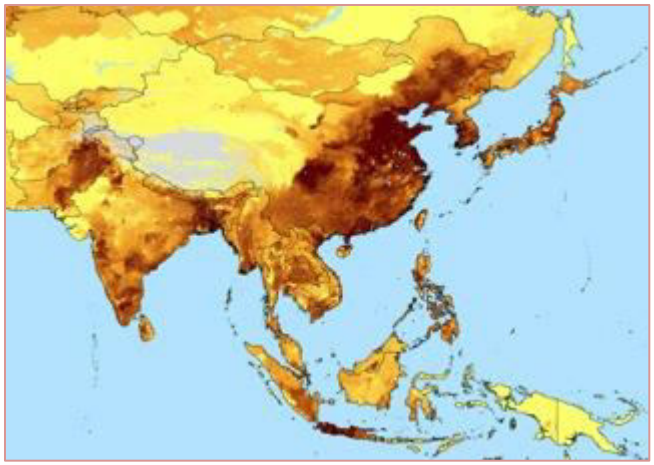
Livestock's contribution to antimicrobial resistance in low- and middle-income countries

Timothy Robinson

Workshop on National Action Plans on Antimicrobial Resistance for Developing Countries: Focusing on Resistance Emanating from Antibiotic Use in Food Animals

New Delhi, India, 10–11 November 2016



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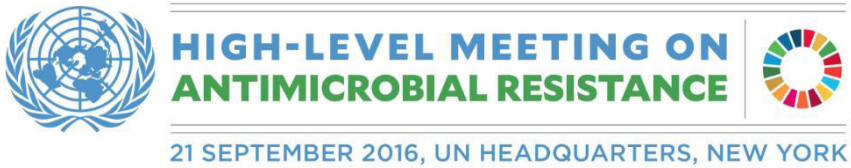
AMR in context

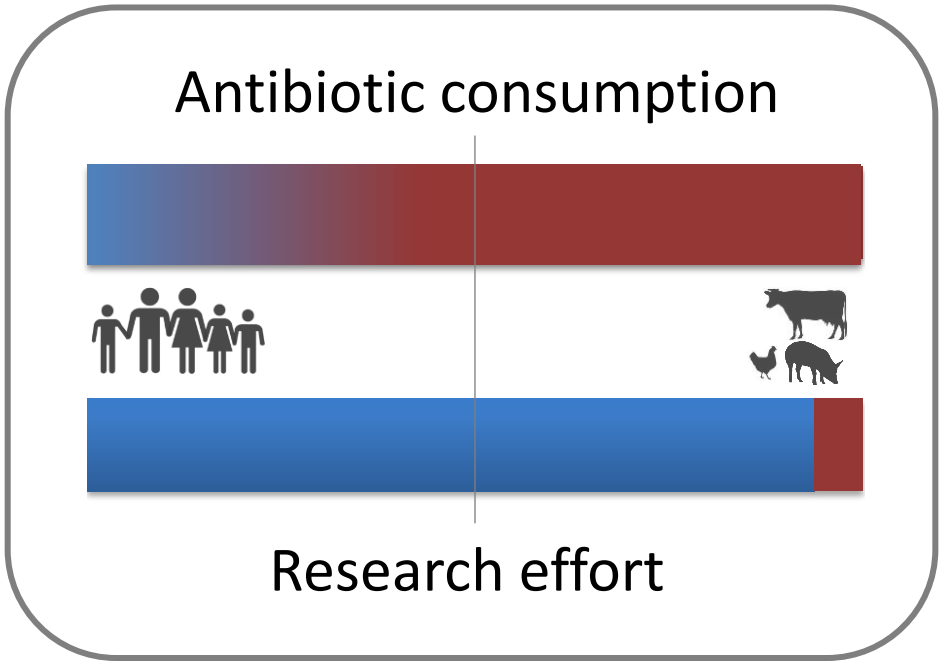
- Unprecedented international concern
  - National Action Plans
- Quintessential *One Health* issue
  - people – animals – environment
- Global phenomenon
- Diverse views on antimicrobial use in livestock production
- Threat to sustainable food production
- Impact on poverty and economic growth



Why livestock in LMICs?

- Rapid sector growth

  pigs – chickens – dairy
- Large share of antibiotic use
- Important livelihood roles of livestock in LMICs
- Conflict: inappropriate use AND poor access to effective antibiotics
- Weak regulation and implementation
- Neglected research area



Key knowledge gaps

A weak evidence base makes identifying effective actions difficult

- Current and projected **consumption** of antibiotics in animal agriculture
- **Transmission pathways** of antibiotic resistance determinants among livestock, people and environments?
- What **interventions** can be effective in diverse settings?

Antibiotic use in livestock

PNAS

Global trends in antimicrobial use in food animals

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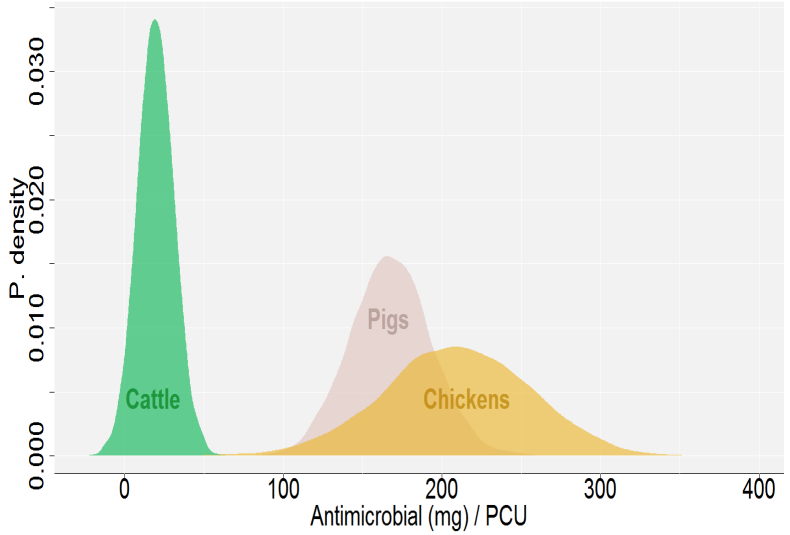
Contributed by Simon A. Levin, February 18, 2015 (sent for review November 21, 2014; reviewed by Delia Grace and Lance B. Price)

- Total consumption in the livestock sector in 2010 estimated at 63,151 tons
- Global antimicrobial consumption will rise by 67% by 2030
- It will nearly double in BRICS (Brazil, Russia, India, China, and South Africa) countries

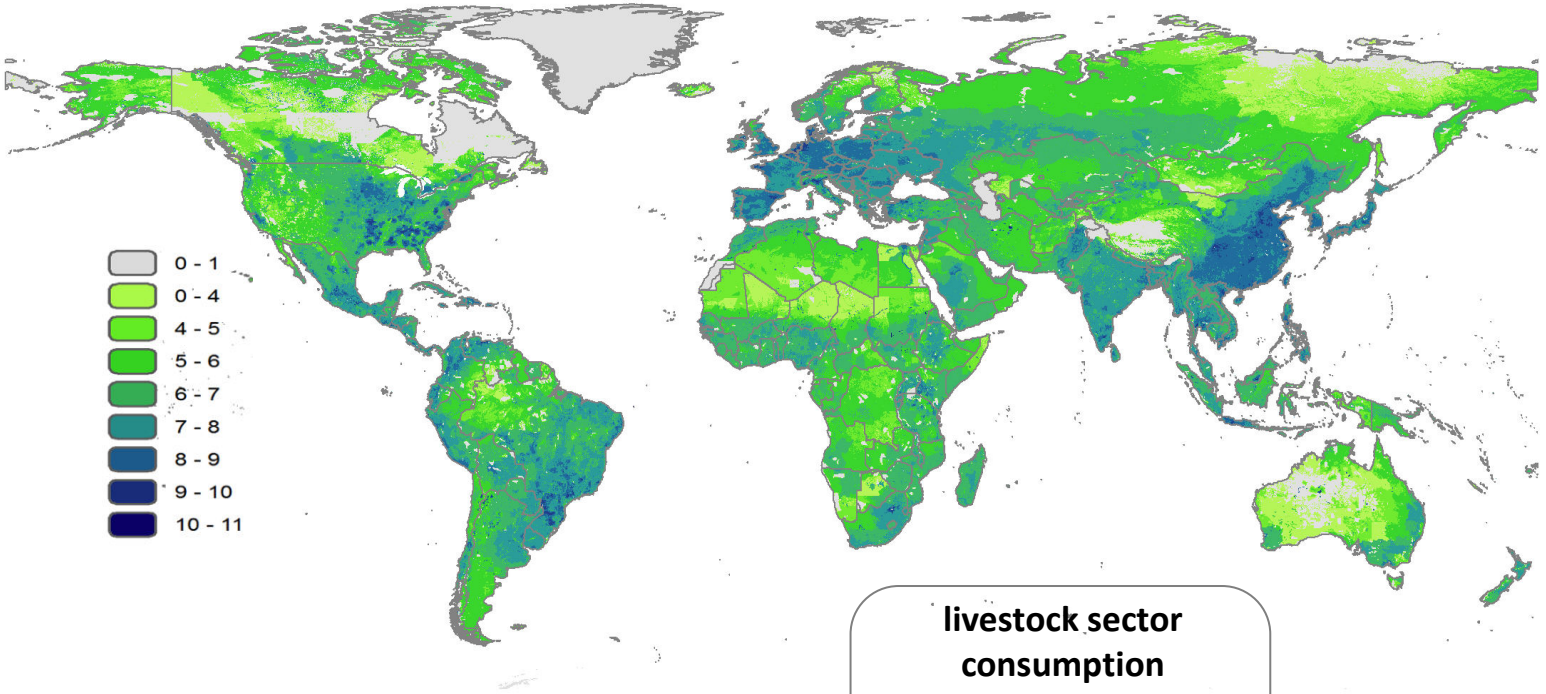


Source: Van Boeckel et al. (2015)

Antibiotic use in livestock

Global antimicrobial consumption in livestock

(mg per 10km pixel)



livestock sector consumption

2010	2030
63,151 tonnes	105,596 tonnes

Source: Van Boeckel et al. (2015)

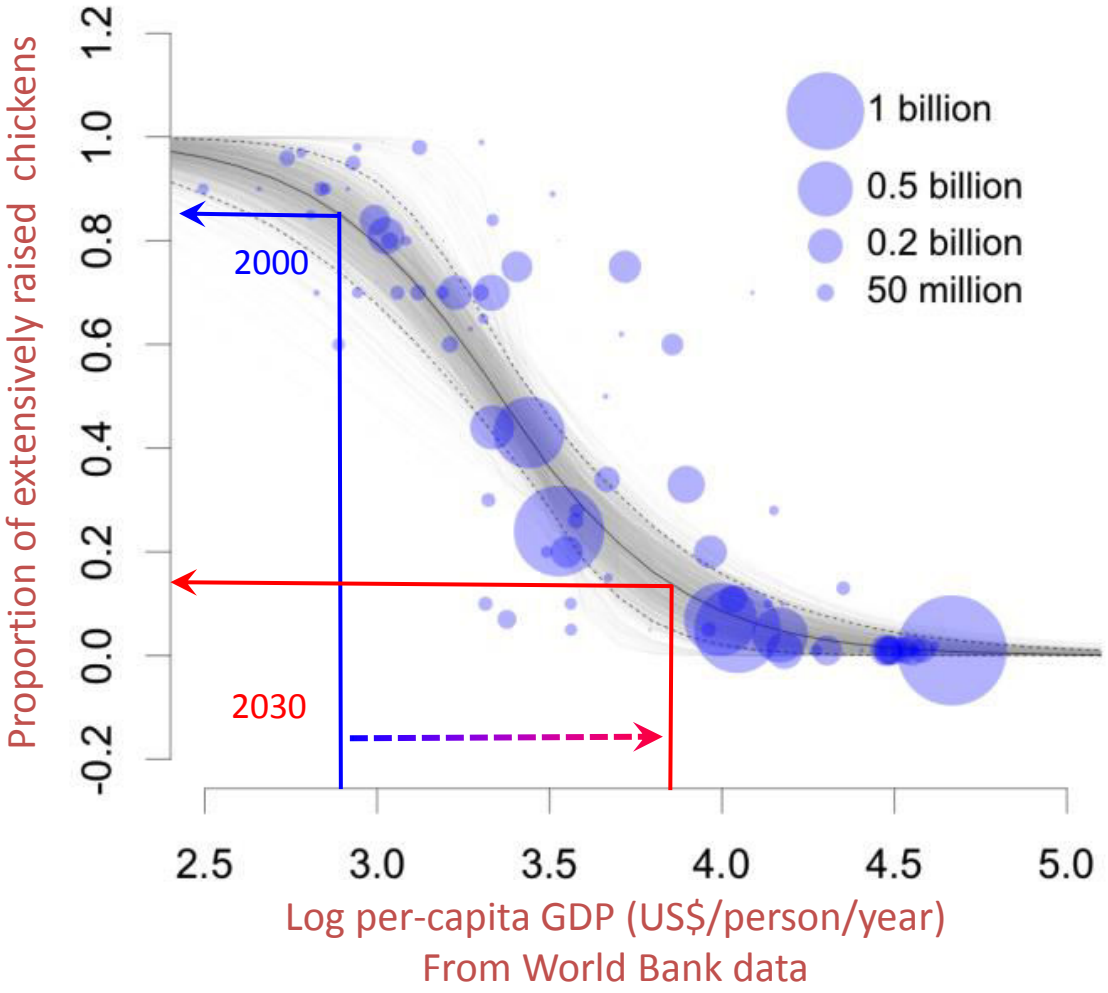
Chicken systems

Extensive chicken production

Intensive chicken production

Source: Gilbert et al. (2016)

Predicting future livestock systems



Chicken production in China

2000

log GDP per capita *c.* $ 2.9

% extensive *c.* 83 %

2030

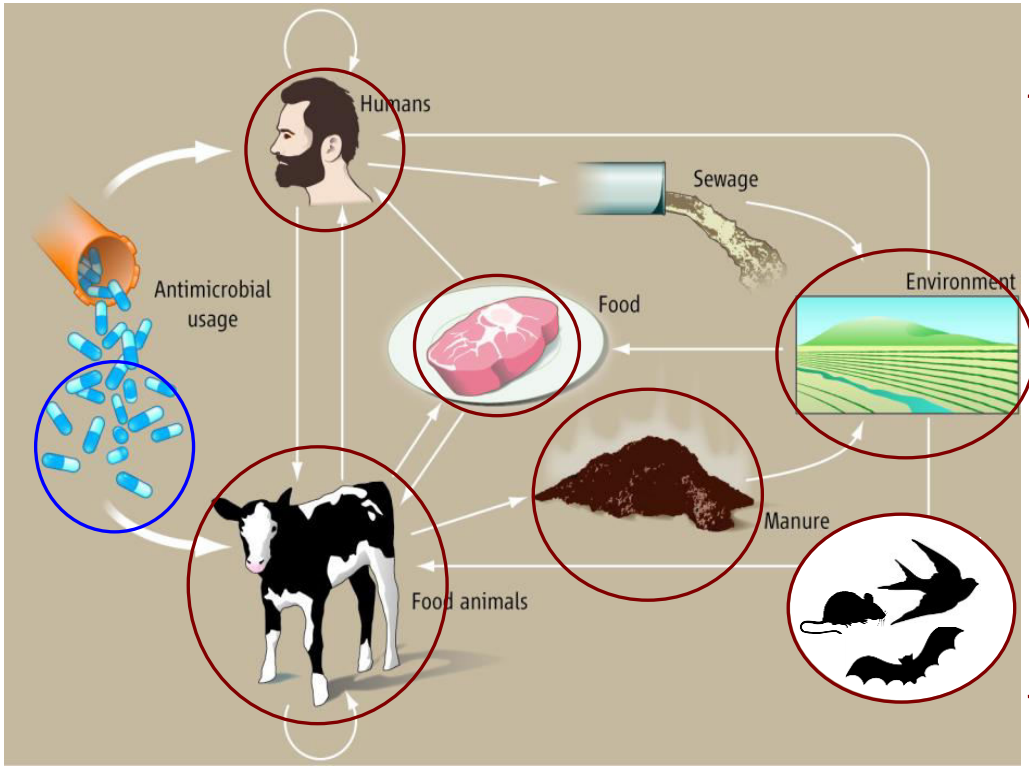
log GDP per capita *c.* $ 3.8

% extensive *c.* 18 %

Improved consumption estimates

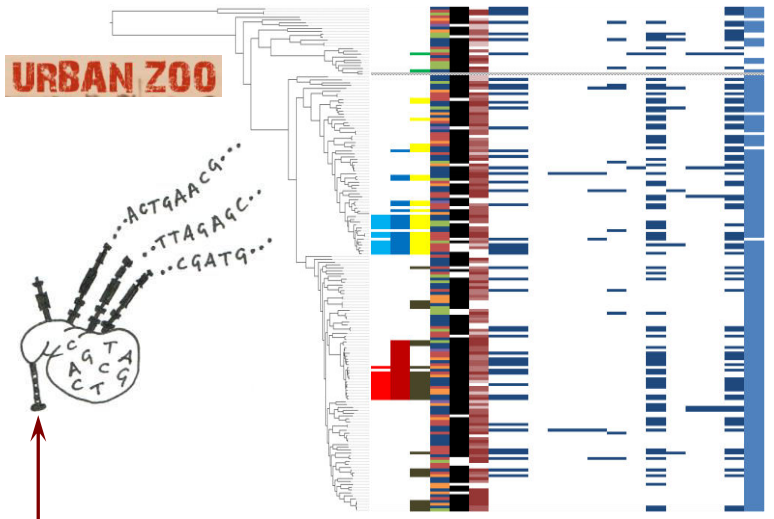
- Breakdown by antibiotic group
- Collect national data on use by livestock system: top-down vs bottom-up
- Link use to livestock sector scenarios
  Shared Socioeconomic Pathways (SSPs)
- Model the global impact of interventions

Biology of AMR transmission



Source: Woolhouse & Ward (2013) *Science*

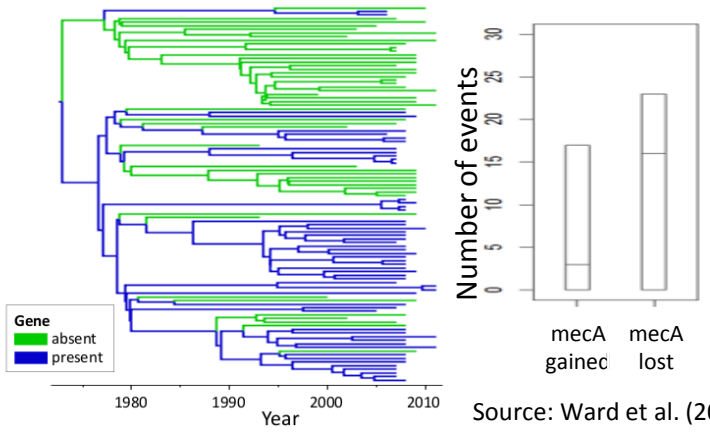
Escherichia coli



Source: Ward et al. (2016)

Staphylococcus aureus CC398

Methicillin resistance history (*mecA*)



Source: Ward et al. (2014)

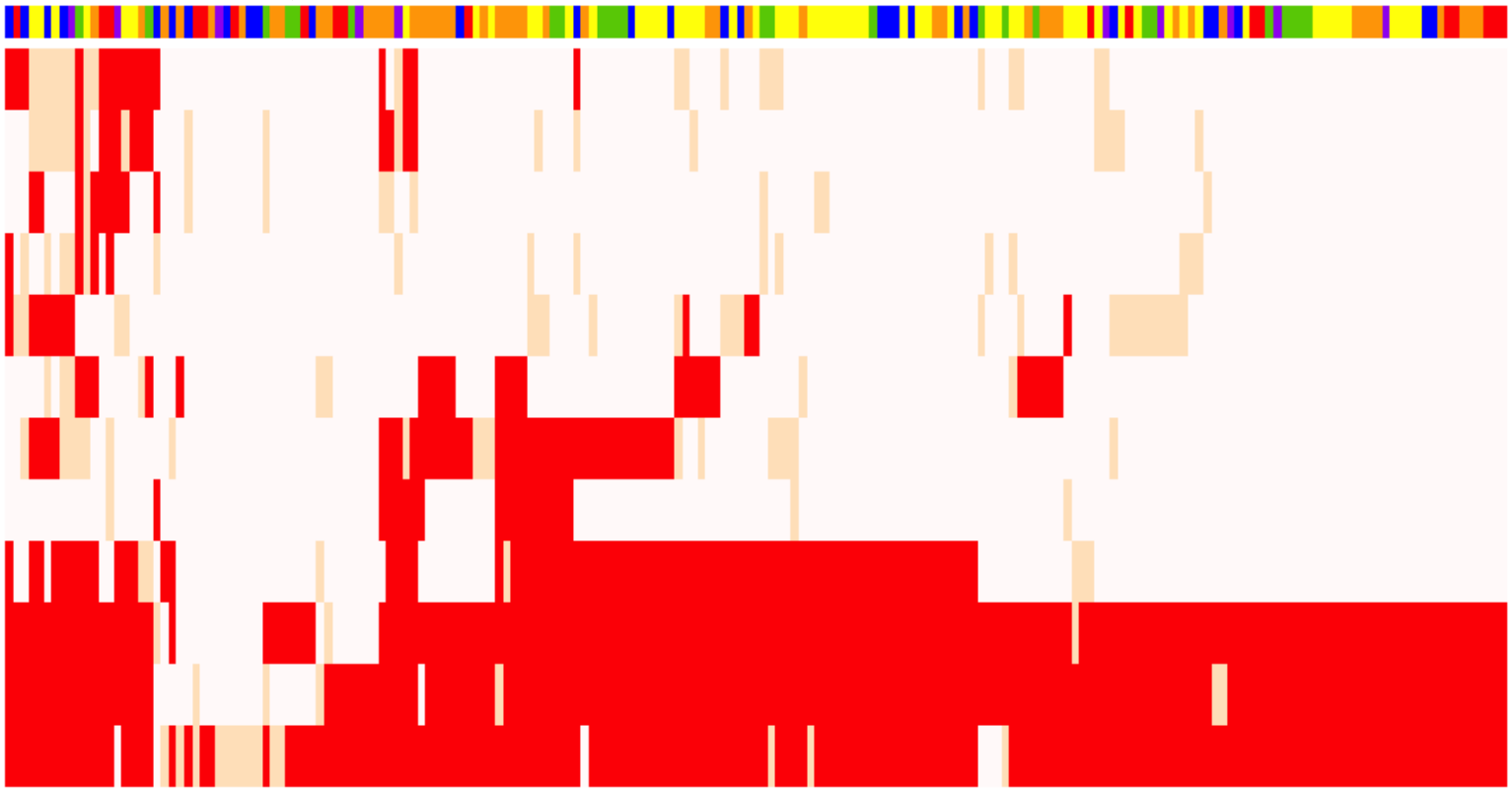
Pilot study

Pilot study

Staff
Breeding pigs
Rearing pigs
Environment
Wild birds
Rodents

Initial screening for antibiotic resistance in commensal *E. coli*

Resistant
Intermediate
Sensitive



cefpodoxime
ceftriaxone
aztreonam
ceftazidime
clavamox
gentamicin
nalidixic acid
ciprofloxacin
chloramphenicol
tetracycline
ampicillin
streptomycin

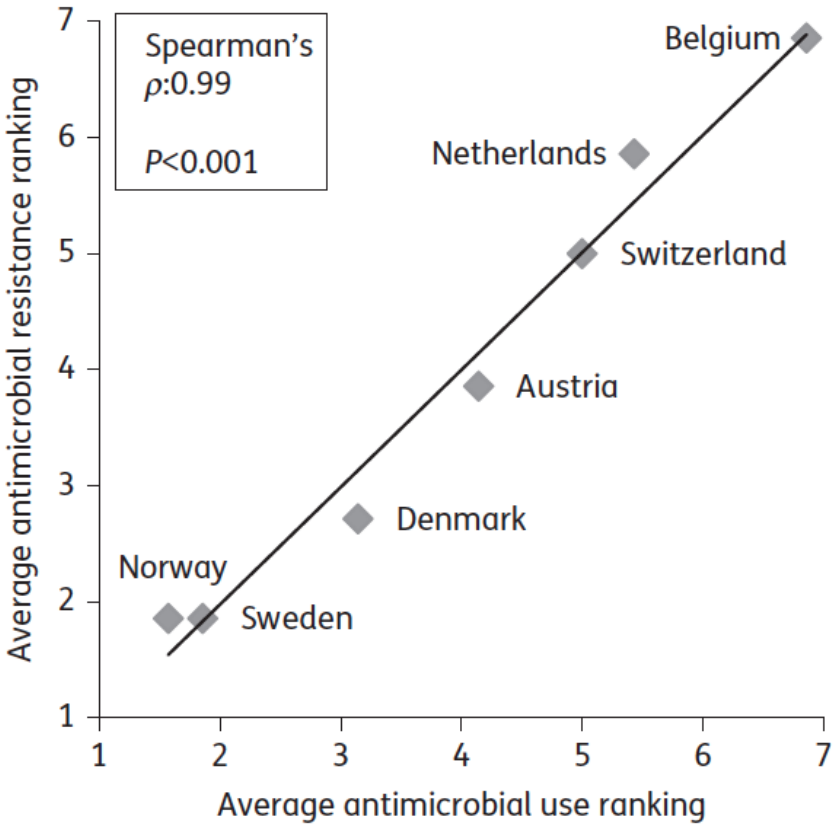
URBAN ZOO

Source: Bettridge et al. (2016)

Interventions to mitigate AMR

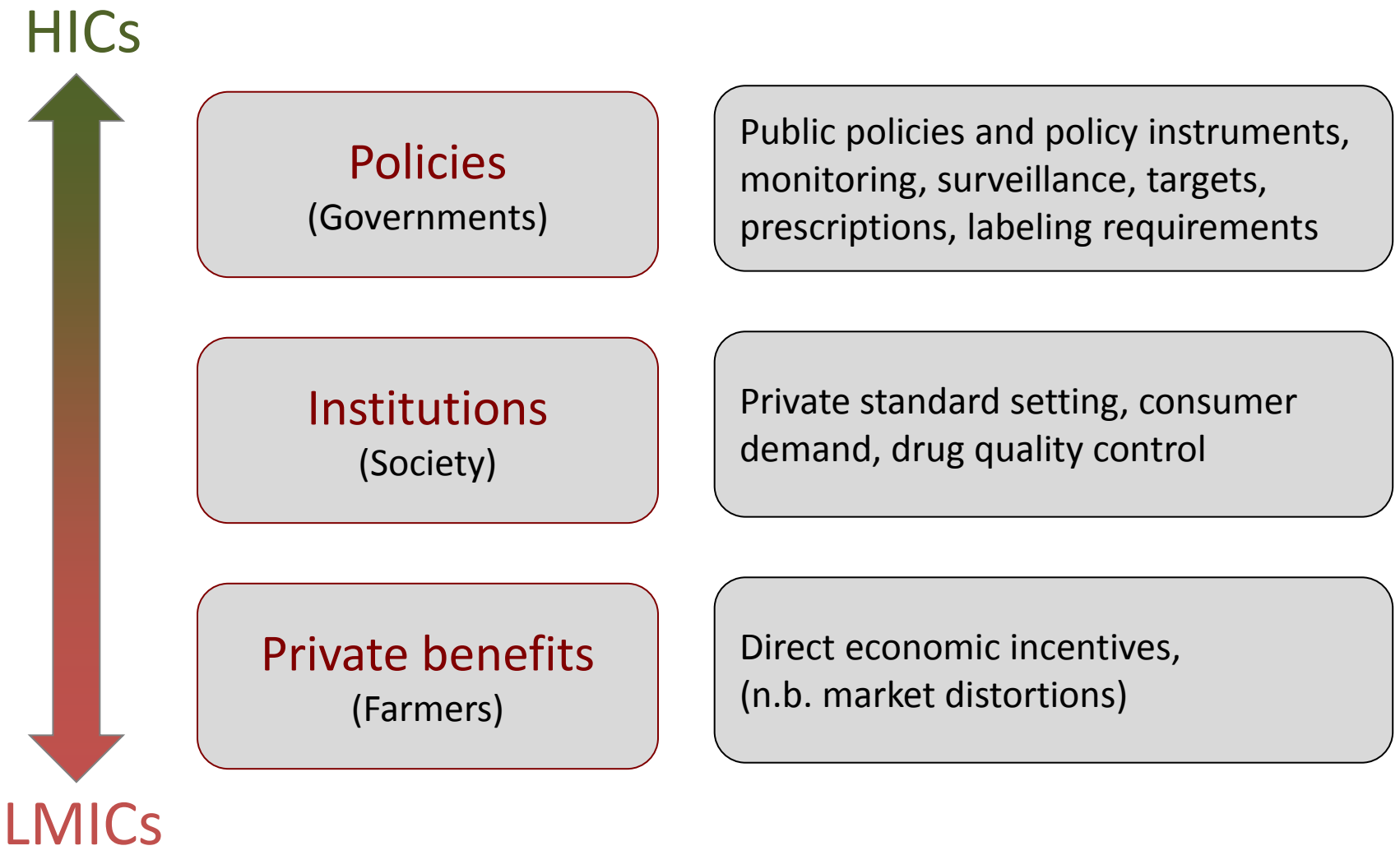
- Reduce overall consumption in livestock production
- Better target antibiotic use
- Reduce antibiotic residues
- Reduce transmission of AMR genetic determinants

- Understanding incentives and behaviour
- Measuring impact of interventions (use, residues, AMR genes)
- Benefit-cost analysis of interventions



Source: Chantziaras et al. (2014)

Interventions to mitigate AMR



Conclusions

- AMR is clearly a **One Health** issue – livestock and environment have a big role to play in finding solutions
- **Livestock sector** has a potentially massive role to play in AMR mitigation
- **Global problem** – but solutions must be found at national and farm levels
- One size won't fit all – HIC solutions won't necessarily be directly **appropriate in LMICs**