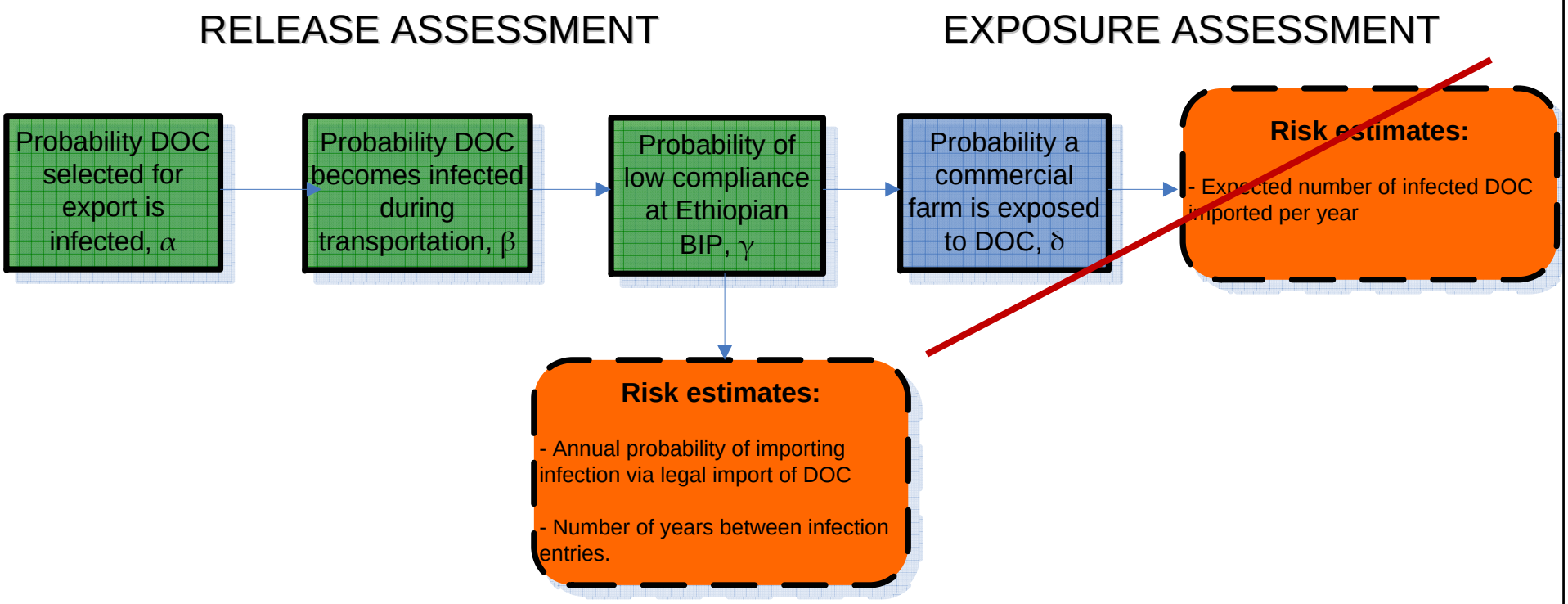
Animal Health Risk Assessments

Quantitative assessment of the risk posed by live bird imports for the introduction of HPAI H5N1 into Ethiopia

Model Pathways



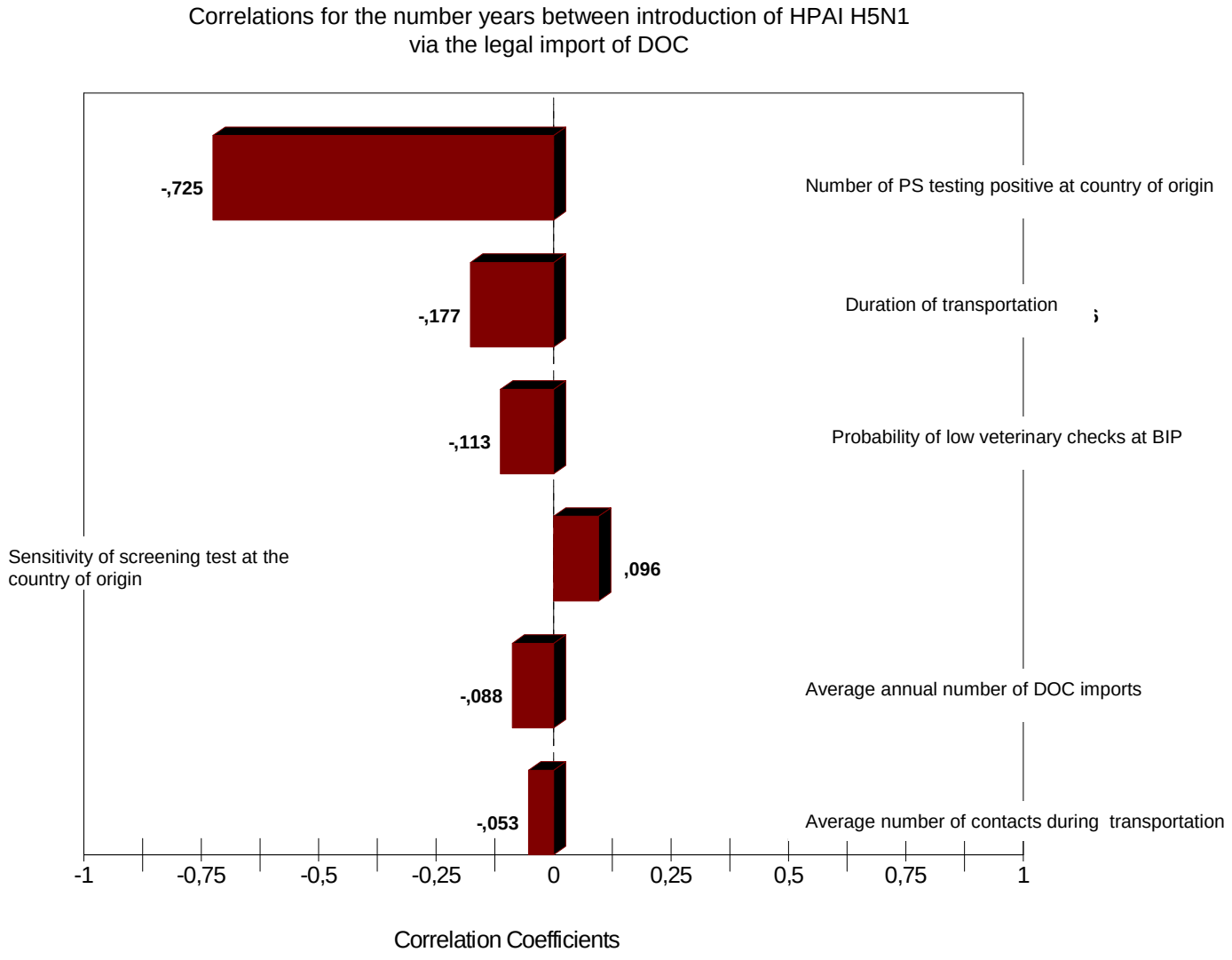
Probabilities Assessed During Model Experimentation



Example of Data Required to Estimate α

PARAMETER	DISTRIBUTION/VALUE	UNIT	SOURCE
Probability DOC selected for export is infected, α			
Number of DOC produced by infected layer up to detection	RiskIntUniform(1;2)	bird	OIE, 2006; NASS, 2005.
Number of parent stock (PS) test-positive	RiskPert(0;0;161)	bird	Assumed: Upper value based on 0.1% of parent stock tested as positive.
Sensitivity of screening test	RiskPert(0.87;0.91;0.93)	%	Data section
Number of parent stock annually tested in all approved farms	161220	bird	Estimated: USDA, 2006; DEFRA, 2006; CBS, 2006; FAOSTAT, 2006

Variables Influencing the Baseline Model



Comparison of Sensitivity Spaces of Both Variables