Food and Agriculture Organization of the United Nations

Antimicrobial Resistance
Effect on Food Supply and Production

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FAO AMR Coordinator


1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE AND JUSTICE
17 PARTNERSHIPS FOR THE GOALS
THE GLOBAL GOALS
For Sustainable Development

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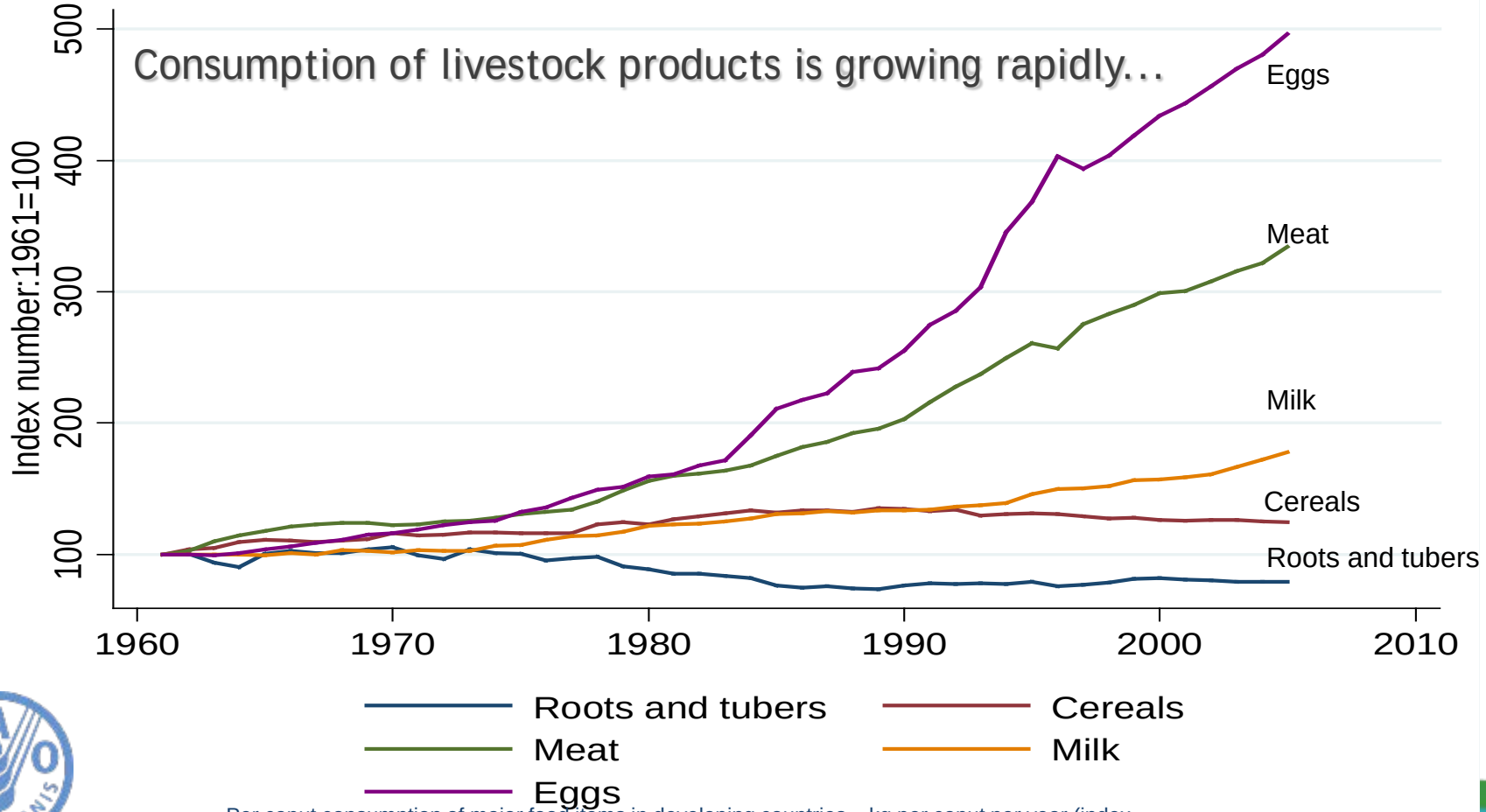
FAO Action Plan

Some Issues

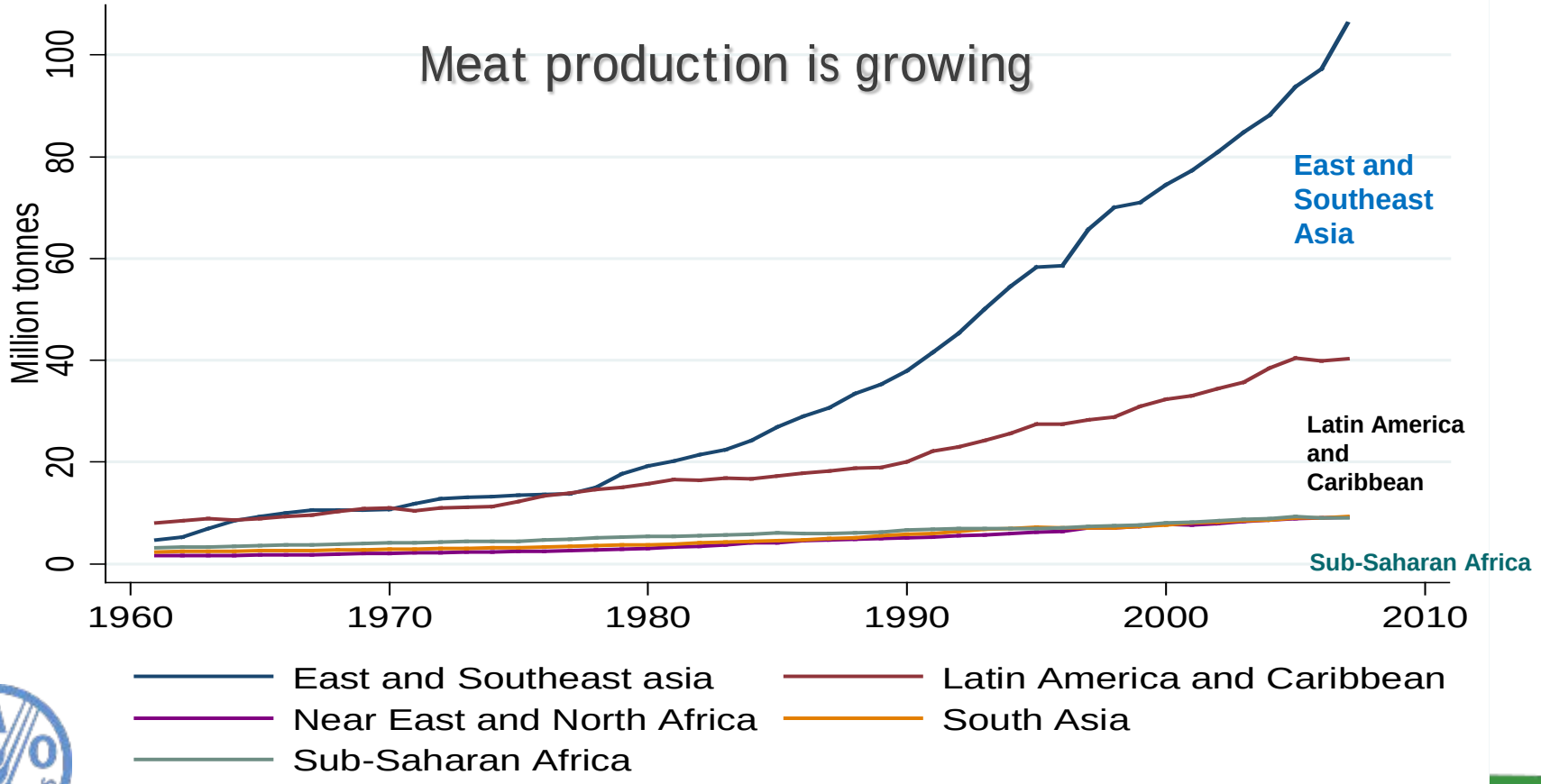
- Hippocratic Oath
- DALY's
- DDD
- Animal Source Foods
- Production Systems
- Value Chains
- Women and children
- Growing Population
- CIA's
- Growth Promotion
- Attribution



Per caput consumption of major food items in developing countries – kg per caput per year (index numbers 1961=100)

Source: FAO-SOFA 2009

Meat production is growing



Source: FAO-SOFA 2009

Global ranking of food and agriculture commodities in value terms (2010)

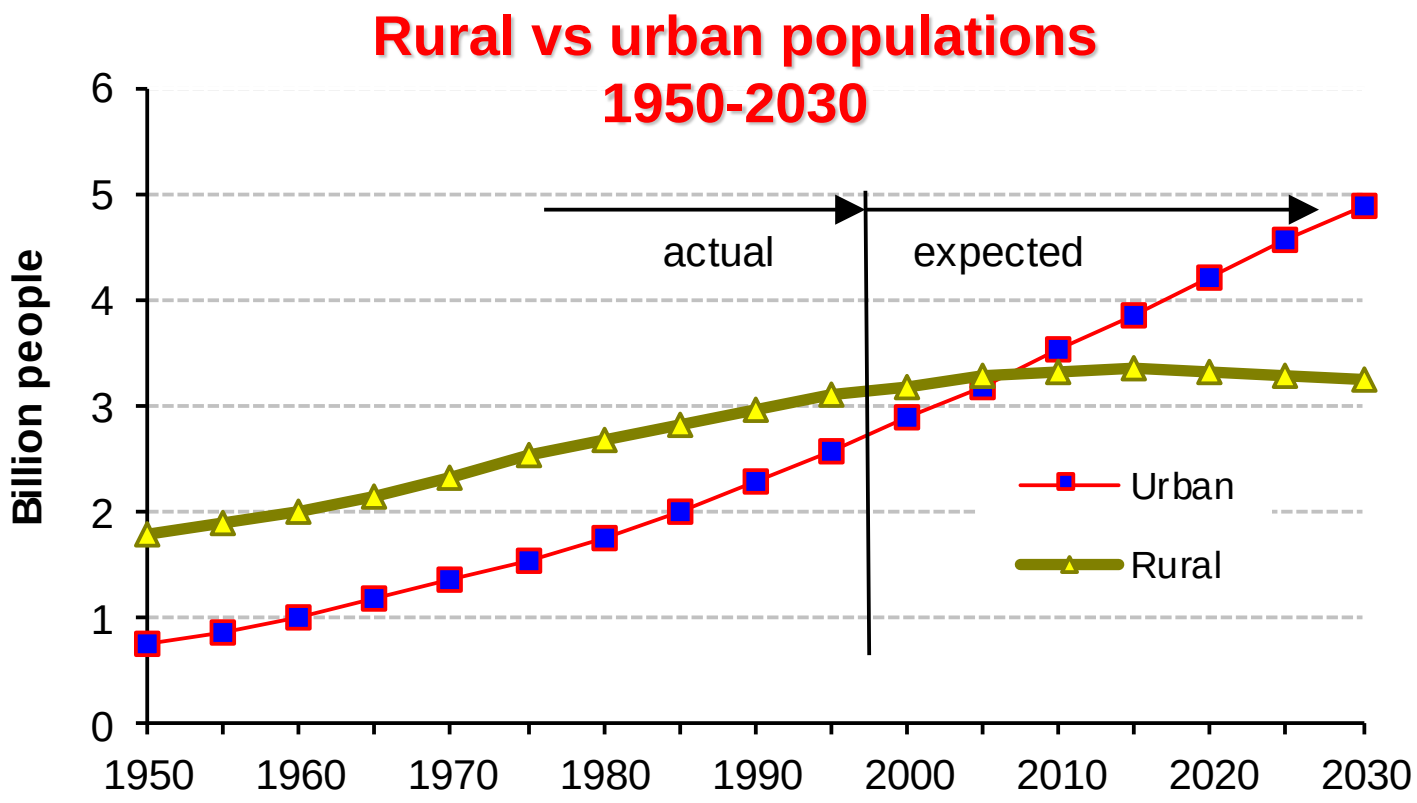
Rank	Commodity	Production value ($ billion)
1	Rice, paddy	180
2	Cow milk, whole, fresh	180
3	Indigenous Cattle Meat	172
4	Indigenous Pig meat	168
5	Indigenous Chicken Meat	122
6	Wheat	81
7	Soybeans	66
8	Tomatoes	55
9	Sugar cane	54
10	Maize	54

642 B

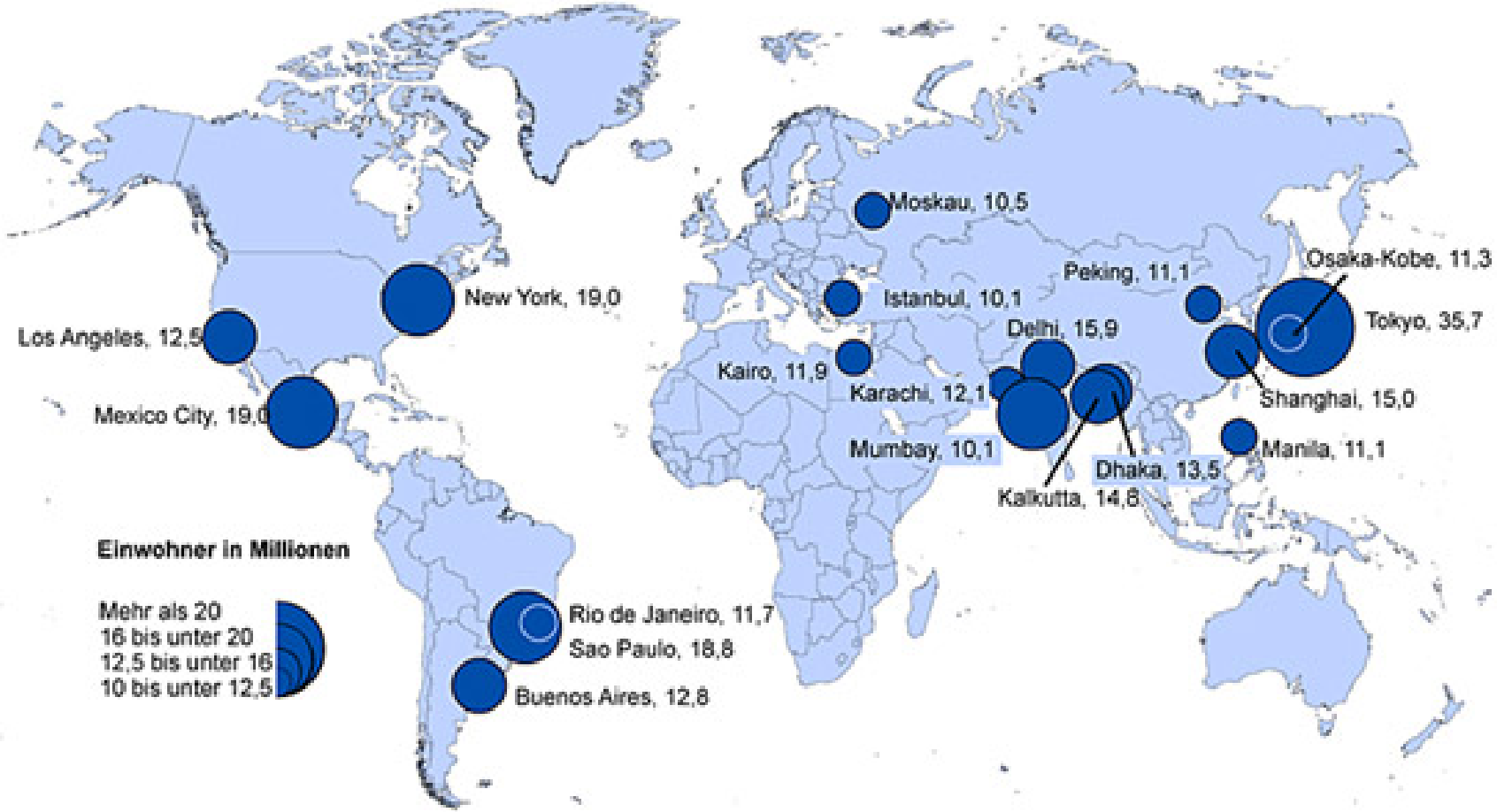
490 B

Source: FAOSTAT

Urbanização em aceleração



UN, World Population Assessment 2002



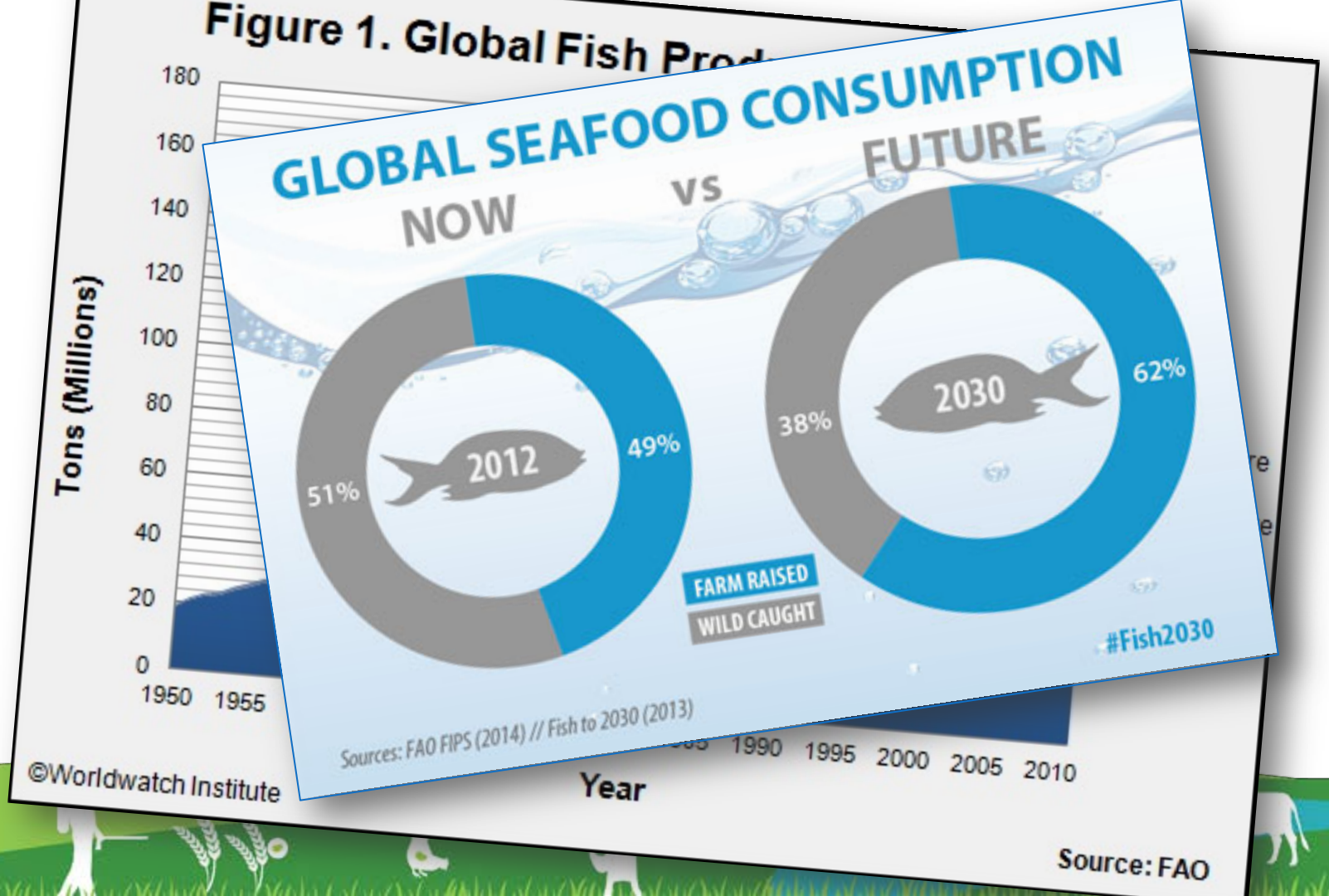


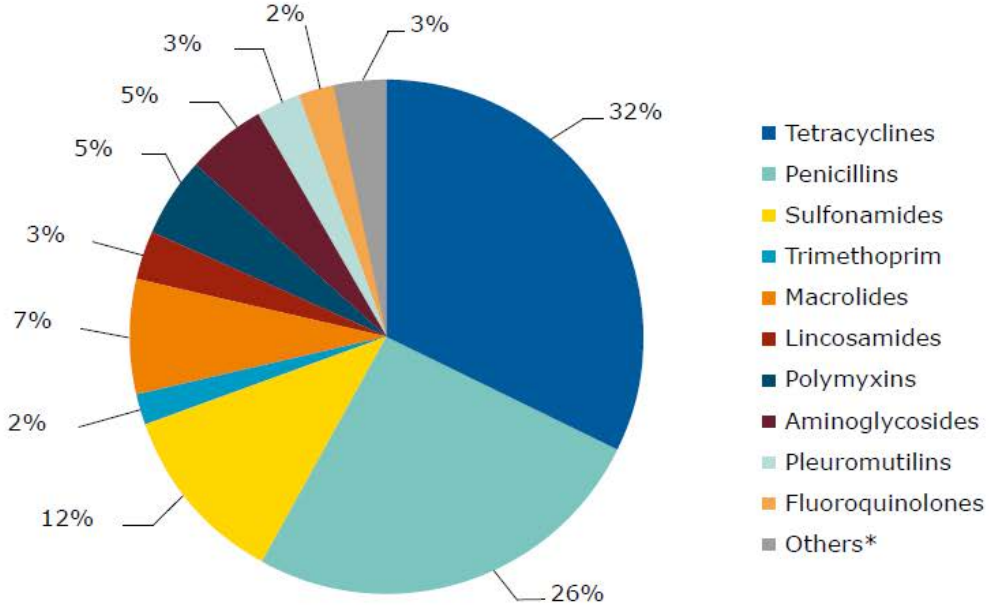
Figure 1. Global Fish Prod
Tons (Millions)
180
160
140
120
100
80
60
40
20
0
1950
1955
1990
1995
2000
2005
2010
Year
©Worldwatch Institute
Source: FAO
GLOBAL SEAFOOD CONSUMPTION
NOW
vs
FUTURE
2012
51%
49%
2030
38%
62%
FARM RAISED
WILD CAUGHT
#Fish2030
Sources: FAO FIPS (2014) // Fish to 2030 (2013)

Does not include aquaculture (growing…)
Does not include crops (growing…)

Fig. S9. Antimicrobial consumption for food animal production by country, in 2013 (light red) and projected for 2030 (dark red).

Van Boecke TP *et al.*
Science 29 Sep 2017

Figure 4. Sales of antimicrobial agents by antimicrobial class as percentage of the total sales for food-producing species, in mg/PCU, aggregated by 30 European countries, for 2016



*Amphenicols, cephalosporins, other quinolones and other antibacterials (classified as such in the ATCvet system).

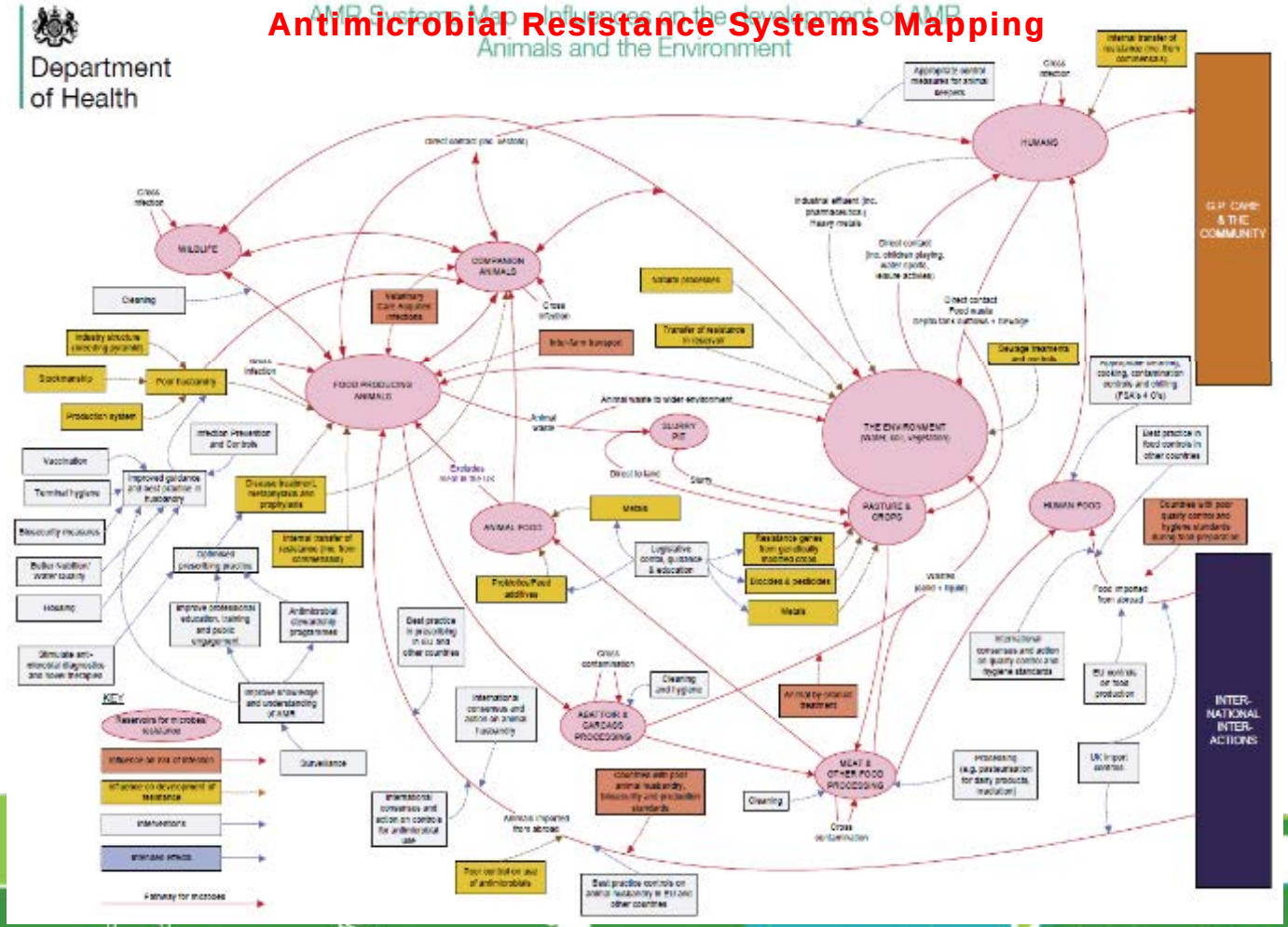
CIA's

- The use of highest-priority, critically important antimicrobials, such as third- and fourth generation cephalosporins, fluoroquinolones, and macrolides for animal use is of the greatest concern (World Health Organization. 2012).

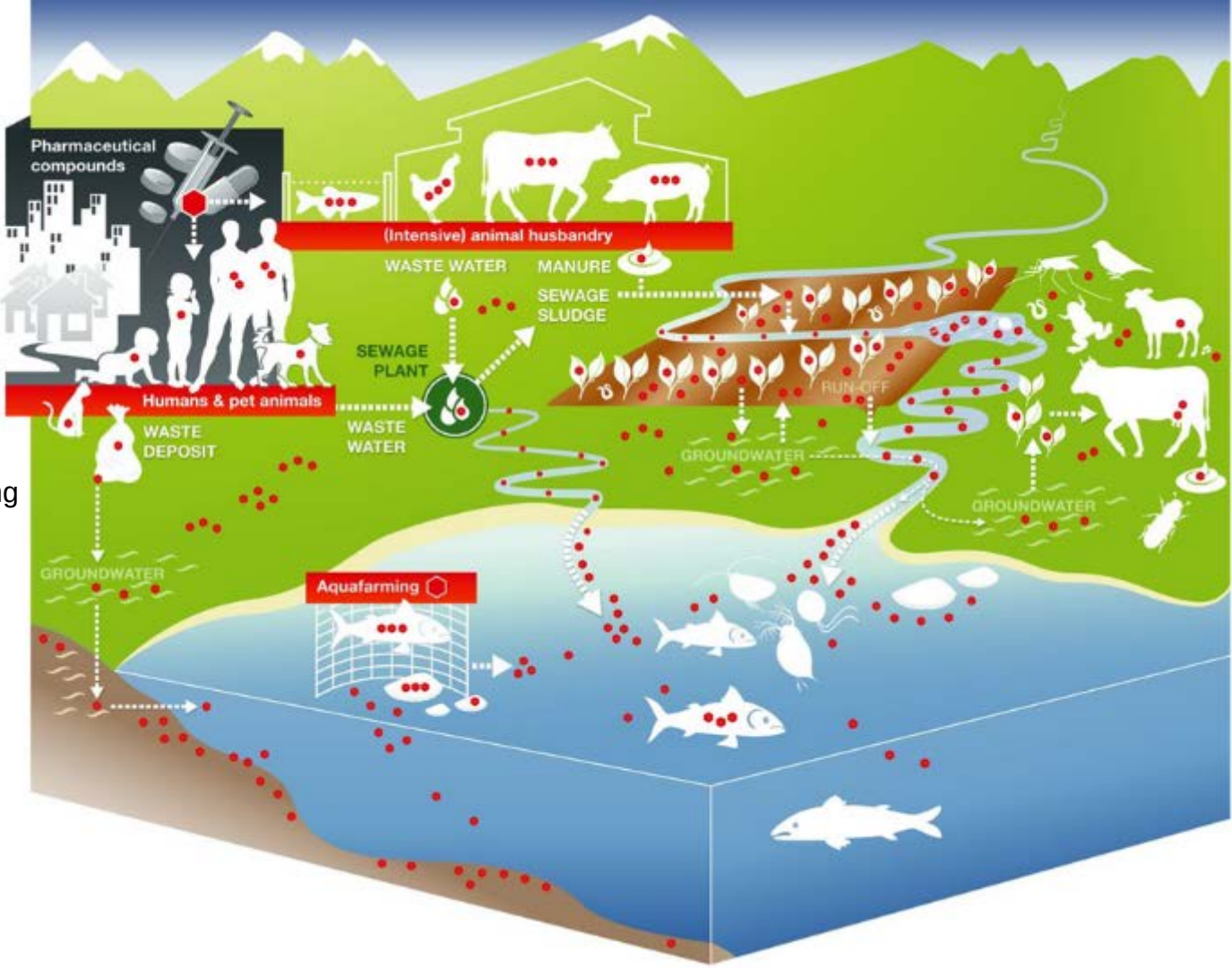
- Growth promotion
- Prophylactic Use
- Therapeutic Use

Crop	Hectares planted	Oxytetracycline			Streptomycin			Total amount of antibiotics (kg)
		Percentage treated	Average no. of sprays	Total active ingredient per year (kg)	Percentage treated	Average no. of sprays	Total active ingredient per year (kg)	
Apple	123,996	12	1.2	3,084	16	1.9	6,169	9,253
Peach	46,458	9	2.2	1,406	–	–	–	1,406
Pear	24,106	41	3.3	3,901	30	2.7	1,905	5,806
Total				**8,391**			**8,074**	**16,465**

Antimicrobial Resistance Systems Mapping

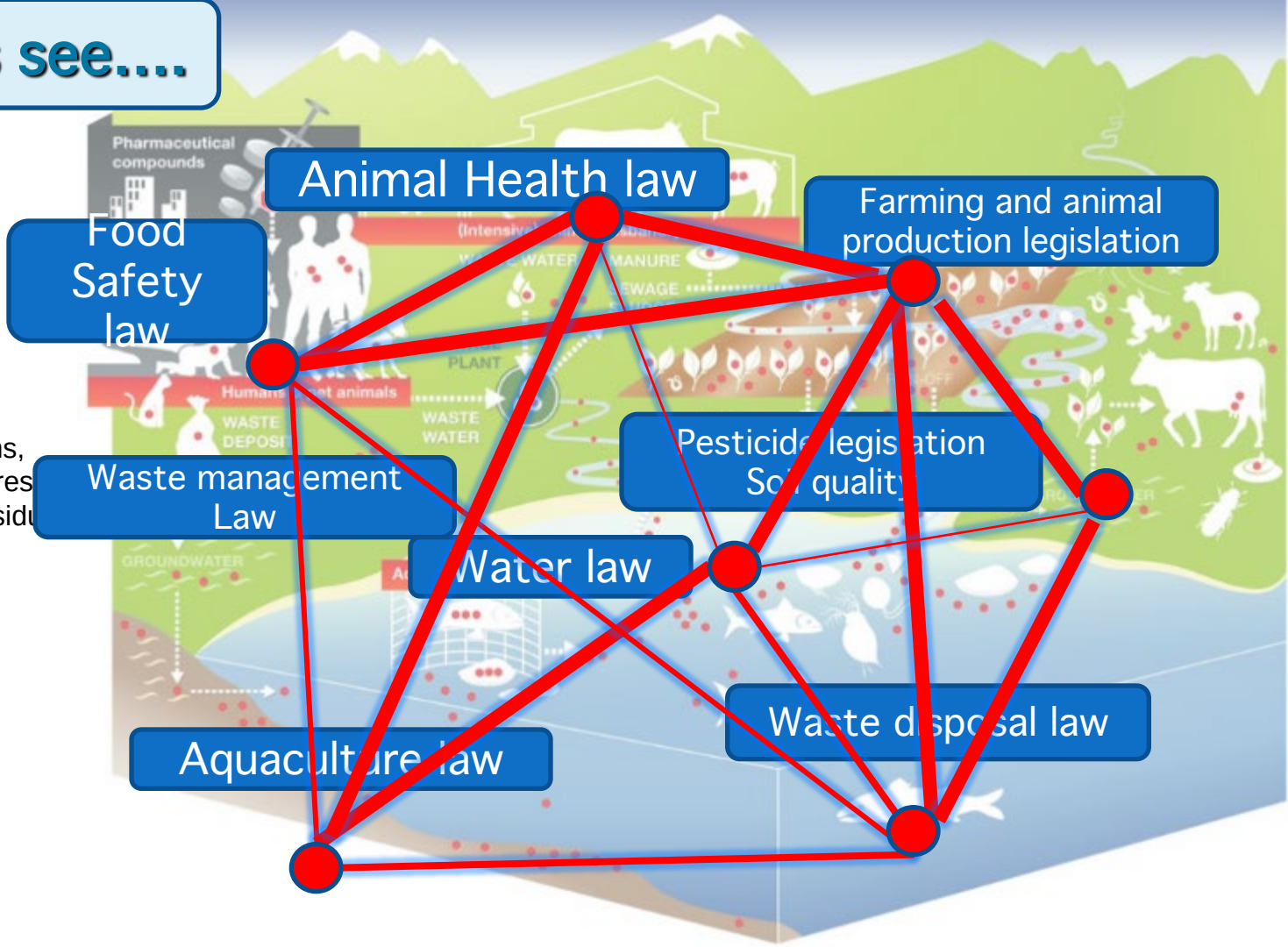


Antimicrobial usage in humans, animals and agriculture, and resulting dispersion of antimicrobial residues into aquatic and terrestrial environments (●●)
(Berkner et al., 2014)



What lawyers see....

Antimicrobial usage in humans, animals and agriculture, and res dispersion of antimicrobial residu into aquatic and terrestrial environments (●●)
(Berkner et al., 2014)



Integrated Surveillance

The Food and Agriculture Sector
- Antimicrobial Use and in Antimicrobial Resistance -

- Aquaculture fish
- Crustaceans
- Mollusks
- Dairy
- Beef
- Sheep, mutton and lamb
- Goat
- Swine
- Bees / Honey

15

SECTORS

- Poultry – layers
- Poultry – broilers
- Turkey
- Rabbit
- Fruit
- Crops
  - Legumes
  - Grains
  - ...

The Food and Agriculture Sector
- Antimicrobial Use and in Antimicrobial Resistance -

3

SECTORS

- Smallholder farms
- Medium commercial operators – local markets
- Intensive, large commercial entities – national and international scope

The Food and Agriculture Sector
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- Aquaculture fish
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45

SECTORS

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  - Grains
  - ...

The Food and Agriculture Sector
- Antimicrobial Use and in Antimicrobial Resistance -

- Food production chain – critical control points for surveillance
- Feed Industry
- Effluents and waste management
- Rivers, streams, ponds, lakes
- **PETS !**

- Pharmaceutical Companies

>50

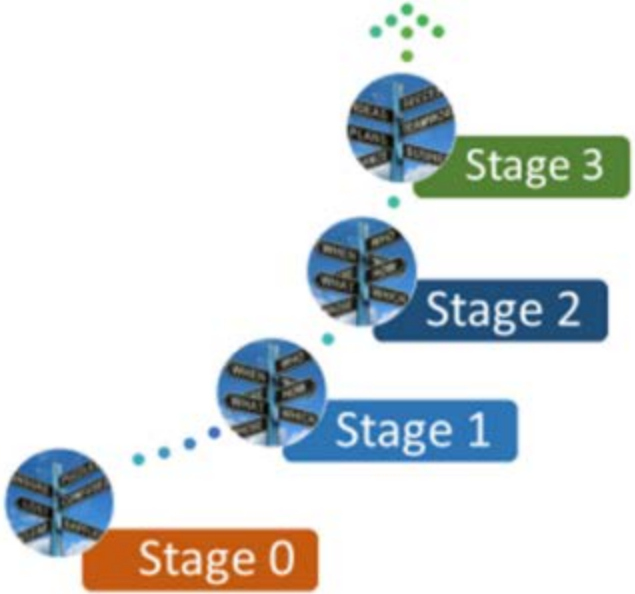
SECTORS

The Food and Agriculture Sector
- Antimicrobial Use and in Antimicrobial Resistance -

- Integrated surveillance? … a **sound** idea
- Complex implementation
- Mosaic of understanding
- Difficult compliance

- Need to start somewhere

Progressive Management Pathway (PMP) on AMR



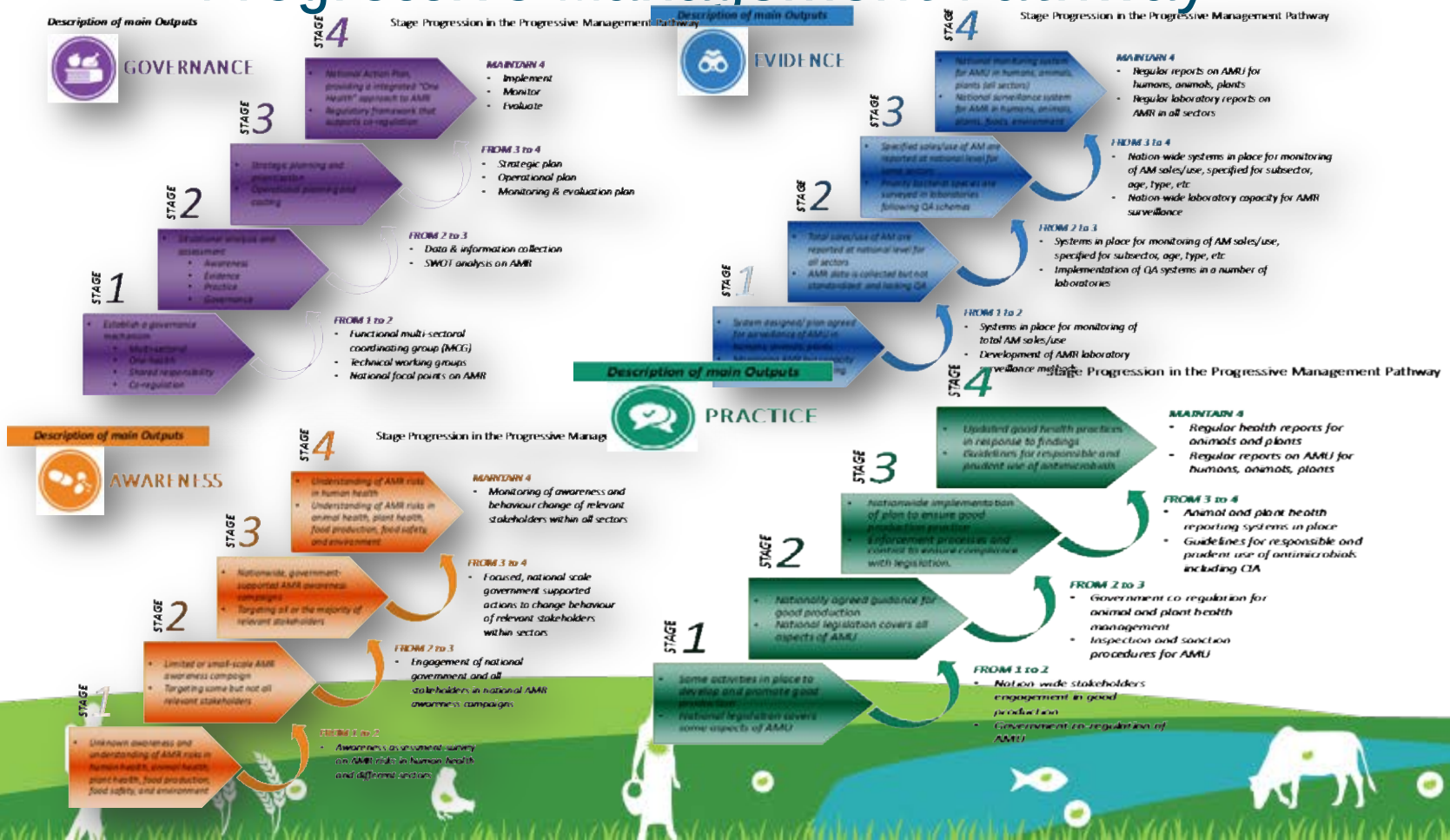
Focus areas

Aw	Evi	Prac	Practices
			Governance

Objectives

1	2	3	4	5	Cross
IEC	SMR	RED	LEG	ALT	CCI
Responsible use of antimicrobials and monitoring of antimicrobial resistance in place					
Implementation of national action plan					
Understanding of current situation and gaps					
None or Low					

Progressive Management Pathway



Tylosin Tartrate Product Sup...
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Poultry Antibiotics Tylosin T...
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Medicine Tylosin Tartrate Injection ...
alibaba.com

Tylosin Injection Price Cattle Sheep ...
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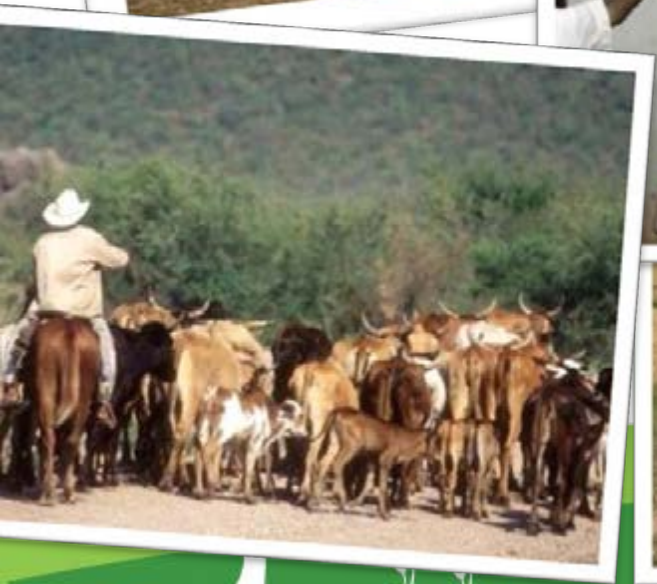
Gaps

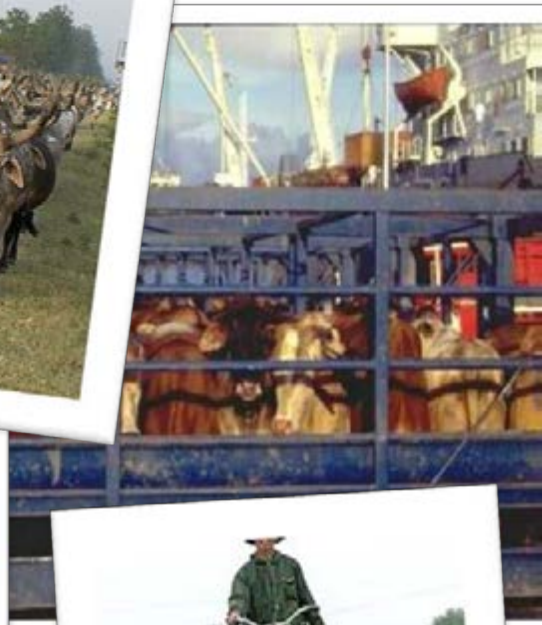
- Global Report on AMR surveillance highlighted the major gaps
  - AMR / foodborne bacteria
  - Impacts on animal and human health.
- The bacteria involved
  - foodborne pathogens, commensals and environmental microbes.
- There is limited knowledge concerning the transmission of AMR within agricultural sites and to humans via foods
- … and human health risks posed by
  - antimicrobial agents (AMA) released in agriculture
  - antimicrobial resistance genes (ARG),
  - and antimicrobial-resistant bacteria (ARB) into the environment.
- Food animals are vehicles of AMR transmission but also are

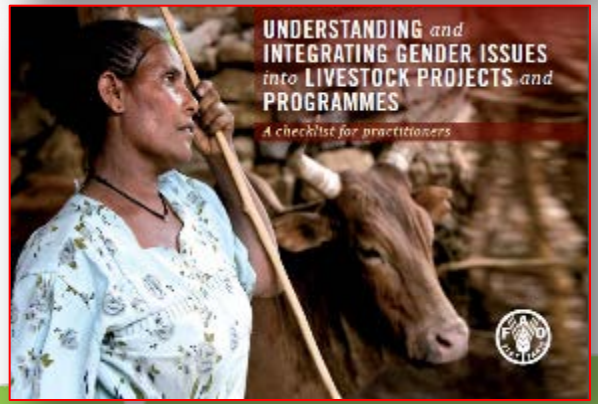
Humans and Animals

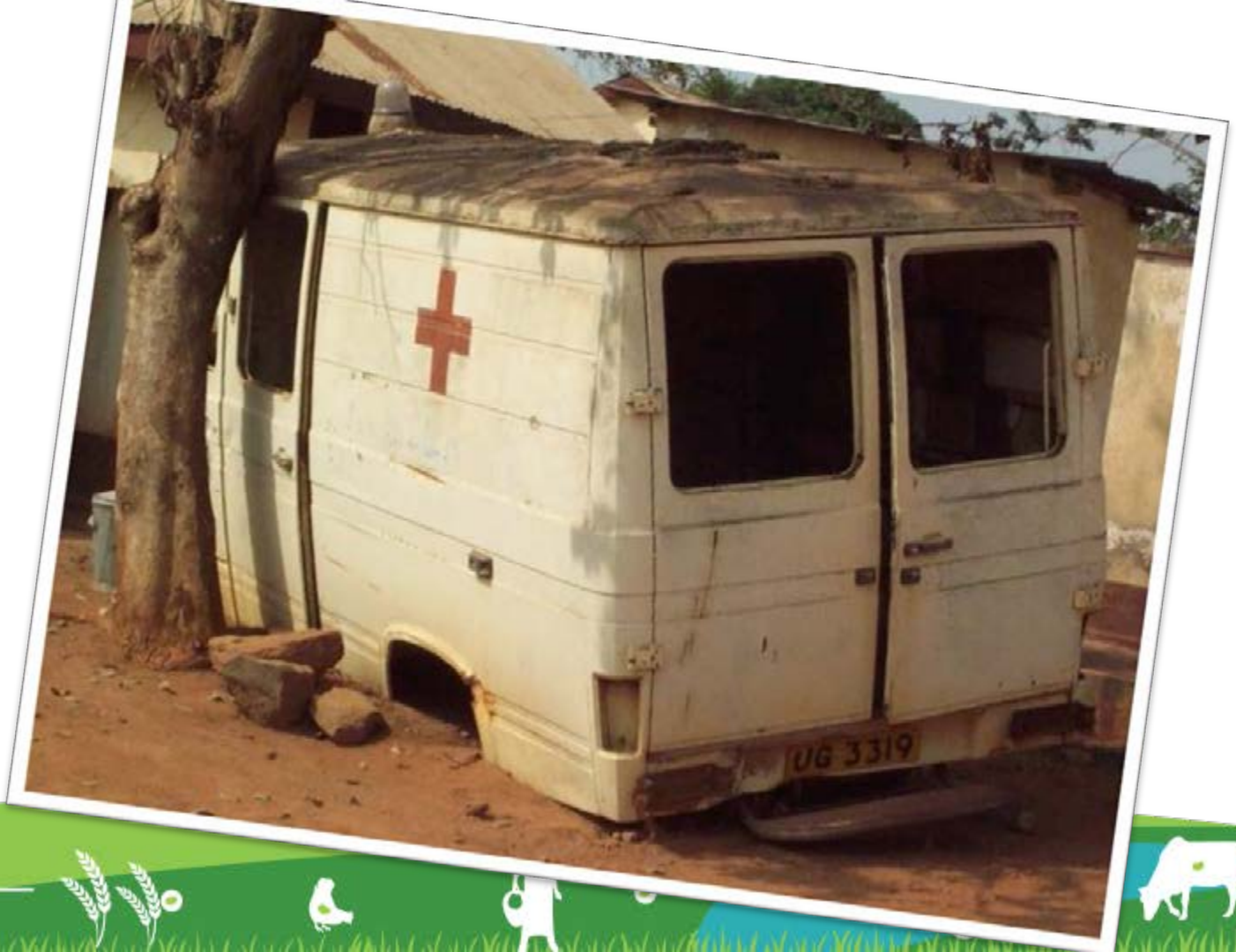
- Most of the literature on the consequences of AMR emergence and spread of bacteria among animals relate to the **potential impact on public health.**
- antibiotics are used to **treat sick animals**, and resistance in animal pathogens may lead to **therapy failure.**
- For all animals, there may be a **negative effect** on health and welfare when diseases cannot be treated.
- Other consequences will vary depending on why and how different animal species are kept…. **Companion, sports, food producing.**







UNDERSTANDING and
INTEGRATING GENDER ISSUES
into LIVESTOCK PROJECTS and
PROGRAMMES
A checklist for practitioners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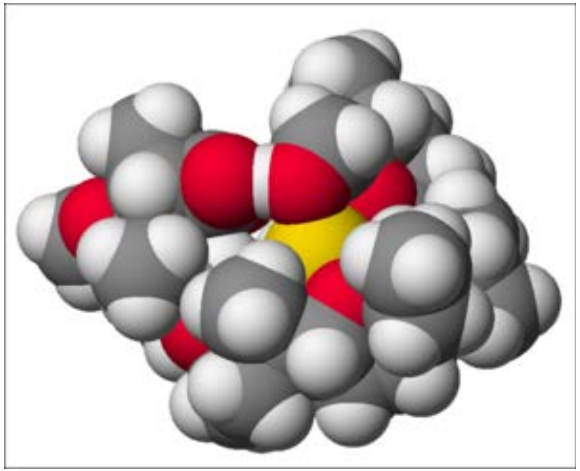
Diseases

- **Contagious** bacterial diseases cause illness and suffering of the animals and thereby bring on economic and welfare losses in food production (Hogeveen et al 2011; Page & Gautier 2012; Vaarten 2012; Duff & Galyean 2007)
- **Respiratory** and **enteric** diseases are among the most important in several species, and **mastitis** is common in animals kept for milk production – cows, buffalo, sheep, goat (Page & Gautier 2012)
- Contagious diseases – **greater risk with higher contact** rates (intensification and large numbers)
- production systems - **congregation** / risk for disease outbreaks is high (Duff &
- *Aquaculture* - fish and shrimp are raised in large numbers with close contact between individuals (Oliva-Teles 2012)



Monensin - ionophore - able to transport cations across lipid membranes of cells in an electroneutral exchange, playing an important role as an Na+/H+ antiporter. It blocks intracellular protein transport, and exhibits antibiotic, antimalarial, and other biological activities.

Used extensively in the beef and dairy industries to prevent **coccidiosis**, increase the production of **propionic acid** and prevent bloat.

Growth Promotion

- Use of antibiotics as growth promoters was banned in Sweden already in 1986; later other countries followed suit, and by 2006 growth promoters were phased out in the whole EU (Laxminarayan et al. 2013; Grave et al., 2006).

- In December 2013 the US FDA in its Guidance for Industry #209[1] recommended that use of antibiotics as growth promoters should be voluntarily phased out.

- FAO DG 2017 "… phase out immediately …" - shared with OIE.
- Ban

1 http://www.fda.gov/downloads/animalveterinary/guidancecomplianceenforcement/guidanceforindustry/ucm216936.pdf

Disease

- **Animal suffering and welfare**
- **Financial losses** directly through higher mortality and indirectly through decreased feed conversion, reduced production and growth, as well as early culling of breeding animals and dairy cows.
- Eventually this leads to **higher costs of commodities** from animal food production for the end consumer.

- Access to effective antibiotics is imperative
- Emergence and spread of resistance leading to depletion of the available arsenal of antibiotics will have serious consequences.

Needs

- To mitigate the impact of bacterial diseases, antibiotics are used ..
  - therapeutically to treat sick animals
  - and for prophylaxis when outbreaks of disease in individual animals or groups of animals are anticipated.

- Poultry, fattening pigs, and fish – oral
- Adult cattle, buffaloes, and breeding pigs - injectable formulations (Page & Gautier 2012).

- Trend - antibiotics introduced for use in farm animals have a **broader spectrum of activity** than older drugs and therefore impose a broader selection pressure for resistance (Vaarten 2012)
- … to substitute penicillin, tetracycline, and trimethoprim-sulphonamides with fluoroquinolones, third-generation cephalosporins, and newer macrolides is done
- …. and it should not be for their direct implications for public health.

Ready for more diseases?

- antibiotic arsenal is reduced
- Less alternatives .. More disease
- *Example:*
  - **Swine dysentery,** a serious enteric infection of growing pigs caused by *Brachyspira hyodysenteriae*.
- large proportion of pigs in a herd are affected and the **disease often persists, … recurring outbreaks**
- **Mastitis**
- **Food-borne diseases**
- **Internal and external parasites, fungal …**


Food and Agriculture Organization of the United Nations
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FAO ANIMAL PRODUCTION AND HEALTH
guidelines
ECONOMIC ANALYSIS OF ANIMAL DISEASES

Impact

- **There are four main sources of impact**
  - Disease effects: the mortality and loss of production caused by clinical or subclinical disease.
  - Market disruption:
    - as a result of consumer fears,
    - supply shortage causing market shocks, or restrictions
  - Control measures: the costs and benefits of measures applied by farmers, governments and industry to prevent or control disease outbreaks.
  - Effects beyond livestock sector: these may include impacts on human health, the public health system, tourism and wildlife

Costs

- Classification of costs of animal disease prevention and control interventions

- **Within the livestock sector**
  - Prevention and preparedness costs
  - Outbreak control costs
  - Costs of changes to management or production systems
- **Beyond the livestock sector**
  - Public health investment
  - Higher food prices for consumers
  - Costs to tourism or wildlife

Benefits

- Classification of benefits of TAD prevention and control interventions
-
- **Within the livestock sector**
  - Increased asset and output value
  - Reduced prevention and treatment costs
  - Reduced costs of outbreak control
- **Beyond the livestock sector**
  - Human lives saved or quality-lifeyears increased
  - Public health treatment costs reduced
  - Tourist sector outbreak control costs reduced

Four Pillars of Food Security – Impact

- **Food availability**: … The availability of sufficient quantities of food of appropriate quality, from domestic production or imports.
- **Food access:** by individuals to adequate resources for acquiring appropriate foods for a nutritious diet.
- **Stability**: … access to adequate food at all times.
- **Utilization**: …. of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being. (This brings out the importance of non-food inputs in food security.)

Tackling AMR in Bangladesh – A One Health Approach

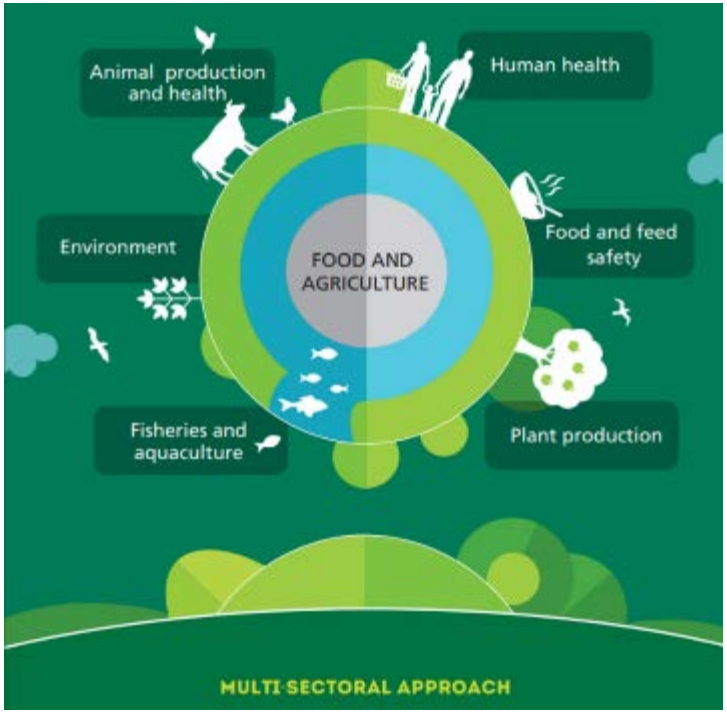
AMR in Kenya – Rising to the Challenge

AMR in the UK: Vets & Farmers Working Together

Conclusions

- The consequences of AMR in bacteria parallel human and veterinary medicine.
- Loss of effective treatments through resistance will **cause suffering for the affected individual,** regardless of whether it is a human being or an animal.
- **Economic consequences** - treatments in animal and human health care (Rx and advanced care). Much higher in human health
- But loss of access to effective therapy will also lead to economic losses due to **reduced productivity** of the animals, and loss of effective therapy in human health care is also associated with losses of productivity and **subsequently to societal costs.**
- **Healthy animals do not need antibiotics**

Thank you for your kind attention



www.fao.org/antimicrobial-resistance

@FAOAnimalHealth on Twitter