

The Economic Impact of Extreme Weather on Scottish Agriculture

25 February 2019





Contents

Executive Summary	3
Introduction	4
Methodology	4
Potential Impacts on Scottish Agriculture	4
Impact on Livestock Numbers	5
Impact on Fodder Supplies	9
Impact on Crop Production	10
Other weather related damages	12
Calculating the Economic Losses	13
Ongoing impacts	14
Supply Chain Impact	14
Meat Processing and Wholesaling	14
Brewing and Distilling	14
Policy Responses	15
Agricultural Lending	16
Agricultural Insurance	16
Discussion	17
Conclusions	18
References	19
Appendix A	23
Appendix B	26
Appendix C	27
Appendix D	30
Appendix E	32



Executive Summary

The severe weather experienced during 2017/2018 impacted on livestock numbers and yields of key crops. The overall losses to Scottish agriculture are estimated at £161 million, equivalent to 6% of total output in 2017. The biggest impact was on the sheep sector which lost £45 million, followed by wheat (£34 million), beef (£28 million), and barley (£26 million).

In terms of animal deaths, the biggest impact was also on the sheep sector, the beef sector also suffered substantial losses, but the largest impact on beef was on the cost of forage and increased feeding due to the longer housing period. Due to a longer production cycle the impact on the beef sector is likely to be felt for some time, due to reduced cattle numbers and availability of cattle for slaughter the losses are likely to be offset by increased market prices for clean cattle.

The poor weather may have contributed to the decision of some dairy farmers to cease production, however overall dairy cow numbers rose during 2018 and herd sizes increased. Some farmers may have experience losses as a result of uncollected milk. Losses to individual dairy farmers, however, were as high as £23,000.

Cereal yields were affected significantly, however the potato yield appears to have been unaffected. Data on the impact on some other crop sectors, e.g., horticulture and soft fruit is not yet readily available to make an assessment.

Farm Insurance claims for fire damage in Scotland during 2018 increased approximately 20% from 2017. Data indicates that long term lending to Scottish agriculture did not increase over the period.

Impacts were also felt on some parts of the food supply chain. For example, some milk processors picked up the costs of uncollected milk; beef processors are also being impacted by reduced availability of cattle. Malt barley prices rose by as much as £50 per tonne during 2018 and whilst this increased raw material costs for brewers and distillers, these are a relatively small share of overall costs and are not likely to heavily impact the prices of beer and spirits in the long term.

Apart from long term trends influencing Scottish agriculture, e.g., a long-term decline in livestock numbers, uncertainty over Brexit is also likely to have impacted the sector during this period however data are not yet available to quantify this supposition.



Introduction

Heavy snow during March 2018 and drought conditions during the summer had a significant impact on Scottish farmers with heavy losses within the livestock sector and poor growing conditions for crops. In addition to these losses, the weather led to increased feeding and irrigation costs, damage to farm infrastructure from the collapse of buildings and increased risk of fire and disruption to normal farming operations, such as delays in field operations and uncollected milk due to snow blocking roads.

The frequency and severity of extreme weather events has increased in recent years. In addition to the weather events of 2017/18, snow storms in 2010 led to severe livestock losses and increased feeding costs for Scottish farmers. The latest set of projected changes in climate for Scotland comes from the 2009 UK Climate Projections (UKCP09) (ASC, 2016). Under a medium emissions scenario, regional summer mean temperatures are projected to increase 0.9-4.5 C by the 2050s compared to a 1961-1990 baseline. Winter precipitation totals are projected to change -2%-31% for the same scenario. Although agriculture is impacted significantly by a changing climate, it is the second largest contributor to Scottish greenhouse gas emissions after transportation (Reid & Wainwright, 2018).

The aim of this study was to estimate the economic costs of the extreme weather events of 2017-2018 in Scotland, to include:

- Cost of loss of livestock;
- Cost of loss of cereal and oilseed rape, vegetables;
- Cost of loss of milk (insurance claims);
- Cost of loans to cover livestock feed shortages;
- The impact on the supply chain and food processing and manufacturing sectors especially brewing and distilling; and
- Determination of Scottish produce that was most impacted or could be in future.

Methodology

The approach quantified the physical losses incurred by farmers as a result of the extreme weather events, and the economic costs involved. A literature review of industry and media reports on the impact on Scottish agriculture of the weather in 2017/2018 informed the bulk of the information herein. The review examined the most recent statistics for 2017/2018 in terms of livestock numbers and crop estimates to quantify the physical losses to farmers during this period as a result of the weather. The study also examined qualitative data on downstream losses and impacts particularly on distilling, brewing and meat processing.

Long term trends in livestock numbers and crop yields were factored out of the estimates to provide an indication of change which are specific to the year 2017/18. The physical losses in terms of animal numbers and loss of production were calculated as estimated replacement costs for livestock, and loss in value of production for crops. To estimate increased feeding costs an assumption was made about the number of additional days feeding required, and the increased fodder demand per animal was calculated and costed.

Potential Impacts on Scottish Agriculture

Meteorological data for Scotland during 2017 and 2018 compared to a baseline 30 year average is presented in Appendix A. An outline of the weather events in Scotland is presented in Appendix B.



The weather conditions impacted on Scottish farmers in a number of ways:

- Loss of livestock, principally through hypothermia and exposure during winter snow storms;
- Dry weather earlier in the summer stunted grass growth and left many farmers without enough pasture to graze their animals, with some having to break into feed supplies typically reserved for the winter months;
- Loss of production during the cold weather and the reduction in crop yields during the drought;
- Increased costs particularly due to additional feeding and irrigation; and
- Loss through damage to farm infrastructure, e.g., storm damage and freezing pipes.

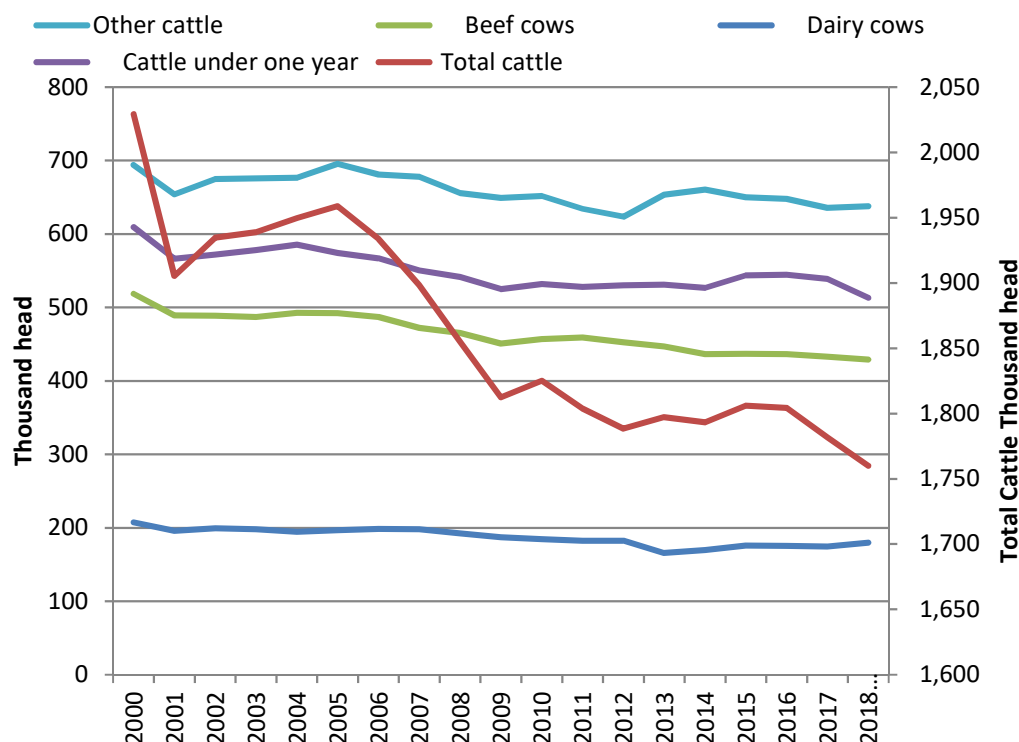
Impact on Livestock Numbers

Impacts of weather on beef, dairy and sheep are provided in the following sections.

Beef

Trends in Scottish cattle numbers are presented in Figure 1. In June 2018, there were 1.76 million cattle in Scotland, a 2% drop on the previous year and the lowest count since 1957. Calf numbers fell to 520,000 down 3.5% from 2017.

Figure 1. Scottish Cattle Numbers 2000-2018.



Source: (Scottish Government a, 2018).

The long 2017-18 winter exhausted livestock farmer's feed stock and dry summer weather reduced the amount of grass grown for feed. The grass shortage led to animals being slaughtered earlier or in higher quantity as farmers look to reduce their cattle numbers to save on feed costs, thus beef slaughtered volumes have been maintained, but the overall effects are likely to be depressed prices



and reduced carcass weights. In addition, there were increased sales of cattle as store, for finishing by producers elsewhere in the country.

The census indicates that losses of adult cattle (cows) was minimal, the number of cattle under one year were down by 27,500 compared with the trend, the wet autumn may have impacted calving rates, however not all of this decline can be explained by the impact of the weather.

Dairy

The UK's largest dairy coop, Arla, agreed to pay its 2,400 UK producers for all litres of milk produced regardless of whether a tanker could reach them. At the time the Agriculture and Horticulture Development Board (AHDB) stated that any market changes due to the weather would likely be to short-term spot milk prices and would not greatly affect UK production (FWi b, 2018). AHDB data on UK milk production during this period is presented in Appendix C.

According to data from the AHDB UK milk production actually rose during March and April 2018. Concentrate feed use per litre of milk produced during the summer months of 2018 was up on the 5-year average, suggesting increased reliance of concentrates due to limited grass growth over the dry summer. On a 12-month rolling average, feed costs per litre of milk produced were also up during February and March 2018 and continued to rise over the summer months.

Commenting on the first six months of the year Janette Mathie, the Secretary of the Scottish Dairy Cattle Association stated that:

'The wet Spring, lack of forage and the uncertain milk price proved too much for some farmers and they made the decision to sell up whilst others have made a huge investment for their future within the dairy industry and increased cow numbers accordingly'.

In July 2018 herd numbers were down to 902 but total cow numbers increased to 179,931 (Scottish Dairy Cattle Association, 2018).

Losses through uncollected milk are not formally recorded. Although total production data for 2018 is not yet available it is likely that the volume of milk production in Scotland was unaffected by the poor weather. Anecdotally, however, there were reports of milk going uncollected during the Beast from the East. One Scottish farmer reported having to dispose of £23,000 of uncollected milk (FWi a, 2018). Some farmers were insulated from negative impacts by processors paying for uncollected milk, and through insurance (FWi b, 2018).

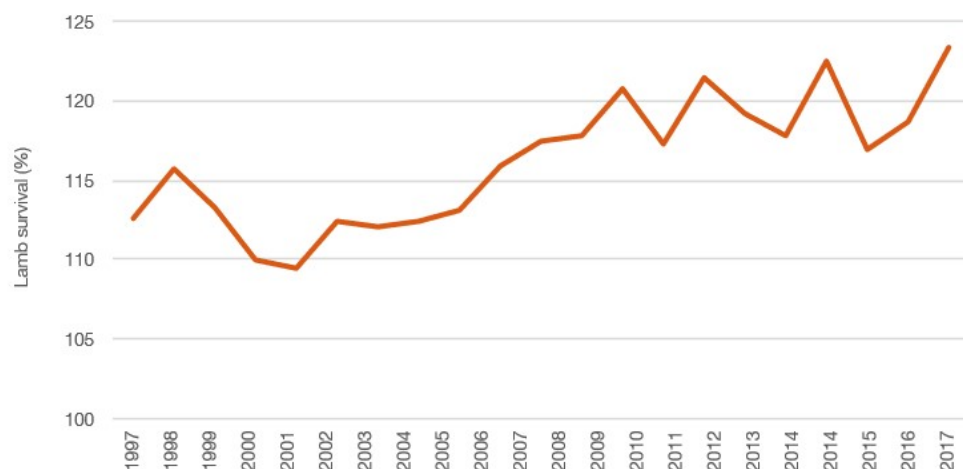
Sheep

The 'The Beast from the East' snow storm hit during lambing season and led to increased losses of new born lambs through hypothermia and exposure to the elements. Lamb survival rates are highly dependent on the season, system and breed, and typically vary from between 80-200% (Figure 2). Scottish lamb numbers hit their lowest point since 2013. Lambs made up 48% of the total sheep flock in Scotland and in 2018 their numbers fell 8% to 3.1 million. By contrast, the Sheep Health and Welfare Group note that there has been an overall upward trend in UK lamb survival rates since 2001 (SHAWG, 2018). In the shorter term, in 2011, 2014 and 2017 there were high survival rates of around 121%, dropping to 117% in the less favourable years of 2013, 2015 and 2016.

Total sheep numbers fell for the first time since 2013 (Figure 3). In June 2018, there were 6.59 million sheep in Scotland, a drop of six per cent from the previous year. Spring snow led to sheep numbers falling to a five-year low, total sheep numbers fell by 6% with lamb numbers falling by 8%, breeding ewe numbers fell by 4% (Scottish Government a, 2018). The ewe pregnancy rate was unaffected by the Autumn weather conditions. However, lamb numbers were 8% down from 2017, indicating heavy losses after scanning, through to the lambing period.

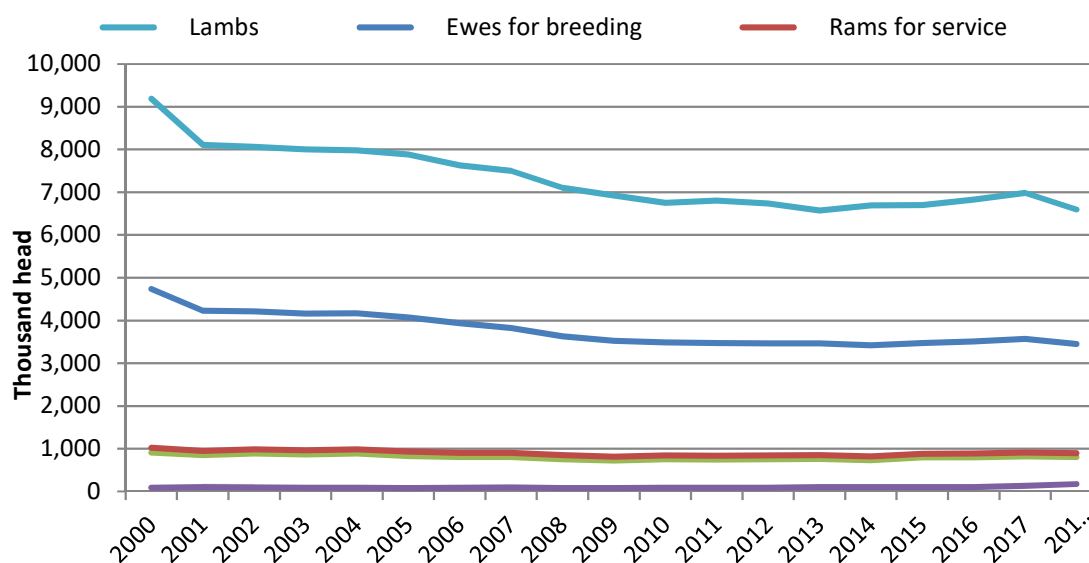


Figure 2. Surviving lamb percentage for the United Kingdom



Source: (SHAWG, 2018).

Figure 3. Total Sheep Population in Scotland (Stacked)

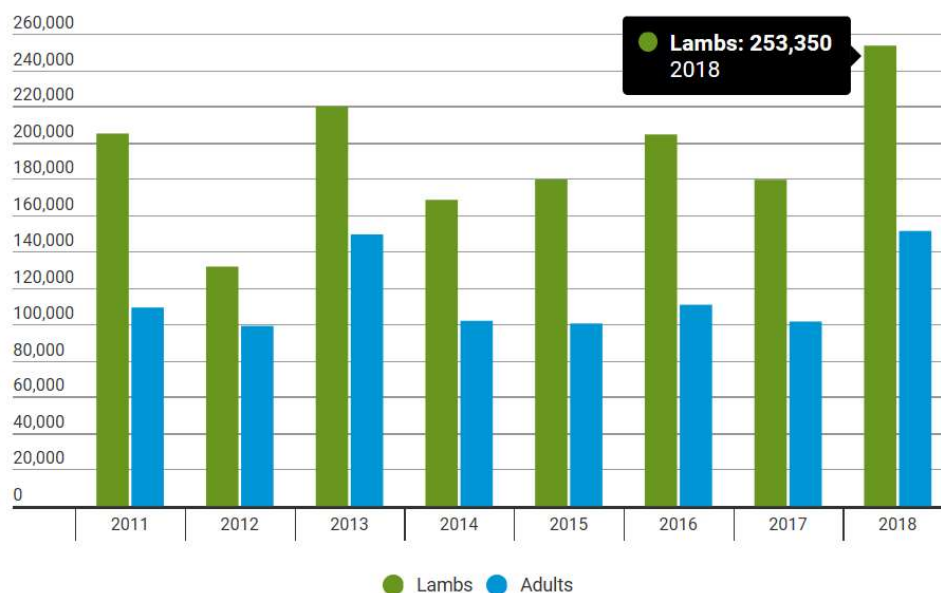


Source: (Scottish Government b, 2018).

UK Fallen Stock Data from the National Fallen Stock Company gives an idea of livestock losses during the spring and has been collected since 2011 (Figures 4 and 5). The losses of both adult sheep and lambs in 2018 were the highest since 2011. The 2018 total was 31% higher than the seven-year average.



Figure 4. UK Fallen Livestock Data 2011-2018 Sheep and Lambs



Source: (NFSCo a, 2018).

Figure 5. UK Fallen Stock Data Total Animals 2011-2018



From: (NFSCo a, 2018).

Feed costs for sheep enterprises were impacted by the need for increased supplementary feed during the snow, and reduced grass growth during the summer months, which in some cases would have led to the need for additional fodder to be bought in. In July 2018 it was reported that for the first

5 months of 2018 UK concentrated feed production for finishing lambs was up by 14% on the year, despite fewer lambs being on farms (AHDB a, 2018). The snowfall in March is likely to have forced the early housing of ewes approaching lambing (Bell, et al., 2018). The impacts are continuing on the sheep sector into 2019 with total clean sheep slaughtered forecast to be 5.5% down on 2017 (Figure 6), and the UK breeding flock is expected to be 3% down on 2018.

Figure 6. Actual and forecast UK clean sheep (lambs) slaughtering 2017-2019

'000 Head	2017	2018	2019 Forecast
Q1	2,920	3,147	2,823
Q2	3,009	2,555	2,732
Q3	3,515	3,404	3,347
Q4	3,854	3,687	3,670
Year	13,298	12,793	12,572

Source: (AHDB a, 2019).

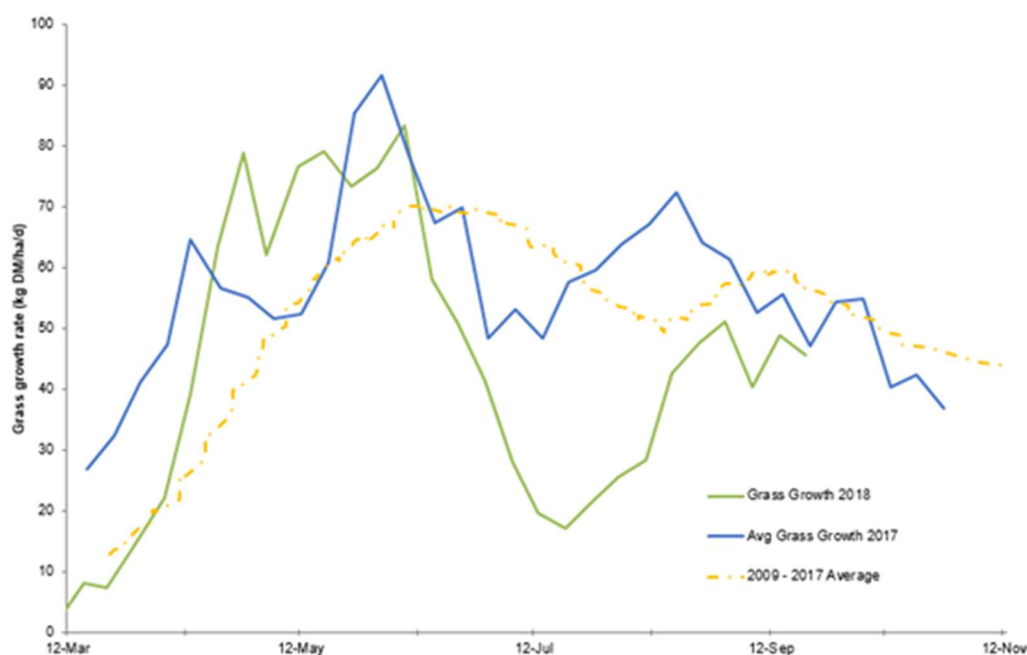
Impact on Fodder Supplies

As well as direct livestock losses due to snow and cold weather livestock farmers were also impacted by the pressure placed on fodder supplies due to the weather events. These losses took the form of longer feeding periods and increased fodder and feed prices. SAC Consulting estimated that a hypothetical 110 cow upland suckler herd may have incurred additional costs of around £8,000 due to higher straw use, from the extended housing period, and higher straw prices, leading to a potential reduction of 19% in beef enterprise gross margin (Bell, et al., 2018).

The Seasonal Grass Growth Rate

Grass growth in 2018 versus 2017 is shown in Figure 7, with reduced growth in the spring, followed by a second period of below average growth over the dry summer months.

Figure 7. UK Seasonal Grass Growth



Source: (AHDB b, 2018).

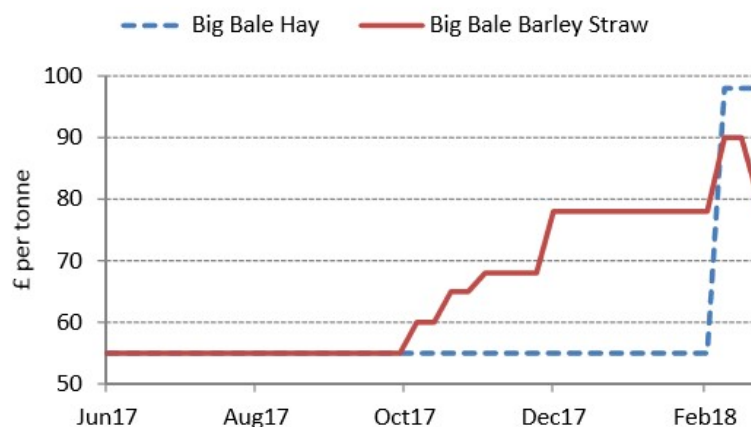
Hay/Silage

It was reported that in northern Scotland, farmers were forced to buy in hay at significant cost as their winter stocks ran out (Countryfile.com, 2018). In addition, with grass scarcely growing during summer, the NFU says many farmers had to buy in additional feed and straw.

Straw

Straw use in Scotland is estimated at around 1.32 million tonnes, mainly for livestock feed and bedding and potential production, if all baled, of 1.66 million tonnes (Bell, et al., 2018). SAC Consulting estimated an increased demand of 36,000 tonnes straw (~£5 million) for each week delay of livestock to green pasture.

Figure 8. Ex-farm straw and hay price evolution, South Scotland



From: (Bell, et al., 2018).

The Scotland's Rural College (SRUC) study noted that the wet weather at harvest reduced the quantity of straw that was baled, as it was too wet to bale, and arable farmers had to plough straw in to complete autumn sowing causing increased prices (Figure 8). Bell, et al. (2018) noted other factors in addition to poor weather conditions which may have driven up straw prices such as increased use of straw for bio-energy production; and increased demand for straw as bedding due to increased concerns over animal welfare. There were also reports during the summer that Scottish farmers were refusing to commit to selling straw, perhaps due to concerns about their livestock.

Data collected by Ofgem as part of its sustainability reporting under the Renewables Obligation, indicates that UK usage of straw in large-scale power generation totalled 560,000 tonnes in 2015/16; a 39% increase from the previous season. It is understood that another large straw fired power plant has come on line in 2017 (Snetterton, Norfolk) which has added a further 250,000 tonnes of straw demand and is expected to have pushed the total demand to 810,000 tonnes or more in 2017/18 and reduced the available surplus (as estimated in 2016) by 15% to 1.345 million tonnes. This rise in demand for straw for bio-energy has undoubtedly led to a significant reduction in straw availability for other uses and is expected to represent the equivalent of around 10% of livestock feed and bedding straw demand in 2017/18.

Impact on Crop Production

The planting area of many crops was reported down, due to poor conditions during the autumn and winter planting season. Waterlogged fields may have soil structure damage that will limit crop yields and take time and cost due to drainage issues or needing to re-seeding.



Cereals

According to the Scottish government total cereal production, area grown and yields in fell in 2018 compared to the previous year due to poor weather conditions at key points in the season (Scottish Government c, 2018). Storm Emma delayed planting, whilst the prolonged spells of hot weather stunted growth.

Around 420,000 hectares of cereals were grown, 3% lower than 2017. The average yield dropped by 9% which led to a 12% drop in production, to 2.5 million tonnes. Oilseed rape has seen a similar pattern to cereal crops with drops in production, area and yield in 2018. Crops grown on heavier soil types (higher clay content) suffered less due to better moisture retention.

Figure 9. Summary of Scottish crop production in 2018 versus 2017

	Area	Yield	Production
Spring Barley	↑ 3% to 250,500 ha	↓ 6% to 5.5 t/ha	↓ 3% to 1.3 million MT
Winter Barley	↓ 21% to 37,500 ha	↓ 4% to 7.1 t/ha	↓ 24% to 268,100 MT
Wheat	↓ 9% to 99,800 ha	↓ 16% to 6.8 t/ha	↓ 23% to 681,00 MT
Oats	↓ 2% to 32,100 ha	↓ 3% to 5.5 t/ha	↓ 5% to 175,800 MT
Oilseeds	↓ 4% to 32,700 ha	↓ 8% to 3.9 t/ha	↓ 12% to 126,300 MT

From: (Scottish Government c, 2018).

The final estimates for the 2018 cereal and oilseed rape harvest in Scotland were released in December 2018. Around 420,000 hectares of cereals were grown, three per cent lower than 2017. The hectareage decrease, combined with a 9% decrease in yield, led to a 12% drop in production, to 2.5 million tonnes. Decreases were due to the unfavourable weather conditions experienced in winter 2017, as well as spring and early summer of 2018. It has been particularly bad for barley and wheat crops, which resulted in a number of farmers choosing to whole-crop due to the low yield and quality.

The area wheat and winter barley were down by 1% due to the poor conditions at sowing, whilst the Spring barley area was up by 0.8%, suggesting farmers who failed to establish crops during Autumn 2017 shifted to spring cropping. Spring barley, Scotland's main cereal crop, experienced a fall in yield of 6% and production fell by 3%.

Oilseed rape yields although down during 2017, were higher than the 2004-2017 average. Thus, the impact is considered minimal. The overall oilseed rape area in Scotland was down to 32,700 ha; however, this is in line with trend.

The dry weather however would have meant that crops did not require as much drying as usual, and some savings could have been made. According to NFU Scotland Combinable Crops Chairman Ian Sands:

"An upside of the hot weather is that most grain will be at acceptable moisture and less drying will be required. Winter crops are getting sown into good quality seed beds and are well ahead of last year, when we struggled to clear fields of some crops and did not have the conditions to start sowing when we needed to."

Potatoes

It was reported that Scottish potato yields in 2018 were 3% above the 2017 figures at 49.2 tonnes per ha. However, total potato production was down, due to a decrease of 1,600 ha in the planted area (Farminguk, 2018).

The potato area was down to 16,900 ha; however, yields were up on 2017, thus the impact on the sector in terms of lost production is considered minimal; however, potato producers are likely to have incurred increased irrigation costs.



Fruit and Vegetables

Data for 2018 production for the fruit and vegetable sector in Scotland is not yet available, however the drought is likely to have impacted on producers through reduced yields, and increased costs of irrigation. UK wholesale fruit and vegetable prices rose as result of the drought in 2018, with irrigated crops suffering in particular. The grocer magazine reported that carrot yields were expected to be down by as much as 30% and that the wholesale price of carrots had risen by as much as 55% (The Grocer, 2018).

Other weather-related damages

The weather events experiences may have impacted on farmers in a number of other ways from building damage, fire and other impacts. Building Damage included wind and snow damage to roofs and burst pipes, causing disruption in water supplies. Other impacts may have included increased labour costs due to an increased need to check on stock or building repair.

Fire

During the dry portion of the summer of 2018, fire costs increased greatly. According to Tim Price, NFU

"Fire remains one of the greatest hazards on the nation's farms. We normally see claims peaking in August and September, but this year [2018] saw a sharp increase in claims during June and July. This was due to the exceptionally hot dry summer which brought harvesting forward by almost a month and resulted in tinder dry crops and overheating of combines, balers, and other harvesting machinery." (NFU Mutual, 2019)

It was reported by NFU mutual that farm fire costs in Summer 2018 for the UK were 137% up on the previous year (The Scottish Farmer, 2018). Anecdotally, fires may have caused loss of grazing forage. Data on the costs of farm fires across the UK during the summer months of 2017 and 2018 is presented in Figure 10 regional data for 2018 is presented in Figure 11.

Figure 10. Cost of farm fires during harvest period. Figures are UK total of 2018 vs 2017

UK Total by Month	2018	2017	% change cost
Jun	£8,957,047	£4,486,583	+ 99.6%
Jul	£12,927,117	£5,448,094	+ 137.2%
Aug	£5,419,487	£8,675,825	- 37.5%
Sept	£4,216,673	£7,420,179	- 43.1%
Total for harvest	£31,520,324	£26,030,682	+ 21%

Source: (NFU Mutual, 2019).

Across the UK farm fires during June and July were up on the 2017 period, the overall costs of claims for farm fires over the harvest period was 21% up on 2017 or up by £5.5 million. The total farm insurance claims for fire in Scotland during the harvest period was £3.5 million, assuming this is 20% up on 2017, there would be an estimated increase of £0.7 million (Figure 11).



Figure 11. Cost of farm fires during harvest period 2018 by region

Area	2018 harvest period cost
England	£24,200,417
North West	£6,675,928
South East	£4,474,682
North East	£4,004,463
South West	£3,939,594
East of England	£3,339,579
Midlands	£1,766,170
Scotland	£3,514,896
Wales	£2,168,308
Northern Ireland	£1,600,704

Source: (NFU Mutual, 2019).

Calculating the Economic Losses

Direct losses to the livestock sector occurred through animal deaths and increased feeding costs due to longer housing periods. Details of the calculations for the livestock losses including the increased feeding costs are presented in Appendix D. The calculations for each sector are presented in Appendix E. Total ruminant livestock losses are estimated at £93.7 million, equivalent to 4.2% of the total output in 2017. Total cereal production losses are estimated at £62 million, compared with total output in 2017 of £403 million (Figure 12).

Figure 12. Estimated Impact of Extreme Weather on Scottish Agriculture 2017/2018

	Est'd Losses	Output 2017	% of Output
Beef	£27,885,346	£583,738,602	4.8
Dairy	£5,881,793	£433,505,397	1.4
Total Cattle	£33,767,139	£1,017,243,999	3.3
Sheep	£44,962,341	£211,054,135	21.3
Increased bedding costs	£15,000,000		
Total Ruminant Sector	£93,729,480	£2,245,542,132	4.2
Crops			
Wheat	£33,704,317	£128,477,266	26.2
Winter barley	£10,241,325		
Spring barley	£15,437,266		
Total barley	£25,678,592	£252,711,032	10.2
Oats	£2,660,892	£22,201,312	12
Total Cereals	£62,043,800	£403,389,611	15.4
Loss from farm fires	£5,700,000		
Total	£161,473,280	£2,751,944,000	5.9



Overall losses across Scottish agriculture are estimated at £161 million, equivalent to 6% of total output in 2017, with the greatest impacts being on the cereal and sheep sectors. The greatest proportionate impact was on the wheat sector (26% of output) and the largest single loss to sheep (£45 million).

Ongoing impacts

Going forward some of losses suffered by the beef and sheep sectors are likely to be offset by increased market prices for finished cattle and lambs. For instance, there are some indications that lamb prices are likely to rise in 2019 (FWi a, 2019). However, a tightening global supply situation is also likely to impact prices. In addition a late Easter (21 April) and an early start to Ramadan (5-6 May) will mean that a peak period of demand will occur at a time when supply of old season lamb will have tailed off, and before new season lamb is available in any significant quantity (FWi b, 2019).

Going into 2019 the AHDB forecast that the UK sheep breeding flock is likely to be 3% down from 2018 due to increased mortality, and the reduced availability of replacements (AHDB a, 2019) with total sheep meat production forecast to be down 1% year on year.

Fodder prices also remain high; however straw prices have fallen from their peak in August 2018, as the dry summer enabled cereal farmers to clear fields in time ahead of drilling, and more farmers baled rather than chopped straw (FWi c, 2019).

Supply Chain Impact

The extreme weather has an impact on the supply chain and consumers. Storm Emma disrupted essential supplies and deliveries to retailers which led to shortages in shops. It was reported that between March and July, the UK wholesale "farm gate" prices of some staples increased by up to 80%. From March to July the farm gate price of onions (+41%), carrots (+80%), lettuce (+61%), wheat for bread (+20%) and strawberries (+28%) rose by a fifth or more each. The Centre for Economics and Business Research said 2018's big freeze and heatwave would end up costing consumers an increased £7.15/month/household (Centre for Economics and Business Research, 2018).

Meat Processing and Wholesaling

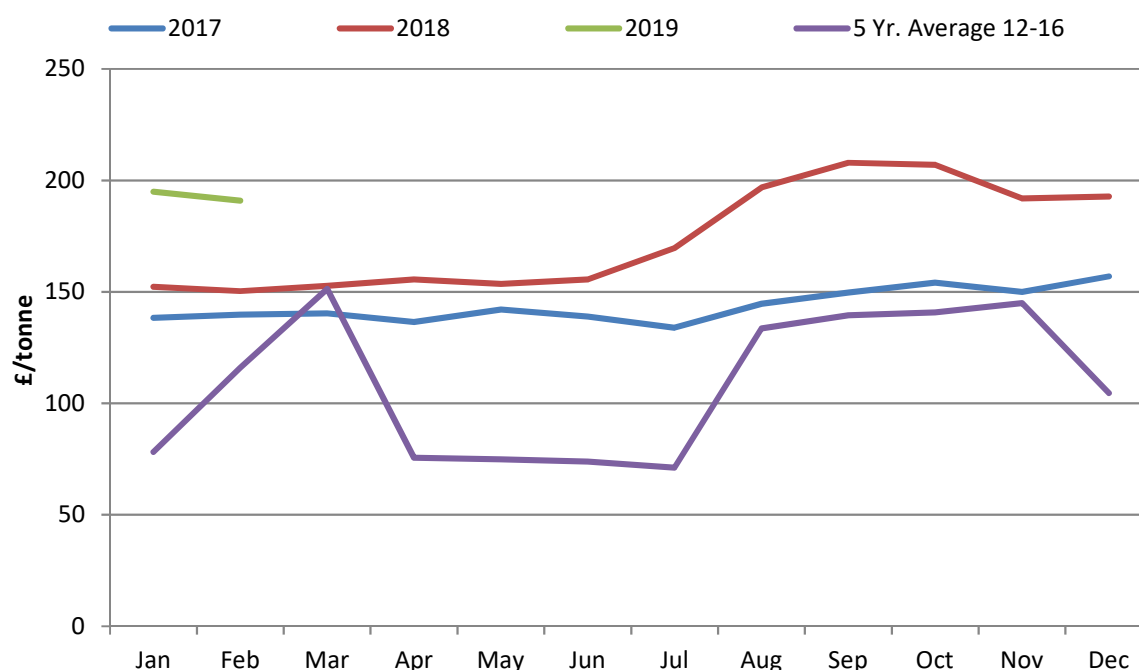
Falling livestock numbers are impacting on the meat processing sector in Scotland, and the Scottish Association of Meat Wholesalers have already expressed concerns over the sustainability and viability of the sector due to falling livestock numbers (Food Manufacture, 2018).

Brewing and Distilling

According to the Scotch Whisky Association approximately 90% of the barley used in Scotch whisky production is sourced from Scottish farms. Approximately 35% Scotland's barley goes into malting and 55% goes for animal feed (Scottish Parliament, 2018). The supply of malt barley to Scotland's distilling and brewing sectors was impacted by both quality and yield issues due to the drought and is likely to face increased raw material costs going forward.

According to the AHDB prices for malt barley surged in summer 2018, driven by reduced supply prospects and increased demand for feed barley (AHDB c, 2018). This follows a normal pattern based on average values for 2012-2016. However, during 2018 the price began to rise substantially starting in June (Figure 13). The data indicates that UK malt barley prices rose from around £150/tonne during 2017 to a peak of over £200/tonne during 2018 and remain high into 2019. Several factors in addition to the weather may have contributed to the price hike including expectations of a poor harvest and increased feed barley prices.

Figure 13. UK Average Monthly Malting Barley Prices 2017-2019



Source: (AHDB Cereals, 2019).

The total annual requirement for malting barley in Scotland is around 900,000 tonnes, of which around 800,000 tonnes is required for Scotch whisky distilling (Scottish Parliament, 2018). Thus, an increase in the region of £50 per tonne in malt barley costs would amount to increased costs of £45 million to the distilling and brewing sectors. For the whisky industry this would represent a cost of £40 million—0.9% of the total value of whisky exports in 2018 of £4.7 billion (Scottish Parliament, 2018).

Aside from direct economic impacts of the drought on supplies of raw materials, the weather may have impacted distilling in other ways. Droughts can lead to low flow from water sources and higher water temperatures impacting fermentation, cooling and overall whisky quality (Scotchwhisky.com, 2017). Water quantity and quality both could have subtle effects on both beer and whisky costs over time.

Policy Responses

Fallen livestock collections have been significantly higher than in 2016 and 2017 and a scheme, based on that previously operated through the National Fallen Stock Company (NFSCo) in 2013, was introduced to help compensate affected producers. The Scottish Government-appointed weather panel recognised that recent severe weather had caused a rise in the number of livestock deaths on farms across Scotland, and that financial support should be provided to those incurring additional costs of disposal of dead cattle and sheep.

A support package from the Scottish government was announced in April 2018, which included a £250,000 fund to support the cost retrieval of fallen stock (NFSCo b, 2018). Support under the scheme did not extend to on-farm disposal of fallen stock and covered losses in the period from February to April 2018.



During the Summer of 2018 the Environment Agency and the Scottish Environment Protection Agency allowed farmers to trade water allowances on a short-term basis to address the drought and irrigate the crops most in need (The Grocer, 2018). It is not clear how successful the policy was to alleviate drought conditions.

The EU Commission agreed to allow farmers to grow grass and other edible forage in areas that are not usually allowed for grazing to support livestock farmers struggling with forage supplies due to the drought. UK secured derogation from the EU's Ecological Focus Area (EFA) winter crop requirements, part of the criteria for receiving basic payment subsidies, which stipulates certain areas, must be left fallow or sown with crop mix that cannot be grazed (Eastern Daily Press, 2018).

Agricultural Lending

Data from the Scottish government indicates that bank advances to Scottish agriculture fell in 2018 in real terms by £13 million (Scottish Government d, 2018). In addition to the £2.34 billion from banks, agriculture has an estimated £1.2 billion of outstanding debt from other sources. This can include debts from hire purchase and leasing. Total debts are estimated to equal 10% of farm assets. Any short-term financial issues did not require additional long-term lending. However, it is likely that some farmers obtained other forms of finance, e.g., trade credit; which in turn may have impacted on some other rural businesses such as feed merchants.

Agricultural Insurance

Between June to September 2018 rural insurer NFU Mutual recorded an increase in claims figures of 21% (£31.5 million) compared with £26.0 million) across the UK (The Scottish Farmer, 2018).

According to Graham Plaister from UK-based loss adjuster firm Agrical, there was a mixture of different farm claims made as a result of the March snow storms. These ranged from general property damage caused by the likes of burst pipes and high winds to specific farming issues like damage to livestock and produce (Autoline Insurance Group, 2018).

There was a spike in claims relating to weight of snow, uncollected milk and the suffocation of livestock like sheep trapped under snowdrifts, any of which can have major impacts on the farming community and their businesses (Autoline Insurance Group, 2018).

Overall, agricultural insurance is underdeveloped worldwide. In UK, it is around £1 billion premium income, since one of the major insurers in that field had a turnover of £900 million in non-life insurance in 2006. (Much of that was non-agricultural, but against that other insurers hold a large part of the broadly-defined agricultural insurance market.)

Generally, cover for growing crops is limited in the private market, due to the potential for catastrophic losses, and the problems of adverse selection and moral hazard. Full multi-peril crop insurance is only available with government backing, and only in a few countries, and generally runs at a large loss for the risk-bearer. As an alternative, governments and other agencies often provide disaster aid to poor farmers, removing some of the need to have insurance, though relief aid has many drawbacks itself. Another difficulty is that the smaller the farmer, the higher the cost of distribution. An interesting point is that in systems where the government bears the risk, often private insurers play an important part in administration, through issuing policies, keeping records, and handling claims (CII, 2009).



Discussion

The severe weather experienced during 2017/2018 undoubtedly impacted livestock numbers and yields of key crops, however other factors are influencing the sector:

- Uncertainty over Brexit and the impact of exports particularly for the beef sector, and the details of post Brexit agricultural support;
- Global/EU supply of key agricultural products; and
- Long term trends in livestock numbers.

Whilst the estimates presented here take account of long-term trends, there is at present insufficient data to account for the impact of expectations of policy changes related to Brexit and levels of confidence within the farming industry. Thus, the estimates presented here are likely to be an overestimate of the impact of the weather events in 2017/18; however, it does present an analysis of the type and scale of impacts on different farming sectors. What is clear is that the impact of the extreme weather varied across different farming sectors.

For example, the main impact on the beef sector was increased feeding costs through prolonged feeding periods and fodder shortages leading to increased demand and costs for bought in fodder. The sheep sector suffered most in terms of animals lost due to exposure and hypothermia and foetal losses. It should be noted that this also represents a cost in terms of animal welfare as well as an economic loss. The dairy sector was impacted through increased feed costs and in some cases uncollected milk. Whilst the overall impact of lost milk collections was relatively low, the impact on some individual farm businesses is likely to have been significant—anecdotally one farm is reported to have lost as much as £23,000 due to uncollected milk.

The increased housing period for beef and dairy animals meant increased demand for fodder and bedding. At the same time, supplies were reduced due to poor grass growth and the reduced availability of straw from the difficult 2017 harvest conditions. The severe winter had its greatest impact on the livestock sector. Whilst this is being offset by higher market prices during 2019, going forward an increased frequency of severe winter weather would impact on the extensive sheep sector and could severely decrease competitiveness with other regions. Potentially, the sheep industry could adapt by lambing later, by increased expenditures on improved housing and/or through longer ewe housing periods.

Straw production in 2017 was affected by the poor weather across Scotland and north and western areas of England and Wales. Poor weather in Yorkshire reduced the quantity of straw baled and created difficulties for Scottish livestock producers, as it is traditionally the nearest large arable area that can supply straw to Scotland. Scottish farmers were forced to source straw from further south in England than normal with straw reported coming from as far as Kent (Bell, et al., 2018). These distant supplies incurred additional transport costs.

The cereals area in 2017/18 was down due to poor conditions for sowing in the autumn of 2017. Overall yields were significantly affected by the drought. Wheat production suffered the greatest loss, with losses estimated at 26% of output. On the other hand, potato yields reported in Scotland were up on 2017.

It is likely that the impacts of the weather on sectors such as soft fruit (raspberries) and horticulture was also significant, however data on production and yields during the 2018 season is not yet available and these impacts are not accounted for in the analysis presented.

Distilling (3% GDP) and brewing (0.3% GDP) are critical to the economy of Scotland (Scottish Parliament, 2018). During 2017/18 Scotland's brewers and distillers have been impacted through increased prices for malting barley. It should be noted that the increased cost of raw materials is a



relatively small component of the overall costs of production and that the overall impact on beer and spirit prices is likely to be minimal in the long term.

Due to the timescales involved in some agricultural sectors, the impact of the losses is still being felt in terms of reduced supplies of finished cattle and lambs leading to increased market prices over the past few months. To some extent, increased prices will offset many of the additional costs borne by farmers over the previous year but may have longer-term impacts.

Whilst it is likely that improved market and weather conditions in 2019 will allow the industry to recover, a scenario with an increased frequency of extreme weather events as seen in 2017/18 will have significant negative consequences for Scottish agriculture.

Conclusions

It is estimated that the weather events of 2017/18 led to losses of up to £161 million, equivalent to approximately 6% of total agricultural output during this period. However, losses varied across the different sectors of Scottish agriculture, both in nature and severity and time scale and some data is not yet available. The heaviest physical and economic impacts were on the livestock sector which experienced heavy losses as a result of the snowstorms in March 2018 and increased feeding costs over the summer.

The sheep sector suffered most in terms of animals lost and increased feed costs (£45 million). The beef sector suffered fewer animal losses but incurred increased feed costs as a result of the need to prolong the housing period for cattle and shortages of fodder (£28 million). The impact of the weather events on the livestock sector is ongoing during 2019 with reduced cattle numbers, lower breeding sheep numbers and reduced lamb production.

Sowing of winter crops was delayed in autumn 2017, which led to a reduced planting area. As a result, crop yields for key crops were negatively impacted. Overall losses to the cereal sector were £62 million—equivalent to 15% of the sector's output in 2017.



References

AHDB a, 2018. *April Sheep Outlook - July Review*, s.l.: AHDB Agricultural and Horticultural Development Board.

AHDB a, 2019. *Sheep Outlook - October 2018 forecast, January Review*. [Online]
Available at: <http://beefandlamb.ahdb.org.uk/wp-content/uploads/2019/01/Sheep-outlook-Iss-1-Jan-19.pdf>
[Accessed 13 February 2019].

AHDB b, 2018. *Latest Grazing Measures*. [Online]
Available at: <https://ahdb.org.uk/news/latest-grazing-measures>
[Accessed 22 January 2019].

AHDB c, 2018. *Ex Farm Malting Barley Price Jumps*. [Online]
Available at: <https://cereals.ahdb.org.uk/markets/market-news/2018/august/14/grain-market-daily-140818.aspx>
[Accessed 13 February 2019].

AHDB Cereals, 2019. *Market Data Centre*. [Online]
Available at: <https://cereals-data.ahdb.org.uk/archive/physical.asp>
[Accessed 15 February 2019].

AHDB Dairy, 2018. *Market Information*. [Online]
Available at: <https://dairy.ahdb.org.uk/resources-library/market-information/#.XEBOFFZ2tPY>
[Accessed 7 January 2019].

ASC, 2016. *UK Climate Change Risk Assessment 2017. Evidence Report - Summary for Scotland*. , London: Adaptation Sub-Committee of the Committee on Climate Change. .

Autoline Insurance Group, 2018. *Beast From The East - How Snow And Storms Affect Farms*. [Online]
Available at: <https://www.autoline.co.uk/contact-us/news/news-detail/11112/Beast-From-The-East-How-Snow-And-Storms-Affect-Farms/>
[Accessed 17 January 2019].

Bell, J., Inman, G. & McDowell, M., 2018. *Straw and Forage Study: A Review commissioned under the Scottish Government RESAS Policy Underpinning: Special Economic Studies - 2017/18*. , s.l.: SRUC Scotlands Rural University College.

Centre for Economics and Business Research, 2018. *Feeling the heat – extreme weather set to cost UK consumers £45 million per week..* [Online]
Available at: <https://cebr.com/reports/feeling-the-heat-extreme-weather-set-to-cost-uk-consumers-45-million-per-week/>
[Accessed 10 January 2019].

CII, 2009. *Coping with climate change: risks and opportunities for insurers*. Chapter 3 Farming and Forestry. , s.l.: Chartered Insurance Institute.

Countryfile.com, 2018. *UK weather 2018: how the extreme weather has impacted on the countryside*. [Online]
Available at: <https://www.countryfile.com/news/uk-weather-2018-how-the-extreme-weather-has->



impacted-on-the-countryside/
[Accessed 15 January 2019].

Eastern Daily Press, 2018. *EU rules relaxed to help drought-hit livestock farmers feed their animals..* [Online]
Available at: <https://www.edp24.co.uk/business/farming/eu-rules-relaxed-for-livestock-forage-1-5712288>
[Accessed 20 January 2019].

EBLEX, 2014. Improving ewe nutrition for Better Returns : EBLEX SHEEP BRP MANUAL 12, s.l.: English Beef and Lamb Executive.

Farminguk, 2018. *UK potato production hits lowest level since 2012.* [Online]
Available at: https://www.farminguk.com/news/UK-potato-production-hits-lowest-level-since-2012_50921.html
[Accessed 10 January 2019].

Food Manufacture, 2018. *Scottish Wholesalers Concerned Over Cattle Decline.* [Online]
Available at: <https://www.foodmanufacture.co.uk/Article/2018/05/09/Scottish-livestock-declines-cause-concern>
[Accessed 9 January 2019].

FWi a, 2018. *Devastated dairy farmer ditches 75,000 litres of milk..* [Online]
Available at: <https://www.fwi.co.uk/livestock/devastated-dairy-farmer-ditches-75-000-litres-of-milk>
[Accessed 16 January 2019].

FWi a, 2019. *Prime lamb market starts year on positive note.* [Online]
Available at: <https://www.fwi.co.uk/livestock/taking-stock/prime-lamb-market-starts-year-on-positive-note>
[Accessed 1 February 2019].

FWi b, 2018. *Farmers shoulder cost of milk lost in bad weather.* [Online]
Available at: <https://www.fwi.co.uk/livestock/extreme-weather-leaves-farmers-counting-cost-dumped-milk>
[Accessed 12 January 2019].

FWi b, 2019. *Red meat supplies set to tighten after extreme 2018.* [Online]
Available at: <https://www.fwi.co.uk/livestock/beef/red-meat-supplies-set-to-tighten-after-extreme-2018>
[Accessed 2 February 2019].

FWi c, 2019. *Fodder prices climb to record levels as demand increases.* [Online]
Available at: <https://www.fwi.co.uk/business/markets-and-trends/input-prices/fodder-prices-climb-to-record-levels-as-demand-increases>
[Accessed 02 February 2019].

Met Office, 2018. *Snow and low temperatures February to March 2018.* [Online]
Available at: <https://www.metoffice.gov.uk/climate/uk/interesting/february2018-snow>
[Accessed 17 January 2019].

Met Office, 2019. *UK Climate.* [Online]
Available at: <https://www.metoffice.gov.uk/climate>
[Accessed 17 January 2019].



NFSCo a, 2018. *NFSCo*. [Online]
Available at: <https://www.nfsco.co.uk/>
[Accessed 20 December 2018].

NFSCo b, 2018. *Scottish Fallen Stock Support Scheme 2018*. [Online]
Available at: <http://www.nfsco.co.uk/news-detail.php?NewsID=83>
[Accessed 27 December 2018].

NFU Mutual, 2019. *Personal Communication*. s.l.:s.n.

Promar Milk Minder, 2019. *Promar Milk minder Dairy Costings*. [Online]
Available at: https://dairy.ahdb.org.uk/resources-library/market-information/farming-data/promar-milk-minder-dairy-costings/#.XEifT_Z2tPY
[Accessed 23 January 2019].

Reid, A. & Wainwright, W., 2018. *Climate Change and Agriculture: How can Scottish Agriculture Contribute to Climate Change Targets?*, s.l.: The Scottish Parliament Information Centre.

Scotchwhisky.com, 2017. *How will climate change affect scotch?*. [Online]
Available at: <https://scotchwhisky.com/magazine/features/13034/how-will-climate-change-affect-scotch/>
[Accessed 10 February 2019].

Scottish Dairy Cattle Association, 2018. *Press Release: July 2018*, s.l.: Scottish Dairy Cattle Association.

Scottish Government a, 2018. *Economic Report on Scottish Agriculture: Section C Time Series*. [Online]
Available at: <https://www2.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport/TimeSeries>
[Accessed 29 December 2018].

Scottish Government b, 2018. *Economic Report on Scottish Agriculture 2018*. [Online]
Available at: <https://www2.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport/ERSA2018>
[Accessed December 26 2018].

Scottish Government c, 2018. *Cereal Harvest Summary*. [Online]
Available at: <https://www2.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/Publications/harvestsummary>
[Accessed 4 January 2019].

Scottish Government d, 2018. *Bank Advances to Scottish Agriculture*. [Online]
Available at: <https://www.gov.scot/publications/bank-advances-scottish-agriculture-2018/>
[Accessed 16 January 2019].

Scottish Parliament, 2018. *Brewing and Distilling in Scotland - Economic Facts and Figures*. [Online]
Available at:
<https://digitalpublications.parliament.scot/ResearchBriefings/Report/2018/10/11/Brewing-and-distilling-in-Scotland---economic-facts-and-figures#Introduction>
[Accessed 15 February 2019].

SHAWG, 2018. *The Sheep Health and Welfare Report 2nd Edition*, s.l.: Sheep Health and Welfare Group (SHAWG).



SRUC, 2018. *SRUC Farm Management Handbook 2018/19*, s.l.: SRUC Scottish Rural University College.

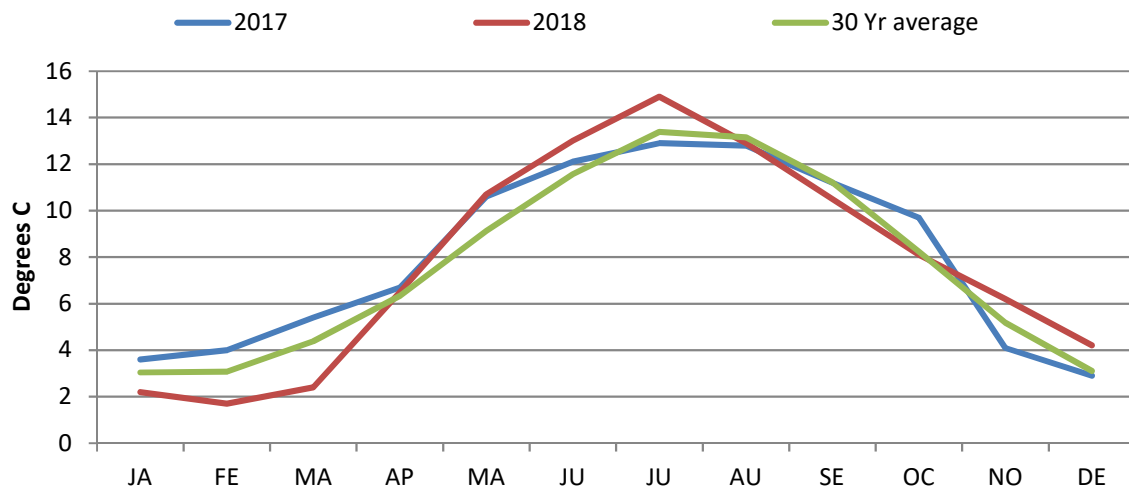
The Grocer, 2018. *Heat Wave: growers warn of potato shortages..* [Online]
Available at: <https://www.thegrocer.co.uk/buying-and-supplying/sourcing/heatwave-growers-warn-of-potato-shortages/570231.article>
[Accessed 1020 January 2019].

The Scottish Farmer, 2018. Dry summer caused fire problems for UK farmers.. *The Scottish Farmer*, 23 Decemebr.

Appendix A

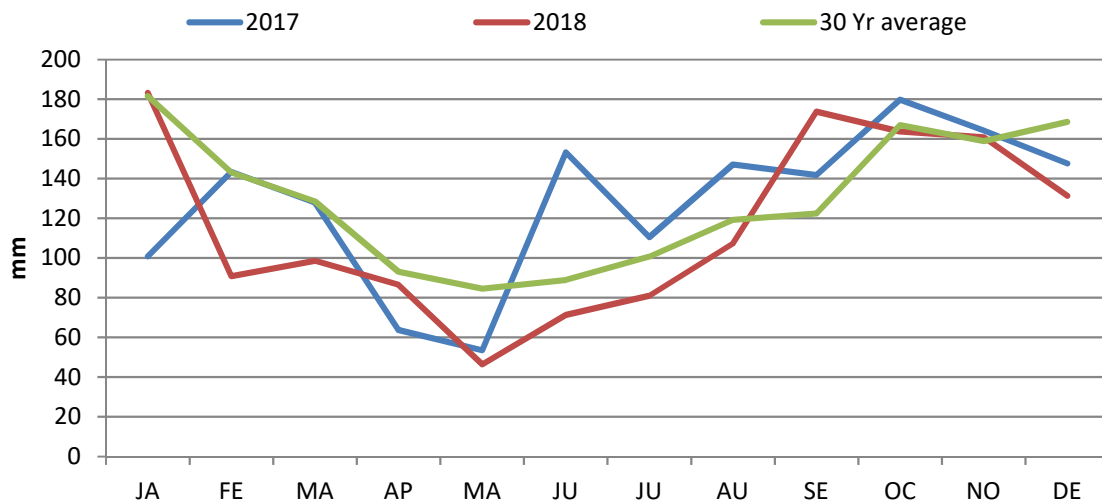
Met Office Data for Scotland

Monthly Mean Temperature



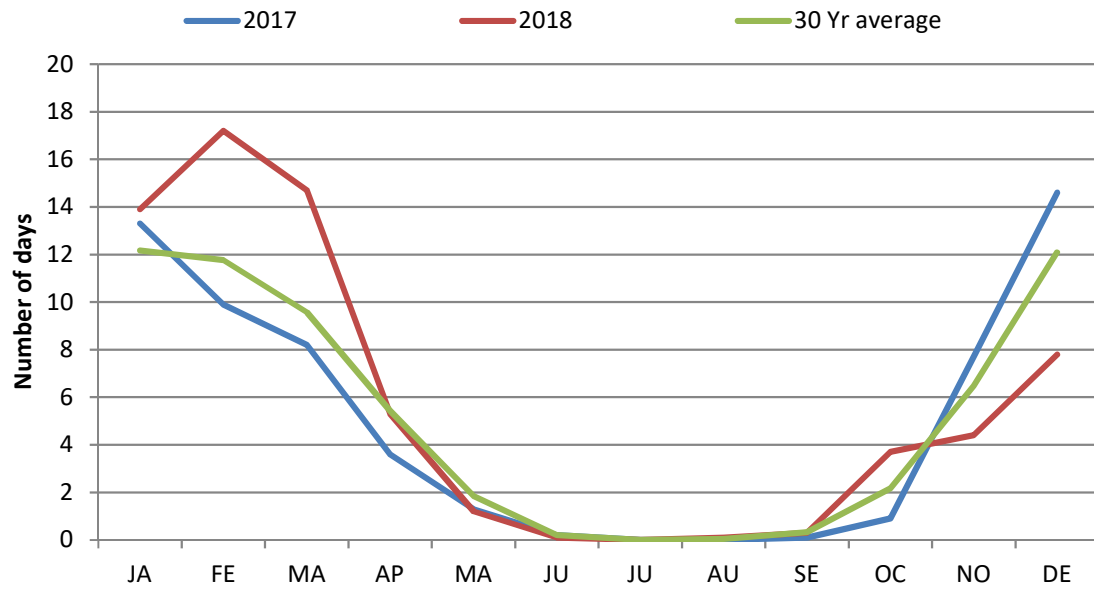
Source: (Met Office, 2019).

Monthly Mean Rainfall



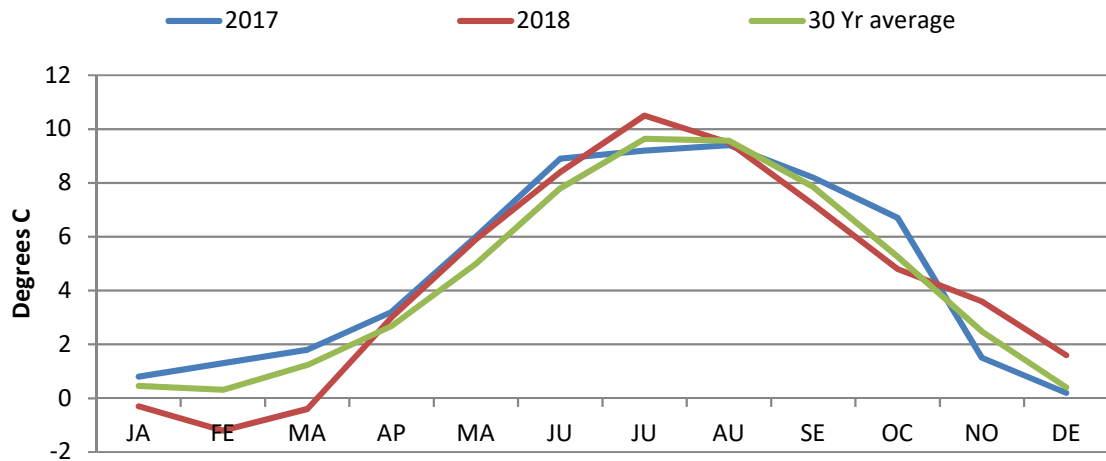
Source: (Met Office, 2019).

Monthly Number of Days Airfrost



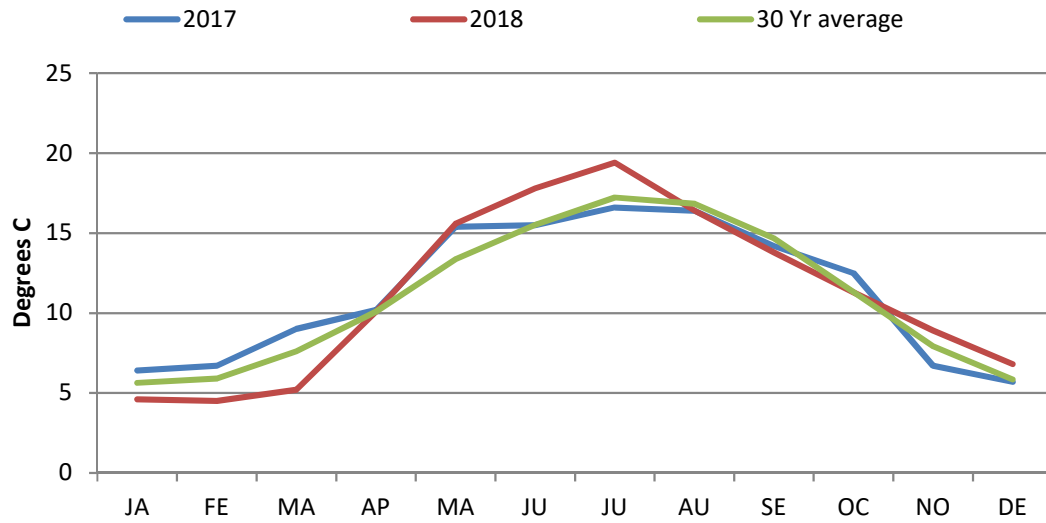
Source: (Met Office, 2019).

Monthly Minimum Temperature



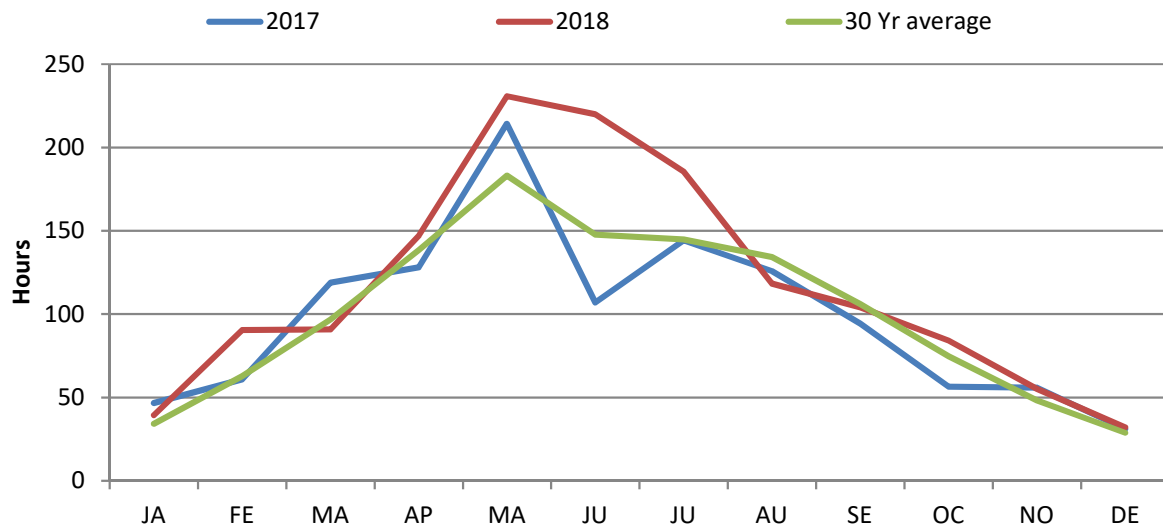
Source: (Met Office, 2019).

Monthly Mean Maximum Temperature



Source: (Met Office, 2019).

Mean Number of Hours Sunshine



Source: (Met Office, 2019).

Appendix B

A Description of The Extreme Weather Events of 2017/2018

Summer 2017

Summer 2017 rainfall was above average across most of Scotland and much of England, particularly importantly in northern arable areas including eastern Yorkshire. In July 2017 monthly rain fall was 64.4 mm above the 30-year average, and rain fall above the baseline until December.

Winter 17/18

Temperatures were slightly below average in Scotland in January 2018, and over a degree below average for almost all of the UK in February, so, despite it being slightly milder than average in December everywhere and also in January for England and Wales, the season overall came in very slightly colder than average, though not as cold as winter 2013.

December and January were both slightly wetter than average for the UK as a whole, but February was rather drier, so overall the winter is close to average for many areas, with East Anglia rather wetter and eastern Scotland somewhat drier. Much of the winter was rather unsettled, and only in the second half of February did we get several generally dry days together.

However, that was followed by winds from the east, temperatures dropping and widespread snowfall over the start of March. These events were subsequently labelled 'The Beast from the East' and Storm Emma. March was the most significant spell of severe winter weather since December 2010 and Snow depths accumulated to 50cm or more across upland areas of northern and eastern England and eastern Scotland. (Met Office, 2018). The Monthly mean temperature in March in Scotland was almost 2 degrees C below the 30-year average.

Summer 2018

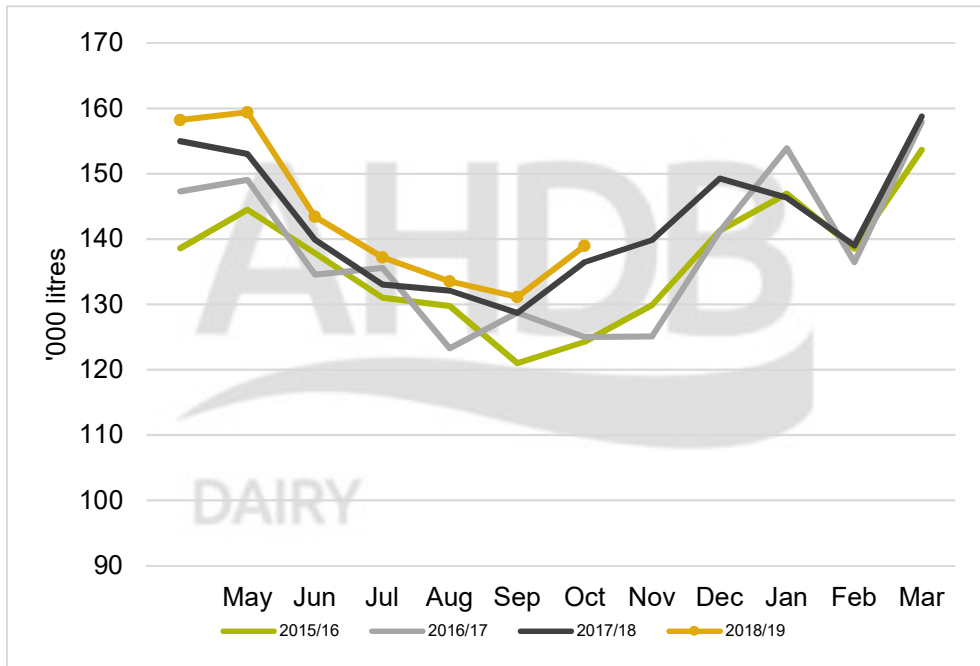
Summer 2018 was the joint hottest summer on record for the UK. Scotland saw regular bands of rain during the period of 13th-20th June and was often less settled from mid-July onwards. (Met Office, 2019).

May, June and July saw an average mean temperature in Scotland 1-degree C over the 30 year mean, however by August temperatures had fallen back to below average. Rainfall in May was 38.2 mm below the baseline, followed by June (-17.5mm), July (-19.5mm) and August (-12.0mm). More rain came in September which was 51.3 mm above the baseline.

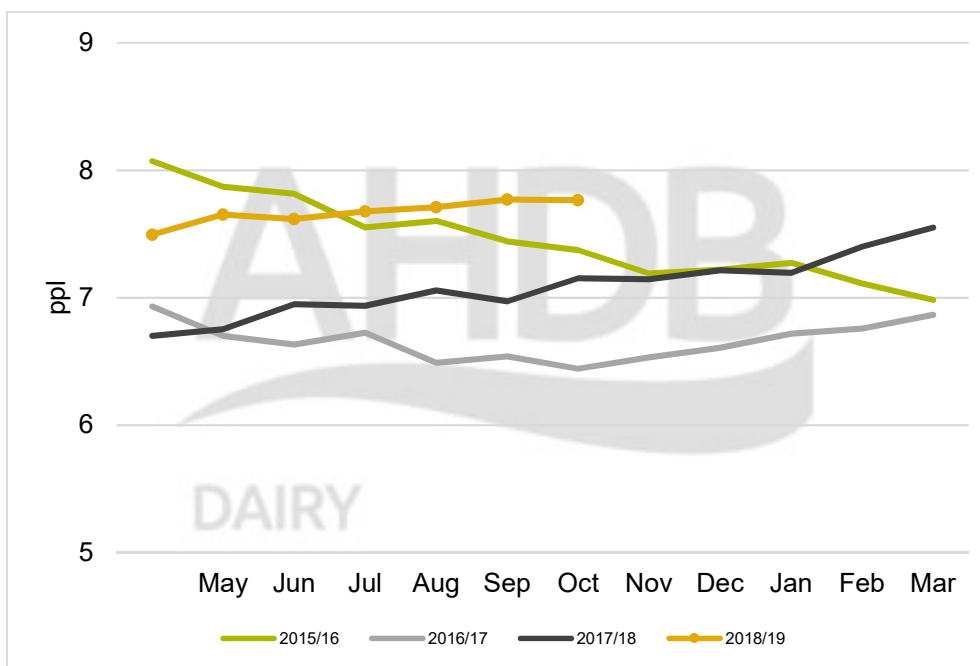
Appendix C

AHDB Milk production data for the UK during 2017/2018

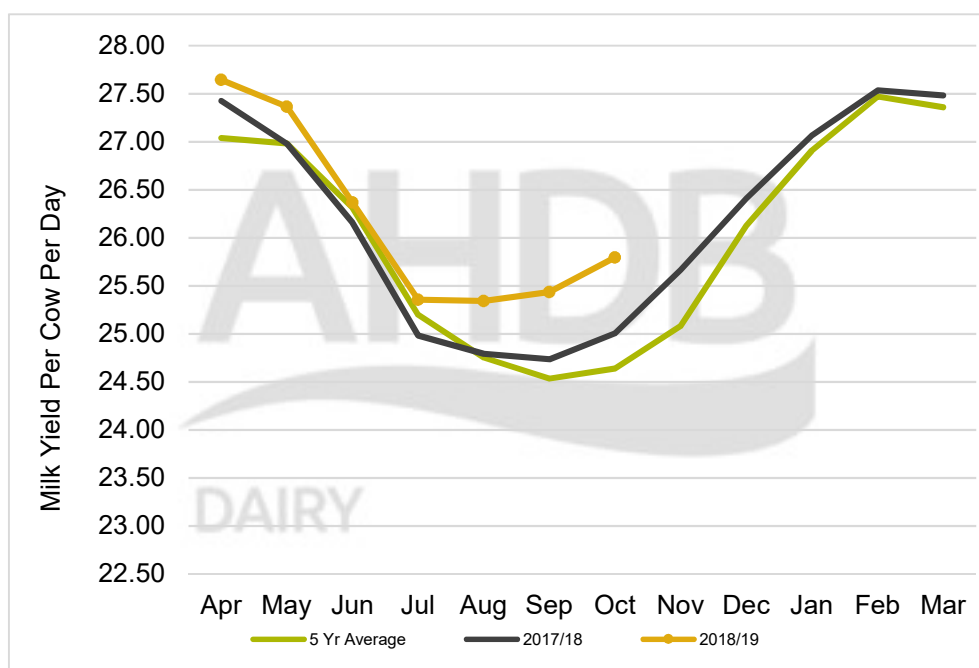
UK Average Monthly Milk Production



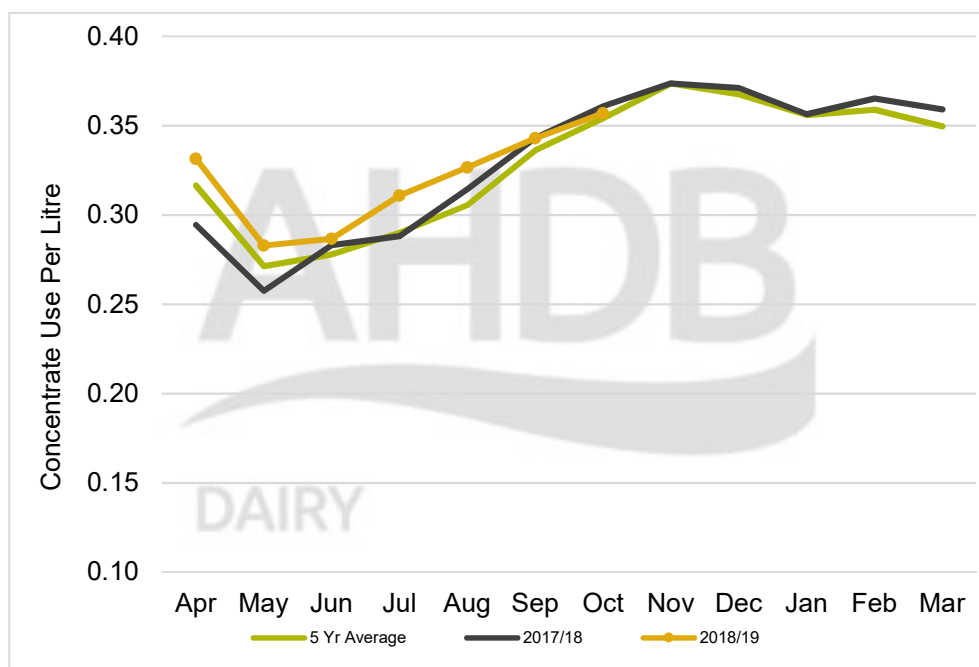
UK Dairy Feed Costs (12 month rolling average)



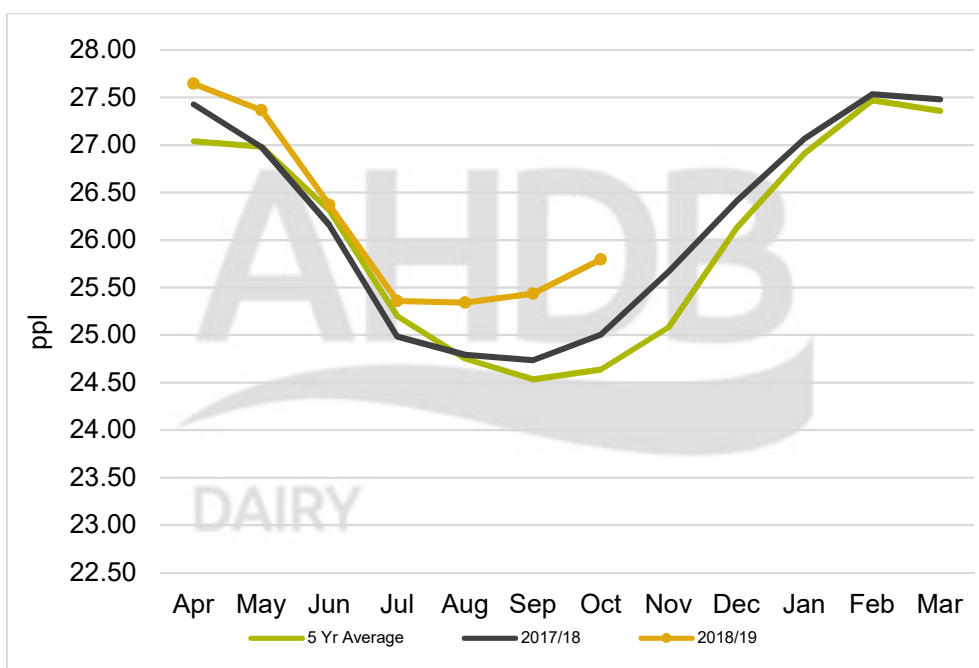
Impact on UK Milk Yield



Impact on UK concentrate use per litre milk produced

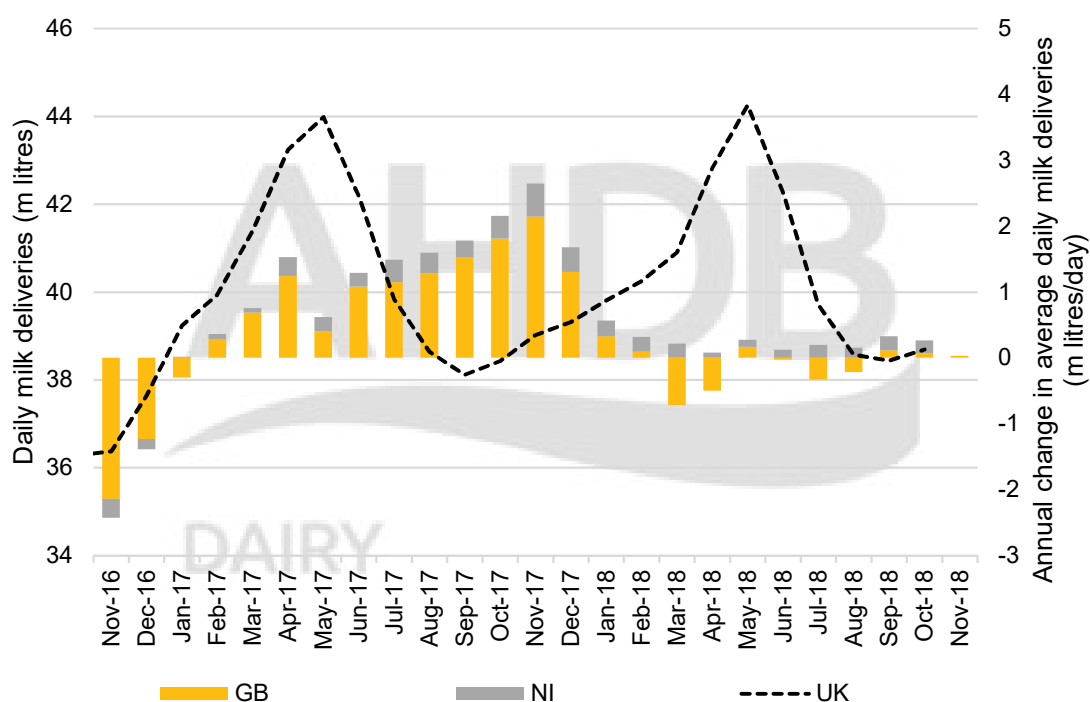


Impact on UK Dairy Feed Costs per Litre of Milk Produced



Source: (Promar Milk Minder, 2019).

UK production in average daily milk deliveries and year-on-year change



From (AHDB Dairy, 2018)

Appendix D

The Assumptions Used in estimating the economic losses to Scottish agriculture

Cattle

Replacement costs

Costings for the value of livestock losses were based on values quoted in the Farm Management Handbook 2018 produced by SRUC. In calculating the value of losses, the following assumptions were made on the value of replacing breeding cattle and calves:

- Replacement Dairy Heifer: £1,300 (SRUC, 2018)
- Replacement Upland Suckler Cow: £1,700 (SRUC, 2018)
- Replacement Calves: £150 (SRUC, 2018)

Animal feeding costs

SAC Consulting estimated grass growth in parts of Scotland could be delayed by up to three weeks (Bell, et al., 2018). Assuming this forecast reflected actual conditions, it is assumed that turnout of cattle was delayed by 21 days. Farmers who required additional fodder and bedding would have bought in additional fodder as big baled hay and additional fodder requirements are estimated in terms of big baled hay rather than silage. Big bale hay is priced at £95/t based on figures from the British Hay and Straw Merchants Association and the Farmers weekly for February 2018 quoted in the SRUC forage study (Bell, et al., 2018). Silage dry matter is taken as 300 g/kg, whilst dry hay dry matter is assumed to be 830 g/kg.

In estimating the additional forage requirements for cattle, the following silage consumption per animal per annum were assumed.

- Dairy Cows - 8.5 tonnes over a 150-day feeding period
- Suckler Cows – 6.4 tonnes over a 180-day feeding period
- Cattle under on year (calves) – 3.5 tonnes over a 180-day feeding period
- Other cattle – 4.5 tonnes over a 180-day feeding period.

The forage costs per day for each livestock type used in estimating additional forage expenditure are presented in the following table.

Calculation of additional forage costs per day

Assumed Dry matter content %						
Hay	83%					
Silage	24%					
Big Baled Hay	95	£/tonne				
	Silage consumption per annum	Days	Silage per day	Dry matter intake kg per day	Hay equivalent kg per day	Forage Costs per day
Dairy cows	8,500	150	56.7	13.6	16.4	£1.56
Beef cows	6,400	180	35.6	8.5	10.3	£0.98
Cattle < 1 yr.	3,500	180	19.4	4.7	5.6	£0.53
Other cattle	4,500	180	25.0	6.0	7.2	£0.69
	Body Weight (kg)	Forage dry matter as % of body weight ¹				
Ewes	50	3.0%	1.5	1.8		£0.17
Rams	100	2.5%	2.5	3.0		£0.29
Other sheep	50	2.5%	1.25	1.5		£0.14

Thus, for example a dairy cow would consume 56.7 kg of silage during the feeding period, or the equivalent of 16.4 kg of hay per day costing £1.56 per animal per day. A 50 kg ewe would require 1.8 kg of hay per day – costing £0.17 per animal per day.

Bedding costs

According to the SRUC every additional week added to the length of the winter housing period would be expected to require an additional 36,000t of straw, which at an assumed price of £140/t would lead to additional costs of £5.0 million per week of additional housing (Bell, et al., 2018). With an assumed delay to turnout of 21 days then the total costs of additional bedding would have amounted to £15 million.

Sheep

Replacement ewes were costed at £85 per head based on the value of draft blackface ewe lambs, whilst the value of a finished lamb was taken as £57 per head based on the value of finished lambs from extensive hill flocks. Replacement rams were valued at £375 per head (SRUC, 2018).

¹ Taken from (EBLEX, 2014).

Appendix E

Calculated Economic Costs of Extreme Weather 2017/2018

Estimated Scottish Livestock Production Losses

[illegible]

Estimated Scottish Crop Production Losses

Scottish Crop Production Losses	000 tonnes							
	Average 2004-17	2017 Prov.	On Trend	2018 Actual	% Change	Estimated Loss (MT)	Value / MT	Value of Loss (£)
Wheat	876.1	889.3	914.3	681.0	-23.4%	233.3	£144.45	£33,704,317
Winter barley	364.9	352.1	340.4	268.1	-23.9%	72.3	£141.63	£10,241,325
Spring barley	1,477.3	1,432.8	1409.0	1300.0	-9.3%	109.0	£141.63	£15,437,266
Total barley	1,842.2	1,784.9	1749.4	1568.1	-12.1%	181.3		£25,678,592
Oats	142.4	184.8	197.9	175.8	-4.9%	22.1	£120.40	£2,660,892
Triticale	4.3	z						
Oilseed rape	125.8	144.0	123.7	126.3	-12.3%			
Potato - main crop and earlies ⁽²⁾⁽³⁾	799.9	778.8	800.4	829.2	6.5%			
Potato - seed ⁽²⁾	300.3	303.2						
Vining peas	24.3	35.6						
Tomatoes	0.6	0.5						
Raspberries	3.4	3.1						
Strawberries	20.8	28.2						

Total crop production losses	£62,043,800
Output 2017	£448,142,216
Overall output down on baseline	13.8%