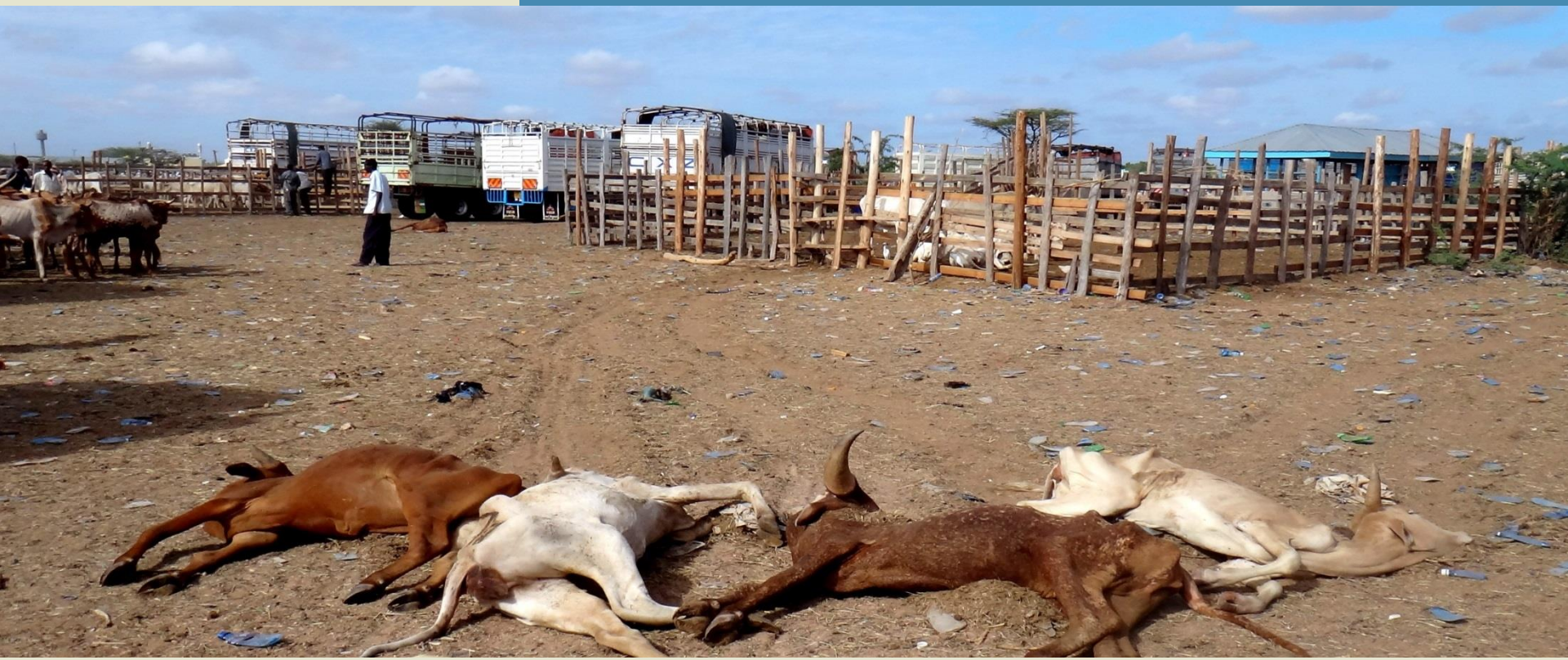


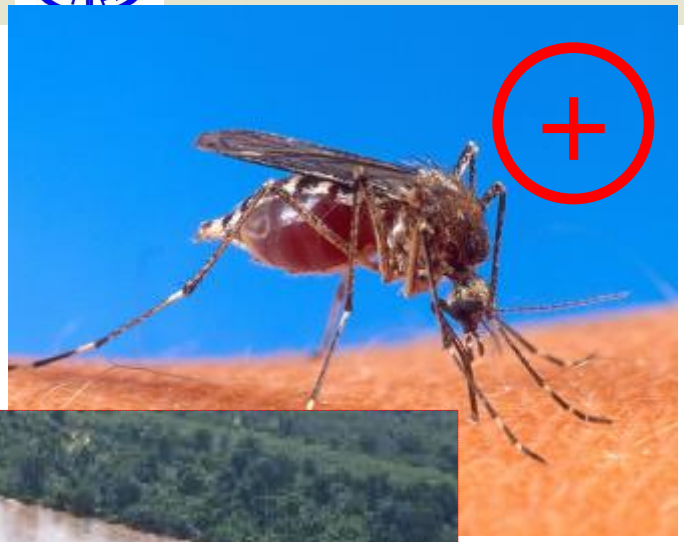
Rift Valley fever in Kenyan pastoral livestock: Individual-based demographic model to analyse the impact of Rift Valley fever

S. Fuhrimann[1,2], T. Kimani[3,4], F. Hansen[3], B. Bett[3], J. Zinsstag[1,2], E. Schelling[1,2]

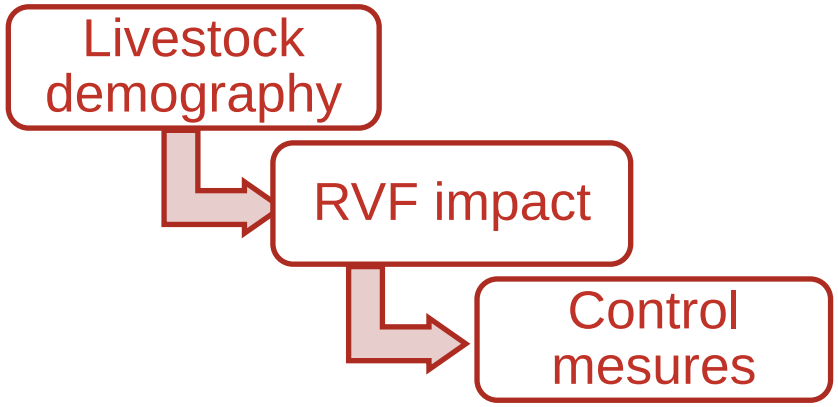
[1]Swiss Tropical and Public Health Institute, Basel; [2]University of Basel; [3] International Livestock Research Institute, Kenya; [4]Food and Agriculture Organization of the United Nations – ECTAD, Eastern Africa

What triggers an RVF outbreak?

1. Infected vectors (AEDES)
2. Flooding of mosquito breeding sites
3. Susceptible host population

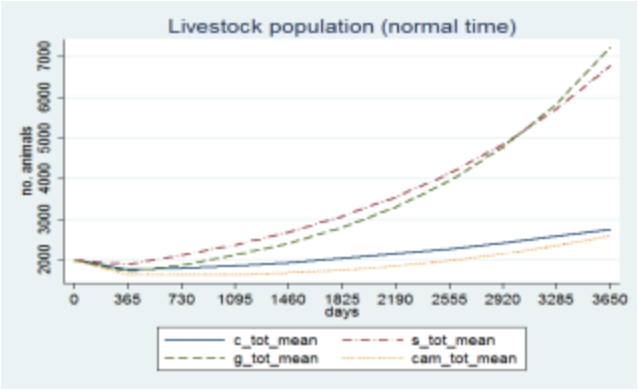


Objective 1:
Model concept



Objective 2:
Collect missing information by farming system-PAP, MFM, MFHP

Objective 3:
Implementation and validation



Objective 4:
Control measures and immunity distribution

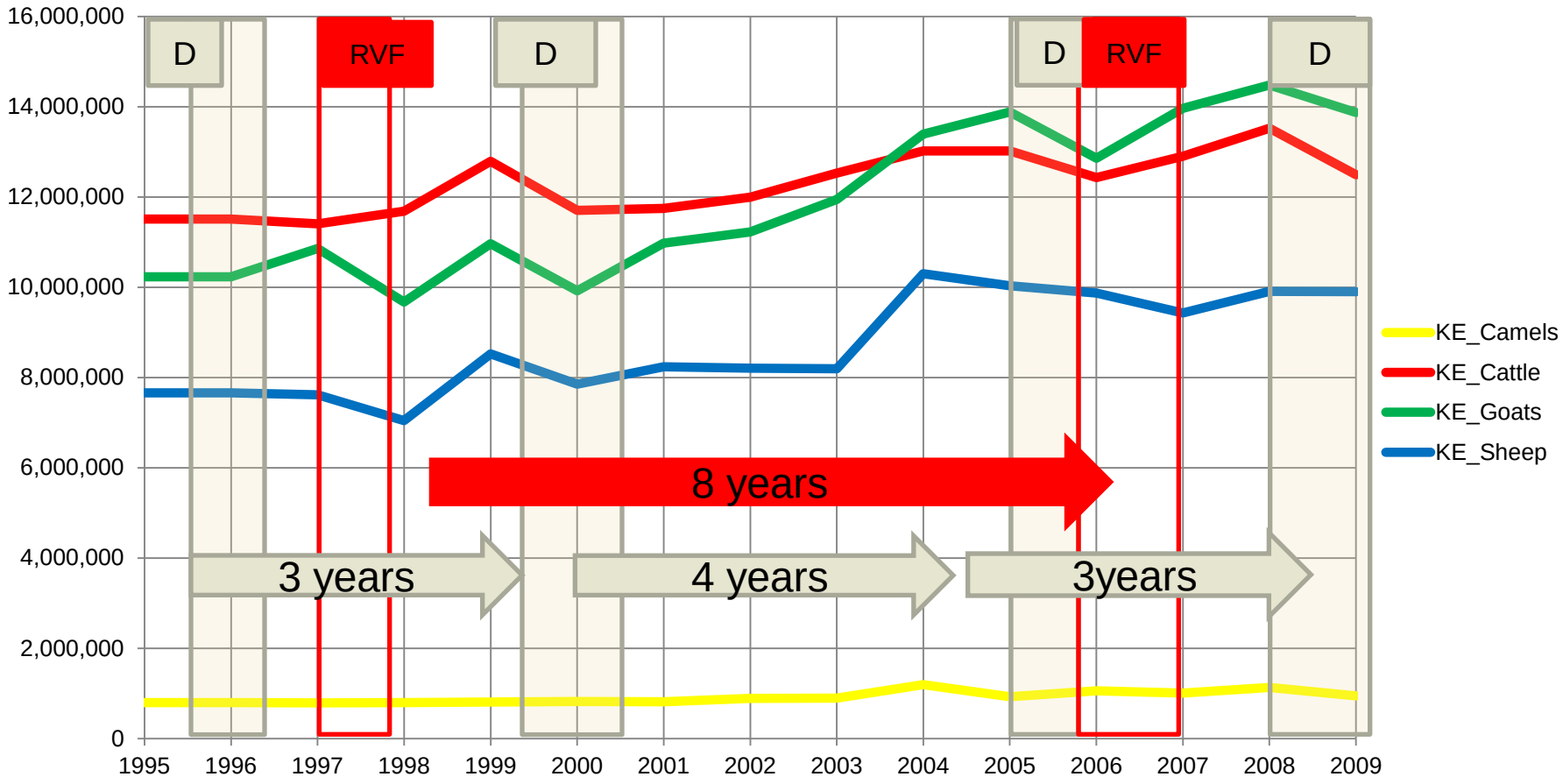
-Individual based model,
Track over days, years

-8 herds

implemented in C++ language with the Borland C++ builder

does not consider the in and out-migration and purchase of livestock

Model conceptualisation



(FAOStat 2011)

1. Reconstruction of:

Livestock population, droughts & 2006/2007 RVF timelines (159 days), next assumed outbreak 2014/2015

Simulations- based on 2000 animals of each species

1: Livestock demography (normal period / drought period)

2: RVF outbreak (2006/2007, assumed 2014/2015)
Infected, mortality, abortion, infected (sold & slaughtered)

3: Immunity distribution after RVF outbreak (2006/2007)
Identify the period when animal popn is not at risk of animal population

4: impacts of RVF outbreak with control measures on 2014/2015
(3 vaccination options, 2 surveillance options, 3 pour on treatments, larvicidal treatment, communication &awareness)

Analysis- 11 scenarios

5: Simulations outputs (proportions) were fed into an excel based framework to compute absolute numbers of various variables

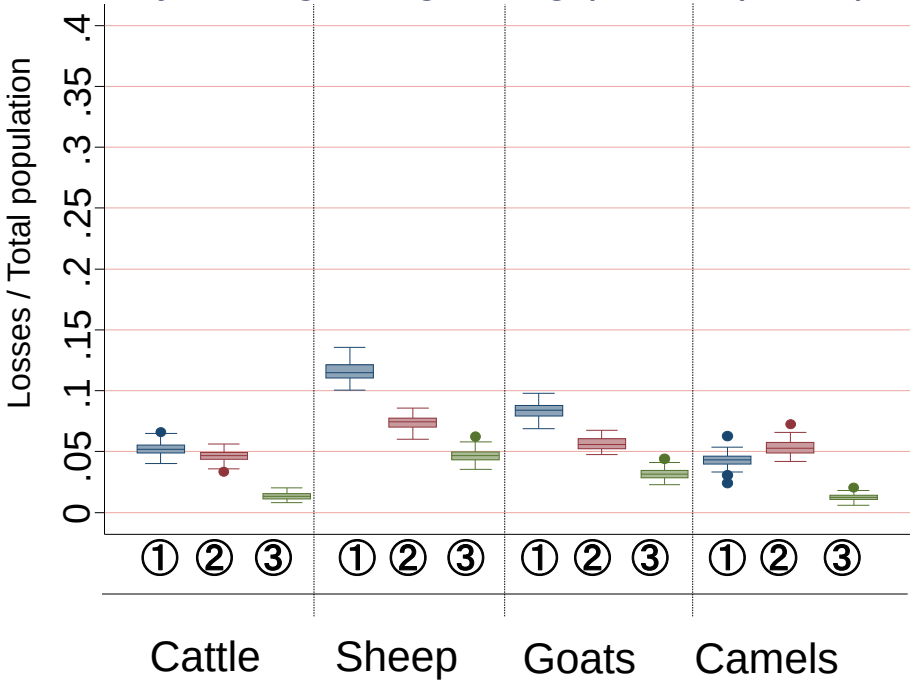
6: A second excel based BCA framework estimated production outs, quantities of outputs and values and BCR

Data inputs

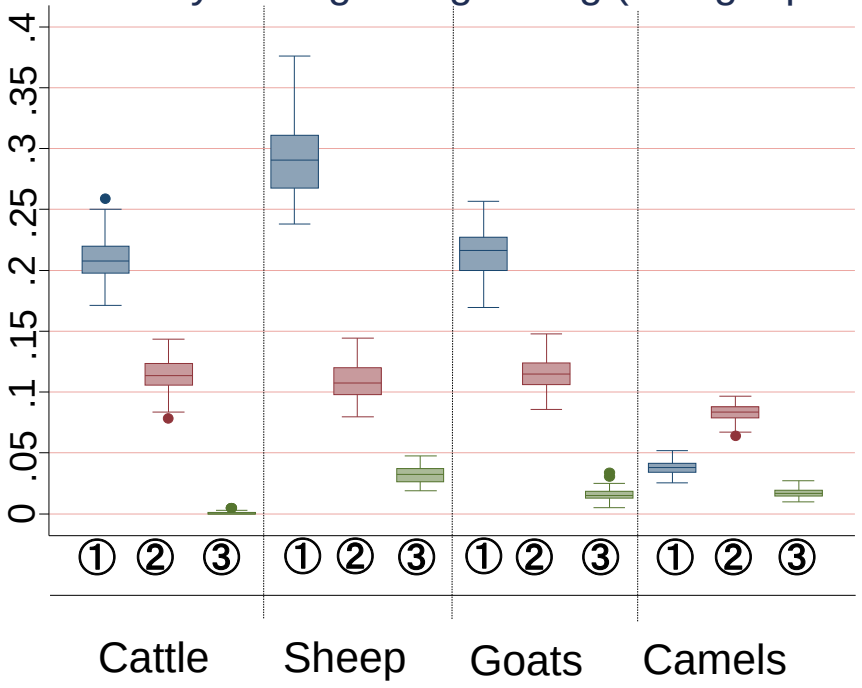
- baseline livestock demographics- herd structure, fertility, use of livestock
- Recovery of livestock production after the outbreak, and
- observations of RVF-like mortality & abortions
- other production losses after the outbreak (inter-epidemic).
- Daily infection probability
- Outbreak duration
- Incubation period
- Infectious period
- RVF case mortalities
- Abortion rates
- Vaccination probabilities
- Data sources:

8 focus group discussions in Garissa, Fafi, Lagdera, and Ijarausing participatory methods,
Jost et al. 2009, Schelling and Kimani 2007, Bird et al. 2009,
key informants, expert opinions

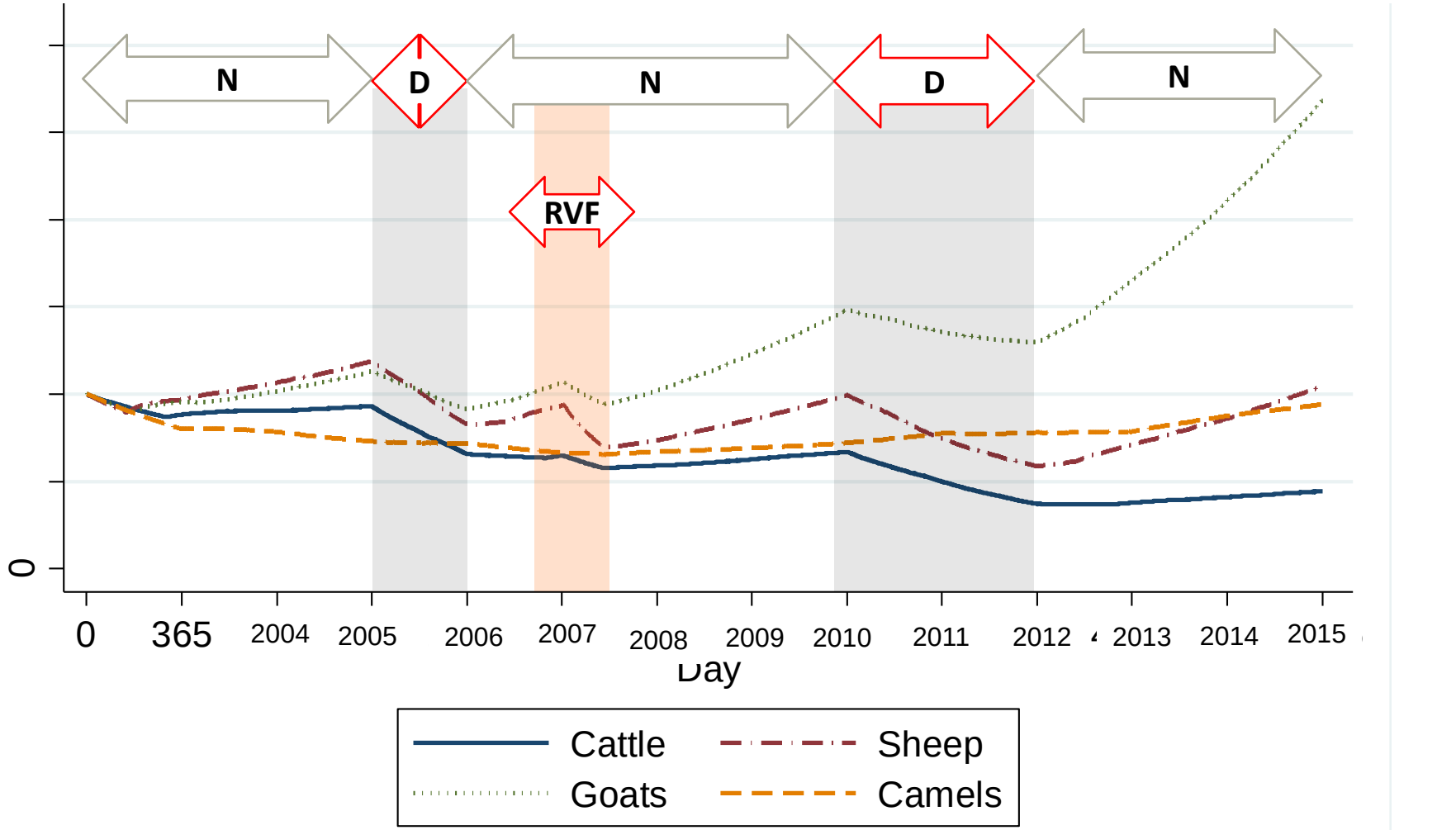
Mortality/Selling/Slaughtering (normal period)



Mortality/Selling/Slaughtering (drought period)

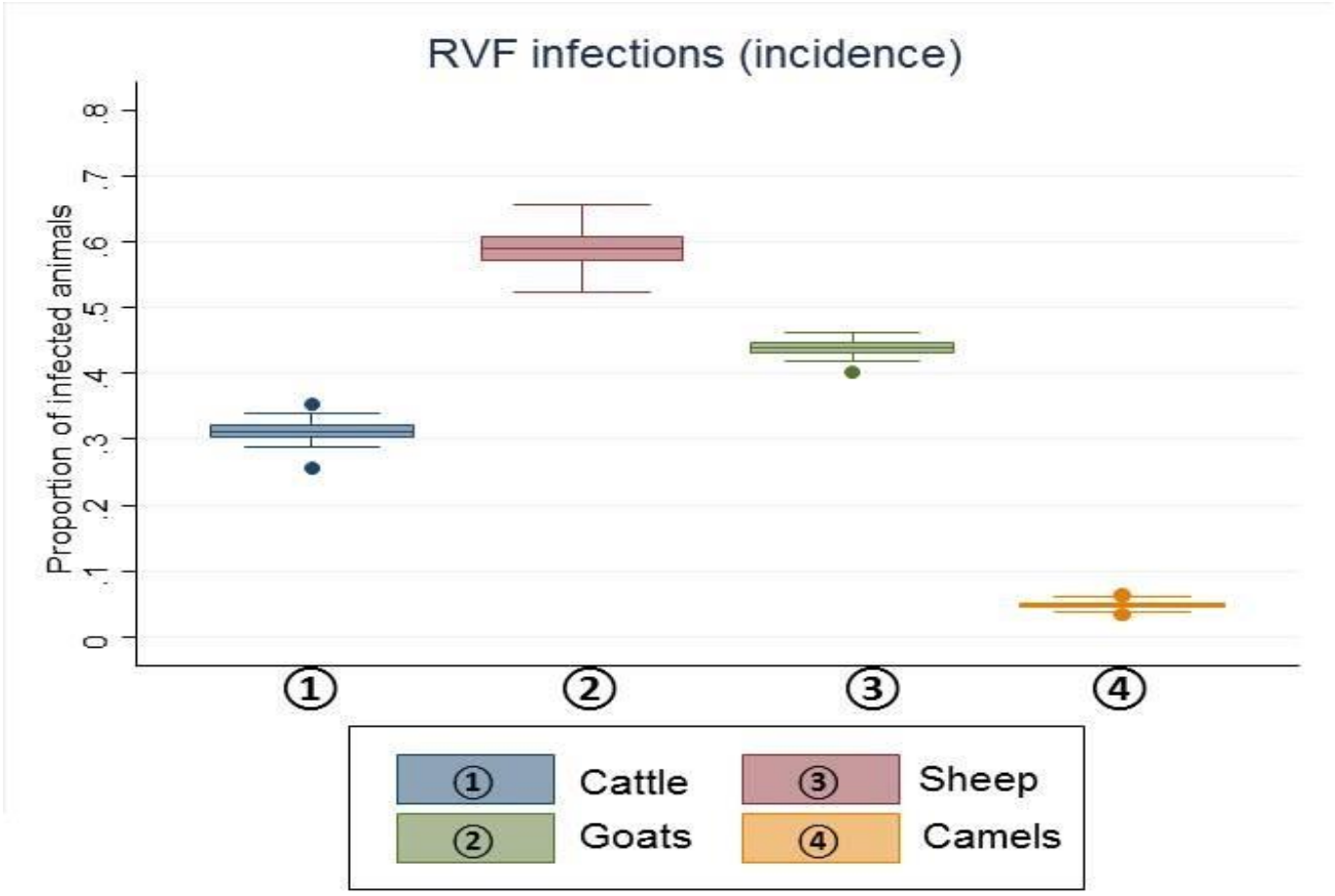


① Mortality ② Selling ③ Slaughtering

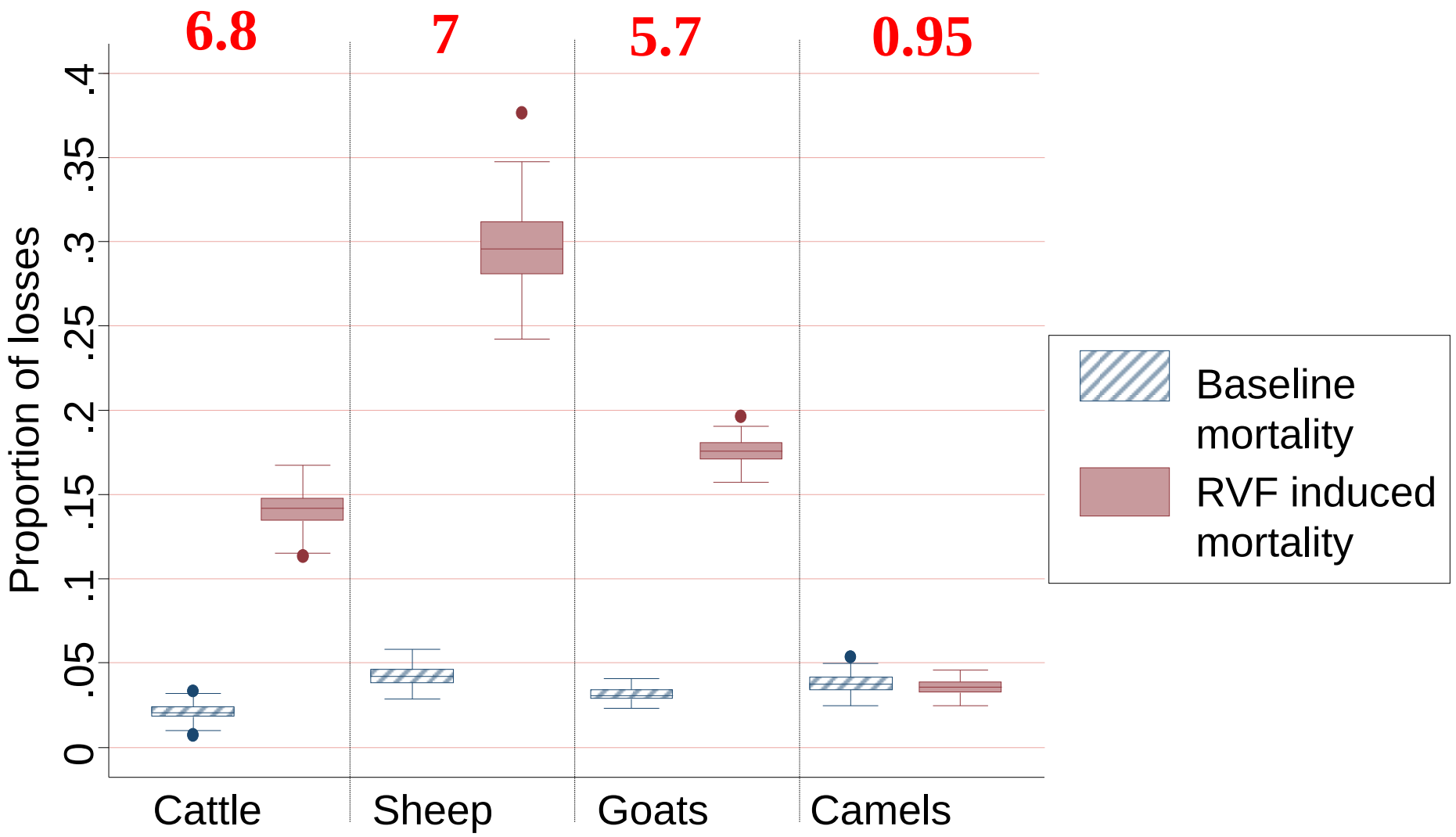


Simulation 2: Demography with RVF outbreak

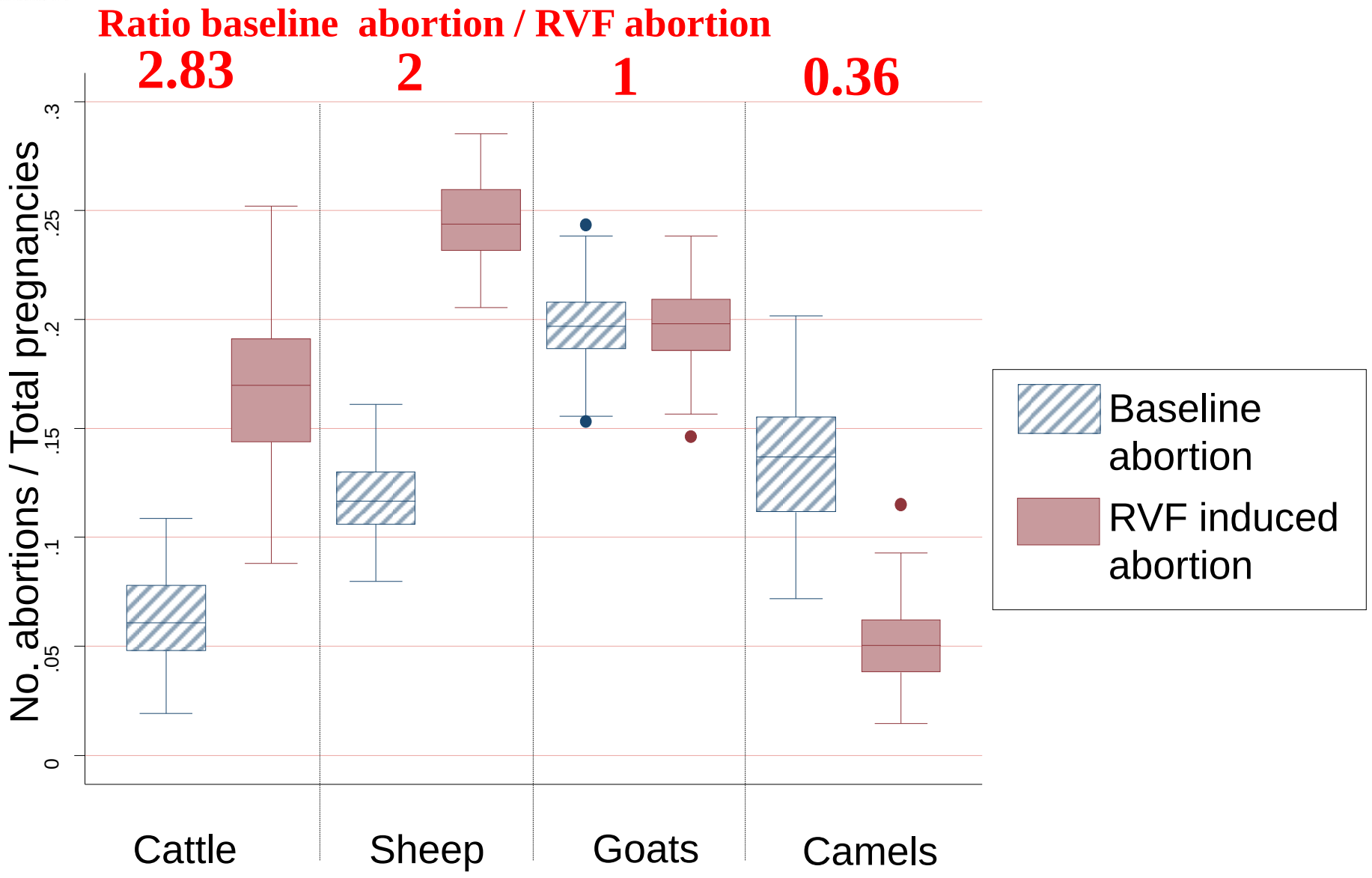
RVF infection



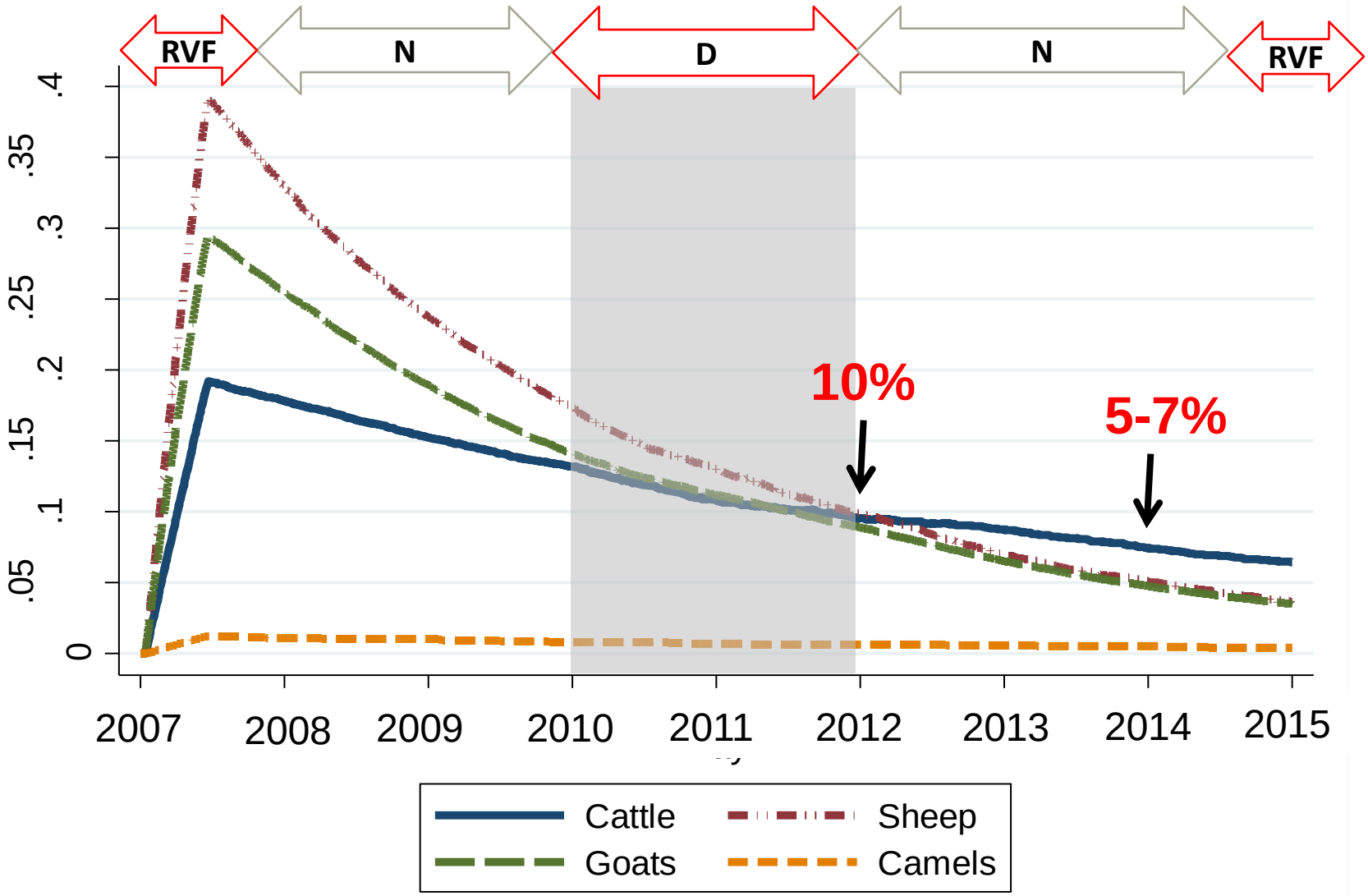
Ratio baseline mortality / RVF mortality



Mortality during RVF outbreak

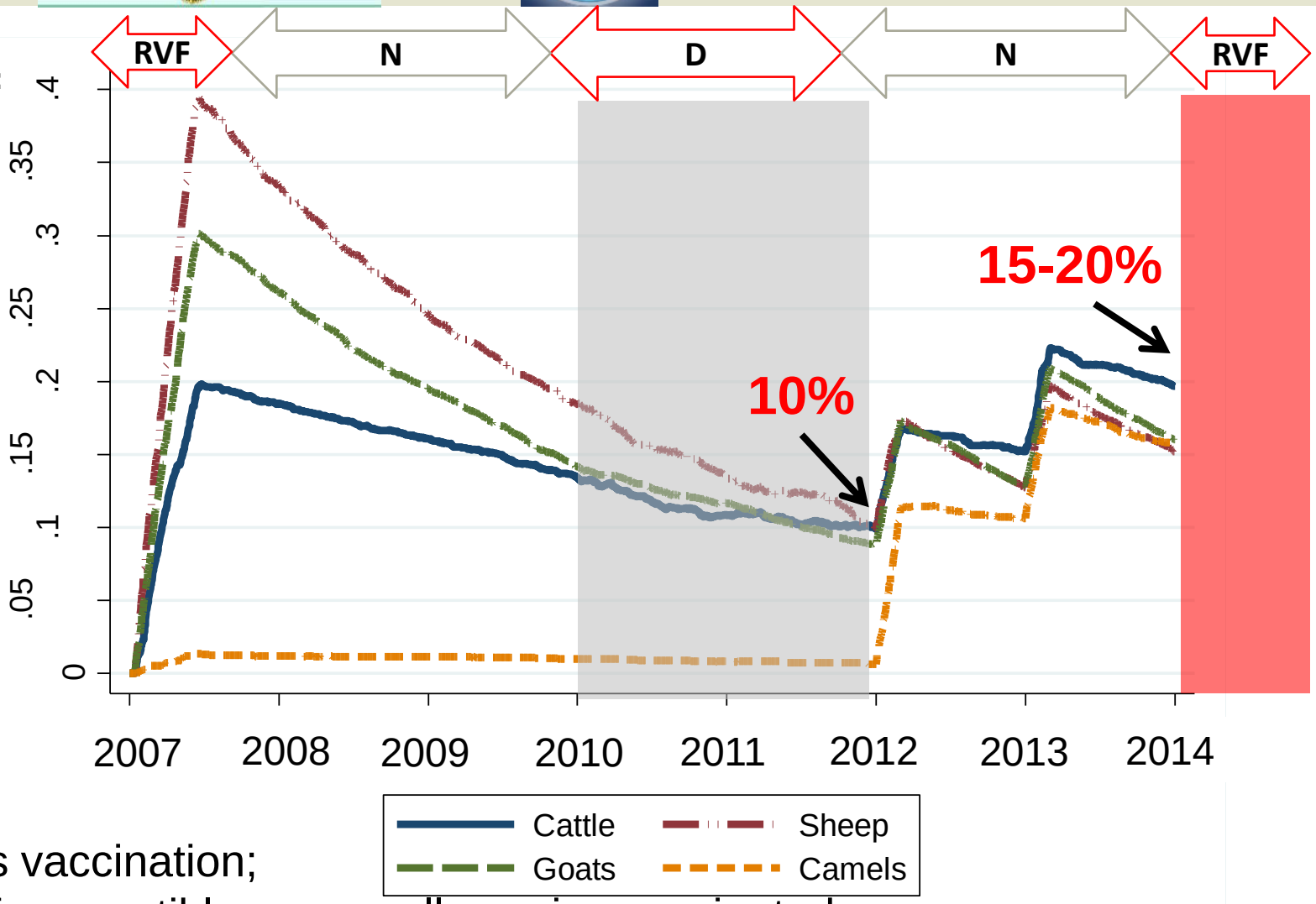


Abortions during 159 days RVF outbreak



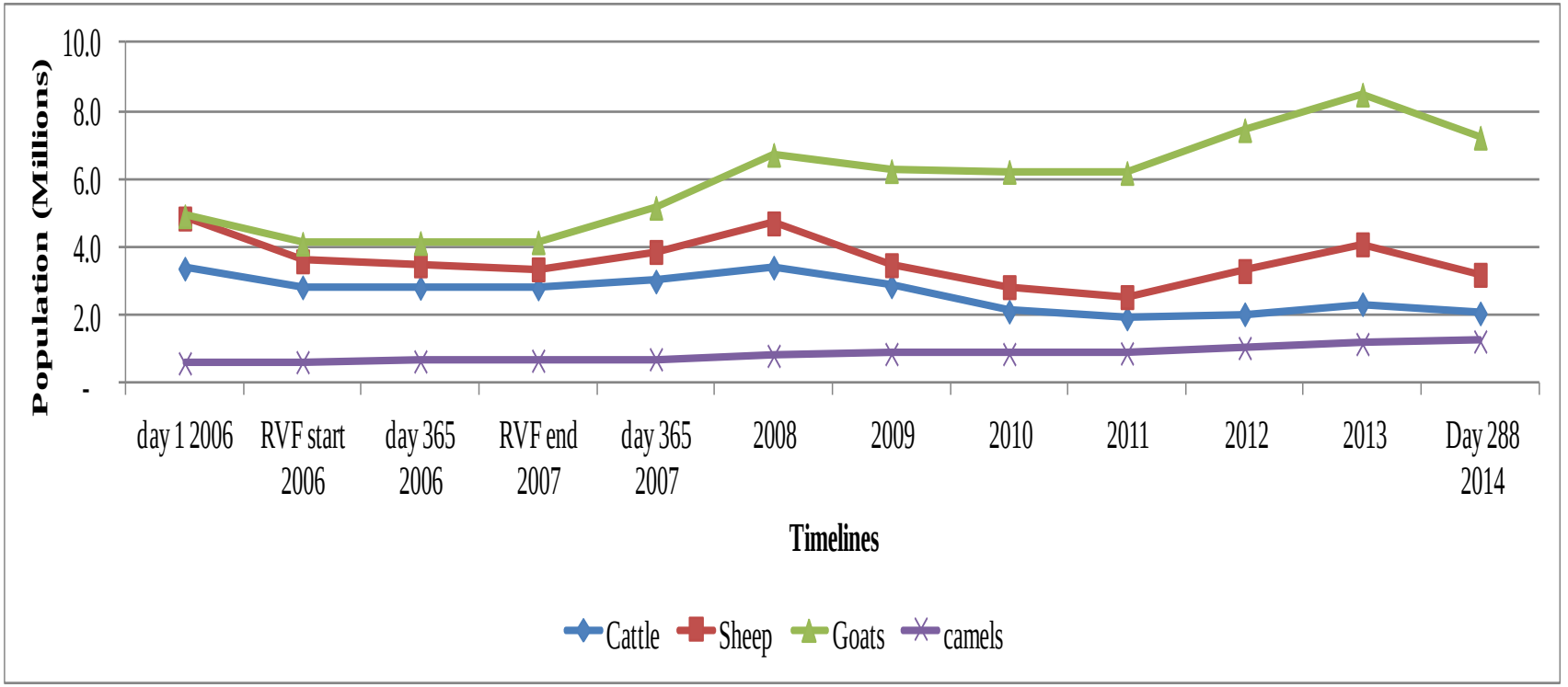
Simulation 3: Immunity distribution

Simulation 3: Vaccination



- 2 years vaccination;
- 10% of susceptible among all species vaccinated

Simulated livestock population trends in PAP



Impacts of Vaccination on assumed 2014/2015 epidemic

- Baseline vaccination – about 0.5 to 0.9 million (7%) million sheep and goats vaccinated annually (S1,S4,S9-11)

- 2012-2013 Annual mass vaccination increasing coverage-41-51% (all species) 27-33% (S3, S8 and S6)

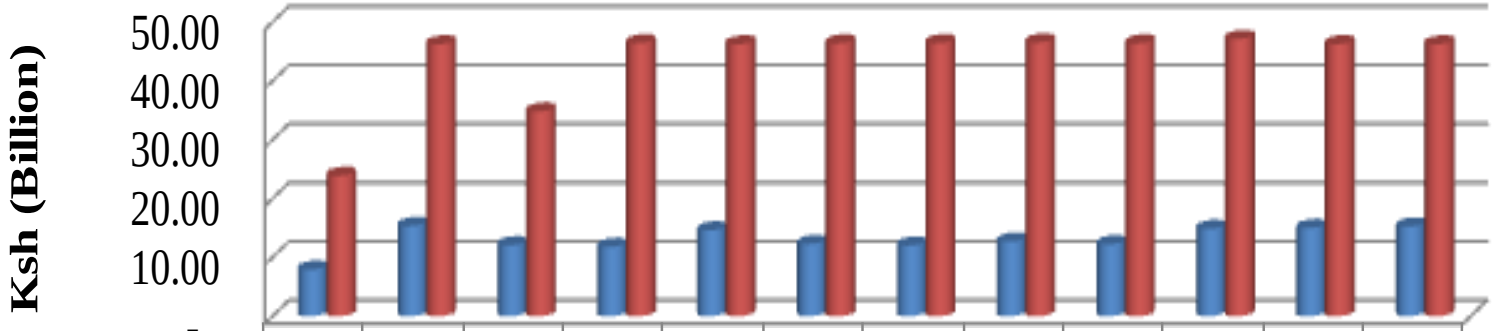
- 2012 mass (35-43%, in each species) and 2013-2014 mass vaccination (8-11%) of young stock (S2, S5 and S7)

Proportion of animals infected-PAP

	2006/2007	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
Cattle	8.60	8.10	4.40	4.00	7.60	4.60	4.20	4.80	4.40	7.90	7.70	8.10
Sheep	20.9	17.5	14.9	14.1	17.0	15.1	14.2	15.3	14.4	17.3	17.2	17.5
Goats	13.8	13.8	10.5	10.3	13.1	10.7	10.4	10.8	10.5	13.7	13.5	13.8
Camels	1.30	1.30	0.70	0.60	1.10	0.70	0.60	0.70	0.60	1.10	1.20	1.20

% Reduction all systems	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
	base	25.6	31.6	5.8	26.4	29.3	24.6	26.8	2.2	2.9	0.7

Production and marketing level Financial losses



	2006/2007	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
RVF losses	7.95	15.3	12.0	11.8	14.6	12.3	12.0	12.7	12.2	14.8	15.0	15.2
Other losses	23.9	46.2	34.8	46.4	46.2	46.4	46.4	46.5	46.4	47.1	46.3	46.2

SAM analysis: the 2006/2007 RVF outbreak reduced the value of total domestic supply by Ksh 3,740.4 million (US$43.5 million).
Livestock 50%, crops 10%, 40% other sectors
Higher than the estimates of Ksh 2.1 billion (Rich and Wanyoike (2010)

Benefit cost analysis

	Inter-epidemic vaccination 0= baseline, 1= 1 mass +2 young 2= 2 year mass	0= Baseline surveillance 1=enhanced surveillance-CBSS	1=Larvicide treatment of mosquito breeding sites after an early warning.	1= private-public sector pour on animal treatments	Incremental benefits (Saved losses	8 year incremental costs	% increase in costs	BCR
Strategy 1 (S1)-	0	0	0	0				
Strategy 2 (S2)-	1	1	1	1	838,268,306	238,456,598	51	**3.52**
Strategy 3 (S3)-	2	1	1	1	909,063,417	253,669,564	54	**3.58**
Strategy 4 (S4)-	0	1	0	1	183,813,322	101,810,137	22	1.81
Strategy 5 (S5)-	1	1	0	1	783,077,379	235,808,059	50	**3.32**
Strategy 6 (S6)-	2	1	0	1	849,203,567	251,141,589	53	**3.38**
Strategy 7 (S7)-	1	1	0	0	675,571,022	163,845,532	35	**4.12**
Strategy 8 (S8)-	2	0	0	0	793,179,938	159,661,508	34	**4.97**
Strategy 9 (S9)-	0	0	0	1	88,754,296	82,292,584	18	1.08
Strategy 10 (S10)-	0	1	1	1	88,754,296	104,458,675	22	0.85
Strategy 11 (S11)-	0	1	0	0	23,145,556	101,810,137	22	0.23

Conclusion

- The model proved its usefulness in describing the livestock demographic dynamics during normal and drought periods in details.
- the simulation of the 2006/2007 RVF outbreak reflects the course of the last RVF outbreak in NE-Province
- Maintaining status quo in terms of control measures and if next epidemic is preceded by a severe drought, the impacts will be high
- Improving vaccination 2-3 years before an epidemic can reduce production impacts significantly
- Two year mass vaccination offers higher benefits than 1 mass followed by vaccination of young animals

Acknowledgement s

1. Swiss TPH
   - Esther Schelling
   - Jakob Zinsstag
2. International Livestock Research Institute
   - Frank Hansen
   - Bernard Bett
   - Tom Randolph
3. CDC/KEMRI
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4. Austin Bitek
5. Egerton University
   - Margaret Ngigi


MINISTRY OF LIVESTOCK DEVELOPMENT
MANDATE
TO PROMOTE AND FACILITATE LIVESTOCK PRODUCTION FOR SOCIO-ECONOMIC DEVELOPMENT AND INDUSTRIALISATION
VISION
TO BE THE GLOBAL LEADER IN FACILITATING EFFICIENT DELIVERY OF SERVICES FOR SUSTAINABLE AND PROSPEROUS LIVESTOCK SECTOR
MISSION
TO CREATE A FAVOURABLE POLICY AND LEGAL FRAMEWORK FOR THE SUSTAINABLE DEVELOPMENTS OF THE LIVESTOCK INDUSTRY AND TO PROVIDE SUPPORT SERVICES THAT INCREASES PRODUCTIVITY VALUE ADDITION AND MARKET ACCESS FOR THE SUB-SECTOR PRODUCTS

Thank you!