A Nuffield Farming Scholarships Trust Report

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Heifer replacement strategies:
cost reduction in the UK suckler beef herd

Sarah Pick

May 2020

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A Nuffield (UK) Farming Scholarships Trust Report

"Leading positive change in agriculture. Inspiring passion and potential in people."

Date of report: May 2020

Title	Heifer replacement strategies: cost reduction in the UK suckler beef herd
Scholar	Sarah Pick
Sponsor	Yorkshire Agricultural Society and the Worshipful Company of Butchers
Objectives of Study Tour	1. Create a blueprint for managing beef heifers to calve successfully at two years of age 2. Understand the selection criteria required to develop a functional suckler cow 3. Explore the changes the UK suckler industry must make to ensure it has a sustainable future
Countries Visited	Canada, USA, Australia Republic of Ireland, Northern Ireland, Scotland
Messages	1. If it is to survive, the UK suckler beef industry must find ways of reducing cost. 2. Ensuring all heifers calve at 2 years is one of the key areas where cost can be reduced. 3. Most beef producing countries have been calving heifers at two years of age since the 1970s. 4. The success of calving heifers at two years of age is driven by nutrition, genetics and effective selection 5. The industry must refocus attention from terminal traits to improving maternal attributes if it is to improve the reproductive efficiency of the UK suckler herd

EXECUTIVE SUMMARY

The long-term future of the UK suckler industry hangs in the balance. Consumer eating habits are changing; people are actively reducing their red meat consumption due to concerns over its association with health, ethics and environment; and instead favouring poultry, fish and meat-free alternatives. This trend is not the only concern for the industry.

The sector has also seen many years of poor returns which is likely to be exacerbated further by the probable loss of direct subsidies as part of the new Agricultural Bill. When compared to other countries, even though the UK beef price is relatively high, profitability is low. This can be attributed to our high cost of production.

Numerous research papers suggest that calving heifers for the first time at two years of age is an effective method of reducing cost of production and increasing cow lifetime reproductive performance. However, it is estimated that only 35% of English suckler producers carry out the practice. This report concentrates on the management practices required to ensure calving heifers at two years of age is successful, with the ultimate aim of reducing cost of production and boosting profits.

As part of my project, major beef producing countries including the USA, Canada and Australia were visited; where calving at two years has been commonplace since the 1970s. Countries closer to home including Scotland, Northern Ireland and the Republic of Ireland, were also explored to uncover examples of best practice in more representative systems.

Successful heifer development was found to be underpinned by nutrition, genetics and effective selection. Nutrition has a significant impact on age at puberty and rebreeding rates; if this isn't optimum, calving heifers at two years of age will be a challenge. The age at which a heifer reaches puberty, along with other maternal attributes, is also influenced by genetics. As an industry we must place more emphasis on maternal traits, rather than the terminal characteristics which have dominated selection decisions for many years.

Selection is key: we should not fight to keep unsuitable heifers within the herd. Creating weight targets, implementing tight breeding patterns and applying rigorous visual and genetic selection criteria ensure that only the most productive heifers enter the herd. This in turn results in the creation of a functional suckler cow which calves unassisted every 365 days; has low maintenance costs; and remains productive for a sufficient period of time to cover her development costs. This inevitably will decrease the industry's cost of production, helping to ensure a long-term, sustainable future for the UK suckler herd.

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Note: for the purposes of this report the costs of American, Canadian and Australian producers have been given in £s sterling. Conversion rates used were those current in May 2020.

DISCLAIMER

The opinions expressed in this report are my own and not necessarily those of the Nuffield Farming Scholarships Trust, or of my sponsor, or of any other sponsoring body.

Please note that the content of this report is up to date and believed to be correct as at the date shown on the front cover

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Chapter 1: Personal Introduction

I was raised on a small beef farm in North Yorkshire, which is where my passion for the beef industry first started. Summers were spent at the national agricultural shows, showing the family's herd of pedigree Simmentals, and winters were spent patiently waiting for the new calves to make their appearance. And then unfortunately I had to grow up ….

Figure 1: The author, Sarah Pick, on her family farm. Photo: author's own

I studied at the local agricultural college and was awarded a first class BSc in Animal Management and Science. I then joined Morrisons Supermarkets on their graduate scheme. This really opened my eyes to the opposite end of the supply chain and highlighted the importance of knowing your customer.

After working in the retail industry for two years I decided I wanted to get back to my farming roots and applied to undertake an MSc in Sustainable Agriculture.

After graduating for the second time, I joined the Agriculture and Horticulture Development Board (AHDB) as a beef specialist. I have since moved positions to join the knowledge exchange team which now means I spend more time out on farm, engaging with beef and sheep producers.

In my spare time, I run, completing my first marathon just before I started my Nuffield Farming Scholarship. I had set myself a target to complete a marathon before I turned 30, and I achieved it, just!

Chapter 2: Background to my study subject

The future of the UK suckler industry hangs in the balance. Over the past forty years there has been a shift in consumer eating habits, with consumption of beef falling to 17kg/year per capita due to concerns over its association with health, ethics and the environment. Conversely the amount of poultry consumed in the UK during the same time period has nearly tripled to 37 kg/year per capita (*AHDB, 2019*).

Changing consumer habits are not the only concern for the industry. Margins are also very small, with the average suckler producer in England losing £196 per cow put to the bull, and the top 25% of farms still only making a profit of £35 per cow (*AHDB, 2016*). These figures do not take into consideration support payments; however, with the introduction of the new Agricultural Bill, it is probable that subsidies will be reduced dramatically. With figures like these being reported, the long-term sustainability of this industry can be brought into question.

When compared to other countries, the UK's cost of production is much greater, with both variable and fixed costs being considerably higher than either European or non-European countries (Figure 2). If we are to compete and prosper on a global stage, this must change.

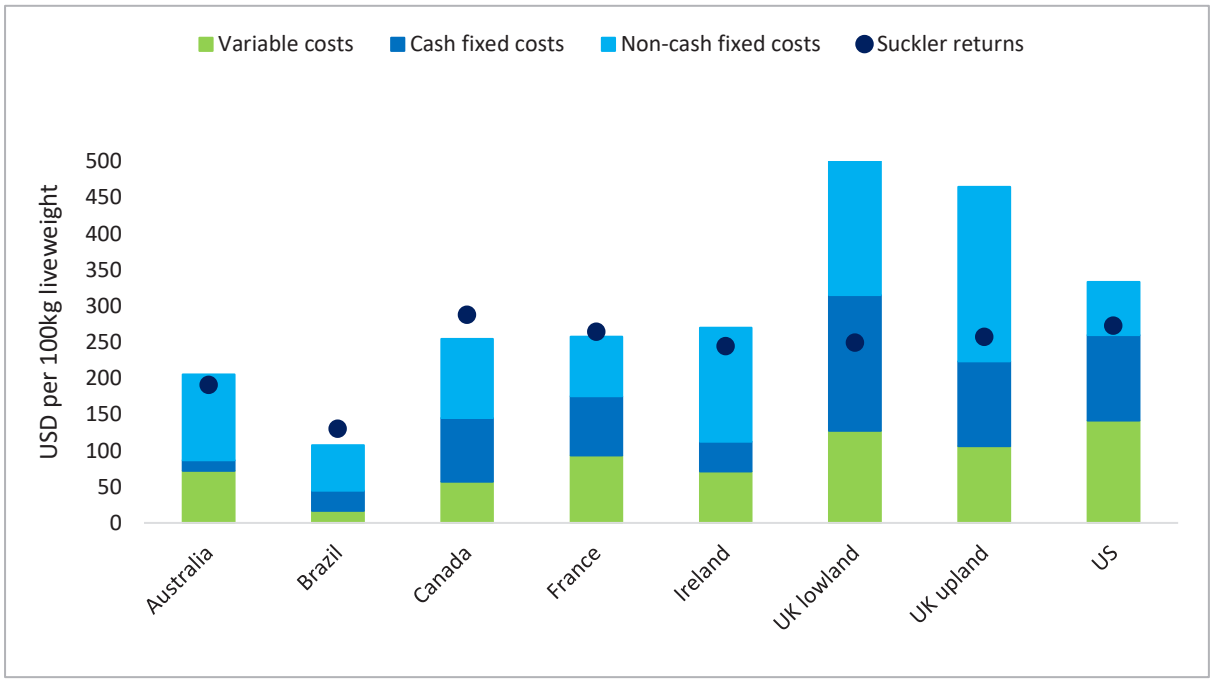

Figure 2: Typical farm suckler herd production costs and output, 2018. Source: AgriBenchmark data, AHDB (2020)

Replacement heifers are the lifeblood of the suckler herd and a valuable source of genetics; however, they are also a big cost to the suckler producer. Numerous research papers have demonstrated that calving heifers at two years old can boost profitability within the sector and is a practice which is now commonplace in the dairy industry. However, it is estimated that only 35% of UK suckler beef producers calve their replacement heifers at 2 years of age. Yet heifer replacement costs represent on

average 8.5% of the total cost of producing the calf and 19% of net margin, with the most progressive herds in terms of profitability having a 30% lower herd replacement cost (*Davis C., a conversation in 2020).* Therefore, heifer management is clearly a major area in which producers can work to reduce their overall costs.

However, calving at two is not straightforward and does require additional management if it is to be successful, and this is likely to be one of the reasons why around 65% of English suckler producers choose not to implement the practice.

I hoped that by undertaking this Nuffield Farming Scholarship I would be able to develop a blueprint for managing heifers which would:

I. help suckler producers successfully implement calving at two, and
II. help them select heifers more effectively, with the aim of producing a 'functional suckler cow', a term I will talk more about later in the report.

Chapter 3: My study tour

I visited the following countries during my study tour:

Scotland *July 2019*	Scotland has some large suckler producers and I wanted to understand the management practices they have in place to ensure calving at two years of age is successful.
Canada *August 2019*	I wanted to understand how heifers are developed to calve at 2 years within such harsh climatic conditions.
USA *August 2019*	The USA is known for its technological advancements in agricultural practices. I wanted to understand the most recent research looking at heifer development strategies.
Northern Ireland **Ireland** *February 2020*	Northern Ireland and Ireland operate a very similar production system to England, so I wanted to understand if calving at two is common and what are Irish producers' views on the future of the suckler industry.
Australia *March 2020*	Australia's cost of production is one of the lowest in the world. I wanted to understand why this was and if the UK could implement any of their practices.

I also took part in a Global Focus Programme (GFP), an intense six-week study tour with six other international Nuffield scholars, which aimed to develop our understanding of agriculture on a global scale. As part of this tour, we travelled to the USA (Florida), Mexico, Brazil, The Netherlands and New Zealand in April 2019. The businesses and people I met during this trip were inspirational and had a huge impact on the way I now view UK agriculture.

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Editor's Note: A UK Nuffield Farming Scholarship consists of:

1. A briefing in London.
2. Joining the week-long Contemporary Scholars' Conference attended by all new Nuffield Farming Scholars worldwide, location varying each year.
3. A personal study tour of approximately 8 weeks looking in detail at the Scholar's chosen topic.
4. A Global Focus Tour (optional) where a group of up to 10 Scholars from a mix of the countries where the scheme operates travel together for 6-7 weeks acquiring a global perspective of agriculture.

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The Nuffield Farming Scholarships scheme originated in the UK in 1947 but has since expanded to operate in Australia, New Zealand, Canada, Zimbabwe, France, Ireland, and Netherlands. Brazil, Chile, South Africa and the USA are in the initial stages of joining the organisation.

Chapter 4: Calving heifers at two years old

The benefits of calving at two years of age are widely recognised. In the USA and Canada calving at two has been common place since the 1970s, and as one Canadian rancher told me *"farmers need to be hinged on the economics and make two-year-old calving work".*

"farmers need to be hinged on the economics and make two-year-old calving work".

The lifetime productivity of the heifer is also increased if she calves at two years of age. Studies have shown they wean 0.9 more calves, produce 137kg more calf weight, and remain in the herd 1.2 breeding seasons longer, than those heifers which calve for the first time at three years (*Nunez-Dominquez et al., 1985).* Calving at two also means you can carry more cows because you have one less group of animals to house and graze. Also, any barren heifers identified post breeding can be finished as prime beef, before reaching 30 months of age.

However, there are negative implications to calving at two; including increased feed costs to ensure heifers reach puberty before the breeding season, as well as an increased risk of calving difficulties. Furthermore, first calved heifers wean 20% lighter calves compared to mature cows and also have an extended post anoestrous (non- cycling) period, which results in lower rebreeding rates. Nevertheless, many of these problems can be solved through genetics, selection and management, which should form part of any successful heifer development programme.

4.1 Importance of a heifer development programme

Firstly I want to start by asking: do you have a heifer development programme?

Before I set out on this journey, I never really thought farmers required a 'programme' to develop heifers but, after speaking with beef producers worldwide, it became very clear that it is vital. Having a fixed programme helps you set targets for your heifers. This ensures that those which don't reach a particular milestone are culled, and only your most productive heifers remain in the herd. Because after all, if you want a good cow then it starts with a good heifer!

But, before we even try to develop heifers we need to set ourselves an end goal – what sort of cow do we want to develop for our system? This is irrespective of breed: it is what traits do I want in my herd which will lead to a more profitable system? As Steven Sandison (Nuffield Farming Scholar, 2015) told me, if you don't have the right cow *"it's like trying to walk up a hill in high heels"* and I know from experience, no one wants to attempt that!

A suckler cow needs to:

1. Calve unassisted every 365 days and wean a live calf
2. Have low maintenance costs
3. Remain in the herd until she is at least five years of age, producing at least three calves to ensure she has covered her development costs.

The industry seems to have become too engrossed in chasing the terminal traits - including growth rate and carcase weight – whilst failing to consider the impact on maternal traits. Weaning weights have increased phenomenally over the years but still, on average, only 85% of cows rear a calf each year (*AHDB, 2016*). As Bart Lardner, a beef professor from Saskatchewan told me: *"Fertility traits are five times more important than improvements in end-product traits – because at the end of the day, there is no point worrying about the growth rates if you haven't got the calf in the first place".*

"Fertility traits are five times more important than improvements in end-product traits".

4.2. The functional suckler cow

The 'functional' suckler cow is a term I picked up whilst travelling in Canada and made me question if I had seen many of these in the UK.

Case study: Jerry Holtman, Alberta, Canada

"Functional efficiency" was a phrase I coined from Jerry Holtman, a rancher from Taber, Alberta. Jerry farms 360 Beef Booster suckler cows. The Beef Booster is a hybrid, consisting of three strains: the maternal, heifer and terminal, with each breeder focusing purely on one of these types. Superior cattle are identified through genomics, and only the top percentage of animals are sold for seedstock.

Figure 3: Jerry Holtman and Author. Photo: author's own

Jerry focuses on breeding cattle for the maternal strain which is based on six traits of economic relevance: fertility; milking ability; weight; conformation; hardiness; and disposition. Over the years Jerry has selected his cattle to improve both functional and reproductive efficiency because, as he says, *"man has the greatest influence on any system, and the weakest part of any operation is the man himself"*. By implementing a strict culling policy, and using the latest technologies, Jerry's herd is achieving a 93% conception rate within a 55-day breeding period.

Jerry is now focusing on tweaking the functional efficiency of his cattle. His aim is to produce a replacement female which thrives in the difficult environment these cattle reside in. Jerry states: *"let nature do all the selecting for us"*. They have to contend with temperatures above 30˚C in the summer and below 30˚C in the winter. One of the major costs with any suckler production system is winter feed. Jerry is hoping to reduce this by selecting animals which put on around 90kg of extra back fat during the summer months. He hopes that these animals will be able to metabolise this fat during the winter and will therefore require less supplemental feeding. It costs Jerry around £410 to keep a cow each year (including depreciation, labour and rent). This is £350 cheaper than the average cost to keep a cow in the UK.

Figure 4: Beef Booster cow and calf grazing in Taber, Alberta. Photo: author's own

4.3. Chapter conclusions

Calving at two years holds the key to reducing the UK's cost of suckler beef production and making the industry more profitable. It isn't easy and does require additional management, as will be explained in the following chapters of this report.

Chapter 5: Heifer management programme: birth to pre-breeding

The main aim of heifer development programmes from birth to pre-breeding is to ensure heifers weigh 65% of their mature weight before breeding. This is because age at puberty is highly correlated with weight and, therefore, the better we manage the heifers during this stage, the higher conception rates should be.

5.1. Age at puberty

Heifers which calve within the first three weeks of the breeding season have higher pregnancy rates, remain in the herd longer, and produce one more calf in their lifetime compared to those heifers which calve later (*Damiran et al., 2018).* Furthermore, heifers which reach puberty before the breeding season and have at least two cycles before being exposed to the bull, have much higher conception rates than those which are exposed to the bull on their first cycle (*Byerley et al., 1987).* Therefore, if we can ensure that more heifers are cycling before the first breeding season, by reducing age at puberty, more heifers are likely to become pregnant during the first three weeks of the breeding period.

Age at puberty is mainly influenced by genetics and nutrition (*Martin et al., 1992)* and therefore a good heifer development plan should aim to maximise both of these factors.

5.1.a. Genetics

Within genetics, the greatest determinates of age at puberty are breed and mature cow size. Table 1 shows that the majority of UK suckler cows consist of Continental genetics. This is very different to the US, Canada and Australia whose herds comprise mainly Angus and Hereford genetics which reach puberty at earlier ages, making them more likely to calve at two years of age.

Over recent years the influence of early maturing genetics in the UK has increased; however, this has mainly been driven by finishing premiums for native-bred cattle.

Table 1: Average ages and weights at puberty by breed. ***Source: Van Eenennaam, 2013***

Breed Group	Age at Puberty		Weight at puberty (kilogram (kg))	Suckler cow sires in the UK (% of total population)
	Days	Months		
Belgian Blue	347	11.5	329	10
Simmental	359	12.0	324	6
Angus	378	12.6	312	14
Charolais	389	12.9	343	7
Limousin	396	13.2	324	18
Hereford	402	13.4	318	6

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5.1.a.i. Heterosis

Heterosis or crossbreeding can bring many advantages to the suckler producer. Heifers reach puberty earlier at heavier weights (*Martin et al., 1992),* and calf survival, growth rate and weaning weight are all increased. Furthermore, crossbred cows have increased longevity compared to purebred females *(Cundiff et al., 1992).*

"no single management practice can have more impact on your bottom line than crossbreeding".

Many of the large beef-producing nations that I visited were using composite (crossbred) cattle, and the majority of the breeds within the composite were British. If we look at other livestock industries, for example pigs and poultry, they have been taking advantage of hybrid vigour for many years.

Case study: John Maddux, Nebraska, USA

One suckler producer who is making full use of hybrid vigour is John Maddux, of the Maddux Cattle Company, Nebraska. He stated to me: *"there is no single management practice, which can have more impact on your bottom line than crossbreeding".* In order to capture the benefits of hybrid vigour, John has developed a "Maternalizer" cow which consists of six different breeds including Red Angus, Tarentaise, South Devon, Red Poll, Hereford and Devon, all chosen for the breed traits for growth rate, age at puberty, milk production and % retail product.

Figure 5: Stockman, the author and John Maddux with mob of two year old heifers and calves. Photo: author's own

The cows have been selected to thrive on minimal, low-cost feedstuffs. Cows calve in May, so they don't require any additional supplement after calving. They are then out-wintered on corn stalks and supplemented with wet distillers. Heifer calves are weaned at 11 months of age, weighing on average 283 kg. They are then fed a total mixed ration for 3-45 days depending on their weight before being turned out to grass. It currently costs John £1100 to develop a heifer (compared to £1687 in UK). This year John has grown irrigated ryegrass in the hope this will replace the total mixed ration: reducing his heifer development costs by £32 per animal.

Figure 6: Maddux Cattle Company bulling heifer. Photo: author's own

John aims to get heifers to 306kg before bulling, which is 61% of his average mature cow weight. John has one overriding selection parameter for heifers – *"that they get in calf"!* Heifers are synchronised and then exposed to the bull for 70 days. John only uses bulls from first calved heifers, which are generally yearlings. Only those heifers which conceive within the first 30 days of the breeding period are retained, which means he gets bigger calves at weaning and the first calved heifers have more time to recover before the next breeding season. Last year 80% of yearling heifers conceived to the first three weeks of the breeding season; whilst 96% of two-year-old heifers and 94% of mature cows conceived within the first 48 days of the breeding season.

5.2.b. Nutrition

Poor nutrition between weaning and breeding can result in fewer heifers reaching puberty before the start of the breeding season, reduced conception rates, and higher pregnancy loss (*Short and Bellows, 1971).* Therefore, getting nutrition right is key to a successful heifer development programme.

During my travels around the UK, one of the major barriers preventing the implementation of two-year-old calving was the difficulty getting heifers to reach 65% of their mature weight before breeding. However, when broken down, heifers only need to achieve 1kg/day whilst nursing on their dam, and 0.7kg/day between weaning and breeding, which should be achievable (Table 2).

getting nutrition right is key to a successful heifer development programme

Table 2: Expected growth rates for replacement heifers from birth to breeding, based on a 650kg mature cow weight. Based on author's own calculations plus using a booklet provided by AHDB: http://beefandlamb.ahdb.org.uk/wp/wp-content/uploads/2015/07/BRP-Managing-replacement-heifers-manual-11-030715.pdf page 10

Birth weight	Average birth weight	40kg
Growth rate from birth to weaning	Average growth rate when suckling dam	**1.0 kg /day**
Weaning weight	Includes birth weight and 1kg growth rate for 200 days	240kg
Growth rate weaning to bulling	423kg minus 240kg = 183kg 183 / 250 days = 0.7kg/day	**0.7kg/day**
Bulling weight		423kg
Mature cow weight		650kg

A growth rate of 0.7kg/day can be attained with good quality silage (DM = 30%, ME = 11.5mJ/kg DM, CP = 16%), and an additional 1-2kg of concentrates (12.5 MJ ME/kg DM, 12% CP DM). Feeding concentrates does increase development costs. However, when based on a 250-day feeding period from weaning to breeding, this equates to a cost of £85 per heifer. When this is considered against the value of an additional calf, it really is worthwhile.

There has been a huge amount of work conducted in the USA looking at cost-effective heifer development programmes. When I travelled to Nebraska, I met with Dr Bob Cushman who explained the "stair step" technique; where heifer growth patterns fluctuate between weaning and breeding, rather than being constant. Heifers are fed low levels of nutrition for the first three months after weaning (0.2kg/day), before being introduced to a nutritionally dense ration (0.9 kg/day) four months prior to breeding (*Figure 6*). This results in lower feed costs (£38) (*Funston and Larson, 2011)* but does not impact growth rate, conception rate or second re-breeding rates (*Freetly et al., 2001*)

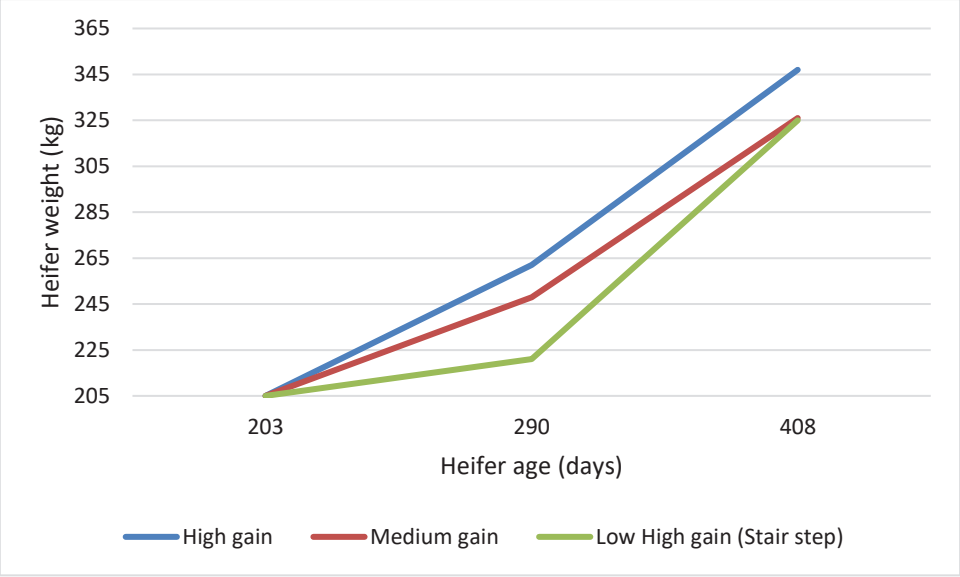

Figure 6: Heifer growth rate using stair step technique (adapted from: Freetly et al. 2001)

Successful heifer development is a fine balance between achieving target weights and cost-effective feeding. As Professor Rick Funston, a beef cattle reproductive physiologist at the University of Nebraska-Lincoln, told me: *"we want to develop heifers on a system which we want them to thrive in as a cow"*. This highlights the importance of reducing our reliance on concentrates and instead focusing on producing good quality grass and forage. Furthermore, we shouldn't worry about getting 100% conception rates in our heifers. As Rick mentioned: *"conception rates above 85% means you are not challenging your heifers enough, because at the end of the day, we only want to keep our best".*

"we want to develop heifers on a system which we want them to thrive in as a cow".

5.2. Selection

Careful selection of heifer replacements is key to ensuring that only the most functional, fertile heifers enter the herd. Between birth and weaning there are very few management practices that can be applied, and therefore most selection decisions at weaning will be made on the weight of the calf and an assessment of the dam.

5.2.a. Dam

As Professor Rick Funston told me, we should prevent keeping heifers from cows which:

- Required assistance at calving
- Calved late in the breeding season (+42 days)
- Failed to wean a calf
- Have large teats making it difficult for a newborn calf to suckle
- Weaned a light calf (growing less than 1kg/day)
- Bad temperament

This highlights the importance of keeping good records, because problems at calving can easily be forgotten by the time it comes to weaning time. A producer in Nebraska informed me that if there are any issues at calving, or the cow is deemed unsuitable to produce replacements from, the heifer calf is tagged with an additional red tag, notifying the farmer that these are not to be retained.

5.2.a.i. Dam age

During my travels one of the questions I battled with was: should we be retaining heifers from our oldest or youngest cows? For example, some producers retain heifers from the youngest cows so that they can progress the genetics in their herd faster. This is often an argument presented in the dairy industry, where farmers are encouraged to artificially inseminate (AI) heifers - rather than naturally mate - due to faster genetic gain and higher expected conception rates. Research in the dairy industry has shown that heifers produced from two-year-old heifers are lighter than those produced from multiparous cows. However, they are more productive, generating more milk in their first lactation (*Handcock et al., 2019).*

However, in contrast to this, many producers and researchers argue (and I would tend to agree) that we should be retaining heifers from the oldest cows in the herd. This is because such cows obviously have the desirable traits we are looking for or they would never have been retained in the herd for that length of time. Professor Rick Funston argues that by selecting heifers from these mature cows we are indirectly selecting for fertility. In a study conducted by Rick and his colleagues, he investigated the effect of dam age on performance of heifer calves. The study found that heifers born to 4-8 year old cows had higher reproductive success in their first and second breeding season; which increased their likelihood of remaining in the herd (*da Silva et al., 2016*). Professor Rick Funston surmised that the poorer performance exhibited by heifers from the younger cows was either due to inadequate nutrition *in utero* as the calf competed with the dam for energy and nutrients for growth; or because young dams produce less milk, meaning the calf is unable to express its true genetic potential. Whatever the reason, it seems selecting heifers from older cows possesses many advantages.

5.2.b. Heifer

The aim of any heifer development plan is that only the heifers which are most likely to conceive early within the breeding season are retained. As already discussed, age at puberty is strongly correlated with weight and, therefore, heifers which do not reach the target of 65% mature weight by 14 months of age should not be retained. Studies have shown that it is much more profitable to cull heifers before the breeding season, rather than retain unsuitable or barren heifers for an extended period of time *(Lamb, 2013).*

During my travels I found the only selection criteria many herds had for their heifers was that they reached their target weight. This is also a great way of selecting heifers which were born at the start of the breeding period, because with being the oldest, they are also likely to be the largest.

Professor Rick Funston mentioned that heifers born during the first 20 days of the calving period have higher weaning weights, pre-breeding weights and higher pregnancy rates than those born later. I witnessed this when I travelled to Northern Ireland and met with a dairy producer who block-calved. Fertility is key to their system and therefore they only serve the 35 earliest-born heifers. It is likely that the dams of these first-born heifers are the most fertile within the herd.

However, many producers also pointed out that any disproportionally large heifers should also be culled because they will likely have high mature weights. This was a real issue in Scotland, with producers struggling to fit large cows into the cubicles through the winter.

"calving at two years of age makes much more business sense".

Case study: John Wyld, Victoria, Australia

John Wyld moved from the UK to Australia in the 1970s. His herd consists of 1400 Hereford and Angus cows and a feedlot for over 1000 cattle. Since establishing his herd, he has always calved heifers at two years of age. He told me *"it's better management to calve at two",* elaborating that *"people can come up with all the excuses why not to do something but, at the end of the day, calving at two years of age makes much more business sense".*

Figure 7: Newly calved two year old heifers at John Wyld's

John selects all of his heifers at weaning, with only the heaviest heifers being retained for breeding. The heifers which don't make the cut are finished in his feedlot. Heifers are artificially inseminated for two cycles and then exposed to the bull for a further two cycles. His average conception rate is 90%. John tries to maintain a young herd, aiming to breed his replacements from heifers to take advantage of any genetic gain.

5.2.b.i. Temperament

Temperament of the heifer has been demonstrated to have both reproductive and economic implications for suckler producers. At the Applied Reproductive Strategies in Beef Cattle conference, which I attended in Tennessee, Dr Cooke (2019) explained that heifers with excitable temperaments have reduced feed intake and altered metabolisms, which often means they reach puberty later. Cattle with flightier temperaments also have higher levels of the stress hormone, cortisol, in their blood stream, which can disrupt reproductive hormones for ovulation and conception, reducing their chances of becoming pregnant. Therefore, any flighty heifers should not be retained.

5.2.b.ii. Genetics

Selecting heifers based purely on their visual characteristics is risky, and can result in undesirable heifers being retained. Estimated Breeding Values (EBV) provide producers with the best information about how a heifer should perform. However, EBV uptake within the UK suckler herd is poor.

EBV uptake within the UK suckler herd is poor.

It is my belief that over the years great emphasis has been placed on terminal traits including growth rate and carcase yield. This has led to the production of dysfunctional suckler cows which are too big, poor milk producers, and unable to effectively thrive on grass and forage. When I met with Lee Leachman of Lee Leachman Cattle, Colorado, he stated that *"the UK has a genetic problem; if it continues to select for terminal traits, calving at 24 months is never going to work".*

"…… if the UK continues to select for terminal traits, calving at 24 months is never going to work".

As referenced earlier in my report, the maternal traits, including longevity and fertility, are worth five times that of any of the terminal traits, so then why, as an industry, have we become so focused on them? A producer told me:

- *Price per head is visible, but not important*
- *Fertility is invisible, but very important*

It is true that many of the maternal traits are poorly heritable and difficult to select for; however, this does not mean we should not consider them when making breeding choices. In Ireland, the Irish Cattle Breeders Federation (ICBF) have recently developed a replacement heifer index after the industry acknowledged that beef producers were focusing on terminal traits in detriment to maternal characteristics. The replacement heifer index allows selection decisions to be made based on genetics rather than just visual appearance.

What is great about the system is that it uses multibreed analysis for pedigree animals as well as crossbred beef and dairy heifers, resulting in greater selection opportunities. The traits within the replacement index are shown in Table 3.

Table 3: Trait and trait emphasis used to calculate the ICBF heifer replacement index ICBF (2017) https://www.icbf.com/wp/?p=9778

Trait	Trait emphasis	Trait type
Maternal calving difficulty	6%	Cow traits 71%
Age 1st calving	6%	
Calving interval	9%	
Survival	8%	
Milk	18%	
Cow liveweight	14%	
Cow docility	4%	
Cull cow weight	7%	
Calving difficulty	7%	Calf traits 29%
Gestation	2%	
Mortality	1%	
Docility	1%	
Feed intake	4%	
Carcase weight	10%	
Carcase conformation	3%	
Carcase fat	1%	

The Beef Data Genomics Programme was introduced by ICBF in 2014, with the aim of encouraging uptake of genetics within the industry. Producers are incentivised with €90 per cow to record data and genotype 60% of their cattle, which provides invaluable information to the database. Since introducing the incentivisation, the number of calves born per cow has increased by 5%, the number of heifers calving at 24 months has increased by 23%, and the calving interval has been reduced by 10 days. Furthermore, there has been no negative impact on carcase traits. A similar breeding index was introduced to the Irish dairy industry in 2001, and since its inception has returned an equivalent of €1.5 billion to the industry (Figure 8).

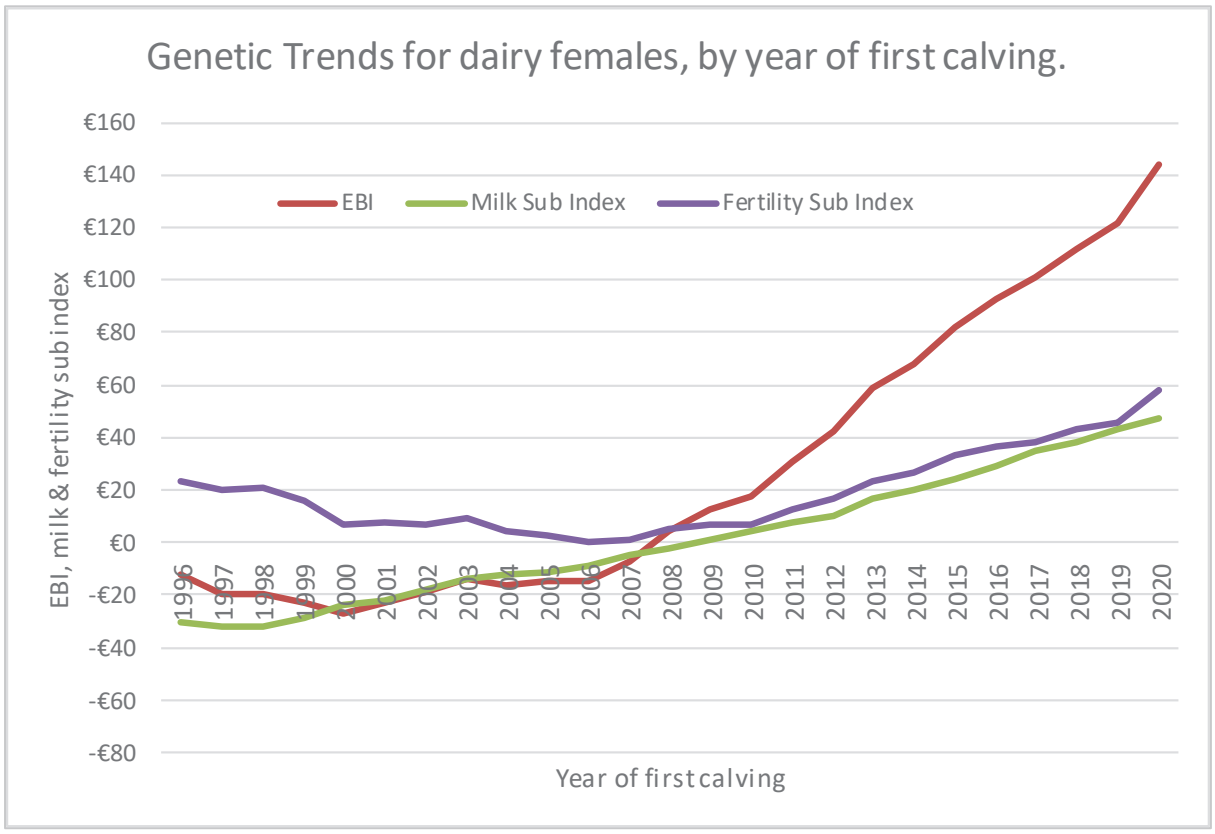

Figure 8: Genetic rate of gain in the dairy industry since the introduction of the Economic Breeding Index (EBI). Source: ICBF (2020)

The development of a multibreed analysis would be ground-breaking for the suckler industry. It would not only lead to an increase in productivity but would also help reduce carbon emissions, helping to rebuild the sector's damaged reputation. I strongly believe that the only organisation who would have the impartiality and drive to make this happen is the levy board.

Maternal EBVs to consider

The most effective way to create genetic change within a suckler herd is through careful bull selection. As Lee Leachman told me: *"choosing the best and worst maternal traits is a difference of £100 per cow per year".*

"choosing the best and worst maternal traits is a difference of £100 per cow per year".

As I travelled the world, the EBVs which were mentioned numerous times in reference to selecting heifers were: calving ease daughters; age at first calving; scrotal circumference; mature size; and milk. The first three are obvious; however, the last two are a little more contentious so I wanted to explain them further.

Mature weight

Over the past 35 years, mature cow weight has been steadily increasing; likely due to selection for terminal traits. This has led to an increase in carcase weights of approximately 2.5kg/year during the same time period (Figure 8) (*AHDB, 2019).*

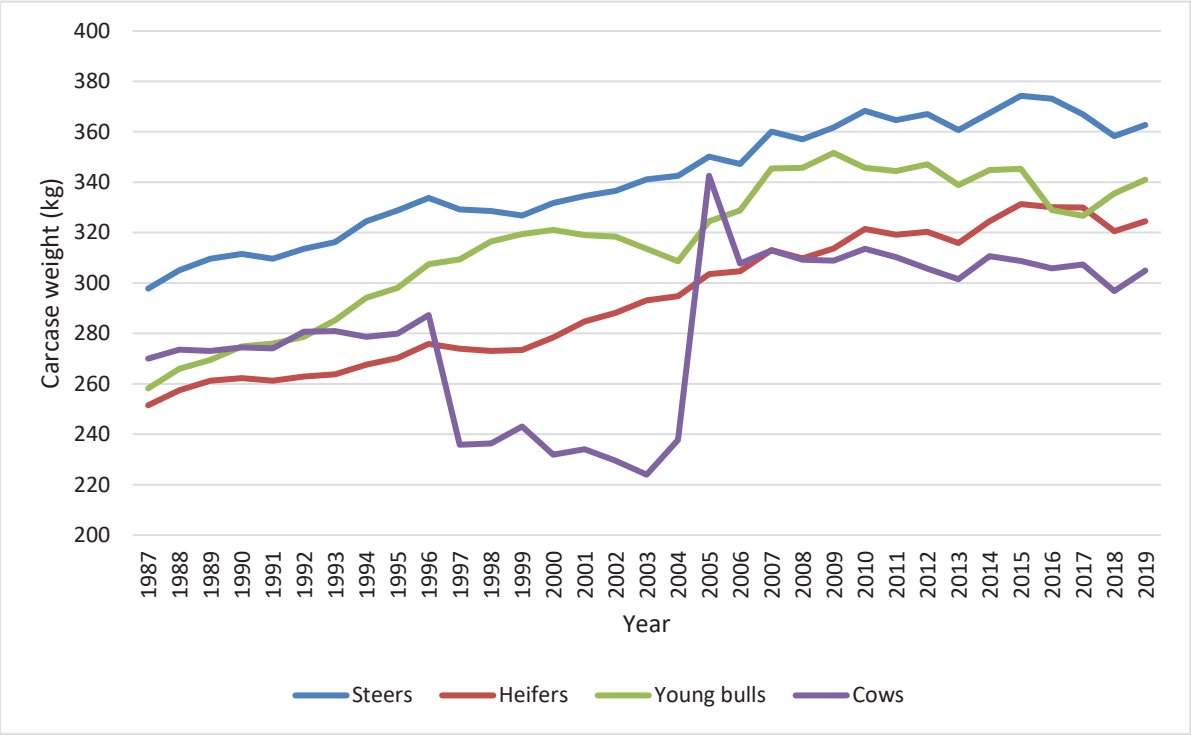

Figure 9: Carcase weight for steers, heifers and cows slaughtered in the UK 1987–2019
Source: DEFRA (2019)

If mature weight is highly correlated with maintenance costs, replacement costs and progeny feed costs, then why do we have such large cows in the UK? Despite large cows having a higher cull cow revenue, this does not outweigh the associated increase in feed costs. Furthermore, as cow weight increases, stocking rate falls, lowering kg beef produced-per-hectare further.

Mature cow size was on the mind of every producer I spoke to: from Northern Ireland to New Zealand. Most were aiming for a mature cow weight of 550-600kg, acknowledging that a cow can become too small. A recent study conducted by AHDB found that the optimum cow size in the UK is 680kg; increasing to 725kg when the cow can be maintained on the grass resources available. Cows over

Mature cow size was on the mind of every producer I spoke to: from Northern Ireland to New Zealand.

700kg not only require more feed, but they require higher feed quality, resulting in feed costs increasing at a faster rate *(AHDB, 2019).*

One of the ways producers are effectively reducing their mature cow size is culling the largest heifers and cows within the herd.

Milk

Milk again is quite a contentious subject, because we want to ensure that the cow has sufficient milk so that the calf can reach its genetic potential; however, we don't want too much milk because it is highly correlated with maintenance costs. Most producers I visited were selecting for average milk yield, in an attempt to reduce cost of production. Lee Leachman told me that milk should only be selected for when producers are selling stores; by the time the animal reaches finishing age, any difference due to milk will have disappeared.

milk should only be selected for when producers are selling stores

Whilst in Nebraska, I met with Travis Mulliniks whose recent paper looked at the effect of 'milkiness' on calf performance. He found that even though the amount of milk that the dam produced affected the 60-day weight of the calf, it had no impact on weaning weight. Furthermore, high milk producing cows (>10kg/day) had poorer rebreeding rates because energy was being partitioned to lactation rather than reproduction (*Edwards et al., 2017*).

In summary, if you don't think milk is limiting offspring performance do not select for it. I would be particularly wary if my herd consisted of a high proportion of dairy genetics because these very milky cows may be increasing the feed costs. I would therefore recommend that calves are weighed at weaning to ensure the cows are producing enough additional weaning weight to compensate for their increased maintenance costs.

5.2.c. Sourcing heifers

Producers who buy replacements must decide whether to source them from a beef herd or dairy herd. The Agriculture and Food Development Authority, Teagasc in Ireland, have calculated that it costs around £300 less to purchase dairy replacements than it does to develop a homebred beef heifer. The beef X dairy suckler cow is superior in terms of milking ability, resulting in more calf weight being produced at weaning. In addition, purchasing dairy replacements is a great way to access superior dairy and beef genetics due to the high proportion of AI used within the industry. So what is not to like?

It seems the main reason is disease; as Doctor Norman Weatherup, College of Agriculture Food and Rural Enterprise, Northern Ireland, highlighted, the beef X Friesian cow is far superior in terms of milk production; however, the health risk far outweighs any additional benefit through milk yield. It is often the case that cows that the dairy producer deems unsuitable to breed replacements from, are served to the beef bull. These issues, including infertility, mobility and mastitis, are then transferred to the suckler herd. As discussed earlier, the additional milk that is produced by the dairy X beef cow also

comes at a cost, with these cows often having a higher dry matter intake (*Murphy et al., 2008*). Furthermore, there is now an increasing influence of Holstein genetics in the dairy industry which can have a detrimental impact on cow fertility and progeny carcase conformation.

I did not see one suckler cow which included dairy genetics

As I travelled through the main beef-producing countries including USA, Canada, Brazil and Australia I did not see one suckler cow which included dairy genetics - for the reasons listed above. If, as an industry, we can work to improve the maternal genetics available in the beef herd, we should have no need to rely on the dairy industry to produce our heifer replacements.

5.3. Chapter recommendations

- Manage heifers to reach 65% of their mature weight at breeding
- Don't be afraid to supplement heifers between weaning and breeding; the benefits of an extra calf will outweigh any additional feed cost
- Consider maternal traits when making selection decisions; these will have a much bigger influence on profitability than terminal traits
- Where possible, breed your own heifer replacements so that you have more control of genetics and the health status of your herd.

Chapter 6: Heifer management programme: breeding to calving

The aim during this part of the heifer development programme is for the highest number of heifers to conceive within the first three weeks of the breeding season; pregnancies to be maintained; and that the heifers reach 85% of their mature weight by calving time.

6.1. Management of heifers: breeding to calving

6.1.a. Nutrition

Inadequate maternal nutrition at any stage of foetal development has been shown to impact calf development, producing calves with lower birth weights; which have a higher chance of morbidity and mortality. Even though 75% of the foetal growth occurs during the last trimester *(Reynolds et al., 2006),* most of the placental growth occurs during the first two thirds of gestation (*Reynolds et al., 1990),* and therefore any disruption caused during this stage can have a big impact on future development of the calf.

Approximately 75-80% of calf losses from breeding to calving are due to early embryonic death *(Edwards and Schrick, 2019*). The embryo does not attach fully to the uterus until 42 days after fertilisation and therefore any dietary changes during this time can impact embryo survivability by altering the uterine environment (*Perry et al., 2013*).

When I travelled to Montana, I met with Doctor Andy Roberts, a scientist from United States Department of Agriculture, Agriculture Research Service. He informed me of a long-term study investigating the effects on subsequent generations of feeding the dam on a low plane of nutrition.

So far, the results have shown that feeding a low plane of nutrition over two successive generations causes dam body condition to increase, but the birth weight of her offspring to fall. Dr Andy Roberts has speculated that this is because changes have occurred to the cow's metabolism which have led to enhanced caloric storage.

Dr Roberts's experimental design is shown over the page:

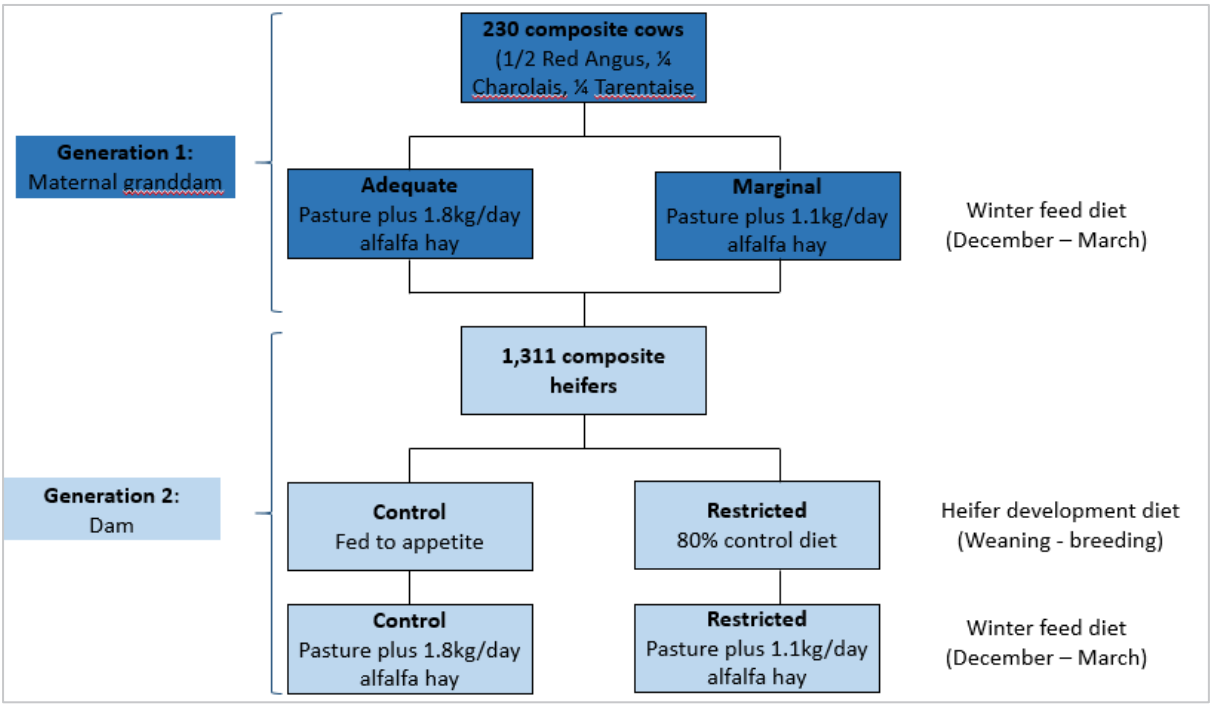

Figure 10: Dr Andy Roberts's experimental design

Figure 11: Dr Mark Petersen, the author and Dr Andy Roberts at Fort Keogh Livestock Range Research Laboratory. Photo: author's own

The study also looked at the effect of the treatments on longevity and found that more heifers from restricted dams were culled before the age of three, due to fertility problems, compared to the adequately-supplemented heifers. This highlights the relatively high nutritional requirement at this

stage of production, when the heifers are trying to distribute energy between themselves and their growing foetus.

one of the major barriers identified for calving heifers at two years of age, is difficulty re-breeding them for the second time.

Whilst travelling, one of the major barriers identified for calving heifers at two years of age, is difficulty re-breeding them for the second time. Heifers have an extended post-partum interval (time between calving and first oestrous) because they require energy for both growth and lactation before finally directing some of it towards reproduction. The post-partum interval for heifers is around 86 days, 18 days longer than cows, and therefore it is important heifers calve early in the breeding season or alternatively calve a couple of weeks before the cows to ensure they are cycling before the onset of the breeding season (*Anderson and Crites, 2019).* Figure 12 demonstrates that heifers which calve early will be cycling before the breeding season; however, those which calve late in the calving season will only have one chance to get pregnant.

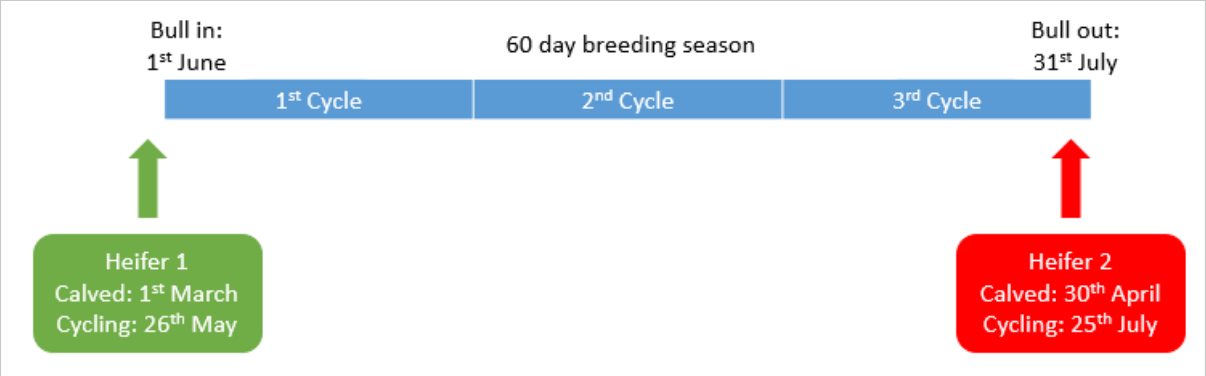

Figure 12: Impact of first conception on rebreeding success. Compiled by the author.

Body condition is the single most important factor linked to resumption of oestrous cycles. Studies have demonstrated that nutrition pre-calving has a bigger impact on the post-partum interval, compared with nutrition post-calving. It is recommended that heifers calve at body condition score 3; this is because thin heifers (< BCS 2.5) have a 30-day extended post-partum interval compared to those which calve at BCS >2.5 (*Anderson and Crites. 2019*). In the past I have known producers who try to 'thin' heifers down before they calve in an attempt to reduce calving difficulties. However, extensive research has shown that this does not reduce dystocia but does result in increased calf mortality and lower weaning weights (*Corah et al., 1975*). Colostrum production and quality can also be impacted, with passive transfer from thin heifers (<2.5) being less effective than those in good condition (>2.5) *(Odde, 1988*). The most successful way of reducing dystocia risk is through genetics which is discussed later in the report.

By the time the heifer calves, she should weigh 85% of her mature weight, which means she should be growing at 0.5kg/day between breeding and calving. During late pregnancy, heifers require 92 MJ

ME/d of energy and 11% crude protein to reach this target. In the UK, heifers are often housed during this time and therefore example rations could include:

Table 4: Example diets (kg fresh weight per day) for pregnant heifers and cows (AHDB, 2015)

	Diet 1	Diet 2
Silage*	32	
Straw	2	8
Concentrates**	-	4.2

*Silage composition: 24% DM, 10.6 MJ ME/kg DM, 13% CP in DM

**Concentrates should contain 22% CP in DM

When I travelled to Australia I met with Meat and Livestock Australia (MLA). In the North of Australia, the majority of the cattle consist of *Bos Indicus* genetics which naturally reach puberty at a later age and therefore good nutrition is imperative to ensure these heifers calve as early as possible. It takes approximately five months to develop a healthy egg to ovulation, which means the process commences during the last trimester of the previous pregnancy. To ensure a healthy egg is produced and the process is not delayed resulting in a longer period of post anoestrous, the MLA recommends that, at least 6 weeks before the start of calving, a protein supplement is introduced. Even though this is an additional cost, the MLA have calculated this will produce a return on investment of $20US per bred heifer (*MLA, 2018).* Although we do not see these climatic extremes here, some of the producers I visited in the UK were increasing protein supplementation one month before calving.

Case study: Joe Goggins, Montana, USA

I met Joe Goggins, the Chief Executive Officer of Vermillion Ranch, in the middle of pregnancy testing 4,000 heifers. Joe implements a very strict heifer replacement policy, with nutrition being key. As Joe says *"you can't starve the profit out of them".* After weaning, heifers are supplemented at grass with chopped hay and 0.5kg of concentrate, plus a dedicated mineral programme. Two months before breeding, heifers are brought into corrals and fed a ration consisting of hay, silage, concentrate and minerals. Heifers are synchronised and heats observed. They receive two cycles of AI and one cycle with the bull. Only those which conceive to the first cycle are retained. Approximately 74% of heifers conceive to AI.

Figure 12: Vermillion heifers in corrals

Heifers calve in corrals, one month before the cows, which gives them more time to recover before the breeding season. The aim is to keep the heifers at body condition score 3 from calving to second breeding. Once calved, the heifers' diet is supplemented with hay, concentrate and minerals until after the breeding season. Again, the calved heifers are synchronised, receive one cycle of AI and are then exposed to the bull for two cycles, achieving a conception rate of 85%.

6.1.b. Breeding period

The majority of operations I visited had a breeding period of between 45-60 days for replacement heifers. As already mentioned, this is a great way of selecting for long-term fertility. I can remember one suckler producer telling me *"those calves born in the first 3 weeks make me money, those born in the second three weeks break even, and those born in the last three weeks lose money",* a statement that has always remained with me.

Case study: Dan Kelly, Nebraska, USA

Dan Kelly runs a herd of 1200 Simmental X Angus suckler cows. He has a very unique heifer selection process. After weaning, heifers are turned back out to graze and are supplemented with alfalfa hay. Three months before the breeding season, supplementation is increased to include distiller's grains, silage and hay. At the end of May, all 500 heifers are synchronised and inseminated to one service. Dan achieves a conception rate of 60% to the one service, which results in a replacement rate of 20%. Any barren heifers are culled. Dan has calculated that the difference between selling an open heifer in August and an in-calf heifer in November is only £200; therefore, it makes more economic sense to sell the barren heifer post pregnancy diagnosis, rather than struggle to get her in calf to sell later in the year.

Figure 14: Dan Kelly in calf heifers. Photo: author's own

6.1.c. Synchronisation and artificial insemination

One of my key learnings when looking at my study topic from a global perspective, is the importance of taking advantage of all of the technologies available to you. Synchronisation and AI can contribute to an effective heifer development programme in several ways:

Synchronisation:

- Reduces the time required for heat detection
- Increases the number of heifers that conceive early during the breeding period
- Labour is required for a shorter period of time at calving
- Calves are older and heavier at weaning

AI:

- Can use bulls, specifically selected for calving ease EBVs, with high accuracy
- Using low calving ease bulls results in less calving problems and calf mortality
- Heifer calves that result from AI will have improved genetics, making them an excellent source for replacements.

In the countries I visited, synchronisation was commonly used because of the additional benefit of initiating cycling of pre-pubertal heifers. At the Applied Beef Reproductive Conference, Tennessee, Dr Rodolfo Cardoso (2019) told the audience that more than 80% of prepubertal heifers are induced to ovulate with synchronisation protocols, with 50% of them conceiving. It is important to remember, however, that these technologies are not a substitute for proper heifer development and nutritional management.

Case study: Rob Star, Nebraska

Robert Star has a herd of 1200 Simmental X Angus cows, along with a 2000-head capacity feedlot. He retains around 200 heifers each year as replacements. The replacement heifers are selected at weaning based on: genetics; birth weight; and date of birth. Robert does not retain any late-born heifers (he only has a 10-week breeding period). After weaning, the heifers are turned out to grass with hay and/or silage and a protein supplement. Two months before the breeding season they are brought into corn stubble corrals, and again supplemented with hay and/or silage and concentrate. Heifers are synchronised and then AI'd only when heats are observed. Last year 50% conceived to one cycle of AI. They then have one cycle with the bull and any not in calf enter the feedlot. The sweeper bulls used are often born from heifers from the previous year, selected for their low birth weights. Robert also AI's around 150 cows to produce stock bulls. Bulls are only retained for two years to maximise genetic gain.

Heifers calve before the cows to ensure they have more time to recuperate before rebreeding and that more labour can be devoted to them during calving. Once calved, heifers are moved into larger grass fields and supplemented with distillers' grains. They are then bred for 12 weeks with the bull. Usually around 5-7% of his first calvers are open. Robert has found he gets poorer conception rates with the second calvers because this is the period when they join the main herd and don't receive the same level of supplementation.

Figure 15: Second calved heifer and calf at Rob Star, Nebraska

6.1.d. Bull selection

One of the major barriers identified by UK suckler producers to calving heifers at two years of age is calving difficulties. Heifers that experience calving difficulties at two years of age produce fewer calves over their lifetime, and the calves are younger and lighter at weaning. Dystocia also extends post-partum anoestrous, reduces conception rates, and increases the likelihood of the heifer being culled from the herd *(Perry and Cushman, 2019).* As I conducted my Nuffield Farming travels I asked every producer how many heifers they assisted to calve. It ranged from around 5-15% - I had expected it to be much higher.

When I met with Lee Leachman of Leachman Cattle of Colorado, he stated that *"the USA would never accept the amount of dystocia in the UK".* It really hit home that, as an industry, we have got used to calving cows. There seems to be a misconception within the industry that a big calf is the sign of a good animal. A producer summed up this belief when he said *"No pull, No Perth"* and this attitude really needs to change.

".. the USA would never accept the amount of dystocia in the UK".

Lee Leachman told me that the majority of the bulls available in the UK would not be suitable for use on heifers. In Canada and the USA there is even a specific market for "heifer bulls": they weigh no more than 30kg at birth and have lighter, smaller frames. Unfortunately, we don't have such a luxury in the UK, and therefore it is really important that selection decisions for bulls are based on their calving ease direct, birth weight, and gestation length EBVs.

In Canada and the USA there is even a specific market for "heifer bulls":

6.1.e. Calving period

During the calving period, it is important heifers are kept in their own management group to prevent bullying from mature cows. Most producers calve their heifers one month before the rest of the herd so that labour can be concentrated on this high-risk group. A producer I visited in Nebraska had a great 'maternity ward' located adjacent to the calving corral. This was equipped with a handling system and a warming box. This had come in very useful the previous year when they had received a really bad snow storm during the middle of calving.

Figure 16 and 17: Warming box and handling system in Nebraska

6.2. Selection of replacement heifers: breeding to calving

Selection of replacement heifers from breeding to calving is only as good as the records that you keep.

"attention to detail is everything".

Heifers which are barren at pregnancy diagnosis or abort before calving should be culled from the herd. Likewise, those which have calving difficulties, dysfunctional udders and teats, or have temperament issues, should not be retained. Heifer calves born from these unsuitable mothers should not be kept as replacements. As Alan Corrigall said when I visited him in Orkney *"attention to detail is everything"*.

6.3. Chapter recommendations

- Supplement heifers to reach 85% of their mature weight by calving
- The breeding period should be less than 60 days, anything not in calf then should be culled
- Use EBVs to select bulls which are easy calving
- Calve heifers at body condition score three, and ideally before the main herd

Chapter 7: Heifer management programme: post calving

7.1. Managing heifers: post calving

The aim at this stage of the heifer development programme is to get the heifer to rebreed, so that she calves again within 365 days. This can be tricky due to the longer post-anoestrous period of heifers as opposed to mature cows. The way in which cattle prioritise energy is shown below. As you can see, the initiation of the next pregnancy is of least priority to the heifer and therefore careful management is required to ensure rebreeding is achieved.

Cattle prioritise energy in the following way:

1. Basal metabolism
2. Activity
3. Growth
4. Basal energy reserves
5. Maintenance of pregnancy
6. Lactation
7. Additional energy reserves
8. Oestrous and initiation of pregnancy

Suckling and nutrition are the two most important factors controlling post-partum anoestrous (*Short et al., 1990).* The majority of the producers whom I spoke with on my travels advocated maintaining supplemental feeding from pre-calving to post re-breeding, to maintain a body condition score of 3. Most producers attempted to reduce feed costs by matching calving with spring grass growth; ensuring that first calved heifers received preferential pastures and were kept separate from the main herd until they had produced their second calf.

7.1.a. Weaning

Suckling has a negative effect on normal reproductive cycles: it is not the energy demand from lactation which delays oestrous, but the actual motion of suckling and the presence of the calf. Even though the effect of suckling can often be overcome with a positive energy balance and adequate body condition, suckling has a much greater impact on first-calved heifers than mature cows *(Johnson and Funston, 2013).*

it is not the energy demand from lactation which delays oestrous, but the actual motion of suckling and the presence of the calf.

Case study: Deseret Ranches, Florida, USA

Deseret Ranches farm a total of 42,000 suckler cows across the United States of America. They use a three-breed cross rotation of Simmental x Brahman, Angus x Brahman and South Devon x Brahman to optimise hybrid vigour.

When I travelled to Deseret, I met with their heifer development manager, Travis Lybbert. Travis is responsible for the development of over 10,000 heifers each year. All heifers calve for the first time at two years of age, which is challenging because the Brahman would naturally calve for the first time much later. Travis has therefore developed a high-nutrition-based development system. At weaning, heifers are selected on size, with those over 250kg retained for breeding. After weaning they are sent to a feedlot and fed a diet containing hay, maize silage, bakery waste and distillers, with the aim that they grow at 0.6kg/day. Heifers are bred in the feedlot, one month before the cows, to an easy-calving Angus bull. They are firstly synchronised and then have access to the bull for 90 days, achieving a conception rate of 83%. After pregnancy diagnosis (PD), they are turned out to grass. Travis understands that a feedlot-based development system is expensive. However, due to the Brahman genetics, his conception rates would be around 40% if he didn't implement it.

Figure 18: Travis Lybbert with author. Photo: author's own

Three months before calving, protein supplementation is again introduced and, one month before calving, molasses are provided as an additional energy source. Heifers calve on pasture, with 1% requiring assistance. After calving, heifers graze preferential pastures plus the same protein supplement and molasses they were fed pre-calving. In the past, rebreeding rates for first calved heifers were 75%, which was a big cost to the business. However, Travis has implemented a procedure where half of the heifers are weaned when the calf is approximately 75 days of age. The heifers who retain their calves, which are usually the heifers in best condition, are put onto preferential ryegrass leys. By using early weaning as a tool, Travis manages to get 98% of the heifers rebred within a 90-day breeding period. Even though this costs him more in additional concentrates to get the calves to the weight they should be at weaning, they eventually finish earlier which coincides with a high demand

for cattle, and therefore premium prices. The heifers also conceive earlier in the breeding season which results in higher weaning weights the following year.

Travis clearly highlights the importance of good nutrition and understanding your costs. Before I left, I asked Travis what were his top tips for managing a suckler herd. His answer was:

1. Know your costs
2. Maximise environment
3. Optimise nutrition
4. Use good genetics
5. Manage with exactness

7.2. Selection of heifers: Post calving

As someone stated at the Applied Reproductive Strategies in Beef Cattle conference *"how much feed are your open cows eating?"*

If there is one key learning from my Nuffield Farming Scholarship it is the importance of culling barren cows. The suckler cow has one job to do – to produce a calf every 365 days. It is difficult enough to return a good profit from suckler cows without keeping those which are not doing their job. Therefore, the main selection criteria of any system post calving is that the cow conceives within a 60-day breeding period. No ifs, no buts!

If there is one key learning from my Nuffield Farming Scholarship it is the importance of culling barren cows.

7.3. The longevity debate

Longevity refers to the length of time the cow remains in the herd and is one of the most economically important traits to the suckler producer. Cows need to produce between 3 and 5 calves to cover their heifer development costs (*Perry and Cushman, 2013).* In the USA, it is reported that 50% of heifers are culled before they reach five years of age, mainly due to infertility, and this results in a huge economic loss to the suckler producer. Longevity is affected by:

1.	Calving difficulty	problematic calving results in an increase in culling
2.	Date of first calving	those heifers which calved earlier, remained in the herd longer
3.	Weight at weaning time	those heifers which were heavier at weaning, remained in the herd longer
4.	Milking ability	cows with increased 'milkiness' had a greater chance of being culled

All of these factors relate to the management practices which have already been discussed in this report. It is clear that if we select for functional efficiency in our heifers, we should indirectly be increasing longevity.

The current herd replacement target reported by the UK industry is 16%, which means that each cow should produce at least seven calves before she is culled. Dr Norman Weatherup, CAFRE, Northern

Ireland, explained that this is too low and we should be aiming for a replacement rate of 25% which means each cow produces an average of four calves. He explained that when the cost difference between a cull cow and a replacement heifer is small, it makes economic sense to cull the less productive cow and bring in the replacement heifer; an opinion supported by Tom Gubbins of TeMania Angus, Australia.

Case study: Tom Gubbins, Victoria, Australia

TeMania consists of 1800 purebred Angus suckler cows producing 700-800 breeding bulls. The herd is run under commercial conditions, with all heifers calving at two years of age and any cows not in calf after 9 weeks culled from the herd. They have been performance recording since the 1950s, conducting extensive progeny testing and collecting processor feedback not only from their own herd but also through their Team TeMania initiative. As part of the Team TeMania initiative, bulls are leased to 40+ herds *in lieu* of offspring performance data, helping to improve the accuracy of Breedplan. Large contemporary groups of cows and youngstock increase the accuracy of the data further, with all animals retained until they are at least 400 days of age so that the contemporary group is maintained. The time and effort TeMania have devoted to genetic development has really paid off with huge gains in growth rate (no increase in birth weight), carcase merit and fertility, whilst also managing to forge a strong bond with Rangers Valley feedlot who produce two of Australia's premium Angus meat products.

Figure 19: Suckler cows at TeMania. Photo: author's own

Tom's view on longevity was that, in a purely commercial setting, cows should be seen as part of the production system and therefore once they stop growing and putting on weight (and increasing in value), they should be culled from the herd. In a commercial setting, cattle use energy for maintenance, lactation, reproduction and growth. Once a cow stops growing - at around five years of age - the energy that was

In my opinion the UK needs to concentrate on implementing much harsher culling policies to create a more functional suckler herd.

once apportioned to growth is instead attributed to maintenance, and unfortunately maintenance does not make you any money; unlike lactation and reproduction. Therefore, it is Tom's opinion that suckler producers should see *"maintenance as a tax"* and cull cows once they produce their third calf.

In my opinion the UK needs to concentrate on implementing much harsher culling policies to create a more functional suckler herd. Once this has been implemented, and replacement rates start to fall, the industry can then implement culling strategies based on cow age.

7.4. Chapter recommendations

- Feed to maintain body condition score 3
- Use early weaning as a strategy to prevent body condition loss
- Keep heifers separate from the main herd until after their second calving
- Maintain a 60-day breeding period and cull any barren females
- Monitor herd longevity and take steps to improve it by: reducing calving difficulties; calving heifers at two years of age; increasing weaning weight; and selecting for an average milk yield.

Chapter 8: The future of suckler beef production?

During my travels, the last question I always asked my host was about the future of the suckler industry. The current picture of the UK suckler industry is not a pretty one; with the amount of beef produced from the dairy herd ever exceeding the amount produced from sucklers. This is likely to be exacerbated further with changes in policies regards euthanasia of dairy bull calves, and therefore you begin to question if there is actually a need for the suckler industry. In the future, will its sole purpose be to produce beef bulls for the dairy herd?

Global travel has highlighted that there definitely is a need for a suckler herd but the purpose has to be to produce top quality beef. Unfortunately, I feel the UK suckler industry has lost its way in this respect. We have become obsessed with conformation and topping the market and have forgotten about what is really important – keeping costs down and producing a top-quality protein which our customers will enjoy and want to purchase again.

The suckler cow has a unique trait in that it can turn indigestible plant matter into an edible human protein source, and therefore the suckler cow should be bred to thrive in the upland areas which are unsuitable for crop production. A number of my hosts said that the future of the industry relies on its strengths in terms of sustainability: but I feel this term is used too much and we have lost its true meaning. To me sustainability has three parts: economic, environment and social.

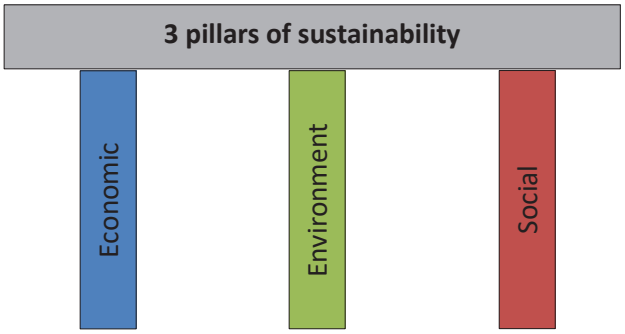

Figure 20: The three pillars of sustainability (diagram drawn by author)

If we take economic first: in this respect the industry is not sustainable when most producers are losing money before subsidies – and subsidies are not going to last. Subsidies provide a comfort blanket, allowing the industry to carry on implementing practices which are not the most efficient at producing beef. Calving age is a prime example of this; calving at two years of age makes huge financial sense but does require additional management; subsidies provide the financial support so that producers can carry on developing their heifers sub-optimally.

The suckler industry's impact on the environment is hinged on its economic performance. Implementing best practice results in faster finishing times, helping to reduce the amount of carbon each animal produces. As highlighted in the report, poor breeding decisions have led to the creation

of dysfunctional suckler cows which have poor fertility and are unable to thrive off grass and forage alone, leading to increased carbon output per kg of beef produced.

The reason our UK cows struggle to perform from grass and silage alone is because of our genetic choices. Over the years, the industry has moved away from traditional British breeds, which dominate suckler herds in most major beef-producing countries, to more Continental types. I believe this has been led in part by the EUROP grid which encourages producers to select for lean, well-muscled animals. Our customers buy beef because it tastes good and they enjoy it, and therefore as beef producers it is our social responsibility to ensure that they have a great meal experience.

The reason our UK cows struggle to perform from grass and silage alone is because of our genetic choices.

The secret to a healthy future for the industry would logically be to develop a "suckler beef" brand to add value. But first a product would be needed which deserved a premium price tag. As an industry we need to identify our weaknesses and work together to increase its sustainability. This means:

1. **Economic**: Prepare for the loss of direct subsidies and implement best practices which will lead to a reduced cost of production.
2. **Environment**: Ensure we develop a functional cow which produces a calf every 365 days and manages to thrive off grass and forage alone, helping to support a number of ecosystem services in upland areas.
3. **Social**: Produce consistently top-quality beef, which encourages repeat purchasing.

To achieve this, we need each part of our fragmented industry to work together: including suckler producers, finishers, processors, retailers, breed societies and other industry bodies. Without these changes I see that the suckler industry will continue on a downward spiral and that would be heart-breaking to watch.

8.1. Chapter recommendations

- Prepare for the loss of direct payments and gain a better understanding of cost of production
- Drive the functional efficiency of replacement females to reduce carbon output per kg beef
- Evaluate the EUROP grid to ensure its payment methods encourage production of 'quality' beef rather than 'quantity'.

Chapter 9: Conclusions

1. Calving at two years of age is commonplace across the world. It undoubtedly increases profitability but, to be successful, additional management is required.

2. Nutrition is one of the biggest factors affecting age at puberty and lifetime productivity. But gaining an extra calf outweighs any additional feed cost associated with calving heifers at two years of age.

3. The industry must use EBVs better to (I) select bulls with superior maternal traits for breeding heifer replacements and (ii) to select easy calving bulls for use on heifers

4. The breeding period should be no longer than 60 days: any heifers or cows not in-calf after that should be culled.

5. The outlook for the suckler herd hangs in the balance. Everyone involved in the industry must work together to increase its sustainability, if it is to have a prosperous, long-term future.

Chapter 10: Recommendations

1. **Suckler producers:** Implement a heifer development programme which allows you to calve heifers at two years of age.

2. **Suckler producers:** Drive the functional efficiency of suckler females through informed selection decisions, harsher culling practices, and greater utilisation of genetics.

3. **Pedigree breeders:** Produce more bulls which enable easier calving and are suitable for use on heifers.

4. **Processors:** Develop a carcase payment system which reflects meat quality rather than carcase yield.

5. **Levy board/ breed societies:** Create a multibreed analysis which will allow producers to use EBVs more effectively: enabling selection based on traits, rather than breed.

Chapter 11: After my study tour

The Nuffield Farming Scholarship was a once-in-a-lifetime experience which has developed me on both a personal and professional level. Firstly, it pushed me out of my comfort zone, forcing me to confront some of my biggest fears including public speaking and travelling independently.

My Nuffield Farming Scholarship has also given me so much confidence, both in terms of my technical ability and also in my decision making. Since receiving my Scholarship I have appeared on local radio and television, presented at a number of industry events, and written articles for both local and national press.

An unexpected learning from my study tour was how to deal with disappointment. Unfortunately, part of my study tour was aborted due to the COVID-19 pandemic, which is still quite difficult to accept after the months of planning and anticipation. However, through this crisis I have learnt how to use digital technologies to enable some of the planned meetings to go ahead.

My work has also benefited tremendously. I have been able to bring ideas back to my team about different methods to deliver successful knowledge exchange. I now plan to drive my recommendations forward through my role at AHDB. I am already involved with a number of working groups which will hopefully allow some of my ideas to come to fruition. I also plan to disseminate the findings of my report through my farmer meetings and contacts – no one will ever be able to go to an AHDB meeting again without hearing about calving heifers at two!

Sarah Pick
May 2020

Chapter 12: Acknowledgements and Thanks

Wow! What an incredible journey this has been, only made possible by some amazing people. Firstly, huge thanks to my family and friends who provided me with the confidence to apply for what I thought was a very long shot. To my colleagues who were all so supportive of me undertaking a Nuffield Farming Scholarship even though it meant they would have to cover my workload. And to Kate Moore, my mentor, who provided me with support and reassurance throughout the whole process.

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Finally, I would like to thank everyone who kindly gave up their time to meet and host me while on my travels; your knowledge and hospitability had no bounds.

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