Jockey Club College of Veterinary Medicine and Life Sciences

香港城市大學
City University of Hong Kong
in collaboration with Cornell University

Regional Trends of Risk Factors for Spread of ASF in Asia

Dirk Pfeiffer

Chow Tak Fung Chair Professor of One Health, City University of Hong Kong, Hong Kong, PR China
Professor of Veterinary Epidemiology, Royal Veterinary College, University of London, United Kingdom
Adjunct Professor at China Animal Health and Epidemiology Centre, Qingdao, PR China

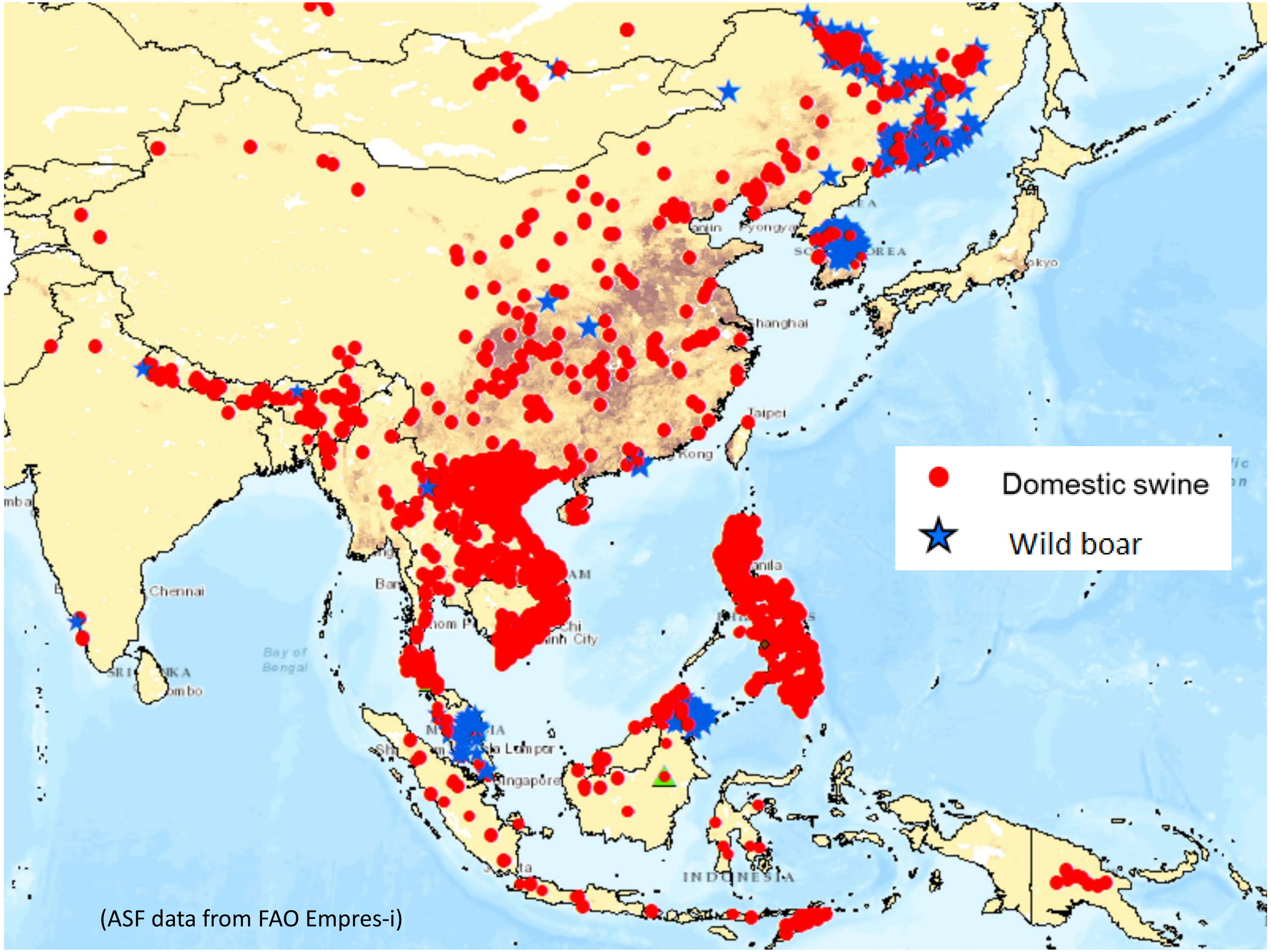
#62 [QS] World University Rankings 2025

#1 [QS] World University Rankings 2024 Veterinary Science

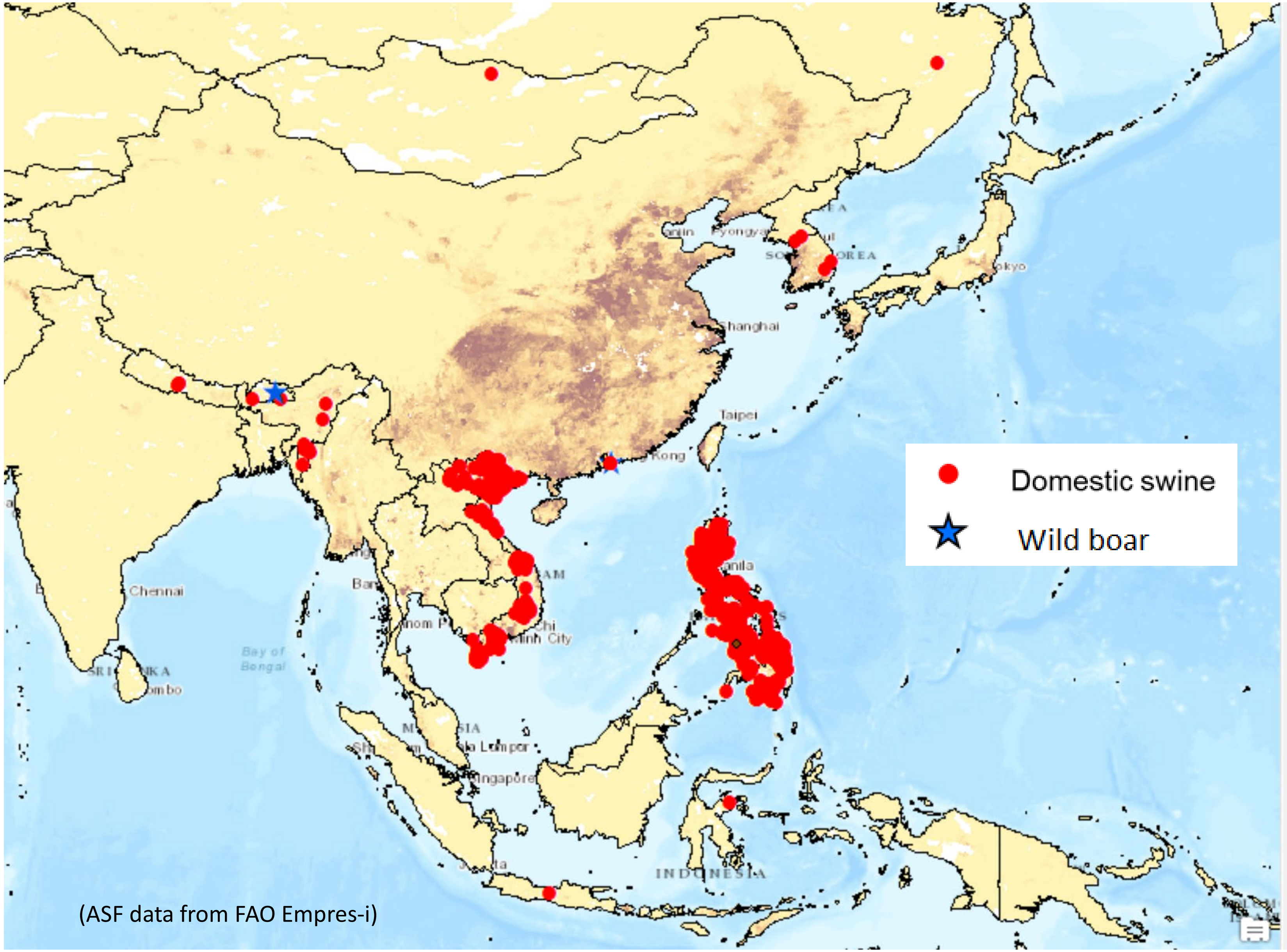
Royal Veterinary College
University of London

Regional ASF Pattern

Reported African Swine Fever Outbreaks since 2018

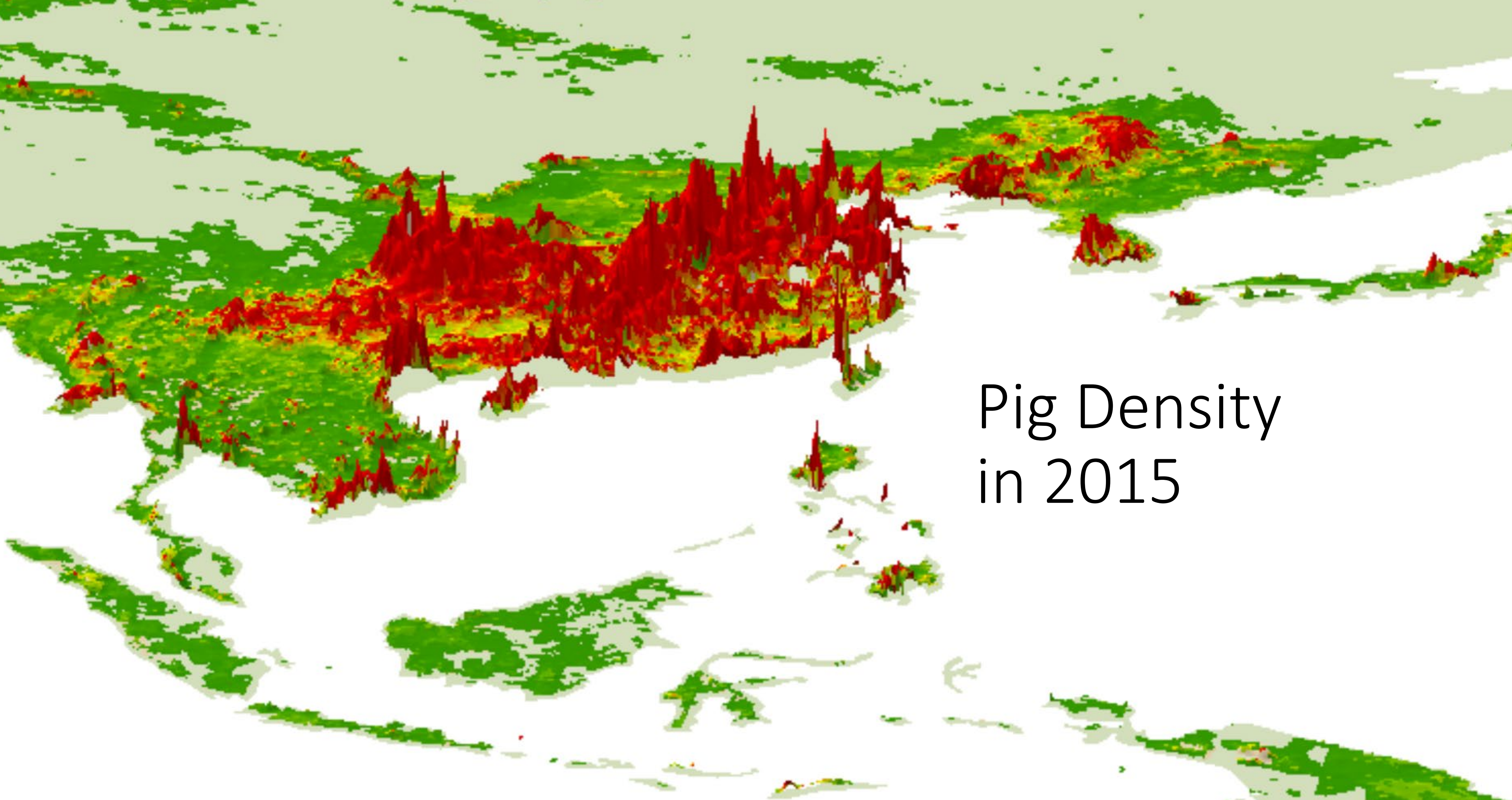


Reported ASF Outbreaks in Jan – June 2024



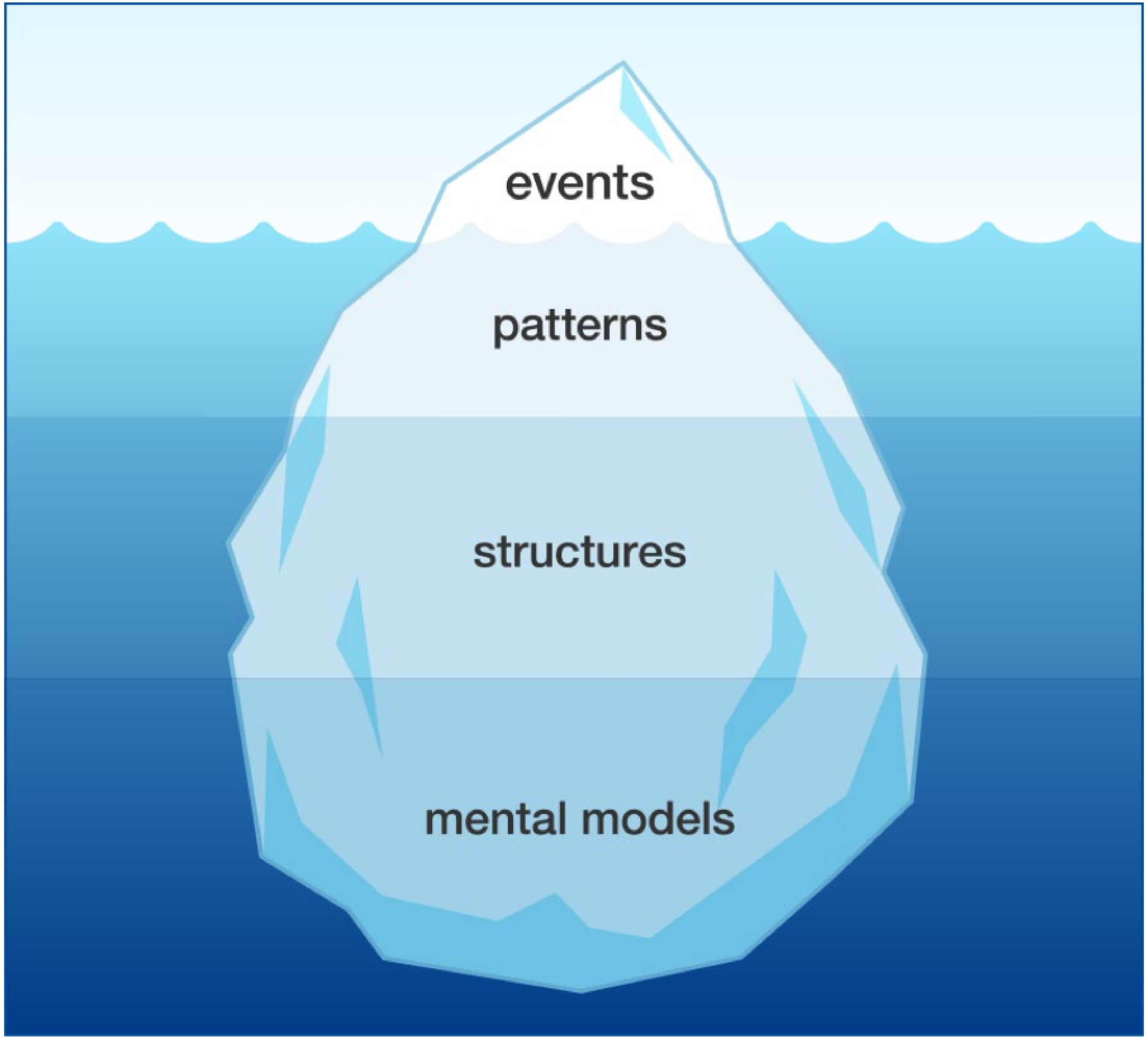
(ASF data from FAO Empres-i)

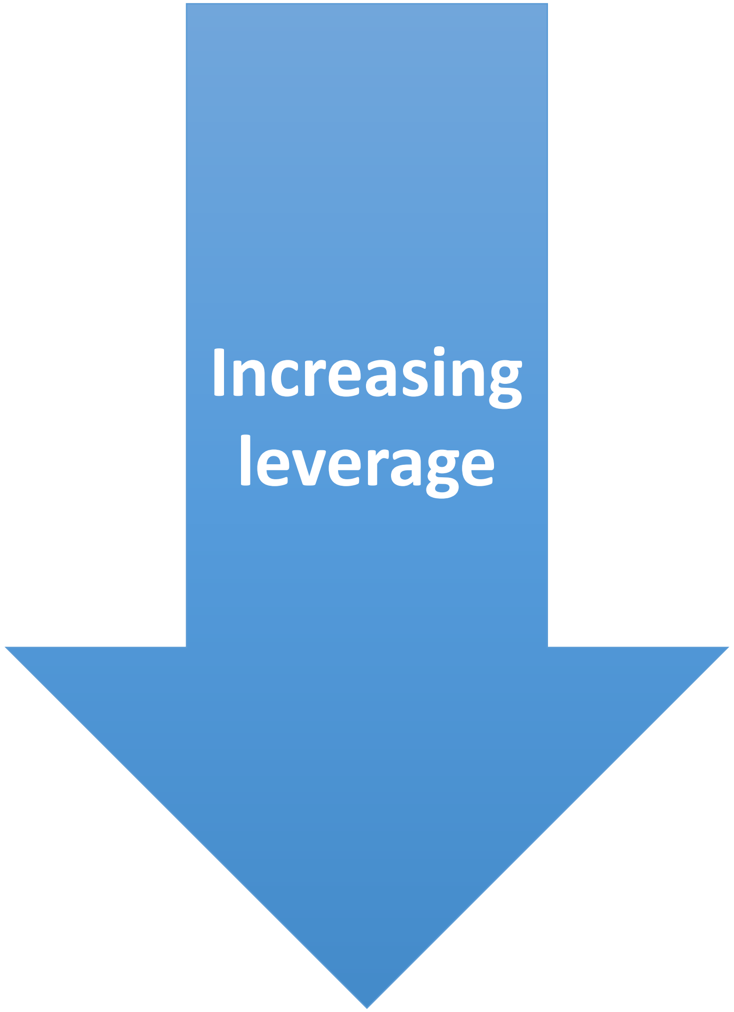
Pig Density in 2015



Pig density data from: Gilbert M, G Nicolas, G Cinardi, S Vanwambeke, TP Van Boeckel, GRW Wint, TP Robinson (2018) Global Distribution Data for Cattle, Buffaloes, Horses, Sheep, Goats, Pigs, Chickens and Ducks in 2010. Nature Scientific data, 5:180227. doi: 10.1038/sdata.2018.227

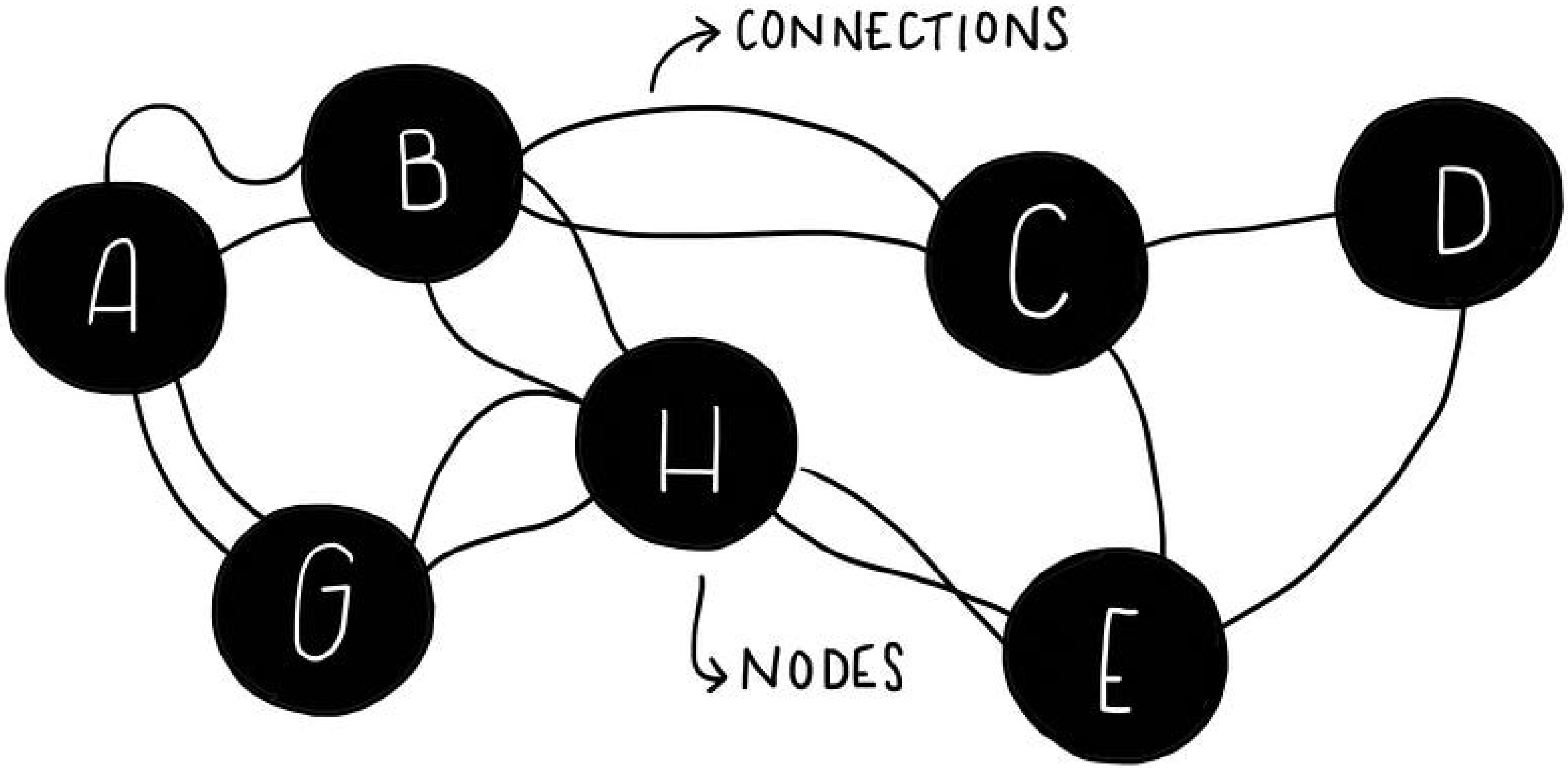
Pork Value Chains as Complex Systems



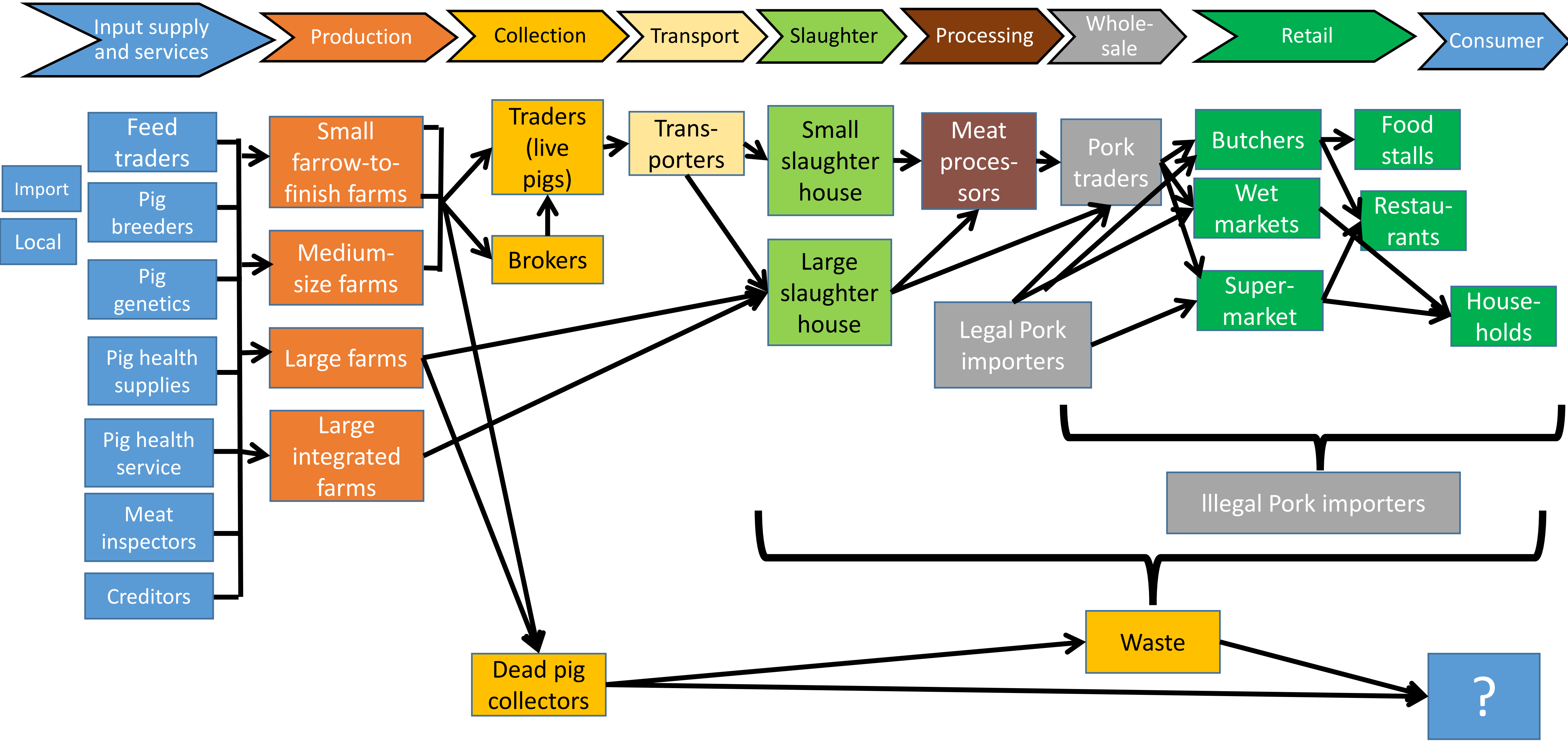


[Iceberg model Sytems thinking | Change Agent (change-agent.jp)](change-agent.jp)

INTERCONNECTED FEEDBACK LOOPS?



Value Chain of Pork Food System



Complex Systems Perspective on Pork Value Chain

Governance

Government

Scientists

Lobby groups

Policy makers

Policies

Enforcement

Incentives

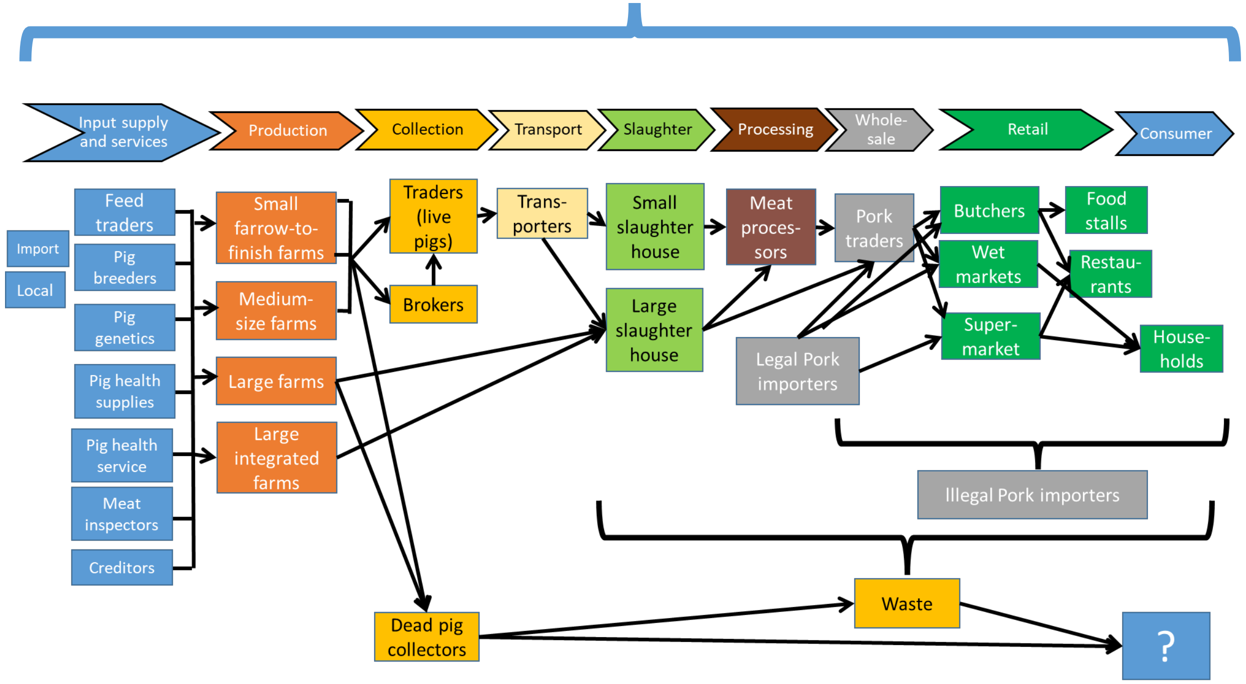
Risk mitigation

Technological

Financial

Social

Other factors



Threats

Animal disease

Global disorder

Natural desasters

Targets

Pork

Profit

SDGs

Political Economy

Power

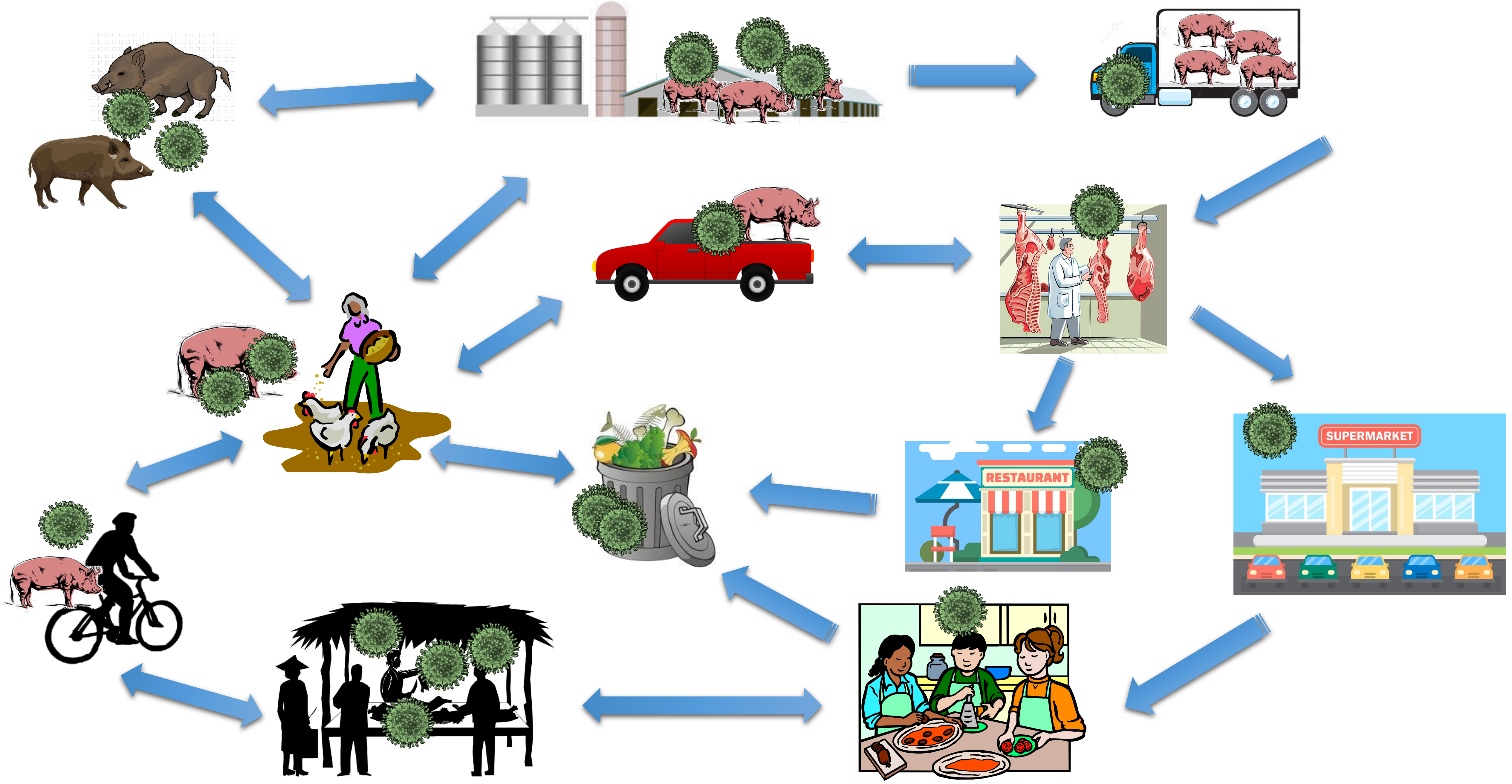
Profit distribution

Gender

Social

Consumer preferences

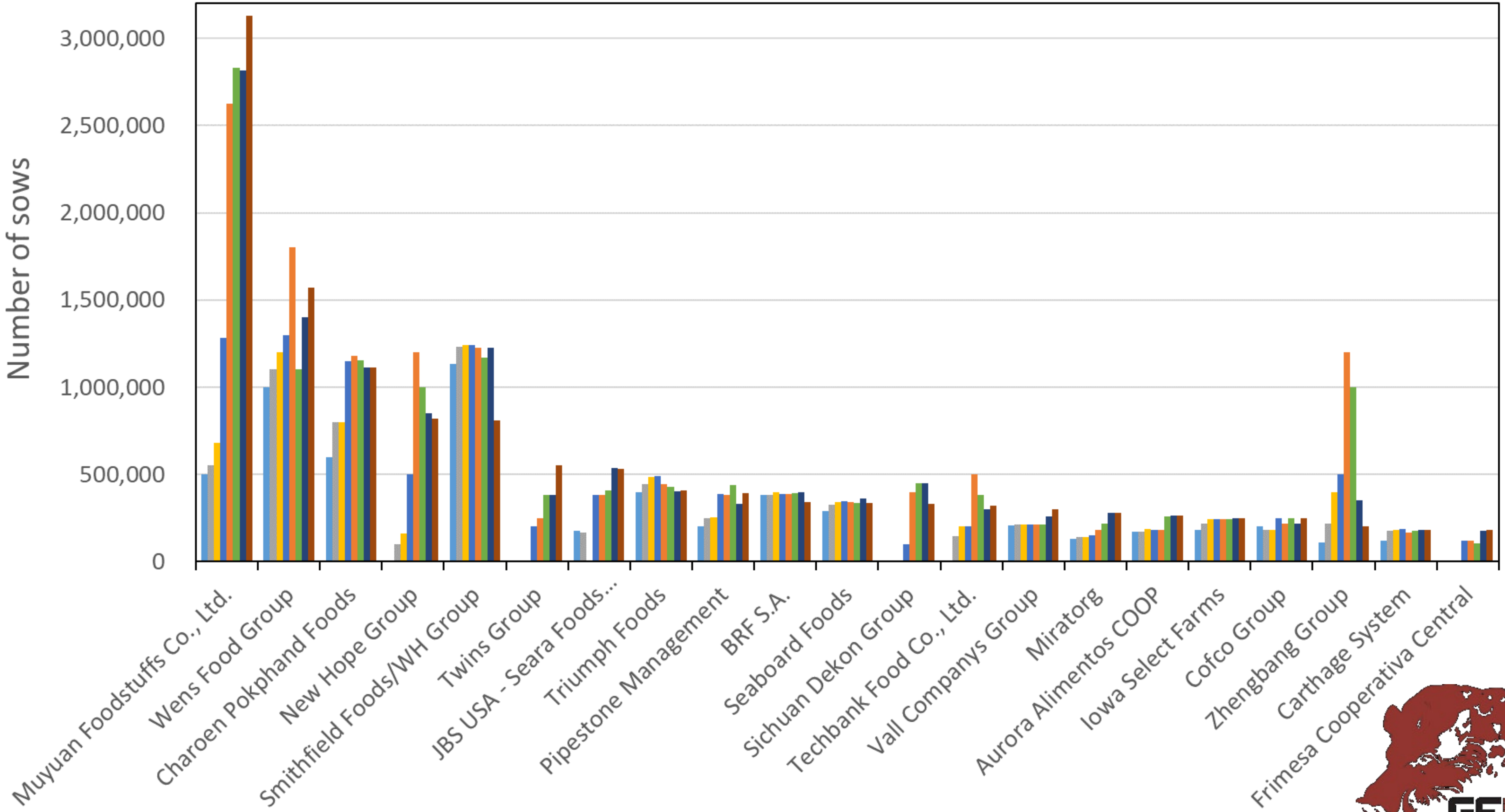
Spread of ASF Virus in Food Systems in South, South-East and East Asia



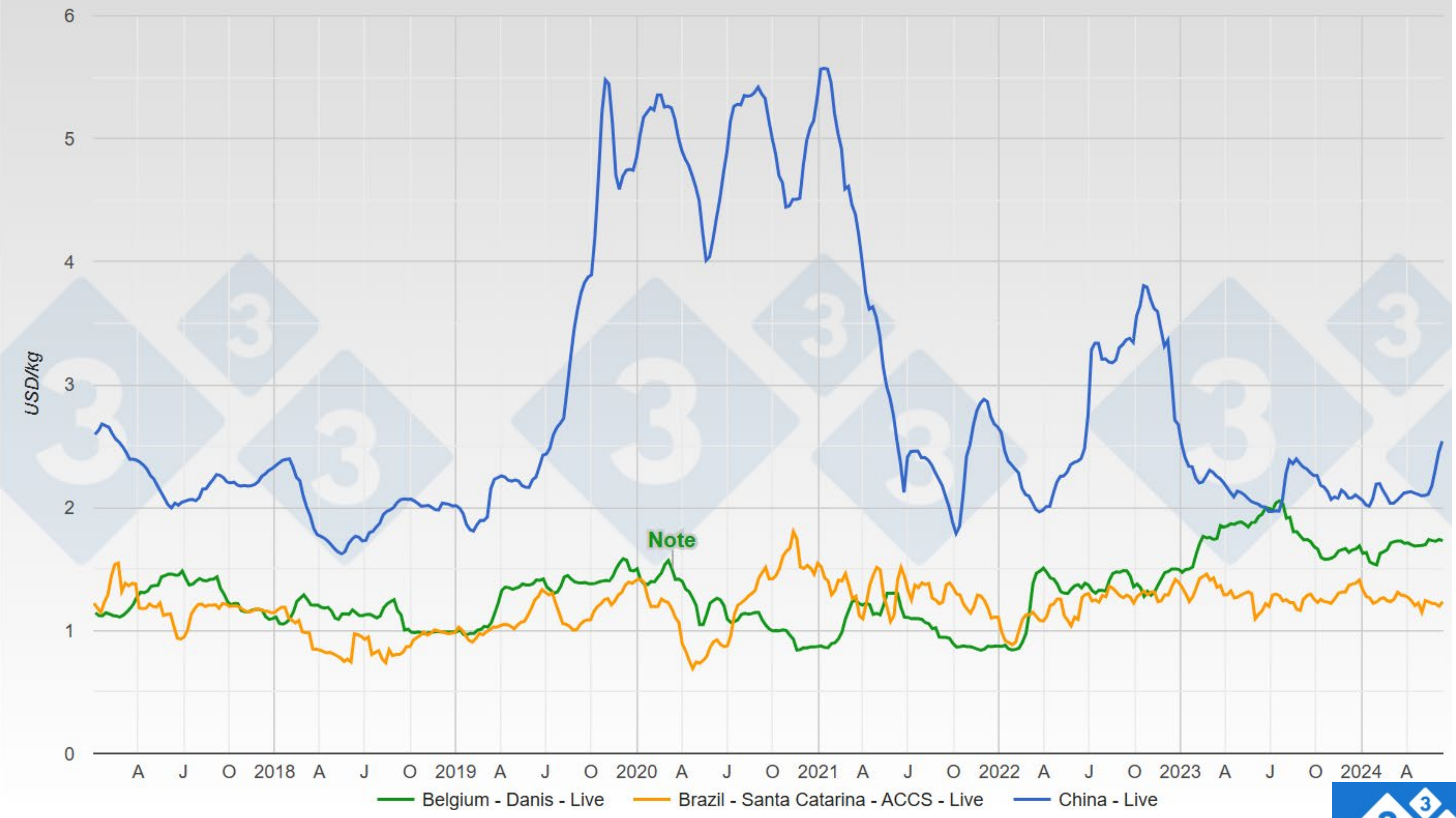
Examples of Positive and Negative Feedback Loops in Pork Value Chain

- response to change is key difference between positive and negative feedback
  - positive feedback amplifies change
  - negative feedback reduces change
- need to be able to predict these when implementing interventions
- examples
  - increased number of legal imports
    - pork price decreases
  - local ASF outbreak
    - pork price increases
      - increase in illegal imports
      - farms increase pig density
  - imported feed price increases
    - pork price increases

Top 20 Global Pig Mega Producers (no of sows) between 2016 and 2023



Temporal Pattern of Daily Pork Prices since 2017 for China, Belgium and Brazil (US$ per kg live weight)

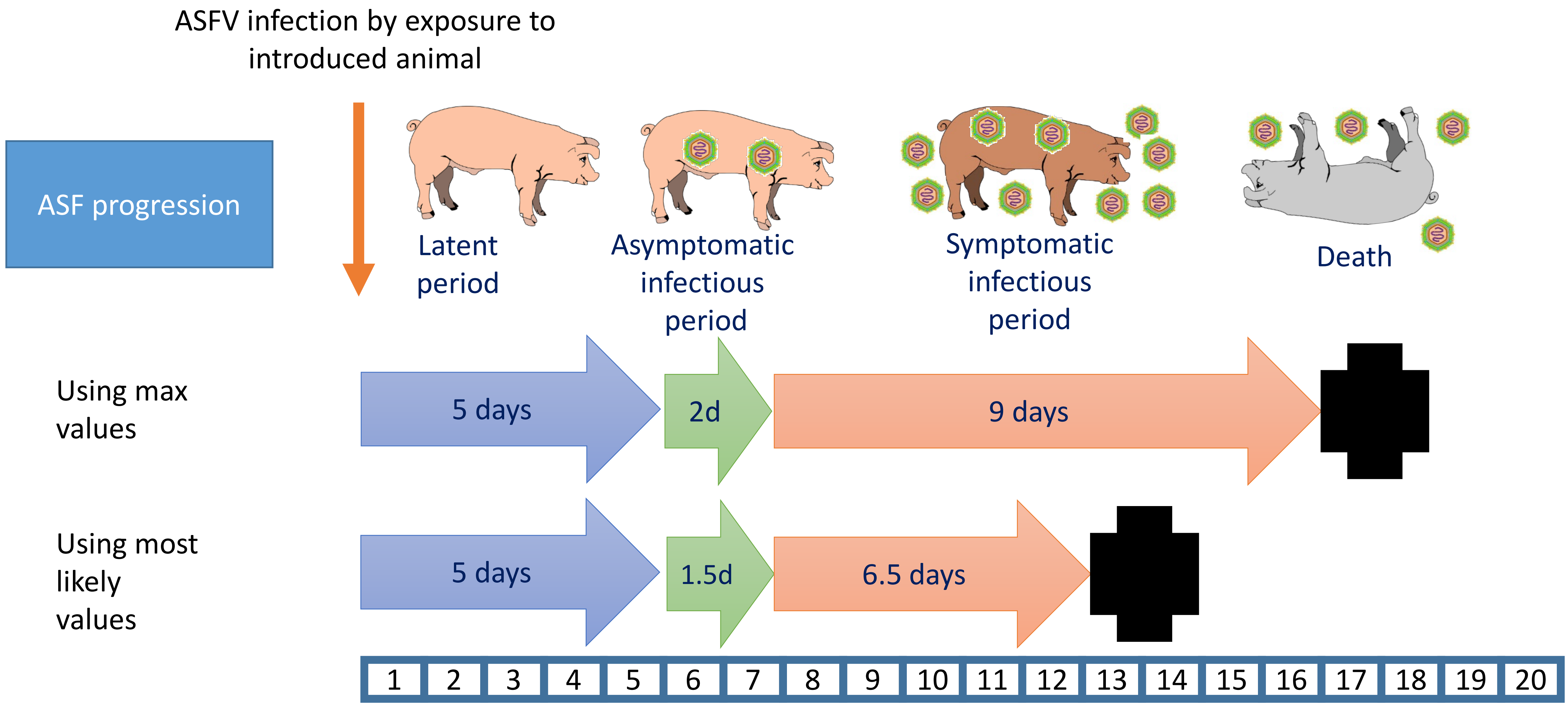


ASFV Spread Characteristics

Quantitative Aspects of ASFV Transmission Dynamics within and between Farms Do Matter!!!

- How effective are different transmission pathways between pigs and between farms?
- How long until an infected pig begins to shed virus?
- How long between start of virus shedding and pigs showing clinical symptoms?
- How long will pigs shed virus?
- How much virus will they shed and when, and through which mechanism?

Assumptions: Infection with ASFV (Georgia 2007/1) and introduced ASFV- infected animal is infectious immediately after introduction



Days since infection

From: Guinat, C., et al. (2016). "Transmission routes of African swine fever virus to domestic pigs: current knowledge and future research directions." Veterinary Record 178(11).

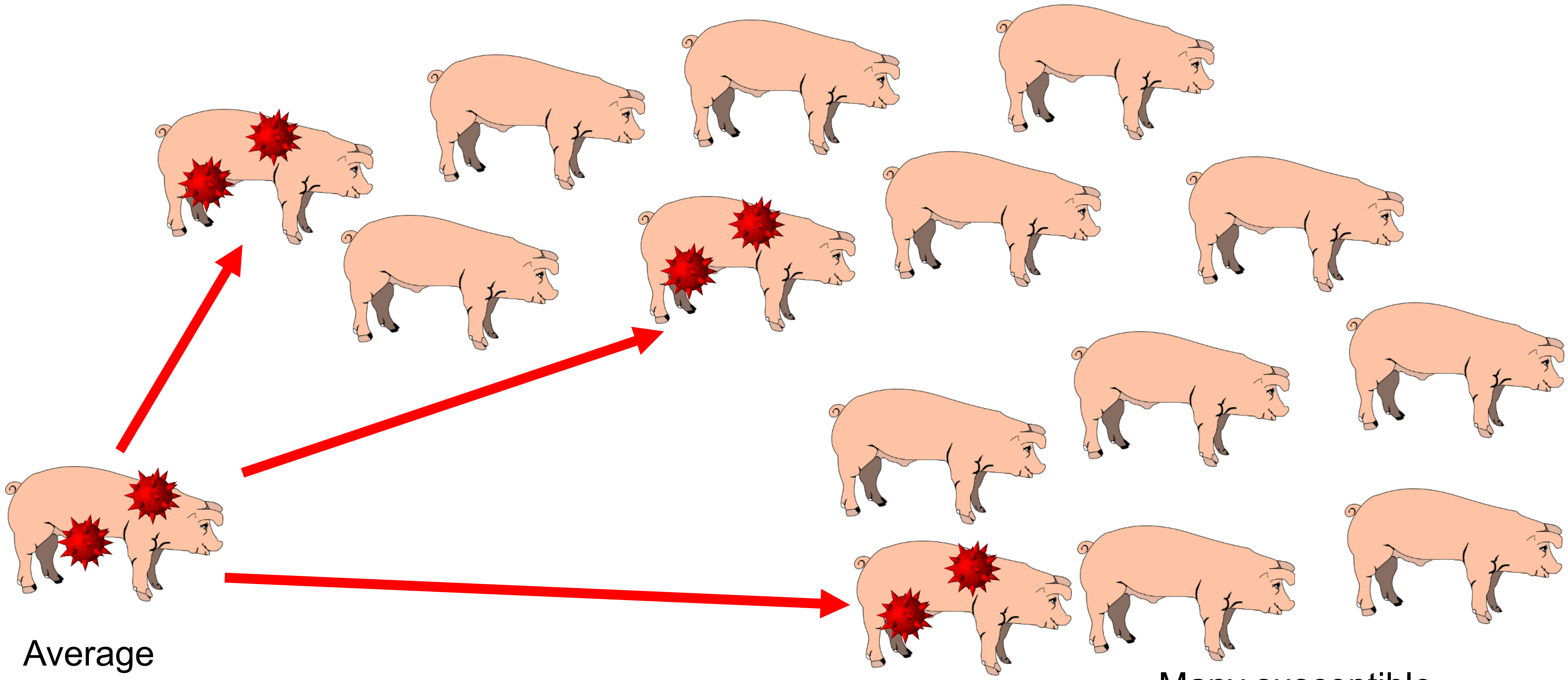
ASFV Model Transmission Parameters

Parameter	Value	Interpretation
Daily number of effective contacts per unit (beta or transmission rate)	0.62	An effective contact is a contact that would result in the transmission of infection if it occurs between a susceptible and an infectious unit. This is also called beta
Length of latent period (days)	4	The average number of days that a unit is infected but not infectious; i.e. length of time from infection to onset of infectiousness.
Length of asymptomatic infectious period (days)	1.5	The average number of days that a unit is infectious without showing clinical signs; i.e. length of time from start of infectiousness to onset of clinical signs.
Length of symptomatic infectious period (days)	6.5	The average number of days that a unit is infectious while showing clinical signs; i.e. length of time from onset of clinical signs to the end of infectiousness.

Within-Herd Transmission Dynamics following Introduction of ASFv

- spread of ASFV by pig-to-pig contact can be slower than some other diseases
  - 1-2 infected pigs introduced to group
  - initially only those 1-2 pigs die
  - 1-2 weeks for increased mortality to occur
    - minimal transmission by aerosol
    - significant virus shedding does not start before clinical signs appear
    - relatively low amounts of virus in excretions and secretions from infected pigs
    - very high amounts of virus in blood and tissues of affected pigs
      - efficient transmission through contact or consumption of carcases of pigs or wild boar or their products

Example – Basic Reproduction Number



$$R_0 = 3$$

Transmission Dynamics of ASFv in Domestic Pigs - Experiment

Estimation of R0 within- and between-pens:

$R0_w$ = 5.0 (95%CI: 2.4 – 9.1)

$R0_b$ = 2.7 (95%CI: 0.7 – 5.2)

Epidemiol. Infect., Page 1 of 10.

doi:10.1017/S0950268815000862

Experimental pig-to-pig transmission dynamics for African swine fever virus, Georgia 2007/1 strain

C. GUINAT[1,2]*, S. GUBBINS[2], T. VERGNE[1], J. L. GONZALES[2], L. DIXON[2] AND D. U. PFEIFFER[1]

[1] *Royal Veterinary College, Department of Production and Population Health, Hatfield, UK*
[2] *The Pirbright Institute, Pirbright, UK*

THE Pirbright INSTITUTE

Basic Reproduction Numbers for Various Infectious Diseases

Measles
12 – 18 people

Equine influenza
2 – 10 horses

African swine fever
2 – 10 pigs

COVID-19
2 – 10 people

Smallpox
3 – 6 people

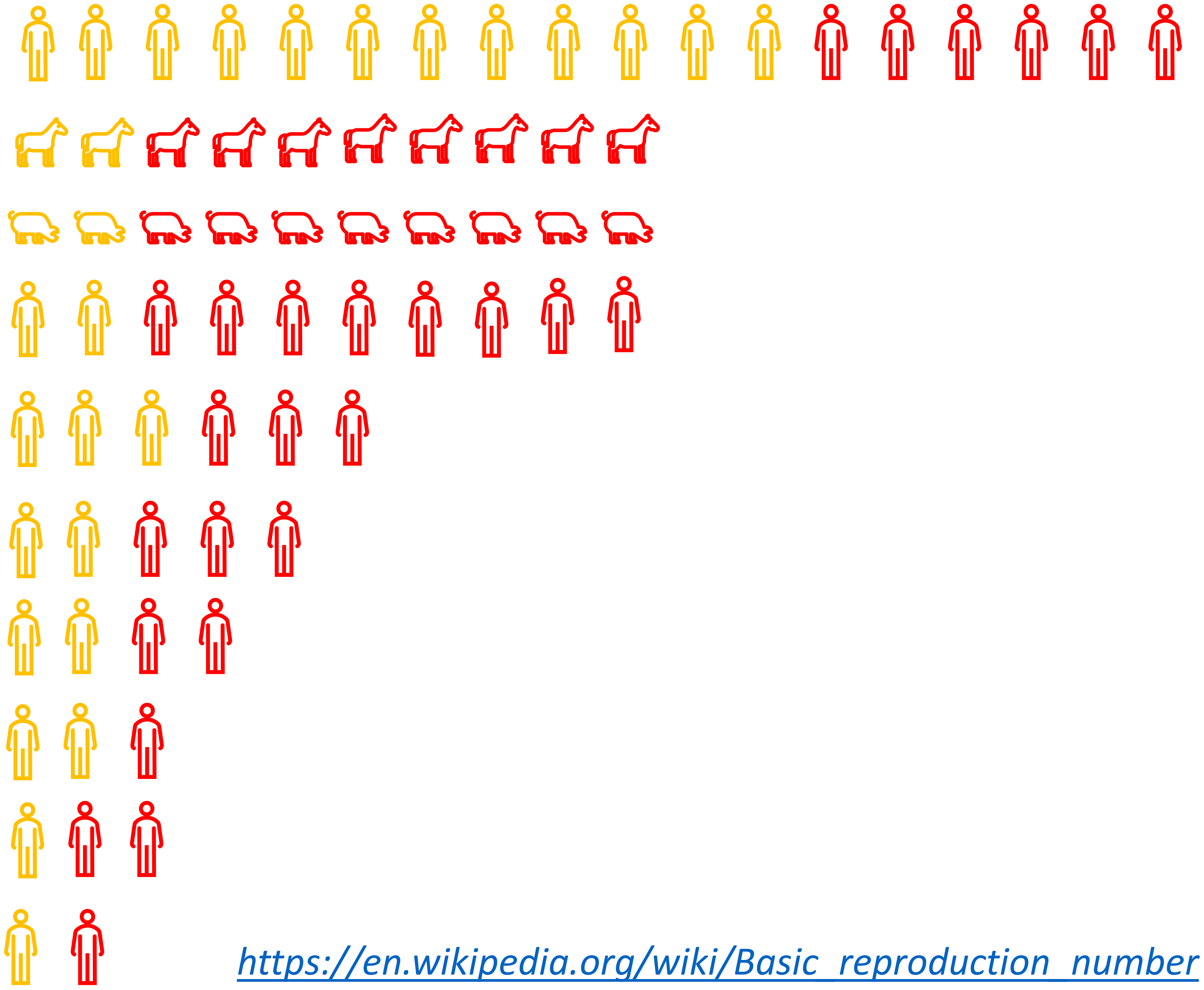
HIV
2 – 5 people

SARS
2 – 4 people

Common cold
2 – 3 people

Influenza 1918
1 – 3 people

Ebola
1 – 2 people



https://en.wikipedia.org/wiki/Basic_reproduction_number
plus other sources

Basic Reproduction Number for ASFV Transmission amongst Domestic Pigs Within Farms

	Transmission scenario	ASFV strain	Latent period (days)	Infectious period (days)	Basic reproduction number (95% CI)	References
Experimental studies						
Pig-to-pig	Direct	Georgia 2007	4	3 to 6	2.8 (1.3 to 4.8)	Guinat et al 2016
				3 to 14	5.3 (1.7 to 10.3)	
	Indirect			3 to 6	1.4 (0.6 to 2.4)	
				3 to 14	2.5 (0.8 to 5.2)	
Pig-to-pig	Direct	Malta 1978	3 to 6	4 to 10	18.0 (6.9 to 46.9)	de Carvalho et al 2013
Field studies						
Pig-to-pig	Within-farm	Russia	15	5	9.8 (3.9 to 15.6)	Gulenkin et al 2011
Pig-to-pig	Within-farm	Ukraine			7.5 (5.7 to 9.2)	Korennoy et al 2016
Pig-to-pig	Within-farm	Russia	5.8-9.7	4.5 – 8.3	9.8 (4.4 – 17.3)	Guinat et al 2017

Updated from: Guinat et al 2016. Transmission routes of African swine fever virus to domestic pigs: current knowledge and future research directions. Veterinary Record

Basic Reproduction Ratio for African Swine Fever

ASFV Genotype	ASFV Isolate	Duration of infectious period (days)	Between-herd R_0	Within-herd R_0	References
II		6.8 (5.0–8.6)			Belyanin et al. (2011)
I	Malta-78; Netherlands-86	6.8 ± 1.8; 4.6 ± 1.4		18.0 (6.9–46.9)	De Carvalho Ferreira et al. (2013)
II	Armenia-08	2–9		6.1 (0.6–14.5); 5.0 (1.4–10.7)	Pietschmann et al. (2015)
II	Georgia 2007/1	3–14		2.8 (1.3–4.8) within a pen; 1.4 (0.6–2.4) between pens	Guinat et al. (2015)
II	Russia	5–15	2–3	4–11	Gulenkin et al. (2011)
IX	Uganda		3.24 (3.21–3.27) 1.63 (1.6–1.72) 1.9 (1.87–1.94)		Barongo et al. (2015)
I	Ukraine, 1977	7 (within a farm); 19 (between farms)	1.65 (1.42–1.88)	7.46 (5.68–9.21)	Korennoy et al. (2017)
II	Russia	4.5–8.3	4.4–17.3		Guinat et al. (2018)
II	Russia	– (wild boar)	1.58 (1.13–3.77)		Iglesias et al. (2016)
II	Czech Republic Belgium	6 (wild boar)	1.95 1.65		Marcon et al. (2020)

From: Gulenkin, V.M., Korennoy, F.I., Karaulov, A.K., 2020. Basic reproduction number for certain infectious porcine diseases: estimation of required level of vaccination or depopulation of susceptible animals. Veterinary Science Today, 179-185.

Basic Reproduction Number for Different Pig Diseases - Part 1

Pathogen (genome/strain)	Duration of infectious period (days)	Between-herd R0	Within-herd R0	References
CSF	18	2.9		Stegeman et al. (1999)
CSF			36 (Paderborn strain) 17 (Brescia strain)	Weesendorp et al. (2009)
CSF		3.39 (between pens)	15.5 (within a pen)	Klinkenberg et al. (2002)
CSF	32		13.7 81.3 (for weaner pigs)	Laevens et al. (1999)
FMD	2.3–6.5		40 (non-vaccinated) 11 (single-dose vaccinated) 1 (four-fold-dose vaccinated)	Eble et al. (2008)
APP	from 2 days to several weeks	10		Velthuis et al. (2003)

From: Gulenkin, V.M., Korennoy, F.I., Karaulov, A.K., 2020. Basic reproduction number for certain infectious porcine diseases: estimation of required level of vaccination or depopulation of susceptible animals. Veterinary Science Today, 179-185.

Mathematical Modelling Tool

About Contact

EPI-interactive

epidemix
version 2

https://epidemix.app/

Visually explore spatiotemporal trends in disease transmission and improve your understanding of disease modelling.

Epidemics 23 (2018) 49–54

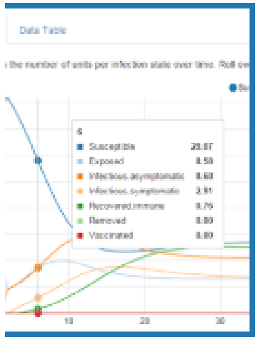
Contents lists available at ScienceDirect

Epidemics

journal homepage: www.elsevier.com/locate/epidemics

epidemix—An interactive multi-model application for teaching and visualizing infectious disease transmission

Ulrich Muellner[a,1], Guillaume Fournié[b,*,1], Petra Muellner[a], Christina Ahlstrom[a], Dirk U. Pfeiffer[b,c]



antaneous data
visualisation

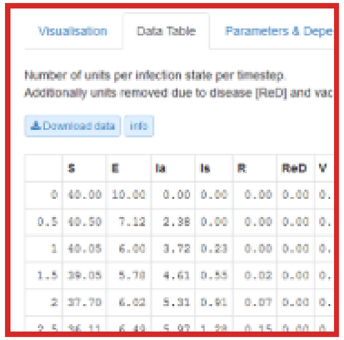


Table view and export options

Epidemix Case Studies in Chinese Language

Select model type

Generic Disease-specific

African Swine Fever (ASF)

The ASF model is pre-populated with published parameter settings for ASF (Guinat et al. 2016) and includes an extended functionality which allows users to add delays in the disease control process to investigate their impact on

Read more

Download parameters Upload parameters

Load pre-defined parameters

Specify details of the model parameters below.

Reset parameters

Select infection states to consider

Current selection

S , E , Ia , Is

All units are removed at end of infectious period

Removed units are not replaced (closed population selected)

At the end of the infectious period: All units are removed

Edit

Define host population features

Current selection

Population size = 100

Closed population

Edit

Define infection and transmission features

Current selection

Visualisation | Data table | Parameter compare | Scenario exercise

Take a tour

在此页面上，您可以透过使用非洲猪瘟 (African Swine Fever； ASF) 疾病模型进行假设场景练习，以了解如何实际应用 Epidemix 于不同情况。

Simplified Chinese (简体中文)

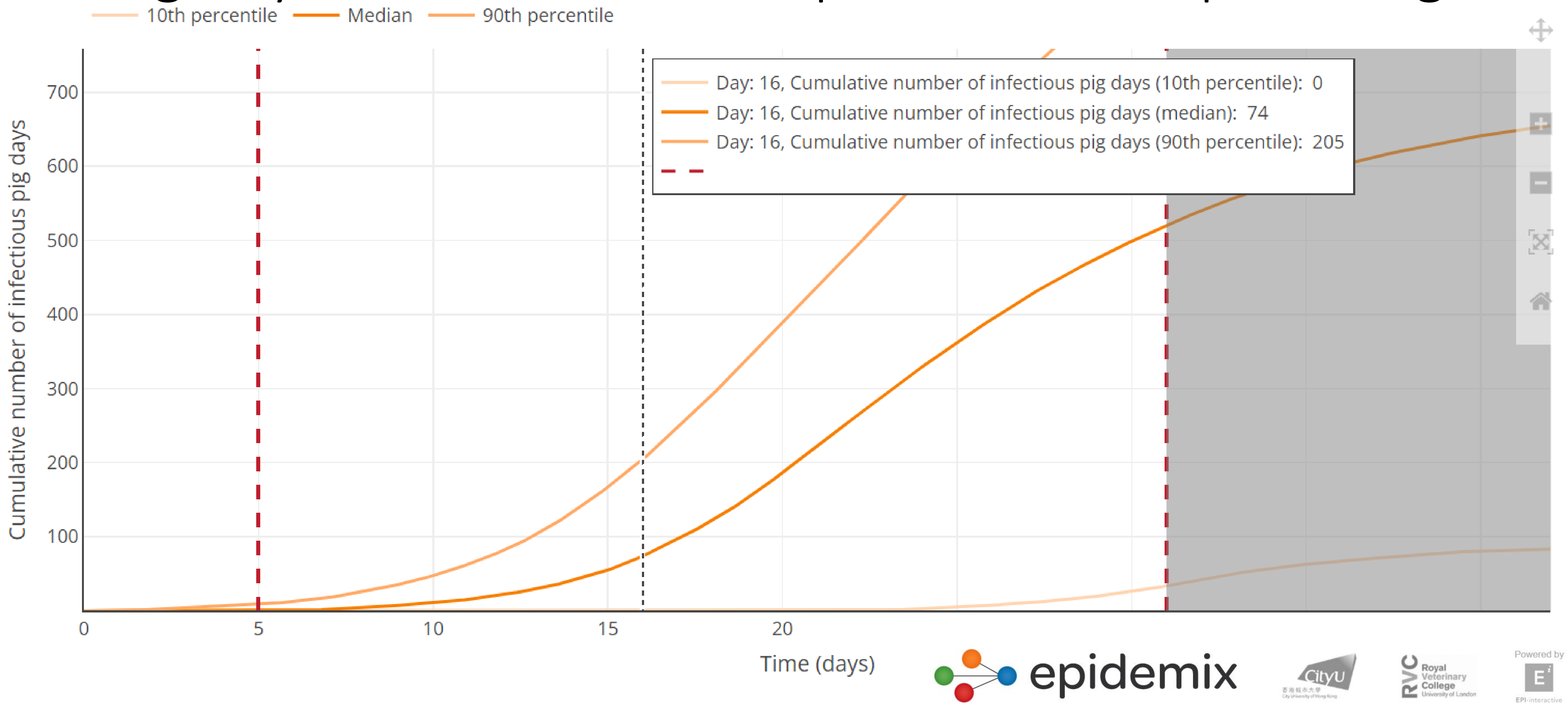
1 简介 — 2 具体任务 — 3 参数 — 4 视觉化 — 5 问题 — 6 总结

这个场景练习展示如何使用 Epidemix 分析非洲猪瘟 (ASF) 病毒的传播动态及对其检测和传播的影响。此场景练习大约需要 30-40 分钟才能完成。

ASF 模型是一个随机隔间模拟模型，预先配置了已发表研究中的非洲猪瘟病毒传播参数 (Guinat 等，2016)。您可以透过「选择模型类型」旁边的蓝色资讯按钮，或在 Faverjon 等 (2021)的这篇期刊文章中找到更多关于模型的详细资讯。此模型产生的输出可用于为农场非洲猪瘟风险管理政策的制定提供讯息，例如旨在防止病毒在猪群内部和猪群之间传播的政策。该工具还可以与世界动物卫生组织 (World Organization for Animal Health； WOAH) 的《非洲猪瘟区隔化指南》(The African Swine Fever Compartmentalisation Guideline document； WOAH，2021) 文件结合使用。

点选“下一步”按钮进入场景练习的下一页。

Modelling of Cumulative Number of ASFV Infectious Pig Days over Time in Group of 100 Susceptible Pigs



‘Normal’ Background Mortality in Pig Herds

- average pig mortality during finishing phase (in 2018)
  - 2.9% in European Union
  - 4.5% in USA
- pigs spent 111 days on average in finishing section (in 2018 in EU),

= daily average pig mortality of 0.03% (3 pigs per 100)

Conclusions

Conclusions

- effective communication requires understanding of underlying system and roles of different stakeholders and actors
  - learn from stories, every outbreak contributes a different ‘story’
- adopt complex systems approach to dealing with ASFV
  - need to consider biological, ecological, social, economic and cultural factors
  - recognise positive and negative feedback loops
- is ASFV a ‘’slow’’ pathogen?
  - slower than CSF, but highly variable
  - beware of potentially long infectious period
  - emerging new strains
  - consider using dynamic models to explore quantitative impact on visibility of clinical signs and mortality for farmers and their staff


National African Swine
DEPARTMENT OF AGRICU
Ang Bago
kay
@BABayAS
0995-132-9339 / 0920-854-3119