Infectious bursal disease in Ethiopian village chickens

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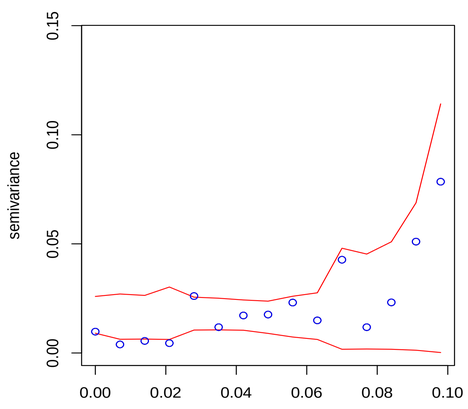
Poultry production in Ethiopia and Infectious bursal disease virus (IBDV)

- The majority of Ethiopian poultry are indigenous birds kept in small backyard flocks, belonging to rural smallholders, and are particularly important to landless in society, and also to women.
- Disease is reported by smallholders to be a major constraint to production, but most outbreaks are attributed to Newcastle disease without any investigation of the pathogens responsible.
- IBDV was first reported in Ethiopia in 2002 in a commercial flock, but the very virulent (vvIBDV) strain type has since been identified in all production systems. This strain is associated with high mortality in birds between 3 and 6 weeks of age.
- Only birds over 3 weeks and less than around 10 weeks of age will have clinical disease (diarrhoea, dehydration, echymotic haemorrhages). Adult birds will seroconvert without showing clinical signs. Chicks under 2 weeks do not normally develop disease, but become immunosuppressed, as the developing B-cells are depleted by the virus, impairing the bird's ability to produce antibodies.

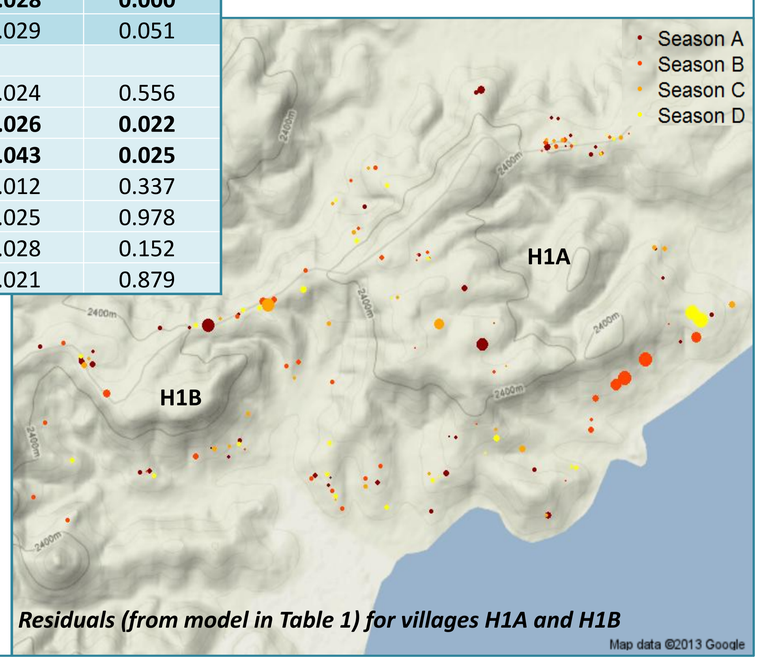
Modelling risk factors

- Multi-level intercept only models were fitted to assess the variation in antibody levels (as measured by the S:P ratio) at each level of the dataset, and the amount of variation between different ELISA plates.
- Intraclass clustering coefficients indicated ~66% of variation was contributed by individual birds, and ~ 13% by the farm. Market shed and region did not contribute significantly, however, the ELISA plate was an important source of variation. Household and plate were therefore fitted in the final multilevel mixed model as random effects, and village and season were included as fixed effects.
- Other household and bird level variables were screened for inclusion in the final model, and retained where there was evidence that they significantly ($p<0.05$) improved model fit (Table 1.)
- Due to the non-normality of the residuals, bootstrap estimates of the standard errors (SE) were estimated. The simulated SE's were lower for the effects of Salmonella titre and outbreak history and only slightly increased for the village effect without altering the significance, providing evidence that our estimates are generally robust, despite non-normality. However, the bootstrapped model suggested that Season B was not significantly different to the other seasons (p=0.09).
- Bird-level residuals were examined for spatial clustering, by comparing them with simulated sets of residuals with no spatial correlation. The variogram shown below suggests that, in adjacent villages H1A and H1B, in Season D, there was more similarity between birds found close to each other, as we might expect with an infectious agent. However, spatial clustering of residuals was not evident for all villages in all seasons.

Table 1: Fixed effects	Coefficient	SE	P
Intercept	0.060	0.026	0.022
Continuous variables			
Salmonella s:p ratio	**0.012**	**0.003**	**0.000**
Categorical variables			
Season A	Reference		
Season B	***0.040***	***0.018***	***0.028***
Season C	0.031	0.027	0.242
Season D	0.033	0.027	0.230
Village H1A	Reference		
VillageIDH1B	**-0.054**	**0.027**	**0.045**
VillageIDH2A	**-0.064**	**0.027**	**0.020**
VillageIDH2B	**-0.070**	**0.026**	**0.006**
VillageIDJ1A	**-0.094**	**0.030**	**0.002**
VillageIDJ1B	-0.055	0.029	0.052
VillageIDJ2A	**-0.116**	**0.028**	**0.000**
VillageIDJ2B	-0.056	0.029	0.051
No outbreak in last 12 months	Reference		
Outbreak in chicks	0.014	0.024	0.556
Outbreak in growers	**0.059**	**0.026**	**0.022**
Outbreak in chicks and growers	**0.097**	**0.043**	**0.025**
Outbreak in adults	0.011	0.012	0.337
Outbreak in chicks and adults	0.001	0.025	0.978
Outbreak in growers and adults	0.040	0.028	0.152
Outbreak in all age groups	-0.003	0.021	0.879



Variogram with tolerance limits of the residuals (from the model in Table 1) for villages H1A and H1B in Season D, showing evidence of spatial autocorrelation over short distances (p=0.02)



Residuals (from model in Table 1) for villages H1A and H1B

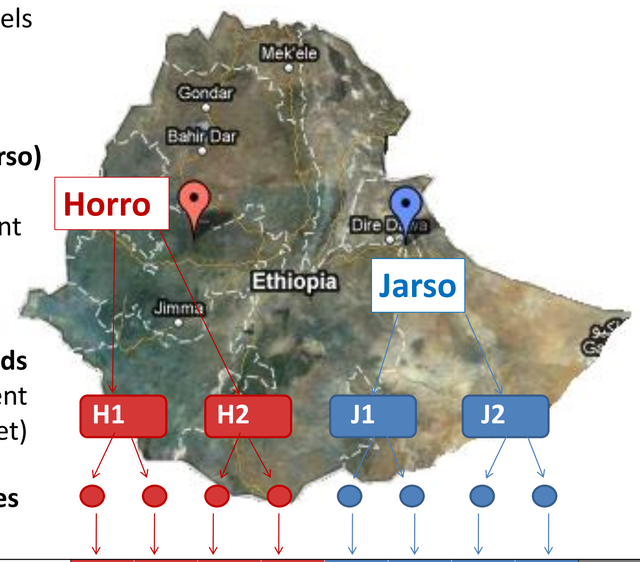
This work is part of a larger collaborative project looking at the infectious disease epidemiology, genetic and socio-economic aspects of poultry keeping in Ethiopia.

Further information can be found at www.ch4d.wordpress.com

CHICKEN HEALTH FOR DEVELOPMENT

Sampling Methods

Data was clustered at 4 levels



2 Regions (Horro & Jarso)
Both in highland areas, but with different social demographics

4 Market sheds
(groups of villages dependent on a single market)

8 Villages

Each village was visited 4 times, and different households were randomly selected

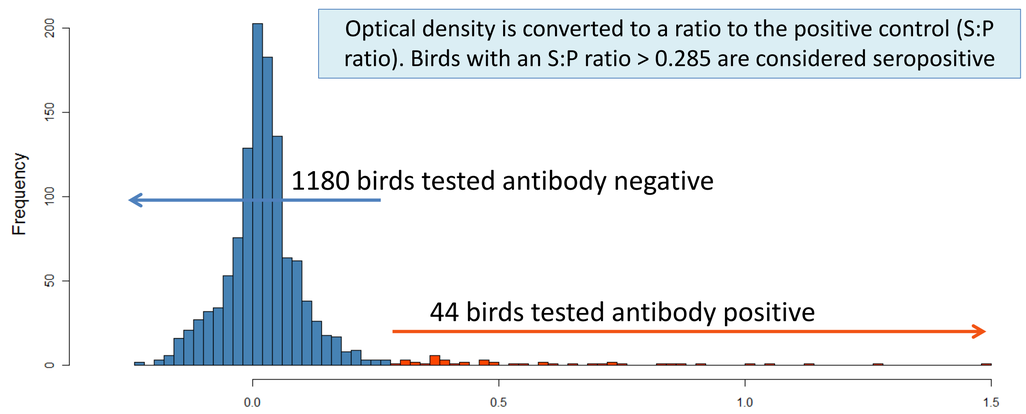
640 Households		H1A	H1B	H2A	H2B	J1A	J1B	J2A	J2B	Total
Season	May 2011	25	25	25	25	25	25	25	25	**200**
	Oct 2011	25	25	25	25	25	24	25	25	**199**
	May 2012	15	15	14	16	15	15	15	15	**120**
	Oct 2012	15	15	16	15	15	15	15	15	**121**
	Total	**80**	**80**	**80**	**81**	**80**	**79**	**80**	**80**	**640**

2 birds of over 6 months of age were randomly selected from each household flock

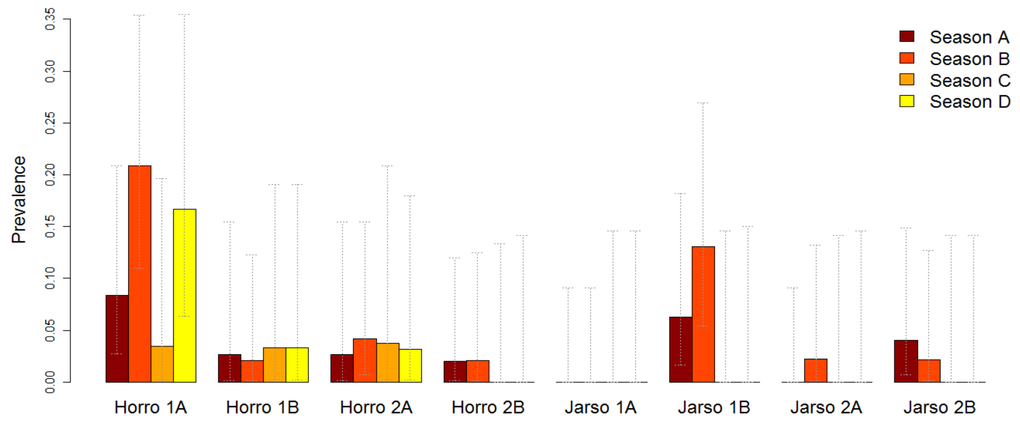
Total: 1280 birds

- Management data for the household were collected in a questionnaire
- Blood was collected into an anticoagulant and transported to the laboratory, where samples were tested for antibodies to IBD using a FlockScreen Antibody ELISA (x-OvO, Inverkeithing,UK).

Optical density is converted to a ratio to the positive control (S:P ratio). Birds with an S:P ratio > 0.285 are considered seropositive



Distribution of S:P ratios. An S:P ratio of 0.285 equates to an antibody titre of ~2400



Seroprevalence by village and season, based on a cut-off S:P ratio value of 0.285

Conclusions

- Infectious bursal disease is or has been circulating in at least seven out of the eight villages in our study.
- The association of seropositivity in a household flock with recent deaths in growers, but not chicks or adults fits with the biology of the disease, and is consistent with IBDV contributing to mortality in this population.
- All seropositive birds had moderate to high antibody levels to *Salmonella,* which makes it unlikely that they were infected as chicks. It is probable that all immunosuppressed birds have died by the age of 6 months.
- The differences between and possibly within villages highlights the need for control strategies to be tailored to the local area, with regard to regional differences in the socio-economic importance of poultry, rather than blanket measures applied.

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