DFID-Funded Collaborative HPAI Research Project: Risk Management Options

J. Otte, D. Pfeiffer, and D. Roland-Holst

International Meeting on Pro-Poor HPAI Risk Reduction

Phuket, 26 October 2010

A Collaborative Research Project Funded by:

DFID Department for International Development

Implemented by:

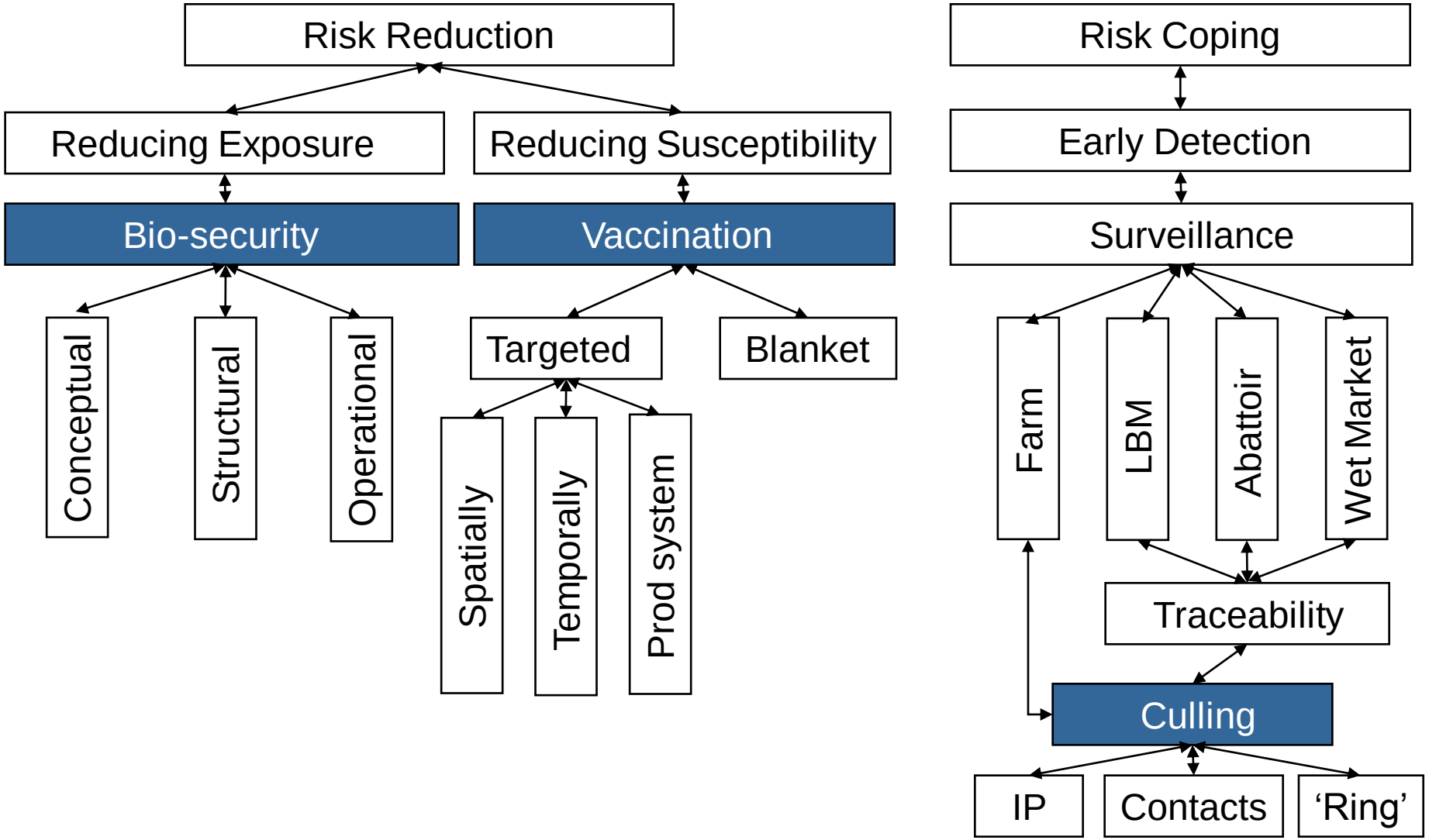
FAO

Royal Veterinary College University of London

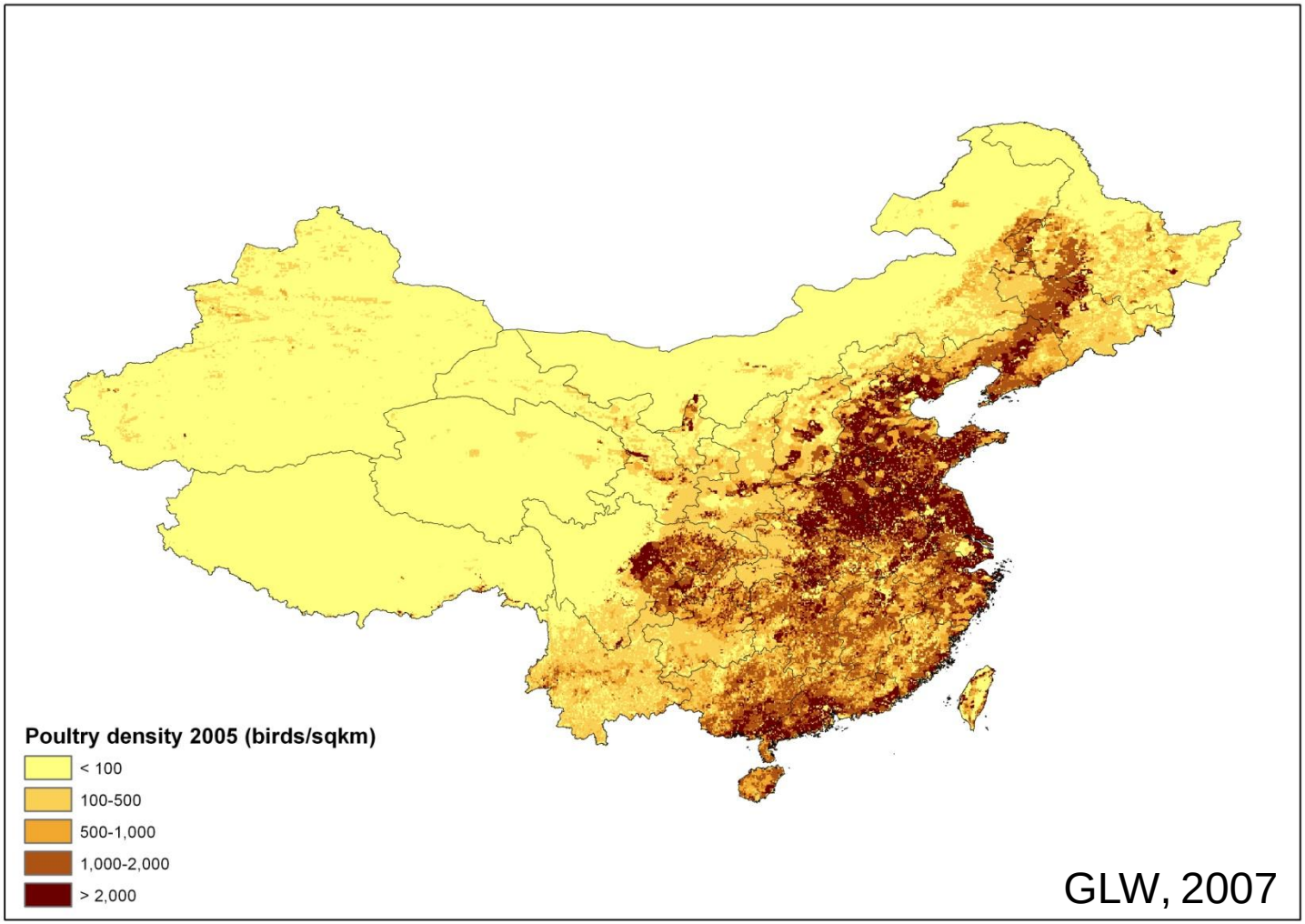
IFPRI

ILRI International Livestock Research Institute

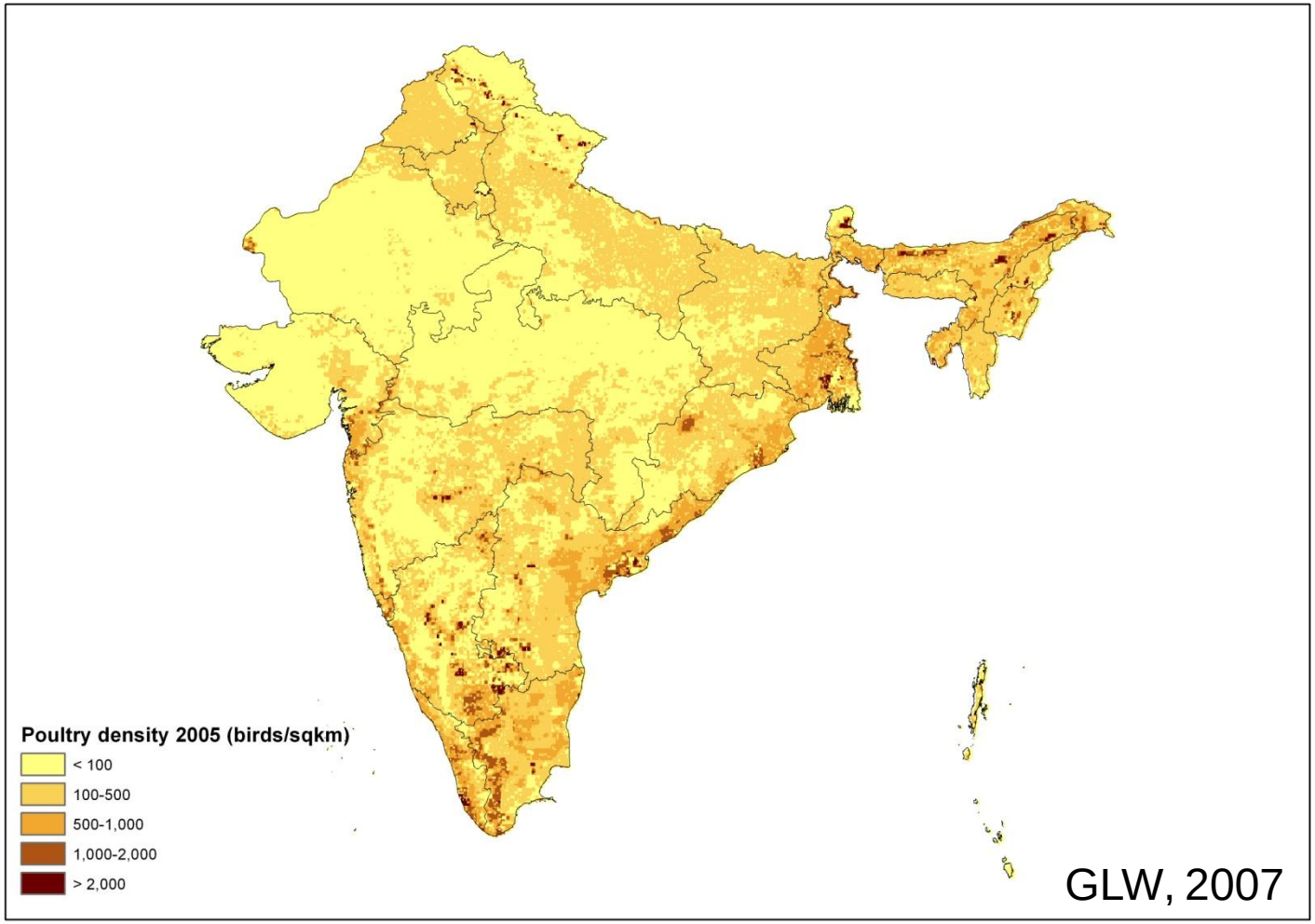
Disease Control Measures



Poultry Density China, 2005

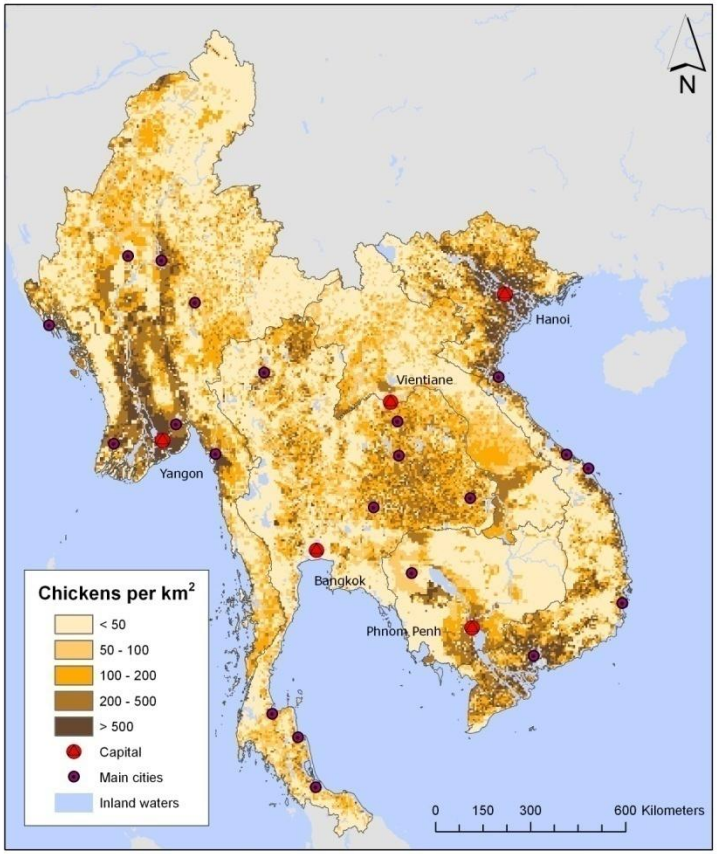


Poultry Density India, 2005



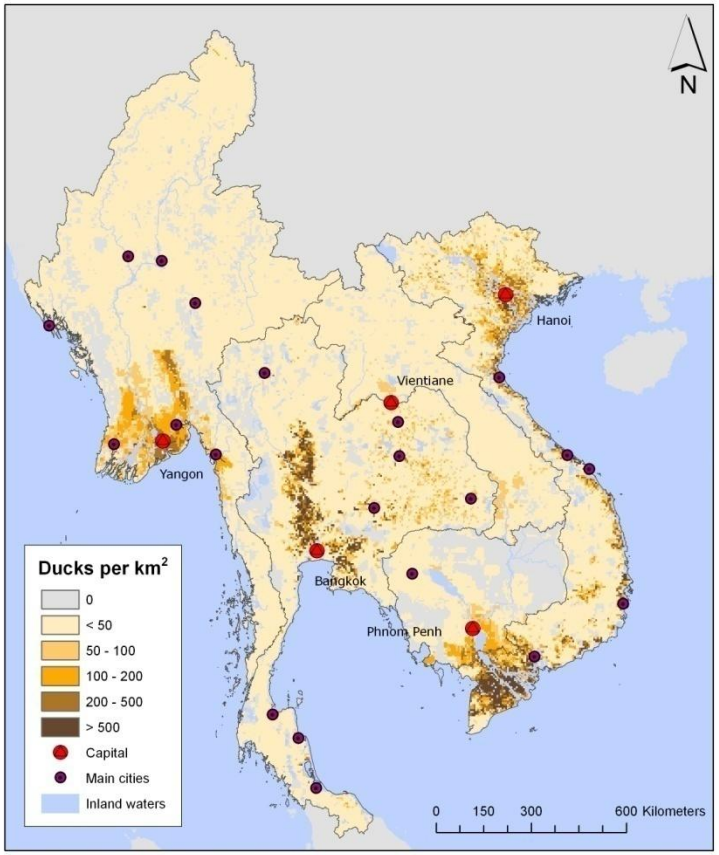
SE-Asia Chicken & Duck Density

Chicken distribution map



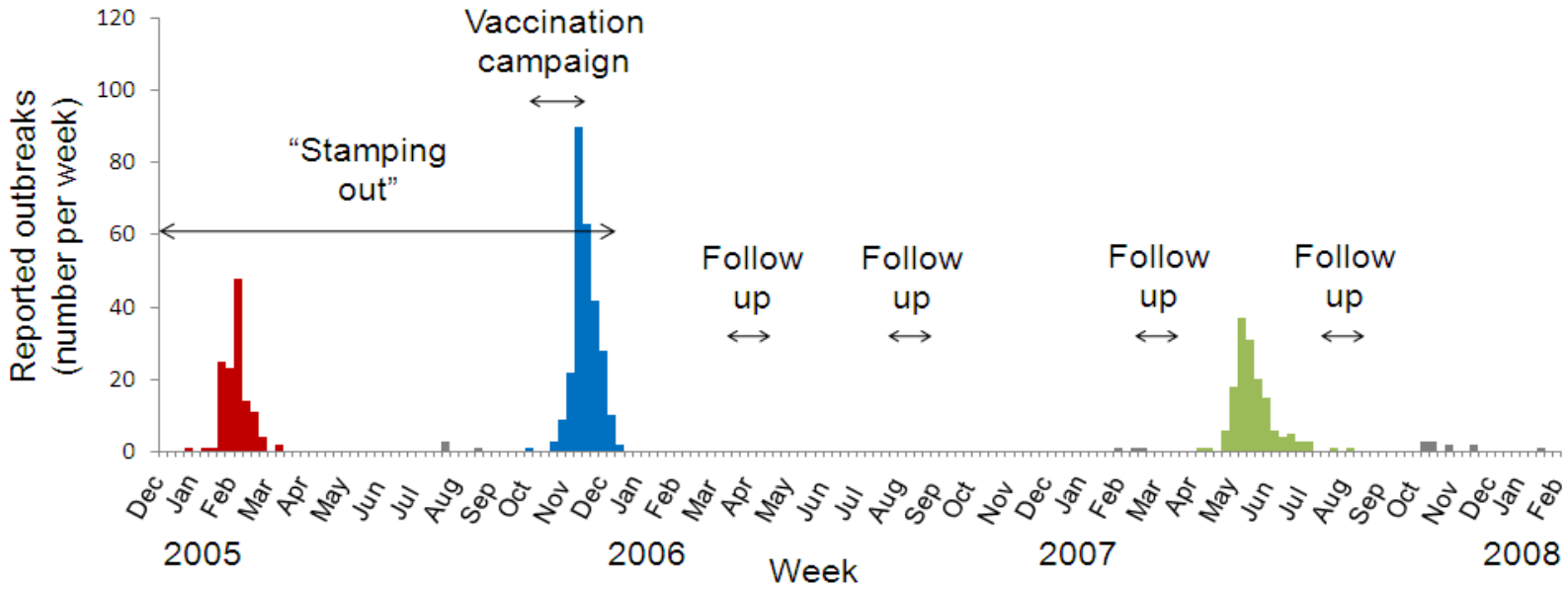
REFERENCE:
Cambodia - DAHP 2003 Census (AVSF 2004), year 2002
Laos - Data elaborated from National Statistical Centre, State Planning Committee, 2000, year 1999
Myanmar - School of Veterinary Science, University of Queensland, Australia, year 2007
Thailandia - Census 2004, Department of Livestock Development
Vietnam - General Statistics Office of Vietnam, Agricultural Census database 2001

Duck distribution map



REFERENCE:
Cambodia - DAHP 2003 Census (AVSF 2004), year 2002
Laos - Data elaborated from National Statistical Centre, State Planning Committee, 2000, year 1999
Myanmar - School of Veterinary Science, University of Queensland, Australia, year 2007
Thailandia - Census 2004, Department of Livestock Development
Vietnam - General Statistics Office of Vietnam, Agricultural Census database 2001

Viet Nam: Outbreaks & Control Measures

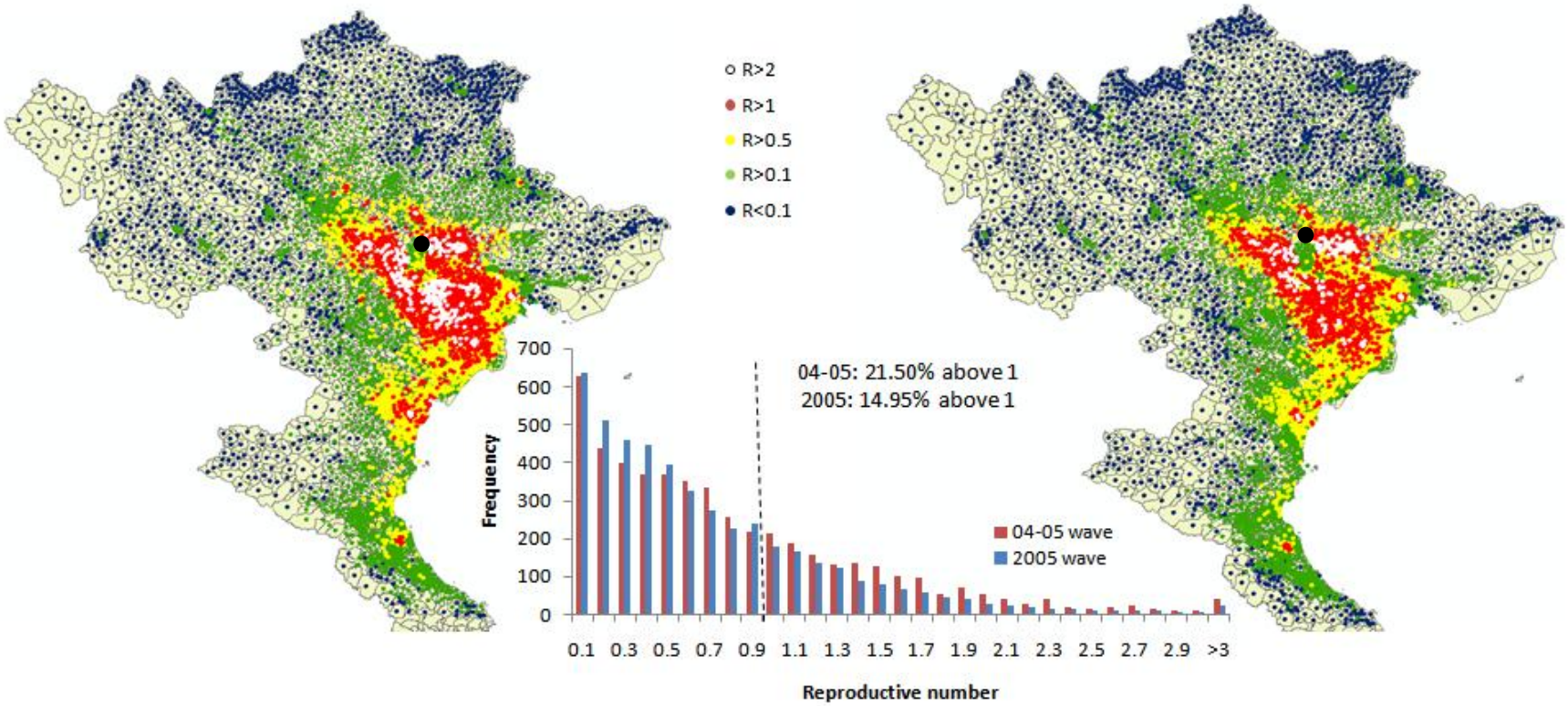


- 'Stamping out' of outbreaks 2004-2005.
- Compensation 10-15% market value increasing to 50% June 05
- First round vaccination campaign Oct-Dec 2005
- Twice yearly follow-up campaigns
- Sero-survey estimated 55% overall protection
- During 2007 only infected flocks culled with ring vaccination

Pre- & Post-Vaccination Comparison: Reproductive Numbers

Wave 2004-05, pre-vaccination

Wave 2005, post-vaccination

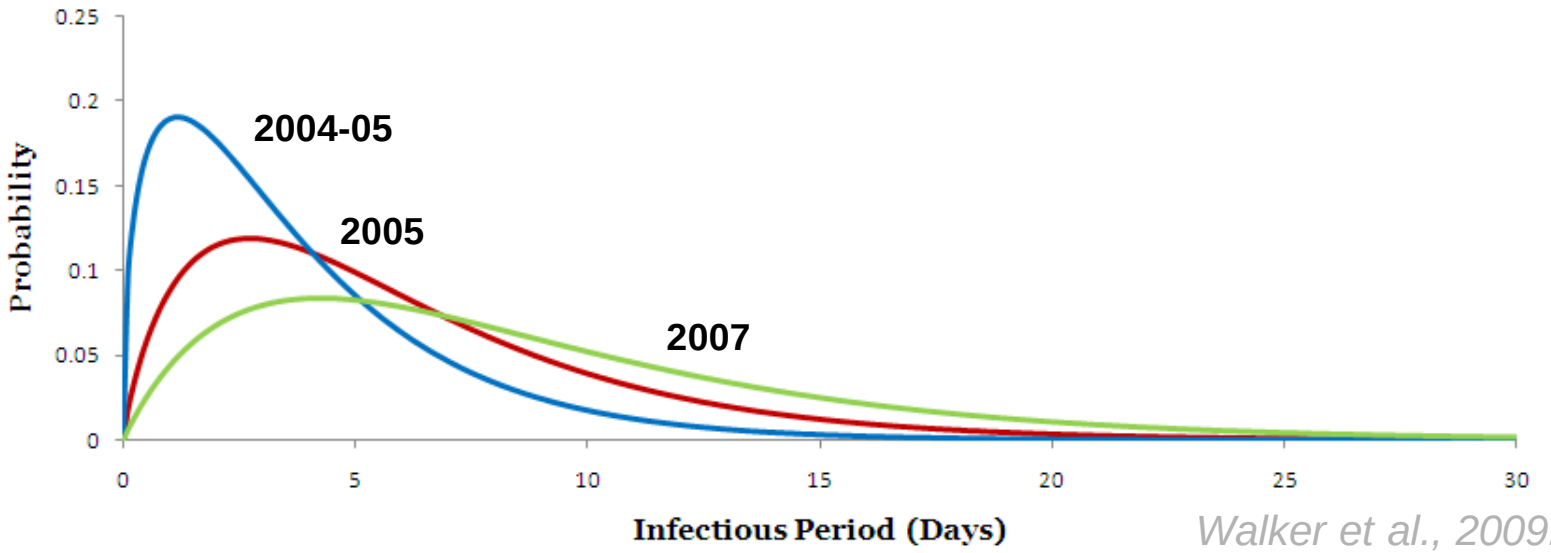


Walker et al., 2009.

Effect of Vaccination (1)

- **Significant reduction in infectivity (daily spread) following vaccination**
- Relative infectivity after vaccination comparable to 45% effective coverage
- Agrees with estimate from serology (55% coverage well within C.I.s)
- **But need to know how long communes were infectious**

Effect of Vaccination (2)



Walker et al., 2009.

- **Increase in infectious period after vaccination**
- May indicate 'silent spread' of infection in vaccinated flocks
  - Infection spreads amongst vaccinated but harder to detect due to delay/reduction in clinical signs.
- Shift in species distribution - unprotected ducks?

Effect of Vaccination (3)

- Reduction in infectivity offset by increased opportunity to spread
- Produced slower but more persistent wave post-vaccination
- RRD once again area of high risk
- **Emphasizes need for more rapid detection and reporting**

Impact of Improved Detection, 2005 Wave

Max. nr. of days to detection	Outbreaks averted (%)	Reduction in duration of wave (%)	Prob. of ≤ 10 outbreaks (%)
21	12	22	2
14	49	50	18
10	84	73	53
04-05 rate of detection	**67**	**56**	**20**

Walker et al., 2009

Private Financial Incentives for Vaccination

System	Vaccinations required	Min. Vaccination costs per prod. cycle (USD cents)	Max. Value at risk of loss (USD)	Min. Break even outbreak risk per prod. cycle (%)
Grant parent chicken hen	4	16	182	**0.1**
Layer chicken hen	4	16	4	**1**
Broiler chicken (white)	2	5	4	**1**
Broiler chicken (crossbred)	2	5	6	**2**
Chicken Flock: Mixed/ Backyard	up to 4	72	33	**3**

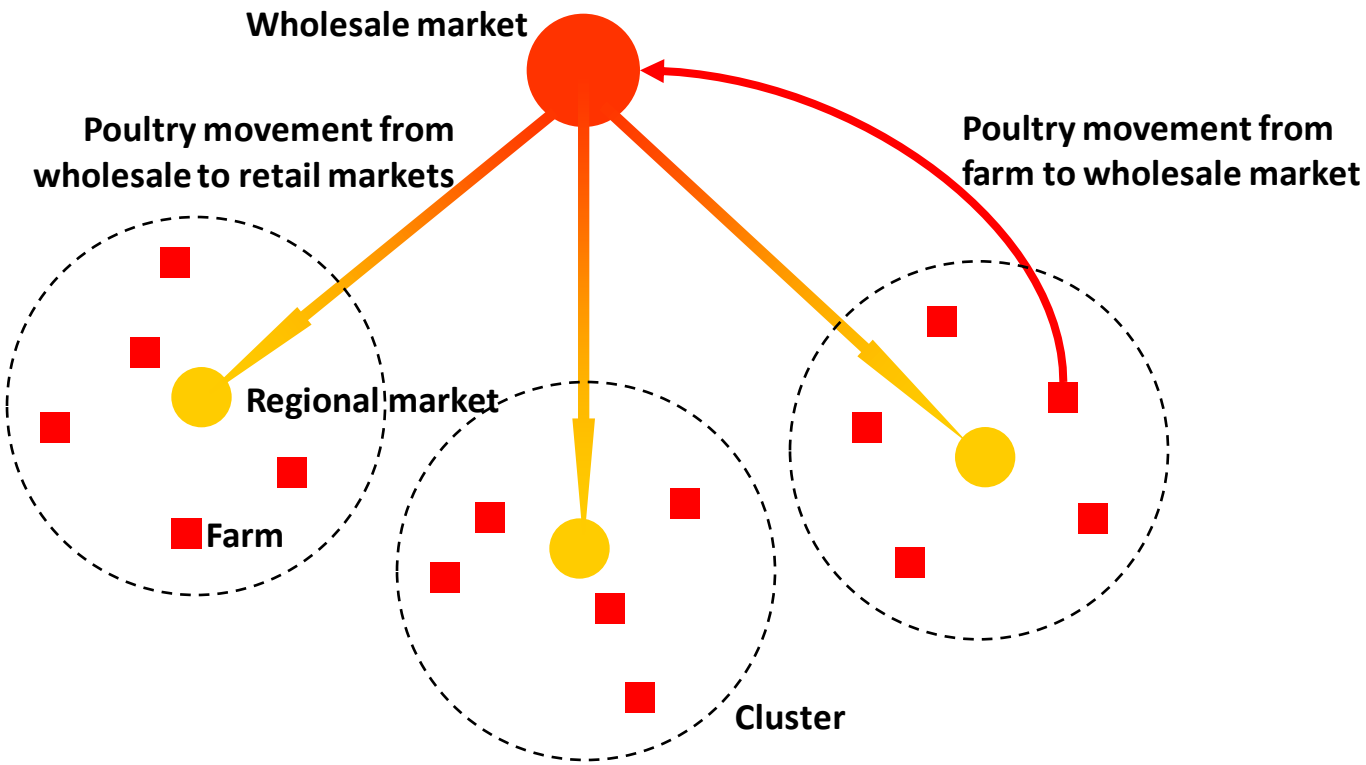
Flock Type / Size & HPAI Risk, Viet Nam

	Risk per 1,000 Flocks			
	2004/05	2005	2007	2008
Backyard	0.013	0.007	0.005	0.0003
Small commercial	0.633	0.227	0.062	0.045
Medium commercial	21.359	8.370	1.848	0.815
Large commercial	90.000	62.500	2.500	2.500
Total	**0.126**	**0.052**	**0.014**	**0.006**

Private Financial Incentives

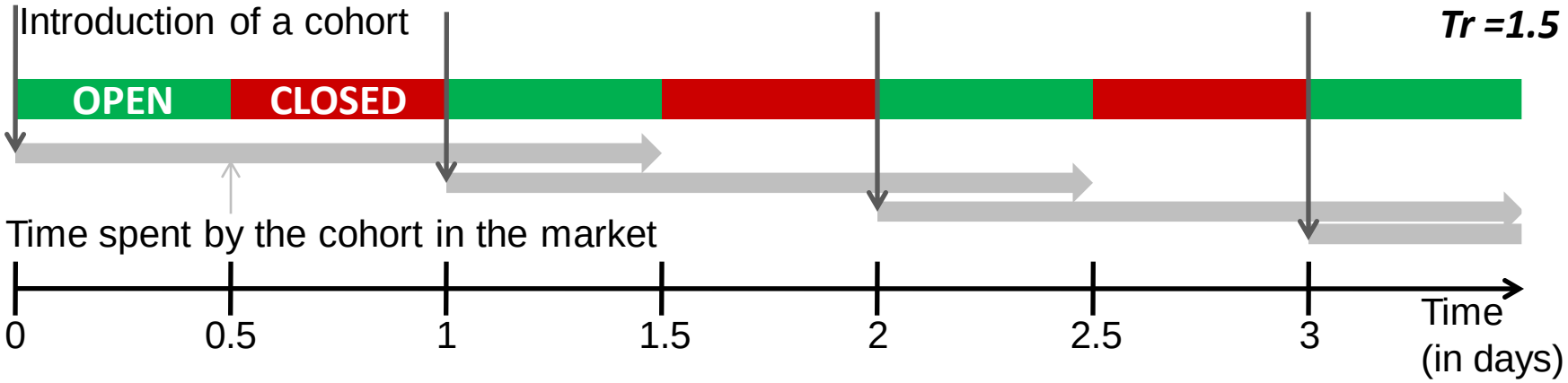
- For (risk neutral) farmers the financial incentives to use vaccination are too low to reach high coverage levels
- Even free of charge vaccination may not be accepted by all flock owners (e.g. hens in lay)
- Higher vaccination incentives and subsequent coverage are only likely to be observed when the perceived private risk increases due to reports/news of surrounding outbreaks
- Vaccination costs for 1,000 industrial broiler flock owner vary between 325 and 651 USD per year
  - Simple improvements such as purchase and use of cleaning and disinfection equipment may cost less and have an equal risk reduction effect

Poultry Trade & Live-bird Markets



Fournie et al., 2009

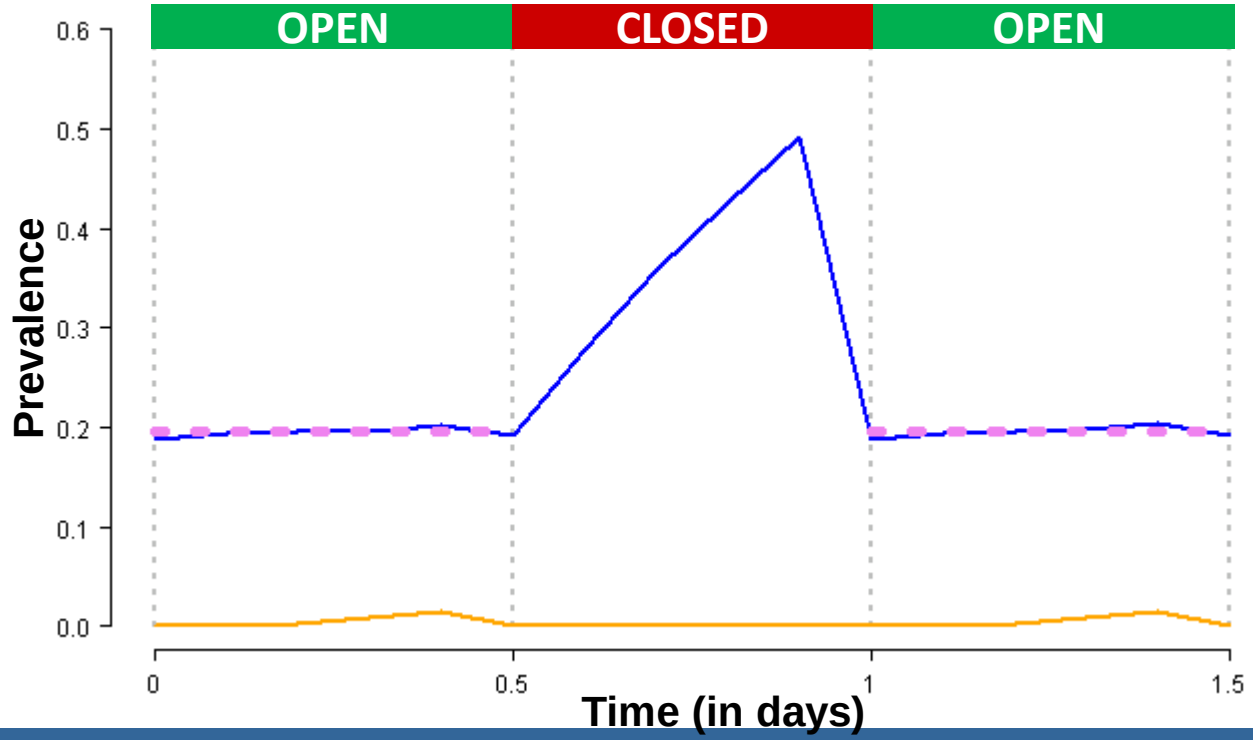
Virus Amplification within LBM



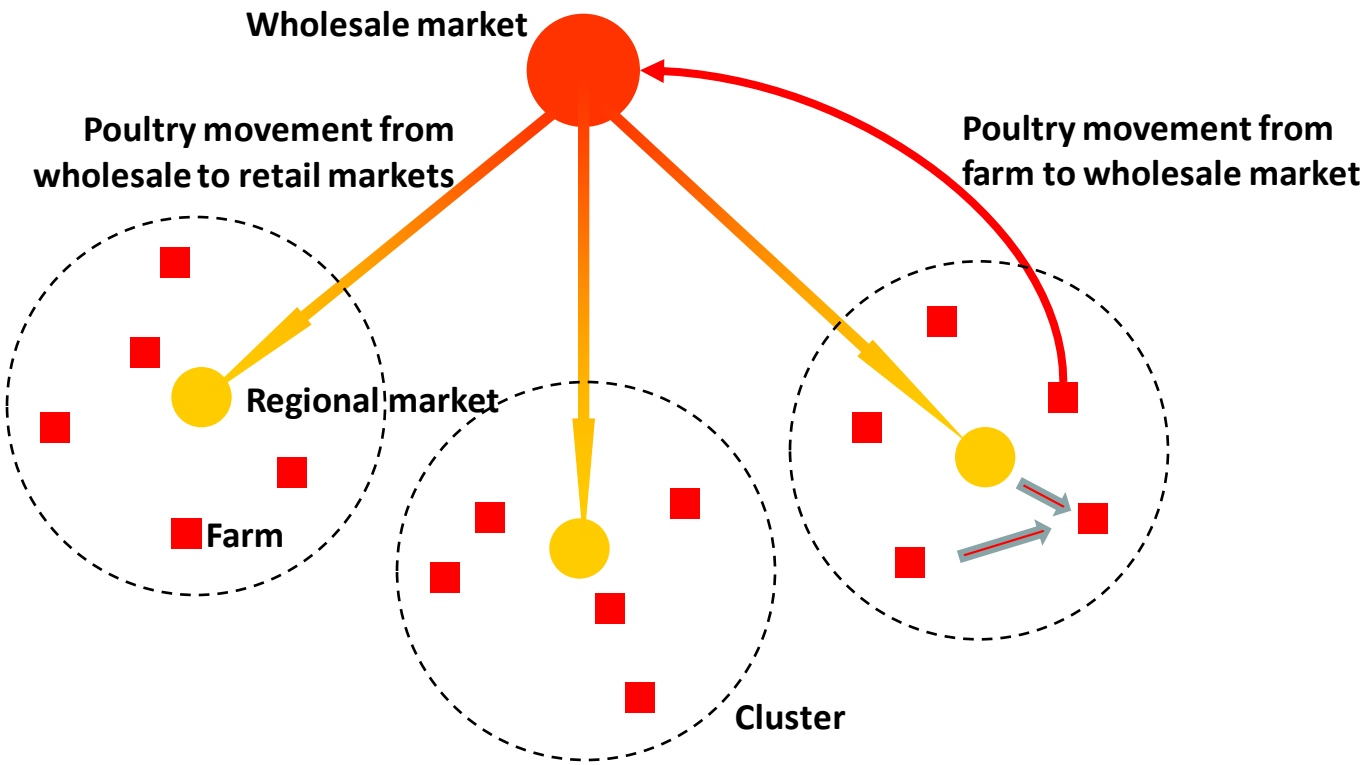
The potential for the virus to circulate silently within the LBM depends on the time a bird remains in the market system

Fournie et al., 2009

Virus Amplification within LBM



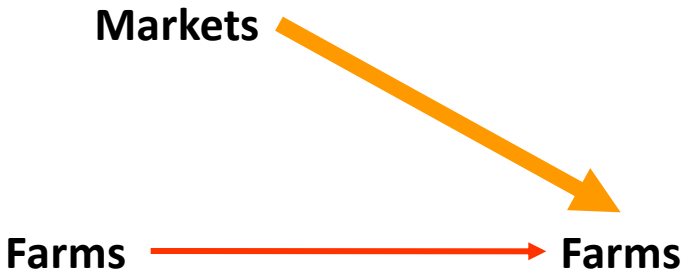
Poultry Trade & Live-bird Markets



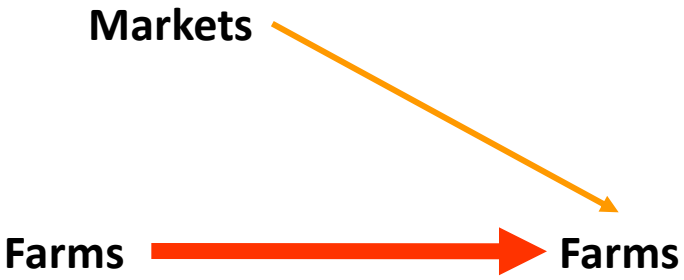
Fournie et al., 2009

Comparison of Interventions in Markets vs. Farms

Main sources of infection: markets



Main sources of infection: other farms



In Farms:

- Detection & stamping out, vaccination

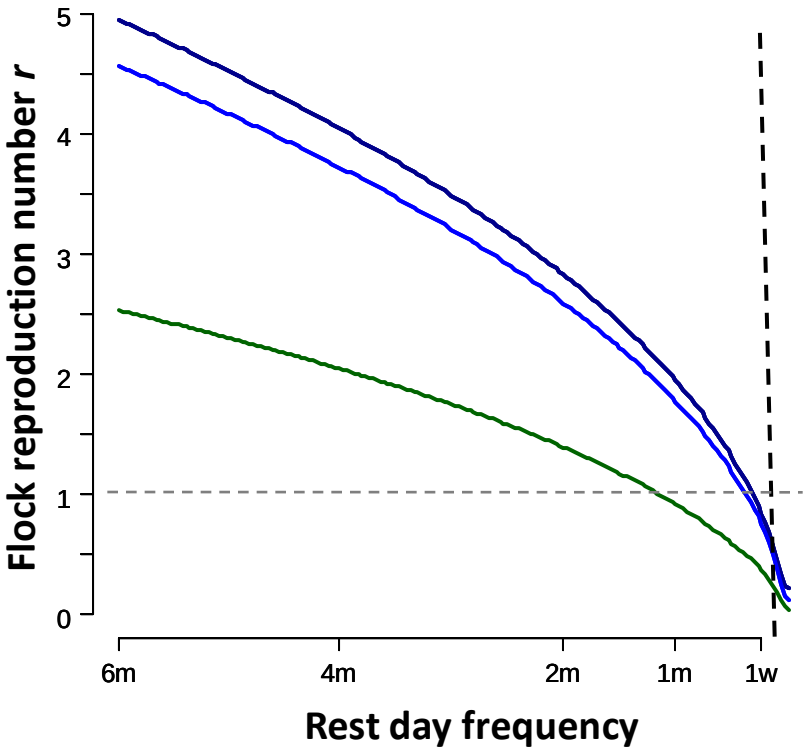
In Markets:

- Rest days, closure

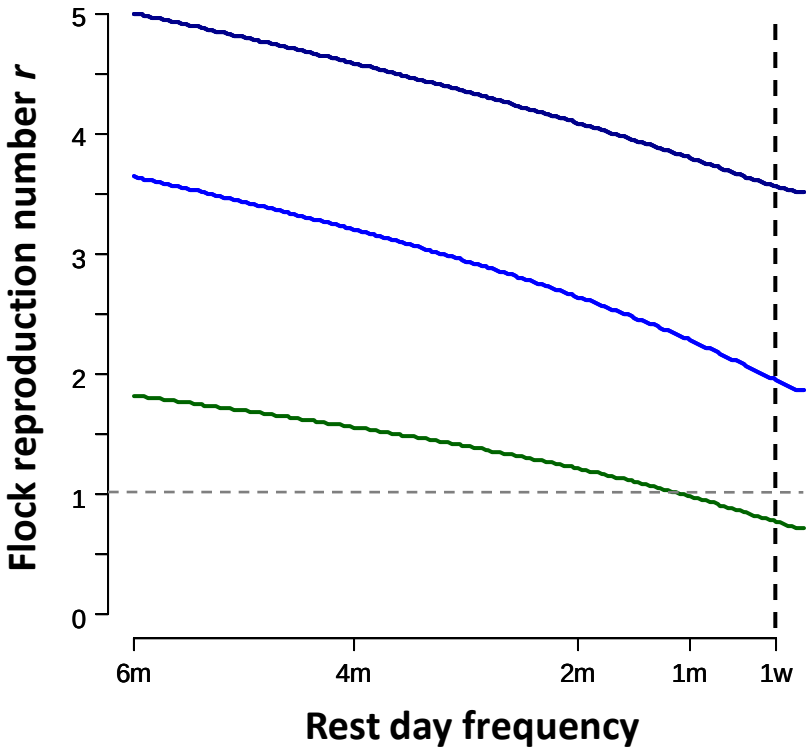
Fournie et al., 2009

Compared Impact of Interventions on Flock Reproduction Number *r*

Main sources of infection: markets



Main sources of infection: other farms



- Rest days
- Rest days + early detection
- Rest days + early detection, vacc 50%

Fournie et al., 2009

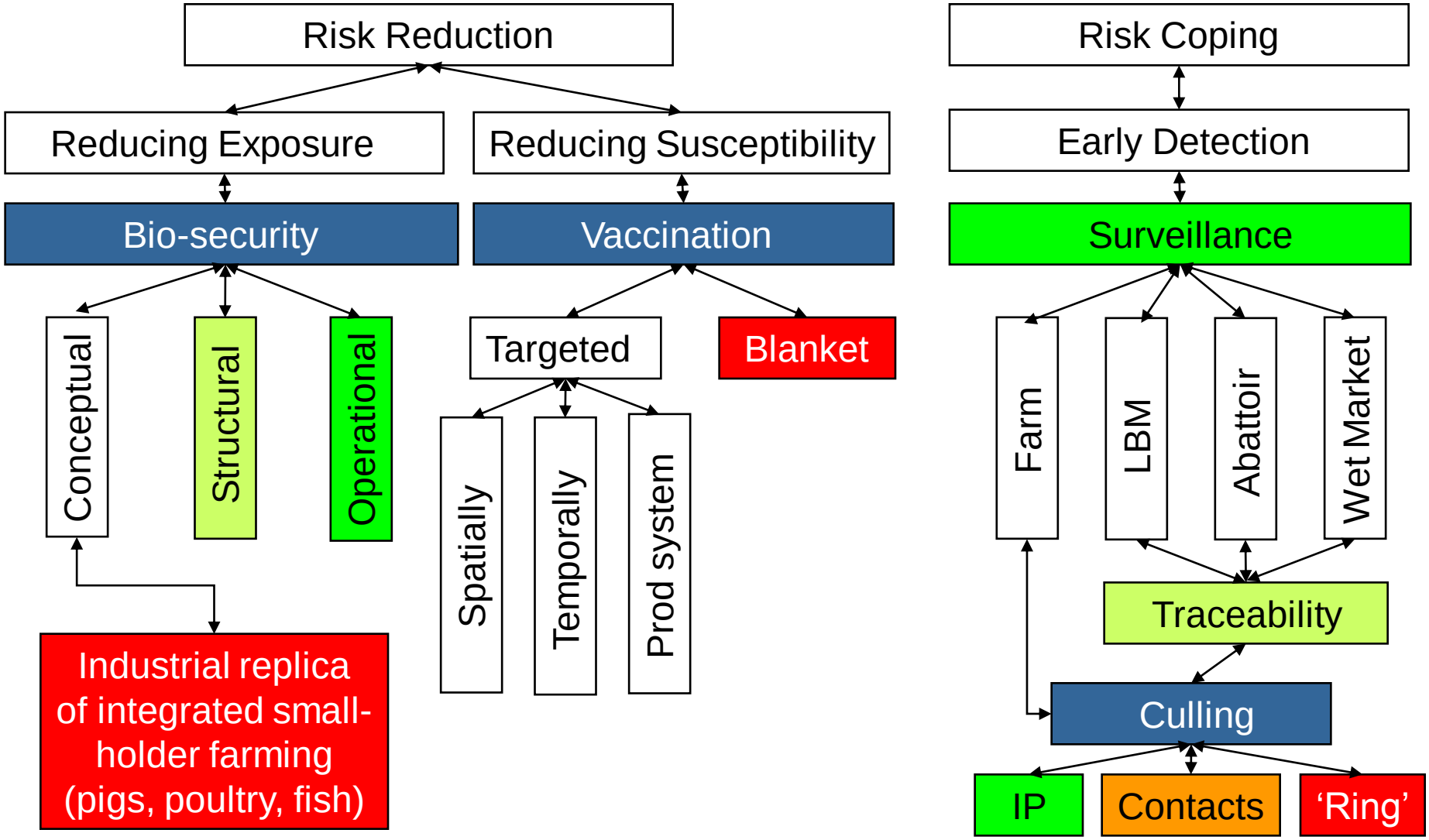
Targeting Control Measures

Scenario*	Probability of extinction at day 48 (%)	Prop. cases averted (%)
B1: Backyard flock 'biosecurity' up	22	77
B2: Comm. flock 'biosecurity' up	8	60
B3: B1 & B2	43	92
V1: Backyard flock vaccination	21	71
V2: Commercial flock vaccination	2	60
V3: V1 & V2	31	99

*Population structure of 1,000 backyard & 250 commercial flocks

Magelhaes et al., in prep.

Disease Control Measures



Conclusions

- Don’t expect the magic recipe and quick victory!!
- Adapt ‘traditional’ approaches to prevailing circumstances, including:
  - disease zoning, compartments, within countries, accreditation schemes, etc
- Pilot new approaches building on advances in:
  - Diagnostics (quick and cheap)
  - Information technologies (SMS, RFIDs, etc.)
  - Market developments
- H5N1 is not the ONLY risky virus!!!

Shortridge et al., 2000. Interspecies transmission of influenza viruses: H5N1 virus and a Hong Kong SAR perspective, Veterinary Microbiology, 74,141-147

`Who cares about H5N1, our jobs are in jeopardy'