

Transmission dynamics of an antimicrobial resistant *Campylobacter jejuni* lineage in New Zealand’s commercial poultry network

Sabrina S. Greening^{a*}, Ji Zhang^{b,c}, Anne C. Midwinter^b, David A. Wilkinson^{b,c}, Ahmed Fayaz^b, Deborah A. Williamson^d, Marti J. Anderson^e, M. Carolyn Gates^a, Nigel P. French^{b,c}

Author affiliations:

^a Epicentre, School of Veterinary Science, Massey University, Palmerston North, New Zealand

^b ^mEpiLab, Infectious Disease Research Centre, School of Veterinary Science, Massey University, Palmerston North, New Zealand

^c New Zealand Food Safety Science and Research Centre, Hopkirk Research Institute, Massey University, Palmerston North, New Zealand

^d Microbiological Diagnostic Unit and Public Health Laboratory, University of Melbourne, Parkville, Victoria, Australia

^e New Zealand Institute for Advanced Study, Massey University, Auckland, New Zealand

* Author for correspondence. Email: S.Greening@massey.ac.nz

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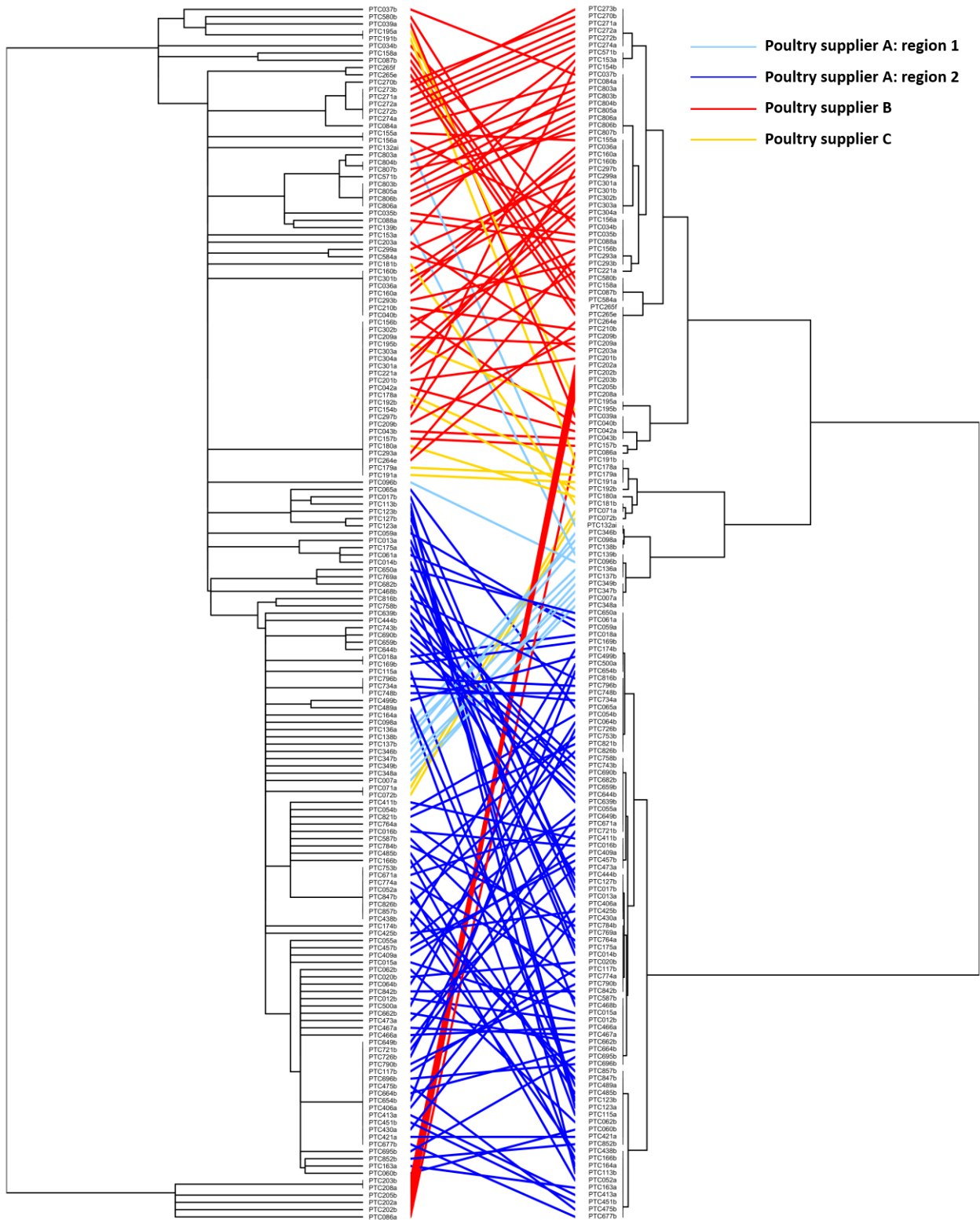
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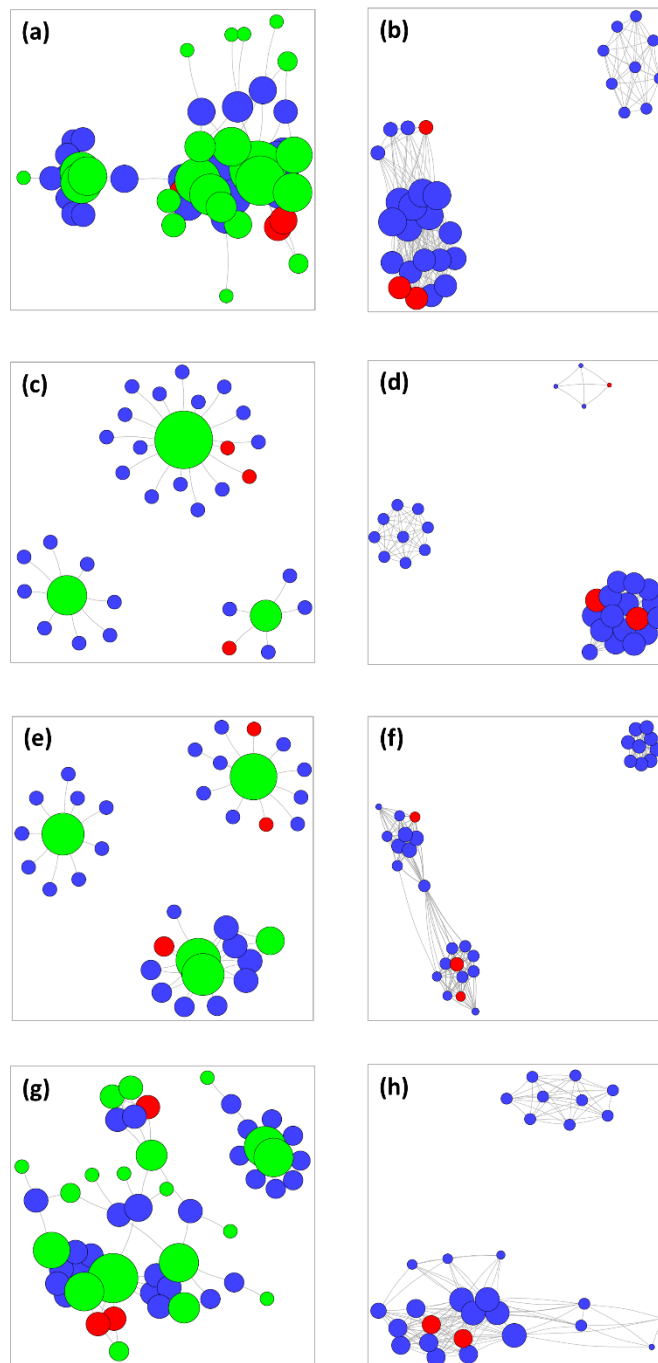
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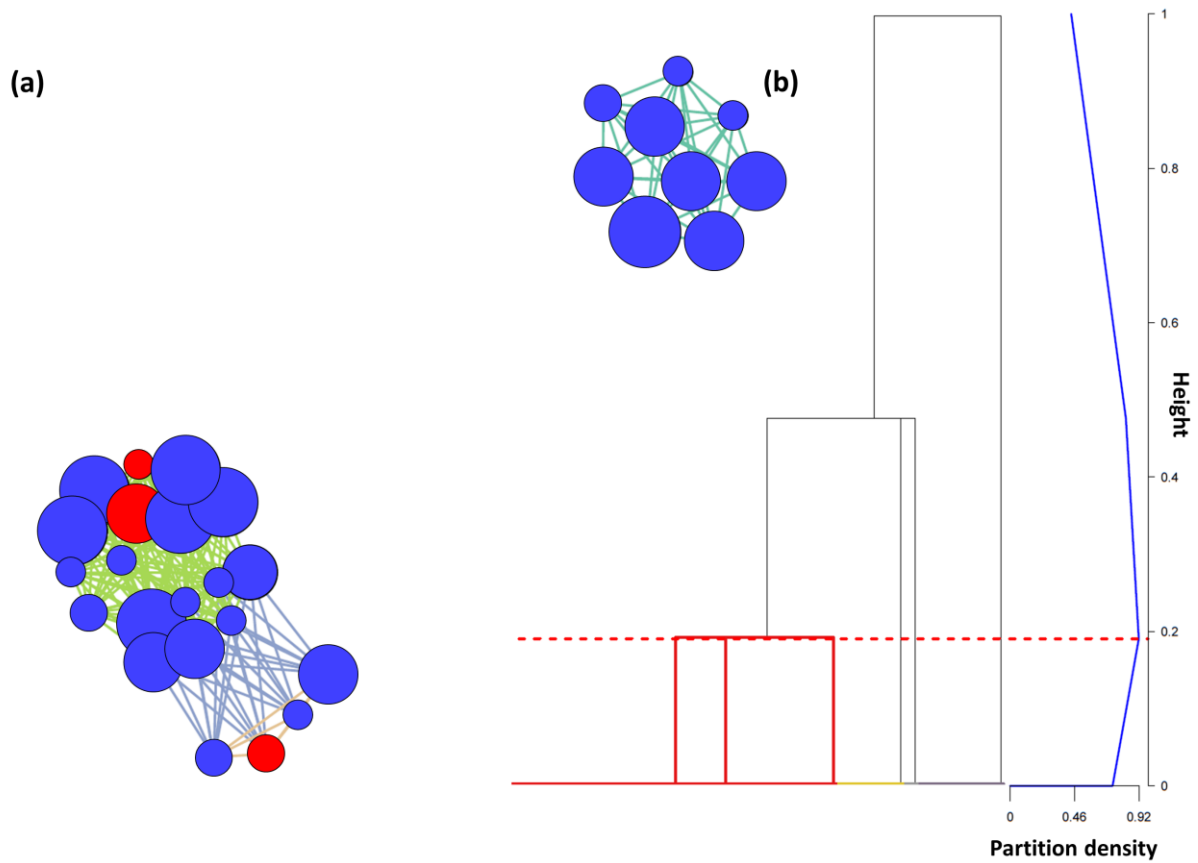
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Supplementary Figure 2. Imputed unimodal network graphs (left) and corresponding bimodal network graphs (right) showing (a, b) all on- and off-farm movements relating to feed, live birds, hatching eggs, waste or new and used litter between New Zealand commercial poultry farms ($n = 30$). Movements have been sub-divided so that the network graphs (c and d) show only movements relating to feed, (e and f) show only movements relating to live birds and hatching eggs and (g and h) show only movements relating to waster and litter. The node colour indicates the type of node (green: transporting company, blue: poultry grower, red: poultry breeder) whilst the node size is proportional to node degree centrality measure.



Supplementary Figure 3. (a) Network graph showing the four link communities identified and (b) the hierarchical cluster dendrogram used to define the cut-off point for community extraction (0.92). Network edges are coloured by the community they belong to whilst nodes are coloured according to the type of poultry enterprise (blue: poultry grower, red: poultry breeder) with size proportional to their node degree centrality measure.



Supplementary Table 1. PERMANOVA model comparing the allelic dissimilarity between 167 *C. jejuni* isolates by parent company (n = 3) and farm (nested within parent company) (n = 30) with *p*-values for each test obtained using 9999 unrestricted permutations. “SS” provides the sum of squares, “MS” the mean squares, and “*df*” the degrees of freedom for each test.

	<i>df</i>	SS	MS	Pseudo- <i>F</i>	<i>p</i> -value
Parent company	2	24308	12154	11.807	0.0001
Farm	27	26554	983.47	3.2949	0.0001
Residuals	137	40891	298.48		
Total	166	91753			

Supplementary Table 2. Resemblance matrix considering the relationship between the allelic dissimilarity matrix and six additional matrix models indicating the network distance, geographical distance and shared parent companies between 167 *C. jejuni* isolates. The matrix was obtained using the Primer (v7.0.) 2STAGE routine using methods described in Anderson et al (2017).

	Allelic dissimilarity	Euclidean distance	Feed network	Live birds network	Parent company	Road distance	Waste network
Allelic dissimilarity	-						
Euclidean distance	0.580	-					
Feed network	0.632	0.869	-				
Live birds network	0.623	0.895	0.941	-			
Parent company	0.438	0.597	0.762	0.744	-		
Road distance	0.584	0.988	0.869	0.905	0.597	-	
Waste network	0.614	0.890	0.940	0.973	0.723	0.899	-

Supplementary Table 3. Resemblance matrix considering the relationship between the residual allelic dissimilarity matrix, after removing the effects of parent company and farms nested within parent company) and five additional matrix models indicating the network distance and geographical distance between 167 *C. jejuni* isolates. The matrix was obtained using the Primer (v7.0.) 2STAGE routine using methods described in Anderson et al (2017).

	Residual allelic dissimilarity	Euclidean distance	Feed network	Live birds network	Road distance	Waste network
Residual allelic dissimilarity	-					
Euclidean distance	-0.024	-				
Feed network	0.040	0.869	-			
Live birds network	0.001	0.895	0.941	-		
Road distance	-0.005	0.988	0.869	0.905	-	
Waste network	0.005	0.890	0.940	0.973	0.899	-

Supplementary Table 4. PERMANOVA model comparing the allelic distance between 125 *C. jejuni* isolates by parent company (n = 3) and farm (nested within parent company) (n = 16) with *p*-values for each test obtained using 9999 unrestricted permutations. “SS” provides the sum of squares, “MS” the mean squares, and “*df*” the degrees of freedom for each test.

	<i>df</i>	SS	MS	Pseudo- <i>F</i>	<i>p</i> -value
Parent company	2	11531	11531	9.6467	0.0002
Farm	13	16931	1302.4	3.9195	0.0001
Residuals	109	36219	332.28		
Total	124	76211			

Supplementary Table 5. Spearman’s rank matrix correlation (*rho*) between each model matrix and (i) the allelic dissimilarity matrix between 125 *C. jejuni* isolates and (ii) the residual allelic dissimilarity matrix after fitting the ANOVA factors of parent company (n = 3) and farm (n = 16) nested within parent company, with *p*-values obtained using 9999 permutations.

	(i) Unconstrained matrix		(ii) Residual matrix	
	<i>rho</i>	p-value	<i>rho</i>	p-value
Feed	0.665	0.0001	0.084	0.0263
Live birds	0.665	0.0001	0.076	0.0318
Waste	0.674	0.0001	0.108	0.0085
Road distance	0.609	0.0001	0.022	0.3162
Euclidean distance	0.603	0.0001	-0.017	0.6146
Parent company	0.573	0.0001	-	-

Supplementary Table 6. Individual distance-based redundancy analysis (dbRDA) models to explain variation in allelic dissimilarities among 125 *C. jejuni* isolates in response to each of two ANOVA factors (parent company or farm nested in parent company) or sets of regression coordinates corresponding to the geographic position (Euclidean distance or road distance) or the network model matrices of interest (feed, live birds or waste), with *p*-values for each of these separate marginal tests obtained using 9999 unrestricted permutations. “Prop” gives the proportion of the total variation explained whilst “*df*” gives the numerator (regression) and denominator (residual) degrees of freedom for the test. Models have been presented in order of decreasing R^2 values.

	Prop.	Pseudo-<i>F</i>	<i>df</i>	<i>p</i>-value
Parent Company	0.3026	26.47	3, 122	0.0001
Farm	0.5248	8.02	16, 109	0.0001
Euclidean distance	0.3539	33.42	3, 122	0.0001
Road distance	0.4128	28.35	4, 121	0.0001
Feed	0.3236	19.30	4, 121	0.0001
Live birds	0.2996	26.10	3, 122	0.0001
Waste	0.2898	24.89	3, 122	0.0001

Supplementary Table 7. Distance-based redundancy analysis (dbRDA) to explain variation in allelic dissimilarities among 125 *C. jejuni* isolates in response to the factors and sets of regressors listed in Table S6, but here conditional tests were done in a sequential step-wise fashion under forward selection based on R^2 . Each test used 9999 permutations of residuals under a reduced model. “Prop” gives the proportion of additional variation explained by adding that set of variables to the model, “Cumul” tracks the cumulative explained variation with each added step, and “*df*” provides the regression and residual degrees of freedom.

Step		Prop.	Cumul.	<i>df</i>	Pseudo-<i>F</i>	<i>p</i>-value
1	+Farm	0.5248	0.5248	16, 109	8.024	0.0001
2	+Road	0.0286	0.5533	19, 106	2.260	0.0624
3	+Feed	0.0222	0.5755	22, 103	1.792	0.1267
4	+Live birds	0.0064	0.5818	24, 101	0.767	0.5288
5	+Euclidean	0.0041	0.5859	26, 99	0.490	0.6234
6	+Waste	0.0026	0.5886	28, 97	0.309	0.9057
7	+Parent company	<0.0001	0.5886	28, 97	-	-

Supplementary Table 8. Top four dbRDA models obtained on the basis of the multivariate analogue to the Akaike Information Criterion (AIC) to explain variation in allelic dissimilarities among 125 *C. jejuni* isolates. Two ANOVA factors (parent company (n = 3) and farms (n = 16) nested in parent company) were included in all potential models *a priori*.

Model selections	R^2	No. Sets	AIC
Feed network, road distance, parent company and farm	0.5755	4	738.52
Road distance, parent company and farm	0.5533	3	738.88
Parent company and farm	0.5248	2	740.63
Feed network, live bird network, road distance, parent company and farm	0.5818	5	740.64

Supplementary Table 9. PERMANOVA model comparing the p-distance between 167 *C. jejuni* isolates by parent company (n = 3) and farms nested within parent company (n = 30) with *p*-values for each test obtained using 9999 unrestricted permutations. “SS” provides the sum of squares, “MS” the mean squares, and “*df*” the degrees of freedom for each test.

	<i>df</i>	SS	MS	Pseudo- <i>F</i>	<i>p</i> -value
Parent company	2	33.159	0.0366	33.159	0.0001
Farm	27	0.0285	0.0011	3.4202	0.0001
Residuals	137	0.0423	0.0003		
Total	166	0.1440			

Supplementary Table 10. Spearman’s rank matrix correlation (*rho*) between each model matrix and (i) the p-distance matrix between 167 *C. jejuni* isolates and (ii) the residual p-distance matrix after fitting the ANOVA factors of parent company (n = 3) and farm (n = 30) nested within parent company, with p-values obtained using 9999 permutations.

	(i) Unconstrained matrix		(ii) Residual matrix	
	<i>rho</i>	<i>p-value</i>	<i>rho</i>	<i>p-value</i>
Feed	0.663	0.0001	0.059	0.0061
Live birds	0.640	0.0001	0.006	0.2738
Waste	0.624	0.0001	-0.003	0.5766
Road distance	0.559	0.0001	0.011	0.3364
Euclidean distance	0.559	0.0001	0.013	0.3160
Parent company	0.499	0.0001	-	-

Supplementary Table 11. Individual distance-based redundancy analysis (dbRDA) models to explain variation in the p-distance matrix among 167 *C. jejuni* isolates in response to each of two ANOVA factors (parent company or farm nested in parent company) or sets of regression coordinates corresponding to the geographic position (Euclidean distance or road distance) or the network model matrices of interest (feed, live birds or waste), with *p*-values for each of these separate marginal tests obtained using 9999 unrestricted permutations. “Prop” gives the proportion of the total variation explained whilst “*df*” gives the numerator (regression) and denominator (residual) degrees of freedom for the test. Models have been presented in order of decreasing R^2 values.

	Prop.	Pseudo-<i>F</i>	<i>df</i>	<i>p</i>-value
Parent Company	0.5088	84.95	3, 164	0.0001
Farm	0.1978	1.269	28, 139	0.1251
Euclidean distance	0.5881	117.1	3, 164	0.0001
Road distance	0.5869	77.19	4, 163	0.0001
Feed	0.5966	80.36	4, 163	0.0001
Live birds	0.5353	94.46	3, 164	0.0001
Waste	0.5249	90.59	3, 164	0.0001

Supplementary Table 12. Distance-based redundancy analysis (dbRDA) to explain variation in the p-distance matrix among 167 *C. jejuni* isolates in response to the factors and sets of regressors listed in Table S11, but here conditional tests were done in a sequential step-wise fashion under forward selection based on R^2 . Each test used 9999 permutations of residuals under a reduced model. “Prop” gives the proportion of additional variation explained by adding that set of variables to the model, “Cumul” tracks the cumulative explained variation with each added step, and “*df*” provides the regression and residual degrees of freedom.

Step		Prop.	Cumul.	<i>df</i>	Pseudo-<i>F</i>	<i>p</i>-value
1	+Feed	0.5966	0.5966	4, 163	80.36	0.0001
2	+Farm	0.1094	0.7060	31, 136	1.874	0.0062
3	+Road	0.0122	0.7182	34, 133	1.912	0.0724
4	+Parent company	0.0064	0.7246	36, 131	1.526	0.1740
5	+Live birds	0.0037	0.7283	38, 129	0.884	0.4970
6	+Euclidean	0.0034	0.7318	40, 127	0.816	0.4330
7	+Waste	0.0018	0.7336	42, 125	0.429	0.8435

Supplementary Table 13. Top four dbRDA models obtained on the basis of the multivariate analogue to the Akaike Information Criterion (AIC) to explain variation in the p-distance matrix among 167 *C. jejuni* isolates. Two ANOVA factors (parent company (n = 3) and farms (n = 30) nested in parent company) were included in all potential models *a priori*.

Model selections	<i>R</i>²	No. Sets	AIC
Road distance, parent company and farm	0.7202	3	-1325.0
Euclidean distance, road distance, parent company and farm	0.7239	4	-1323.3
Parent company and farm	0.7066	2	-1323.1
Live birds, road distance, parent company and farm	0.7237	4	-1323.1

Supplementary Table 14. PERMANOVA model comparing the p-distance between 125 *C. jejuni* isolates by parent company (n = 3) and farms nested within parent company (n = 16) with *p*-values for each test obtained using 9999 unrestricted permutations. “SS” provides the sum of squares, “MS” the mean squares, and “*df*” the degrees of freedom for each test.

	<i>df</i>	SS	MS	Pseudo- <i>F</i>	<i>p</i> -value
Parent company	2	0.049461	0.02473	21.913	0.0001
Farm	13	0.015983	0.001229	3.8939	0.0001
Residuals	109	0.034415	0.000316		
Total	124	0.099859			

Supplementary Table 15. Spearman’s rank matrix correlation (ρ) between each model matrix and (i) p-distance matrix between 125 *C. jejuni* isolates and (ii) the p-distance matrix after fitting the ANOVA factors of parent company ($n = 3$) and farm ($n = 16$) nested within parent company, with p-values obtained using 9999 permutations.

	(i) Unconstrained matrix		(ii) Residual matrix	
	<i>rho</i>	<i>p-value</i>	<i>rho</i>	<i>p-value</i>
Feed	0.649	0.0001	-0.039	0.8238
Live birds	0.647	0.0001	-0.066	0.9719
Waste	0.630	0.0001	-0.084	0.9862
Road distance	0.579	0.0001	-0.065	0.9120
Euclidean distance	0.575	0.0001	-0.065	0.8982
Parent company	0.540	0.0001	-	-

Supplementary Table 16. Individual distance-based redundancy analysis (dbRDA) models to explain variation in the p-distance matrix among 125 *C. jejuni* isolates in response to each of two ANOVA factors (parent company or farm nested in parent company) or sets of regression coordinates corresponding to the geographic position (Euclidean distance or road distance) or the network model matrices of interest (feed, live birds or waste), with *p*-values for each of these separate marginal tests obtained using 9999 unrestricted permutations. “Prop” gives the proportion of the total variation explained whilst “*df*” gives the numerator (regression) and denominator (residual) degrees of freedom for the test. Models have been presented in order of decreasing R^2 values.

	Prop.	Pseudo-<i>F</i>	<i>df</i>	<i>p</i>-value
Parent Company	0.4953	59.87	3, 122	0.0001
Farm	0.6554	13.82	16, 109	0.0001
Euclidean distance	0.5466	73.54	3, 122	0.0001
Road distance	0.5445	48.21	4, 121	0.0001
Feed	0.5489	49.07	4, 121	0.0001
Live birds	0.5393	71.40	3, 122	0.0001
Waste	0.5264	67.79	3, 122	0.0001

Supplementary Table 17. Distance-based redundancy analysis (dbRDA) to explain variation within the p-distance matrix among 125 *C. jejuni* isolates in response to the factors and sets of regressors listed in Table S6, but here conditional tests were done in a sequential step-wise fashion under forward selection based on R^2 . Each test used 9999 permutations of residuals under a reduced model. “Prop” gives the proportion of additional variation explained by adding that set of variables to the model, “Cumul” tracks the cumulative explained variation with each added step, and “*df*” provides the regression and residual degrees of freedom.

Step		Prop.	Cumul.	<i>df</i>	Pseudo-F	p-value
1	+Farm	0.6554	0.6554	16, 109	13.82	0.0001
2	+Road	0.0270	0.6824	19, 106	3.006	0.0136
3	+Feed	0.0156	0.6979	22, 103	1.768	0.1245
4	+Euclidean	0.0057	0.7036	24, 101	0.965	0.3933
5	+Live birds	0.0031	0.7067	26, 99	0.519	0.7823
6	+Waste	0.0021	0.7088	28, 97	0.348	0.8770

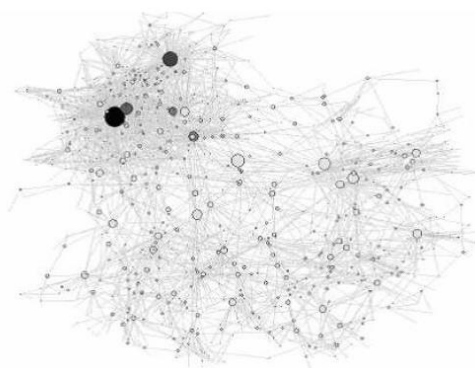
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Model selections	R^2	No. Sets	AIC
Feed network, road distance, parent company and farm	0.6979	4	-997.18
Road distance, parent company and farm	0.6824	3	-996.90
Euclidean distance, Feed network, road distance, parent company and farm	0.7036	5	-995.55
Live bird network, road distance, parent company and farm	0.6884	4	-995.29

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CONTACT STRUCTURES IN THE NEW ZEALAND COMMERCIAL POULTRY INDUSTRY



Dear Producer,

We are conducting a survey to describe the extent and nature of contacts between commercial farms in the New Zealand poultry industry. Specifically, we are interested in contacts made through the sale of feed, transportation of live poultry and poultry products, regular visits made by industry personnel, and the movement of waste products such as manure, litter and dead birds.

Why are we conducting this survey?

Contacts are an important means by which diseases can spread from farm to farm. There have been many changes in the poultry industry since the last contact survey was conducted in 2006. We want to know how these changes have impacted your risk of getting disease from other farms and how we can better help to protect your livelihoods.

How will we use the survey information?

We will use this data to reconstruct the industry contact network and develop simulation models to predict how diseases like Avian Influenza and Campylobacter may spread.

Confidentiality

All information will be treated as strictly confidential and no information will be used in any way that could reasonably be expected to identify individual persons, practices or organisations.

The study results will only be useful if **all** producers take part. We greatly appreciate your valuable time in completing the survey questions.

Sincerely,

Dr. Carolyn Gates
Massey University

Thank You!



Massey University



Ministry for Primary Industries
Manatū Ahu Matua



This research study is being conducted by the EpiCentre at Massey University and is fully endorsed by the Poultry Industry Association of New Zealand (PIANZ) and the Egg Producers Federation of New Zealand (EPF) with support from the Ministry for Primary Industries.

INSTRUCTIONS

Please read carefully before beginning the survey

In this questionnaire, we would like you to think about individuals and companies that have visited your farm (e.g. to supply or remove birds, goods or products) throughout the past year. We use the term **farm** to refer to facilities where birds or eggs are kept under a common system of management. In most situations, a farm will be a single physical location. Sometimes a farm may be made up of several distinct physical locations in close proximity, which we call **sites** (see Section 1.3).

For each **farm**, you will be asked to fill out information on:

Farm Demographics

1. Enterprise and farm details
2. Farm capacity and management

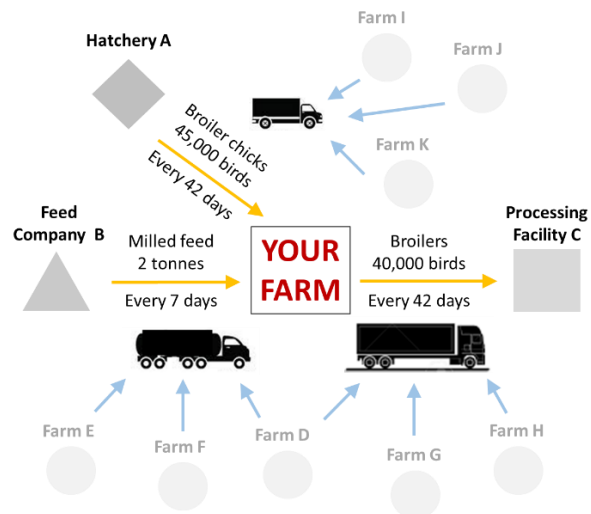
Routine Contacts

3. Transport companies
4. Feed companies
5. Live birds and hatching eggs
6. Table eggs and poultry products
7. Regular movements of personnel
8. Manure, litter, and dead birds

Other Information

9. Biosecurity risks
10. Additional feedback

How many farms are you in contact with?



We will need to link data from all survey respondents to create the final industry contact network so it is important that you provide us with as much accurate detail as possible about the identity of individuals and companies that have visited your farm. Once the study has been completed, you will be provided with a risk map similar to the figure above showing the number of direct (yellow) and indirect (blue) connections to your farm. The identity of the indirect connections will be hidden in the figure to preserve confidentiality.

Returning the questionnaire

Please return the questionnaire using the prepaid addressed envelope provided.

Questions

If you have any questions or concerns about completing the questionnaire or participating in the study, please contact:

Carolyn Gates

Massey University
Institute of Veterinary, Animal and Biomedical Science (IVABS)
Private Bag 11-222 Palmerston North 4442
Tel: (06) 951 8140
Email: c.gates@massey.ac.nz

1. ENTERPRISE AND FARM DETAILS

1.1. Details of the person filling in this questionnaire

Name	
Position	

1.2. Farm contact details

Name	
Street or PO Box number	
Town	
Phone (business)	
Phone (home)	
Phone (mobile)	
Facsimile	
Email	
Parent company (if applicable) ^a	

^a A parent company refers to the organisation that owns birds that are raised on one or more farms. Tegel Foods Limited, for example, would be referred to as a parent company.

1.3. Farm location details	Address (town or city only)	Agribase ^b (if present)	Farms Online ID ^c (if present)
Main site (1)			
Other site (2)			
Other site (3)			
Other site (4)			
Other site (5)			

^{b,c} We will only use this information to determine the spatial location of your farm so that we can report how many other commercial farms are in close proximity.

1.4. What type(s) of commercial poultry operation do you run on the farm?

If more than one type of commercial poultry operation is present, please indicate approximately what % each contributes to your total farm production.

	Present? (check all that apply)	% of total farm production
Commercial - Breeder	<input type="checkbox"/>	
Commercial - Layer hens	<input type="checkbox"/>	
Commercial - Pullets	<input type="checkbox"/>	
Commercial - Broilers	<input type="checkbox"/>	
Commercial - Turkeys	<input type="checkbox"/>	
Commercial - Hatchery	<input type="checkbox"/>	
Commercial - Ducks	<input type="checkbox"/>	
	Total	100%
Other (e.g. emu, ostrich, aviary birds)– please specify types and numbers of such birds.		

2. FARM CAPACITY AND MANAGEMENT

2.1. Over the past year, on average, how many live birds (or fertile eggs for hatcheries) were typically housed on the farm at any given time?

Please also indicate (a) the total number of sheds in which these birds were housed, (b) the average number of birds per shed, and (c) the total combined housing capacity of all sheds present on the farm.

Species	Approximate number of live birds (or fertile eggs)	(a) Total number of sheds	(b) Average shed capacity	(c) Total farm capacity
Layers				
Pullets				
Hatchery only (give fertile egg numbers)				
Broilers (when birds present)				
Turkeys				
Ducks				

2.2. How would you describe the typical flow of live birds (or fertile eggs for hatcheries) on and off farm?

Please indicate (a) if the management for the poultry species is all-in-all-out OR if multiple age classes are present at the same time, (b) the average length of the production cycle (#) specifying the **time units** in days, weeks, or months (i.e. 42 days), and (c) the average time that sheds are left empty before new birds (or fertile eggs) are introduced (#) specifying the **time units** in days, weeks, or months (i.e. 1 week).

Species	(a) Flow of birds (choose one)		(b) Length of production cycle		(c) Downtime between cycles	
	All-in-all-out	Multiple age classes	#	Time units	#	Time units
Layers	<input type="checkbox"/>	<input type="checkbox"/>				
Pullets	<input type="checkbox"/>	<input type="checkbox"/>				
Hatchery only (give fertile egg numbers)	<input type="checkbox"/>	<input type="checkbox"/>				
Broilers	<input type="checkbox"/>	<input type="checkbox"/>				
Turkeys	<input type="checkbox"/>	<input type="checkbox"/>				
Ducks	<input type="checkbox"/>	<input type="checkbox"/>				

2.3. Which of the following best describes your (a) current housing type and (b) intended housing type to comply with regulatory changes by 2022.

	(a) Current	(b) Future
Free range housing	<input type="checkbox"/>	<input type="checkbox"/>
Colony housing	<input type="checkbox"/>	<input type="checkbox"/>
Barn housing	<input type="checkbox"/>	<input type="checkbox"/>
I do not intend to produce after 2022		<input type="checkbox"/>

3. TRANSPORT COMPANIES

In this question, we are interested in knowing which transport companies and/or individuals have conveyed poultry or poultry related products (including eggs, feed, manure and dead birds) onto or off your farm during the past year.

For movements ONTO and OFF farm, please indicate the town or city of origin for the transporter (i.e. if Company A transported poultry from your farm to a processing plant and the company's depot was in Wanganui, list Wanganui as the address of origin of the transporter).

3.1. Please list the name and location details of individuals or companies that transported poultry or poultry-related product ONTO or OFF your farm over the last 12 months (in order of importance based on frequency of contacts). For part (d), please indicate the category number from the list below the table. For part (e), please indicate the average time interval between two consecutive contacts. For part (f), please indicate how much product is transferred with an average contact.

Example: Transport company X from Wellington transports 3000 adult birds onto your farm once every 40 days.

(a) Name	(b) Direction of transport (select one) Onto Off		(c) Origin address (town or city only)	(d) Category **	(e) Average time interval between two consecutive contacts		(f) How much poultry or poultry product is transferred?	
					Time Interval	Units	Quantity	Units
<i>Example: Transport company X</i>	X	<input type="checkbox"/>	<i>Wellington</i>	<i>3</i>	<i>40</i>	<i>days</i>	<i>3000</i>	<i>birds</i>
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						

** Categories include those who transport:

- | | | | |
|--------------------|---|------------------------|----------------------------|
| (1) Feed. | (3) Day old chicks, pullets, and adult birds. | (5) Poultry product. | (7) Dead birds. |
| (2) Hatching eggs. | (4) Table eggs. | (6) Manure and litter. | (8) Broilers for slaughter |

4. FEED COMPANIES

In this question, we are interested in the origin of feed that is used on your farm and the destination of feed that might be sent from your farm to another location. In the majority of cases, there will only be a one-way flow of feed onto a farm. However, if feed is ever sold onwards or returned to a distributor, we would also like to know.

In each case, please indicate the town or city of origin (or destination) of the feed. For example, if you purchased feed from Company B whose depot was in Napier, give Napier as the address of the feed supplier.

4.1. Please list the name and location details of individuals or companies that moved feed ONTO your farm or received feed moved OFF your farm over the last 12 months (in order of importance based on frequency of contacts). For part (d), please indicate the category number from the list below the table. For part (e), please indicate the average time interval between two consecutive contacts. For part (f), please indicate how much product is transferred with an average contact.

Example: Feed company A from Nelson moves 20 tonnes of bagged feed onto your farm every 25 days.

(a) Name	(b) Direction of transport (select one) Onto Off		(c) Origin or destination address (town or city only)	(d) Category **	(e) Average time interval between two consecutive contacts		(f) How much poultry or poultry product is transferred?	
					Time interval	Units	Quantity	Units
<i>Example: Feed company A</i>	X	<input type="checkbox"/>	<i>Nelson</i>	2	25	<i>days</i>	20	<i>tonnes</i>
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						

** Categories include:

(1) Milled feed.

(3) Home mix.

(5) Others

(2) Bagged feed.

(4) Combination of bought in and home mixed feed.

5. LIVE BIRDS AND HATCHING EGGS

In this question we are interested in the origin of live birds (including day-old chicks and point-of-lay pullets) and/or hatching eggs that came onto your farm and the destination of live birds (including broilers for processing, end-of-lay birds) and/or hatching eggs were sent from your farm to another location.

5.1. Please list the name and location details of individuals or companies that moved live birds and/or hatching eggs ONTO your farm or received live birds and/or hatching eggs moved OFF your farm over the last 12 months (in order of importance based on frequency of contacts). For part (d), please indicate the category number from the list below the table. For part (e), please indicate the average time interval between two consecutive contacts. For part (f), please indicate how much product is transferred with an average contact.

Example: 2500 adult broilers birds are moved to Processor Z in Hamilton from your farm every 42 days.

(a) Name	(b) Direction of transport (select one)		(c) Origin or destination address (town or city only)	(d) Category **	(e) Average time interval between two consecutive contacts		(f) How much poultry or poultry product is transferred?	
	Onto	Off			Time interval	Units	Quantity	Units
<i>Example: Processor Z</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<i>Hamilton</i>	<i>4</i>	<i>42</i>	<i>days</i>	<i>2500</i>	<i>birds</i>
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						

**** Categories include:**

(1) Hatching eggs.

(2) Day old chicks.

(3) Pullets.

(4) Adult birds.

6. TABLE EGGS AND POULTRY PRODUCTS

In this question we are interested in the origin of table eggs and/or poultry product (e.g. dressed chickens) that came onto your farm and the destination of table eggs and/or poultry product that was sent from your farm to another location.

6.1. Please list the name and location details of individuals or companies that moved table eggs and/or poultry products ONTO your farm or received table eggs and/or poultry products moved OFF your farm over the last 12 months (in order of importance based on frequency of contacts). For part (d), please indicate the category number from the list below the table. For part (e), please indicate the average time interval between two consecutive contacts. For part (f), please indicate how much product is transferred with an average contact.

Example: 10 kg of poultry feathers are moved to Processor ABC in Wellington from your farm every 3 months.

(a) Name	(b) Direction of transport (select one) Onto Off		(c) Origin or destination address (town or city only)	(d) Category **	(e) Average time interval between two consecutive contacts		(f) How much poultry or poultry product is transferred?	
					Time interval	Units	Quantity	Units
<i>Example: Processor ABC</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<i>Wellington</i>	<i>3</i>	<i>3</i>	<i>months</i>	<i>10</i>	<i>kg</i>
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						

**** Categories include:**

(1) Table eggs.

(2) Poultry product.

(3) Feathers and/or offal

7. REGULAR MOVEMENTS OF PERSONNEL

In this question, we are interested in the movement of people associated with the poultry industry onto your farm and the destination of permanent members of your farm staff to other locations where poultry are present. We are not interested in details of every single movement, only those that occur on a regular basis (e.g. routine visits by advisors, contractors, and personnel from other premises where poultry are kept).

7.1. Please list the name and location details of those permanent staff members who made an ON FARM or OFF FARM visit to other locations where poultry were present over the last 12 months (in order of importance). For part (a), please indicate the category number from the list below the table. For part (c), please indicate the average time interval between two consecutive contacts.
Example: A veterinarian based in Tauranga visits your farm for regular health inspections once every month.

(a) Category**	(b) Origin or destination address (town or city only)	(c) Average time interval between two consecutive contacts	
		Time interval	Units
<i>Example: 1</i>	<i>Tauranga</i>	<i>1</i>	<i>month</i>

**** Categories include:**

- | | | |
|--|--|--|
| (1) Veterinarians, advisors, industry representatives. | (3) Permanent employees on your farm | (5) Individuals from premises where non-commercial poultry are kept. |
| (2) Contractors (those having direct contact with poultry sheds or equipment e.g. cleaning and maintenance crews). | (4) Individuals from premises where commercial poultry are kept. | |

8. NEW LITTER, MANURE/USED LITTER, AND DEAD BIRDS

In this question, we would like to know about the movement of manure/used litter, and dead birds to and from your farm. In the majority of cases, there will be a one-way flow of manure/used litter and dead birds off the farm, but there may also include the movement of new litter to the farm. We use the term “dead birds” here to refer to those birds that have died on site.

8.1. Please list the name and location details of individuals or companies that moved new litter, manure/used litter, or dead birds ONTO your farm or new litter, manure/used litter, or dead birds moved OFF your farm over the last 12 months (in order of importance). For part (d), please indicate the category number from the list below the table. For part (e), please indicate the average time interval between two consecutive contacts. For part (f), please indicate how much product is transferred with an average contact.

Example: 100 kgs of manure are moved to Company ABC of Napier from your farm every 45 days.

(a) Name	(b) Direction of transport (select one)		(c) Origin or destination address (town or city only)	(d) Category **	(e) Average time interval between two consecutive contacts		(f) How much product is transferred?	
	Onto	Off			Time gap	Units	Quantity	Units
<i>Example: Company ABC</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<i>Napier</i>	<i>2</i>	<i>45</i>	<i>days</i>	<i>100</i>	<i>kg</i>
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						
	<input type="checkbox"/>	<input type="checkbox"/>						

**** Categories include:**

- (1) Dead birds. (2) Manure /used litter. (3) New Litter

9. BIOSECURITY RISKS

9.1. Please answer the following questions about the workers on your farm.

How many full-time workers are present?		
How many part-time workers are present?		
Workers are assigned to (select one):	<input type="checkbox"/> Whole farm	<input type="checkbox"/> Specific sheds

9.2. Which of the following biosecurity measures are implemented on your property?

Please indicate how frequently they are implemented.

	Never	Rarely	Sometimes	Often	Always
Vehicle disinfection before entering farm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dedicated clean coveralls for each shed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dedicated boots or boot covers worn for each shed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Footbaths at shed entrances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Monitored rat and mouse bait stations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bird-proofed housing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bird-proofed feed storage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9.3. Which of the following equipment is shared with other farms?

Choose all that apply. For part (b), please indicate whether the shared equipment is cleaned and disinfected between farms.

	(a) Equipment	(b) Is the equipment cleaned and disinfected between farms?
Vehicles and trailers	<input type="checkbox"/>	<input type="checkbox"/> No <input type="checkbox"/> Yes
Gates and panels	<input type="checkbox"/>	<input type="checkbox"/> No <input type="checkbox"/> Yes
Lawn mowers	<input type="checkbox"/>	<input type="checkbox"/> No <input type="checkbox"/> Yes
Pressure sprayers / washers	<input type="checkbox"/>	<input type="checkbox"/> No <input type="checkbox"/> Yes
Skid steer loaders (tractors with buckets for cleaning out sheds)	<input type="checkbox"/>	<input type="checkbox"/> No <input type="checkbox"/> Yes
Other equipment	<input type="checkbox"/>	<input type="checkbox"/> No <input type="checkbox"/> Yes

9.4. Please answer the following questions about the water supply on your farm.

Select ONE option for each question

What is the main source of drinking water for poultry on your farm?	<input type="checkbox"/> Town supply <input type="checkbox"/> River <input type="checkbox"/> Bore <input type="checkbox"/> Other, please specify:
How is the drinking water treated?	<input type="checkbox"/> No treatment <input type="checkbox"/> Chlorine dioxide <input type="checkbox"/> Ultraviolet <input type="checkbox"/> Other, please specify:

9.5. Please answer the following questions about litter management on your farm.

What type of litter do you use?		
Is a litter shed present?	<input type="checkbox"/> No	<input type="checkbox"/> Yes
How often are the sheds cleaned out?	<input type="checkbox"/> Partially after each run	<input type="checkbox"/> Fully after each run
What disinfectant do you use?		
How moist is the litter?	<input type="checkbox"/> Too dry	<input type="checkbox"/> About right <input type="checkbox"/> Too wet
Do you use litter treatment?	<input type="checkbox"/> No	<input type="checkbox"/> Yes, please specify:

9.6. Do you see wild birds or waterfowl (a) in the same area as poultry (e.g. within sheds or within ranges on free-range operations) or (b) on any ponds or waterways present on the farm? If you do have ponds or waterways on the farm, (c) what is the approximate distance of the ponds or waterways from the poultry sheds?

	(a) In the same area as poultry?	(b) On ponds or waterways on the farm?	(c) Approximate distance of pond or waterway from sheds (metres)
Wild birds	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> NA*	
Waterfowl	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> NA*	

* I do not have any ponds or waterways present on the farm.

If you answered yes to question (a) and/or (b), please indicate which of the following wild bird or waterfowl species are observed:

	(a)	(b)
Sparrow	<input type="checkbox"/>	<input type="checkbox"/>
Starling	<input type="checkbox"/>	<input type="checkbox"/>
Sea gull	<input type="checkbox"/>	<input type="checkbox"/>
Duck	<input type="checkbox"/>	<input type="checkbox"/>
Others (please specify):	<input type="checkbox"/>	<input type="checkbox"/>

9.7. Please answer the following questions about contact with backyard (non-commercial) poultry operations.

	No	Yes	NA
Do point-of-lay birds get sold directly to backyard flocks from your farm?	<input type="checkbox"/>	<input type="checkbox"/> *	<input type="checkbox"/>
Do end-of-lay birds get sold directly to backyard flocks from your farm?	<input type="checkbox"/>	<input type="checkbox"/> *	<input type="checkbox"/>
How many independently-owned backyard flocks are adjacent to your farm (i.e share a farm boundary)?			

*** If you answered yes to either of these questions, would you mind telling us how these birds are advertised for sale?**

10. ADDITIONAL FEEDBACK

10.1. How concerned are you about the following poultry health issues on your farm?

	Not at all concerned	Slightly concerned	Somewhat concerned	Moderately concerned	Extremely concerned
Campylobacter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Salmonella	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Avian influenza	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coccidiosis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Antibiotic resistance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Welfare	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

10.2. What would you describe as the biggest concern facing your farm?

10.3. What areas of future research would have the most benefit to your farm?

10.4. Would you be willing to participate in follow-up surveys?

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>

Thank You!

We greatly appreciate your time in filling out this survey.



Ministry for Primary Industries
Manatū Ahu Matua

