VETERINARY VACCINOLOGY NETWORK

Livestock vaccines in sustainable livestock development and health

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Vaccination: the key disease prevention tool

Artificial induction of population/herd immunity has a sound theoretical base and an outstanding history of success when safe and efficacious vaccines are effectively delivered

James Phipps
14th May 1796

Painting by
Robert Thom
(1915 – 1979)

Painting from the
University of Michigan
Health Systems
collection

You let a doctor take a dainty, helpless baby, and put that stuff from a cow, which has been scratched and had dirt rubbed into her wound, into that child. Even, the Jennerians now admit that infant vaccination spreads disease among children. More mites die from vaccination than from the disease they are supposed to be inoculated against

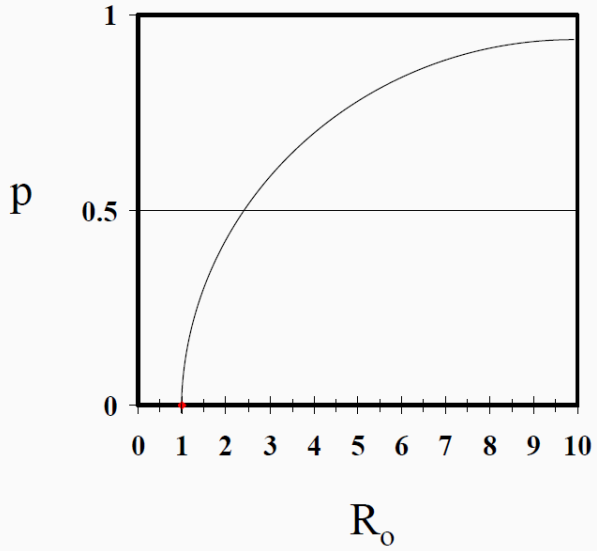
George Bernard Shaw, 1929

Direct effect of immunity induced by vaccination on the reproductive number (R_0) of infectious organisms in populations

A fraction of the population is removed from the susceptible to the immune class, diminishing the number of susceptibles and therefore the effective reproductive capacity of the organism

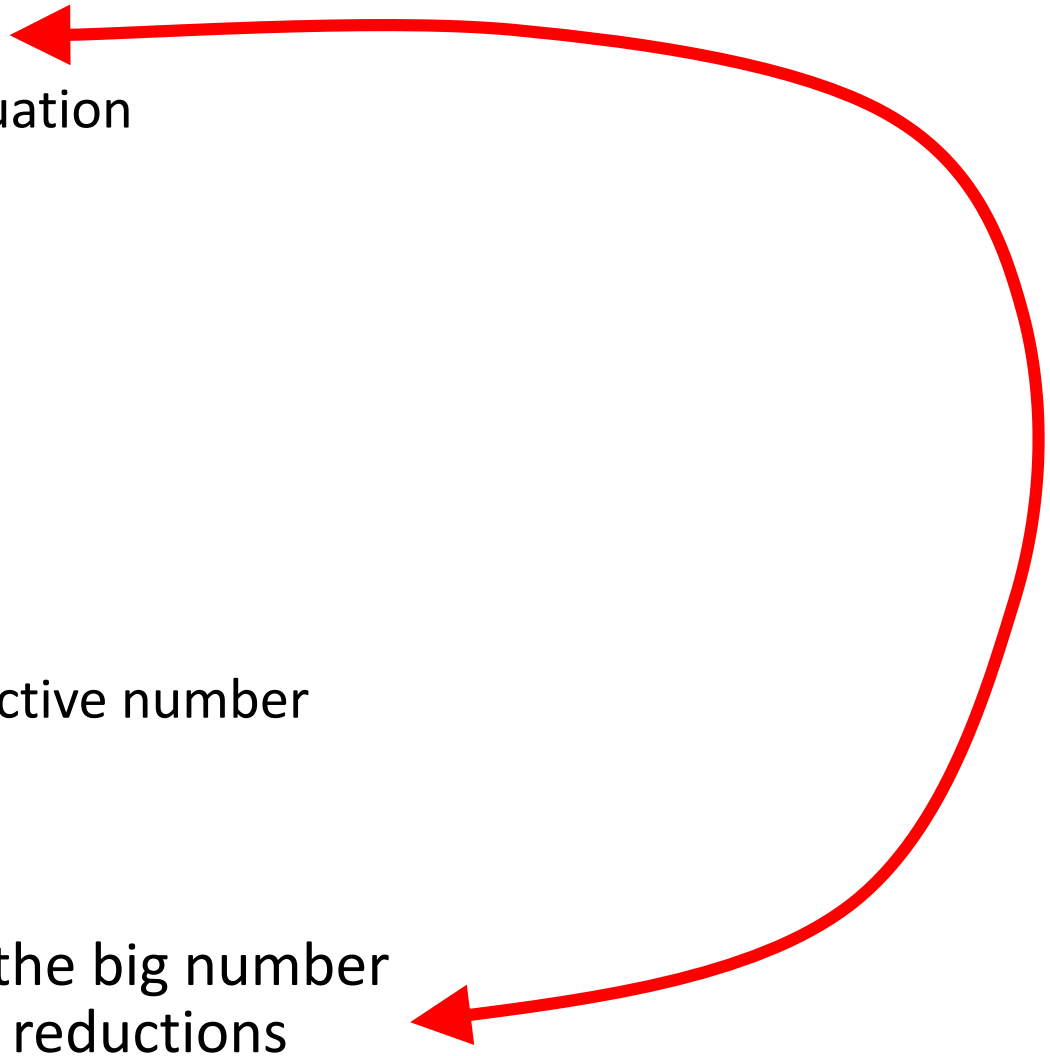
i.e. from $R = R_0 x$ (x = population susceptible)
to $R = R_0 (1- p)$ (p = population successfully immunised)

For eradication, $p_c = 1 – (1/ R_0)$
(p_c = critical proportion to be immunised)



Vaccinology; the broader perspective

- **Discovery**
  - Pathogenesis
  - Antigen identification and evaluation
  - Immune responses
  - Vector and adjuvant selection
- **Evaluation**
  - Control studies
  - Clinical trials
  - Field testing
- **Delivery**
  - Host population characteristics
  - Disease epidemiology; reproductive number
  - Vaccine qualities
  - Partners, incentives, strategies
- **Impact**
  - Justification for investment; the big number
  - Returns from disease impact reductions



The themes of this meeting

- Epidemiology and economics
- Novel tools and technologies
- Protective immunity
- Immunogen design

Some contributions of epidemiology and economics

1. Priority setting: which diseases come first?
2. Interventions: in controlling or eradicating a given disease, what are the merits of different strategy and policy options?
3. Disease control implementation: how can the optimal delivery and adoption of selected interventions be best achieved?

ELSEVIER

Preventive Veterinary Medicine 48 (2001) 231–260

PREVENTIVE VETERINARY MEDICINE

www.elsevier.nl/locate/prevetmed

Can epidemiology and economics make a meaningful contribution to national animal-disease control?

Brian Perry*, John McDermott, Tom Randolph

International Livestock Research Institute (ILRI), PO Box 30709, Nairobi, Kenya

Accepted 2 October 2000

Recommendations from the Veterinary Vaccinology Network on Strategic Goals for Veterinary Vaccines

- An analysis of the potential financial return on investment for the development of a vaccine i.e. the benefit:cost ratio
- Benefits for food security and production efficiency
- Benefits for food safety
- Contribution to the alleviation of poverty
- Contribution to mitigation of climate change, through the improved use of animal resources

Recommendations from the Veterinary Vaccinology Network on Strategic Goals for Veterinary Vaccines

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- Benefits for food security and production efficiency
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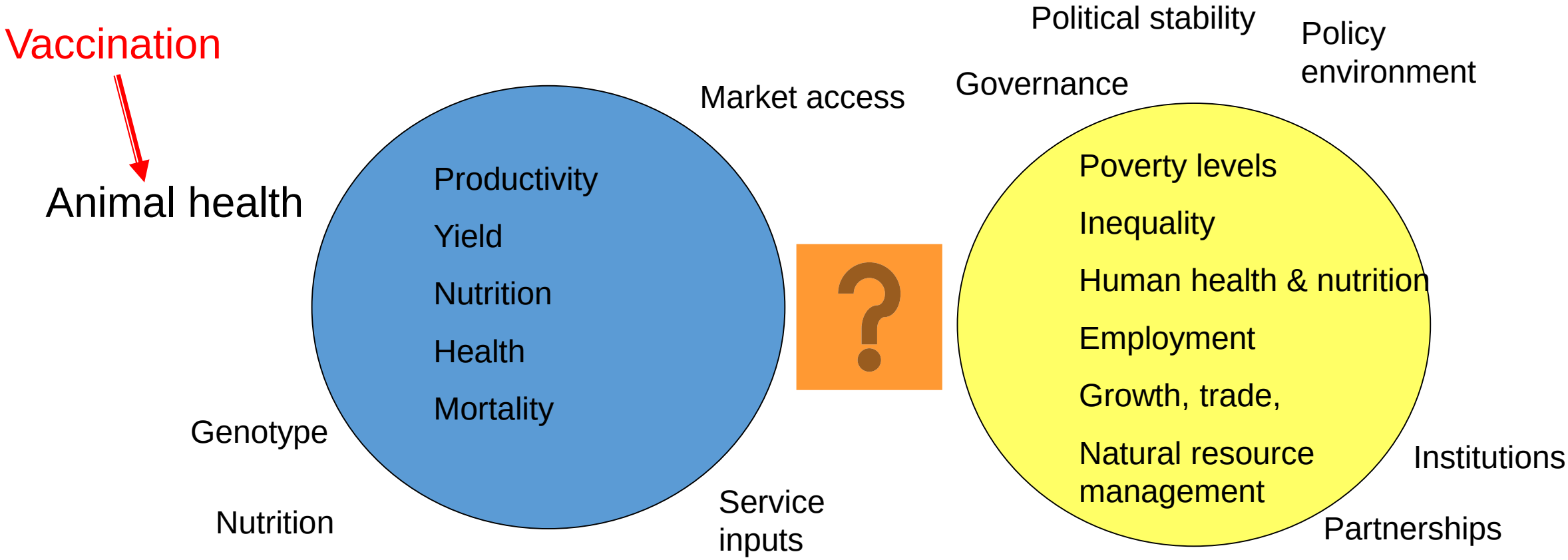
- Contribution to the alleviation of poverty
- Contribution to mitigation of climate change, through the improved use of animal resources

The apparent divide between livestock-associated outputs …….and human development outcomes



The livestock sphere in agriculture

The human development sphere

The concept of 3 global livestock system trajectories

PNAS

Current drivers and future directions of global livestock disease dynamics

Brian D. Perry[a,1], Delia Grace[b], and Keith Sones[c]
[a]*Nuffield Department of Clinical Medicine, University of Oxford, PO Box 437, Gilgil 20116, Kenya;* [b]*Market Opportunities Theme, International Livestock Research Institute (ILRI), Nairobi 00100, Kenya; and* [c]*Keith Sones Associates, Nairobi 00502, Kenya*

Edited by Philip Thornton, Consultative Group on International Agricultural Research, Edinburgh, United Kingdom, and accepted by the Editorial Board March 25, 2011 (received for review September 2, 2010)

- **Developed countries**

The worried well

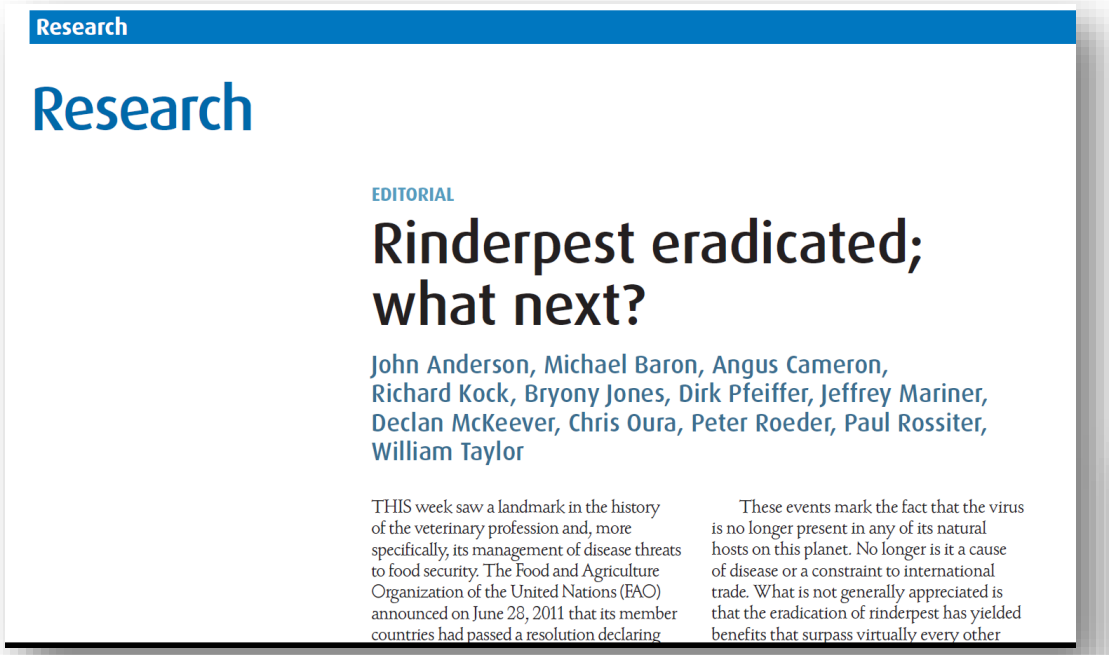
- **Developing countries**

The hotspots

The coldspots

Disease prioritisation; some different approaches

The veterinary or bench science approach?



Research

Research

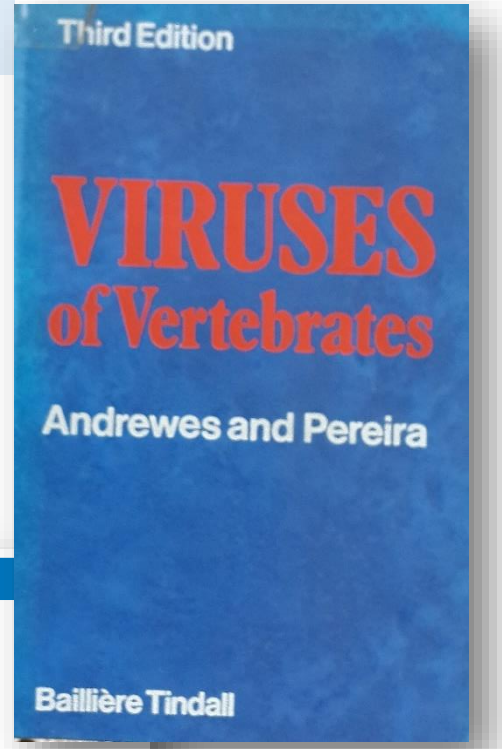
EDITORIAL

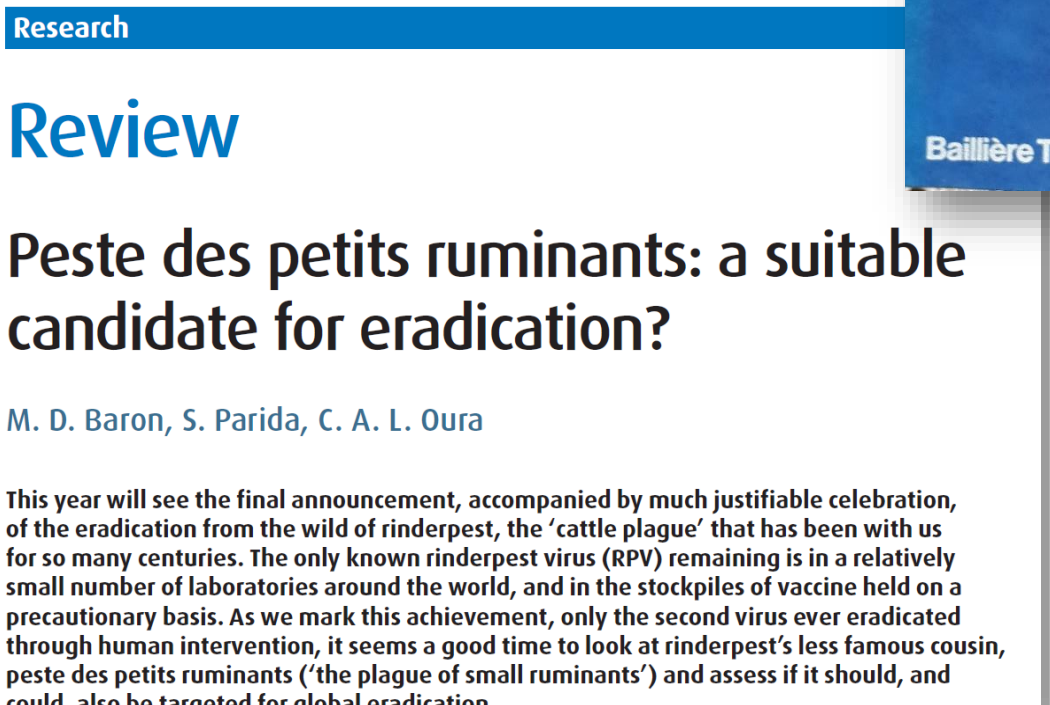
Rinderpest eradicated; what next?

John Anderson, Michael Baron, Angus Cameron, Richard Kock, Bryony Jones, Dirk Pfeiffer, Jeffrey Mariner, Declan McKeever, Chris Oura, Peter Roeder, Paul Rossiter, William Taylor

THIS week saw a landmark in the history of the veterinary profession and, more specifically, its management of disease threats to food security. The Food and Agriculture Organization of the United Nations (FAO) announced on June 28, 2011 that its member countries had passed a resolution declaring

These events mark the fact that the virus is no longer present in any of its natural hosts on this planet. No longer is it a cause of disease or a constraint to international trade. What is not generally appreciated is that the eradication of rinderpest has yielded benefits that surpass virtually every other





Research

Review

Peste des petits ruminants: a suitable candidate for eradication?

M. D. Baron, S. Parida, C. A. L. Oura

This year will see the final announcement, accompanied by much justifiable celebration, of the eradication from the wild of rinderpest, the 'cattle plague' that has been with us for so many centuries. The only known rinderpest virus (RPV) remaining is in a relatively small number of laboratories around the world, and in the stockpiles of vaccine held on a precautionary basis. As we mark this achievement, only the second virus ever eradicated through human intervention, it seems a good time to look at rinderpest's less famous cousin, peste des petits ruminants ('the plague of small ruminants') and assess if it should, and

The sponsor's view?

BILL & MELINDA GATES foundation

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AGRICULTURAL DEVELOPMENT

LIVESTOCK OVERVIEW AND APPROACH

PRIORITY DISEASES

For animal health, we focus on the diseases that cause significant loss for smallholder farmers in sub-Saharan Africa and South Asia.

Disease	Cattle	Small Ruminants	Poultry
Bovine Tuberculosis	✓		
Brucellosis	✓	✓	
Contagious Bovine Pleuropneumonia (CBPP)	✓		
Contagious Caprine Pleuropneumonia (CCPP)		✓	
East Coast Fever	✓		
Ectoparasites	✓	✓	✓
Endoparasites	✓	✓	✓
Foot and Mouth Disease	✓	✓	
Goat Pox and Sheep Pox		✓	
Lumpy Skin Disease	✓		
Newcastle Disease			✓
Peste des Petits Ruminants (PPR)		✓	
Rift Valley Fever (RVF)	✓	✓	
Trypanosomiasis	✓	✓	

DEFRA Animal Health Policy and Implementation Evidence Plan

Policy Objective	Current/ Near-term Evidence needs	Future Evidence needs
Policy preparedness for exotic diseases.	• A multi-disciplinary programme of research and surveillance in-line with policy objectives on a range of notifiable exotic diseases such as Foot and Mouth Disease (FMD), Avian Influenza (AI), Newcastle Disease (ND), Classical Swine Fever (CSF), African Swine Fever (ASF), Rabies, infectious diseases of horses, Vector-Borne Diseases (VBDs, such as Bluetongue (BTV) and African Horse Sickness (AHS)) and notifiable mycoplasma diseases of livestock. • Improved control tools (for example developing improved diagnostic tests and developing vaccines) where this would offer a clear benefit to our response to exotic disease e.g. to develop a diagnostic test that reduces the economic burden of our control measures by reducing the length of time that premises with a suspect case of disease are held under restrictions. Including establishing the economic case for control changes. Includes current research on development of improved diagnostic tests for FMD, lyssavirus, ASF and VBDs (e.g. BTV) and FMD, AHS and ASF vaccine development. • Research on epidemiology and understanding virus survival (in commodities and the environment) to inform policy development, disease control strategies and to enable provision of advice and guidance to stakeholders. Includes current research on epidemiology for FMD, VBD (e.g. BTV)	• Continued provision of expertise and capability to inform on a wide range o exotic disease threats and address pc specific evidence questions as they a • Continued improvement in control too (diagnostic tests and developing vacc where there is a clear benefit to our preparedness and response to exotic diseases. • Social science to support preparedne particularly focused on decision making under uncertainty and response to risk situations. • Social science and statistics to support better understanding of the socio-economic implications for and impacts of mitigation and outbreak controls (for example modelling the net impact on exports affected by outbreak bans and assessing the true cost of movement controls).

www.defra.gov.uk

Vaccination as a Control Tool for Exotic Animal Disease

Key Considerations

March 2010

The international development view?

Typology of different impacts of disease on poor livestock keepers and other actors in livestock commodity value chains

Reducing vulnerability:

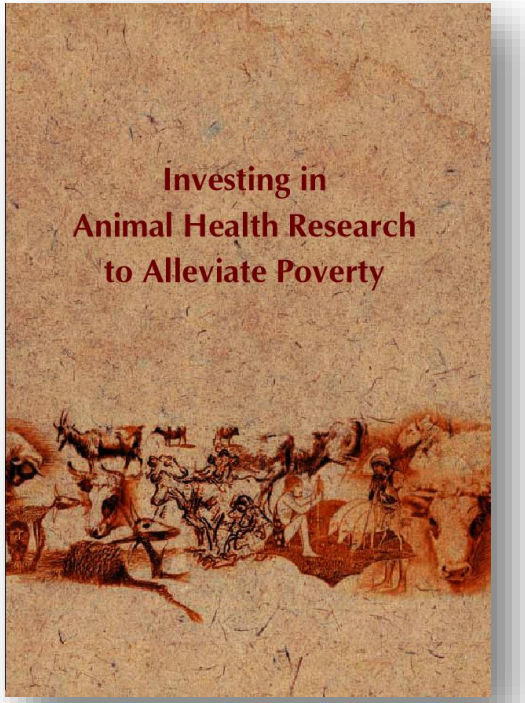
- High livestock mortality (Newcastle disease, HPAI, Rift Valley fever)

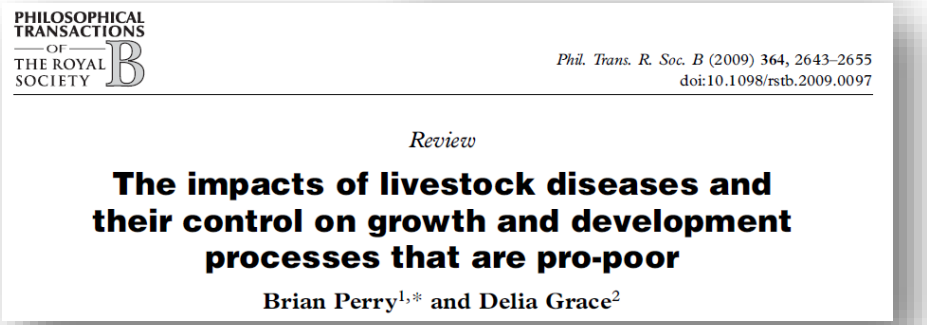
Promoting sustainable intensification:

- Endemic diseases (parasitism, vector-borne)
- Mastitis, dystocia, metabolic diseases

Improving access to market opportunities:

- Transboundary diseases
- Disease and food safety risks in commodities




PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

Phil. Trans. R. Soc. B (2009) **364**, 2643–2655
doi:10.1098/rstb.2009.0097

Review

The impacts of livestock diseases and their control on growth and development processes that are pro-poor

Brian Perry[1,*] and Delia Grace[2]

DISCONTOOLS Approaches to the prioritisation of diseases to focus and prioritise research in animal health: A worldwide review of existing methodologies

Reference	CVOs	Veterinary surveillance: Prioritisation Project	ETPGAH	Priority setting of emerging zoonoses	Joanna McKenzie et al.	Krause et al.	Jo-Anne Doherty	WHO guideline on setting priorities	Perry et al	C. Heffernan
Country	EU	UK	EU	NL	NZ	GER	CA	World	Africa/Asia	EU
Year	Feb-08	2006	Jul-07	2006	2007	2008	2000	2006	2002	2009
Organisation	European Commission	DEFRA	ETPGAH	RIVM	EpiCentre Massey Univ	Robert Koch Institute	Division of disease surveillance, Laboratory Centre for Disease Control, Health Canada	WHO	International Livestock Research Institute	Livestock Development Group, University of Reading
Prioritisation objective	Risk management. To identify where the EU should act.	Driven by economic considerations. Provide a guide to AH and Welfare policies	Following AP and SRA publications. Risk assessment	Public Health	Wildlife pathogens For Surveillance strategy	Epidemiological research and surveillance	National surveillance. Development and evaluation of programs. Best use of resources.	Best use of limited human and financial resources for disease surveillance with changing needs.	Rank disease constraints to poverty alleviation	Create a ranking of those diseases with the greatest impact on poverty
Number of diseases	No	25	34	?	82 pathogens	85	43	No	76+	?
Number of criteria	34	40	24	9	3	12	10	Should be 5 to 8 criteria	3 with sub components	4
Scoring system	5-tiered	5- and 3-tiered	5-tiered	4- and 5-tiered	4-tiered	3-tiered	3- and 4- and 5-tiered	5-tiered	5 tiered	none
Weighting applied	Systematically	Relative weight Systematically	No	Perceived threat Systematically	No	Systematically	No	One proposition: using scoring the importance of the different criteria.	Yes	No
Methodology of collecting opinion	Working Party of CVOs	Workshops	Workshops. Questionnaires.	Steering Committee Consortium	Electronically	Delphi	Subcommittee	Workshop with one facilitator	Workshops,	Interviews and questionnaires
Number of participants	?	23 UK organisations	?	?	?	11	?	No	200+	265 households comprising 2453 individuals
Type of participants	CVOs	government and non-government stakeholders	?	?	Wildlife disease experts and EpiCentre project team members	Epidemiologists at National Public Health Institute		No	Front line vets services, research institutes, NGOs, universities,	Livestock-keeping households

Key messages

- Disease prioritisation is generally demand-led, but the growth of effective vaccine development platforms, combined with other factors, has given increasing credibility to supply-led initiatives
- The diversity and polarity of priorities between livestock system trajectory settings

Why do we want to know the impact of disease X, and what, specifically, do we want to know?

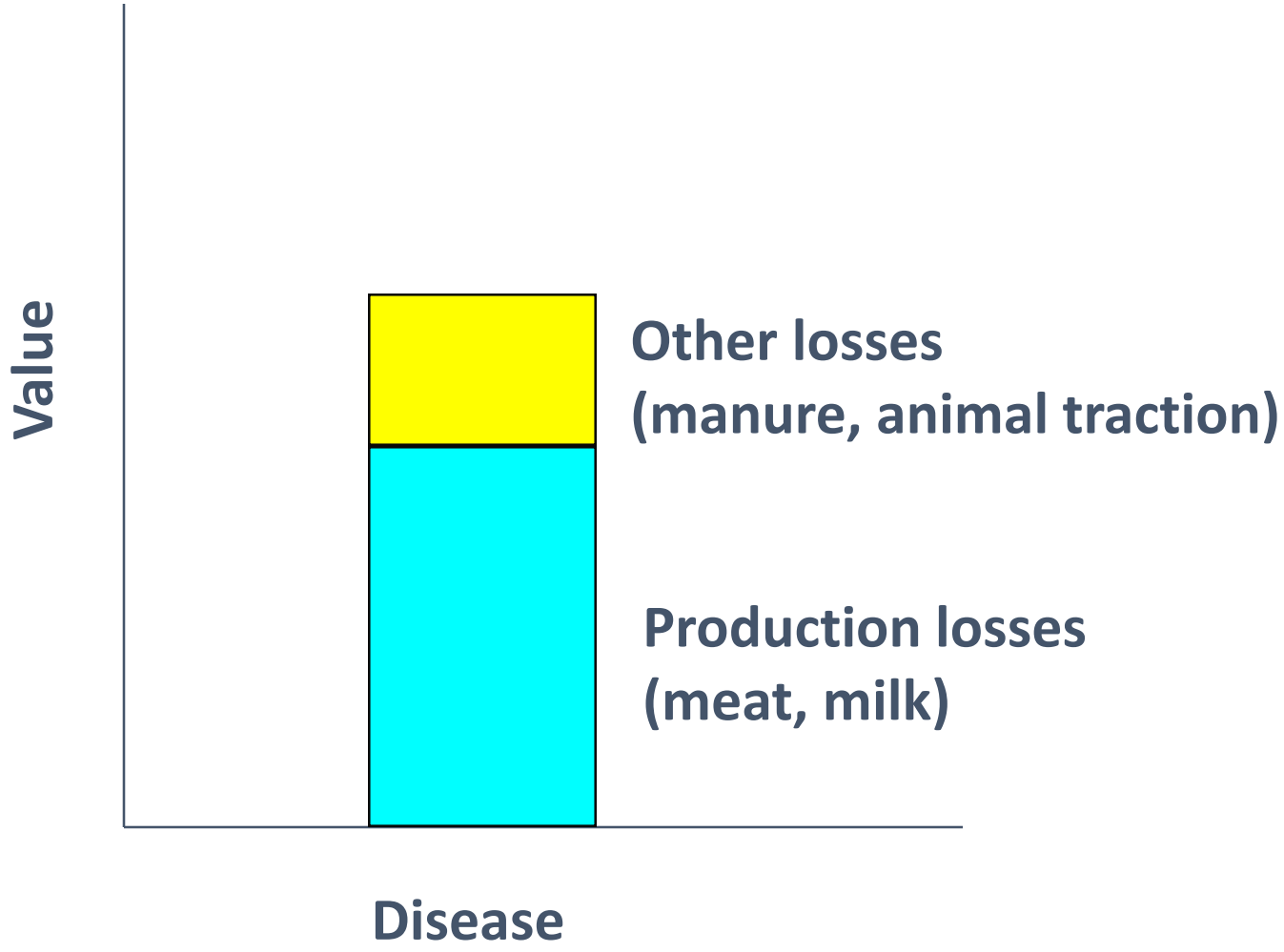
- We think it will help us get money for our control programme/research project
- We think it will present the good news as to what bad news this disease really is
- We think the audience will be impressed by a (hopefully BIG) $$ or ££ figure
  - But will it have context?

…but what do we ***really*** want to know?

- Where does this disease fit in the agricultural priorities for sustainable and inclusive growth?
- What impact will this disease have if it enters…..
- Prioritise *between* this and other livestock diseases to guide research and disease control investment policy
- *Within* control of this disease, compare the relative economic merits of different intervention policies and strategies, including vaccines

The economic impact of a disease

the first step?

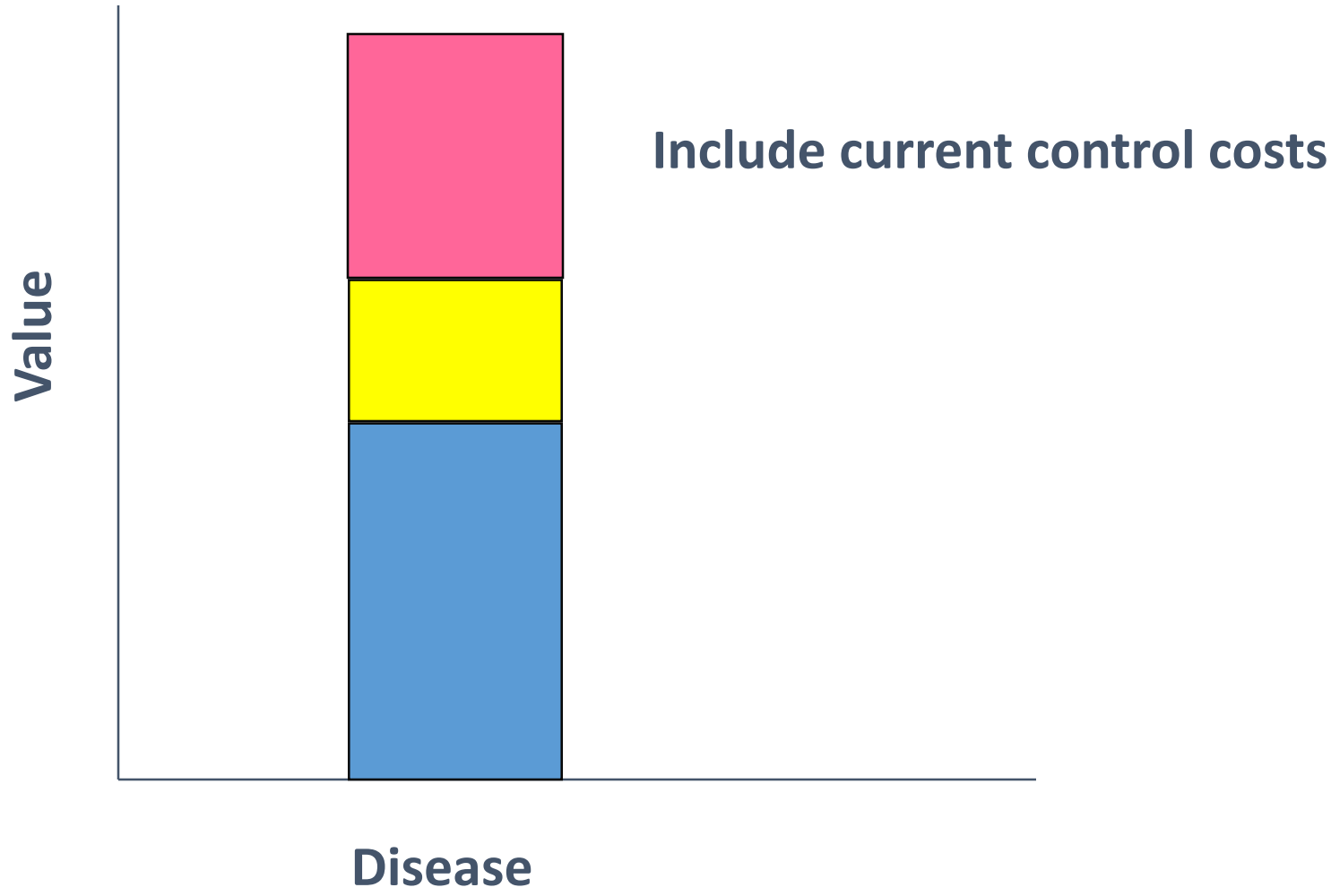


What is the value of costing productivity losses?

- Produces that magic number
- Can (sometimes) be aggregated from farm to national levels
- But, interpretation of aggregated figures difficult; no guarantee of farmer incentives to control
- Where control is the main option (rather than eradication), does not represent potential benefits to control, as certain losses will continue

The economic impact of a disease

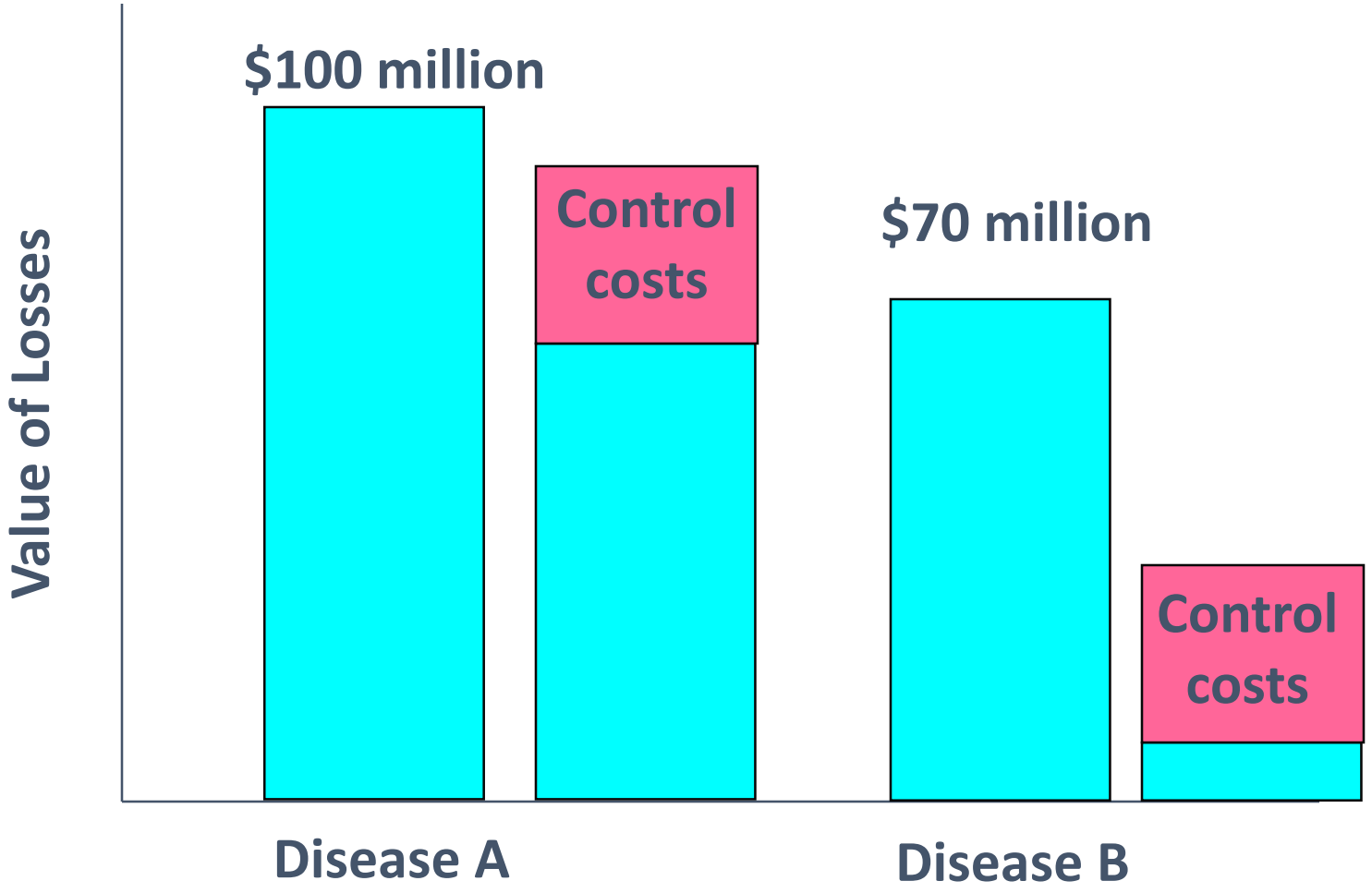
the next step?



Added value of considering costs

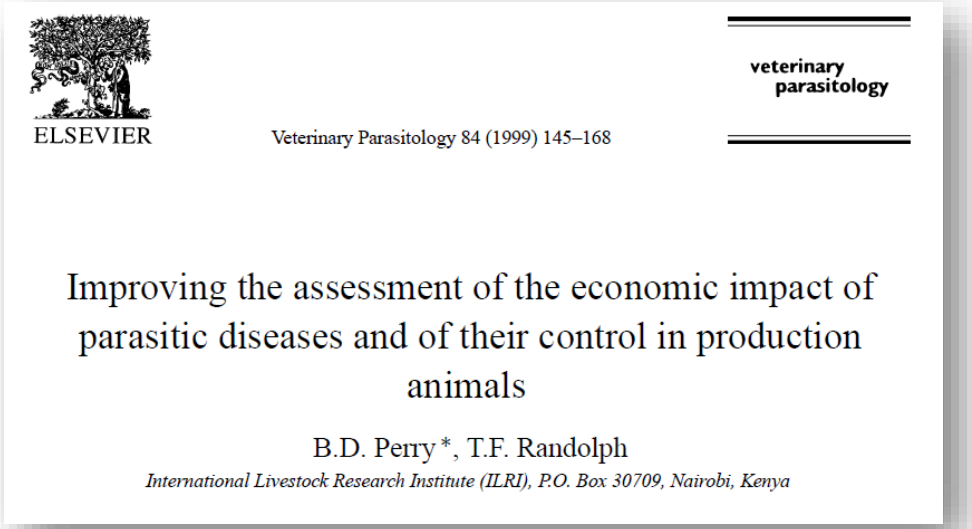
- Includes consideration of the financial value of disease already controlled, not just that component uncontrolled
- Adds another dimension to total loss calculation, *but does not really add utility to the resulting monetary figure*

The inadequacy of total loss estimations in priority setting



The estimation of ***avoidable*** losses

- How to best allocate scarce resources
- How to understand the trade-offs in resource allocation
- The use of economics in developing rules and techniques for decision making



Modelled economic returns to disease control

- Merits and pitfalls

Returns to vaccine research against trypanosomiasis

ELSEVIER

Agricultural Systems 59 (1999) 79–98

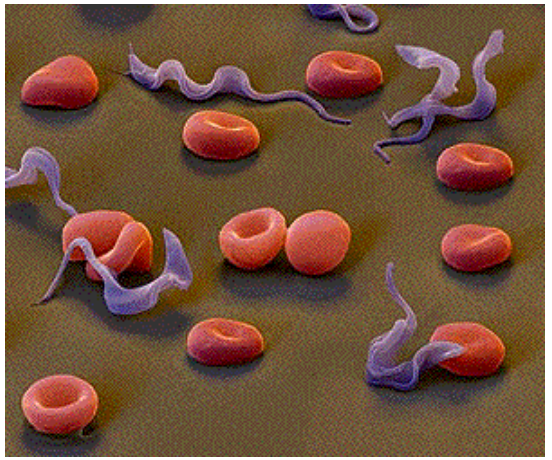
AGRICULTURAL SYSTEMS

Measuring the costs of African animal trypanosomosis, the potential benefits of control and returns to research

P.M. Kristjanson *, B.M. Swallow, G.J. Rowlands, R.L. Kruska, P.N. de Leeuw

International Livestock Research Institute, PO Box 30709, Nairobi, Kenya

- Benefits of improved trypanosomiasis control (meat and milk productivity only) $700 million per year in Africa
- Disease estimated to cost livestock producers and consumers $1.3 billion annually
- Adoption period: 12 years; maximum adoption rate: 30%;
- Benefit/cost ratio of 34:1



Returns to vaccine research against trypanosomiasis

- Valuable estimation and methodology for returns to trypanosomiasis control
- Attribution to vaccine research and use highly questionable; the role of more effective use of currently available technologies (traps, insecticides, chemotherapy, genetically engineered livestock, etc.)
- Differences will be in cost of research, probability of success, time of research, adoption rates, etc.
- 15 years on: no vaccine (and results based on one being available 5 years ago)
- ILRI abandoned trypanosomiasis vaccine research in 2002!

Returns to heartwater vaccine development and deployment in Zimbabwe

Experimental & Applied Acarology, 22 (1998) 725–740

Distributions of the vectors of heartwater, *Amblyomma hebraeum* and *Amblyomma variegatum* (Acari: Ixodidae), in Zimbabwe

T.F. Peter[a*], B.D. Perry[b], C.J. O'Callaghan[ce], G.F. Medley[c], W. Shumba[a], W. Madzima[d], M.J. Burridge[e] and S.M. Mahan[ae]

Investigating the epidemiology of heartwater (*Cowdria ruminantium* infection) by means of a transmission dynamics model

C. J. O'CALLAGHAN[1]*, G. F. MEDLEY[1], T. F. PETER[2] *and* B. D. PERRY[3]

[1] *Department of Biological Sciences, University of Warwick, Coventry CV4 7AL, UK*
[2] *University of Florida/USAID/SADC Heartwater Research Project, Veterinary Research Laboratory, PO Box CY 551, Causeway, Harare, Zimbabwe*
[3] *International Livestock Research Institute (ILRI), PO Box 30709, Nairobi, Kenya*

(*Received 6 January 1997; revised 7 February 1998; accepted 7 February 1998*)

ELSEVIER

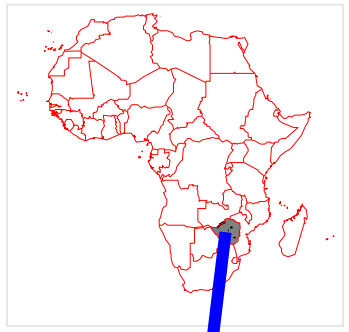
Preventive Veterinary Medicine 39 (1999) 173–189

PREVENTIVE VETERINARY MEDICINE

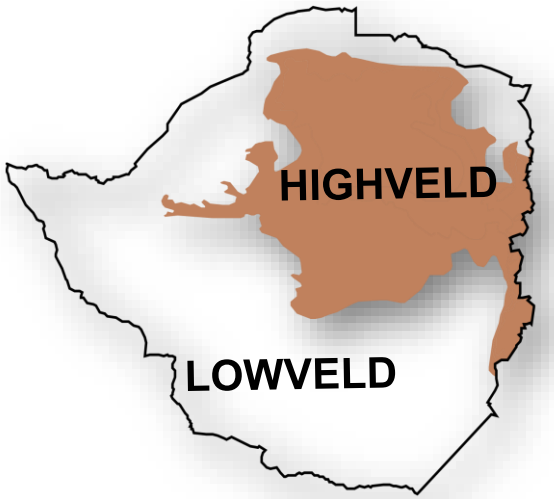
An assessment of the economic impact of heartwater (*Cowdria ruminantium* infection) and its control in Zimbabwe

A.W. Mukhebi[a], T. Chamboko[b], C.J. O'Callaghan[c], T.F. Peter[b], R.L. Kruska[a], G.F. Medley[c], S.M. Mahan[b], B.D. Perry[a,*]

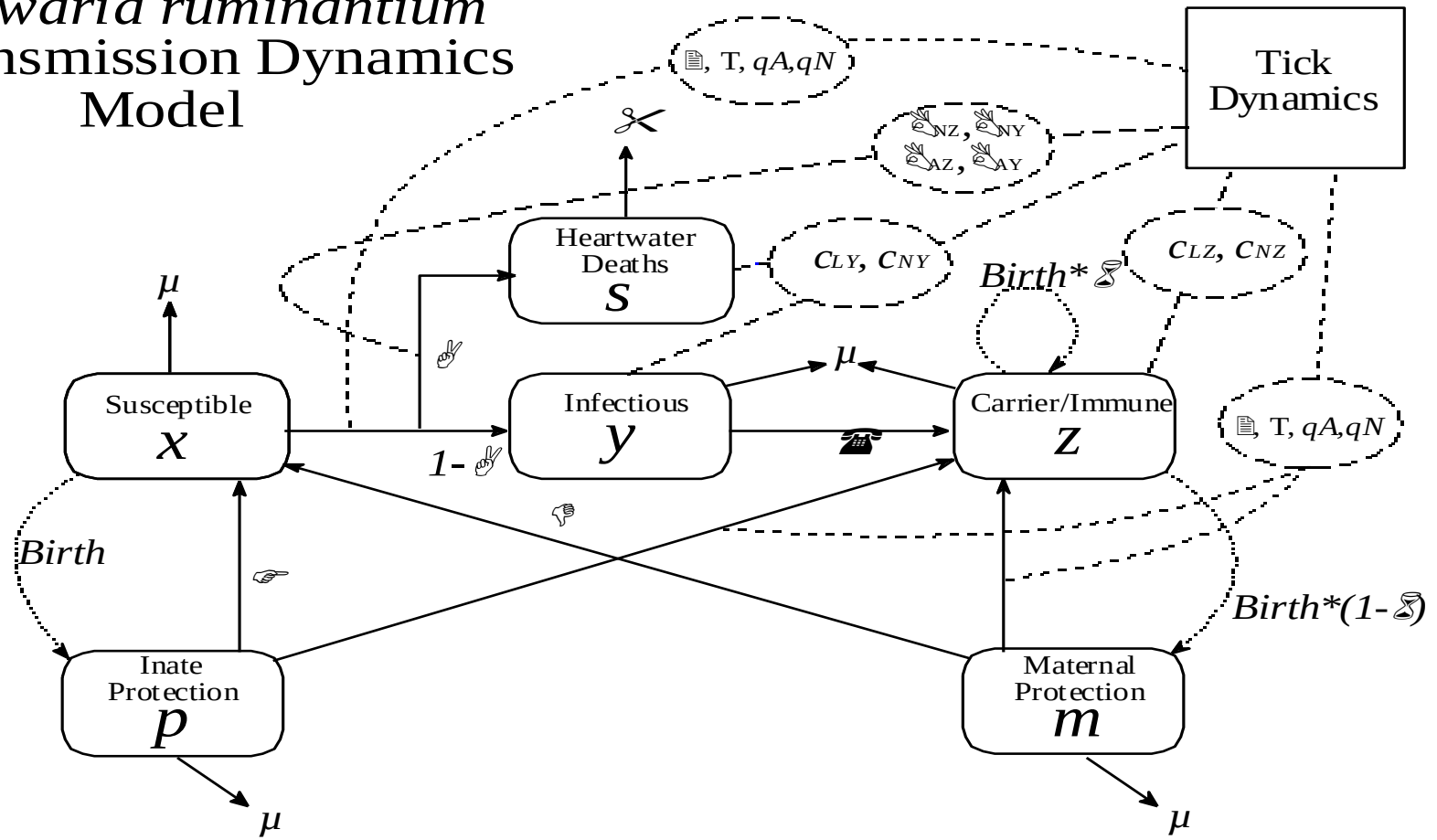
Economic impact of heartwater & its control in Zimbabwe



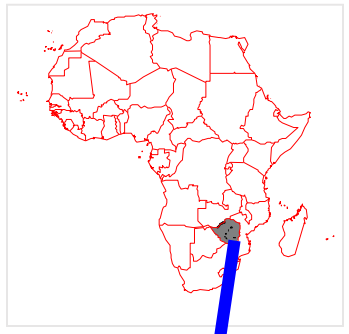
Zimbabwe



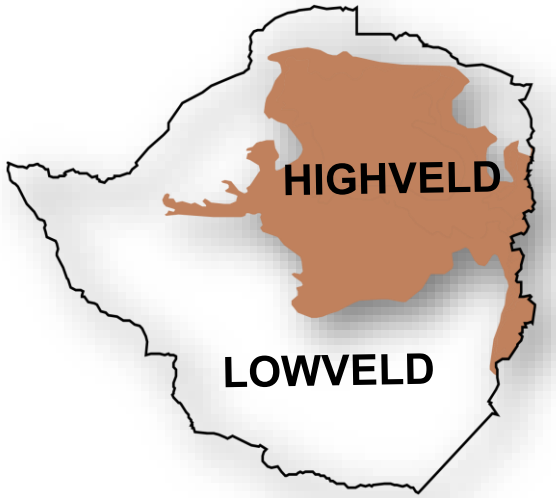
Cowdria ruminantium Transmission Dynamics Model



Economic impact of heartwater & its control in Zimbabwe



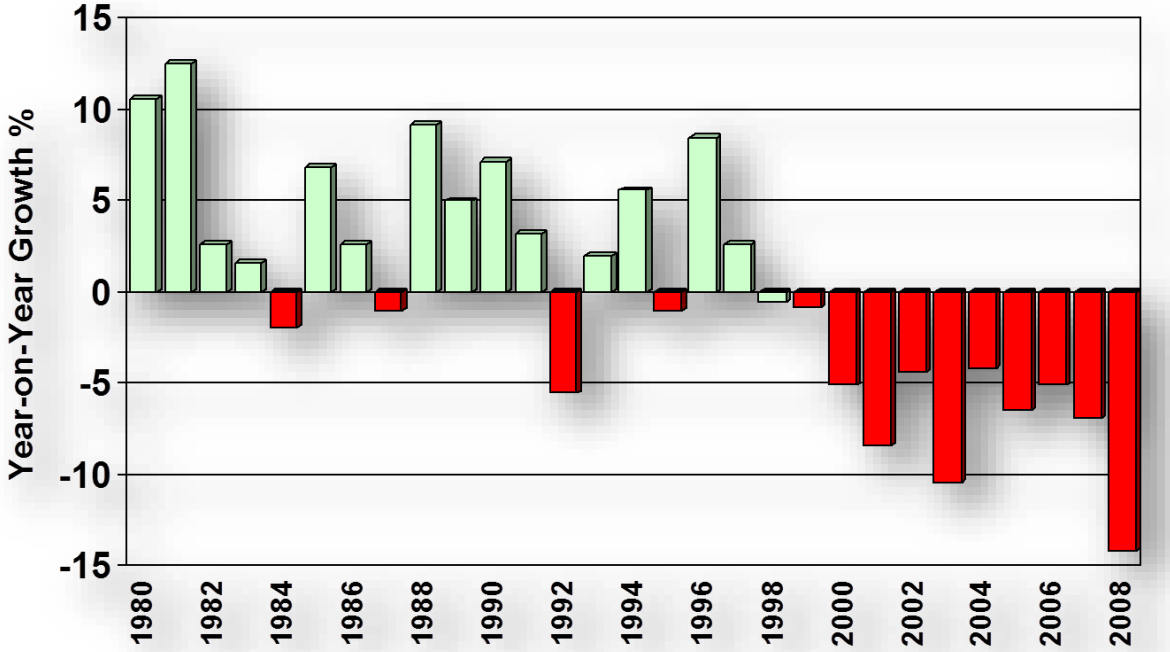
Zimbabwe



- **Baseline Scenario**. Heartwater distribution of 1997 (Peter *et al*., 1998a) and national control strategy based on the use of acaricide application
- **Scenario A**. Assumed heartwater spread and eventually cover the entire country (Norval *et al.,* 1994; Perry *et al.,* 1997) and that baseline control strategy based on the application of acaricides would continue to be applied.
- **Scenario B**. Deployment of new heartwater vaccine. Assumes disease continues to spread throughout the country, and new vaccine becomes available for adoption by farmers over the 10-yr analysis period

Economic impact of heartwater & its control in Zimbabwe

- Total national economic losses of US$ 5.6 million
- Annual losses per animal 25 times greater in commercial than communal system
- Greatest component of loss acaricide cost (76%), milk loss (18%) & treatment cost (5%)
- BCR of new vaccine 7.6:1 in commercial & 2.4:1 in communal systems
- Annual market potential of 500,000 doses per year over 10 years


Year-on-Year Growth %
15
10
5
0
-5
-10
-15
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
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2004
2006
2008


ONE HUNDRED
BILLION DOLLARS
Issue date: 1st July 2008
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RESERVE BANK OF ZIMBABWE

The economic impact of foot and mouth disease control and eradication in the Philippines

T.F. Randolph [1], B.D. Perry [1], C.C. Benigno [2], I.J. Santos [2], A.L. Agbayani [3], P. Coleman [4], R. Webb [5] & L.J. Gleeson [6]

Rev. sci. tech. Off. int. Epiz., 2002, 21 (3), 645-661

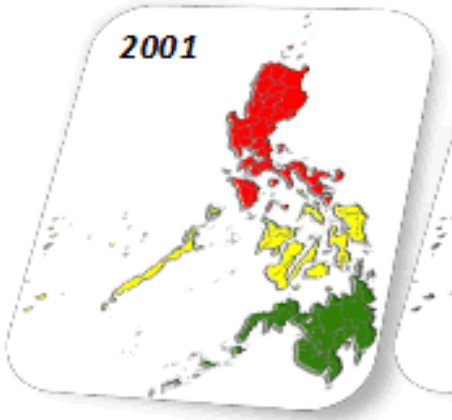
- *Ex ante* evaluation of different FMD control strategies in 1999
- Stochastic simulation of FMD incidence based on historical data
- Benefit cost analysis, with 3 control intensity scenarios, and 4 trade scenarios
- Eradication economically viable (BCR of 1.6 – 2.4:1 even if new export trade not created); export trade brings high BCR
- Most benefits captured by commercial pig sector

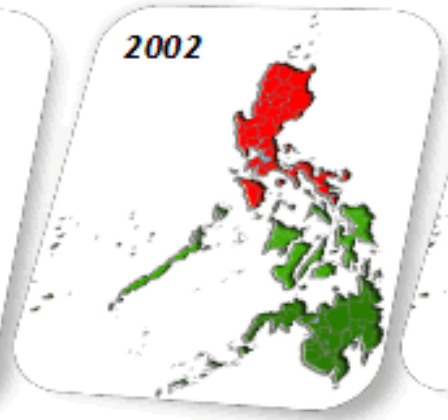
Benefit-cost indicators for the foot and mouth disease eradication scenarios, under varying export assumptions
(million Pesos)

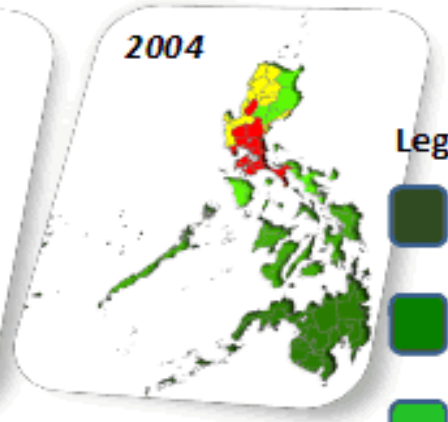
Scenarios		No exports	Low-value exports only [a]	High-value exports only [b]	Both low- and high-value exports [c]
Scenario 1					
Sum of discounted benefits	2004	1,286	1,837	5,818	6,369
Sum of discounted costs		533	533	533	533
Net present value		**753**	**1,304**	**5,285**	**5,836**
Benefit-cost ratio		**2.41**	**3.45**	**10.89**	**11.95**
Scenario 2					
Sum of discounted benefits	2006	1,107	1,563	4,857	5,312
Sum of discounted costs		533	533	533	533
Net present value		**574**	**1,030**	**4,324**	**4,779**
Benefit-cost ratio		**2.08**	**2.93**	**9.11**	**9.97**
Scenario 3					
Sum of discounted benefits	2010	869	1,204	3,628	3,663
Sum of discounted costs		533	533	533	533
Net present value		**336**	**672**	**3,095**	**3,430**
Benefit-cost ratio		**1.63**	**2.26**	**6.81**	**7.41**

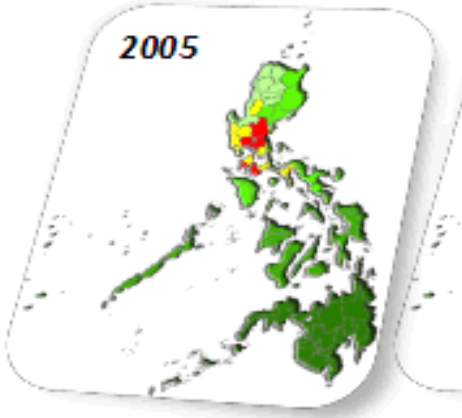
Total present value of costs and benefits over 25-year time horizon, by sector (Eradication Scenario 1, No exports)

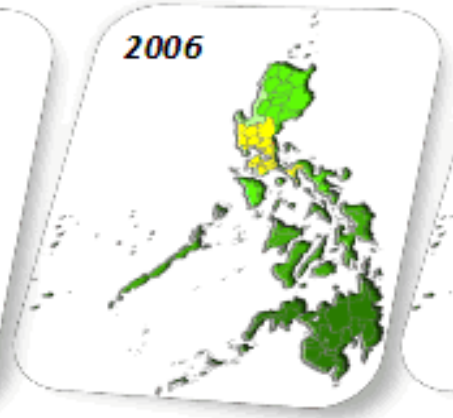
	Total Present Value *Million pesos*	Share
COSTS		
Public		
Eradication effort	**532.8**	**100.0%**
BENEFITS		
Public	**151.5**	**11.9%**
Avoided containment costs	151.5	
Commercial	**1,072.3**	**84.2%**
Avoided production losses	12.5	
Avoided prevention costs	1,056.0	
Avoided treatment costs	3.8	
Backyard	**49.4**	**3.9%**
Avoided production losses	39.6	
Avoided treatment costs	9.8	
Total benefits	**1,273.2**	**100.0%**

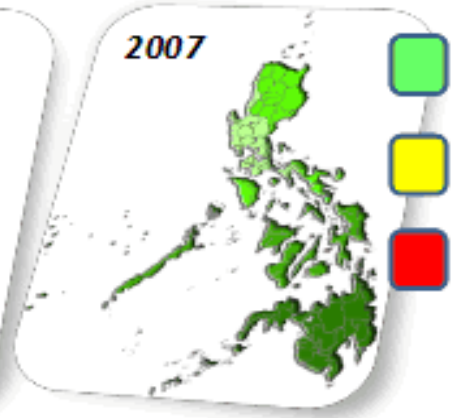












Legend

- 2001 OIE Recognized FMD Free
- 2002 OIE Recognized FMD Free
- Locally recognized FMD free without vaccination
- Locally recognized FMD free with vaccination
- Protected Zone
- Surveillance Zone

2008

Local declaration of the remaining provinces of Luzon as FMD Free where vaccination is practiced

2009

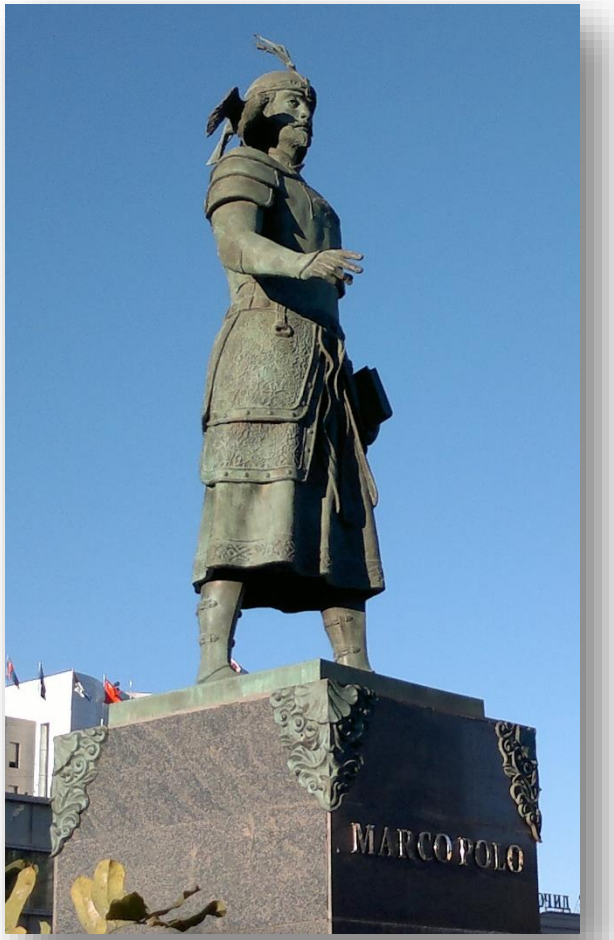
Withdrawal of vaccination in the remaining provinces in Luzon in preparation of OIE Application

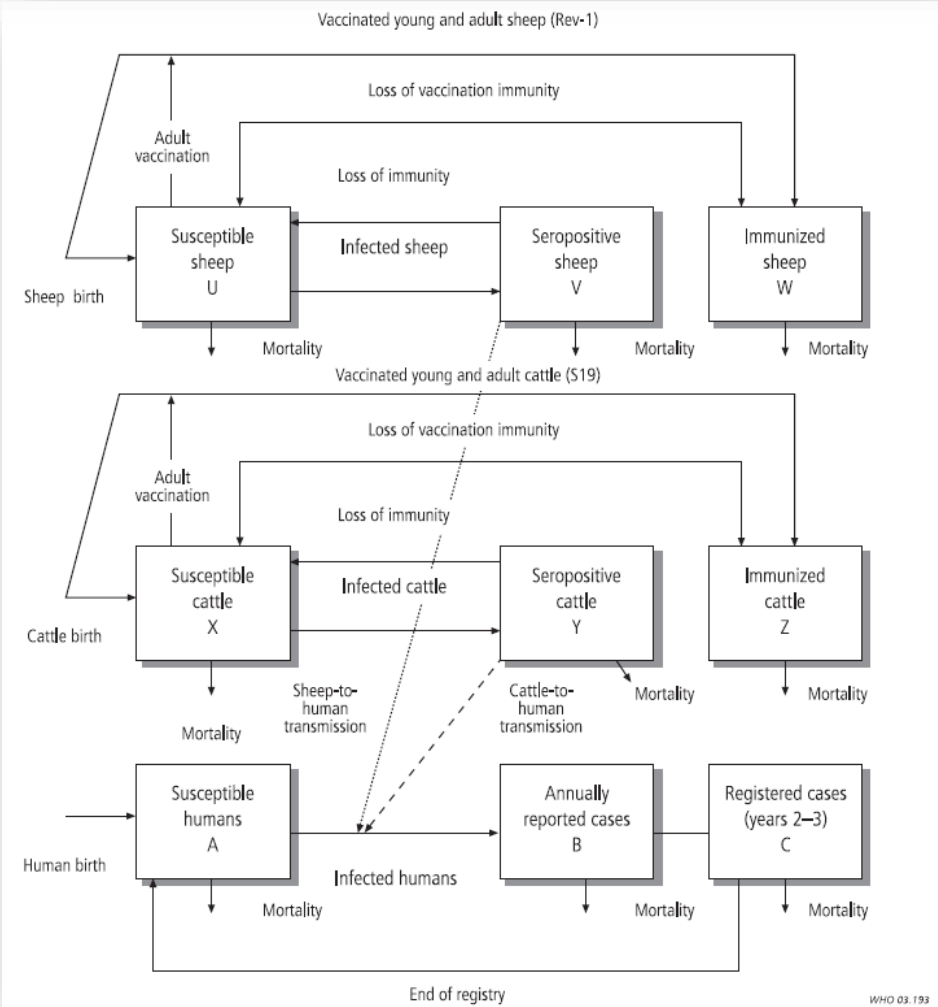
2010

OIE Recognition of Zones 1 & 3 as FMD-free where vaccination is practiced

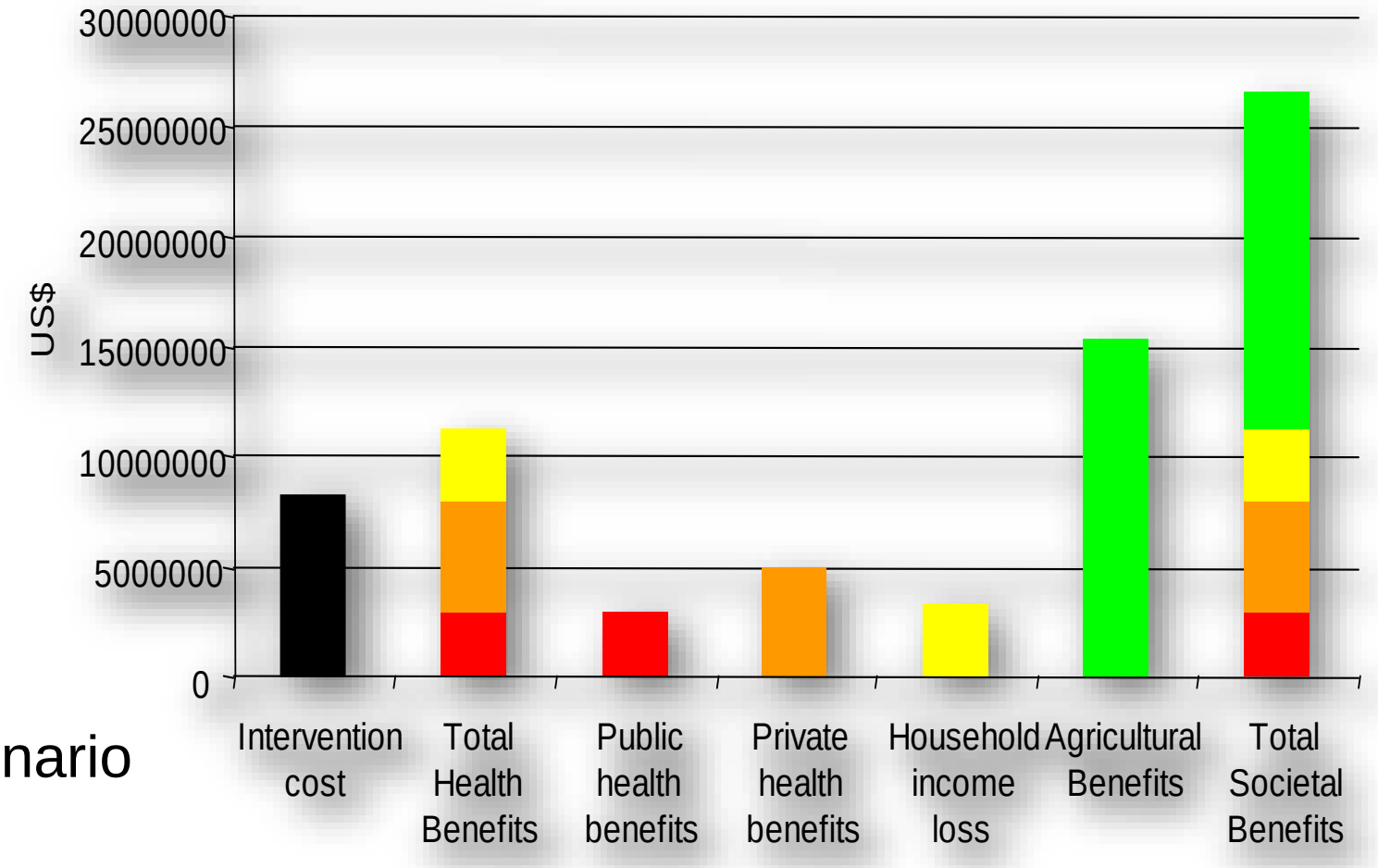
Human health benefits from livestock vaccination for brucellosis: case study

Felix Roth,[1] Jakob Zinsstag,[1] Dontor Orkhon,[2] G. Chimed-Ochir,[3] Guy Hutton,[1] Ottorino Cosivi,[4] Guy Carrin,[4] & Joachim Otte[5]





Benefits and costs of animal brucellosis mass vaccination in Mongolia (Roth et al., 2003)



Discount rate 5%

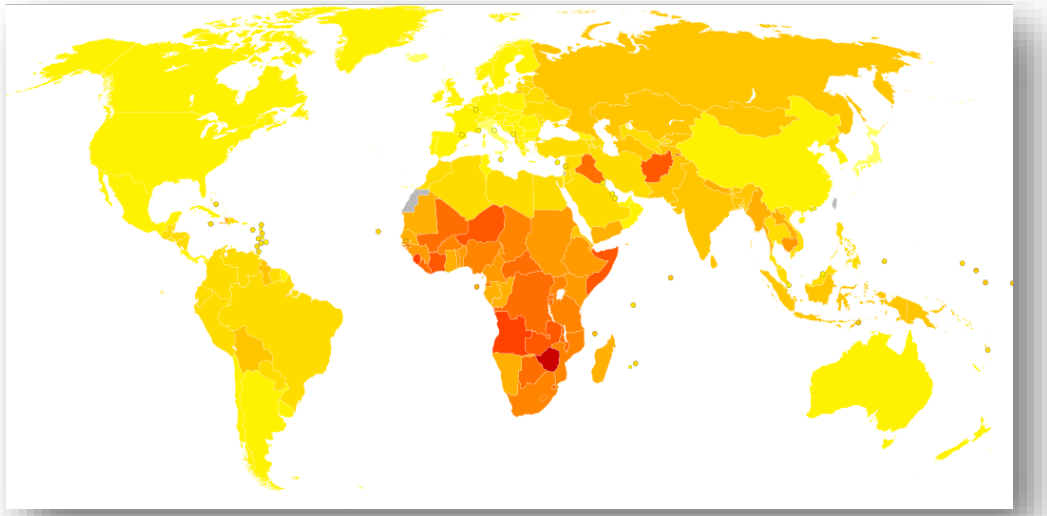
Cost sharing scenario

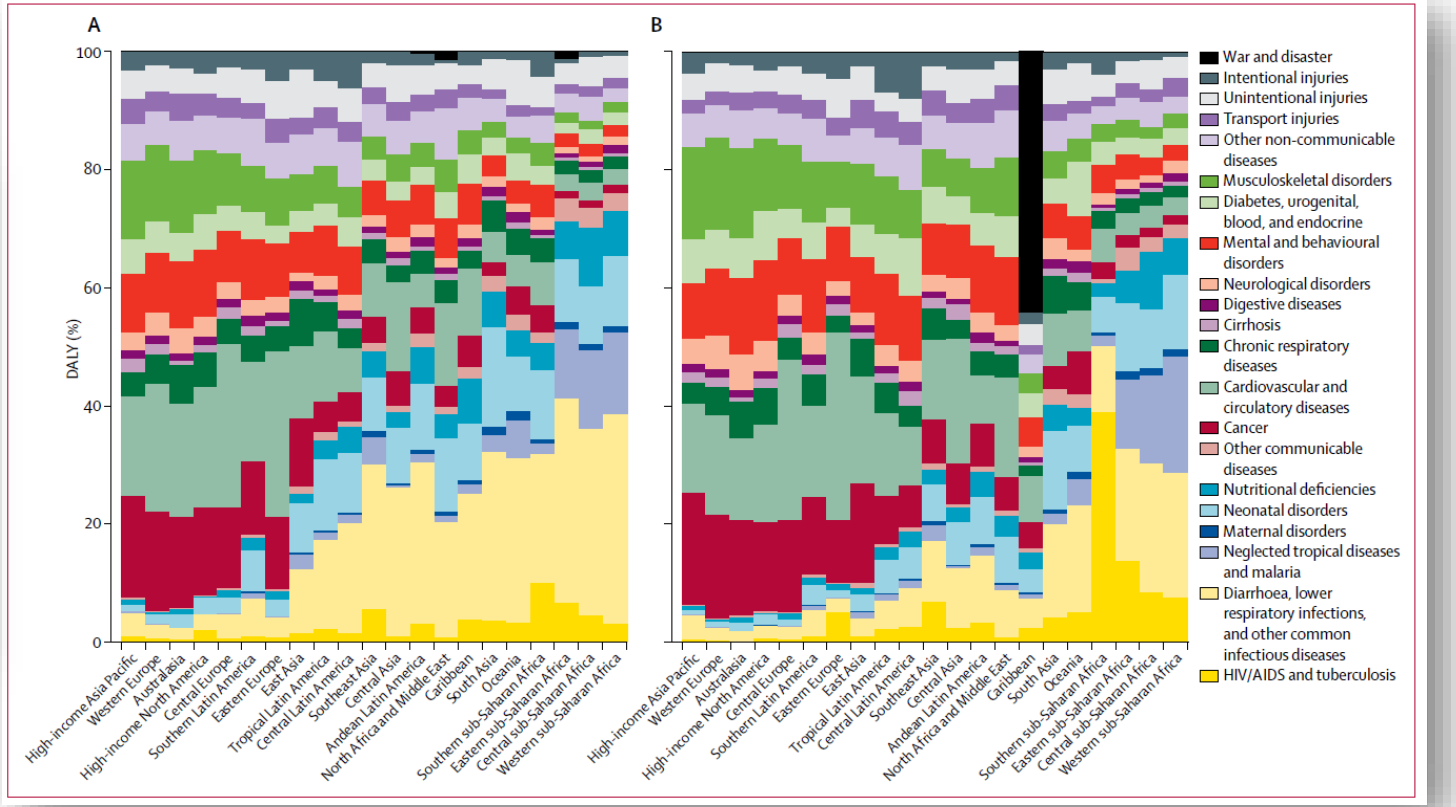
Roth F, Zinsstag J, Orkhon D, Chimed-Ochir C, Hutton GCO, Carrin G et al. Human health benefits from livestock vaccination for brucellosis: case study. Bull World Health Organ 2003;81:867-876

Key messages

- Modelling exercises can be extremely useful in evaluating returns to investment on disease control
- Such models, to be valid and useful, are data hungry
- Scenario analysis presents a pragmatic technique to assess alternative options and outcomes
- Epidemiological models to support these scenarios require clear and transparent criteria
- Economic impact assessments are most effective when conducted in partnership with strategy and policy makers

The impacts of human vaccines: the Disability Adjusted Life Year (DALY)





DALYs averted through human vaccines

WHO disability-adjusted life year (DALY) threshold:

- Low-income countries
  - <$150 per DALY averted = **attractive**
- Middle-income countries
  - <$500 per DALY averted = **attractive**
  - <$100 per DALY averted = **highly attractive**

From 2012 literature review:

Among 44 articles reporting DALYs since 2000,

- 52% of articles reported that vaccines cost ≤ $100 per DALY averted
- 77% of articles reported that vaccines cost ≤ $500 per DALY averted

Source: Ozawa S, et al. Vaccine. 2012; Dec 17;31(1):96-108

Returns to vaccines in the human health sector: expanding horizons

Hutubesy, R. (2012). WHO

"Traditional cost-effectiveness too narrow"

Perspective		Type of Benefit	Definition
Broad	Narrow	Health gains	Reduction in mortality or morbidity through vaccination presented in natural units of health[a]
		Health care cost savings	Savings of medical expenditures, health care system savings, and household savings because vaccination prevents illness episodes
		Care-related productivity gains	Savings of parents' productive time because vaccination avoids the need for taking care of a sick child
		Willingness to pay & Value of statistical life	Individuals or society's economic valuation of the long-term benefits from vaccination, including productivity gains and benefits of averting pain and suffering from vaccine-preventable diseases
		Outcome-related productivity gains	Increased productivity from averted mortality and morbidity, including the productivity benefits from improved cognition and physical strength, as well as school enrollment, attendance and attainment
		Behavior-related productivity gains	Benefits accruing because vaccination improves child health and survival and thereby changes household choices, such as fertility and consumption choices
		Outbreak prevention savings	Benefits accruing to society from saved costs of outbreak investigations and prevention

The most important zoonoses in terms of human health impact, livestock impact, amenability to agricultural interventions, severity of disease and emergence (WHO et al)

From: Grace et al., 2012. Mapping of poverty and likely zoonoses hotspots. Report to DFID.

Disease	Wildlife interface	Deaths human annual	Affected humans annual	Death >1000 people	Affected> 1 million people	Animal impacts high	Farm interve ntion	Other (score =1)	Total score
Gastrointestinal (zoonotic)	Important	1,000,000	800,000,000	2	1	1	1	0	**5**
Leptospirosis	Very important	123,000	1,700,000	2	1	1	1	0	**5**
Cysticercosis	Sometimes	50,000	50,000,000	2	1	1	1	0	**5**
Tuberculosis (zoonotic)	Sometimes	100,000	554,500	2	0	1	1	0	*4*
Rabies	Important	70,000	70,000	2	0	0	1	Severe	*4*
Leishmaniasis	Important	47,000	2,000,000	2	1	0	1	0	*4*
Brucellosis	Sometimes	25,000	500,000	2	0	1	1	0	*4*
Echinococcosis	Not important	18,000	300,000	2	0	1	1	0	*4*
Toxoplasmosis	Important	10,000	2,000,000	1	1	1	1	0	*4*
Q fever	Important	3,000	3,500,000	2	1	0	1	0	*4*
Trypanosomosis (zoonotic)	Important	2,500	15,000	2	0	1	1	0	*4*
Anthrax	Sometimes	1,250	11,000	2	0	1	1	0	*4*
Hepatitis E *	Sometimes	300 000	14 000 000	2	1	0	1	0	*4*
Chagas	Important	10,000	8,000,000	2	1	0	0	0	3
Chickungunya	Very important	12,500	500,000	2	0	0	0	Emerge	3
Clostridium difficile disease	Possible	3,000	300000	2	0	0	0	Emerge	3
Dengue fever	Minor	20,000	50,000,000	2	1	0	0	0	3
Ebola	Very important	500	800	2	0	0	0	Severe	3
Hanta disease	Very important	1,750	175,000	2	0	0	0	Emerge	3
Avian influenza	Important	77	145	0	0	1	1	Emerge	3
*Bov. Spongiform Encephalopathy^*	Sometimes	182	188	0	0	1	1	Severe	3
Psittacosis	Important	2,250	22,000	2	0	0	1	0	3
Japanese encephalitis	Possibly bats	11,000	40,000	2	0	0	1	0	3
Buffalo pox	Not important	Negligible	Common	0	1	1	1	0	3
Rift Valley fever	Important	45	150	0	0	1	1	Emerge	3

Note: high human mortality gets a double weight of as the most important criterion for many stakeholders. Total score = (human death x 2) + (humans affected) + (high livestock impacts) + (farm intervention possible) + (other concerns: severe or emerging disease). The maximum possible score is therefore 6 and the minimum 0.

* Importance of zoonotic transmission not fully known ^ Not a problem in poor countries

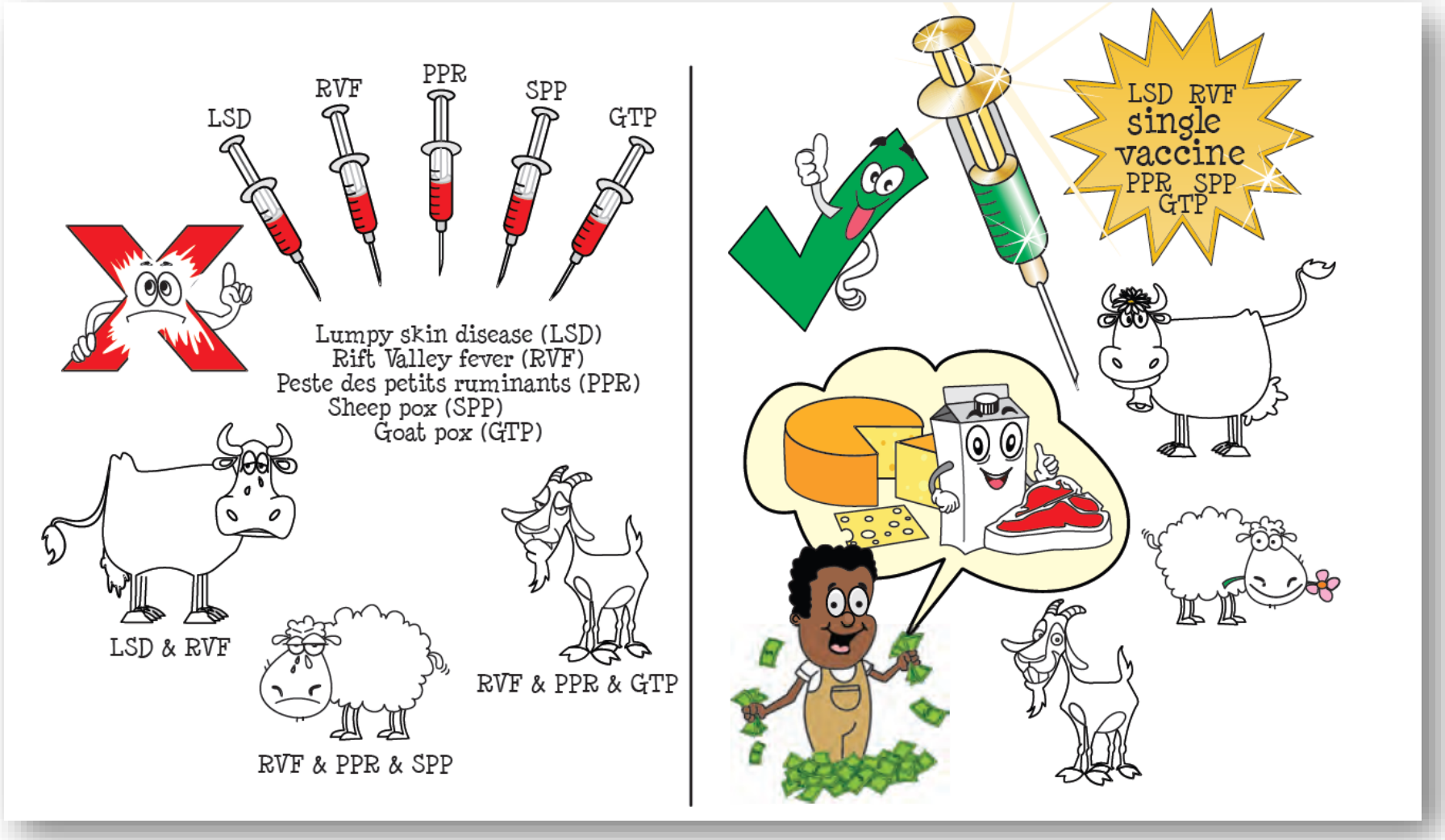
Vaccinology; the broader perspective

- **Discovery**
  - Pathogenesis
  - Antigen identification and evaluation
  - Immune responses
  - Vector and adjuvant selection
- **Evaluation**
  - Control studies
  - Clinical trials
- **Delivery**
  - Host population characteristics
  - Disease epidemiology; reproductive number
  - Vaccine qualities
  - Partners and incentives
- **Impact**
  - Justification for investment; the big number
  - Returns from disease impact reductions

Vaccine deployment and uptake pathways: key hurdles to be crossed

- Product thermostability
- Product availability
- Product affordability
- Length of immunity
- Dosage and packaging
- One-off versus boosters; logistics
- Public versus private good
- Organised versus individual
- Incentives
- Herd flock size and distribution
- Long and short generation species

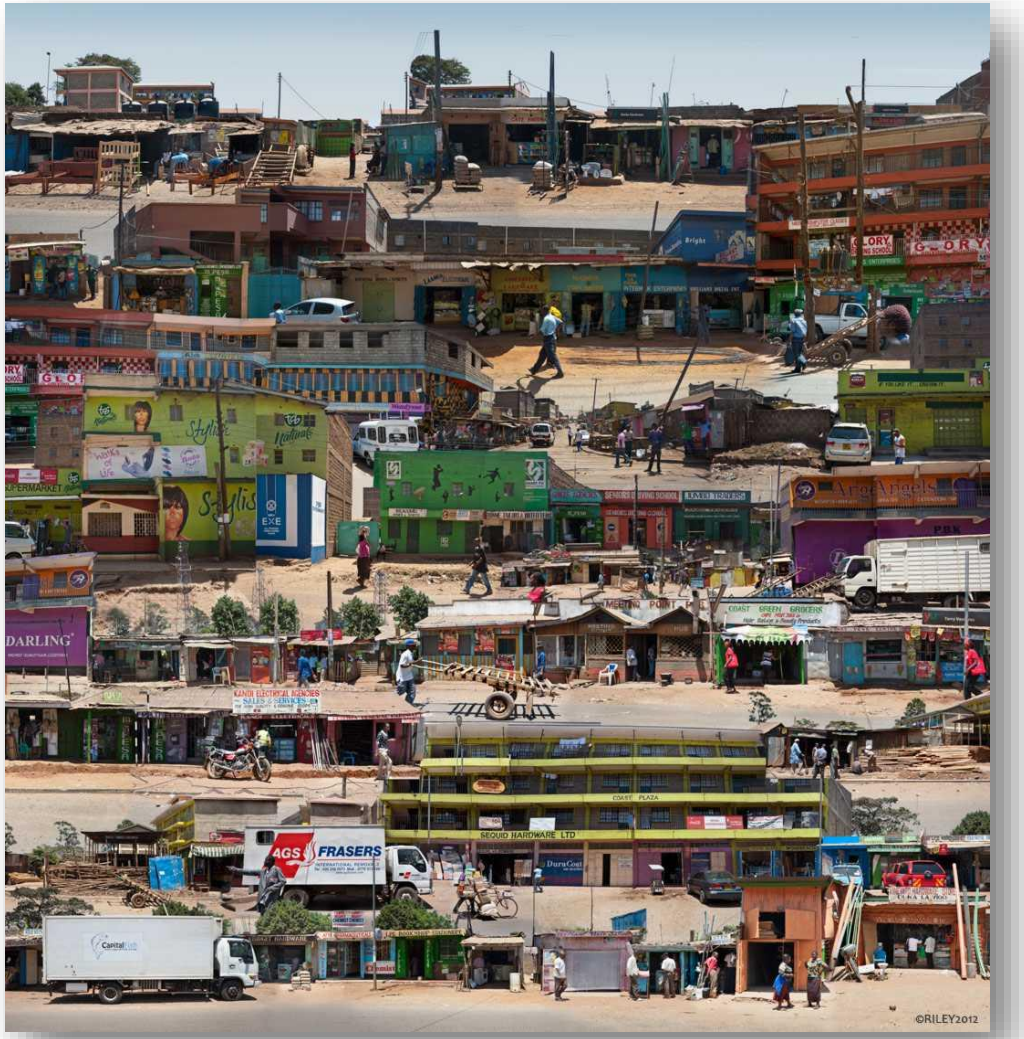
The attractiveness of multiple pathogen vaccine packages



Canadian International Food Security Research Fund

Lumpy skin disease, sheep pox, goat pox, Peste des Petits Ruminants, and Rift Valley fever

The “simple” issue of achieving target population immunity through effective vaccine delivery



- Kawangware, Nairobi, Kenya
- High density low income urban population

ELSEVIER

Preventive Veterinary Medicine 22 (1995) 137–142

PREVENTIVE VETERINARY MEDICINE

Short communication

Increasing rabies vaccination coverage in urban dog populations of high human population density suburbs: a case study in Nairobi, Kenya

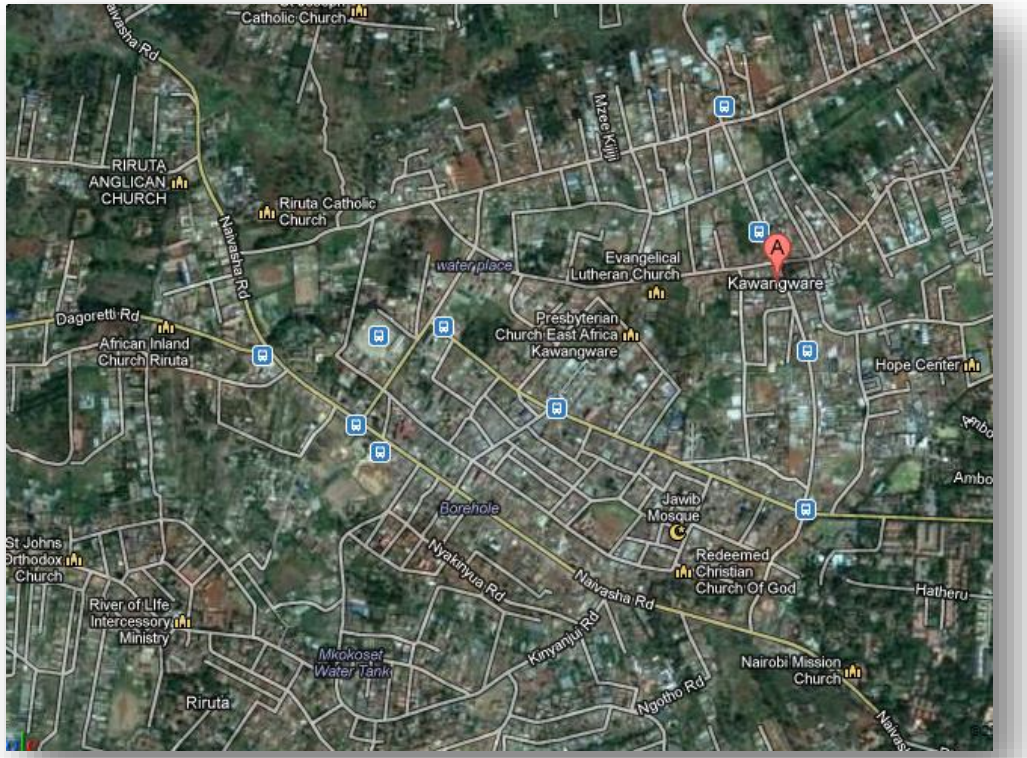
B.D. Perry[a,*], T.M. Kyendo[b], S.W. Mbugua[c], J.E. Price[c], S. Varma[d]

[a]*International Laboratory for Research on Animal Diseases (ILRAD), P.O. Box 30709, Nairobi, Kenya*
[b]*Department of Veterinary Services, Nyayo House, P.O. Box 34188, Nairobi, Kenya*
[c]*Faculty of Veterinary Medicine, University of Nairobi, P.O. Box 29053, Nairobi, Kenya*
[d]*P.O. Box 40373, Nairobi, Kenya*

Accepted 13 June 1994

Urban rabies vaccination Kenya

- Standard approach 2 days vaccinators at single location
  - Coverage 2%
- Study approach 5 days and roaming teams of vaccinators with collars
- Visual “capture-recapture” using distinct transects 8 days later
  - Coverage 68 – 75%
- Key factors: children engaged, school holidays, interface with community, etc.



Vaccine distribution; whose responsibility?

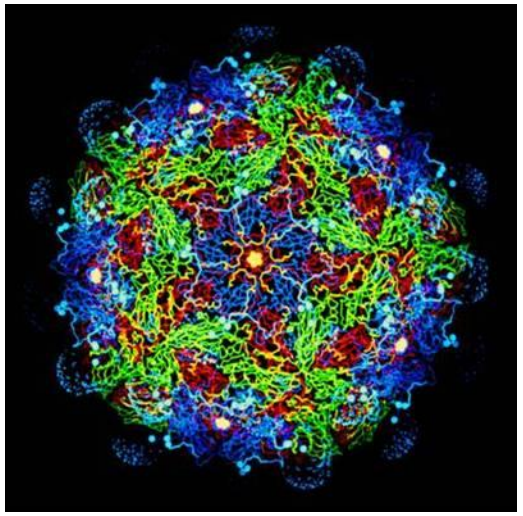
- Public sector?
- Private sector?

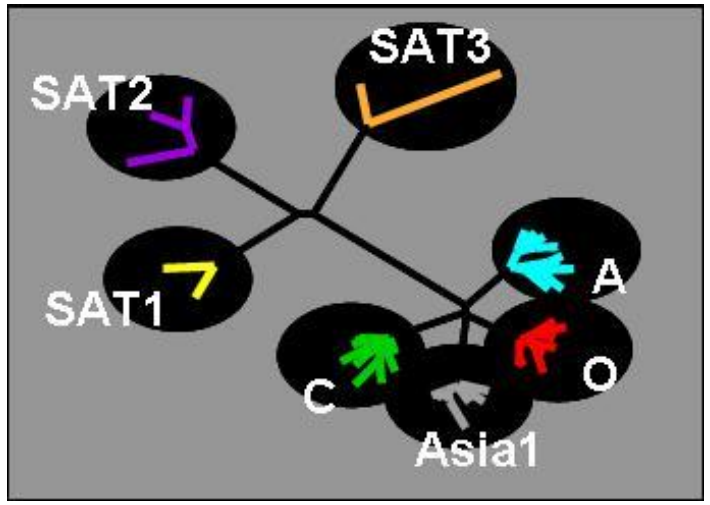
The concepts of rivalry and excludability

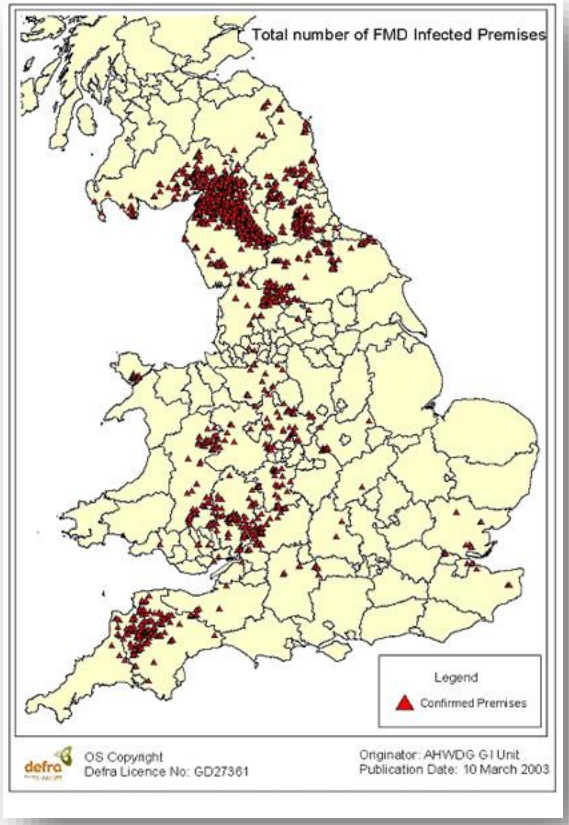
New Institutional Economics		Excludability	
		Low	High
Rivalry	Low	Public goods Once produced, non payers can access (control of epidemic, zoonotic & food-borne diseases)	Toll goods Benefits to single entity (Vaccine production, diagnostic services)
	High	Common pool goods Several can use (tsetse control on public land)	Private goods (service to one) e.g. endemic diseases

Canine distemper, leptospirosis, parvo vaccinations

Public or private good?







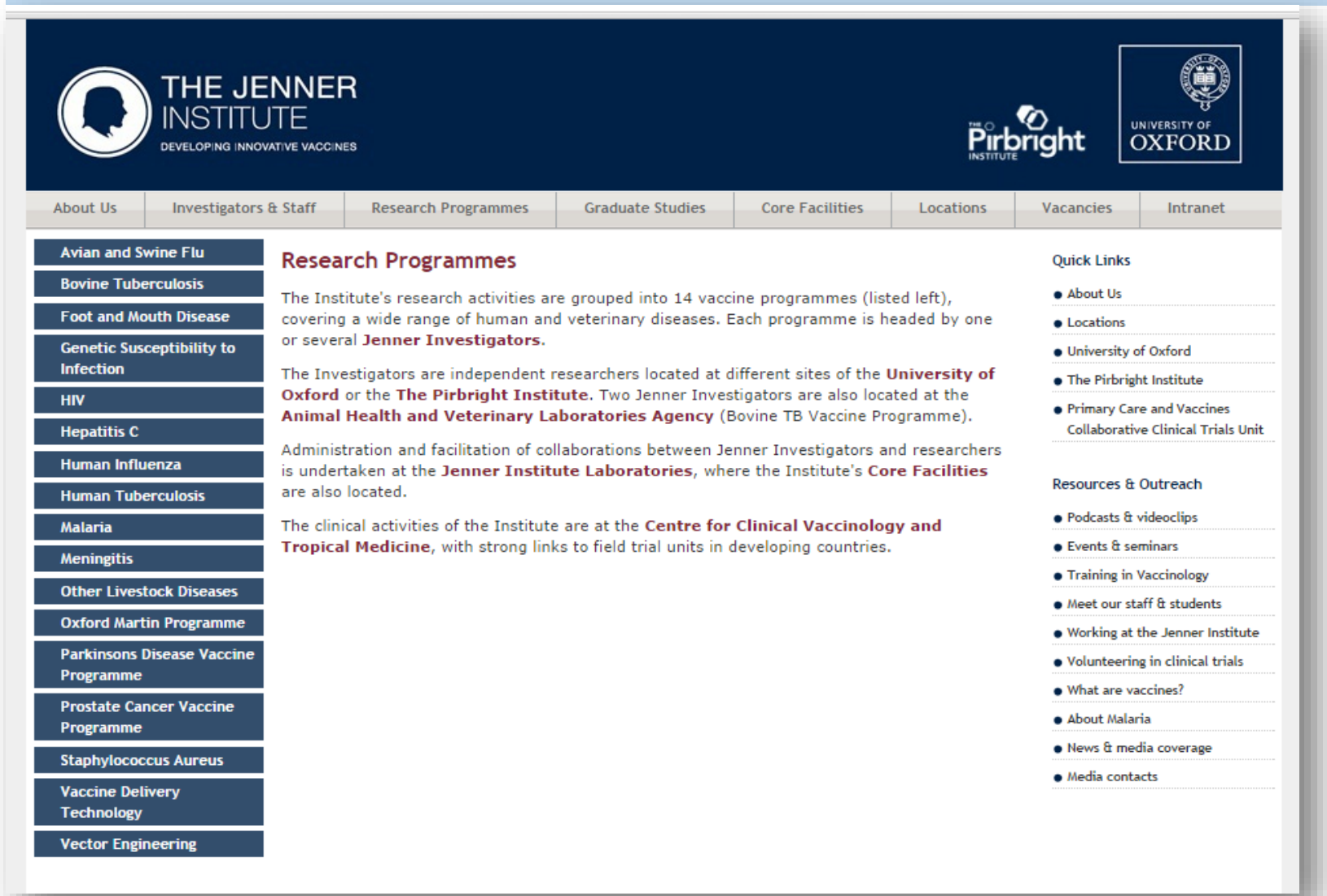
Is foot and mouth disease control/vaccination a public or a private good? The contrasting arguments in UK and some developing country settings

Key messages

- Important to consider vaccine delivery, adoption and impact pathways at the earliest stage of vaccine development
- The key role of the private sector and pharmaceutical industry
- Key to understand incentives for vaccine use
- Different models of delivery; public, private, the role of willingness-to-pay studies, etc.
- The differences in approach between livestock system trajectories

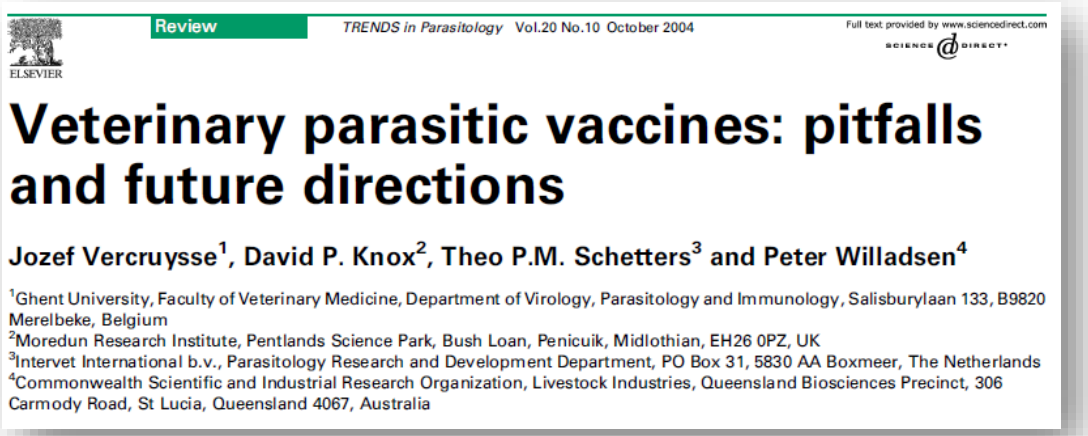
The fickle science and market realities of vaccines for endemic diseases in developing countries

The excitement at the new vaccine development research approaches



The multiple challenges of parasite vaccine development

- The technical challenges of parasite vaccine development
- The competition of vaccines with anti-parasitic drugs, and the slow responses in developing countries to emerging antimicrobial and anti parasite resistance
- The relatively small size of the market, and the competing interests of the international pharmaceutical industries in human and companion animal products
- The weak purchasing powers of smallholder producers
- The weak and poorly funded public veterinary services



Review TRENDS in Parasitology Vol.20 No.10 October 2004

Full text provided by www.sciencedirect.com

ELSEVIER

Veterinary parasitic vaccines: pitfalls and future directions

Jozef Vercruysse[1], David P. Knox[2], Theo P.M. Schetters[3] and Peter Willadsen[4]

[1]Ghent University, Faculty of Veterinary Medicine, Department of Virology, Parasitology and Immunology, Salisburylaan 133, B9820 Merelbeke, Belgium
[2]Moredun Research Institute, Pentlands Science Park, Bush Loan, Penicuik, Midlothian, EH26 0PZ, UK
[3]Intervet International b.v., Parasitology Research and Development Department, PO Box 31, 5830 AA Boxmeer, The Netherlands
[4]Commonwealth Scientific and Industrial Research Organization, Livestock Industries, Queensland Biosciences Precinct, 306 Carmody Road, St Lucia, Queensland 4067, Australia

Rev. sci. tech. Off. int. Epiz., 2007, 26 (1), 105-115

Control of parasitic disease using vaccines: an answer to drug resistance?

J. Vercruysse (1), T.P.M. Schetters (2), D.P. Knox (3), P. Willadsen (4) & E. Claerebout (1)

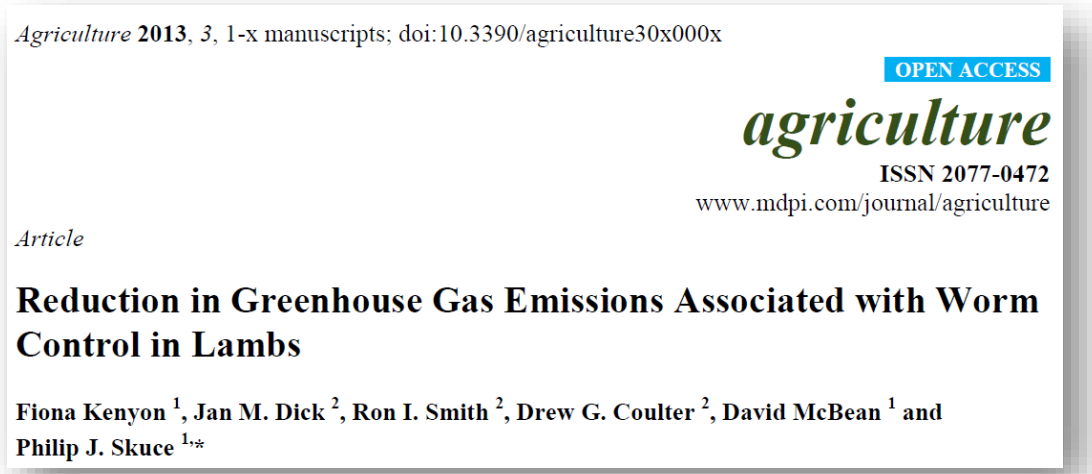
The eclipsing of TBDs and other endemic diseases of livestock as priority in developing countries

- Structural adjustment of the 80s and 90s: the decline in public sector support to TBD control; now generally considered a private good
- Changing demography of many agricultural environments
- The wider distribution of endemic stability following acaricide use decline?
- The emergence and prioritisation of trans-boundary and emerging diseases
- The weakness of investor-friendly data on endemic livestock diseases and their impact

The contrasting interest of the Worried Well in endemic disease and GHG emission reduction

Inefficiency and GHG emissions

- Endemic, production-limiting diseases have negative outcomes, including death or cull, reduced live weight gain, reduced milk yield and quality, reduced fertility, abortion and/or increased waste in the system



Agriculture **2013**, *3*, 1-x manuscripts; doi:10.3390/agriculture30x000x

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Article

Reduction in Greenhouse Gas Emissions Associated with Worm Control in Lambs

Fiona Kenyon [1], Jan M. Dick [2], Ron I. Smith [2], Drew G. Coulter [2], David McBean [1] and Philip J. Skuce [1,*]

knowledgescotland

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The Impact of Animal Health Status on Greenhouse Gas Emissions from Livestock

Published on 8 July 2014 in Climate, water and energy , Food, health and wellbeing

The endemic disease of livestock conundrum: yet another north south divide?

The south

- Driven by dramatically increasing demands for meat
- Focus of improving productivity, production efficiency; sustainable intensification
- Weak voice of livestock producers and value chain actors
- Little attention paid to GHG emissions

The north

- Demands for meat reducing
- Widespread media awareness of livestock and GHG emissions
- Increase in anti-meat lobbies
- Commercial interest in assigning life cycle analysis values to livestock (and other) products

Counter economic argument for population immunity from industry?

- Low return on investment in infectious disease vaccines as vaccination programmes succeed
- Particularly important for endemic diseases of livestock in developing countries
- Higher potential for investment by the pharmaceutical industry in lifestyle and age-related diseases of man, such as prostrate cancer and Alzheimers

Over-vaccination of pets – an unethical practice

UPDATE! The WSAVA Vaccination Guidelines Group has published Vaccination Guidelines for New Puppy Owners (May 2013) on the WSAVA Vaccination Guidelines webpage. *Dog and puppy owners need to read these guidelines very carefully.* I have highlighted important points in this copy of the Vaccination Guidelines for New Puppy Owners which are also relevant for adult dogs.

Also refer to my correspondence with Professor Ronald Schultz of the WSAVA Vaccination Guidelines Group in which Professor Schultz responds to my letter challenging over-vaccination of dogs with unnecessary 'boosters'.

Over-vaccination of companion animals, and exploitation of pet owners, is a massive international scandal.

RECENT POSTS

Petition against HPV vaccines – please consider signing this petition! November 19, 2014

Arrogant scientists and dangerous 'gain-of-function' experiments – a letter to the US National Science Advisory Board for Biosecurity (NSABB) October 27, 2014

Request for retraction of the Cochrane Vaccines Field systematic review re vaccine safety and aluminium August 11, 2014

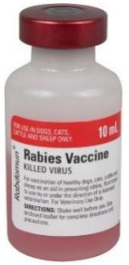
UPDATE: Interim response from NHMRC re vaccination policy and practice in Australia July 21, 2014

UPDATE: Vaccine safety and aluminium – a challenge to Cochrane July 17, 2014

Vaccine safety and aluminium – a challenge to The Cochrane Collaboration

http://www.vaccinationnews.org/DailyNews/2003/May/09/IsYourPet9.htm

- Cost of rabies vaccine: 61 cents
- Cost to owner: $15 to $38 (plus the $35 office visit)
- Cost of 18-oz. package of Kellogg's Sugar Frosted Flakes® :$2.20
- Cost retail: $2.75 retail
- Applying vet's mark-up: Frosted Flakes cost $137 (without office visit); $260 with office visit



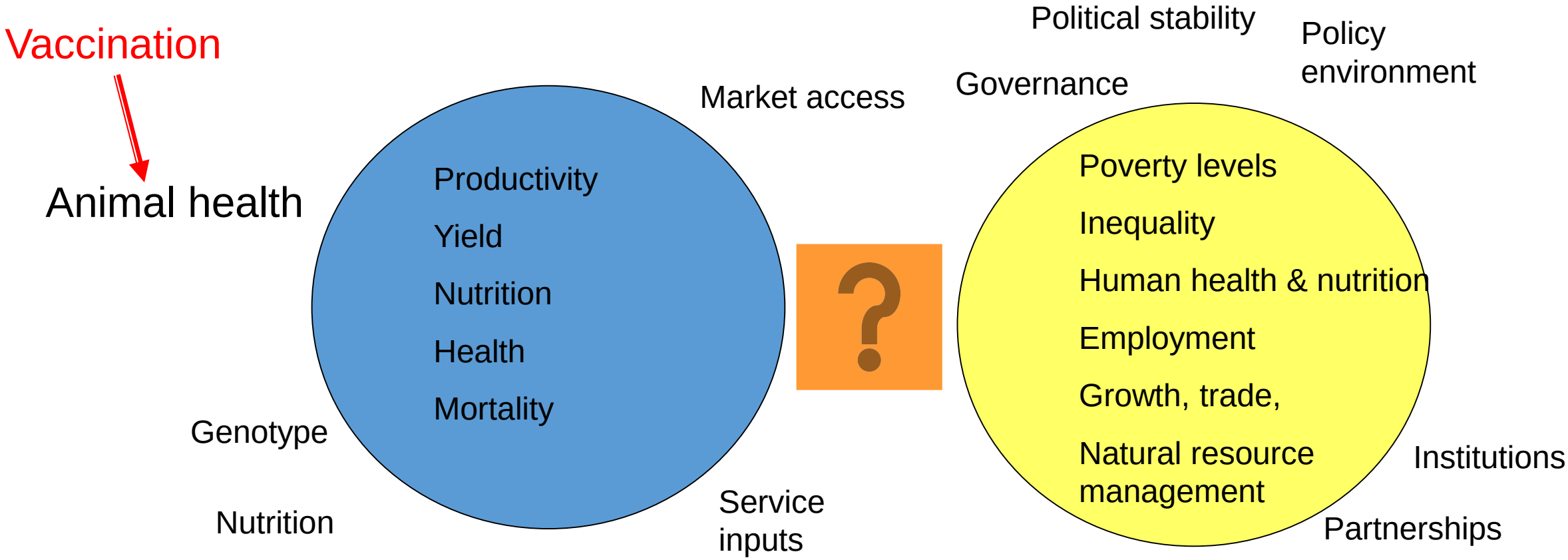
Key messages

- Vaccine development is complex, but advances in technology are offering new and exciting opportunities for parasite vaccine development
- Developing country markets for such vaccines are theoretically abundant, but realistically more limited
- Private sector engagement and public/private partnership development to help guide investment and market opportunities will be increasingly important in achieving vaccine impact in the field
- There is a need for sound communication and public engagement with regard to building public confidence in vaccine approaches

Recommendations from the Veterinary Vaccinology Network on Strategic Goals for Veterinary Vaccines

- An analysis of the potential financial return on investment for the development of a vaccine, i.e. (e.g.?) the benefit:cost ratio
- Benefits for food security and production efficiency
- Benefits for food safety
- Contribution to the alleviation of poverty
- Contribution to mitigation of climate change, through the improved use of animal resources

The apparent divide between livestock-associated outputs …….and human development outcomes



The livestock sphere in agriculture

The human development sphere

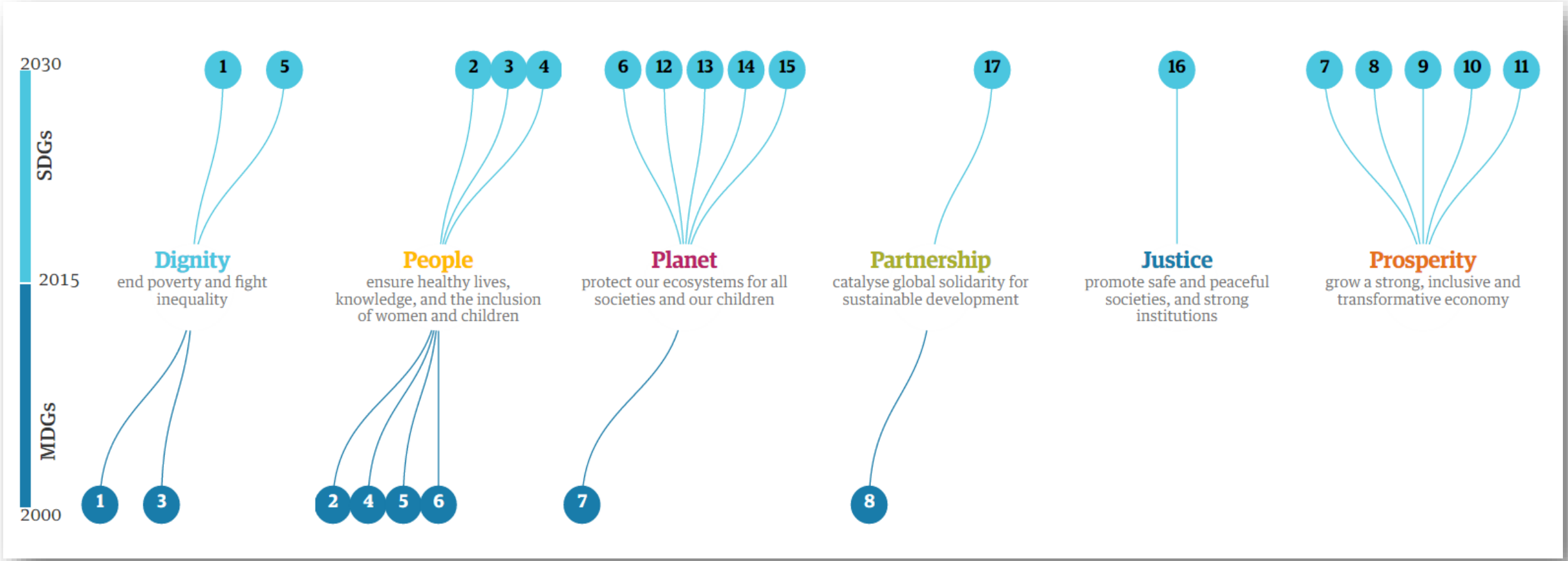
The relevance of livestock disease vaccines to the sustainable development goals

A reminder…..what were the MDGs?

1. **Eradicate extreme poverty and hunger**
2. **Achieve universal primary education**
3. **Promote gender equality and empower women**
4. **Reduce child mortality**
5. **Improve maternal health**
6. **Combat HIV/AIDS, malaria and other diseases**
7. **Ensure environmental sustainability**
8. **Develop a global partnership for development**

Measured by 18 targets and 48 indicators

MDGs and SDGs: the interface



The dialogue on post-MDG goals and targets

The UN actors:

- High Level Panel of Eminent Persons, Post-2015 Development Agenda

THE WORLD WE WANT

- UN Special Advisor to the UN Secretary General on Post-2015
- UN General Assembly Open Working Group, Sustainable Development Goals
- UN System Task Team on the Post-2015 Development Agenda

Sustainable Development Goals

Three dimensions of sustainable development

- Environmental
- Economic
- Social

Concept of being

- Action orientated
- Concise
- Concrete
- Easy to communicate
- Limited in number
- Aspirational

First draft of Sustainable Development Goals

1 End poverty

2 Empower girls and women and achieve gender equity

3 Provide quality education and lifelong learning

4 Ensure healthy lives

5 Ensure food security and good nutrition

6 Achieve universal access to water and sanitation

7 Secure sustainable energy

8 Create jobs, sustainable livelihoods and equitable growth

9 Manage natural resource assets sustainably

10 Ensure good governance and effective institutions

11 Ensure stable and peaceful societies

12 Create a global enabling environment & catalyze long term finance

Current draft of Sustainable Development Goals

1. End poverty in all its forms everywhere

2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture

3. Ensure healthy lives and promote well-being for all at all ages

4. Ensure inclusive and equitable quality education and promote life-long learning opportunities for all

5. Achieve gender equality and empower all women and girls

6. Ensure availability and sustainable management of water and sanitation for all

7. Ensure access to affordable, reliable, sustainable, and modern energy for all

8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

10. Reduce inequality within and among countries

11. Make cities and human settlements inclusive, safe, resilient and sustainable

12. Ensure sustainable consumption and production patterns

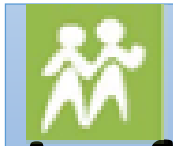
13. Take urgent action to combat climate change and its impacts

14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development

15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

17. Strengthen the means of implementation and revitalize the global partnership for sustainable development



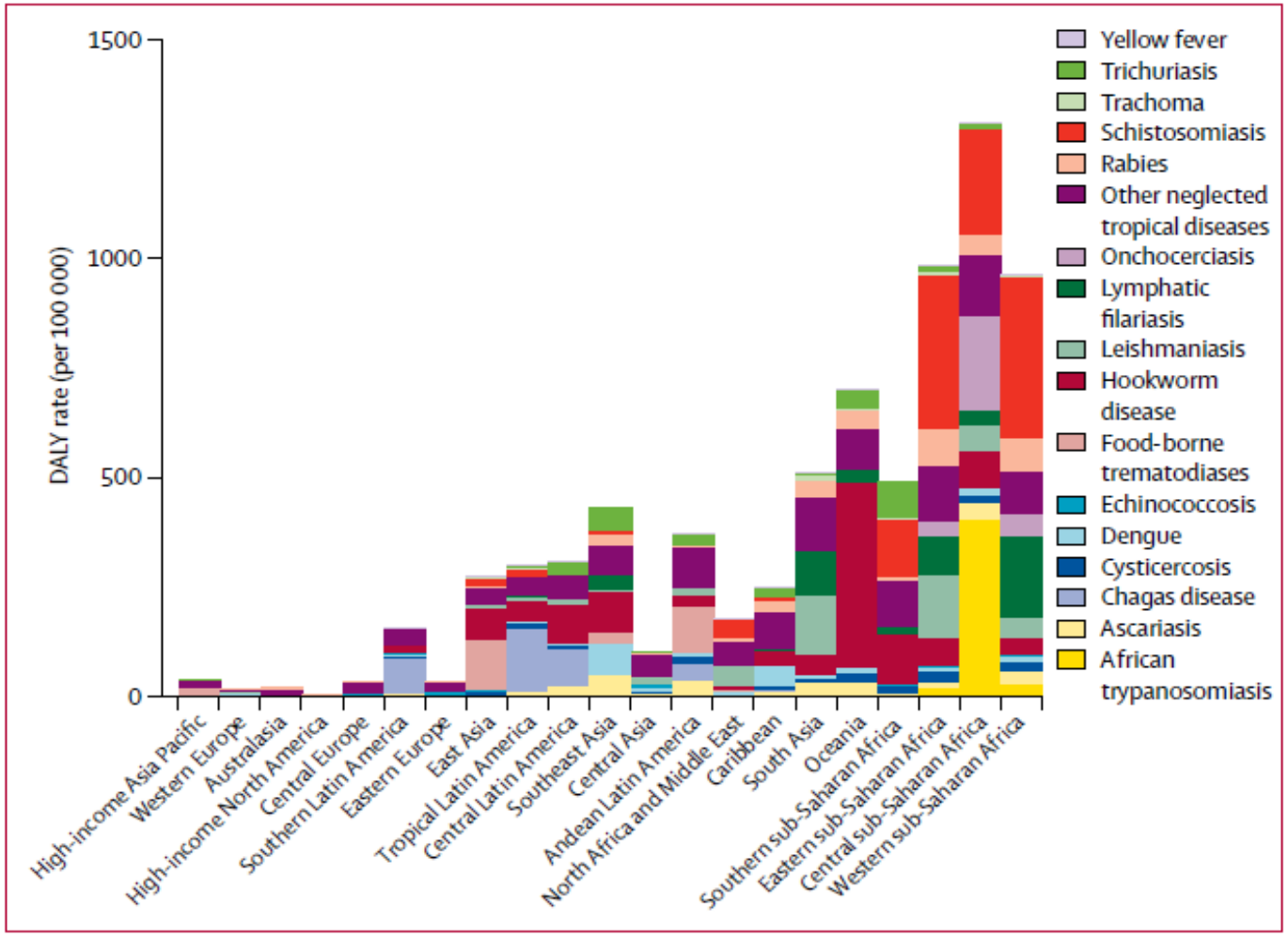
1 End poverty in all its forms everywhere

Positive contributions of livestock

- Value of livestock sector c. $1.4 trillion
- Provides 17% of calories and 33% of protein, globally
- Account for 40% of agricultural GDP
- Employs 1.3 billion people
- Provides livelihoods for 800 million poor small holders
- Contribute nutrients and traction for mixed farming
- Serves as a bank, and insurance against hard times (e.g. drought)

3. Ensure healthy lives

3. By 2030 end the epidemics of AIDS, tuberculosis, **malaria**, and **neglected tropical diseases** and combat hepatitis, water-borne diseases, and **other communicable diseases**



5. Achieve gender equality and empower all women and girls

- 1% of African women own land but 10% own livestock
- Usually responsible for poultry, animals at the homestead, watering, feeding and looking after sick animals
- High involvement processing and sale of animal source foods
- Prepare most food for household consumption
- Giving women the same resource access as men would add 20-30% to farm yield (FAO, 2011)

The International Science and Partnership Council (ISPC) White Paper on drivers of global livestock research needs, 2014

A STRATEGIC OVERVIEW OF LIVESTOCK RESEARCH UNDERTAKEN BY THE CONSULTATIVE GROUP FOR INTERNATIONAL AGRICULTURAL RESEARCH (CGIAR) CONSORTIUM

Brian Perry[1], John Morton[2], Werner Stur[3]

http://ispc.cgiar.org/system/files_force/ISPC_WhitePaper_StrategicReviewLivestock.pdf?download=1

Summary of key drivers of global livestock research

- Economic growth
- Population growth and urbanisation
- Climate change
- Feed use efficiency in livestock systems
- Natural resource management (incl. water footprint)
- Effluent pollution
- Animal and human health risks
- Vulnerability of pastoral & dryland systems
- Balance of goods & bads of livestock
- Gender aware and socially inclusive approaches
- Weakness in research outputs to development outcomes

The livestock and health contexts of SDGs

- SDGs: framework around which governments and international community can focus and coordinate development efforts between 2015 and 2030
- The livestock sector and animal health are directly relevant to most SDGs
- Role of SDGs in guiding investment
- Urgent need to ensure the visibility of livestock and health in these policy debates, increase awareness of policy-relevant investment needs and opportunities

Key messages

- The merits of better alignment of vaccine research interventions with new SDGs for funding, endorsement and credibility
- The likely increasing priority given to development of technologies to prevent, control and diagnose zoonotic, food borne and emerging diseases
- Need for strong arguments for parasite vaccines for endemic livestock diseases
  - GALVmed live ECF vaccines
  - BMGF new generation ECF vaccines

Post script
Some other good causes to which vaccines will contribute

Some other good causes to which vaccines will contribute

The global calculator

Land, food and bioenergy

	Metric	Unit	2011	2020	2030	2040	2050
Lifestyle	Calories consumed	kcal per person per day	2,180	2,200	2,220	2,260	2,330
	Calories consumed which are from meat	kcal per person per day	190	190	190	200	200 to 220
	Total non-commercial forest area	Millions of hectares	3,800	3,700 to 3,800	3,800 to 3,900	3,800 to 4,000	3,800 to 4,100
Land use	Bioenergy crop production	EJ	10	15 to 20	30 to 45	35 to 70	40 to 95
	Growth in crop yields relative to 2011	%	–	10 to 15	20 to 30	30 to 45	40 to 60
	Proportion of cattle that are fed grains and residues (intensified)	%	6	5.6 to 7.3	4.7 to 9.9	3.9 to 12.4	3 to 15
	Increase in animal density for pasture-fed cattle	%	–	10	20 to 25	35 to 40	45 to 50
	Proportion of food crops that are wasted post-farm	%	25	25	20	20	15 to 20

The Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants - Google Chrome

www.ccacoalition.org

CCAC
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TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

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Agriculture

The primary sources of methane emissions from agriculture are livestock enteric fermentation, livestock waste management, rice cultivation, and agricultural waste burning. Of these, livestock waste management offers the most viable, near-term opportunities for methane recovery and utilization.

- Agriculture
- Coal Mines
- Municipal Solid Waste
- Oil & Gas Systems
- Wastewater
- Steering

The GMI Agriculture Subcommittee is dedicated to reducing the impacts of climate change by providing international leadership to mitigate global methane emissions through the abatement, recovery, and use of methane from agricultural sources. The Subcommittee promotes collaboration between delegates from Partner Countries and Project Network members to build capacity, develop strategies and markets, and remove barriers to methane mitigation project development in order to increase environmental quality, improve rural livelihoods, strengthen the economy, and expand opportunities for renewable energy production and use.

- Subcommittee Statement of Purpose (PDF, 3 pp, 47 KB)
- Subcommittee Meeting Minutes
- Subcommittee Action Plan (PDF, 10 pp, 191 KB)

Translate this page

Global Methane Initiative provides fact sheets and links to resources in Chinese, Russian, and Spanish.

Select Language

Figure 2: Estimated and Projected Global Anthropogenic Methane Emissions by Source, 2010 and 2020