Sero-epidemiology of zoonotic diseases in the Adamawa Province, Cameroon

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Background and aims

In sub-Saharan Africa a number of zoonoses are still widespread, posing a continuous threat to human health and livestock productivity.

For many of these diseases the prevalence, incidence and distribution are poorly known and usually underestimated, making priority setting and control programmes difficult to implement.

The purpose of this study was three-fold:

- to estimate animal and herd-level seroprevalence of *Brucella abortus*, *Leptospira* serovar Hardjo and *Coxiella burnetii* in West African zebu cattle;
- to explore the geographical distribution of these diseases;
- testing for spatial clustering.

Materials and methods

Data from a population-based cross-sectional study conducted in the Adamawa Province, Cameroon in 2000 to look at FMD prevalence and risk factors [1], were used for this study.

- **Study population**: cattle herds reared in the five Divisions of the Adamawa Province (Fig. 1);
- **Sampling**: a stratified two-stage random sampling strategy, based on the rinderpest vaccination records, resulted in 146 herds (Fig. 2) and 1377 animals;
- **Epidemiological information**: management and housing information was collected using an interviewer administered pre-tested questionnaire. Sex, age and breed recorded for each animal;
- **Laboratory tests**: all serum samples were tested for specific antibodies presence using commerical serological kits

  iELISA (Brucelisa 400, VLA, Weibridge, UK)
  Lateral Flow Assay (*Brucella* IgM/IgG LFA, Royal Tropical Institute, Amsterdam,NL)
  cELISA (Linnodee Lepto Kit, Linnodee Animal Care, Ballyclare, UK)
  ELISA (CHEKIT-Q fever, IDEXX Switzerland AG, CH)

- **Prevalence estimation**: design-based analysis was performed to calculate individual and herd-level seroprevalence;
- **Exploratory Spatial Data Analysis**: spatial clustering was explored using two global measures: Moran's *I* [2] and Cuzick and Edwards' [3]

  AND

  two local measures: scan statistic test [4] and LISA [5]

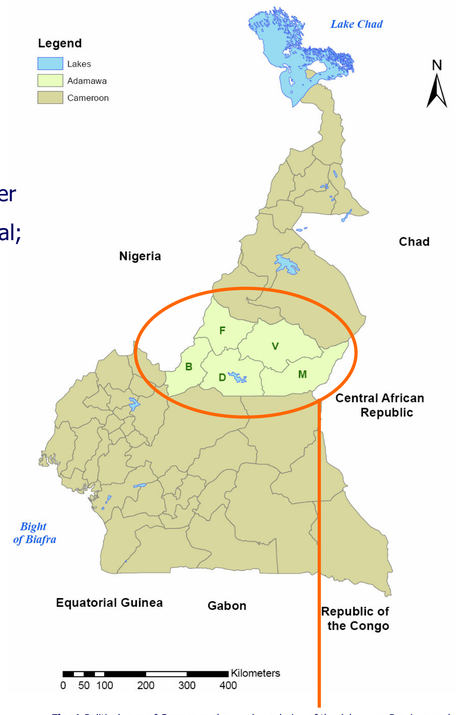

Fig. 1 Political map of Cameroon showng boundaries of the Adamawa Province and the 5 Divisions: B–Mayo-Banyo; D–Djérem; F–Faro et Déo; M–Mbéré; V–Vina.

Results

Prevalence estimation

Table 1 Individual and herd-level design-based seroprevalence by disease and Division

	Brucellosis (iELISA) % [90% CI]		Brucellosis (LFA) % [90% CI]		Leptospirosis % [90% CI]		Q fever % [90% CI]	
Study area								
	animal level (n=1377)	herd level (n=146)	animal level (n=1377)	herd level (n=146)	animal level (n=1377)	herd level (n=146)	animal level (n=1377)	herd level (n=146)
Djérem	1.05 [0.31÷3.48]	6.31 [1.98÷18.02]	0.69 [0.12÷3.73]	3.12 [0.57÷15.35]	35.42 [26.61÷45.34]	93.83 [81.98÷98.02]	30.52 [18.83÷45.41]	75.03 [54.42÷88.29]
Faro et Déo	1.71 [0.46÷6.22]	13.34 [4.49÷33.48]	2.09 [0.52÷8.04]	13.34 [4.49÷33.48]	26.63 [18.92÷36.08]	100 [--]	36.28 [23.1÷51.91]	93.32 [69.89÷98.83]
Mayo-Banyo	0.35 [0.02÷1.99]	3.02 [0.55÷14.98]	0.20 [0.04÷1.16]	3.02 [0.55÷14.98]	19.11 [14.99÷24.05]	90.92 [79.41÷96.29]	28.27 [22.14÷35.34]	93.94 [82.39÷98.09]
Mbéré	2.31 [0.64÷8.02]	13.34 [4.49÷33.48]	1.80 [0.35÷8.83]	10.04 [1.69÷41.47]	32.87 [25.36÷41.37]	88.34 [73.69÷95.34]	42.84 [32.26÷54.12]	76.75 [48.81÷91.88]
Vina	2.54 [1.19÷5.36]	14.88 [7.77÷25.70]	2.22 [0.95÷5.07]	10.42 [5.37÷19.24]	34.84 [29.74÷40.31]	95.85 [87.43÷98.70]	28.03 [22.23÷34.67]	87.53 [76.04÷93.92]
Overall	**1.74** [0.81÷2.66]*	**10.13** [5.39÷14.87]	**1.50** [0.58÷2.42]§	**7.59** [3.32÷11.86]	**30.46** [27.30÷33.61]	**93.35** [90.10÷96.61]	**31.67** [27.34÷35.99]	**84.41** [78.47÷91.14]

iELISA - indirect ELISA; LFA - *Brucella* IgM/IgG Lateral Flow Assay; * n=1373, no sera left for 4 samples; § n=1375, tests not re-run on 2 samples.

- since cattle are not vaccinated in Cameroon against these diseases, antibody presence could be considered a measure of natural exposure to wild strains (Tab. 1);
- misclassification of diseased herds resulted from original sampling protocol assumptions (90% CI and within-herd 50% prevalence);
- females had increased chances of testing positive for all the 3 diseases, as did older animals (>2yrs) (Tab.2);
- Brucellosis, Leptospirosis and Q fever were spread in the Adamawa Province and characterized by different distribution patterns (Fig. 3).

Table 2 Brucellosis, Leptospirosis and Q fever individual-level seroprevalence by age and sex categories

	Brucellosis(iELISA) % [90% CI]	Brucellosis (LFA) % [90% CI]	Leptospirosis % [90% CI]	Q fever % [90% CI]
Animal category				
young* (n=663)	0.23 [0.09÷0.55]	0.07 [0.01÷0.28]	10.53 [8.69÷12.7]	10.42 [8.84÷12.25]
adult§ (n=714)	1.50 [0.83÷2.69]	1.38 [0.81÷2.76]	20.44 [18.68÷22.32]	21.14 [17.52÷25.28]
male (n=411)	0.09 [0.02÷0.34]	0.22 [0.1÷0.83]	7.82 [6.46÷9.43]	7.05 [5.32÷9.27]
female (n=966)	1.64 [0.93÷2.87]	1.24 [0.61÷2.39]	23.14 [20.75÷25.64]	24.52 [20.42÷29.13]
Overall	**1.74** [0.81÷2.66]	**1.50** [0.58÷2.42]	**30.46** [27.30÷33.61]	**31.67** [27.34÷35.99]

*= ≤2yrs ; §= >2yrs

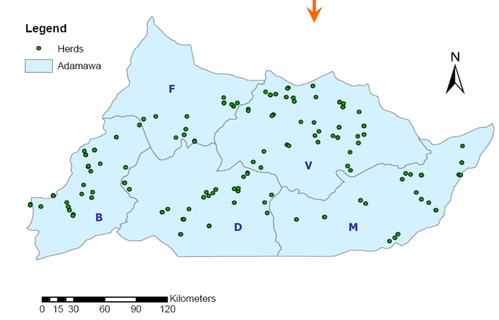

Fig. 2 Sampled herds (n=146) locations in the Adamawa Province, Cameroon (B–Mayo-Banyo; D–Djérem; F-Faro et Déo; M–Mbéré; V–Vina).

Exploratory Spatial Data Analysis

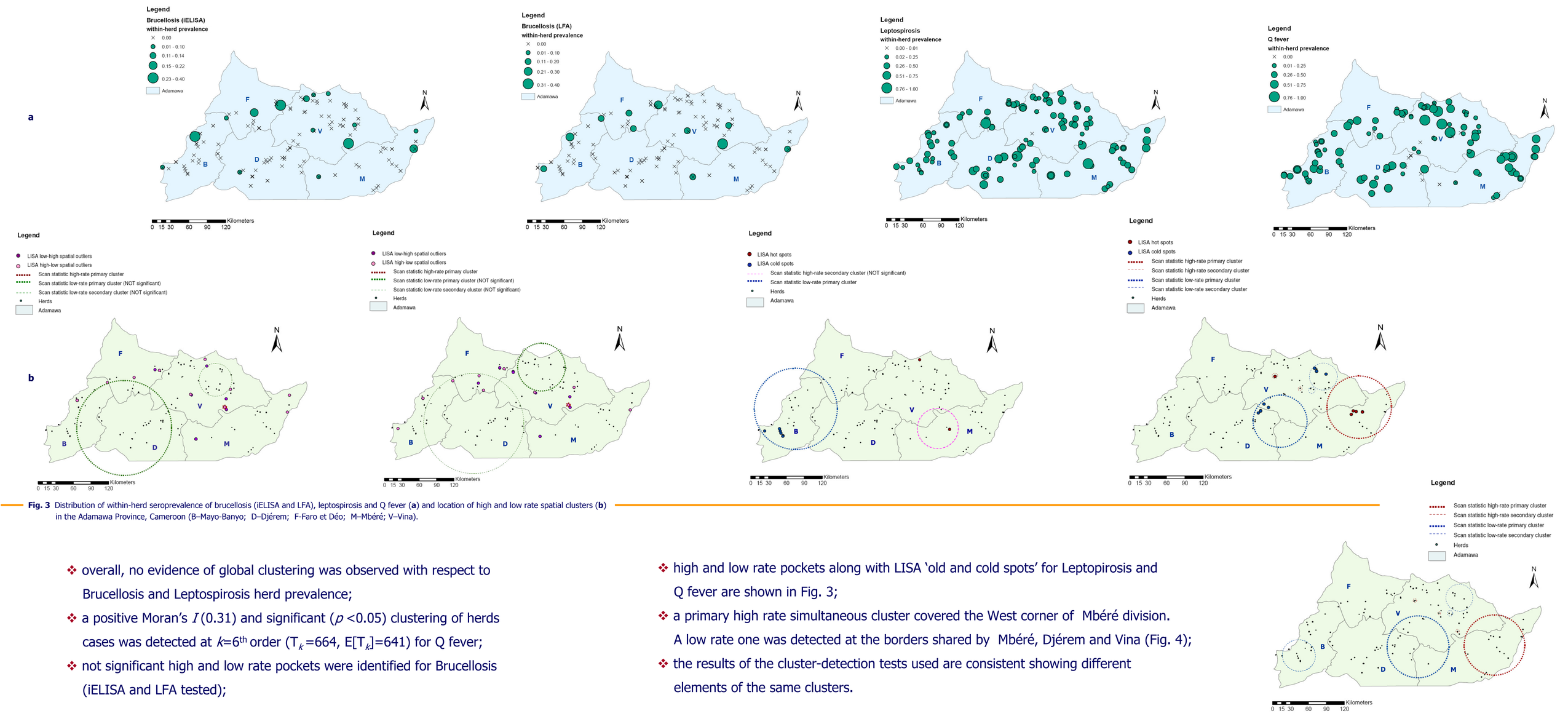

Fig. 3 Distribution of within-herd seroprevalence of brucellosis (iELISA and LFA), leptospirosis and Q fever (**a**) and location of high and low rate spatial clusters (**b**) in the Adamawa Province, Cameroon (B–Mayo-Banyo; D–Djérem; F-Faro et Déo; M–Mbéré; V–Vina).

- overall, no evidence of global clustering was observed with respect to Brucellosis and Leptospirosis herd prevalence;
- a positive Moran's *I* (0.31) and significant (p <0.05) clustering of herds cases was detected at k=6th order (T_k=664, E[T_k]=641) for Q fever;
- not significant high and low rate pockets were identified for Brucellosis (iELISA and LFA tested);
- high and low rate pockets along with LISA 'old and cold spots' for Leptopirosis and Q fever are shown in Fig. 3;
- a primary high rate simultaneous cluster covered the West corner of Mbéré division. A low rate one was detected at the borders shared by Mbéré, Djérem and Vina (Fig. 4);
- the results of the cluster-detection tests used are consistent showing different elements of the same clusters.

Fig. 4 Clusters locations of simulatneous diseases in the Adamawa Province, Cameroon (B–Mayo-Banyo; D–Djérem; F–Faro et Déo; M–Mbéré; V–Vina).

Discussion

- new information about the seroprevalence and distribution of these three important zoonotic diseases in a large region of SSA has been presented;
- a very low apparent seroprevalence of Brucellosis (<2%) resulted compared to very high seroprevalence of Leptospiosis (31%) and Q fever (32%);
- the very high herd-level seroprevalence of Leptospirosis and Q fever suggest potentially very high levels of human exposure;
- the study of spatial patterns using a combination of global and local estimates of clustering may provide important clue to underlying exposure heterogeneities.

HOWEVER

- the herd-level estimates are likely to be biased and the true herd-level prevalence underestimated, particularly for Brucellosis, because of the relatively small within-herd samples;
- other possible approaches in the data analysis should be considered to model the sources of uncertainty and produce more reliable estimates;
- a better understanding of the burden of these neglected zoonoses could be addressed by analysing human and livestock cases jointly.

References:

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