AGRI-FOOD & BIOSCIENCES INSTITUTE

Farm fragmentation metrics for cattle enterprises in Northern Ireland – *implications for epidemiology*

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Introduction

- Many farms in Northern Ireland (NI) are understood to be **highly fragmented**
- Fragmented farms consist of numerous and discontinuous land parcels (fields)
- Fragmentation may **increase exposure of cattle to neighbouring infection sources**, e.g. contiguous infected herds and diseased wildlife
- However, there is a paucity of quantitative studies which quantify farm fragmentation, or consider it as an epidemiological risk factor

Region-wide hexagon heat maps of farms and land parcels

Number of registered cattle farms

Number of land parcels

Number of farms associated with land parcels
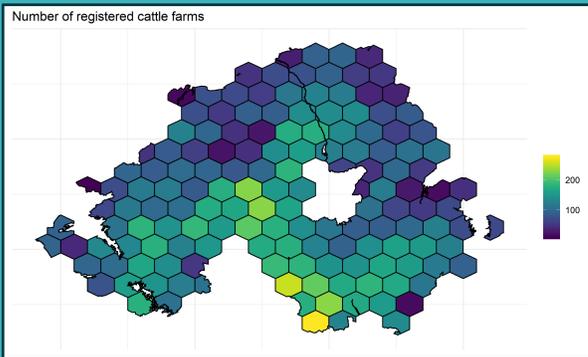
Current understanding of farm distribution

Registered cattle farms (derived from homestead lat-long) per 10km cell (N = 19,008, median farms per cell: 110; IQR:78)
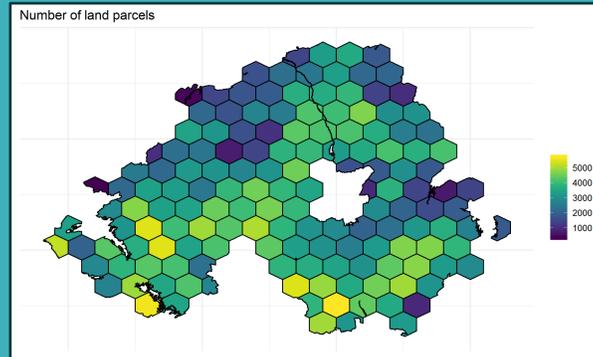
Land parcels associated with cattle farms per 10km cell (N = 487,212, median land-parcels per cell: 3304; IQR: 4034)
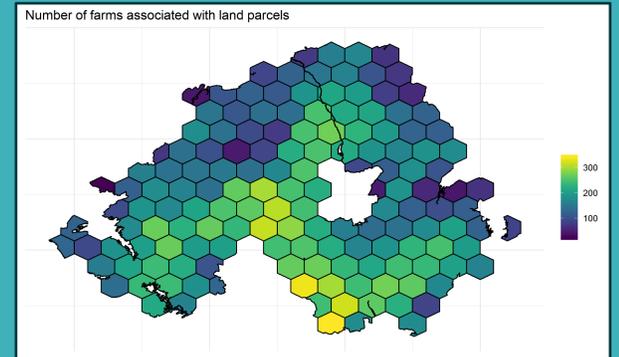
Cattle farms associated with the land parcels present per 10km cell (median farms per cell: 175; IQR: 231)

Our current understanding of farm distribution is poor; e.g. in some cells, there are more than 5000 land parcels, associated with over 200 herds. However, **farms may be associated with land parcels dispersed throughout multiple cells**. Defining the location of "farm" is not trivial

Herd level metrics of farm fragmentation

- Number of **land parcels** per farm: median 24; IQR: 25 (max = 444)
- Number of **fragments** (distinct, discontinuous clusters of land parcels) per farm: median 3; IQR: 4 (max = 47)

N fragments per farm	Description	N farms	%age farms
1	No fragmentation	3133	16.48
2-4	Little fragmentation	9119	47.97
5-7	Medium fragmentation	4137	21.76
8-10	High fragmentation	1546	8.13
11+	Very high fragmentation	1073	5.64

Distribution of farm fragmentation by farm area

- **Small Farm**
  < 0.164 km^2 (<16.4ha)

- **Medium Farm**
  >=0.164 km^2 <= 0.312 km^2 (>=16.4 ha <=31.2 ha)

- **Large Farm**
  > 0.312 km^2 (>31.2 ha)
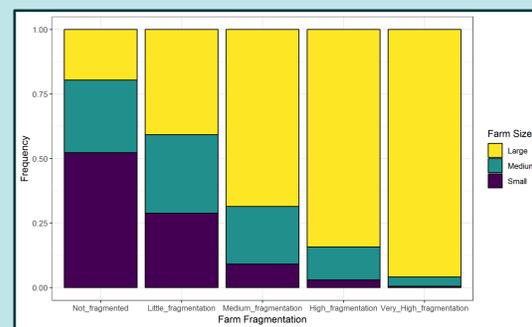
Farms that are more fragmented are also larger
(Ordinal Chi-Square: Z = 61.33; p <0.001)

Distribution of farm fragmentation by fragment dispersal

- **Low distance between fragments**
  < 0.52 km

- **Medium distance between fragments**
  >=0.52 km <= 3.04 km

- **Large distance between fragments**
  > 3.04 km
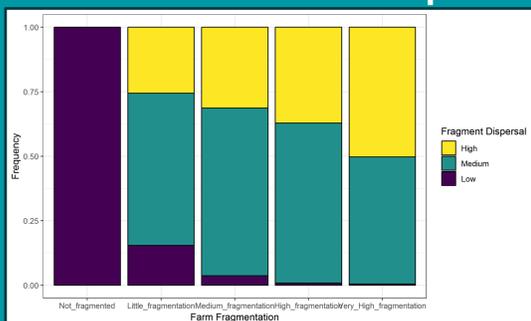
Farms that are more fragmented are also more dispersed
(Ordinal Chi-Square: Z = - 69.60; p <0.001)

Distribution of fragmentation by production type

- **Dairy** 7.9% not fragmented, 11.9% highly fragmented

- **Beef Suckler** 17.9% not fragmented, 4.75% highly fragmented

- **Beef Fattening** 24.7% not fragmented, 2.14% highly fragmented
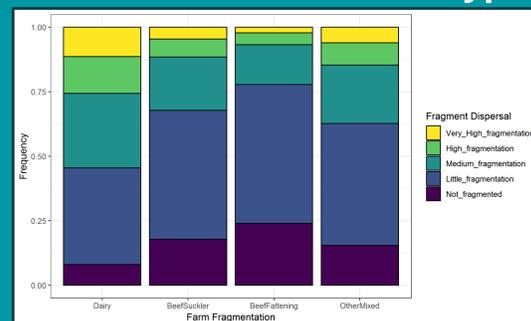
Different herd types are associated with different levels of fragmentation
(Ordinal Chi-Square: Z = 16.08; p <0.001)

Interpretation

- Cattle farms in NI are highly fragmented (35% of farms have five or more fragments) which means that **cattle herds may be vulnerable to infection from neighbouring herds.**

- Highly fragmented farms are also larger than less fragmented farms; farm area *may* be linked to other factors associated with disease e.g. herd size; **these risk factors may also be confounded with fragmentation**

- The fragments in highly fragmented farms are more widely dispersed than those in less fragmented farms, which may introduce **logistical complexities for animal testing and disease surveillance** if herds are distributed across multiple distal fragments

- Dairy farms appear to be more fragmented than beef farms, **which may be associated with animal husbandry practice, or farm diversification (as all land parcels may not be used directly by the dairy business)**

- These points form ongoing research questions