UNIVERSITY of GLASGOW

Waves of foot-and-mouth disease in East Africa and advances in practical surveillance

M. Casey, R. Reeve, H. Auty, K. Bachanek-Bankowska, V. Fowler, P. Hamblin, D. Haydon, R. Kazwala, T. Kibona, A. King, D. King, A. Ludi, A. Lugelo, T. Marsh, V. Mioulet, D. Mshanga, D. Paton, K. Parekh, S. Parida, S. Cleaveland, and T. Lembo

The Boyd Orr Centre for Population and Ecosystem Health, University of Glasgow, UK

The Queen's Anniversary Prizes
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Zonal Veterinary Investigation Centres (Arusha & Mwanza), Tanzania

Tanzania Wildlife Research Institute

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Sokoine University of Agriculture, Tanzania

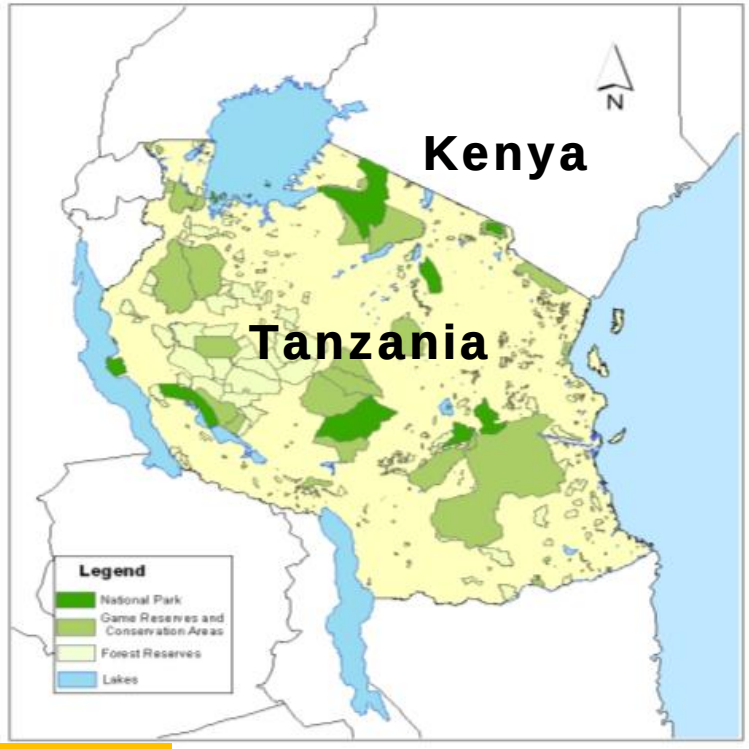
Washington State University, USA

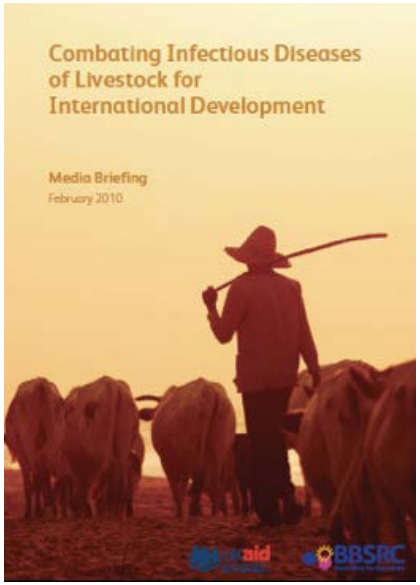
Department of Agriculture, Food and Marine, Ireland

Merck Animal Health/Intervet

Miriam Casey, formerly University of Glasgow, currently Department of Agriculture, Food and Marine (Ireland)

FMD studies in interface areas of northern Tanzania

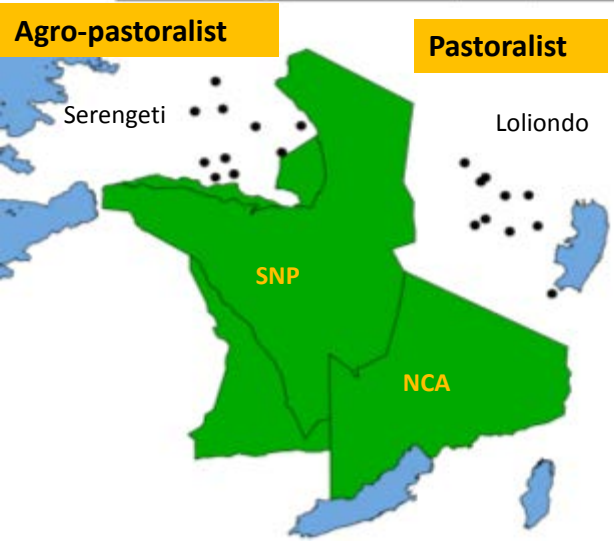


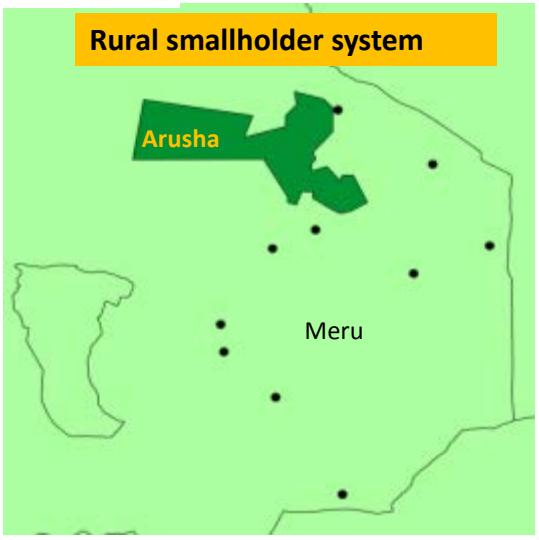


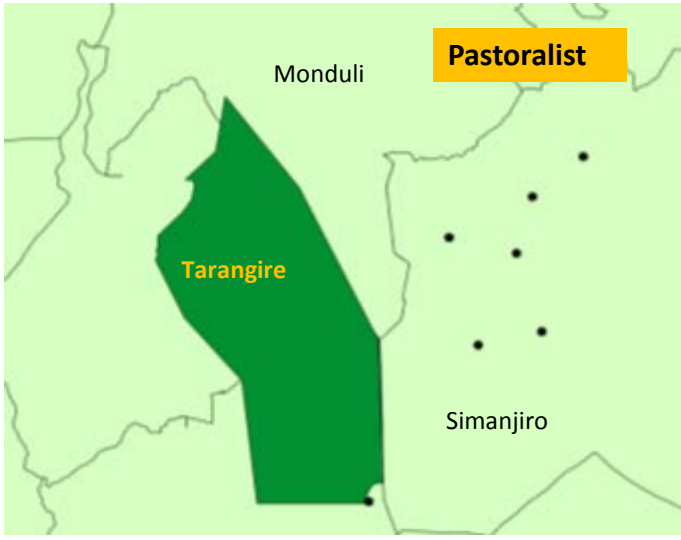
BBSRC bioscience for the future

DFID Department for International Development

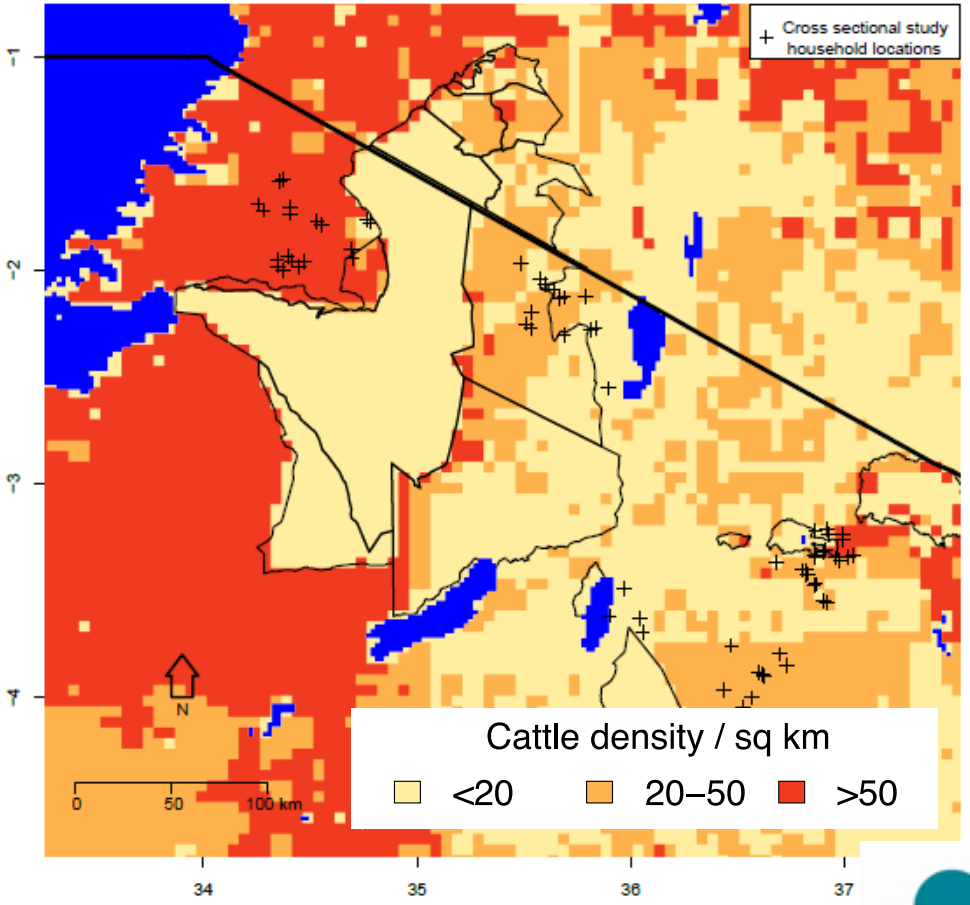
The Scottish Government







More intensive studies in the Serengeti ecosystem



BILL & MELINDA GATES foundation

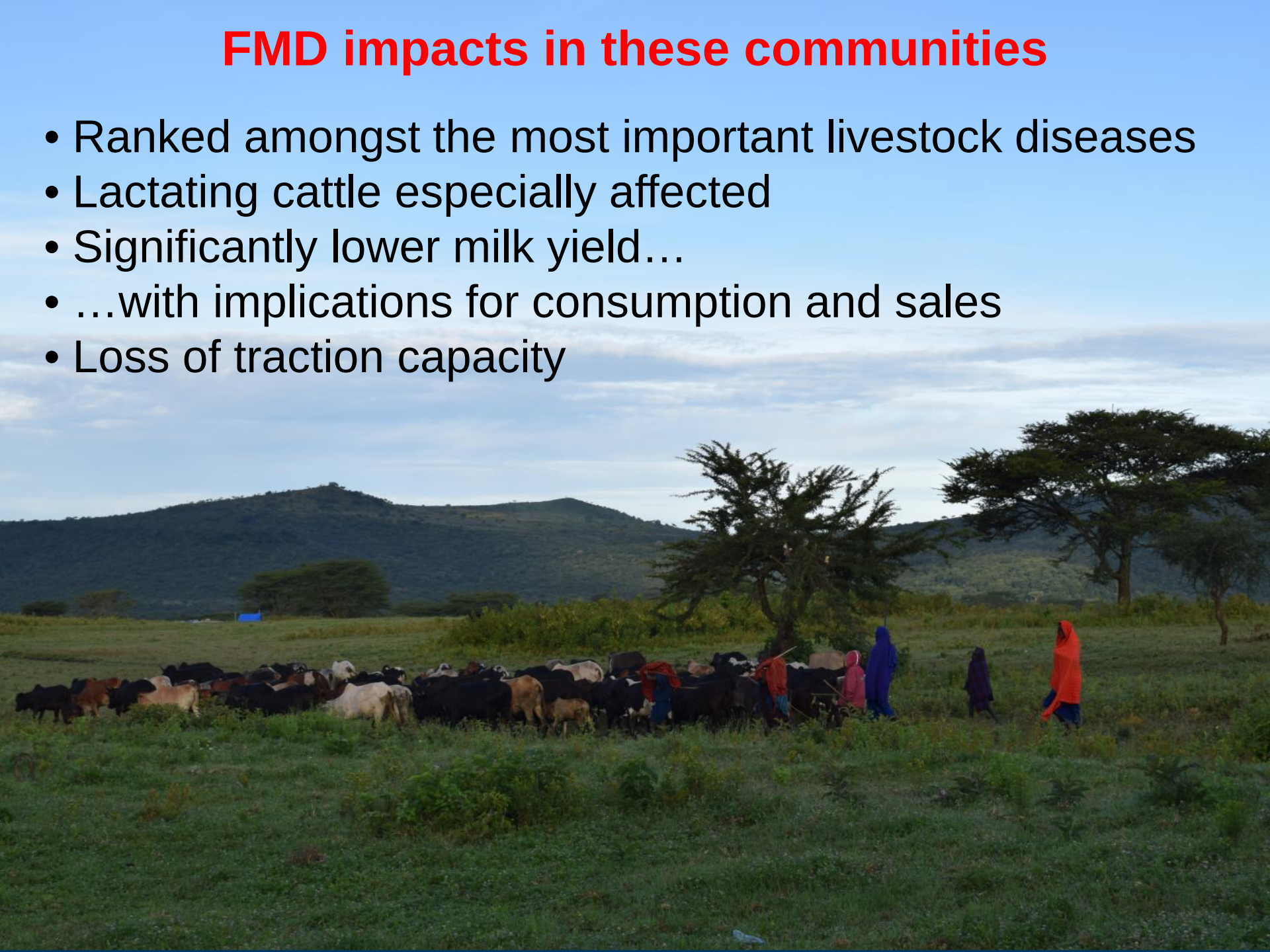
MSD Animal Health

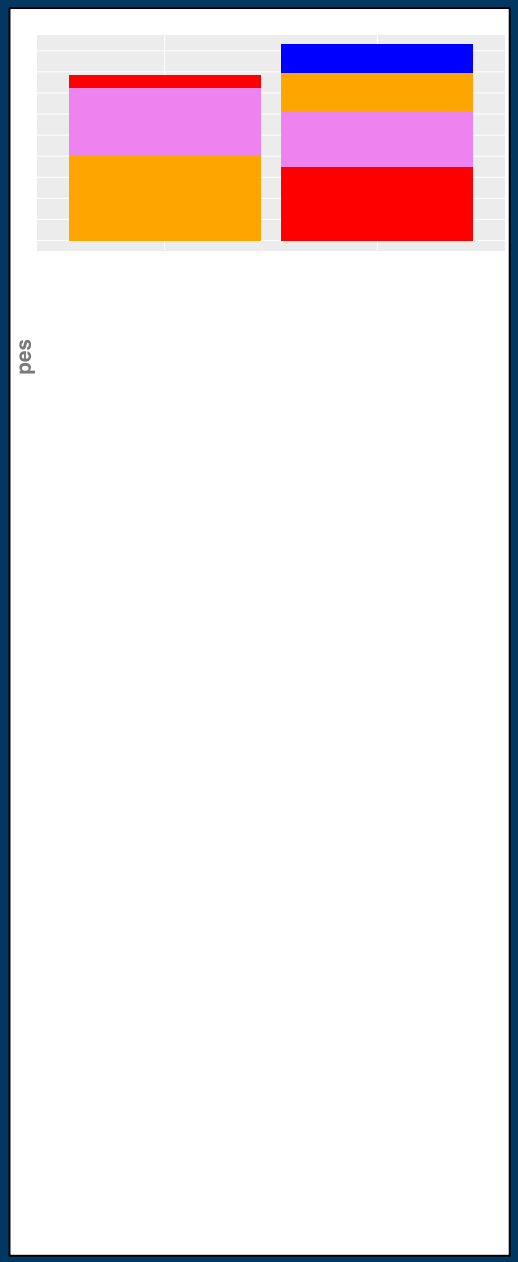
AfricanBioServices

SULSA Scottish Universities Life Sciences Alliance

FMD impacts in these communities

- Ranked amongst the most important livestock diseases
- Lactating cattle especially affected
- Significantly lower milk yield…
- …with implications for consumption and sales
- Loss of traction capacity





Drivers of infection in cattle

- o Cattle more exposed than small ruminants
- o Significant predictors in cattle:
  - Age
  - Production system
  - Herd size
  - New acquisitions
- o No significant wildlife-related predictors
- o Most prevalent serotypes - O in cattle and SAT1 in buffalo
- o Least prevalent serotypes - SAT2 in cattle and A in buffalo

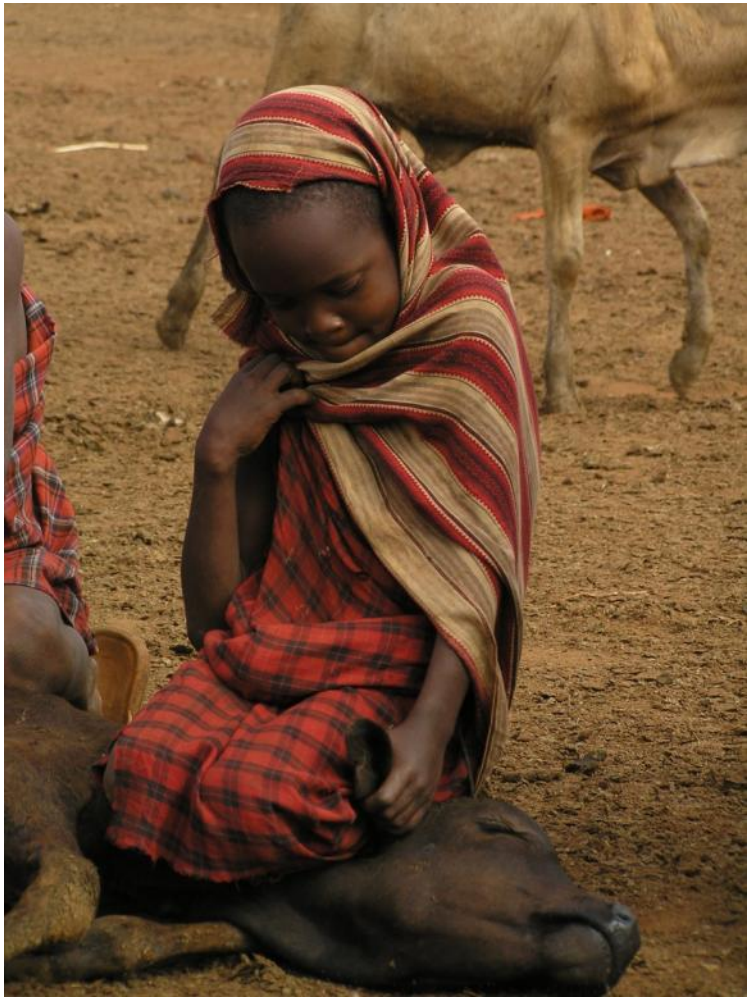
Vaccine-based control strategies

- Vaccination provides a potential solution for controlling disease in rural Africa and…

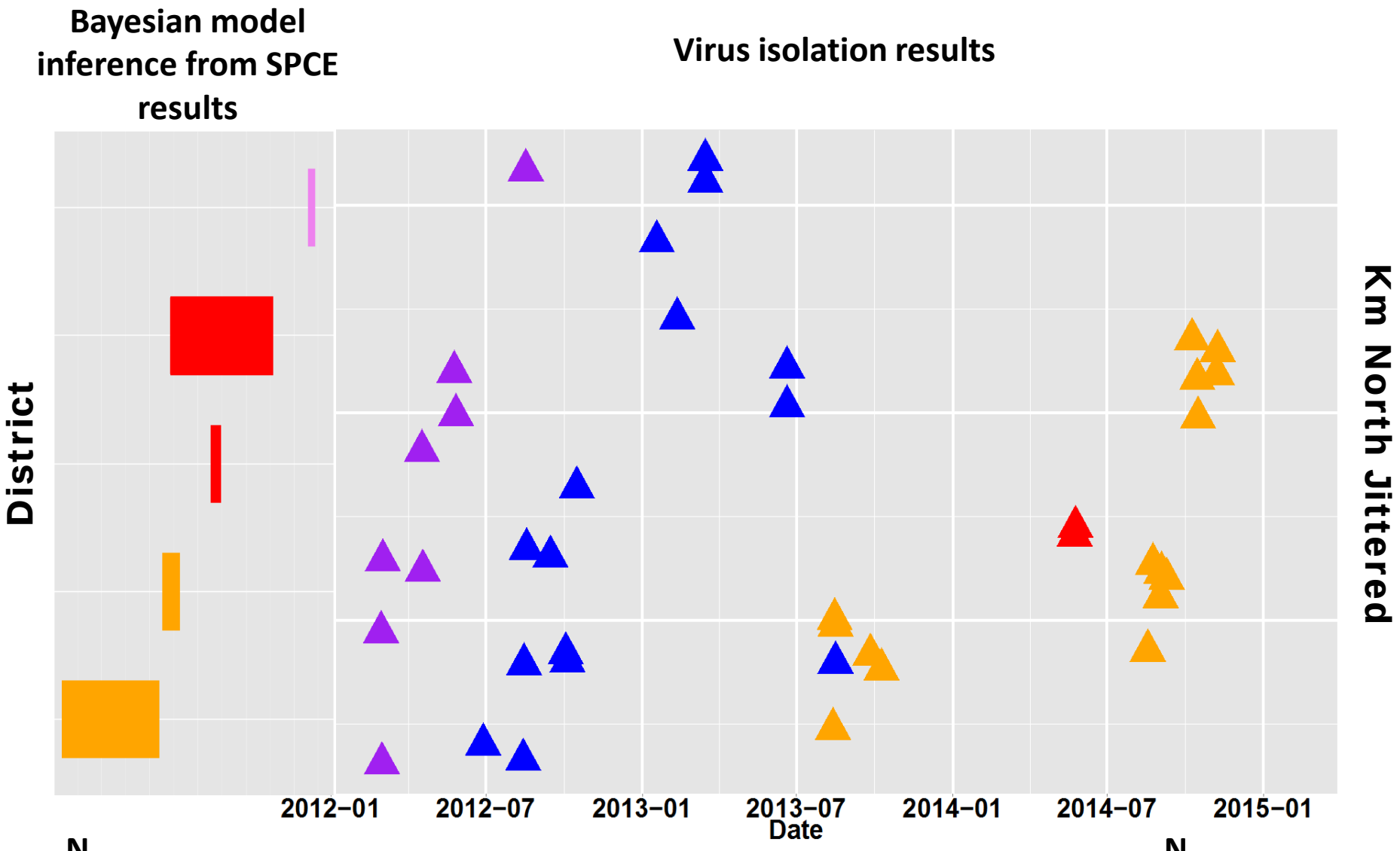
- …would be culturally and politically acceptable

But many constraints

- Limited capacity locally for field surveillance and serotype-specific diagnostics
- Limited data on circulating strains for vaccine selection:
  - » High diversity of viruses and little cross-protection
- Insufficient understanding of temporal and spatial patterns of virus circulation to devise strategies for vaccine delivery
- Lack of effective polyvalent vaccines against such a large range of serotypes



Northern Tanzania (2011-2015)



N
96 sera
60 herds
36 villages

N
85 viruses
37 herds
23 villages

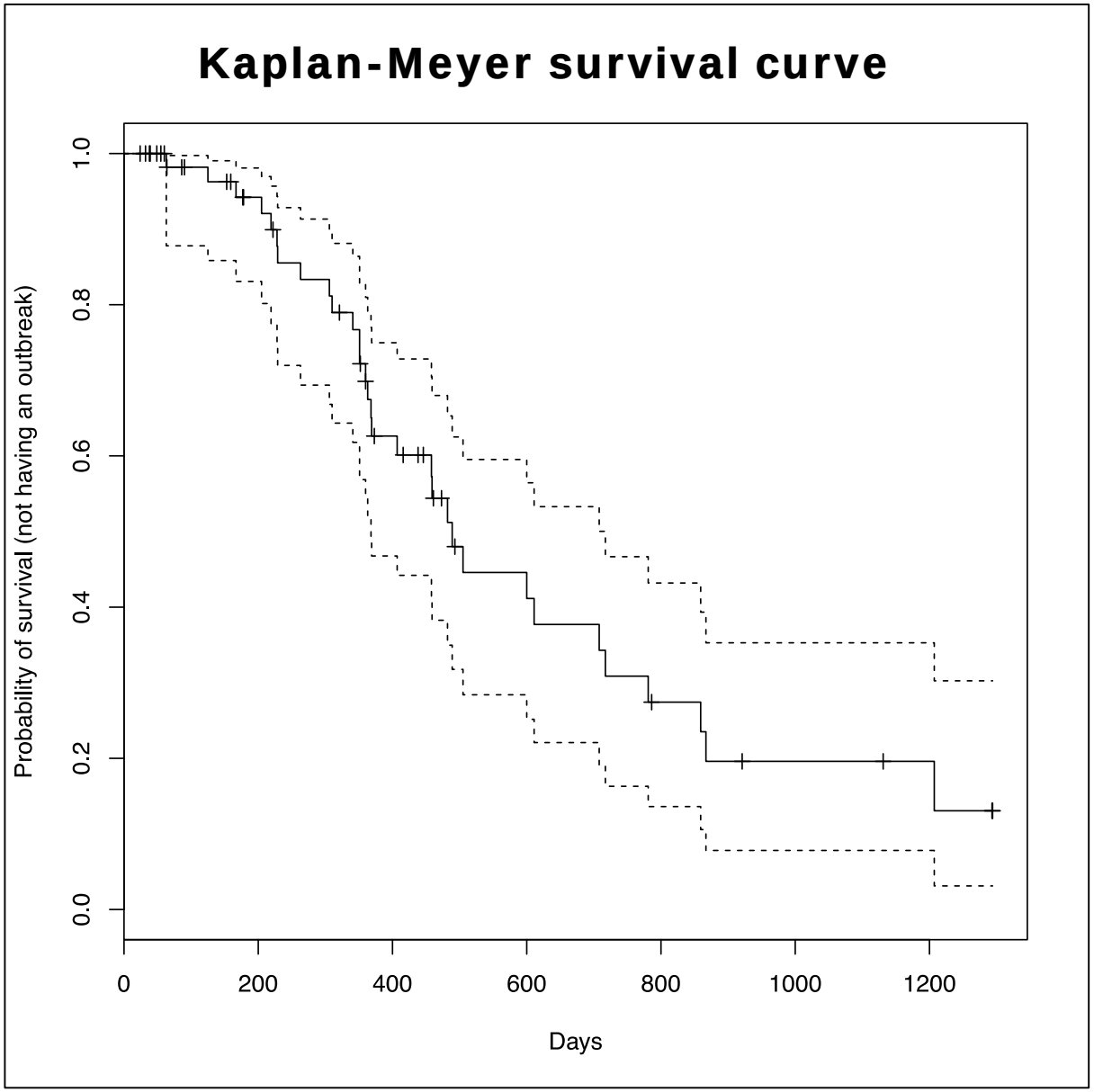
Northwards direction in Serengeti

Days since first outbreak ~Km north

	Dependent variable		
	Days (SAT2)	Days (A)	Days (SAT1)
Km North	6.553***	7.581***	23.541***
(SE)	(1.211)	(1.965)	(3.139)
Constant	-21.923	71.688**	95.283***
(SE)	(16.104)	(32.063)	(33.398)
Observations	13	23	40
R^2	0.727	0.415	0.597
Adjusted R^2	0.702	0.387	0.586
Residual Std Error	26.912 (df = 11)	92.151 (df = 21)	108.237 (df = 38)
F Statistic	29.290*** (df = 1; 11)	14.879*** (df = 1; 21)	56.259*** (df = 1; 38)
			*p<0.1; **p<0.05; ***p<0.01

Frequency of outbreaks

- Median time between outbreaks - **489 days** (IQR: 351-859 days) in 34 longitudinally tracked herds
- Four herds tracked through 4 outbreaks over < 3 years
- Sequential outbreaks caused by **different serotypes**

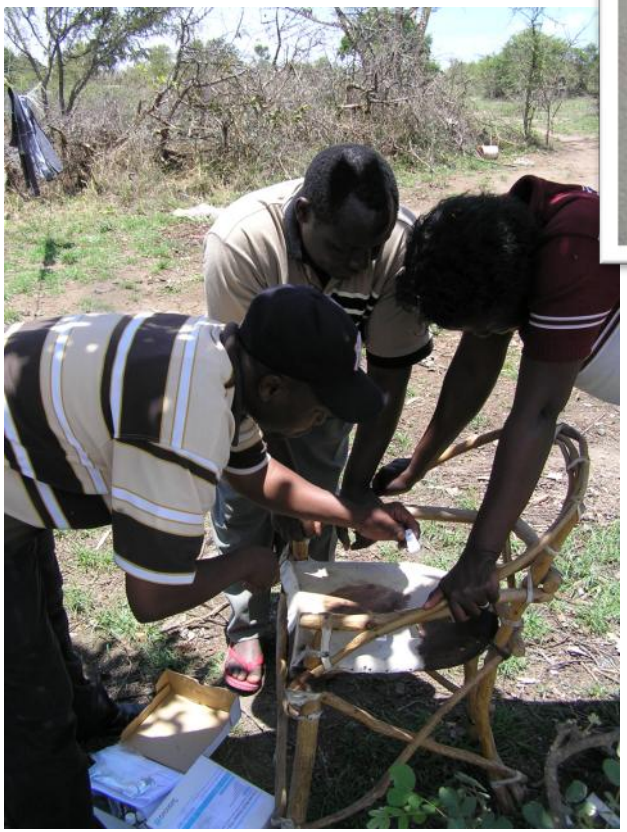


What does this mean in terms of FMD control and further research needs?

- Temporal patterns of antigenic dominance in Tanzania
- Serotype-specific (monovalent) vaccination in advance of expected waves of infection

- BUT…

- Can we improve surveillance and viral characterisation across Africa to determine if…
- …this pattern is consistent across broader geographical scales?



Field-based solutions for surveillance and high-resolution molecular epidemiology

- Nucleic acid recovered from 20 lateral-flow devices (LFDs) from clinical cattle two years after collection

- Typing successful on all samples (various % of genome recovered)

Research priorities – grassroots-level surveillance and in-country diagnostics

- Local-level information networks (mobile phone technologies? WhatsApp?)
- Strategies for deployment and recovery of LFDs
- Serotype-specific LFDs
- Diagnostic and molecular platforms in the field and local laboratories
- Sharing connections across Africa to characterise large-scale circulation patterns