The economic impact of Johne's disease in an Irish dairy herd: A case study

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Abstract

An epidemiological investigation, examining the economic impact of Johne's disease in an Irish dairy herd, concluded that infection was introduced into the herd in 1993 with the importation of 20 Dutch heifers. The practice of feeding pooled colostrum and milk was considered to have disseminated *Mycobacterium avium* subspecies *paratuberculosis* (MAP) widely throughout the herd. Farm performance declined substantially between 1993 and 2003, as a result of reduced milk yields, increased culling and reduced cull cow values. This negatively impacted on the profit margin per litre milk sold and per cow. The performance relative to a group of 25 to 30 peers also deteriorated over the study period. Farm performance was superior to that of its peer group until the late 1990s, but was markedly worse by 2002. Profit margin per cow had been €272 greater than, but fell to €230 less than, the group median in 2002. Similarly, when compared to the group median, average milk yield per cow was 814 (14.7%) litres above, but fell to 778 (13.9%) litres below in 2002. Economic recovery commenced in 2003 as a result of the application of control measures that were applied from 2002 onwards.

Introduction

Paratuberculosis (Johne's disease) is a chronic granulomatous enteritis of ruminants, including cattle. It is caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP). The disease is characterised by persistent diarrhoea, weight loss and protein losing enteropathy. Most infected cattle excrete the bacteria in faeces months to years before clinical signs of infection develop (Sweeney, 1992). Eradication of Johne's disease requires the removal of all sources of infection, the dominant source of infection being the presence of sub-clinically infected animals (Whittington and Sergeant 2001). Control programmes in dairy herds involve hygienic measures to prevent the establishment of infection in young calves, and the systematic culling of infected animals.

Johne's disease can cause significant economic loss in affected herds. Losses are associated with reduced milk yield, lower reproductive efficiency, premature culling and decreased cull cow values.Johne's disease has been a scheduled and notifiable disease in the Republic of Ireland since 1955. It was uncommon prior to the mid 1990's, with only 92 cases diagnosed between 1932 and 1992; these cases were primarily in imported animals (Dept. of Agriculture and Food records). In 1992, the Single European market was introduced, facilitating the free movement of goods and services within the EU and thereby increasing the opportunity for the importation of cattle from continental Europe. The Single Market removed the national pre-import test and certification requirements for Johne's disease and also the requirement for imported livestock to be placed in quarantine for up to six months after arriving in Ireland. During quarantine, imported animals had been subjected to additional Johne's disease test. Between 1992 and May 2004, approximately 85,000 cattle were imported from continental Europe the bulk of which were potential breeding animals. Of these, 8,223 came from the Netherlands, 6,832 from Denmark and 29,105 from France (Central Statistics Office, personal communication). In the years between 1995 and 2002, the Dept. of Agriculture and Food received notification of 232 Johne's disease infected cattle in 106 herds. In

1997, a serological survey, using the absorbed ELISA test, of 224 imported animals in 36 herds, revealed that 36% of the herds involved had at least one positive animal (O'Doherty *et al.*, 2002). Using the same test in a random sample of 143 herds in three counties, more than 30% of herds had one or more reactors (J. Egan, personal communication). The indications are that the prevalence of Johne's disease in Ireland has increased since the introduction of the Single European market.

This paper describes the impact of an outbreak of Johne's disease on performance in a dairy herd in Co. Tipperary, Ireland.

History

The case farm is family-owned and managed by the owner with some outside assistance. All cows were Holstein Friesians prior to the introduction of Montbéliarde cattle in 1998. Replacement dairy cattle were purchased from the Netherlands in 1993 (Figure 1). The aim, for many years, has been to have cows calving at a 365-day interval. Artificial insemination (AI) is still used in the earlier stages of the breeding season, while natural service is used subsequently to serve any cows not in calf to AI. Breeding cattle are routinely vaccinated biannually for leptospirosis and cattle are vaccinated against black disease two to three times per year. During 1993 to 2004, the average herd size was 81, varying from a low of 69 in 1996 to 90 in 2001. The first clinical signs associated with Johne's disease were observed on the case farm in 1995, and the first laboratory diagnosis of the disease was made in April 2000. In retrospect, an additional 11 cows, four of which were the original Dutch imports and others progeny of these, were identified as potentially Johne's infected between 1995 and 2000, based on clinical signs of ill thrift combined with persistent diarrhoea. A widespread herd Johne's disease problem was diagnosed in 2002. Observed clinical signs included persistent diarrhoea, weight loss, illthrift and depressed milk yield. The farmer observed "bottle jaw" or intra-mandibular oedema in the later stages of the disease. He said that cows remained bright and alert up until the end stages of the disease. He also noted in retrospect that affected cows appeared less fertile.

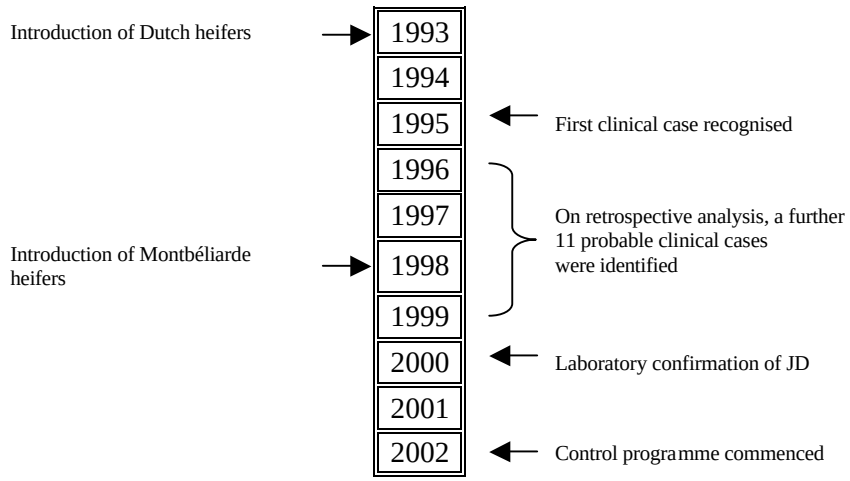

Figure 1 Time line from introduction of infection to introduction of control measures

On-farm investigation

This case was brought to the attention of the national Department of Agriculture and Food (DAF) in late February 2002. The farmer agreed to participate in a pilot Johne's disease control programme under the auspices of DAF. A detailed epidemiological examination was conducted to determine how Johne's disease had entered and spread within the herd. This investigation concluded that Johne's disease was introduced through the purchase of a cohort of 20 heifers from the Netherlands in 1993. Up to four of these imported animals went on to develop clinical signs consistent with a

diagnosis of Johne's disease, but this was not confirmed by laboratory diagnosis. At least five of the progeny of these imported animals were subsequently diagnosed with Johne's disease. The farmer had not previously purchased cattle from outside Ireland. There was no evidence to suggest that Johne's disease was in the herd prior to the introduction of the Dutch cattle in 1993.

The practice of feeding pooled milk and colostrum was considered to have facilitated the spread of infection within the herd. The farmer routinely fed pooled colostrum to calves up to seven weeks of age. Examination of farm records revealed clusters of infection among calves, which were known to have been consuming milk when cows, which subsequently exhibited clinical signs consistent with Johne's disease, were providing milk into the calf milk supply.

Farm productivity and profitability

The case farm formed part of a wider Teagasc (Irish Agriculture and Food Development Authority) DairyMIS group. This DairyMIS group consisted of 25 to 30 herds of a similar size in the Munster region, which recorded various production and economic data for Teagasc.

Average milk yield

In 1994, a large number of heifers entered the herd, which reduced the milk yield of the herd in that year. Between 1995 and 1998, the average milk yield for the case herd was in the upper quartile of the DairyMIS group, and was just short of the 90th percentile in 1995 and 1997. By 1999, average milk yield had decreased to that of the group median and it continued to fall to the 10th percentile for the group in 2002 (Figure 2). For example in 1995 and 1997 respectively, average yield was 714 litres (13.6%) and 814 litres (14.7%) litres per cow greater than that of the group median. A decline in herd yield in the case farm relative to its peers commenced in 1997 and continued until 2002 when the average yield was 778 litres (13.9%) litres less than that of the group median, and indeed was almost equivalent to the 10th percentile. In the case herd, there was a difference of 1,528 litres (24.0%) in the average milk yield between the years with the best and worse milk yields (1997 and 2002). Milk yield in 2003 and 2004 respectively were 5,636 litres and 5,418 litres.

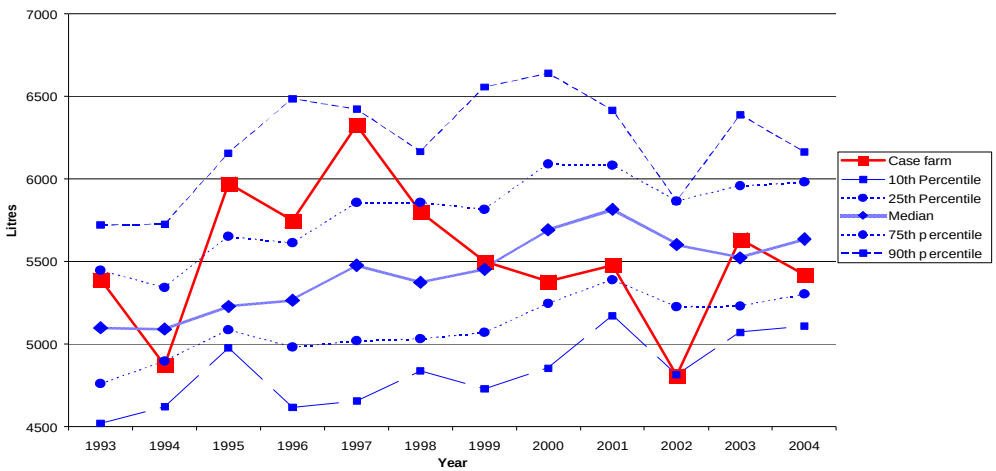

Figure 2 Milk yield during 1993 to 2004: case farm, in comparison with peers in the DairyMIS group

Profit margin per cow

The profit margin per cow was calculated by adding the value of milk sold plus the value of milk fed to calves, subtracting the value of concentrate fed and fertiliser spread and dividing this by the average number of cows in the herd. Until 1999, the profit margin per cow exceeded that the median of the peer group (Figure 3), indeed profit margins per cow were in the upper quartile for much of the 1990's and was on average €155 greater than that of its peers. In 1995 and 1996, respectively, the profit margin per cow was €264 and €272 greater than that of the medians for the

years involved. Equivalent figures of profit margin per herd were €22,968 and €18,768, respectively. However, there was a decline in the profit margin on the case herd starting in 1997; in 1999 the profit margin per cow was equivalent to the group median, and in the lowest group quartile from 2000 until 2003. Indeed from 1999 until 2003, the margin per cow in the case herd was on average €130 less than that of its peers. The profit margin per cow was €168 (€12,768 for the herd) and €253 (€19,734) less than the group median in 2001 and 2002, respectively. This represents a cumulative reduction in margin per cow of €285 over the course of the study period. Profit margin per cow increased in 2003 and 2004, reversing the decline in previous years.

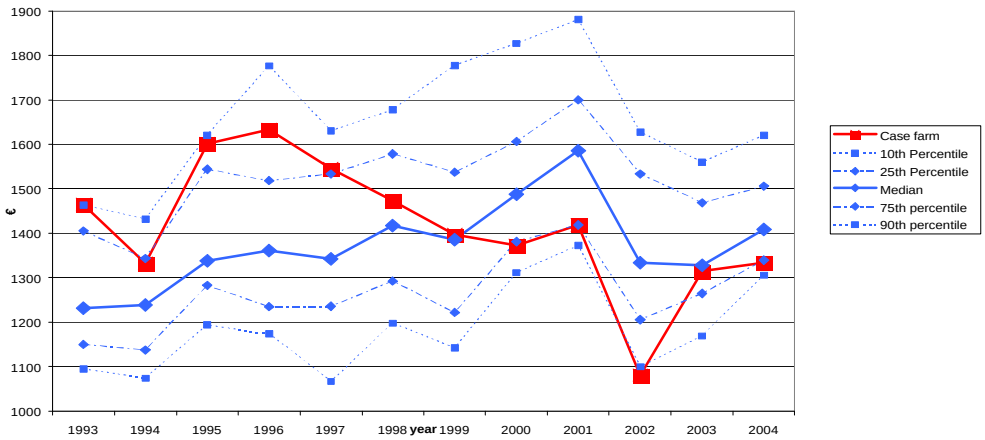

Figure 3 Profit margin per cow 1993-2004: case farm, in comparison with peers in the DairyMIS group

Involuntary culling

Involuntary culling consisted of all cow disposals, apart from disposals due to cows being surplus to requirements or old age. Prior to 1997 involuntary culling in the case herd was less than that of the group median (Figure 4). The involuntary culling rate in 1997 and 1998 was slightly greater than the median for the group. It diminished between 1999 and 2001, where it was equivalent to 25th percentile, but peaked in 2002 and 2004. Involuntary culling was in excess of the 90th percentile for the group in 2002.

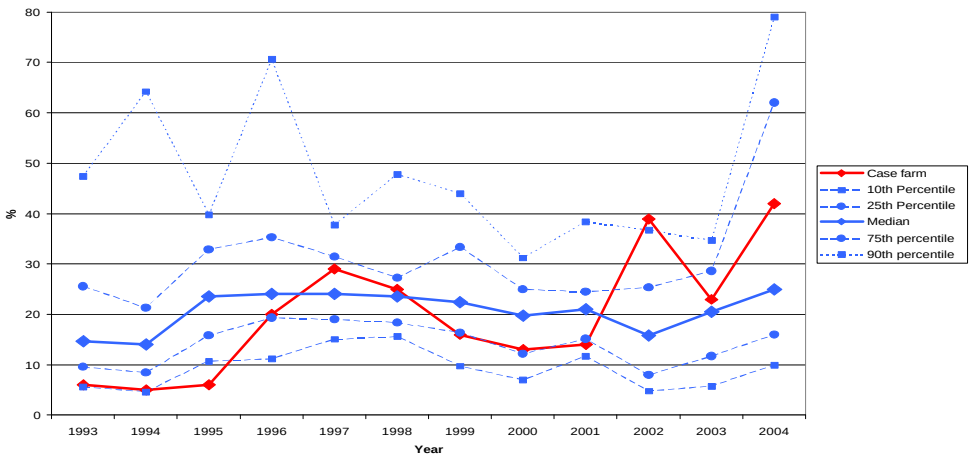

Figure 4 Involuntary culling 1993-2004: case farm, in comparison with peers in the DairyMIS group

Culling due to infertility

A closer examination of the relative causes of culling in the herd revealed that there was a marked increase in the proportion of involuntary culling due to infertility between 1994 and 2000 (Figure 5). Between 1996 and 2000, infertility accounted for between 40% and 80% of involuntary culling in the case herd, and was in the upper quartile for the group in 1996, 1998 and 2000. Between 1996

and 2000, the group median for the proportion of cows culled due to infertility was 34-50%. From 2002 infertility declined as the main cause of involuntary culling.

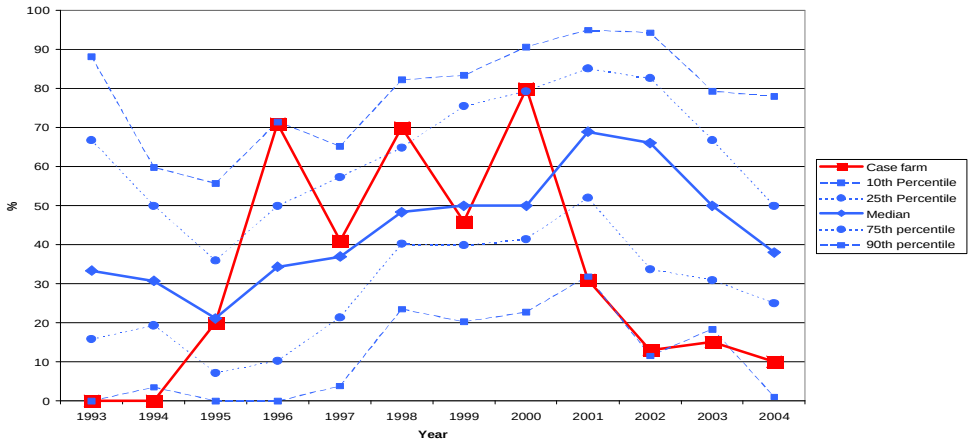

Figure 5 Percentage culling due to infertility during 1993 to 2004 on the case farm, in comparison with peers within the DiaryMIS group

Discussion

The farmer responsible for the herd under investigation here was seeking to improve herd genetic merit, but had concerns about the risk of brucellosis associated with native sourced cattle and hence imported Dutch heifers. At that time he was unaware of Johne's disease, and therefore did not consider it as a relevant animal health risk. Ignorance thus played a major role in the introduction and dissemination of Johne's disease in this herd. Failure to maintain a closed herd (i.e. introducing cattle from outside) has been shown to result in a 5% reduction in net margin (van Schaik *et al*., 1998). A US study found that almost half of US dairy managers had limited knowledge of Johne's disease, which has hampered the effectiveness of control programmes (Wells and Wagner 2000).

It is probable that Johne's disease was introduced into the case herd with the Dutch heifers. There are several reasons to support this view. There was no history of Johne's disease in the herd prior to their introduction. Further, the purchase of infected cattle is recognised as a significant method of introducing Johne's disease into herds (Cetinkaya *et al.*, 1997; Wells and Wagner 2000). At the time up to 55% of Dutch dairy herds had one or more animals serologically positive for Johne's disease (Mushens *et al*., 2000) and the imported animals would have originated in between six and nine herds. Finally, up to four of the animals imported went on to develop clinical signs consistent with Johne's disease as did a number of their progeny.

Following on from Johne's disease diagnosis in 2002 the farmer was anxious to implement a control programme in an effort to reverse the significant economic losses experienced in the previous few years. He had been a successful and profitable farmer prior to the emergence of Johne's disease in his herd. Reduced milk yield, lower feed conversion efficiency, increased involuntary culling, higher replacement rates, decreased fertility, increased mortality and reduced cull cows values are all synonymous with Johne's disease (Ott, *et al*., 1999). DairyMIS data revealed that average herd yields, milk protein content, margin per 1000 litres of milk produced, margin per cow and culling rates were superior or equal to those of his peers until the late 1990's. However, from the mid 1990's there was a steady decline in farm performance until 2002 when the Johne's disease control programme was introduced on the farm. There was a 24% difference between the best (1997) and the worst (2002) annual average milk yield over the course of the study period. It was not possible to determine how much of this reduction in milk yield was directly attributable to Johne's disease. Data from North America have documented reductions of 19.5% and 15%, respectively, among cows clinically and sub-clinically infected with Johne's disease (Chi *et al*., 2002). Lower yields during 2002, in all herds in the DairyMIS group, may have been

weather-related; nonetheless, the yields in the case herd were 13.9% less than that of the group median. The extent of the reduction in milk yield has been correlated to the prevalence of Johne's disease infection within herds (Ott *et al*., 1999). The reduction in milk yield is more pronounced as cows advance in age as infection becomes more advanced (Johnson *et al*., 2001). These factors may have contributed to the dramatic reduction in yields in 2002, when the problem was finally diagnosed and a considerable number of clinical cases became apparent. In the case herd, there was both an absolute and relative drop in average milk yield. Milk yield was in excess of the group median in 2003, but declined closer to the 25th percentile in 2004 when in order to re-build cow numbers proportionately more of the herd comprised home-bred 1st lactation animals than usual.

In the USA it has been reported that Johne's positive herds experience an economic loss of $100 per cow, compared to Johne's negative herds (Ott *et al*., 1999). The same study also reported that herds with 10% or more of their cull cows having clinical signs consistent with Johne's disease suffered economic losses in excess of $200 per cow.

Reports published from the UK (Esslemont and Kossaibati, 1997) and Australia (Stevenson and Lean, 1998) describe average involuntary culling rates of 22% and 24%, respectively. The median involuntary culling rate of the DairyMIS group was between 16% and 24%. In the case herd, the involuntary culling rate did not markedly exceed the peer group median until 2002 when the control programme was instigated. This finding was somewhat unexpected as it was suspected that Johne's disease would have increased the level of involuntary culling in the herd. However, it is possible that some of the cows culled voluntarily as surplus to requirements or where the farmer's perception was that the cow was infertile may have been related to Johne's disease.

In the above mentioned UK and Australian studies, infertility accounted for 36.5% and 32% of cows culled respectively, which is substantially less than the range described in the case herd of 50 to 80% between 1996 and 2001. While the group median for culling due to infertility was greater than that described in the UK and Australian studies, this may be a consequence of the grass-based production system and seasonal calving pattern in Ireland, where many dairy herds cease to attempt to impregnate cows once they will exceed a 365-day calving interval. The culling due to infertility in the case herd was in upper quartile for much of the period between 1996 and 2000. Although culling due to infertility was increasing in the peer herds, the group median was still less than that of the case herd. This high level of culling due to infertility in the study herd probably prevented a marked deterioration in the herd calving index. Johne's disease may have been partly responsible for the failure of so many cows to attain the ideal 365-day calving interval required on the case farm and therefore their consequential cull for 'infertility'. The marked increase in the culling rate in conjunction with a marked reduction in the proportion of cows culled for infertility in 2002, 2003 and 2004 came about due to the culling Johne's infected animals as part of the control programme.

The economic loss on the case farm was further compounded by the farmer's difficulty in finishing cull cows for slaughter in the latter years of the study period. It was not possible to quantify this loss but a US study estimated that there was a 25% reduction in cull cow values in herds infected with Johnes disease (Chi *et al*., 2002). The Johne's status of the peer herds in the DairyMIS group is undetermined and it is possible that in making the comparison to these herds that the economic impact of Johne's disease in the case herd is underestimated. While this case study relates to only one herd, which may not be representative of the 'average' Irish farm, the fact remains that substantial economic loss occurred consequent to the entry of Johne's disease into the herd. These losses have been reversed with the implementation of control measures, and the farmer involved is confident that he can farm his way out of the problem and return to profitability. The study involving this herd continues.

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