Economic Impact of Health and Welfare Issues in Beef Cattle and Sheep in England

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1 Executive Summary

The economic impact of sub-optimal health and welfare is significant and costs the livestock industry millions of pounds each year. The purpose of this report is to quantify these costs.

Many farmers achieve high performance with high standards of health and welfare, but some have much poorer performance which is often a result of health and welfare problems. The main factors affecting the incidence of disease are multiple but often include:

- Lack of appreciation of a disease issue and the extent of the problem in the flock or herd
- The ‘hidden’ costs of the disease such as poor liveweight gain, are often difficult to measure and can go unnoticed for months if not years
- Lack of contact with the farm vet

This report has investigated 5 key diseases in sheep and cattle. These diseases were identified through literature review and verified by nationally recognised beef and sheep vets.

The cost of the disease and the cost benefit of prevention and a general summary can be found in Table 1.

Table 1: Summary of diseases in English flock and herd

Disease	Page	Cost of disease to industry per year	Reference	Cost of disease per affected animal £ per animal (Calculated in this report	Cost benefit of disease prevention £ per animal in flock or herd (Calculated in this report
Sheep					
Lameness	12	£24 million to British sheep industry	Nieuwohf and Bishop, 2005	90 (per ewe)	4.40 (per ewe)
Abortion	15	£32 million to UK sheep industry	Bennett and Ijpelaar, 2003	122 (per ewe)	10.90 (per ewe)
Ectoparasite (scab)	17	£8.3 million to British sheep industry	Nieuwohf and Bishop, 2005	12.30 (per ewe)	10.50 (per ewe)
Intestinal parasites stomach worms	19/20	£84 million to British sheep industry	Nieuwohf and Bishop, 2005	4.40 (per lamb)	3.50 (per lamb)
Liver fluke	22	£13-15 million for English beef and sheep	Eblex Stock Briefing, 2011	6 (per lamb)	5.60 (per lamb)
Cattle					
BVD	28	£36.6 million to UK cattle industry	Bennett and Ijpelaar, 2003	58 (per cow)	42 (per cow)
Johne’s	32	£13 million UK cattle industry	Caldow and Gunn 2009	45 (per cow)	
Respiratory Disease	33	£50 million UK cattle industry	Potter, 2010	82 (per calf)	76 (per calf)
Diarrhoea (calf scour)	35	£11 million to UK cattle industry	Bennett and Ijpelaar, 2003	58 (per calf)	47 (per calf)
Liver fluke	36	£23 million to UK cattle industry	Bennett and Ijpelaar, 2003	90 (per calf)	87 (per calf)

All the costs calculated in this project are based on practically realistic examples but will vary according to the severity of an outbreak and promptness of treatment.

2 Introduction

This review was commissioned by Eblex to assess the economic impact of sub-optimal health and welfare in beef cattle and sheep in England.

The purpose of this review is to provide Eblex with independent evidence on which to base future funding decisions on research and development and knowledge transfer to maximise the benefit to their levy payers and the wider industry.

The report considers the following:

- Identification and brief descriptions of the 10 major health and welfare issues in the beef and sheep sectors
- Incidence of each disease
- Costs to the industry and
- Estimated costs of prevention

The financial cost of an outbreak has been calculated for each disease. The calculations are expressed either as cost per animal affected (taking into consideration that only a proportion of the flock or herd would be affected during an outbreak) or cost per flock/herd assuming that each animal is affected. The latter is used where the entire flock or herd would be exposed and performance affected to some degree (e.g. worms or fluke). The former example is used when the disease only affects a proportion of the flock or herd despite all animals being exposed (e.g. lameness, abortion and BVD).

Case studies have been used for two of the major diseases to highlight the impact of disease and the effects of implementing better prevention and control.

A STEEPLE analysis has been carried out to demonstrate the drivers behind decisions that farmers make and how they are likely to change in the future.

Recommendations have been made on research and development and knowledge transfer that Eblex might consider funding in order to tackle the major issues identified, mitigate future threats and improve the health status of livestock on English farms.

The project team included ADAS consultants Nerys Wright, Kate Phillips and Elwyn Rees. Information was supplied by MSD Animal Health and specialist veterinary input was provided by Harriet Fuller and Steve Borsberry.

The literature review was based on current available research using archives and published papers in addition to industry information from recent studies. The literature review was undertaken between January and June 2012.

3 Background

It is well recognised and acknowledged within the beef and sheep industry that sub-optimal health and welfare is responsible for reduced performance and that this is a significant cost to the industry.

The number of lambs reared per ewe and calves reared per cow is fundamental to the profitability and future viability of beef and sheep farms. Eblex Business Pointers 2011 show that the farms with the highest profitability are those that have the highest rearing percentages i.e. those rearing more lambs per ewe and more calves per cow are generally seeing higher profit margins. (The figures in Table 2 indicate very good performance for LFA beef farms, however the sample size is small and it is assumed that LFA herd performance across the country is actually very similar to lowland levels).

Table 2: Eblex (2011a) – Suckler Herds

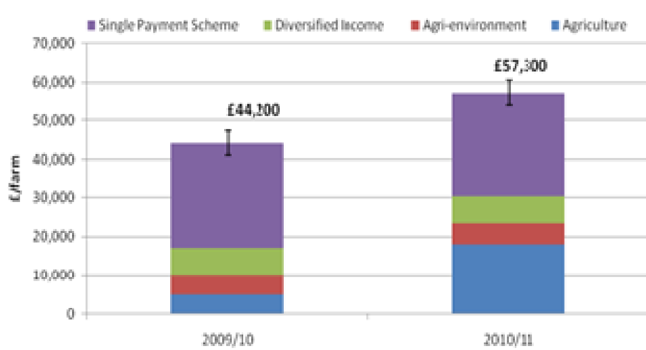
	Lowland		LFA	
	Calves reared %	GM £/cow	Calves reared %	GM £/cow
Top third	87	222.14	97.8	267.87
Average	85.9	164.45	92.4	246.80

Table 3: Eblex (2011a) – Breeding Flocks

	Lowland		LFA	
	Lambs reared %	GM £/ewe	Lambs reared %	GM £/ewe
Top third	162	73.90	157	75.56
Average	159	59.49	144	55.81

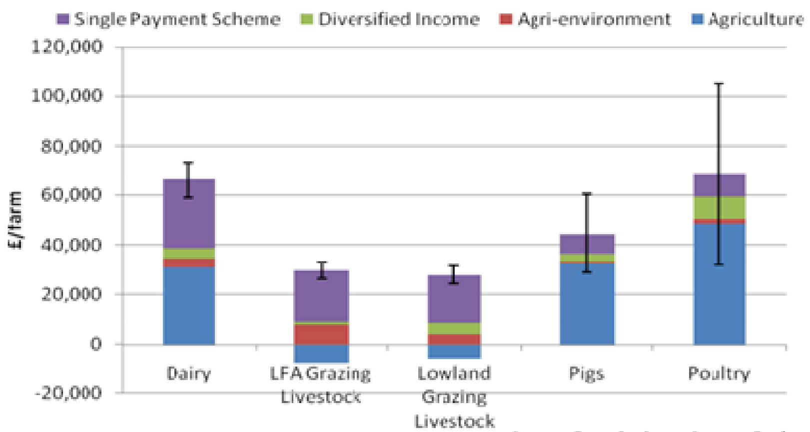
The Defra Farm Business Survey (Defra, 2011a) highlights that the overall income from Single Payment was the largest contributor to farm business income for all farm types. Average receipts from the Single Payment in 2010/11 remained the same as in 2009/10 but income from agriculture increased (see Figure 1).

Figure 1: Breakdown of average farm business income in England (2009/10 and 2010/11)



Further analysis of the value of Single Payment on different farm types highlights that the largest payments were on livestock farms (lowland, LFA and dairy) and that pig and poultry businesses received less and were generating more income from agriculture (see Figure 2).

Figure 2: Breakdown of farm business income for all farm types in England



Source: Defra, (2011a)

Figure 2 shows that the contribution from the agricultural enterprise to the overall farm business income was negative for both lowland and LFA grazing livestock. The Single Payment contributes a significant part of the income on these farms.

Just over 50% of farm businesses in England have some diversified activity related to their agricultural holding. This is often due to poor profitability especially on upland livestock farms where 15% of LFA grazing farms failed to make a profit in 2010/11 and around 60% had an income of less than £20,000 (Defra, 2011a).

3.1 The English Sheep Flock

The sheep flock in England currently consists of about 6.5 million breeding ewes and their offspring. This is 44% of the 14 million breeding ewes in the UK. Ewe numbers have steadily declined from the 8 million in England before Foot and Mouth in 2001 (Defra, 2011b).

The current national lamb rearing percentage is 119% (i.e. 1.19 lambs reared per ewe mated) (Defra, 2011b). This has increased by 7% in the last 4 years. This is largely due to a decrease in the number of hill ewes and a shift to more prolific lowland breeds. It is also likely to be a result of a reduction in ewe numbers and an improvement in performance of those remaining.

Despite this trend of increasing productivity, overall the sheep industry continues to lose a large number of lambs between conception and sale. Nationally, losses are thought to be between 15% - 20% from scanning to sale but on some farms losses can reach over 30%. This is often a result of a disease outbreak such as Toxoplasma abortion. There are some excellent farms that record losses of less than 10% and achieving this is possible if health and welfare is optimal and there are no adverse weather conditions.

Nationally, ewe mortality is about 5% per year and again this can range from 2 to 10% on individual farms. Losses can be even higher when there is a disease outbreak (e.g. liver fluke) or severe weather.

There is significant scope for reducing lamb and ewe losses which would ultimately lead to a greater number of lambs sold and/or ewe lambs retained. This in turn will reduce costs such as disposal of fallen stock and veterinary medicines and increase farm income.

There is also considerable scope to improve lamb growth rates by better control of internal and external parasites, reduction of pneumonia and clostridial diseases.

3.2 The English Beef Herd

There are approximately 2 million suckler cows over the age of 2 years in the UK and 960,000 of those are in England (46% of the UK beef herd) (Defra, 2011b).

The average rearing percentage in English suckler herds is 89% (i.e. for every 100 cows put to the bull 89 calves are sold (Defra, 2011b). However, there is huge variation in individual farm performance and some farms will rear less than 89% whilst others will perform better. However, the fact remains that on average the English beef herd is not performing to its maximum potential.

The national average calf mortality from birth to weaning is 5%, with up to 10% calf losses in calves reared from the dairy herd (analysis from BCMS database June 2011). The average barren rate of the English herd currently stands at approximately 6% (Eblex, 2011a). Again, there are huge variations depending on disease or fertility issues with some farms reporting a barren rate of 30%. This is almost certainly as a result of a disease outbreak e.g. BVD.

As highlighted in Table 2, there is significant scope to improve the number of calves born alive, weaned and subsequently sold or retained. Disease also impacts on growth and development of cattle and accounts for poor performance on many farms.

3.3 Summary

In addition to the losses and mortality rates identified above, the industry needs to be mindful that disease is a very important factor when assessing the welfare status and physical and financial performance of a flock or herd.

The market value of cattle and sheep has seen improvements over the last few years with prices reaching unprecedented levels during 2011. The price paid to farmers for finished cattle improved by 25-30% over the last 18 months and the increased value of cull cows has been even more dramatic. The increased value of lambs and cull ewes has also been significant with a 20kg lamb carcase being worth £7 - £10 more than a year ago and cull ewe prices averaging over £70 per head with some making as much as £120 per head. However, recent concerns over the value of the Euro may well depress prices through 2012 and into the future.

High prices are an additional incentive for farmers to improve physical performance of their stock, maximise profits and reduce reliance on Single Payment and agri-environment schemes.

There is significant scope to improve the physical and financial performance of beef and sheep farms through improved control of common diseases and improved welfare. Assessing the economic impact of poor health and welfare with particular attention to diseases that can be effectively controlled by improved veterinary medicines or husbandry will highlight the financial savings that could be made on many farms.

4 Summary of Literature Review

The literature review provides information on the incidence of disease, costs of treatment and the cost of preventing an outbreak (e.g. vaccination). The five major health and welfare issues for the sheep and beef sectors have been identified as the following:

Table 4: Major health and welfare issues for the sheep and beef sectors

Sheep	Beef
Lameness (footrot and scald)	BVD
Abortion (Toxoplasma, Enzootic abortion, Campylobacter)	Johne's
Ectoparasites (specifically scab)	Respiratory disease (IBR, PI3 and BRSV)
Internal parasites (specifically worms)	Diarrhoea (calf scour)
Liver fluke	Liver fluke

For the purposes of this report, 'major health and welfare issues' have been defined as the diseases causing the greatest loss to the industry taking into consideration the incidence, symptoms, losses (both in mortality and reduced performance) and costs. The top five have been discussed and agreed with Eblex, ADAS and collaborating vets.

The literature review is based on currently available, published research. Information that was not available in published papers but was required for cost benefit analysis has been estimated by ADAS and veterinary collaborators.

Poor nutrition is known to compromise the immune system resulting in sub-optimal health and welfare, poor fertility, reduced liveweight gain, and overall reduced physical performance. Nutrition is not within the remit of this project, it has been assumed in the cost benefit calculations that nutrition is adequate and is not a contributory factor in any of the diseases discussed.

The next section of the report summarises the diseases, quantifies the most recent estimates of the economic impact and shows a cost benefit analysis of reducing the level of the major endemic diseases in the national herd and/or flock. Where appropriate, information from ADAS case studies has been provided.

The cost implications of some of the multi-factorial diseases in beef and sheep are poorly documented and not easily quantifiable e.g. calf scours, respiratory disease and liver fluke. It is therefore difficult for a producer to calculate what a disease outbreak costs and why improvements need to be made. However, some of the diseases that cause the greatest loss to the English farming industry such as BVD and abortion are more easily quantified but preventative measures are often not implemented.

5 Sheep Flocks in England

5.1 Lameness – Footrot and Scald

Footrot and scald are the most common causes of lameness in sheep in England. Footrot is a bacterial infection which causes under-running and separation of the horn of the foot from the underlying tissues, starting at the heel. In scald, or interdigital dermatitis, there is inflammation of the interdigital skin but no under-running of the horn. The two conditions are caused by the same bacterium, *Dichelobacter nodosus*. There are many strains of *Dichelobacter nodosus*, and these vary in virulence. Scald may be due to infection with more benign strains, or may represent early cases of infection with more virulent strains that will progress to under-running of the horn, if not treated promptly.

Lameness in sheep indicates that the animal is in pain. Animals that are in pain spend less time feeding than their healthy counterparts. In severe cases of lameness, sheep may spend much of their time lying down, so will be spending significantly less time grazing. Failure to feed adequately will have many effects:

- Young animals will grow more slowly, so take longer to reach slaughter weight
- Breeding ewes will conceive and rear fewer lambs
- Ewes in late pregnancy are more likely to suffer from metabolic diseases such as twin lamb disease, and as a result are more likely to die
- Lame rams will have lower libido, and if in poor condition, are likely to be sub-fertile

Lameness is one of the biggest causes of poor health and welfare in the English sheep flock. A recent opinion published by the Farm Animal Welfare Council (FAWC, 2011) highlighted that in 1994, the first producer estimate of the prevalence of lameness in English flocks was estimated to be 8.4% (Grogono-Thomas and Johnston, 1997). A decade later, a questionnaire was sent to 3,000 English farmers and flock lameness was estimated to be 10.4% (Kaler and Green 2008). This information suggests that, over the 10 year period from 1994 to 2004 the prevalence of lameness did not reduce and may even have increased slightly.

There are other causes of lameness which have been well documented but in 80% of flocks footrot/scald is the most common, accounting for approximately 90% of lameness in the national flock (Winter, 2004).

It is well known that some farmers can control lameness well and some report a prevalence of only 2%. This low level is not down to luck. These farms are known to implement a sound policy to tackle lameness using a range of approaches to help them:

- Correct diagnosis of the cause of lameness
- Culling persistently lame ewes
- Selecting replacement ewes with sound feet
- Quarantining on arrival
- Catching and treating lame ewes quickly after they become lame
- Treating with antibiotic and anti-inflammatory
- Effective foot bathing
- Vaccination against footrot

Across the entire British sheep industry, the total cost of Footrot per annum has been estimated at £24 million (Nieuwhof and Bishop, 2005) and given current sheep prices the 2012 figure is likely to be significantly higher. The breakdown of costs is as follows:

- Cost of lost performance = £7 million
- Cost of treatment (including some culling) = £3 million
- Cost of prevention =£14 million (including foot bathing and trimming)

The Farm Animal Initiative (FAI, 2010), has shown the direct costs of footrot in sheep to be £8.38 per ewe. This is based on treatment and labour costs alone. Using current lamb prices we have estimated the cost of lameness including indirect costs such as reduced performance and additional feeding to maintain body condition. Costings are shown below and are based on a 10% incidence of lameness in a flock of 500 lowland ewes with 165% lambs reared as opposed to 170%.

Table 5: Calculation of the cost of lameness (direct and indirect costs)

Cost	Calculation	£
Reduced performance (25 ewes having single lambs instead of twins @ £80 per lamb - £10/lamb variable costs = £70/lamb)	25 x £70	1750
Additional feeding for 25 twin bearing ewes if thin post lambing to rear lambs (£6 per head for 25 ewes)	25 x £6	150
Cost of replacing 10% of lame ewes due to lameness and poor performance at £140/head less cull value of £50/hd = £90	5 x £90	450
Labour to treat lame ewes (10 hours at £12 per hour)	10 x £12	120
Antibiotic and anti-inflammatory (£1 per injection, 2 injections per ewe for 50 ewes)	50 x £2	100
Foot bathing 4 times for whole flock (500 ewes and 825 lambs) £50 for labour and £100 zinc sulphate	4 X 150	600
Lambs (825) taking 2 weeks longer to finish at grazing cost of £0.8/week at the same lamb price	825 x 2 x 0.80	1320
Total cost per flock of 500 ewes		4490
Total cost per affected ewe		89.80
Cost per ewe in the flock		8.98

As Table 5 highlights, the cost of lameness is £8.98 per ewe in the flock when the incidence is 10%. The cost of lameness is calculated to be £89.80 per affected ewe.

A trial carried out by Warwick University during 2005/06 found that catching and treating lame sheep at an early stage of lameness resulted in significant improvements in flock performance (Wassink et al, 2010). A summary of the results comparing the improved treatment regime to a standard regime, found that the ewes given the prompt treatment had:

- significantly fewer lame days
- fewer high locomotion scores
- higher body condition score
- fewer barren ewes, dead ewes and lambs
- higher lambing rate 179% vs. 166%
- higher rearing rate 174% vs. 156%
- more lambs finished before weaning 18% vs. 6%
- cost saving of £600 per 100 ewes (intervention cost £135)

Vaccination is an effective method to consider when farmers are trying to reduce the incidence of footrot in a flock. However, the vaccine must not be expected to solve a footrot problem alone and other husbandry methods (as described above) also need to be carried out. The benefit of vaccination and foot bathing to reduce the incidence of lameness to 2% is calculated in Table 6 below.

Table 6: Cost benefit of reducing lameness by vaccination (flock of 500 ewes)

Treatment cost benefit	**Calculation**	**£**
Incidence of lameness at 10% in 500 ewe flock at £89.80/ewe (see Table 5).	500 x £8.98	4490
Cost of vaccine (2 doses at £1/dose/ewe)	500 x £2	1,000
Labour to administer vaccine (8 hours at £12 per hour)	8 x £12	96
Labour for foot bathing twice a year	100	100
Zinc sulphate for foot bathing	200	200
Lameness reduced to 2% i.e. 10 ewes lame @ £89.80/ewe	10 x £89.80	898
Cost benefit -whole flock		+2,196
Cost benefit per ewe in the flock		4.39

Implementing a foot bathing and vaccination programme to reduce the incidence of footrot from 10% to 2% would have a cost benefit of £4.39 per ewe in the flock.

Similar costings at an individual farm level would help farmers to quantify the cost of lameness compared to the cost of available treatments. Reading University have created a model which uses the incidence of lameness on a farm and current costs of treatment and calculates a cost benefit of reducing lameness by various means (www.fhpmodels.reading.ac.uk/models.htm). The programme is very useful in experienced hands but the software is difficult to download, assumes the aim is to reduce incidence to 1% and does not provide a timescale i.e. per year.

Results from trial work at FAI farms (FAI, 2010) has lead to increased confidence in the lameness protocols that farmers are using to reduce lameness on large commercial farms (correct diagnosis, vaccination, culling, etc). MSD Animal Health has reported that sales of 'Footvax' grew by 28% between 2010 and 2011. This also coincided with higher lamb prices and increasing cost of feed and other inputs which might have had a contributory effect.

There are other causes of lameness in sheep that have not been quantified in this section of the report. Contagious ovine digital dermatitis (CODD) and white line disease (or shelly hoof) are the two other common causes of lameness after footrot and scald. There are currently no estimates of the cost of these diseases and the conditions are not well understood.

5.2 Abortion – Toxoplasma, Enzootic abortion and Campylobacter

The most commonly diagnosed causes of infectious abortion in sheep in England and the UK are enzootic abortion (Chlamydophila abortus), toxoplasma and Campylobacter. The consequences of these infections include:

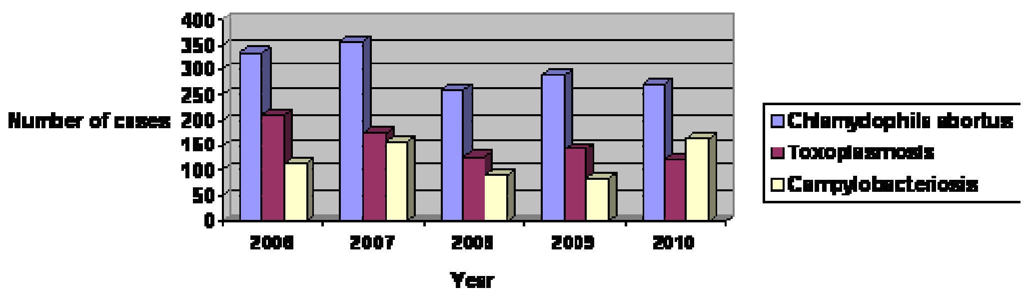
- More barren ewes
- Aborted lambs
- Stillborn lambs
- Weak, non-viable lambs
- Reduced performance in surviving lambs
- Sick ewes post abortion (especially Campylobacter), some of which will die

Infectious abortion in sheep flocks in England is a major problem. An ADAS survey in the 1990's found that 45% of lamb losses were caused by abortion in lowland flocks. A more recent survey carried out in Wales in 2011 found that 24% of lowland farm lamb losses were attributable to abortion (HCC, 2012).

There are very effective vaccines available for enzootic abortion and toxoplasmosis, but their uptake in the UK is not widespread. Additionally, a greater awareness of flock biosecurity could significantly reduce the losses from these diseases. Enzootic abortion is most commonly introduced to a flock with purchased ewes, so it is advised that farmers keep purchased replacements separate from the main flock until after lambing – even if they have been vaccinated.

There is currently no vaccine licensed in England for prevention of campylobacter, however it is possible to import the vaccine used in New Zealand under special license (VMD will assess individual cases before approval is granted). AHVLA data supports the opinions of sheep farmers and vets that the incidence of abortion caused by campylobacter is increasing (see Figure 3).

Figure 3: Breakdown of causes of abortion diagnosed in submissions to AHVLA 2006-10



Source: AHVLA

The cost of enzootic abortion and toxoplasma in the UK flock was estimated to be £20 million and £12 million respectively (Bennett and Ijpelaar, 2003). These estimates included loss of production, cost of treatment, control and monitoring but did not include the costs associated with human health.

Some farmers believe that abortions are inevitable, and accept an ongoing low level of abortion (e.g. 2 to 5% of ewes). However, non-infectious abortion is likely to affect less than 1% of well managed ewes. Some farmers mitigate the losses from infectious abortion by purchasing spare lambs from other farmers to foster on to ewes that have had non-viable lambs. This practice risks introducing other diseases into the flock, and may mask the losses from abortions and stillbirths.

No statistics were found on the incidence of enzootic abortion and toxoplasmosis abortion outbreaks on farms and the average losses incurred in England. However, from working closely with focus farms on a range of projects, ADAS has gathered data that suggests that losses from an outbreak can result in losses ranging from 2% up to 30% in a severe outbreak. Grumbling abortion problems, which tend to go unnoticed, can cause losses of between 5 to 6% (Intervet, 2005).

The cost of an abortion outbreak in a 500 ewe flock where the number of lambs reared falls from 170 to 153% is shown in Table 7.

Table 7: Cost of an abortion outbreak in a 500 ewe flock

Cost	Calculation	£
**85 fewer lambs reared @ £70 (sale value of £80 less £10 variable costs to rear*)	85 x 70	5950
Fallen stock charges for dead lambs @£1.50/head	85 x 1.50	127.50
Total loss		6077.50
Total cost per ewe affected (assume 10% affected)	6077.5÷50	121.55
Cost per ewe in flock	6077.5÷500	12.16

*£3/head marketing, £2/head vet and med and £5/head feed
** Assumes 50 ewes lose 85 lambs

If 50 ewes were affected in a flock of 500 ewes this would amount to a loss of £6080. These calculations assume that the ewe is kept rather than culled (if ewes abort with toxoplasma or campylobacter there is no need to cull since they develop immunity to the disease but with enzootic abortion culling would be advised and costs would be higher).

There are two vaccines available for enzootic abortion (Enzovax produced by MSD and Cevac Chlamydia produced by CEVA Animal Health) and one vaccine available for toxoplasma (Toxovax produced by MSD). There have however been issues with the supply of the vaccines for the last two breeding seasons.

Table 8: Cost benefit of vaccinating against abortion in a 500 ewe flock

Vaccination cost benefit	Calculation	£
Vaccinate replacements (assuming 100 per year for a flock of 500 ewes at 20% replacement rate at £6 per ewe)	100 x £6	600
Cost of labour to administer the vaccine at 50 p/ewe	100 x £0.50	50
Total cost to vaccinate replacement ewes		650
Cost of abortion outbreak for 500 ewe flock(see Table 7)		6077.50
Cost benefit of vaccination to prevent abortion per ewe in the flock (assuming 50 ewes affected at £121.6/ewe minus cost of vaccination/500 ewes)	6077.50 – 650, ÷500	10.86

* Assuming only replacements are vaccinated annually until entire flock is protected.

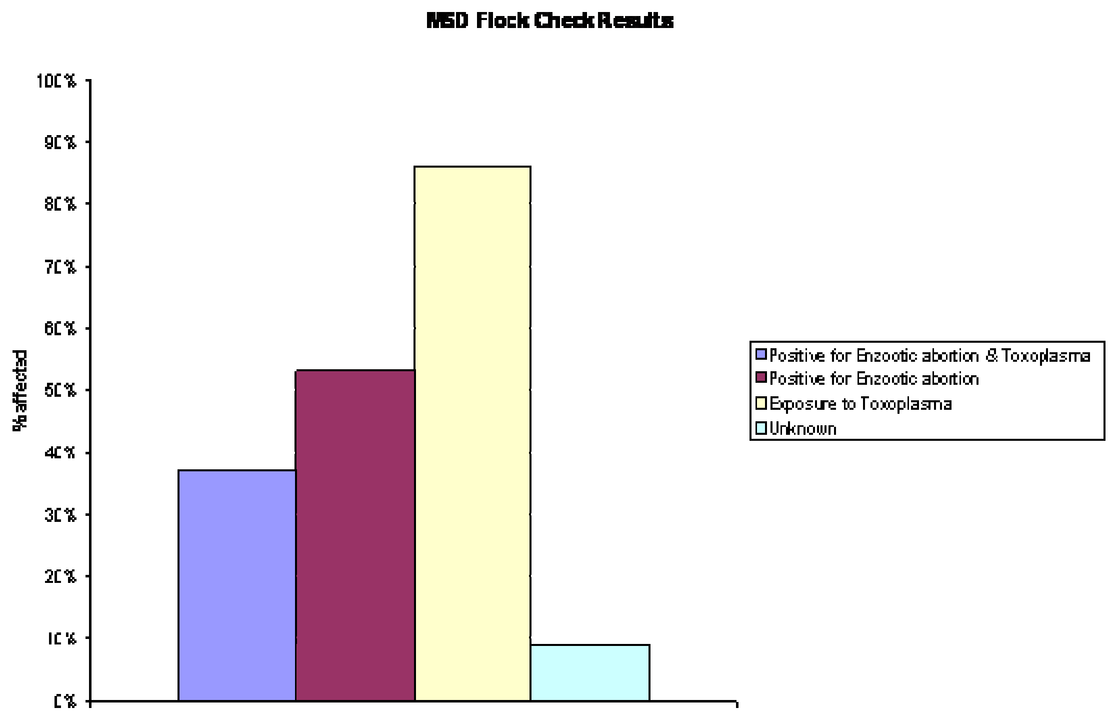
Spending £6.50 per replacement can avoid losses of £12.16 per ewe in the flock.

On most farms, a ewe will only need to be vaccinated with the two different abortion vaccines (Toxovax and Enzovax or Cevac Chlamydia) once in her productive lifetime. However it cannot be guaranteed that every abortion will be avoided.

In an enzootic abortion storm, some farmers choose to inject breeding ewes with an Oxytetracycline antibiotic to reduce the severity of the outbreak. This is not a hugely expensive process; depending on the quantity used. A 100ml bottle can cost £5.50 and would treat 12 ewes (based on a ewe weight of 80kg). This works out at approximately £0.50 per ewe. This is an effective control method in the face of an outbreak of enzootic abortion but should not be used as a replacement for vaccination.

MSD Animal Health provides a screening service to monitor the presence of abortion agents in unvaccinated flocks that have a high barren rate (barren ewe check – toxoplasma surveillance only) and for flocks that suffer from an abortion storm (Flock Check surveillance for both enzootic abortion and toxoplasma). The results from the 2011 surveillance provided by MSD and are summarised in Figure 4.

Figure 4: Flocks positive to Enzootic abortion and/or Toxoplasma - 2011 Flock Check



Of the 360 samples submitted to MSD for 'Flock Check' during 2011, 37% of samples were found to be positive for both enzootic abortion and toxoplasma, with 53% positive to Enzootic abortion only and 86% having had exposure to only toxoplasma. A further 9% of samples were unknown i.e. not Enzootic abortion or toxoplasma. Out of the 166 samples submitted for 'Barren Ewe Check' in 2011, 79% of ewes had exposure to toxoplasma. Vaccination against Toxoplasmosis has been shown to produce a 6.4% increase in the number of lambs reared (Intervet, 2005)

5.2.1 Sheep Case Study

A flock of 650 North Country Mules based near Wolverhampton was affected by an abortion outbreak in 2008. The flock was not vaccinated against toxoplasma or enzootic abortion.

The ewes scanned at 186% (1209 lambs were expected from scanning). A total of 348 lambs were lost from scanning to sale during 2008. This equated to losses of 29% (348/1209 x 100), with 264 of the losses, amounting to 22% (264/1209 x 100) attributable to the abortion outbreak. The number of losses to abortion was determined by submissions to the VLA and accurate record keeping during lambing. AHVLA analysis determined that toxoplasma was the abortion agent on the farm.

As a result, the flock replacements were vaccinated against enzootic abortion and toxoplasma when they were purchased. This meant that the proportion of the flock vaccinated increased per year until they were all vaccinated by year 4 (replacement rate of 25% annually). The ewes were vaccinated against both toxoplasma and enzootic abortion because the cost of the additional vaccine was calculated to outweigh the risk of buying in enzootic abortion and the associated losses.

The vaccination programme has seen positive results in terms of increased scanning results and reduced barren rates in addition to a reduction in overall lamb losses. This is demonstrated in Table 9.

Table 9: Case study – flock barren rate and scanning percentage

Year	Barren rate	Scanning results	Lamb losses
2008/09	3%	186%	29%
2009/10	2%	196%	19%
2010/11	1.5%	200%	15%

The barren rate of the flock has halved to 1.5% and the scanning results improved by 14%. Over a flock of 650 ewes, this equates to an additional 91 lambs at scanning over 2 lambing seasons. Lamb losses from scanning to sale also reduced significantly over the same period to 15%. In 2010, only 3% of lamb losses were attributable to abortion, this is a reduction of 19% over 2 lambing seasons.

Table 10 calculates the cost benefit of implementing an abortion vaccination programme for two breeding seasons following the outbreak in 2008. The calculation is based on a 650 ewe flock with a 25% replacement rate over a 2 year period (50% of the flock was vaccinated by the end of year two).

Table 10: Case study - cost benefit of vaccinating flock against Toxoplasma and Enzootic abortion

Vaccination cost and benefit	Calculation	£
Cost of vaccination (for 2 breeding seasons)		
(1 vaccine at £6 per ewe for 320 ewes (160 per year))	320 x £6	1,920
Labour costs to administer (3 hours at £12 per hour per year for 2 years)	(3 x £12) x 2	72
Total cost		1,992
Reduced lamb losses from abortion from 22% to 3% = 226 more lambs at £70 per lamb (assumes £80 lamb at sale minus variable cost of rearing of £10/lamb)	226 x £70	15820
Additional income minus additional cost (over 2 years)		+13828
Additional income per ewe in the flock (650 ewes)	£13828 / 650	21.27

5.3 Ectoparasites – Sheep scab

There are a number of parasites that live on the skin or fleece of sheep. Sheep scab is one of the most serious and is caused by infection with the mite Psoroptes ovis, and is the most important ectoparasitic infection of sheep in England and the UK. The sheep scab mite causes such intense irritation to the sheep, that severely infected animals may have fits and die. It is the faeces of the mites, and not the mites themselves, that cause the intense irritation (Nieuwhof and Bishop, 2005). This explains why dipping resolves the signs of scab more quickly than the use of injectable endectocides.

After sheep become infested with Psoroptes mites, it can take several weeks before the symptoms of wool loss and itching are noticed. During this time, the infestation can have spread throughout the flock. The standard way to diagnose sheep scab is by microscopic examination of skin scrapings/wool samples to detect the presence of mites. However, in early infestations where mite numbers are low, detection can be difficult. Researchers at the Moredun Institute have developed a blood test that can detect antibodies to the sheep scab mite very soon after infection, and it is hoped that this test will be useful in identifying recently infected flocks before the infection is able to spread and cause production losses.

Sheep scab is highly contagious and in affected flocks over 90% of sheep may be infested (Sargisson et al., 1995). Sheep scab is recognised as a problem, or potential problem, in virtually all sheep-keeping countries of the world.

Sheep scab is no longer a notifiable disease in England therefore the true incidence is not known and estimates are based on surveys. A questionnaire was sent to sheep farmers, asking them about the prevalence of scab, between March 2007 and February 2008. The results suggested an average prevalence of 8.6% (±1.98) (Rose et al., 2009). The areas with the highest prevalence were Northern and South west England, Wales and Scotland. Analysis of the reported cases of scab highlighted the following factors to be important:

- height above sea level
- temperature and rainfall
- sheep abundance

Some sheep farmers do not practice good flock biosecurity, and this has facilitated the spread of sheep scab to all areas of the UK. SCOPS (Sustained Control of Parasites in Sheep) provides guidance on quarantine treatments to prevent the introduction of sheep scab to a flock, but adequate quarantining is not practiced on a number of sheep farms in England and throughout the UK. The problem of poor fencing leading to stray sheep is also widespread and contributes to the potential spread of the parasite.

The cost of sheep scab to the British sheep industry was last calculated by Nieuwhof and Bishop in 2005. They estimated the cost to be £8.3 million per year. This included:

- £1.8 million for labour
- £5.0 million for treatments
- £0.8 million in lost income for farmers
- £0.7 million in structures (infrastructure of facilities e.g. dip baths)

The data and the costs were based on the assumption that 15% of animals (ewes and over-wintered (store) lambs) in a flock were affected in 10% of British flocks. If the incidence was found to be higher, the costs to the industry would rise proportionately. These costs do not include lamb losses and reduced performance in affected flocks. Whilst this is a figure often quoted in the industry, it appears that these figures are very basic and may warrant further investigation and more detailed analysis.

Nieuwhof and Bishop (2005) stated that due to the costs of sheep scab being mainly in preventative measures, short of an eradication programme a reduction in incidence will have limited effect.

More research has been done in Wales and Scotland on the cost implications of scab compared to England. Sheep scab is currently a notifiable disease in Scotland and relates to The Sheep scab (Scotland) Order 2012.

Only a few countries, notably Australia, New Zealand, the USA and Canada, have managed sustained eradication of the problem, usually through well-defined strategies, effective use of chemicals and robust approaches to implementation. In terms of control, the approaches used and the extent of success varies. Although geographically large and usually with extensive systems of sheep production, Australia and New Zealand have managed to remain disease free, probably aided by their 'island' status. Where eradication has been attempted and failed, poor biosecurity, lack of co-ordination, uncontrolled movements of stock, unfavourable economic conditions, insufficient resources, lack of motivation and due diligence in treatment, commonly feature as compromising factors. Some countries, for example France, have reverted to compulsory treatment, at least on a regional basis to try to control the problem.

Since the deregulation of compulsory dipping in 1992, the incidence of sheep scab has increased across the UK. The current treatments available are very limited and include organophosphate (OP) dips and injectable endectocides such as Ivermectin and Moxidectin. There are serious concerns about both of these treatment options.

Concerns regarding OP dips:

- Risks to human health – farmers need a certificate of competence and protective clothing
- Dipping facilities are not adequate and could lead to pollution of the environment, water courses etc
- Labour requirements are high
- Post dipping management of the sheep is crucial to avoid OP getting into water courses
- Meat withdrawal period is long and has recently increased from 35 to 70 days making OP use on some farms impractical

Concerns regarding injectables:

- Misdiagnosis leading to inappropriate use – i.e. scab being confused with lice and flocks being treated for lice when scab treatment is required
- Meat withdrawal periods are long and vary from 44 to 104 days
- Resistance to the endectocides – since the injectable products treat both endo and ectoparasites, there is the risk of further development of anthelmintic resistance.

Tables 11 and 12 demonstrate the cost benefit of preventing a scab outbreak versus treatment following an outbreak of scab pre-lambing.

Table 11: Cost of an outbreak of sheep scab in a 500 ewe flock (per ewe)

Cost of outbreak	**Calculation**	**£**
Rearing percentage of the flock reduced from 170% to 155%), lambs valued at £80 at sale less variable cost of rearing @£10/lamb	75 lambs @ £70	5250
Whole flock treatment of scab, £1.40 per injection per ewe	500 x £1.40	700
Labour to treat whole flock, 2 days labour at £100 per day	2 x £100	200
Cost of scab outbreak – flock		6150
Cost per ewe	£6150 / 500	12.30

Table 12: Cost benefit of preventing an outbreak of scab in a 500 ewe flock

Treatment cost benefit	Calculation	£
<u>Treatment to prevent scab outbreak</u>		
1 injection per ewe at £1.40 per injection	500 x £1.40	700
Labour to treat whole flock 2 days @£100/day	2 x £100	200
Cost to prevent scab outbreak		900
Cost to prevent scab outbreak per affected ewe	£900 / 500	1.80
<u>Cost benefit per affected ewe</u>		
Cost £12.30 (see Table 11) minus cost of prevention £1.19	£12.30 – £1.80	10.50

As the table shows, if scab is allowed to enter a flock and remain untreated resulting in a reduction in lamb sales, the losses can amount to over £12 per ewe in the flock (this depends on how long the disease is allowed to progress) whilst the cost of preventing a scab outbreak amount to £1.80 per ewe or less. It is always essential to treat every sheep in the group – not just those affected. There may also be an effect on skin value but at present in England farmers are not paid on skin quality and anecdotally there is more damage to skins from shearing and clipping injuries (personal communication Randall Parker Foods). However skin value will be reduced further down the supply chain.

Stubbings (2007) showed a reduction in profit of £18.84/ewe after a winter outbreak of scab. The calculations were based on an intensive lowland flock normally rearing 172% lambs with lambs reared reduced to 158% as a result of scab. This also included increased feed and veterinary costs and lower value of fleeces.

5.4 Endoparasites – worms

Parasitic gastroenteritis or PGE is the term used to describe disease caused by roundworms in the stomach and intestines of sheep. Of all the samples from sheep submitted to the AHVLA, PGE is consistently the most commonly diagnosed condition. Anthelmintic resistant worms have only become a significant problem in England and the UK in the last 10 years, but PGE was still the most commonly diagnosed condition prior to this time. This shows that despite the availability of cheap, highly effective anthelmintics, some farmers have been failing to control worms in their sheep. Now that many anthelmintics are less effective, due to the increase in resistant worms, the challenge of controlling worms in sheep is even greater.

The important species of sheep worms in the UK are:

- *Teladorsagia circumcincta*
- *Trichostrongylus* species
- *Nematodirus battus*
- *Haemonchus contortus*

The symptoms of worm infestations vary slightly with the main species of worms involved, but include:

- Reduced appetite
- Diarrhoea (not *haemonchus*)
- Reduced absorption of nutrients
- Anaemia (*haemonchus* only)

The result of these symptoms is poor performance, ill thrift and even death.

One of the main challenges to farmers is timing anthelmintic treatments to when they are most needed. In the UK, some farmers have been reluctant to take up the practice of collecting faecal samples for worm egg counts prior to worming. Unlike the rest of Europe, anthelmintics do not have to be prescribed by vets in England, and this may be a factor in the failure to use these products in the most effective way. Perhaps as a result of the ready availability of cheap anthelmintics, these products have been widely and often inappropriately used by some sheep farmers. As a result we are now in a position where resistant worms are widespread and it is becoming increasingly difficult to control worms on some sheep farms.

There are currently 5 different ‘groups’ of chemicals available to treat and prevent worm infections. These groups are often described as colours for ease of reference. The different groups work to inhibit the lifecycle of the worm in different ways because they have different active chemicals, but all work to have the desired effect of reducing the worm burden. These groups are listed in Table 13.

Table 13: Anthelmintic groups for sheep

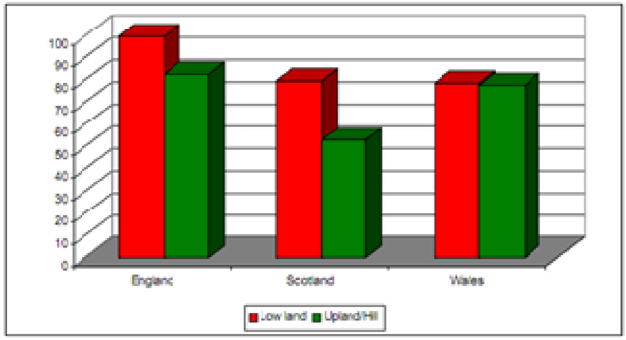
Group Number	Group Colour	Group Name
1	White	Benzimidazole (BZ)
2	Yellow	Levamisole (LV)
3	Clear	Macrocyclic Lactone (ML)
4	Orange	Amino Acetonitrile Derivatives (AD)
5	Purple	Spiroindole (SI)

There are several different products available within groups 1 to 3 but currently only one product in each of groups 4 and 5. Changing the product a farmer uses to worm his sheep does not always mean changing the active ingredient.

Resistant worms may appear on a farm either because worming practices have selected for resistant worms, or because resistant worms have been brought in with purchased sheep. As with sheep scab, SCOPS produce guidelines for farmers on effective quarantine treatments to reduce the risk of importing resistant worms, but few farmers follow this advice (HCC, 2011). Understanding the different species of worms, the different classes of anthelmintics, and the developing resistance patterns is complex. In most cases, farmers would see significant benefits from using the expertise and knowledge of sheep vets or consultants in devising an effective worm control strategy specific to their farm.

There is most resistance to the Benzimidazole (BZ) group of wormers. Figure 5 highlights that over 90% of farms in England have some level of resistance on their farms to BZ wormers. Unfortunately, farmers do not perceive the level of resistance as that much of a problem on their farms. In a survey carried out across GB in 2010 only 10% of farmers perceived anthelmintic resistance to be present on their farms (Morgan et al., 2011).

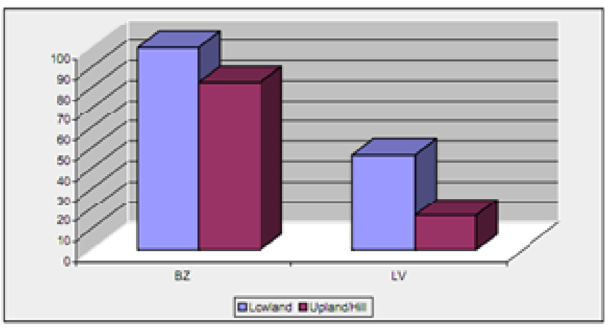
Figure 5: Incidence of resistance to Benzimidazole on farms in Great Britain



(Source: SCOPS, 2007)

Ongoing research conducted as part of the SCOPS initiative in England and Wales highlighted that there is also increasing resistance to the Levamisole (LV) wormers (yellow drenches).

Figure 6: Resistance on farms in England SCOPS Study 2007



(Source: SCOPS, 2007)

These figures highlight the fact that resistance is also increasing to the Levamisole group. Continued misuse of these products will only increase the problem.

Resistance to the macrocyclic lactones (MLs) is less common than to the BZ and LV groups but ML resistance is increasing. Two new products have become available over the last 18 months (Orange - 4 and Purple - 5) and the aim is to preserve the activity of all the groups by incorporating the new wormers (which have no or very little known resistance) into worm control programmes.

The estimated cost of gastrointestinal parasites to the British sheep industry is £84 million (Nieuwhof and Bishop, 2005). This figure refers to loss of production in lambs only and does not consider the breeding ewe flock. Reduced growth rate and lost performance in lambs is estimated to cost £63.7 million and treatment and control is estimated to cost £20.3 million (£11.7 million is spent on labour and £8.6 million on medicines). Since ewe and lamb prices have increased steadily since 2005, the financial losses are likely to be significantly higher in 2012. The biggest loss, based on the costings from Nieuwhof and Bishop, was the loss in production. This assumes that a high worm burden results in lamb losses, reduced liveweight gain and increased cost of finishing lambs.

A high worm burden can reduce daily live-weight gain by 50% without showing any clinical signs in the lambs (SCOPS, 2007). Table 14 shows the cost benefit of implementing an effective worm control programme. The example assumes a 10% reduction in live-weight gain in lambs. The calculations in Table 14 and 15 assume all animals are affected.

Table 14: Cost of delayed finishing of lambs due to worm burden - per lamb affected

Cost - Feeding lambs to gain 4kg to finish	**Calculation**	**£/lamb**
Assuming growth rate of 200g/day for 3 weeks at 80p per week per head grass keep	£0.80 x 3	2.40
Plus 10kg of concentrate at £200 per tonne	10kg x £0.2	2
Additional cost per affected lamb		4.40

Table 15: Cost benefit of effective worm control for 100 lambs - per lamb affected

Monitoring/treatment cost benefit	**Calculation**	**£/lamb**
Cost of a pooled composite faecal egg count (FEC) to monitor worm burden	1 x £20	20
Cost of wormer product (£0.50 per lamb)	£0.50 x 100	50
Labour 2 hours at £12 per hour	2 x £12	24
Total cost for 100 lambs		94
Total cost per affected lamb	£94 / 100	0.94
Cost benefit of prevention per affected lamb		
£4.40 (see Table 14) minus prevention costs of £0.94	£4.40 – £0.94	3.46

Note: The FEC relates to a sample taken once during the season and does not reflect the cost of regular FEC and treatment throughout the year. Losses from worms can be much greater, including deaths and reduced performance over a longer period.

5.5 Liver fluke

Fasciolosis or liver fluke is caused by the parasite Fasciola hepatica. Disease results from the migration of large numbers of immature fluke (ingested from pasture) through the liver (acute), or from the presence of adult fluke in the bile ducts (chronic), or a combination of both (sub-acute). Liver fluke affects sheep and cattle and is most pathogenic in sheep.

Adult liver fluke produce eggs which are passed out in sheep/cattle faeces and onto the pasture. In order for the fluke eggs to develop into immature fluke (which are ingested by the animals), an intermediate host is required. The mud snail Galba (Lymnea) truncatula is the host.

Acute fasciolosis, normally only seen in sheep, is caused by large numbers of metacercariae migrating through the liver. This migration causes extensive damage to the liver resulting in the sheep becoming weak and dying suddenly.

Chronic fasciolosis is seen in both sheep and cattle and occurs months (often 4-5 months) after a relatively moderate intake of infective metacercariae. These metacercariae migrate into the bile ducts and mature. This form of fasciolosis results in anaemia, reduced appetite and loss of condition. This chronic form can result in death if not treated (although sudden death is more common with acute fluke). The sub-clinical infection which impacts on growth rate and reproductive performance of the herd or flock has the biggest impact at this stage.

The mud snail is able to multiply rapidly and produce 100,000 offspring in 3–4 months (SCOPS, 2012). Adult fluke inside the animal lay eggs that are passed out onto pasture in faeces. At suitable temperatures (>10^{o}C with moisture), a miracidium develops within the egg. This hatches and migrates, actively seeking the snail host. If the snail is not present, the miracidiae die within hours as they are unable to survive outside the snail host. If they find a snail host, they undergo two further developmental stages and become infective cercariae. These cercariae emerge from the snail when the temperature and moisture levels are suitable (>10^{o}C).

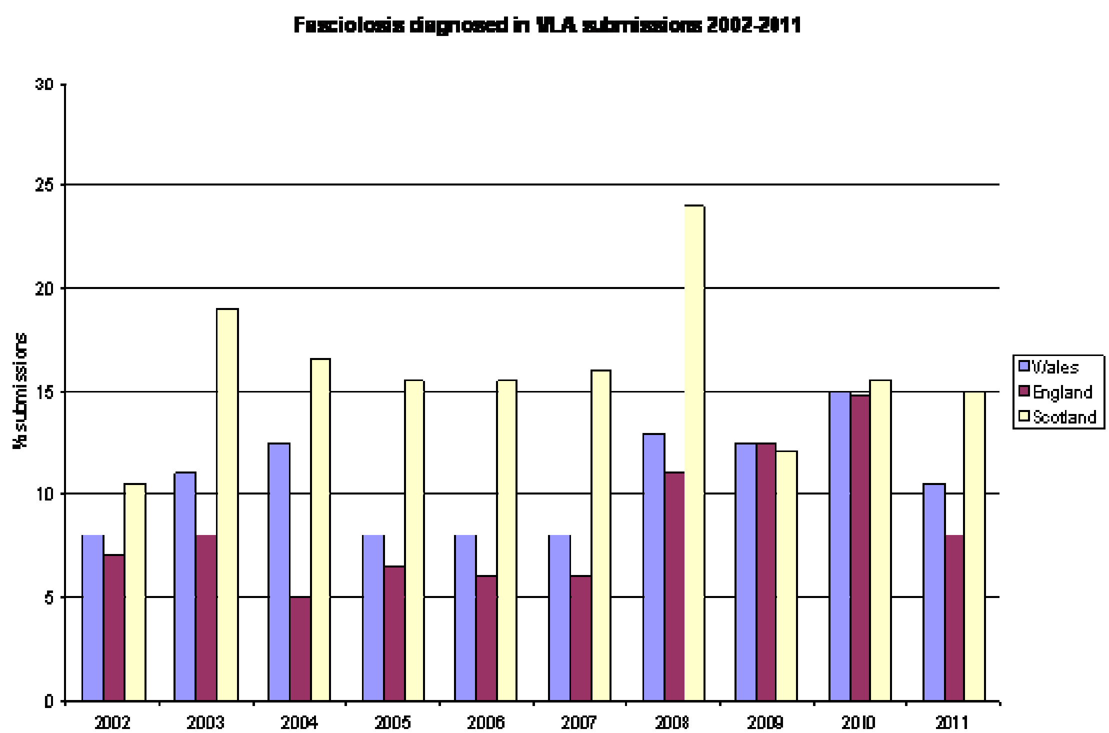
The cercariae migrate on to wet herbage and encyst as metacercariae. These metacercariae are ingested and they migrate to the liver (as immature fluke). They burrow their way through the liver and into the bile duct causing damage to the liver tissue en route.

Fasciolosis was historically a problem seen in wetter parts of the country such as the Western regions of England (Fox et al., 2011). The increased incidence in relatively new areas of England is attributable to the wet summers of 2008, 2009, 2010 and 2012. Wet ground favours the development of the habitat of the mud snail, Galba (Lymnea) truncatula, which is the intermediate host in the liver fluke lifecycle (Winter and Phythian, 2011).

The warmer, wetter summers have seen disease outbreaks in unexpected regions e.g. eastern regions of England which have resulted in production losses and welfare concerns (Kenyon et al., 2009). A survey conducted by Merial Animal Health in 2010 found that 90% of vets interviewed agreed that the incidence of fluke had increased in Eastern England.

AHVLA submissions highlight that the incidence of fluke has increased in the last ten years and is especially a problem in Scotland but the incidence did reduce in 2011 compared with 2009 and 2010. However the risk remained high for producers in Northern England and Wales due to the wet, mild winter of 2011.

Figure 7: Percentage of AHVLA scanning surveillance submissions in which Fasciolosis was diagnosed 2002-2011



Sheep are particularly susceptible to liver fluke and it can result in poor flock performance and death. Fluke is often over-looked in cattle because the signs are very subtle and clinical disease is rare meaning that mortality from fluke is very low but herd performance can be severely affected.

Treatments for fluke have historically been very effective but they need to be targeted to the fluke season and determined by the different stages of fluke (early immature, immature and adult).

The drug with the greatest efficacy against all stages of liver fluke in sheep is triclabendazole (TCBZ) which is a benzimidazole derivative. This is effective against both adult and young fluke (Fairweather, 2005). Another factor that has contributed to the increased incidence of fasciolosis is the emergence of resistance to TCBZ (Brennan et al., 2007) which has seen historically successful treatment protocols failing and leading to some significant losses on farms. Resistance was first reported in Australia in 1995 (Overend and Bowen, 1995). This is a cause for concern since the livestock industry relies heavily on this drug. It is also the drug of choice for fasciolosis in humans.

There are no vaccines available for the prevention of fasciolosis (McManus and Dalton, 2006); which is why the use of anthelmintics and other management options such as fencing and draining wet areas of land form the basis of liver fluke control (Torgerson and Claxton, 1999 and Knubben-Schweizer et al., 2009).

Reading University has produced a costings model which is available on their website (http://www.fhpmodels.reading.ac.uk/models.htm). The model enables farmers to cost out the impact of liver fluke on their individual farms but it could be improved by having the option to input specific information about rainfall, weather and land type. If the module had the capacity to break down the losses to give a clearer picture of when losses are occurring and are leading to financial losses (for example reduced lamb growth rate, reduced scanning percentage and mortality) this would be helpful. Unfortunately, the model is difficult to download which may be restricting its use.

Abattoirs have been publicising the number of liver rejections recently to highlight the impact of fluke on the industry. Studies carried out by Dunbia from cattle and sheep slaughtered in their plants showed that 34% of sheep livers and 50% of cattle livers are rejected annually. Condemned lamb livers are worth 20p compared to a healthy liver worth £1 (Vion, personal communication, March 2012).

Food Standards Agency data published in 2010 showed that 7.23% of sheep livers were rejected due to damage caused by liver fluke. This equates to a loss of £1,040,213 at current market values for the loss of livers alone. This loss does not take into consideration the lower live-weight gain and reduced performance of the sheep caused by the fluke.

However, losses due to rejection of livers are only a small part of the overall cost of fluke infection to the industry. The main losses include:

- Reduced live weight gain
- Lower feed conversion efficiency
- Reduced fertility
- Lower milking ability
- Deaths due to acute or untreated chronic infections

Table 16: Cost of fluke delaying finishing of lambs

Cost	Calculation	£/lamb
4 weeks extra to finish at £0.80 grass keep per week	£0.80 x 4	3.20
14kg concentrates at £200/tonne	14kg at £200/tonne	2.80
Total cost per affected animal		6.00

Table 17: Cost benefit of administering a flukicide treatment to lambs

Cost	Calculation	£/lamb
Cost of flukicide treatment (assuming weight 31-40kg)	£0.20 x 100	0.20
Cost of labour to administer		0.24
Total cost of fluke prevention per treated lamb		0.44
Cost benefit per affected animal		
Cost of fluke at £6.00 (see Table 18) minus treatment costs	6.00 – 0.44	5.56

Note: this example does not include mortality from acute fluke (which might also occur) and no account has been taken of the reduced value of damaged livers to the abattoir

In lambs, liver fluke has been found to reduce daily live-weight gain by up to 30% (Eblex, 2012).

6. Diseases in the English Beef Herd

6.1 Bovine Viral Diarrhoea (BVD)

The BVD virus (BVDV) is a pathogen which causes substantial losses to the UK dairy and beef industries (Weldegebriel et al, 2009). Bennett and Ijpelaar (2003) estimate the annual cost of prevention and control of BVD to be £25–60 million. There are several different symptoms of BVD hence the disease can go undetected for several years. An outbreak of BVD in the suckler herd is likely to result in:

- Infertility – barren cows or increased calving interval
- Abortions
- Higher calf mortality
- Increased incidence of other diseases e.g. calf scour, pneumonia due to the immunosuppressive effect of BVD infection
- Losses due to Mucosal disease

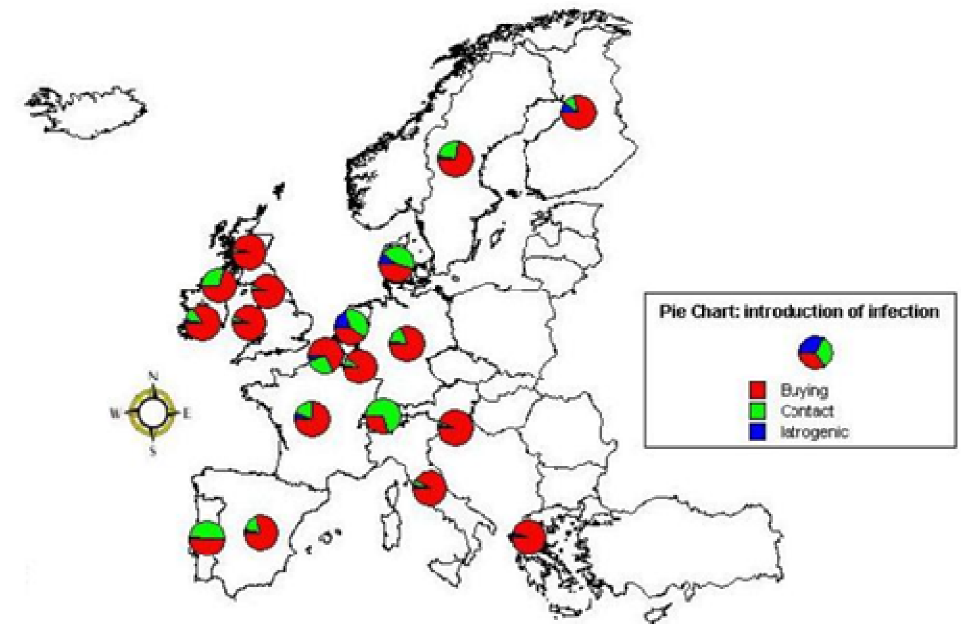
The main risk of infection comes from cattle that are persistently infected (PI). If a cow is in the first 110 days of gestation when she first comes into contact with the virus and pregnancy results in a live calf, the calf is born immunotolerant to the BVD infection and remains persistently infected (PI) with the virus for life (Brownlie et al.,1987; Peterhans et al., 2003). The virus is able to cross the placenta during the early stages of pregnancy; it is not recognised by the foetus as being foreign and is able to establish itself within the genetic makeup of the unborn calf. The calf is then a PI and constantly sheds the virus infecting other animals that it comes into contact with.

Animals that are infected with BVD virus after birth often show no signs of disease and eliminate the virus within a few weeks. However, BVD virus causes immunosuppression, so other diseases, such as pneumonia are more common in groups of cattle if a BVD PI is present.

There are two BVD vaccines available on the market in the UK. These have been available for a number of years, but vaccination as a stand-alone measure, (i.e. without identifying and removing PI animals) has never been shown to improve the epidemiological situation (Moennig et al., 2004). PI animals do not always perform in an inferior way and they can go undetected for several years. If kept for breeding they will always give birth to PI calves.

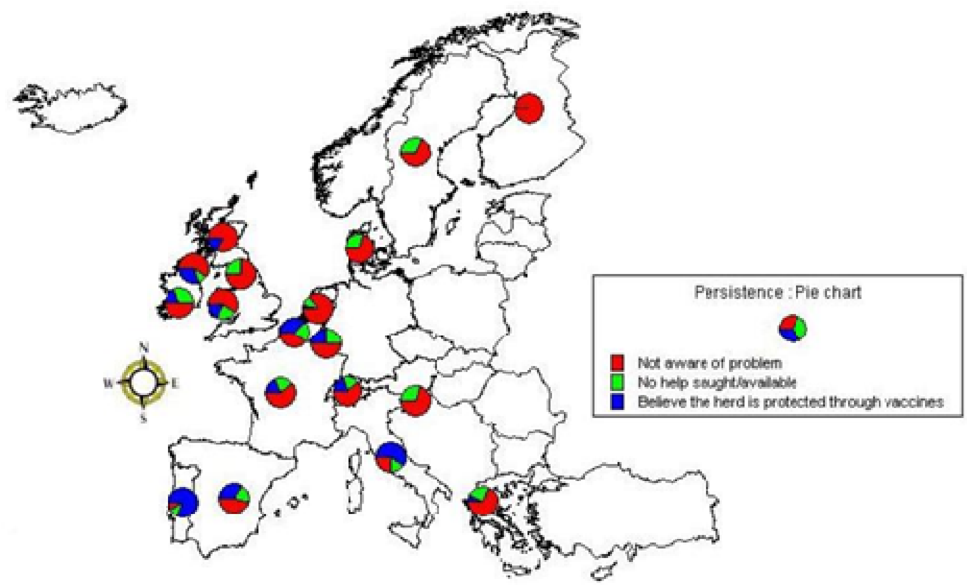
A European Union (EU) Commission funded Thematic Network on control of BVDV finalised its report on BVD in Europe recently (Moennig and Brownlie, 2006). An element of the report included a survey on the cause of spread of BVD in European countries and why the incidence of disease is not reducing. Figures 8 and 9 highlight that in England the main source of infection is from buying in infected stock. This accounted for more than 90% of the sources of infection. 60% of farmers were not aware there was a problem in the herd and 20% believed that implementing a vaccination programme protected their stock. A further 20% believed the relationship with their vet meant that they did not feel they had the appropriate help and advice available.

Figure 8: Introduction of infection into European herds



Latrogenic and passive transmission would be human introduction of BVD to uninfected herds through contaminated equipment, clothes, drugs, semen and embryos. This was believed to be a greater concern in the Netherlands, Denmark and Sweden.

Figure 9: Why BVD remains on farms in Europe



Surveys indicate that the range of PI animals present in infected herds in Europe is often within the range of 0.5 to 2% (Houe., 1999, Rüfenacht et al., 2001) and that up to 29% of herds could contain one or more PI (Gunn et al., 2004).

It has been estimated (Paton et al., 1998) that 65% of UK herds have encountered the virus and have a detectable antibody titre and 95% of the national herd has been exposed to the virus at some point. In 2003, BVDV was calculated to cost the UK cattle industry (beef and dairy) £39.6

million per year placing the disease as the third highest cause of loss after mastitis and lameness (£180m and £54m per year, respectively) (Bennett and Ijpelaar, 2003).

The £39.6 million was broken down into the following categories:

- Reduced milk yield- £0.2 million
- Fertility problems - £1.7 million
- Mortality and premature culling- £23.1 million
- Abortion and stillbirth - £11.6 million
- Control costs - £1.8 million
- Monitoring costs - £1.2 million

There are more recent estimates of the costs of BVD suggesting £50-£75 million per year (XL Vets, 2012). These figures reflect the increased input costs such as feed and veterinary and medicines and the increase in the value of beef in the UK since 2003, however they are not peer reviewed papers and remain estimates. Barrett et al (2011) apportioned the costs of BVD as shown below:

- Immunosuppression of calves 7%
- PI calves 19%
- PI cows and heifers 16%
- Abortions 9%
- Congenital defects/growth retardation 5%
- Other reproductive losses 44%

These estimates do not include costs of treating disease conditions resulting from BVD infection (e.g. scour, pneumonia and mucosal disease). Some farmers may treat for these ailments oblivious to the fact that the main cause of them is the BVD virus. Undetected BVD is a massive threat to the performance and financial viability of any herd, but the cost of BVD in a beef herd is very difficult to assess. However, Gunn et al (2004) estimated that the cost of a BVD outbreak in a commercial suckler herd with no immunity to the virus was likely to be £37 per cow as a result of infertility and abortion alone. The current cost, when the increased market value of cattle is taken into account, is likely to be in the region of £50 for every suckler cow in the herd. These figures take no account of losses due to diseases such as pneumonia and scour leading to poor growth rates and higher variable costs.

Data provided by MSD Animal Health show that 60% of herd samples submitted for MSD Beef Check between January 2011 and June 2011 were found to be positive for antibodies to BVD. This highlights that the incidence of the disease is not reducing and new cases are found every year. It is very frustrating that the technical tools and the knowledge needed for eradicating BVD are at hand but they are not being implemented in an effective way to reduce the incidence of disease.

BVD is not a notifiable disease in England but it is notifiable in eight European countries; Austria, Belgium, Denmark, Finland, Germany, Norway, Sweden and Switzerland (Source: EU Thematic network on control of BVDV). Several EU Member States have already embarked on large eradication programmes - France (Joly et al., 2004), The Netherlands (Moen, 2005) and Germany (Moennig et al., 2004). Time-limited, project type control efforts have also been implemented in Rome and in the Lecco and Como regions of Italy (Ferrari et al., 1999, Luzzago et al., 2004). Closer to home, Scotland and Northern Ireland implemented a BVD eradication and control programme from 2011. Phase one of the Scottish BVD Scheme, which involved subsidising farms to the value of £36 per herd and a further £72/herd if the farm tested positive for presence of BVD, found that out of 3,063 beef farms that took part, 23% of herds tested positive for BVD compared to 52% of dairy herds (Scottish Government, 2011).

England has not implemented a country wide programme although there have been several regional projects across the country.

The culling of PI animals followed by improved bio-security between farms is a control model that has been used on a nationwide basis in Scandinavian countries (Greiser-Wilke et al., 2003) and in other European countries. In the UK, some farmers have adopted this method and monitor their herds annually for the presence of PIs. However, many farmers in England do not know the BVD status of their herds. Vaccination alone is rarely successful in controlling BVD and needs to be accompanied by a testing programme to identify and eliminate PI animals.

As a consequence of its economic importance and the fact that it is a controllable disease, there is political pressure to consider greater control and eradication where possible (Gunn et al., 2004).

6.1.1 Case Study - BVD

A beef herd of 120 breeding cows in Derbyshire suffered an outbreak of BVD infection in 2009/10. In previous years there had been low barren rates when the cattle were pregnancy scanned in December/January.

Table 18: Case study – farm barren rates 2006-2011

Year	Barren rate (%) at scanning
2006/07	5%
2007/08	5%
2008/09	2.5%
2009/10	27%

In the 2009/10 season, 32 cows were barren. The problems continued over calving with a higher than normal mortality rate and a number of calves scouring and running a high temperature – all of which were attributable to the BVD virus. Blood analysis from the breeding cattle indicated a very high exposure to BVD which suggested that the virus was circulating in the herd. A purchased stock bull was identified as the source of infection. The following table summarises performance as a result of the BVD outbreak compared to performance after vaccination.

Table 19: Case study – effect of BVD on herd performance

	2009/10	2010/11
Barren rate %	27	11
Calving period weeks	34	22
Calf mortality %	11	5

The table below sets out the financial benefits of vaccination.

Table 20: Case study – direct costs of BVD outbreak

Costs	Calculation	Cost £/cow
<u>Increased barren rate from 5% to 27% i.e. 26 more cows are barren</u>		
26 fewer suckled calves at sale @ £600 /head* minus production costs per calf to weaning (assumed to be £60/head **)	26 x (600-60)	14,040
Calf mortality increased from 5% to 11%		
7 calves died up to 6 months of age at forecast sale value of £600* minus production costs**	7 x £540	3,780

Total cost – herd		17,820
Cost per cow (based on 120 cows)		148.50

*300 kg liveweight @ £2.00/kg

**Production costs – marketing £15, transport £20, vet/meds £5 and feed £20.

Table 21: Case study - cost benefit of identifying PI animals and vaccinating against BVD

Costs	Calculation	£
Cost of vaccination (2 doses at £3 per dose for 120 cows)	(120 x £3) x 2	720
Labour costs to administer (2 days per vaccination)	2 x £100 per day	200
Cost of PI testing the herd (2.5 hours vet time @ £100/hr plus Lab fees + materials (£750))	(2.5 x 100) +750)	1000
Total cost of BVD vaccination and prevention	720+200+1000	1,920
Additional income (reduced barren rate from 27% to 11% = 19 additional suckled calves at forecast sale value of £600/head* minus production costs**)	19 calves at £540/ head	10,260
Additional income from lower calf mortality – reducing from 11% to 5% (£600/head* minus production costs**)	7 calves at £540 /head	3,780
Additional calf value minus additional cost	14,040 – 1,920	12,120
Additional income per breeding cow (120 cow herd)	12,120	101

*300 kg liveweight @ £2.00 / kg
**Production costs – marketing £15, transport £20, vet/meds £5 and feed £20.

This is an extreme example of the effect that BVD can have on a naïve herd. Not all infections will spread this quickly or be apparent to the farmer. On some farms BVD will go undetected for several years due to a low incidence and symptoms may be attributed to pneumonia and scour outbreaks when the source of the problem is BVD. Due to the high number of barren cows following this outbreak of BVD, the culls were not sold but instead returned to the bull for calving later in the year. This affected conception rates the following year because a number had calved late and required additional time before conception was feasible. Continued vaccination and tighter calving pattern would result in a further reduction in the herd barren rate (similar to what was achieved prior to the outbreak).

The financial benefit shown in the table does not account for a reduction in labour from a reduced calving interval, reduced veterinary costs (from reduced incidence of scouring and pneumonia) and reduced stress on the farmer.

The case study outlined above shows exceptional financial consequences of BVD invading a cattle herd. Tables 22 and 23 below show the financial cost of a more typical occurrence of BVD in a 100 cow suckler herd with calves sold at an average of 270kg live-weight. .

Table 22: Typical cost of a BVD outbreak in a 100 cow suckler herd

Costs	Calculation	Cost £/herd (100 cows)	Cost (£/cow)
Increased barren rate from 5% to 12% amounts to 7 fewer suckled calves at sale @ £540 /head. Production costs per calf to weaning are assumed to be £54/head *	7 x £486 = £3,402	3,402	34
Calf mortality increased from 3% to 8%			
5 calves died up to 6 months of age at forecast sale value of £540*.	5 x £486 = £2,430	2,430	24
Total cost		5832	58

270 kg live weight @ £2.00/kg less *£54 production costs – marketing £12, transport £17, vet/meds £5 and feed £20

Table 23: Typical estimated cost benefit of eliminating PI animals and vaccinating against BVD in a 100 cow suckler herd

Cost benefit of prevention	Calculation	£/herd (100 cows)	Cost (£/cow)
Cost of vaccination (2 doses at £3 per dose)	2 x £3	600	6
Labour costs to administer (1 day per vaccination for 100 cows)	2 x £100 per day	200	2
Cost of PI testing the herd (2 hours vet time @ £100/hr plus Lab fees + materials(£600))	£200+£600	800	8
Total cost of BVD vaccination and prevention	600+200+800	1,600	16
Additional income - reduced barren rate from 12% to 5% = 7 additional suckled calves at forecast sale value of £540/head.less production costs*	7 calves at £486/head	3,402	34
Reduced calf mortality from 8% to 3%	5 calves at £486/head	2,430	24
Additional calf value minus additional cost	5,832- 1,600	4232	42

*270 kg live weight @ £2.00/kg less £54 production costs – marketing £12, transport £17, vet/meds £5 and feed £20

Note that the costings in Tables 22 and 23 are based on BVD being introduced to a naïve herd, so the effects and corresponding losses are still substantial. In herds where BVD is endemic and consequently most animals have antibody and are immune, fewer animals will be affected so the losses will be less.

There are two methods available to farmers to identify PI cattle in their herds. The farm vet can take blood samples that are sent away for analysis or tissue sampling tags (TSTs) can be used which are available from various sources (e.g. Allflex, Nordic Star) and these are also sent away for analysis.

The TST is designed to remove a sample of tissue from the ear of an animal (whilst tagging) allowing farmers to take a sample for analysis without a vet present.

6.2 Johne's Disease

Johne's disease is caused by the bacterium *Mycobacterium avium* subspecies *paratuberculosis* (MAP). This bacterium is closely related to the organism causing bovine tuberculosis (*Mycobacterium bovis*).

Johne's is a disease where the number of clinically affected animals in a herd is often far exceeded by the number of animals that are infected, but not yet showing signs of disease, i.e. are subclinically affected. It has been suggested that in heavily infected dairy herds there are likely to be 25 infected animals showing no clinical signs to every animal that is exhibiting clinical signs (Whitlock and Buergelt, 1996). This happens because cattle are most susceptible to infection with MAP in the first few months of life, but the disease has a long incubation period, with signs of advanced disease most commonly seen at three to five years old. The characteristic signs present in cattle suffering from Johne's disease are:

- Severe and persistent (watery) diarrhoea
- Extreme weight loss

Animals that are in the sub-clinical phase of the disease often show:

- Reduced milk yield
- Poor body condition
- Longer calving interval

The prevalence of Johne's infected herds in the UK is not known. Caldow et al (2001) estimated the likely UK herd prevalence (diary and beef) to be 20% (based on prevalence figures from other countries and limited regional data). Herds with a high prevalence of Johne's disease usually have increased replacement rates because of reduced performance (Chiodini et al., 1984) and reduced cull values. Scottish Agricultural College estimated in 2009 that the cost of Johne's to the UK cattle industry amounted to £13 million per year (Moredun, 2010).

Efforts to control Johne's disease are hindered by diagnostic limitations. Available tests either detect the organism in faeces or detect antibody in blood or milk. However, none of these tests reliably identify animals that are infected but still in the silent phase of the disease. As a general rule, it is difficult to identify infected animals until they are two years old or more. This means that it is not possible to reliably screen purchased animals before they enter a herd. An animal may test negative on several occasions, and then test positive. There is also the potential for impaired testing specificity attributed to other mycobacterial exposure (Osterstock et al., 2007; Roussel et al., 2007). Control of the disease is further constrained by the absence of economically feasible and practical treatments (Manning and Collins, 2001). Bhattarai et al., (2012) also reported that as an industry there is very limited information on the losses caused by Johne's which makes it harder for producers to make sound decisions based on economic benefits. A summary of a study undertaken between 1999 and 2009 evaluating the losses associated with Johne's disease in beef herds has shown that offspring of cows positive for MAP in faeces or ELISA results were lighter at weaning by 9.7% and 14.9% respectively (Bhattarai et al., 2012). These findings suggest that infected beef herds suffer significant economic losses.

Cattle that are infected with Johne's disease shed the bacteria in their faeces. Clinically infected cattle have higher concentrations of MAP in their faeces and milk compared to sub-clinically infected cattle (Nauta and van der Giessen, 1998). The volumes of MAP shed tend to increase as the disease progresses in the animal. The routes of transmission of the disease between cattle are:

- drinking contaminated colostrum
- ingesting faeces that may be present on unclean teats
- contaminated feed
- contaminated environment or water supplies
- transplacental infection

Young calves are especially vulnerable to infection and 80% of infected animals will have caught the disease within the first month of life. One gram of faeces from an infected cow can contain 5 million organisms and less than 1,000 of these are needed to infect a young calf (Ayele et al, 2001). The infection can also be passed across the placenta which means that offspring of infected cattle may be infected. For cows showing signs of Johnes disease, about 4 out of 10 will produce a calf that has been infected in utero. Whilst for subclinically infected cows, only 2 out of 10 calves are likely to be infected in utero.

The incubation period for the disease is 1 to 15 years but more typically around 2-6 years (Caldow et al., 2001). This means that after infection the animal looks normal for the early years and indeed may never develop the disease. Therefore an infected replacement heifer may test negative for several years before she tests positive and finally shows signs of the disease. The condition is rarely seen in cattle slaughtered by 24 months of age. For every clinical case present in the English herd there could be 25 subclinical cases, some of which may be highly infectious (Whitlock and Buergelt, 1996).

Research has shown that a strategy to improve management measures which reduce the route of infection during the early stages of life results in a fall of 25% in the herd prevalence of Johne's and a reduction in the total costs associated with the disease (Bennett and Ijpelaar, 2005). This study also suggested that testing and culling does little to reduce prevalence and does not reduce total costs over a 10-year period.

For every animal that develops clinical signs there may be 7 to 10 animals excreting MAP organisms and a further 7 to 10 in the silent period of infection. In heavily infected herds more than 25% of animals may be infected. A UK study of dairy herds published in 2009 demonstrated that out of 13,688 cows from 136 dairy herds 65% of herds had at least one animal that tested positive on the ELISA test for Johne's and 2.5% individual animals tested were positive (Defra, 2009b). A local slaughter house survey of cull cows in the south west of England (Cetinkaya et al., 1996) identified MAP in 3.5% of cull cows. There is no published data on the prevalence of Johne's in UK beef herds.

There is currently no authorised vaccine available in the UK for the control of Johnes disease. However, in specific circumstances where the use of vaccine is considered necessary for controlling the disease in a UK herd, it is possible to obtain permission to import and use an inactivated vaccine from Spain by applying for a Special Import Certificate (SIC) from the Veterinary Medicines Directorate (VMD).

Vaccination does not decrease the number of infected animals in the herd (Wentink et al., 1994) but it is effective in reducing the number of MAP shedders (Körmendy, 1994) and it reduces the number of sub clinical cattle becoming clinically ill (Wentink et al., 1994). If cattle are vaccinated, it is less easy to interpret the results of diagnostic tests, so it becomes more difficult to identify infected animals. For this reason, vaccination is now rarely used in UK herds. Regular testing and management to reduce the potential for disease transmission are now the preferred control options in the UK

Table 24 shows an estimate of the cost of Johne's disease in a herd of 100 suckler cows where 10% of the cows are infected. It is assumed that the presence of the disease results in 5% less calves being produced per annum and 5% of the calves produced each year weigh 36 kg less at weaning. It also assumes that Johne's disease results in 2 cows with clinical Johnes being slaughtered and unable to enter the food chain due to emaciation and in an additional 3 cows being culled each year.

Table 24: Annual cost of Johne's disease in 100 suckler cow herd – spring calving with an average calf weaning weight of 270 kg.

Description	Calculation	Annual cost £
Two fewer weaned calves at forecast sale value of £540 (£2/kg). Production costs are assumed to be £54/head.	2 calves x £486	972
5 lighter calves at weaning	5 calves x (36kgx £2*)	360
5 additional female replacements @ £1,000/head less 3 culls @ £600/head	(5 x £1000)-(3 x £600)	3200
Typical total annual cost for 100 cow suckler herd infected with Johne's disease		4532

*270 kg live weight @ £2.00/kg less £54 production costs – marketing £12, transport £17, vet/meds £5 and feed £20.

6.3 Respiratory Disease

Respiratory disease is an infection of the respiratory tract and is caused by infectious agents (bacteria and/or virus). Respiratory disease occurs when bacterial/viral agents are combined with poor air quality and ventilation, poor husbandry and stress. A reduction in the animal's appetite results in a reduction in live-weight gain and if left untreated it creates so much damage that the animal cannot breathe effectively and becomes starved of oxygen resulting in death. Antibiotics are effective for treating the bacterial infections associated with respiratory disease and improvements can usually be seen within 24-48 hours if caught early enough. Anti-inflammatories are also administered to reduce the damage caused by any inflammation. This also results in an improvement in the well being of the animal resulting in increased appetite.

The first symptom in an animal suffering from respiratory disease is a reduction in feed intake, followed by a high temperature (39°C and above), discharge from the nose and coughing followed by a depressed and lethargic appearance.

The main viral causes of respiratory disease in cattle in England are:

- Infectious bovine rhinotracheitis (IBR)
- Parainfluenza 3 (PI3)
- Bovine respiratory syncytial virus (BRSV)
- BVD– to some extent

This section covers only IBR, BRSV and PI3 as BVD has been discussed in section 5.1.1.

Respiratory disease can affect cattle of all ages but it is predominantly seen in young cattle from 3 to 15 months of age. Affected cattle are highly infectious and shed virus and bacteria in large quantities via infected discharge from the nose.

The environmental and management factors that significantly predispose cattle to respiratory disease (Snowder, 2009) include the following:

- Housing – poor ventilation or draughts
- Housing - mixing stock of various ages
- Temperature – a sudden cold snap or hot weather
- Stress caused by housing, moving or mixing animals

- Poor stock management such as inadequate intake of colostrum at birth, poor nutrition and poor hygiene

A severe outbreak of respiratory disease may affect up to 50% of animals within a group and mortality can be high. In many instances, the main financial loss associated with an outbreak is not the mortality per se but the long term reduction in animal performance of animals that have succumbed to disease and have then recovered. An animal that has suffered from respiratory disease tends to have reduced live-weight gain and subsequently higher feed costs as a result of reduced feed conversion efficiency.

The costs of respiratory disease to the industry are hard to determine with estimates in the range of £50 million to £80 million per year (Potter, 2010, Barrett, 2000). In 2007, NADIS estimated the cost to be £60 million. Scott (2012b) quoted the cost per animal as £30 for a mild case and up to £500 when the afflicted animal dies.

The direct costs in a dairy herd are attributed to; the dead animal, labour involved with treatment, veterinary involvement and medicines. The longer term costs in animals that recover are seen as; fibrosis, loss of functional lung capacity and a resultant reduction in daily live weight gain (Potter, 2010).

The average cost of an outbreak from a detailed survey of 12 cases (sponsored by Pfizer Animal Health but carried out independently by National Animal Disease Information Service (NADIS) veterinary practices) during 2010 was calculated as a minimum of £43.25 per ill calf in the herd. A target liveweight gain to 6 months – of 0.7kg/day can often be reduced to 0.4kg/day after respiratory infection.

Infectious bovine rhinotracheitis (IBR) was first recognised in the UK in the 1970’s. At that time the most severe form of IBR had a morbidity rate of up to 100% and a mortality rate of up to 5%. The cost to vaccinate all cattle on the farm against IBR annually is thought to be £2 to £3 per head (Scott, 2012b).

It is important to acknowledge that a broad approach is required to manage the risks of respiratory disease in a herd. Vaccination will be ineffective if housing is still poor and calves of mixed ages are housed together, or there is another underlying cause of disease that has not been identified and is not being controlled.

Tables 25 and 26 calculate the cost benefit of vaccinating cattle against respiratory disease against the cost of disease. The calculation is based on a group of 25 calves.

Table 25: Estimated cost of pneumonia outbreak in group of 25 weaned six month old suckled calves.

Cost	Calculation	£/animal in group
Reduced average growth rate in 10 calves – 0.10kg /day from 6 months of age to slaughter at 24 months of age. (540 days x 0.10 kg/day x £2/kg)	540 x0.1 x £2=£108/calf affected. X10 ÷ 25	43
Cost of vaccination after outbreak (£5/head for intranasal vaccine + £1 labour)*		6
Cost of treating 5 sick weaned calves with antibiotic, electrolytes and vet costs - £43/head (Source NADIS)	(43 x 5) ÷ 25	8.60
Loss of one calf out of 25 at 6 months old @ £600	600 ÷25	24
Cost of pneumonia outbreak per calf in group of 25 animals.		81.60

*intranasal vaccine @£5/dose. Injectable vaccine needs 2 doses @£5 each hence cost would be £10 plus labour.

Total estimated cost of pneumonia outbreak in 25 calves is £2,040

Table 26: Cost benefit of vaccination to prevent pneumonia outbreak in group of 25 weaned suckled calves

	£/calf in group
Cost of pneumonia outbreak (See table 25)	81.60
Cost vaccination per animal	6
Cost benefit of vaccination when 100% effective per calf	75.60

The potential cost benefit of vaccinating the whole group would be £1,890. NOTE: No costs have been included for improved housing or changes to management to reduce the incidence of respiratory disease.

It is cost effective to administer vaccine at housing for youngstock where pneumonia is a known risk; however it should not be done in isolation because nutrition, ventilation, stress and stocking densities all play a crucial role in reducing pneumonia.

6.3.1 Cost Benefits of Improved Housing

Correct ventilation is one of the most important features of any cattle building. Most UK cattle buildings are poorly ventilated due to inadequate ridge ventilation which prevents stale air from escaping.. In any one year a severe outbreak of Bovine Respiratory Disease in a group of weaned calves could cost at least £82/head per animal affected (see Table 26 above). In a typical group of 40 calves the total financial loss would be £3,280. This cost is likely to be made up as follows -– 40% due to loss of live-weight gain, 31% medicines, 14% mortality, 10% vet costs and 5% other costs. (Hampton Veterinary Group, 2012) Moreover, in a poorly ventilated building an outbreak of respiratory disease (depending on weather conditions and the susceptibility of the animals etc) is likely to occur every year.

Significant enhancements to the ventilation of a cattle building can often be done at a fraction of the cost of a single outbreak of respiratory disease. For example, in a building accommodating 40 cattle the cost of materials would be very low (estimate £250) for creating roof air outlets through lifting roof sheets onto wooden batons or the removal of roof sheets in strategic places. There would be additional costs for labour and machinery,

6.4 Diarrhoea (Calf Scour)

Viruses and protozoa are the main causes of infectious calf scour. An outbreak of infectious scour is often serious and invariably costly to any cattle enterprise. Scour is the most common disease in young calves and it accounts for roughly 50% of all calf deaths (Ohnstad, 2012) as well as reduced performance. The main causes of scouring and the incidence on beef farms sampled through MSD Scour Check during 2009 were:

- Rotavirus - 37%
- Coronavirus – 28%
- E-coli – 5%
- Cryptosporidiosis – 30%

less common causes include:

- Coccidiosis
- Salmonella

A national calf survey carried out by Intervet-Schering Plough Animal Health (ISPAH) in 2010 found that over 70% of cattle farms had experienced calf deaths from scour during the year. In 2003, enteric diseases were estimated to be costing the national herd £11 million per annum (Bennett and Ijpelaar, 2003).

It has been estimated (DairyCo Technical Information, 2011) that each year in the UK 8% of the calves born into the national dairy herd die within 6 months of birth. This equates to about 160,000 calves which has an important knock on effect as almost 50% of the prime beef produced in UK originates from the dairy herd (Eblex (2011) states - 57% from dairy herd and 43% from beef herd). Most of these animals would have been taken from their mothers at about 2 days of age and reared artificially on reconstituted milk substitute. Inadequate intakes of colostrum and poor environmental hygiene are the main management factors involved in this high percentage loss.

Heifers are known to produce colostrum with 25% less immunoglobulins than mature cows; therefore a proportionately greater amount of colostrum should be given to calves born to heifers (Scott, 2012a). Another measure to mitigate the effects of reduced immunoglobulin levels in heifers would be to calve them earlier than the main herd so the calves born to heifers are exposed to a lower level of infection.

Similar to respiratory disease, growth rates of calves that have suffered from scour are much lower and incur a significant cost to the industry. Growth rates can be reduced substantially (by up to 0.6kg/day) prior to weaning compared to the expected live-weight gain of 1 kg/day or more. The cost of an outbreak of scour can average £33 per at risk calf. However costs can be five times that figure when calves die as a result of scour (Defra, 2008).

Viruses like rotavirus and coronavirus, and the protozoa cryptosporidium are not treatable with antibiotics. The best way to reduce the impact of these is through vaccination and good management practices on farm.

Vaccinations are available to prevent coronavirus, rotavirus and E-coli, although it is currently thought that only 10-15% of the national beef herd receive an annual vaccine (Farming UK, 2011). The vaccine should be administered to pregnant cows 12 to 3 weeks prior to calving so that the antibodies pass into the colostrum to the young calf soon after birth. However, it is important to note (as with pneumonia) that a vaccination policy will only work when used in conjunction with other good management procedures such as adequate intake of colostrum in the first 6 hours of life, a clean calving environment and clean, well-bedded calf pens. The high cost of straw in 2011/12 could have had implications on the incidence of scours.

Table 27: Estimated cost of scour outbreak in 100 cow suckler herd (assuming 90 calves born)

Cost	Calculations	£/cow/ in herd
Reduced average growth rate for 86 calves of 0.1 kg/day for 180 days. Selling price £2/kg.	(86 x 0.1 x 180 x £2)÷100	31
4% calf mortality Calves valued at £540 less £54 production costs*	(4 x 486) ÷100	19.44
Treatment of scour (electrolytes, artificial milk etc) – 30 calves treated @ £25/head	(30 x 25) ÷ 100	7.50
Cost of scour outbreak		57.94

*270 kg live weight @ £2.00/kg less £54 production costs – marketing £12, transport £17, vet/meds £5 and feed £20.

Total cost of scour outbreak in 100 cow herd is £5794.

Table 28: Cost benefit of preventing an outbreak of scour

	Calculations	£/cow
Cost of vaccinating all cows with Rotavec corona (coronavirus, rotavirus and e.coli) (£10/head vaccine + £1 labour)		11.00
Cost benefit of vaccination per cow	57.94 - 11	46.94

Benefit for herd of 100 suckler cows with 90 calves reared is £4,225

NOTE: No costs have been included for changes to husbandry and management to reduce incidence of scour.

6.5 Liver Fluke in Cattle

In 2003 liver fluke was estimated to cost the GB cattle industry (dairy and beef) approximately £23 million annually (Bennett and Ijpelaar (2003) Defra Project ZZ0102). More recently in 2011, EBLEX estimated the cost of liver fluke for the beef and sheep industry of Great Britain to be in the region of £13-15 million (Eblex, 2011b). The cost is often higher in cattle due to the fact that cattle livers are bigger and more valuable, but also due to the fact that sub-clinical fluke infection tends to go unnoticed in cattle. It is often seen as poor body condition and poor fertility in suckler cows and reduced milk yield in dairy cows.

Sanchez-Vazquez. & Lewis. (2013) showed that carcases from cattle that had liver fluke had a reduction in carcase value of 0.3% or £11 per animal in the raw data or £2.30 by multivariable Gaussian generalised linear mixed-effects models (GLMMs), as a consequence of reduced weight (-5kg), reduced carcase fatness and conformation. These results indicate a much lesser effect on carcase value than anecdotal evidence would suggest. Work undertaken by Harbro Ltd (personal communication, M. Vickers 2013) has shown that that liver fluke can delay finishing in cattle by 27 days and reduce carcase weight by 2.5 kg, or alternatively in a separate study, fluke was found to delay finishing by 2 days and reduce carcase weight by 15 kg. The figures in table 19 are based on this data, and also assume a reduction in carcase conformation of half a score.

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Table 29: Cost of fluke in finishing beef cattle (assuming 27 days delay in finishing time, reduced carcase weight by 10 kg and reduced carcase conformation by half a score)

Cost	Calculation	£/head
27 days longer on-farm at £1.50 per day per animal (variable costs)	27 x £1.50	40.50
Loss of 10 kg carcass weight (330 kg vs 320kg) and half a conformation score lower (deadweight 320 kg at £3.72/kg instead of £3.75/kg))	330kg x£ 3.75 p/kg = £1237.5 – (320kg x £3.72)	47.10
Cost of finance associated with delayed income for 27 days per animal (2.5% interest)		2.08
Total cost per animal affected		89.68

The cost of housing animals over the winter ranges from £1.20 to £1.80/animal per day. The cost covers variable costs only – feed, straw, vet and med. The cost is determined by the ration and for the purposes of this exercise a mid range of £1.50 per animal per day has been used.

Poor conformation would account for the fact that the animal is older going to slaughter, has taken longer to finish due to poor health and has made some compensatory growth. This is in addition to the additional costs of keeping the animal on farm for longer.

Finance cost amounting to £2.08 per animal (due to delay in payment of 27 days into the bank) is based on the following assumptions: 0.5% Bank of England base rate plus 2% over base on £1190 (315kg at £3.72p/kg) for 27 days (27/365= 0.07 of a year). £1,190 multiplied by 2.5% x 0.07 = £2.08.

No mortality has been factored into the losses in production because cattle most commonly suffer from chronic disease where mortality is relatively uncommon. The largest losses associated with liver fluke are losses in production, which can often go unnoticed.

Table 30: Cost benefit of preventing fluke in beef youngstock

Cost benefit of flukicide treatment	**Calculation £**	**£/head**
Cost of flukicide treatment	2.50	2.50
Labour to administer flukicide @£12/hr, 24 animals per hour)	12÷24	0.50
Total cost per animal treated		3.00
Cost of fluke outbreak per animal (see Table 29)		89.68
Cost benefit of fluke treatment per affected animal	108.25 - 3	86.68

The cost benefits of preventing fluke by administering a flukicide treatment at housing eliminates the losses associated with fluke such as delay to finish and reduced carcase value with a positive cost benefit of about £87 per affected animal.

7. STEEPLE analysis

A STEEPLE analysis is undertaken to assess what the social, technological, environmental, ethical, political, legal and economic factors are that affect or influence decision making processes. This method is used to mitigate risks.

The key challenges and opportunities facing English beef and sheep producers have been considered through a STEEPLE analysis.

	Issue	**Impact**	**General effect of the impact**	**Effect on Animal Health & Welfare**
Sociological				
Ageing population of farmers and fewer young entrants entering the industry.	Difficult to attract new entrants into agriculture because of poor profitability and poor public perception of farming industry. Ageing farmers remaining on their farms and not selling or renting the farms out. Number of farms without succession increasing.	Lack of skilled livestock workers and stockmen to look after livestock.	Affecting herd and flock health and welfare. Closure of local schools and associated community hence less potential new entrants.	Unskilled workers not able to recognise and treat sub-clinical and clinical diseases resulting in higher mortality, increased incidence of disease and losses in production. All resulting in poorer animal health and welfare.
Consumers wanting more control over the way food is produced – buying organic and local food	Consumers want to know more about where their food is coming from and how it was produced.	Increase in farm shops and consumers buying locally produced products. However during the recession cost has had an impact. Buying cheaper cuts of meat than in the past.	Consumers ask more questions about sourcing of their food which drives agriculture to improve production.	May lead to increased efficiencies and improved health and welfare.
Negative public perception of agriculture. Criticism of too much red meat in the diet	New and emerging diseases like Schmallenberg and the ongoing TB discussions do not provide a positive image of English farming	Consumers buy less red meat	If demand for red meat drops, prices will fall. Farmers may exit farming or continue and make financial losses which puts added pressure on their ability to buy feed, medicines and bedding.	Resulting in a reduction in the number of breeding animals in England and/or poorer animal health and welfare.
Budget constraints on households	Rising costs of living such as fuel and oil bills plus reduced employment	Households have less disposable income. People are buying cheaper cuts of meat and only buying larger more expensive cuts such as leg of lamb or beef roasting joint on	This has resulted in lamb consumption in England falling dramatically. Reduction in meat consumption in England means that if export	Dramatic drop in the value of lamb could result in: mass exodus from sheep industry.

	Issue	Impact	General effect of the impact	Effect on Animal Health & Welfare
		special occasions.	market was closed/restricted this would lead to a large number of surplus lambs in England.	Farmers may reduce the amount they spend on production costs such as feed, vet & med which would result in reduced performance and poorer animal welfare.
Importing protein sources from EU countries	High quality protein sources fed to animals to maximise productivity such as soya, are imported from non EU countries which are not sustainable sources.	If these sources are lost then English beef and sheep producers will not have sources of high quality protein available. If prices of these increase they will become uneconomical to purchase.	Not feeding livestock adequate amounts of good quality protein would reduce performance and lead in some cases to poor animal welfare. Alternative protein sources need to be researched and developed.	Inadequate feeding especially protein would lead to increased disease incidence and reduction in performance of the flock and/or herd resulting in poor animal health and welfare.
Technological				
Uptake of IT in agriculture in a computer dominated world.	Uptake is very variable amongst farmers, often determined by age and acceptance of change. However, more services are online e.g. BCMS and SPS applications	Farmers without access to a computer will not be able to keep up with advances in agriculture and may not be able to submit SP forms and keep BCMS up to date if they become online only.	Farmers may breech cross compliance rules which would lead to financial penalties on their Single Payment (SP).	Loss of SP income may result in cost cutting such as buying fewer vaccines for their cattle, reducing flukicide treatment in their flock etc. This would have a negative impact on animal health welfare.
Genetically modified crops	Consumers are reluctant to purchase GM crops or animals fed on GM products.	Could result in a reduction in consumer confidence and result in buying less meat or restricted feed available to livestock farmers.	A reduction in meat consumption/demand could result in reduced price for stock leading to decreased profitability for farms.	If feed is restricted this could lead to welfare issues.
Energy generation opportunities e.g. solar, wind.	Increasing costs of fuel and energy may result in improved payback periods on renewable energy sources.	Reduce costs of production and reduced carbon footprint of agriculture.	Benefits to improved farm profitability and reduction in carbon footprint/greenhouse gases.	Farmers may invest in their livestock and other infrastructure which would benefit animal health and welfare e.g. improved housing leading to less scour and pneumonia.
Economic				
Public sector job cuts and reduced government funding	Reduced government funding may lead to reduced jobs and less funding for research and development in the agricultural sector (as well as other sectors).	Fewer advances in animal research which could hinder increases in productivity and scientific breakthroughs.	Production will not improve and performance will remain stagnant. This will also affect ability to reduce GHG emissions. This would make us	No improvements would be made in level of animal health and welfare based on new research and development.

	Issue	Impact	General effect of the impact	Effect on Animal Health & Welfare
		Could leave England behind the rest of the world.	less competitive in the World marketplace.	
Reduction in AHVLA funding	Reduction in government spending resulting in the potential closure of 8 AHVLA sites.	Closures result in further transportation of animal samples to laboratories or farmers failing to diagnose causes of mortality and disease incidence as a result of the distance to their nearest lab	Deterioration of samples as a result of incorrect storage during transportation. Farmers not getting diagnosis on diseases and loss of specialist skills from AHVLA vets and staff.	Reduced performance and welfare concerns due to poor diagnosis of disease on the farm. Delays in diagnosing zoonotic or new disease causing it to spread and cause huge economic impact e.g. bluetongue, foot and mouth disease, Schmallenberg
High commodity prices	Rises in VAT, price of fuel, feed and fertiliser.	Increasing the cost of production when the consumer needs to keep spending down.	Higher costs of production leads to reduced profit margins which in turn affects investment in housing, machinery and changes to husbandry practices.	Leads to poor animal health and welfare standards and lower production rates.
Bank lending	Whilst base rate is at its lowest for decades, banks are increasing arrangement fees, base rates and changing lending criteria.	Borrowing money is not as cheap as the base rate suggests and this has lead to restrictions on funds available to farmers with high borrowings.	This affects farmer's ability to borrow money, pay bills and generally run the farming business. May also result in selling land, stock, machinery to release capital or even selling the entire farm.	Limited money will force farmers to change their spending habits so they may no longer buy the best feed, or may cut back on vaccines against diseases – this could reduce animal health and welfare in a time when production needs to improve to maximise income.
Population growth	World population is growing and adapting to more westernised diets.	Greater demand for red meat abroad which is leading to export opportunities.	Prices are higher because of export opportunities. Vulnerable to exchange rate changes.	Increasing prices for livestock may lead farmers to invest in infrastructure which would improve animal health and welfare.
Migrant workers	Fewer migrant workers are able to enter the country due to restrictions.	Affects labour availability at peak work times e.g. harvesting and shearing. Puts added pressure on current workforce.	Management jobs either get left undone or unskilled labour is employed to undertake these jobs.	Results in reduced performance and possibly increased disease incidence.
Environmental				
Climate change adaptation	Climate is changing resulting in unusual weather patterns.	Longer growing seasons, dryer winters, more extreme weather events such as flooding and	Changes to operations may be required e.g. housing later, additional blow fly treatments	Some adaptations will have positive impacts on animal health and welfare e.g. housing

	Issue	Impact	General effect of the impact	Effect on Animal Health & Welfare
		drought.	etc.	later due to warmer, shorter winters. However, some changes may result in poorer animal health and welfare e.g. increased blowfly season leading to increased incidence of strike.
Climate change	Warmer weather	Leading to the emergence of new diseases such as Bluetongue, Schmallenberg etc.	Could result in huge production losses and impact on public perception of farming practices	New diseases harder to control and/or prevent leading to increased losses and poorer animal health.
Greenhouse Gas emissions	UK committed to reducing greenhouse gases. Agriculture plays a major role in this reduction.	Agriculture will need to reduce GHG emissions by improved performance, reduced reliance on artificial fertiliser applications and best practice application of manure/slurry.	All the things mentioned will have a positive effect on farm performance and reduce costs as well as meeting the GHG reduction.	Improved efficiency to meet the reduction in GHG emissions can be done by improvement in animal health and welfare alone.
Water management	Dryer seasons	Leading to drought conditions in certain regions in England.	Farms will need to change farming practices to meet water availability – harder for livestock producers as lack of water will limit numbers kept and cause welfare concern.	Lack of water to livestock is a huge welfare concern and would need addressing as a matter of urgency.
Greening of CAP	Governments wish to make CAP payments greener.	Could reduce the overall farm income if agri-environment and SFP are merged and could reduce stocking densities and land available for improvement and production.	Alter the number of animals per farm which could affect performance and profit. Could also lead to farmers leaving the industry due to the constraints they face.	Loss of headage payments has necessitated an improvement in production efficiencies to improve profitability of farming businesses; however, not all have achieved this. Further restrictions could see further polarisation of the industry with some improving health and welfare and others remaining stagnant or reducing performance.
Political				
Greenhouse gas emissions	See environmental			
Greening of CAP	See environmental			

	Issue	Impact	General effect of the impact	Effect on Animal Health & Welfare
Global food security	Growing population and increasing demand for food is high on Defra's agenda.	Farmers need to produce more food but not at the expense of the environment. Need to strike a balance between both.	Need to ensure livestock numbers do not reduce to a level that results in the UK needing to import the majority of beef and lamb because production levels cannot be met here i.e. we are not self sufficient.	Improving the health status of the English herds and flocks could increase the production of meat.
Labelling of food	More regulation is likely on labelling of food products in terms of origin and welfare.	More segregation by farming system and possibly price differentiation.	More variation in price across niche and commodity markets. Winners and losers.	Winners will thrive and improve animal health and welfare and losers will continue to struggle.
Legislative				
GM/pesticide legislation	Farmers are restricted by what products they are able to use due to UK/EU legislation.	Prevents the use of pesticides and certain feeds which could improve production and efficiency.	Falling behind the competitiveness of the countries that are able to use restricted UK products. This leads to increased cost of production making some imported feeds cheaper than home grown but not produced in the same way.	Animal welfare standards are higher in England than a lot of countries.
Greening of CAP	See environmental			
Cost of legislation	Nitrate Vulnerable Zones (NVZ) legislation relating to the time and amount of manure/slurry applied to agricultural land.	Requires storage facilities for manure/slurry during closed periods. Often requires capital investment to meet the legislation.	Adds significant cost to a farm business and is likely to be a driver to some farmers exiting earlier than anticipated – to avoid the legislative requirements.	Financial investment may reduce farm profitability and lead to cut backs in other areas of the farm production system such as feed, vaccines and wormers/flukicides.
Health and safety	Health and safety on farms is increasing. Many farmers and farm workers are injured every year on farms	Legislative requirements on health and safety on farms is increasing.	Some will not employ labour to help because of health and safety laws. Do not apply the same concerns to their own welfare.	If farmer is injured and unable to feed stock and unable to source suitable staff this could result in poor animal health and welfare standards.
Ethical				
High welfare standard on food produced in England	High welfare standards mean that animals are kept in better conditions	Positive to promote this to consumers but often leads to higher costs of production	Higher costs need to be passed on to the consumer.	

8. Threats to English beef and sheep farmers

There are many factors that affect the decisions farmers make on how to run their businesses and what changes they will implement now and in the future. Some of these factors will be at a national scale and will affect all farmers. However, there are some that will only affect individuals or people living in certain areas of the country e.g. on a local and regional scale.

In order to analyse potential future changes in animal health and welfare, it is important to understand the wider issues faced by farmers as these will ultimately affect farmer's decisions.

A summary of the greatest threats facing beef and sheep producers in the future is summarised below.

8.1 Individual farmer level or regional

Lack of succession is a problem for many farming businesses and it is a huge threat to the future of those businesses. This, accompanied by fewer young people coming into agriculture, could see a reduction in the number of small family farms and an increasing number of large farms. Large farms are not a threat to English production; however some farms could become dominant in an area occupying all the farming land that may become available presenting difficulties for new entrants into agriculture. Large farms may also result in reduced local employment through economies of scale and ability to buy more up to date machinery.

Regional weather creates problems for all farming types but drought is a particular threat to livestock farmers. Figures 10 and 11 show rainfall in the UK during 2011 compared to the average from 1930-1990.

Figure 10: Rainfall 1930-1990 average

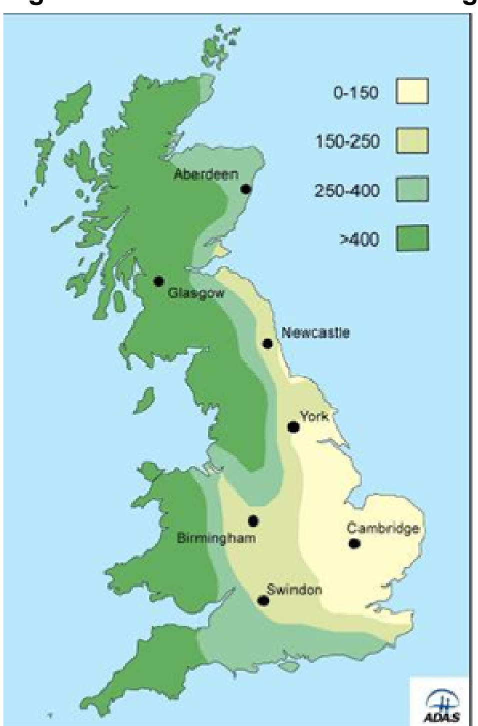
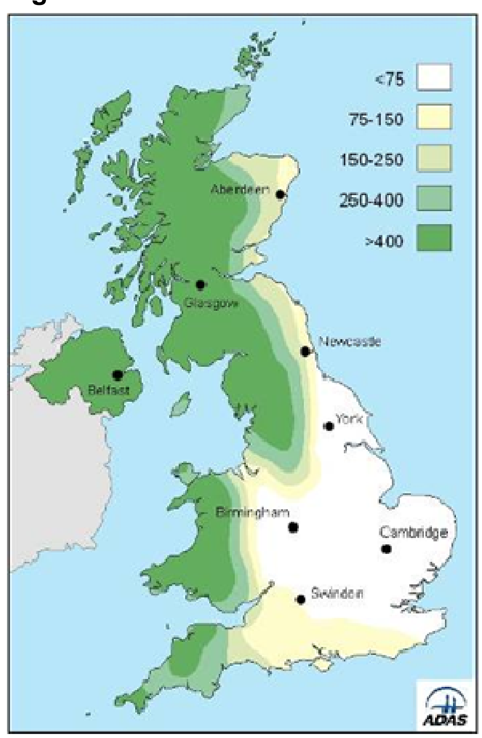


Figure 11: Rainfall 2011/12



The dry weather in the first half of 2011 had a significant impact on crop and grass growth and affected large parts of the country. The South East of England has historically suffered from drought conditions but the affected area has increased during 2011 and is having a wider impact. Farmers need to consider the impact that this will have on their farming practices and implement changes to adapt should this become a frequent trend in the future.

New and emerging diseases have an impact on the entire country; however they often start in localised areas and then spread. A good example of this is Schmallenberg virus. It is an industry wide concern but it is currently only affecting certain regions of the country mainly in the south east of the country. The ability to stop new diseases entering the country is very limited because they may not be caused by livestock movements but by windborne and unseen carriers making them harder to control. The financial impact of Schmallenberg could be very serious in the longer term and will be determined by incidence on individual farms and related production losses.

8.2 Throughout England

The direct cost of the Common Agriculture Policy (CAP) to Europe is €122 billion, of which €44 billion is transferred directly to farmers (Oxford Economic Forecasting, 2005). With the enlargement of the EU and other pressures, the CAP budget could potentially be reduced and other methods of support to farmers may be required to ensure that the EU can continue to meet food security and environmental objectives.

The last major reform of the CAP in 2003 saw the introduction of the Single Farm Payment. Further reform in 2013 is expected. The beef and sheep sectors are likely to be greatly affected by further CAP reform due to previous dependency on subsidies. It is likely that any reduction in the amount of subsidy livestock farmers receive will directly affect profitability (see section 3 on farm business income and reliance on Single Payment). This could result in one of two responses:

Farmers respond to subsidy cuts by cutting costs such as feed, vaccines and preventative treatments possibly resulting in reduced (or at least stagnant) performance and sub-optimal health and welfare.

Farmers respond by recognising that reductions in subsidy require an improvement in livestock performance and will aim to improve productivity and the associated standards of management.

The average age of beef and sheep farmers in England is 58 (ADAS, 2007). This is seen as a threat to the industry because ageing farmers are often more reluctant to embrace change, less likely to adapt their farming practices and have historically been dependant on subsidy and headage payments. New, young entrants into agriculture very often bring innovative ideas and strive to improve performance and aim to make money without reliance on subsidy.

The Climate Change Act (2008) commits the UK to 80% statutory reduction in greenhouse gas emissions by 2050 across all sectors of the economy. Farming and land use are responsible for about 7.4% of total UK emissions (Defra, 2009a). The UK Low Carbon Transition Plan requires English farmers to make and maintain a reduction in greenhouse gas emissions of at least 11% than currently predicted by 2020 (27 Mt CO2). This equates to a saving of three million tonnes per year. This is currently voluntary, however if the reductions are not realised it is likely that legislation will be introduced to ensure the reductions are achieved.

Climate change is resulting in unusual weather patterns, as witnessed during March 2012 (warm, sunny weather up to 23oC). This accompanied by dryer winters is resulting in a change to regular livestock practices e.g. housing later, turning out earlier and an extended blowfly season. Due to the regional effects of these weather patterns, 57% of farmers are likely to be affected over the next 10 years and contingency plans need to be made (Defra, 2009a).

New and emerging diseases caused by midges and mosquitoes are a risk especially in the South East, but their presence, and often their spread, results in implications for the entire country. The role of AHVLA premises in England is never more crucial than during times of national disease outbreaks as seen recently with the emergence of Schmallenberg and in 2007 with Bluetongue and Foot and Mouth disease.

The percentage of beef and sheep farmers using a vet or consultant to advise them on preventative flock health is still very low. Despite this, our collaborating vets both agree that the amount of preventative work they both do has increased over the last few years. However, this is not entirely due to the increase in the value of livestock; it is also as a result of industry communication and awareness of the costs of disease. There is a need for beef and sheep vets to be more pro-active and to encourage farmers to implement preventative treatments to reduce the incidence of disease.

Farmers are able to purchase anthelmintics and some vaccines (e.g. clostridial vaccines) from merchants. Whilst merchants are required to be Suitably Qualified (SQP) the training they undergo is not to the same level as a veterinary surgeon and the individuals will very often not know the farm history. The SQP has to assume that the farmer has had an appropriate diagnosis by a vet and not just assumed for instance that ‘dirty lambs’ need a wormer.

9 Conclusion

The diseases identified in this report have the potential to cause huge economic loss to the English beef and sheep industry, costing individual producers thousands of pounds every year. There are definite advantages of reducing the incidence of these major diseases on farms but despite industry wide campaigns, promotions and publicity the messages have not been acted upon on a large enough scale for the industry to see significant improvements. Performance and financial figures published annually by Defra, Eblex and others highlight that there is indeed room for improved animal performance in the beef and sheep sectors.

10 Recommendations

10.1 Knowledge Transfer

10.1.1 Farm meetings

On farm and 'focus farm' meetings allow farmers to see the real benefits of best practice in action (e.g. Eblex Better Returns and South West Healthy Livestock). Improvements in physical and financial performance have been demonstrated by a number of projects funded through Defra, RDPE and alike throughout England over the last few years.

However, there is a common perception that it is only farmers who want to improve and are willing to change their systems who attend such meetings and there is still a large number of farmers who would benefit but do not attend. Novel methods of engaging with these 'hard to reach' farmers are required if improvements are to be made across the industry.

Eblex, Defra, ADAS, veterinary surgeons and others providing knowledge transfer to farmers should continue to promote best practice events along the entire food chain from producer to processor and where possible encourage collaboration.

10.1.2 Sheep Scab

The incidence of scab has not been truly estimated for several years. ADAS, Duchy College and Bristol University have recently produced a questionnaire which has been sent to sheep farmers to ask them about the incidence and severity of the problem in England and Wales. The results of the questionnaire will be analysed and actions based on this survey may be implemented. Farmers have been asked if they would like assistance in dealing with scab and the results will be available later in the year. Certainly there are areas of the country where scab is endemic and producers have to treat as a matter of course but if concerted action was organised and coordinated then there may be a chance of eradicating or controlling the disease better.

10.1.3 Contractor Database

Many farmers do not use pregnancy scanning and improvements in management and feeding can be made if scanning results are used. Knowing the number of lambs expected gives a base-line against which future performance, lamb losses, empty ewes etc can be measured. Some farmers claim that they cannot find a reliable scanner. It may therefore be useful to provide a database of sheep scanners by region to enable farmers who want access to a sheep scanner to have the appropriate details. The National Association of Agricultural Contractors (NAAC) provides a list of sheep contractors available. However, as at March 2012 only six contractors were listed. One factor that may affect the number of contractors on the NAAC is the joining fee and annual fee thereafter. Scanning results within region could be added to the database (if farmers wanted to anonymously provide their scanning data). This could provide crucial information on the barren rate at scanning and prolificacy of flocks (in comparison with previous years).

10.1.4 Liver fluke

There would be significant value in abattoirs providing more information to farmers on offal and carcase rejections at the time of slaughter. Often a report from the abattoir, detailing liver rejections is the first time that a farmer realises that fluke is present on the farm. If fluke goes undetected, production losses will continue, there may be resistance to a flukicide or the farmer is perhaps using the wrong product.

10.1.5 Use of Farm Medicines

A campaign on the appropriate use of veterinary medicines, vaccination techniques and adherence to manufacturer's guidelines with specific attention to anthelmintics, and the use of combined fluke/worm products and vaccines could benefit farmers.

10.1.6 Farm Records

The literature review has highlighted that whilst there are estimates of the national cost of disease in the UK, farmers do not perceive that their farms are included. Careful analysis of farm records, in many cases, highlight underlying disease issues and this should be encouraged. Improved surveillance and asking farmers to report or summarise disease incidence on farm will provide individual farms with the information to make changes to control disease better and it would also provide more information to the industry about the 'real' costs of sub-optimal health.

10.1.7 Vet Interaction

In general, vets are visiting beef farms more often than sheep farms; however this is mainly due to TB testing. Nevertheless, the TB testing visit provides vets with the opportunity to discuss other issues on-farm and provide advice. It is suggested that farms receive at least one annual visit from a vet to satisfy the regulations for the prescription of vet only medicines, such as antibiotics. A vet should only prescribe to animals under his/her care. However, many sheep farmers do not appreciate the value of an annual vet visit, and will not have had a vet on the farm for significantly more than 12 months. This may be an area where vets need to promote to farmers their obligations to comply with legislation, and the benefits that regular vet visits can bring. There is no legislative reason for routine or annual vet visits to sheep farms. Some farmers do not see the need for an annual visit unless there is a serious disease outbreak and secondly the number of vets dedicated to sheep work is very low. Eblex could consider providing a subsidised annual sheep health check for sheep farmers. This could involve an annual meeting between a vet and sheep farmer to discuss antibiotic use, vaccination programmes and worm/fluke strategies. In order to meet this demand, we also recommend that Eblex invest in training young sheep vets on issues outside their core vet expertise but pertinent to the sheep industry such as benchmarking, profitability and nutrition.

10.2 Research and Development

10.2.1 Respiratory Disease and Scour

As vaccination to reduce respiratory disease and scour are only effective when all other husbandry and management issues are correct, a 'housing check' for beef animals may help to reduce the incidence of pneumonia and scours through timely reminders of best practice and making changes to buildings and/or housing arrangements. It could also result in improved efficacy of vaccines used. An annual subsidised meeting between the farm vet and farmer looking specifically at ventilation, size and cleanliness of the buildings on a farm is recommended. A pilot trial looking at a small sample of farms that have suffered a severe outbreak of respiratory disease and/or scour during calving 2012 (by working in conjunction with farm vets) could be implemented. If this was deemed successful and demonstrated a cost benefit to the industry, it could be rolled out wider into other regions in England.

10.2.2 Costing Models

Reading University has produced a series of costings models which are available free of charge on their website. The models available are for BVD and Johne's in suckler herds and footrot, scab and liver fluke in sheep. Whilst the modules are very comprehensive and involve complex calculations there are aspects of the models which could be improved.

The models must be downloaded and saved onto the computer before they can be used. This requires the user to download ‘isee player’ onto their desktop and then save the models individually. There are guidance notes available on the website however they are not easy to follow and could be a barrier to producers using the models. A simplified downloading module would provide producers with the opportunity to have easier access which could improve uptake.

10.2.3 Lameness in Sheep

A recent series of 20 meetings on sheep lameness held throughout England (delivered by ADAS and Eblex funded through Defra Animal Welfare Division) promoted the most recent research on control and treatment of footrot. There was some reluctance by producers to adopt some of the new aspects of the research in particular to a reduction in routine foot trimming. Farmers were particularly reluctant to stop trimming badly infected feet (having been taught to ‘get the air to the infection’ in the past) and to treat with antibiotic and trim 5-7 days later once the infection has subsided. Some of the farmers who attended these meetings could be contacted in a few months time to find out how they have found the new approach to lameness and if lameness in the flock has improved as a result.

10.2.4 Eradication Schemes

Consider the role that Eblex could have in eradication schemes. The two diseases that require particular attention in terms of eradication are scab and BVD. A subsidised service to test for the presence of BVD in English herds (similar to the protocol in Scotland) would provide farmers with the information on the presence (or absence) of the disease and allow them to plan a course of treatment and protection for their herd.

10.2.5 Text Reminders

Improving and extending the ways farmers receive information is crucial to making improvements. Text reminders before tupping and calving about best practice could be sent from a central point. Developing an ‘App’ for smart phones to help farmers access information and updates could also be considered. These are both quick ways to get short messages across to the industry without taking the time to attend a meeting or read a lengthy article or booklet.

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