The animal welfare and environmental benefits of Pasture for Life farming – interim findings

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0.1 Foreword

This interim report seeks to address ***the environmental and animal welfare benefits of the raising of ruminants wholly on pasture***, as reflected in the ***Pasture for Life*** certification mark and its underlying standards. It has been prepared by farmers in response to requests for information on the two topics and follows on from a similar report on the human health benefits arising from animals raised to Pasture for Life standards.

The environment and **animal welfare** are both complex subjects, involving a range of inter-related factors that in turn reflect science, culture and perception. Yet many of the published reports addressing them focus on single issues. To address this, the Pasture-Fed Livestock Association (PFLA) is involved in two major research projects (see box) that address this complexity. Starting in 2018, and spread over three years, they will generate significant data from working farms and permit these interim findings to be updated.

RESEARCH PROJECTS ADDRESSING THE ENVIRONMENT AND ANIMAL WELFARE
The SEEGSLIP project (Sustainable economic and ecological grazing systems – learning from innovative practitioners) is being led by the Centre for Ecology and Hydrology and aims to evaluate the ecological, agronomic and social impacts of the pasture-fed livestock approach to grazing management. Funded by the Global Fund for Food Security, the three-year project will involve up to 60 Pasture for Life farmers and “investigate the potential of Pasture for Life for transforming livestock systems across the UK”. The three-year **CEFAW** project (Christian Ethics of Farmed Animal Welfare), led by the University of Chester and funded by the Arts and Humanities Research Council, will review the practices and ethics of farmed animal welfare and propose institutional policies concerning the raising of farmed animals and the consumption of products derived from them. The PFLA is one of several organisations involved and the project will provide an opportunity to review the Pasture for Life standards and practices in relation to animal welfare.

Early in 2017, 50 farmers and 25 soil/plant scientists met on a farm at a PFLA-organised event to consider options to monitor the “pulse” of the soil, using proxy indicators that farmers could easily measure at no cost - such as earthworm counts, infiltration rates, slake test, brix and above-ground biodiversity. A group of PFLA farmers has now developed protocols for such measurements, as well as an app to record the results of each indicator in the field. Collation of these measurements over the next three years will also contribute to the practical knowledge of the environmental benefits of Pasture for Life.

Pending the results of these three farm-based projects, this interim report seeks to summarise the current state of knowledge on the benefits to animal welfare and to the environment from the application of the Pasture for Life standards, based on published papers and supplemented by a survey of members, carried out in early 2018. It is work in progress and there is still much to learn, but our findings suggest that the application of Pasture for Life standards can generate significant environmental and animal welfare benefits and outcomes. A summary of the findings follows. All references supporting the observations in the summary can be found in the main report.

0.2 Summary

1. Background to the report and its focus. The world's soils present the largest terrestrial carbon reservoir whilst, both globally and in the UK, two thirds of farmland (the solar panel that feeds the world) is pasture. Ruminants can efficiently convert this into produce of value to mankind while at the same time playing a vital role in nutrient cycling, environmental habitat and the complex food webs that have evolved over millennia. The capacity of pasture to build the fertility and health of the soil, and the vital role of grazing animals in that process, has been known since time immemorial. Until WW2, it was an integral part of most farming systems in UK. The shift to grain feeding began in the 1960s, allowing farmers to increase their profitability. Although attractive at the farm level, feeding grain to ruminants is an inefficient process and purely financial calculations of farm profit take no account of its effect on the environment.

With a growing recognition of the environmental costs, and that the cost of concentrate feed is around five times that of grazed grass, there is a shift towards feeding ruminants increasingly on pasture. The Pasture-Fed Livestock Association (PFLA) was set up in 2011 by a group of farmers to encourage the raising of ruminant animals wholly on grazed and conserved pasture and forage, together with the benefits to the animals so raised, to the environment and to human health. It has established a certification mark (Pasture for Life) that is underwritten by a set of independently audited standards.

2. The Pasture for Life Standards (PfL). The Pasture for Life standards include several key criteria relating to animal husbandry and to farmland management. These include what an animal may eat (essentially pasture and forage) and may not eat (largely grains and by-products), stocking rates, grazing management and the diversity of plants. The standards include both **requirements** (obligatory) and **recommendations**.

3. What consumers want to buy. Consumer research carried out in both the UK (by the PFLA) and in the US shows that consumers purchase pasture-fed and grass-fed meat for benefits relating to (in order of priority) health and nutrition, the environment, animal welfare and meat quality, including flavour.

4. Farmer motivation. Apart from the anticipated benefits of lower production costs, many of the farmers adopting Pasture-for-Life standards recognise their contribution to the environment and to animal welfare. A 2018 survey of PFLA members backs this up. More than 60% of respondents noted improvements in species diversity and to the health of their livestock whilst 51% stated that becoming pasture-fed had definitely (and 25% possibly) increased the length of their grazing season.

5. Comparing farming systems – Pasture for Life and Organic. Both Pasture for Life and Organic systems capture the ambition of farmers and the desire of consumers for meat and milk to be produced in a manner that shows care for the environment and for animal welfare. Both systems require access to grazed or conserved pasture, 100% in the case of Pasture for Life and more than 60% in the case of organic (i.e. <40% of an organically raised animal's diet can be grain). Organic regulations do not permit the application of artificial

fertilisers or herbicides. PfL standards do permit their use, although it is discouraged, and the 2018 survey demonstrates that usage falls as pasture management changes.

6. **Grass-fed and grain-fed in the market place.** The terms “grass-fed”, “pasture-fed” and “grain-fed” have no legal basis within the UK and, with the exception of produce certified as Pasture for Life, they do not guarantee to consumers that animals have been subject to any specific feeding or husbandry regime. Our Papers, “Why Grass-fed must mean Grass-fed” and “The Health benefits of Pasture for Life certified production” expand on the importance of giving a legal definition to the term grass-fed.

7. **The UK beef supply.** Beef farming systems in the UK range from those such as Pasture for Life (wholly pasture-fed) to grass-fed suckler-cow systems which may use supplementary feeding of concentrate to intensive systems that use a predominantly grain-based diet – with the requirement for housing increasing with the proportion of grain fed. The number of Concentrated Animal Feeding Operations (CAFOs) in the UK appears to be increasing. Demand for grain by UK conventional beef production is approx. 1.25 m tonnes/year, around 10% of UK cereal production or 150,000 hectares of arable land.

8. **International beef supply.** Beef is imported into the UK from Ireland, Poland, Brazil, Uruguay, Botswana, Namibia, Australia and the United States. Some of these are covered by trade agreements that may define the production standards. Grain-fed cattle in the USA are typically produced in feedlot-based production systems – with over 90% of beef cattle raised in feedlots of over 1,000 head of cattle. Such systems can have significant negative consequences for the environment and for animal health and welfare.

When considering the environmental and animal welfare benefits of Pasture for Life certified beef, the most immediately relevant comparisons are with the alternative UK and Republic of Ireland systems, whilst comparisons with systems prevalent in major beef exporters from outside the EU may become increasingly relevant depending on the outcomes of post-Brexit trade agreements.

9. **The production of sheep meat.** The UK is self-sufficient in sheep meat, of which one third is internationally traded – reflecting seasonal supply and demand. The Pasture for Life standards require that neither ewes nor lambs are fed grain (except ewes carrying multiple lambs where a derogation may be given) and focus on matching breed, diversity and lambing to eliminate feeding grain – which in the UK requires approx. 16,000 ha of land.

10. **How Pasture for Life changes the farming system and can lead to more sustainable land management.** When cattle are predominantly grain-fed then the cattle are essentially a means of adding value to grain and the environmental impacts can be placed physically outside the production unit, externalised and hidden. When partially grain-fed, the cattle add value to a mix of inputs – grass/grass-silage and grain. The system is intrinsically more complex than feeding grain or forage alone and any economic inefficiencies in grassland production and use (e.g. excessive use of fertilisers or over-stocking) may be masked through the feeding of cereals.

When cattle are entirely grass-fed they are simply a means of adding value to grass. There is no further input to which to add value, and there is no complexity within the system that could mask inefficiencies. Hence, *certain of the environmental benefits of Pasture for Life farming result from an approach that recognises and monetises the externalities of production, because those externalities are represented as direct, on-farm costs.* It is, in effect, a system that is based solely on Natural Capital.

11. The animal welfare benefits of pasture-fed raising of ruminants. This overview of the relationship between the Pasture for Life standards and animal welfare precedes a three-year study on the ethics of animal welfare, which will review the impact of the Pasture for Life standards on the welfare of the animals so raised. What follows, based on published reports (many of which focus on dairy cows) and a survey of PFLA farmers, should therefore be considered as work in progress.

Animal welfare science, which addresses well-being, was born in response to the Government's Brambell report (1965). It is still a relatively young science and animal welfare is less easily defined and measured than is animal health, itself an element of animal welfare. The Farm Animal Welfare Council has developed a framework based around the concept of Quality of Life (QoL) and *"a life worth living"* (FAWC, 2009) and the Five Freedoms are enshrined into UK legislation in the form of the Animal Welfare Act 2006. Through the Treaty of Amsterdam (1997), later subsumed into the Treaty of Rome, EU legislation also recognises that animals are sentient beings and that full regard should be paid to this when drawing up legislation relating to farmed animals and their welfare.

Quality of Life comprises three interlinked and synergistic elements: **biological functioning** (including health); **affective states** (emotions and feelings); and, **the ability to live natural lives** (Benson and Rollin, 2004). When all are met, an animal can be said to be living a good life or experiencing a positive sense of well-being. Pasture for Life scores well on each of these criteria.

Existing welfare assessment schemes that incorporate the key components of welfare in the form of the 5 Freedoms and Quality of Life include the *EU Welfare Quality Network* and the UK-focused *Advancing Animal Welfare Assurance (Assurewel)* and its offshoot adopted by the UK pig industry (*Real Welfare*). They look at animal-based indicators, and not just inputs, noting what the animals are telling us about the system in which they are kept and how well it is meeting their welfare needs. Other, independently assessed higher welfare farm assurance schemes (such as the RSPCA's ***Assured, Organic*** *and* ***Pasture for Life***) also incorporate these elements – providing animals with the potential to experience a good life.

A recent PFLA survey of consumers rated "free-range", strongly associated with well-being, as the most important criterion and consumers are keen to understand how Pasture for Life standards can facilitate such well-being. These standards require that *ruminant animal systems are matched to an animal's natural metabolism and minimise physiological and psychological stress* – and that Certified Farms must be able to demonstrate high standards of animal welfare, in turn reflected in specific standards and indicators.

A conclusion by Arnott (2014) is typical of many papers reviewed: noting that: *"Regarding health, cows on pasture-based systems had lower levels of lameness, hoof pathologies, hock lesions, mastitis, uterine disease and mortality compared with cows on continuously housed systems. Pasture access also had benefits for dairy cow behaviour, in terms of grazing, improved lying/resting times and lower levels of aggression".*

A comprehensive review by a veterinarian (Tikofsky) notes benefits from access to pasture in relation to lameness, mastitis, milk quality, reproduction, longevity, young stock health and behaviour. A similar review of dairies focused on grazing in the US noted: "*Grazing cows get more exercise, usually have fewer health problems and typically live longer."*

Welfare is also influenced by grazing and soil management – with benefits arising from animals being able to remain outside grazing for longer and with more diverse and deeper rooting swards providing access to a range of minerals. 51% of PFLA surveyed farmers stated they have definitely (and 25% possibly) increased the length of their grazing season. Benefits from rotational grazing arise in relation to reductions in the incidence of gastrointestinal worm infections and liver fluke. 46% of PFLA farmers surveyed had reduced their use of anthelmintics since becoming pasture-fed, whilst 66% noted improved health of their animals and 51% recorded lower vets' bills. Welfare benefits also arise through reducing the risk of nutrition-related complaints seen amongst farmed cattle, such as sub-acute ruminal acidosis (SARA) – which is associated with grain-fed diets and results in, amongst other things, diarrhoea, laminitis and liver abscesses. Primarily a disease of dairy cattle, it also affects beef cattle - predominantly in intensive feedlot systems.

Whilst more work needs to be done (and will be done in the upcoming three-year study) to better understand the relationship between the Pasture for Life approach and animal welfare, both published work and the experience of participating farmers suggest that there are significant and identifiable benefits in terms of the health of the animals, their general welfare and their opportunity to express themselves.

12. The environmental benefits of pasture-fed raising of ruminants. Farming is about managing the relationships between the world's (living) soils, the plants that grow in them, the animals that feed on them and the various cycles of carbon and other gases, water and nutrients. The question that we ask here is: "How does the raising of ruminants primarily or wholly on pasture contribute to managing and sustaining that relationship?" The PFLA encourages farmers to raise their ruminant animals wholly on pasture and forage, seeking to mimic natural grassland systems – closed loop nutrient recycling, the natural cycles of carbon and water, the preservation and reinstatement of natural capital, the encouragement of biodiversity and the capacity of grazed pasture to regenerate soil. How does this contribute to the environment ***in the round***?

Why "pasture-fed"? A farmer can consider his soil as his capital and the crops that it produces as the interest or dividend on that capital. Pasture can play a key role in ensuring that some of that interest is returned to the soil to maintain its biological capital. The decision to use the term ***"pasture-fed"*** rather than ***"grass-fed"*** reflects that **"grass"** could be a monoculture of a shallow-rooting grass fed with artificial fertiliser on an intensive farm (or golf course) whilst **"pasture"** suggests a **biodiverse population of deep-rooting grasses and herbs,** with overtones of pastoral care.

Benefits to wildlife and biodiversity. Many of the important plant and wildlife species have evolved in tandem with grazing animals and depend on them for their survival. Where pasture is sensitively managed, it can generate benefits to both wildlife and biodiversity whilst longer rest periods can encourage the setting of seed.

Soil and Water benefits – flood and drought mitigation. Soils play a vital role in retaining moisture, determined largely by its inherent structure and the level of organic matter. Its capacity to do so is influenced in turn by the nature and degree of plant material on the soil surface, with pasture playing a vital role. A widely-quoted figure of *"each 1% organic matter increases soil moisture holding capacity (down to 30cm) by 150 – 200,000 litres/ha"* appears to bear scrutiny. This ability to store (and filter) water in times of heavy rain can reduce run-off that could otherwise cause erosion and flooding – a measurable benefit to society. The larger root-mass of mob-grazed pasture can contribute to this. 70% of the UK's drinking water is sourced from the uplands, where pasture plays an important role.

Reducing the environmental impacts of fertilisers and sprays. 2018 survey figures show that application of Pasture for Life standards leads to lower usage of fertilisers and sprays.

Avoiding the environmental impacts of certain feedstuffs: maize and soya. The prohibition of certain foodstuffs, such as maize silage and soya, has a direct effect on the environmental impacts of beef and sheep farming systems.

Efficiency of feed intake. Ruminants are poor converters of grain and the intensive, and inefficient (in both real and environmental terms) use of large quantities of cereals to feed ruminants is not sustainable in the long term.

The carbon cycle. Whilst the environmental benefits associated with pasture, described above, are generally recognised there is more debate around the issue of carbon. At the global level, the world's soils represent the largest terrestrial carbon reservoir, of which more than 70% has been lost since the industrial revolution. The potential for well-managed soil to re-absorb some of this carbon is increasingly being recognised – as well as the significant role of pasture in that process.

A detailed report by the Food and Climate Research Network (Confused about Grazing) aims *"to provide clarity to the often highly polarised debate around livestock production and consumption,* and, in particular, *to identify the net benefits (or otherwise) of grass-based* *production systems specifically* ***in the context of climate change****.* Whilst focusing on the levels of methane produced by farmed ruminants and the ability of soil to sequester carbon, the report recognises the wide variation in grazing systems and factors affecting them and acknowledges that: *well-managed grazing systems can aid the process of soil carbon sequestration…and provide an economic rationale for keeping carbon in the ground*". Its overall conclusion, however, is that *whilst grazing livestock have their place in a sustainable food system, that place is limited.*

Two responses to this report note that: **(a)** *as the authors state, the report does* ***not*** *answer the "enormous and difficult question" of whether farmed animals fit in a sustainable food system, nor "which systems and species are to be preferred (A Greener World)….and (b) ..We defend the role of grazing animals, as we know from years of practical farming experience that systems with cattle or sheep at their core are able to remain highly productive, repair degraded soils and avoid the GHG emissions associated with the manufacture of nitrogen fertiliser, equivalent to about 8 tonnes of* CO_2 *for every tonne of nitrogen used." (Young).*

A report from Rothamsted looks at the effect of incorporating **product quality**, as opposed to **quantity**, into the carbon footprinting framework for a range of meat products. Using the omega-3 content of meat products as an example, quantitative case studies demonstrate that relative emissions intensities associated with different systems can be dramatically altered when the **nutrient content** of meat replaces the **mass** of meat as the functional unit, with cattle systems outperforming pig and poultry systems in some cases.

The issues around carbon are clearly complex and the debate will go on. In the interim, the PFLA will continue with its monitoring of the ecological, agronomic and social impacts of the pasture-fed livestock approach to grazing management through the SEEGSLIP project and the recording of soil health parameters using the app that its members have developed.

An international perspective. The UN FAO Sustainable Grasslands Working Paper (2013) states that "…*results suggest that a grassland based system of livestock production is a viable proposition. At a global level, calorie and protein supplies would be sufficient to meet the requirements of the official FAO 2015 projections…..* ***these results support the notion of a grassland-based system of livestock production that is capable of meeting food security demands while imposing a lighter footprint on the environment - positive outcomes for both the human and environmental pillars of sustainability."***

In conclusion. The Pasture for Life standards are focused on establishing a system of raising ruminant animals as far as possible wholly on pasture in a largely closed loop system using natural capital. With the continuing decline in the health and productivity of the nation's soils, the role that pasture can play within the arable rotation in terms of rebuilding soil fertility and controlling weeds is increasingly being recognised. Whilst the actual environmental benefits arising from a pasture-fed system will vary significantly with the nature of the pasture and with how it is managed, there are some common environmental benefits - which will vary between farms in the degree to which they are expressed.

"*With appropriate management of grazing enterprises, soil function can be regenerated to improve essential ecosystem services and farm profitability. Affected ecosystem services* ***include carbon sequestration, water infiltration, soil fertility, nutrient cycling, soil formation, biodiversity, wildlife habitat, and increased ecosystem stability and resilience" (Teague 2014).*** Pasture also provides a natural and unstressed environment within which ruminants can express themselves, whilst also producing nutrient dense meat and milk that has measurable health benefits for those consuming them.

1.0 Introduction and background.

Both globally and in the UK, around two thirds of farmland (the solar panel that feeds the world) is pasture. In the UK, 42% of this pasture is rough grazing, 48% is more than five years old and 10% is under five years. Ruminants can efficiently convert this pasture into produce of value to mankind while at the same time playing a vital role in nutrient cycling, environmental habitat and complex food webs that have evolved over millennia. The world's soils represent the largest terrestrial carbon reservoir, containing 2,300 Pg. of soil organic carbon (SOC) down to 3 metres (Jobaggy 2000). Since much of this soil is under pasture, how it is managed is likely to influence the climate.

The capacity of pasture to build the fertility and health of the soil – and the vital role of the grazing animal in that process - has been recognised since time immemorial and is confirmed by current research (e.g. Machmuller 2015, Teague 2018). Until the second world war, pasture was an integral part of most farming systems in the UK, not only because of its soil-building capacity but also because it was required to feed the horses that provided draft power. This changed when grassland was ploughed up to increase domestic, wartime food supply, made easier by the advances in mechanisation and the development of chemical-based inputs to increase production. These inputs were relatively cheap and affordable and embraced by farmers and policy-makers alike. However, they also came with hidden impacts on soils, on wildlife and on the quality of produce itself, many of which we have thus far been struggling to address.

The shift to the raising of ruminants on grain began in the early 1960s with the emergence of "barley beef", allowing farmers to increase the profitability of their farms by feeding grain. Many were, in effect, renting land from other farmers, both in the UK and internationally, who produced the grain for them.

Although attractive at the level of the individual farm, purely financial calculations of farm profit take no account of the effect on the environment at the farm/catchment level (in terms of effluents, decline in soil fertility, heavy dependence upon fossil fuels, decline in biodiversity and farm birds, release of GHGs etc.) nor at the international level (clearing of large amounts of forest to produce soybean, reduction in marine fish stocks etc.). Feeding cereals to ruminants is an inefficient process. Ruminants are poor converters of grain, with feedlot cattle typically having a food conversation ratio of around 6:1 (Shike, WD 2013), whilst around a third of the world's cereals are fed to animals. Globally, the 80% of N and P in crop and grass harvests that feeds livestock ends up providing only around 20% (15-35%) of the N and P in human diet (Sutton et al 2013). With growing recognition of the environmental costs of feeding grain to ruminants, of the national decline in soil fertility and that the cost of concentrate feed is around five times that of grazed grass (AHDB 2015), there is a shift towards feeding ruminants increasingly on pasture.

In 2011, the Pasture-Fed Livestock Association (PFLA) was set up by a group of farmers to encourage the raising of ruminant animals wholly on grazed and conserved pasture, with benefits to the animals so raised, to the environment and to human health. The concept of "wholly pasture-fed" revolves around seeking to mimic natural grassland systems – closed loop nutrient recycling, the natural cycles of carbon and water, the preservation and reinstatement of natural capital, the encouragement of biodiversity and the capacity of grazed pasture to regenerate soil. This paper seeks to outline the broad benefits, for the farmed environment and for farm animal welfare, of adopting the Pasture for Life standards. Separate papers (a) provide evidence on the human health benefits of these standards and (b) make the case for a proper legal definition of the term "grass-fed" so that consumers can identify products that are genuinely 100% grass-fed.

The Pasture for Life standards were first introduced in 2011 (revised every two years) to underwrite the Pasture for Life certification. Certified Pasture for Life meat and dairy products are currently produced on around 60 farms, with a further 40 farms actively working towards certification. The PFLA currently has 330 members, mainly farmers.

A booklet entitled ***Pasture for Life: It can be done*** (2016) provides vignettes of some of the PFLA's early members and addresses the viability of wholly pasture-fed production using economic data provided independently by AHDB Beef and Lamb's Stocktake programme.

Whilst this interim paper focuses on beef and sheep, which are the areas of production that have seen the greatest uptake of the standards, much of the research evidence has come from the dairy sector, for which Pasture for Life standards were approved in 2017.

Most Pasture for Life certified farmers are involved in research projects to critically appraise the impacts of adopting these standards. As noted in the foreword, these projects include;

(a) a three-year programme led by the Centre for Ecology and Hydrology to evaluate the ecological, agronomic and social impacts of the pasture-fed livestock approach to grazing management;

(b) Research into the effect of wholly pasture-fed dairy production on the nutritional qualities of milk, led by Newcastle University;

(c) a three-year project, led by the University of Chester, which will review the practices and ethics of farmed animal welfare; and

(d) on-farm assessments of soil health using proxy indicators and an app developed by PFLA members[1].

This paper seeks to summarise the evidence to date until that research is published. It considers the effects of Pasture for Life standards on environmental and animal welfare outcomes and includes results from a recent survey (2018) of farmers who have adopted these standards, to assess whether and how the expected impacts are being realised.

[1] http://bit.ly/2nd2D36

2. The Pasture-for-Life Standards

2.1 Key elements of the standards.

The Pasture-for-Life standards[2] (currently Version 3.1, first implemented in 2016 and due for revision in 2018) include several key criteria relating to animal husbandry and to farmland management. Such requirements (with the relevant Certification Standard paragraph number in parenthesis) include:

(4.2) The number of livestock should be properly matched to the capacity of the grassland and the soil conditions – noting that *"The PFLA recognises that in practice, the sustainable stocking rate is as diverse as the grassland"*

(4.2.1) All livestock operations must be based primarily upon providing access to pasture or other forage areas where animals can graze.

(4.2.3) Grass and forage must be the feed source consumed for the lifetime of the animal, with the exception of milk consumed by young stock prior to weaning.

(4.2.6) Animals must not be fed grain or any other form of cereal based feed concentrate.

(4.2.7) At all times when conditions allow, Certified Animals must be maintained on rotational grass leys, permanent pasture, fields of forage crops with at least 90% forage cover, or on unbroken ground.

(4.5.10) The following sources of feed are specifically prohibited under the Certification Standards:

- **Grains**
- **Dry harvested grain legumes**
- **Maize and maize silage**
- **Soya**
- **Sunflower and safflower**
- **Oilseed and expeller products**
- **Grain residue or by-products including brewer's grains**
- **Any bought-in root crop products, including sugar beet and derived products**
- **Any by-products from food processing or animal feed processing industries**
- **Stock feed potatoes, vegetables or fruit**
- **Waste food products such as bread**

[2] https://www.pastureforlife.org/certification/

In addition to the clearly stated **requirements,** the standards also include **recommendations** that certified farms are encouraged to adopt. Conscious of their potentially negative effect on the environment, the standards **recommend** that ***"Pasture and grassland must be managed in a way that minimises the use of artificial fertilisers (7.2.2[3]) and herbicides (7.2.3[4]).***

The standards further recommend that:

Grazing management should allow a variety of vegetation structure – short to tall, sparse to tussocky - to develop (7.2.6).

Diverse mixes of plants such as grasses, legumes and herbs should be established and/or maintained in pastures (7.2.7).

2.2 An overview of the likely impacts.

An indicative overview of the likely impacts of Pasture for Life Standards on the natural environment, in terms of both natural capital assets and ecosystem service flows on participating farms, is shown in Tables 1 and 2.

Table 1: Pasture for Life Standards – likely impacts on Natural Capital Assets

Natural Capital Assets (habitat types)	Extent	Condition
Enclosed farmland:		
Temporary pasture (temporary improved grassland)	↗	↗
Permanent pasture (permanent improved grassland)	↗	↗
Permanent unimproved pasture (semi-natural grasslands)	→	↗
Field margins	→	↗
Hedgerows	→	↗
Mountains, Moorlands and Heaths	→	↗
Water - Openwaters, Wetlands & Floodplains	→	↗

Key: ↗ Improving/increasing; → No net change; ↘ Deteriorating/decreasing

[3] Noting that: The successful establishment of clover within grass leys can significantly reduce the need for artificial fertilisers. Every 10% of clover within a sward is equivalent to applying 50kg/ha of Nitrogen. A grass ley containing 40% clover will eliminate the need for other sources of Nitrogen. Apart from considerable cost savings, the elimination of artificial sources of nitrogen will reduce harmful emissions of nitrogen oxide gases and the quantity of leached nitrates entering water supplies.

[4] Noting that: Herbicide sprays can have a detrimental effect on diversity within grass leys and diminish the mineral availability and nutritional value of the grazing.

Service Group	Ecosystem Service	Change
Provisioning	Crops	↘
	Livestock	↗
	Wild foods	→
	Fibre	↗
Regulating	Climate regulation	↗
	Flood regulation	↗
	Water quality regulation	↗
	Soil quality & erosion regulation	↗
	Air quality regulation	→
	Disease and pest regulation	↗
	Pollination	↗
Cultural	Wild species diversity	↗
	Recreation	→
	Education	→
	Cultural heritage	→

Table 2: Pasture for Life Standards – likely impacts on Ecosystem Service Flows

Key: ↗ Improving/increasing; → No net change; ↘ Deteriorating/decreasing

3. What consumers want to buy.

The Pasture for Life standards provide a far more detailed definition of a farming system than would typically be expected by consumers. Consumer research carried out in both the UK (by PFLA) and in the US, where the 100% Grass-fed market is longer established, shows that consumers purchase pasture-fed and grass-fed meat for the following main reasons (Lin 2013, Pirog 2004)

- Health and nutritional benefits [see separate PFLA paper]
- Environmental benefits (see section 12)
- Animal welfare benefits (see section 11)
- Meat quality, including flavour.

4. Farmer motivation.

Apart from the anticipated economic benefits associated with lower production costs, the motivation of many of the farmers who choose to farm to Pasture for Life standards is perhaps best reflected in a recognition that Pasture for Life contributes to both the environment and to farm animal welfare.

Figures from the 2018 survey of PFLA farmer-members (reflected in the infographic below) back this up, with 64% of respondents noting improvements in species diversity and 66% of respondents noting significant, positive improvements to the health of their livestock since adopting a pasture-fed approach. No respondents reported any negative impacts (to the environment or to animal health or welfare) from adopting a pasture-fed approach. 51% of respondents stated that becoming pasture-fed had definitely increased the length of their grazing season and a further 25% possibly so.

Table 3. Summary of changes/activities since becoming pasture-fed (2018 survey)

Activity / changes	%
Were previously buying or growing cereals for animal feed	**64**
Reduced antibiotic use	**53**
Reduced wormer use	**46**
Reduced vet bills	**51**
Improved health of animals	**66**
Longer grazing season (definitely)	**51**
Longer grazing season (maybe)	**25**
Significant changes to grassland management	**81**
Reduced fertilizer use	**32**
Increased diversity of grassland	**64**
Increased insect populations	**56**
Increased mammal populations	**53**
Increased bird populations	**64**

Both the environmental rationale and farm animal welfare rationale are of particular importance to farmers as the UK government considers whether, how, and where it will support agriculture. Whilst environmental and animal welfare benefits can be used to justify public support in a manner that is broadly acceptable to the general public, they must also be sufficiently specific to be applicable and measurable in the field. The application of the Pasture for Life certification standards, independently inspected and assured, achieves this.

5.0 Comparative farming systems - a comparison of Pasture for Life and Organic. It may be helpful to consider the environmental and animal welfare benefits of a farming system in the context of the alternatives. Pasture for Life beef and lamb is sold in competition with, or alongside, meat that may be marketed as being from a variety of other production systems; including organic-certified, grass-fed and grain-fed. The closest of these to Pasture for Life is organic-certified, insomuch as:

(i) Both Pasture for Life and Organic are underpinned by robust and independently inspected certification schemes and;

(ii) Both Pasture for Life and Organic capture the ambition of farmers and the desire of consumers for meat and milk to be produced in a manner that shows care for the environment and for farm animal welfare.

60% of Pasture for Life certified farms (and around 75% of the total number of Certified animals) are also organic-certified.

The Pasture for Life and the organic certification schemes each add something to the other. For example, the EU Organic Regulations state that: *Livestock shall have permanent access to open air areas, preferably pasture, whenever weather conditions and the state of the ground allow this, unless restrictions and obligations related to the protection of human and animal health are imposed on the basis of Community legislation*[5]," whilst the Pasture for Life standards provide a greater degree of specificity:

(4.2.1) All livestock operations must be based primarily upon providing access to pasture or other forage areas where the animals can graze. A zero-grazing system, where fresh forage is harvested during the growing season and fed to confined animals, is prohibited.

(4.2.7) At all times when conditions allow, Certified Animals must be maintained on rotational grass leys, permanent pasture, fields of forage crops with at least 90% forage cover, or on unbroken ground.

The essential difference between Pasture for Life and organic lie in:

(i) **Allowable feedstuffs.** Under organic certification, 60% (on a dry matter basis) of the daily diet of ruminants must consist of fresh or dried fodder, roughage or silage. This means that up to 40% (on a dry matter basis) of the daily ruminant diet on an organic farm can be made up of grain, whereas under Pasture for Life certification cereal feeding is not permitted;

(ii) **Allowable fertilizers.** EU Organic Regulations state that: *The total amount of livestock manure, as defined in Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources, applied on the holding may not exceed 170 kg of nitrogen per year/hectare of agricultural area used*[6].

Whilst under Pasture for Life certification there is no formal limitation on the application of manures or inorganic fertilizers, the use of the latter must be minimised or, where possible, eliminated via a grassland management plan. In practice, Pasture for Life farmers recognise the limitations of inorganic fertiliser as it has a significant impact on the diversity of the sward and hence the efficacy of the system. As grassland management changes, based on a holistic approach to decision-making and rotational grazing systems, so does the use of fertiliser drop.

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[5] Ref: Council Regulation (EC) No 834/2007 on organic production and labelling of organic products

[6] Ref: COMMISSION REGULATION (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0889&from=EN

(iii) **Sprays:** EU Organic Regulations do not permit any agrochemical herbicides or sprays (with the exception of a small number of products in specific circumstances, with approval). Under Pasture for Life certification, sprays can be used but, as with fertilizers, their use must be minimised or, where possible, eliminated.

The experiences of PFLA members show that as farmers make management changes to make more of their pastures, they are finding that they are reducing their use of fertilisers and herbicides. 32% of respondents to the 2018 survey stated that becoming pasture-fed had led to them reducing their inputs of synthetic fertilizers, whilst no respondents reported any increase in their use of fertilizers or sprays. 64% of respondents had seen an increase in the diversity in their grasslands. Although the Organic and Pasture for Life standards take a different approach, there are some common outcomes. Indeed, those farmers who are both organic and pasture for life certified may see themselves as the Gold Standard for ruminant production.

6.0 Grass-fed and grain-fed meat in the marketplace

Terminology. The terms 'grass-fed,' 'pasture-fed' and 'grain-fed' are used within trade agreements to specify the allowable feeding regimes for beef that is imported into the EU. For example, *Commission Implementing Regulation (EU) 593/2013* provides for beef quotas of 10,000 tonnes, "…obtained from steers or heifers having been exclusively fed with pasture grass since their weaning," of 1,300 tonnes, "…from exclusively pasture-grazed steers or heifers," and of 11,500 tonnes from bovine animals, "…fed for 100 days or more on nutritionally balanced, high-energy-content rations containing not less than 70% grain."

Lack of definitions. Beyond these specific international trade agreements, the terms 'grass-fed,' 'pasture-fed,' and 'grain-fed' have no legal basis within the UK and, with the exception of Pasture for Life certified meat, they do not guarantee to consumers that animals have been subject to any specific feeding or husbandry regime. Our Papers, "Why Grass-fed must mean Grass-fed" and "The Health benefits of Pasture for life certified production" expand on the importance of giving a legal definition to the term grass-fed.

How meat is marketed. However, the majority of beef and sheep meat in the UK is not marketed through its production system; but rather according to the breed (e.g. Aberdeen Angus beef), country-based quality marks (e.g. Scotch beef and Welsh lamb) and post-slaughter treatment (e.g. 'matured for two weeks') as well as through basic 'assurance schemes' (e.g. Red Tractor) and, depending on the cut of meat, through nutritional factors (e.g. 'less than 20% fat'). For the majority of meat retailed in the UK, it is not possible at the point of sale to discern how and in what system that meat was produced. Understanding the alternative systems to Pasture for Life requires a closer examination of where our meat comes from.

7.0 The UK beef supply

Beef farming systems in the UK range from those such as Pasture for Life (which advocate a lower-input, grazing and forage based diet) to grass-fed suckler-cow systems which may use supplementary feeding of grains and concentrate feeds towards the finishing stages of production through to intensive systems that use a predominantly grain-based diet. As the proportion of grain in the lifetime diet increases, so does the need to house these cattle – with the most intensive systems known in the US as Concentrated Animal Feeding Operations (CAFOs). The extent and nature of such intensive operations was highlighted recently by The Guardian[7], suggesting that "*the UK is now home to a number of industrial-scale fattening units with herds of up to 3,000 cattle at a time being held in grassless pens for extended periods".*

At the two extremes, whereas Pasture for Life livestock must be at pasture at all times when conditions allow, intensively-raised cattle will typically be housed from the point of weaning. The majority of beef on sale in the UK is produced either in the UK or in the Republic of Ireland. Beef farming systems in the Republic of Ireland are, for the most part, similar to those seen in the UK - with a diverse range of systems from the low-input, pasture-fed approach to high-input, 'intensive' systems.

Figures from Redman (2017) indicate that conventional finishing of suckler-bred store cattle will consume 360-630 kg of concentrates per head; whilst intensive beef production will require more than 2.1 tonnes per head of a barley/concentrate feed. This suggests a conservative estimate of the grain demand of UK conventional beef production to be in the region of 1.25 million tonnes/year, equivalent to 10% of the UK's cereal production or 150,000 hectares of arable land.

8.0 The international beef supply

Sources of beef imports. There are beef imports to the UK from several countries including Ireland, Poland, Brazil, Uruguay, Botswana, Namibia, Australia and the United States. For some of these, the production methods are set out within the trade agreements that allow for tariff-free (or reduced-tariff) trade so that, for example, the UK's beef imports from Australia are predominantly, although not exclusively, from grain-fed livestock (MLA, 2017).

Feedlot systems. Grain-fed cattle in the USA are typically produced in feedlot-based production systems, where over 90% of beef cattle are raised in feedlots of over 1,000 head of cattle and there are over 5 million beef animals in feedlots of over 32,000 head (USDA, 2016). Such systems have been demonstrated to produce significant negative consequences for the environment and for animal health and welfare. For example, the hormone supplements commonly used in feedlot cattle production (but banned in the EU) include

[7] https://www.theguardian.com/environment/2018/may/29/revealed-industrial-scale-beef-farming-comes-to-the-uk

compounds with androgenic, oestrogenic and progestogenic activities; and the endocrine and reproductive systems of wild fish have been demonstrated to be adversely affected by feedlot effluent (Orlando *et al*, 2004).

Feedlot production of cattle is also associated with ruminal acidosis (see below in section 12), with the incidence, prevalence and severity being associated with the number of days on high concentrate feeds and dry matter intake (Castillo-Lopez *et al*, 2014). Whilst ruminal acidosis clearly presents a challenge to the health and welfare of cattle, there are wider consequences for human and animal health. Ruminal lesions resulting from acidosis pre-dispose cattle to liver abscesses, with an incidence of 12-32% in most feedlots (Nagaraja & Lechtenberg, 2007). The control of liver abscesses has typically depended on the use of antimicrobials, particularly Tylosin (Nagaraja & Chengappa, 1998). In so doing, the United States' feedlot cattle systems are creating animal health and welfare challenges and addressing them through the widespread use of antibiotics – with self-evident negative consequences.

When considering the environmental and animal welfare benefits of Pasture for Life certified beef, the most immediately relevant comparisons are with the alternative UK and Republic of Ireland systems, whilst comparisons with systems prevalent in major beef exporters from outside the EU may become of increasing relevance depending on the outcomes of post-Brexit trade agreements.

9.0 The production of sheep meat

The UK is self-sufficient. The UK is self-sufficient in sheep meat production insomuch as it consumes marginally less sheep meat (by volume and by value) than it produces. However, approximately one third of the sheep meat produced in the UK is exported, mostly to France and other EU Member States, and approximately one third of the sheep meat consumed in the UK is imported, predominantly from New Zealand but also to a small extent from Australia and the Republic of Ireland. This reflects the seasonality of production and of the consumer demand for different cuts of meat. In relation to the environmental and animal welfare benefits of Pasture for Life certified sheep meat, the most immediately relevant comparisons are with the alternative UK systems, and to a lesser extent with the systems prevalent in New Zealand, Australia and the Republic of Ireland.

Sheep production systems. UK sheep production is stratified into hill, upland and lowland production. For much of the year, hill and upland breeding ewes are kept extensively, grazing on rough pasture and moorland. However, at stages in the breeding cycle they are brought to lowland pastures and may be fed supplementary, concentrated feeds. Figures from Redman (2017) indicate that upland ewes will receive on average as much as 40kg concentrate feed in a year. Lowland ewes are also fed concentrates, usually at a slightly higher level and on average 48 kg/year.

Pasture for Life standards for sheep. The correct feeding of pregnant ewes can be critical to their health and welfare, so as to avoid pregnancy toxaemia (twin lamb disease). Reflecting this, the Pasture for Life standards permit, under stated conditions and with a derogation, cereal feeding of pregnant ewes carrying multiple lambs and those in poor condition - to prevent welfare problems; but the meat from such ewes must not then be marketed as Pasture for Life. Essentially this allows for breeding ewes to be fed grains on welfare grounds, whilst avoiding the use of grains and concentrates as feedstuffs for non-breeding sheep. This allowance is intended as a transitional measure for farmers entering into Pasture for Life sheep production. Soya and a few other products such as maize, are prohibited in all circumstances. Changes in breed, diversity or grass leys and lambing time should eliminate the need for supplemental feeding without recourse to grain feeding.

Outside of Pasture for Life certification, late season lambs and store lambs in the UK may be fed concentrates to finish them, subject to low cereal prices: and there is a direct relationship between store lamb prices and late season grass availability. Figures from Redman (2017) indicate an average of 10kg concentrates per lamb for lowland spring lambing flocks, and between 2kg and 10kg concentrates per lamb for upland spring lambing flocks. In contrast, the Pasture for Life standards are based around the concept that breed selection, the timing of lambing and the management of grazing must be determined so as to eliminate the need for supplementary feeding in meat sheep. Whilst the use of grain in sheep production is markedly less than in cattle production, it would nevertheless appear to be an inefficient and poor use of cereals to be used as feedstock for sheep, utilizing a further 16,000 ha or more of arable land.

10.0 How Pasture for Life can lead to more sustainable land management

What is the impact on the whole farm system of prohibiting the feeding of grain or concentrates, maize or high-energy bought-in feedstuffs? Described for beef cattle below; similar, although perhaps less overt, differences are seen for sheep meat production.

Predominantly grain-fed. When cattle are predominantly grain-fed (e.g. in intensive beef finishing systems) then the limiting factors in the farm's productivity are the available housing (i.e. the limit on the maximum number of cattle that can be placed in the system) and the volume of grain that can be grown or bought-in. Cattle in such a system are seen as a means of adding value to cereals and the system's success is contingent on the input-prices paid for cereals and the output-prices achieved for sold-cattle. Critically, the environmental impacts of these systems can be placed physically and economically **outside the production unit**; they can be externalised and hidden. The environmental impacts of grain production, and of any disposal of farmed manures to the land, do not have any direct effect on the efficiency of the predominantly grain-fed beef farming operation or on its profitability.

Partially grain-fed. When cattle are partially grain-fed, for example in a typical grass, grass-silage and concentrate feeding system, then the limiting factors in the farm's productivity are the availability of housing (e.g. for the winter period), the availability of grass and grass-silage and the volume of grain that is grown or bought-in. Cattle in such a system are a means of adding value to a mix of inputs, including both grass/grass-silage and cereals, and the system's success is contingent on the relative costs of production of grass and grass silage, the input-prices paid for cereals and the output-prices achieved for sold cattle. The system is intrinsically more complex than feeding grain-alone or feeding forage-alone, and the relationship between the cost of inputs and their actual feed value is less clear.

Of particular concern when cattle are partially grain-fed, is that the economic inefficiencies in grassland production and use [such as the excessive application of fertilizer or grassland damage through over-stocking, which will result in negative environmental impacts] may be masked through the feeding of cereals.

Moreover, the limiting factors of the availability of grass and grass-silage and the volume of grain that is grown or bought in are interchangeable. Farmers can increase their stock numbers, to be considerably higher than the levels that would be possible when feeding grass/grass-silage alone, by importing (or growing) cereal inputs. If cereal prices are predicted to be low then there is an economic incentive to increase stocking levels and this may, in theory at least, tend towards the over-stocking of livestock on pastures. The statement made within Natural England's 2009 report, *The Environmental Impacts of Land Management*, highlights the issue of stocking rates on lowland grassland farms:

> "Management for lowland grazing livestock enterprises is generally closely associated with high stocking rates, short-term grass leys, high rates of inorganic fertiliser use and the disposal of large quantities of slurry."

Wholly pasture-fed. When cattle are entirely pasture-fed, as they are under the Pasture for Life certification scheme, then they are simply a means of adding value to pasture. There is no further input to which to add value, and there is no complexity within the system that could mask inefficiencies. If too many cattle are introduced to the system, then there is insufficient feed and growth is compromised; if too much fertilizer is applied to grassland, then the costs of the excess are seen directly in a reduced profit margin. The environmental impacts of these system are placed physically and economically within the production unit; they are internalised to a much greater extent than intensive production systems; and they are explicit. As such, ***certain of the environmental benefits of Pasture for Life farming result from an approach that recognises and monetises the externalities of production, because those externalities are represented as direct, on-farm costs.*** It is, in effect, a system that is based purely on Natural Capital.

Because of the no-grain stipulation, of the additional prohibitions on bought-in concentrate feeds, and of the need to graze animals whenever possible, the overall carrying capacity of a Pasture for Life certified farm is likely to be reduced compared to those utilising grain.

Furthermore, Pasture for Life producers must appraise their stocking to ensure that they do not over-graze. Over-grazing, which will result in a decline in the available feedstuff from the land, cannot be compensated for in the Pasture for Life system by the introduction of bought-in concentrate feeds. This means that the Pasture for Life farm system is more likely to be managed at or marginally below its natural carrying-capacity. As such, land degradation is made *less likely* by the choice of Pasture for Life farming systems. This is borne out by the recent (2018) PFLA survey of Pasture for Life producers and producers aiming to become Pasture for Life certified. There was a consistent theme within the results of this survey that, since adopting a 'Pasture-Fed' approach, 81% of producers had a greater focus on pasture management with 76% saying that this had either definitely or maybe resulted in a longer grazing season. This is discussed further in section 12 below.

11.0 The animal welfare benefits of wholly pasture-fed raising of ruminants.

11.1 Background. This brief overview of the relationship between the Pasture for Life standards and animal welfare precedes a three-year study on the ethics of animal welfare to be led by the University of Chester. This study will include detailed consideration of the impact of the Pasture for Life standards on the welfare of the animals so raised, as well as the related ethics surrounding them. It will provide a much more comprehensive review than is currently possible. What follows here reflects the current state of our knowledge, based on published reports – some of which deal with animal health (which is more easily measured) rather than with animal welfare (of which health is a part but which tends to be more subjective and less easily measured) - and on feedback from our farmers. It should be considered as work in progress.

In response to the Government's Brambell report[8], published in 1965, animal welfare science was born. Forty-one years later Marian Dawkins, Professor of Animal Behaviour at the University of Oxford observed: *"Animal welfare science is a relatively young discipline; but is one of the most comprehensive, drawing on all branches of biology, including behavioural ecology, evolution, ethics, animal behaviour, genetics, neuroscience and even consciousness* (Dawkins, 2006). It is also *"a science in which judgements are not solely based on scientific evidence but also on philosophical value statements and economic benefits" (King, 2003*).

The Farm Animal Welfare Council has developed a framework based around the concept of Quality of Life (QoL) and *"a live worth living"* (FAWC, 2009) and Parliament has enshrined the Five Freedoms into UK legislation in the form of the Animal Welfare Act 2006. As far back as 1997, the Treaty of Amsterdam - later subsumed into the Treaty of Rome - acknowledged in EU legislation that animals are sentient beings and that full regard should be paid to this when drawing up legislation relating to farmed animals and their welfare.

[8] *The report of the Technical Committee to Enquire into the Welfare of Animals Kept under Intensive Livestock Husbandry Systems: Brambell, FW 1965*

There are existing welfare assessment schemes – including the ***EU Welfare Quality Network*** and the UK-focused ***Advancing Animal Welfare Assurance (Assurewel)*** and its offshoot adopted by the UK pig industry ***Real Welfare***) - that incorporate the key components of welfare in the form of the 5 Freedoms and Quality of Life. More importantly, they look at animal-based indicators and not just inputs. It is essential to look at what the animals are telling us about the system in which they are kept and how well it is meeting their welfare needs. Other, independently assessed, higher welfare farm assurance schemes (such as ***Organic*** *certification, the* RSPCA's ***Assured*** *and* ***Pasture for Life***) also incorporate these elements.

The five freedoms associated with animal welfare
1. Freedom from **Hunger and Thirst** by ready access to fresh water and diet to maintain health and vigour.
2. Freedom from **Discomfort** by providing an appropriate environment including shelter and a comfortable resting area.
3. Freedom from **Pain, injury or disease** by prevention or rapid diagnosis and treatment.
4. Freedom **to express normal Behaviour** by providing sufficient space, proper facilities and company of the animal's own kind
5. Freedom from **Fear and Distress** by ensuring conditions and treatment which avoid mental suffering

Quality of Life has three interlinked and synergistic elements: **biological functioning** (including health); **affective states** (emotions and feelings); and **the ability to live natural lives** (Benson, 2004). An animal can be said to be living a good life, or experiencing a positive sense of well-being, when all are met. Pasture for Life scores well on these three criteria:

1. animals show lower levels of health issues and require less medication, especially antibiotics and anthelmintics (discussed in greater depth below);

2. ruminants are evolutionarily adapted to live at pasture in social groups eating forage plants to meet their nutritional needs. The Pasture for Life system allows these fundamental needs to be met in respect of an ability to live a natural life; the animals live in their ecological niche;

3. the combination of good health and the ability to live a natural life lead, combined with good stockmanship, lead to animals experiencing positive, affective states.

Such "well-being" is of growing concern and interest to consumers. A consumer survey by the PFLA in 2017 found that the attribute rated as most important amongst those buying pasture-fed and grass-fed meat in the UK was that the animal was 'free-range'. 'Free range' is associated by many consumers with improved animal welfare; an association that is underpinned by ethical considerations of animal well-being and of what is 'natural', as well as veterinary considerations for animal health and welfare.

11.2 Animal welfare and the PFLA standards.

The PFLA standards note that the overarching objective in respect to animal welfare is that: *Pasture for Life certified ruminant livestock systems must ensure that production is matched to an animal's natural metabolism, and as such minimises the psychological and physiological stress that can so often compromise animal welfare.*

The Standards also state (3.9) state that Certified Farms *must be able to demonstrate high standards of animal welfare. Indicators of animal welfare include:*

- ✓ *Maintenance of animals in good body condition, supported by body condition scoring.*
- ✓ *Animals fed according to their age and stage of production as evidenced by a Nutrition*
- ✓ *Plan and supported by feed and forage analyses*
- ✓ *Maintenance of animal health beyond absence of disease to promotion of good health*
- ✓ *Absence of signs of stress or discomfort*
- ✓ *Absence of signs of injury*
- ✓ *Appropriate techniques for management tasks such as castration, disbudding etc.*
- ✓ *Ability for animals to perform their natural behaviours*
- ✓ *Appropriate facilities for handling and treating animals*
- ✓ *Protocols for the disposal of fallen s*tock
- ✓ *Provision of isolation facilities*

For **Dairy producers**, health management must also include:

- ✓ *Minimisation of mastitis and the use of antibiotic treatments*
- ✓ *Lameness and lameness scoring*
- ✓ *Fertility recording*
- ✓ *Calving records*

11.3 The relationship between animal welfare and pasture-based systems.

An extensive review of the welfare of dairy cows in pasture-based and housed systems by Arnott *et al* (2017) concluded: *"Regarding health, cows on pasture-based systems had lower levels of lameness, hoof pathologies, hock lesions, mastitis, uterine disease and mortality compared with cows on continuously housed systems. Pasture access also had benefits for dairy cow behaviour, in terms of grazing, improved lying/resting times and lower levels of aggression. Moreover, when given the choice between pasture and indoor housing, cows showed an overall preference for pasture, particularly at night. Dairy cattle spent 71% of their time on pasture compared to 21% indoors when given the choice".* It also noted higher rates of mortality in housed/concentrate-fed cattle than those with access to pasture.

A study by Logue et al (2014) found that pregnancy rates are higher when cattle are grazed and that *"Housing aspects are limited in application by economics and in most cases still do not match grazing for welfare in temperate climates".* Charlton and Rutter (2017) found that: "*Cows at pasture had lower levels of lameness and mastitis, and cows with free access to pasture and indoor housing also produced more milk than those continuously housed. Approximately half of this extra milk was attributed to grass intake, and increased lying, improved comfort and/or lower stress probably accounted for the rest."*

A well-referenced overview of the positive relationship between pasture and animal health (covering lameness, mastitis and milk quality, reproduction, longevity, young stock health and behaviour) is provided in a thorough presentation by Linda Tikofsky, a veterinarian at Cornell University.

As is evident, much of the work on this topic has been done in relation to dairy animals - and a significant amount in the US. Steven P. Washburn (of the Department of Animal Science North Carolina State University) provides a general picture of the benefits of grazing dairies in the US in his paper ***Lessons learned from Grazing Dairies,*** *noting* (p64) *"Grazing cows get more exercise, usually have fewer health problems and typically live longer".*

Mark Rutter (2010) of Harper Adams notes: *"The evolutionary and domestic ancestors of sheep and cattle will have evolved diet selection behaviours that enabled them to select a diet that met their individual nutrient requirements whilst minimising the risk of being killed through predation or by eating toxins. Preventing animals from expressing their innate diet preferences by feeding them mixed rations may cause frustration and so compromise animal welfare, although this hypothesis requires further research."* A second study, involving the same author, noted that: "*Overall, dairy cows expressed a partial preference to be at pasture, spending 68.7% of their time at pasture (Motupalli 2014).*

11.4 Animal welfare is also influenced by grazing and soil management.

One of the key benefits to building more resilient soils is the potential for them to be grazed right through the winter. This has significant animal welfare benefits as well as cost savings to the farmer. By keeping animals outside in winter longer, the amount of time they are confined inside - at a greater risk of respiratory disease and ecto-parasites - is reduced. Some PFLA members have been able to keep cattle out all winter, even on very heavy soils, without damaging them - whilst other farmers are able to reduce the time that animals spend in confinement. In the 2018 survey, 51% stated that becoming pasture-fed had definitely (and 25% possibly) increased the length of their grazing season.

The deeper rooting swards, as well as the increased diversity, also helps to make available - in both grazed pasture and conserved forage - a broader spectrum of minerals from deeper soil profiles that may not be available near the surface.

11.5 Health benefits from rotational grazing.

There are health benefits arising from rotational grazing as opposed to set stocking – reflecting the old Shepherd's saying that *sheep should not hear the church bells twice in any paddock.* This can have a direct consequence on farm animal welfare, in particular regarding the prevalence, treatment and control of diseases such as gastrointestinal nematode infections and liver fluke.

The National Animal Disease Information Service (NADIS) states that, *"Gastrointestinal nematode infestations are perhaps the most important group of conditions limiting intensive sheep enterprises,"* and, *"With traditional management of sheep on permanent pasture in the UK, parasitic gastro-enteritis in growing lambs results from ingestion of very large numbers of infective larvae from pasture during mid-summer."*

Gastrointestinal parasitism of sheep leads to reductions in meat, wool and milk production and declines in reproductive performance. Intensive use of anthelmintics to control gastrointestinal nematodes also selects for anthelmintic resistance (Papadopoulos, 2012).

Anthelmintic resistance is prevalent on sheep and beef farms across the EU. In the UK, Taylor *et al* (2009) found that 97% of sheep farms studied had nematode populations with alleles conferring resistance to benzamidazoles and 40% with alleles conferring resistance to imidazothiazoles. Geurden *et al* (2015) found anthelmintic resistance to naturally acquired gastro-intestinal nematodes in cattle in 8 of 40 farms sampled across the UK, Germany and Italy. De Graef *et al* (2013) highlight documented reports of multi-drug resistance in cattle gastrointestinal nematode populations in New Zealand and in South America.

Results of our 2018 farm survey suggest that the control of gastro-intestinal nematode infestations based on the avoidance of infected pastures may be more readily implemented with diverse pastures, rotational grazing and reduced stocking rates. Reducing stocking density is also one of several non-anthelmintic measures aimed at decreasing the risk of liver fluke infestations (European Medicines Agency, 2016).

The Pasture-for-Life standards recognise the issue of anthelmintic resistance and the need for alternative control strategies with the following requirement:

Stocking rates, the use of 'clean' and 'mixed' grazing and pasture management must be the primary method of controlling internal parasites (7.2.10).

46% of survey respondents had reduced their use of anthelmintics since becoming pasture-fed and many farmers also noted, in response to an open question on the animal health and welfare benefits of becoming pasture-fed, that they have seen lower worm counts and reduced use of anthelmintics. 66% noted improved health of their animals and 51% recorded lower vet bills.

11.6 Avoiding the direct animal welfare impacts of certain feeding systems.

The restrictions within the Pasture for Life standards on certain types of feeds and feeding practices may also reduce the risks of certain nutrition-related complaints commonly seen amongst farmed cattle, such as sub-acute ruminal acidosis.

Sub-acute ruminal acidosis (SARA) is a condition in cattle in which rumen pH is depressed for several hours per day due to the accumulation of volatile fatty acids and insufficient rumen buffering. The consequences of sub-acute ruminal acidosis include, amongst other things, diarrhoea, laminitis and liver abscesses (Plaizer *et al*, 2009) whilst Nagaraja & Chengappa (1998) highlight that the incidence and severity of liver abscesses increases as roughage levels in the diet decrease.

SARA is associated with grain-fed diets, because grains are generally more digestible than forages and because grain-fed diets require less chewing, and so reduce the volume of bicarbonate-rich buffering saliva (Plaizer *et al*, 2009).

Whilst recognised predominantly as a disease of dairy cattle within the UK, sub-ruminal acidosis also affects beef cattle. In the UK, the beef cattle most likely to be affected by SARA are those in intensive beef systems. For meat produced outside the UK it is beef cattle within feedlot systems, such as those in Australia and the US, that are most likely to be affected.

53% of respondents to the 2018 survey of PFLA farmer-members stated that they had reduced their use of antibiotics since becoming pasture-fed and, in response to an open question on the animal health and welfare benefits of becoming pasture-fed, respondents also stated that they have seen reduced acidosis, reduced laminitis, reduced respiratory disease and, in consequence, reduced reliance on antibiotics.

In summary, whilst more work needs to be done (and will be done in the upcoming three-year study) to better understand the relationship between the Pasture for Life approach and animal welfare, both published work and the experience of participating farmers suggests that there are significant and identifiable benefits in terms of the health of the animals, their general welfare and their ability to express themselves.

12.0 The environmental benefits from the pasture-fed raising of ruminants

Derived from the old French word "environ" (meaning surrounding), **the environment** is all encompassing and complex. It covers the natural and built environment, climate (change), noise, pollution, biodiversity and the hydrological and nutrient cycles – as well as humanity itself and the interrelated soil and human microbiomes. It is endlessly studied – most frequently in terms of specific issues taken in isolation. Given this complexity, how can we look at the relationship between pasture-fed ruminants and "the environment", particularly when farmers are being pressured to produce more and more food? Below we seek to address the question in relation to the soil and how we care for it, to what we mean by pasture, to biodiversity, to flood and drought mitigation, to the carbon cycle, to the avoidance of some of the negative characteristics of industrial farming and to the contribution that pasture can make within mixed farming systems.

12.1. Why "pasture-fed" rather than "grass-fed?" A priority for the PFLA founders was to decide whether to use ***"grass-fed"*** (as in the US) or ***"pasture-fed".*** The decision to use "***pasture-fed"*** reflects that **"grass"** could be a monoculture of a shallow-rooting grass, fed with artificial fertiliser on an intensive farm (or golf course) whilst **"pasture"** suggests a **biodiverse population of deep-rooting grasses and herbs,** with overtones of pastoral care.

Grass (above) or pasture (below)

Pasture covers a wide range of situations including permanent pasture, long and short term leys (which may be part of a mixed farming system), with wide variations in ecology, plant species mix, the type of animals grazing on them and how both the pasture and animals are managed.

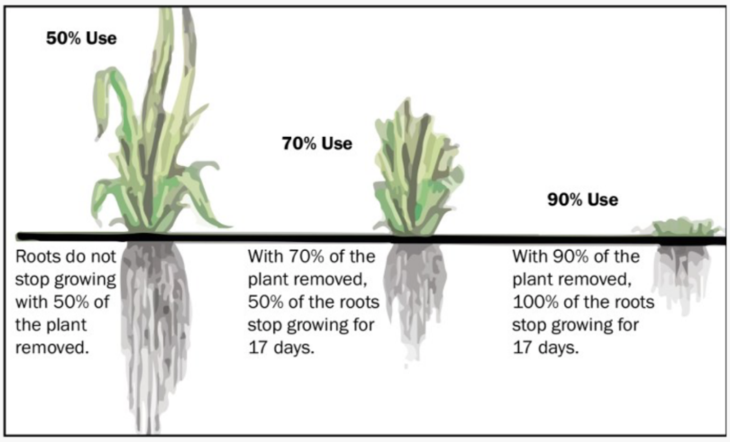
Ruminants are mobile, self-replicating anaerobic digesters capable of converting solar-powered, biodiverse pasture into nutrient dense food - generating environmental benefits through building soil fertility, absorbing carbon and both holding and filtering moisture that might otherwise result in flooding. Where animals are raised to Pasture for Life standards, and the use of artificial chemicals is either absent or minimised, many of the damaging effects of intensive animal production arising from emissions and effluents are avoided.

12.2 Benefits to soil, biodiversity and wildlife. Traditionally, an all-grass system implies lower farm stocking rates – which can generate several potential benefits. These include:

- Reduced compaction, poaching or other damage to the soil structure (Daniel *et al*, 2002) resulting in lower levels of erosion and sedimentation and potentially in ammonia, methane and nitrous oxide (Cuttle *et al*, 2007)
- Benefits to terrestrial and aquatic habitats and associated wildlife, from biodiversity, varied grassland structure and reduced inputs and pollution. Perkins *et al* (2000) suggest that*: "…mosaics of fields managed as short-term leys and permanent pastures with low-intensity cattle grazing over the autumn and winter would provide the combination of heterogenous sward structure, areas of bare earth and presence of some seedling plants necessary to maximise the range of bird species able to use a given area of agriculturally improved grassland throughout the winter."*
- Where lower stocking densities lead to reduced compaction there may be further benefits to farmland birds. Soil penetrability has been shown to significantly influence the abundance of yellow wagtails, an insectivorous farmland bird; as well as other soil-probing species. The relationship between yellow wagtail abundance and soil penetrability appears to result from the increased abundance of invertebrates above more penetrable ground during the breeding season (Gilroy *et al*, 2008).

Many PFLA members practise pasture management based on tried and tested rotational grazing methods. These include **rational grazing** (a term coined by Andre Voisin in the 1950's in his book Grass Productivity), and increasingly **mob grazing** and **holistic planned grazing** (Peel at al). The emergence of mob grazing and holistic planned grazing - based on intense periods of grazing that leave significant residues behind followed by extended periods of recovery – generally permits overall stocking rates to be increased whilst maintaining many of the benefits of a lower stocking rate, particularly when using biodiverse, herbal leys. These innovative methods are producing some of the most exciting advances in pasture management that we have seen in recent years. The longer re-growth/rest periods allow increases in productivity without chemical inputs when compared to continuous grazing systems - whilst allowing the soil to recover. When a large herd of animals grazes a small area intensively for a short period before moving on, a significant proportion of the grazing is left behind as trampled biomass. This biomass is returned to feed and maintain the **biological capital of the soil**, whilst also providing a significant solar panel to stimulate regrowth and take pressure off the plants' roots.

Christine Jones, in her Fundamentals of Soil, notes that: *it is important that less than 50% of the available green leaf be grazed. Retaining adequate leaf area reduces the impact of grazing on photosynthetic capacity and enables the rapid restoration of biomass to previous levels. She notes that "Over a 12-month period significantly more forage will be produced if pastures are grazed 'tall' rather than 'short'". (Voth 2015).*



Growth of both tops and roots is significantly impaired if more than 50 percent of the green leaf is removed in a single grazing event (10).

Many important plant and wildlife species ***have evolved in tandem with grazing animals and depend on them for their survival***, a point made strongly by Natural England in its report, *The Importance of Livestock Grazing for Wildlife Conservation*. This is a key reason why the RSPB uses cattle on its reserves, noting that livestock farming is *"essential to preserving wildlife and [the] character of iconic landscapes".*

The longer rest periods found in mob grazing and holistic planned grazing may also allow grasses and flowers to set seed, leading to **increased plant diversity** and pasture recovery through natural seeding, providing the opportunity for wildflowers to propagate and increase in number while also providing a food source for the pollinators at the heart of the farming system. Our 2018 survey showed that 64 % of respondents had seen an increase in bird-life, 53% an increase in mammal life and 56% an increase in insect life.

Many PFLA members use these herbal leys and native plant communities, including wildflowers, that provide an important resource for pollinators and other wildlife. The longer grass offers more cover for species like field voles and hare which in turn lead to thriving populations of barn owls and kestrels feeding on the small mammals.

Existing Stewardship schemes already support the creation and management of these kinds of grasslands and the PFLA encourages members to increase such pasture to further increase the resilience of their farming systems.

12.3 Soil and Water benefits – flood and drought mitigation. Soils play a vital role in retaining moisture for the plants growing in it. Their capacity to do so is determined largely by its inherent structure and by the level of organic matter. A widely-quoted figure of *"each 1% organic matter increases soil moisture holding capacity (down to 30cm) by 150 – 200,000 litres/ha"* appears to bear scrutiny (Bryant, 2015). This ability to store (and filter) water is also important for both rural and urban communities, retaining water for subsequent household and industrial use and, in times of heavy rain, absorbing water that could otherwise run off and cause flooding. Its capacity to do so is influenced in turn by the nature and degree of plant material on the soil surface, in turn influenced by how it is managed. This is seen dramatically in the Pontbren project, in which the judicious fencing of streams, planting of trees on 5% of the area and reduced stocking rates led to soil infiltration rates that were 67 times faster[9]. The UK's uplands, in which pasture plays an important role, are an important source of water, with 70 per cent of the UK's drinking water being sourced there (Reed et al).

The longer rest periods achieved in rotational grazing noted above allow the forage plants to reach their full potential and this in turn allows them to build a larger root-mass. Where this includes a wide range of species, as in herbal leys, this increases both the root mass and the rooting depth which allows water to more easily infiltrate, reducing soil erosion, leading to higher levels of soil organic matter and slowing the rate at which rainwater reaches rivers and streams - in turn reducing the risk of flooding. By leaving greater grass residues, and with longer rest periods, rainfall is used more effectively and turned into larger amounts of plant growth. This in turn is grazed and returned to the soil through manure and trampled forage. This capacity to hold water, reduce flooding and mitigating drought has a measurable value to society.

12.4 Reducing the environmental impacts of fertilisers and sprays. Figures from the 2018 survey show that the application of Pasture for Life standards leads to lower usage of fertilisers and sprays. Apart from considerable cost savings, the elimination of artificial sources of nitrogen will reduce harmful emissions of nitrogen oxide gases and the quantity of leached nitrates entering water supplies. Herbicide sprays can have a detrimental effect on diversity within grass leys, diminish both the mineral availability and nutritional value of the grazing and result in water pollution (Cuttle et al 2007). Off-farm, there is reduced fossil fuel use and energy consumption associated with the manufacture of inorganic fertilisers and pesticides (Bhogal *et al,* 2007). In general, the risk of nitrate pollution is lower with extensive and low intensity cattle (and sheep) production systems compared to intensive systems (Baldock *et al*, 2007).

[9] https://www.ceh.ac.uk/news-and-media/blogs/tree-planting-and-reducing-flooding-will-it-work

12.5 Avoiding the environmental impacts of maize and soya. The prohibition of maize silage and soya, directly affects the impact of beef and sheep farming systems on the environment. ADAS (2016) notes that maize production is associated with significant amounts of surface runoff, sediment, phosphorus and nitrate losses to water which are *"within the range of those reported for other tillage crops,"* but that *"soil degradation is higher due to trafficking when soils are wet; that maize production can lead to depletion of soil organic carbon; and that it results in relatively low levels of biodiversity".* Expansion of soybean production has been associated with the removal of forests and savanna in South America, especially in Argentina, Brazil, Bolivia and Paraguay. In addition to the obvious reduction in biodiversity, this has had direct consequences for global greenhouse gas emissions, local micro-climates, soil erosion & water pollution (WWF, 2018).

12.6 Efficiency of feed intake. It is frequently suggested that grain and other supplementary feeding of cattle and sheep is a more efficient way to produce food, and specifically protein, for human consumption, than producing beef and sheep on forage alone. There are two broad questions to be asked:

- Does grain and other supplementary feeding lead to either more or less efficient farming (in terms of resource inputs) per unit of production, so that there is overall either more or less environmental damage?
- Does grain and other supplementary feeding lead directly to environmental damage that cannot sensibly be factored-in to comparative metrics, such as loss of habitats or species? Put simply, does feeding a quantity of grain or other supplementary feed to ruminants lead to unacceptable environmental damage?

The key question is: "what do we consider to be the 'unit of production'?" If we measure the inputs needed *per kg of beef* and endeavour to produce beef as efficiently as possible, then we will end up with quite different results to if we measure the outputs *per unit of land*, with no net inputs or environmental 'take'. That is, asking *'what is the most efficient way to get this much meat?*' is a rather different question to *'what amount of meat can we get if we do not want to cause any damage?'*

Previous reviews have generally taken the first of these approaches; i.e. assessing the most efficient ways to produce *large* volumes of beef or other animal protein, usually with a focus on greenhouse gas emission reduction. This is not a sustainable approach to take to livestock production of any sort. The global potential to raise livestock production, and particularly the environmental resources needed for that production, is clearly limited.

Industrial livestock production, which is dependent on feeding grain to animals, is intrinsically inefficient, wasteful not just in the poor conversion of the grain but also of the land, water and energy used to grow them. Ruminants that are raised on pastures or other grasslands convert grass and other vegetation into food that we cannot eat and are able to use land that is not suitable for other forms of food production.

12.7 The carbon cycle. Whilst the environmental benefits associated with pasture, described above, are broadly accepted there is much debate around the issue of carbon. Whilst in the natural world, carbon recycles in a balanced way through the processes of photosynthesis, respiration, combustion and decomposition, it is now widely accepted that human activity, particularly through the burning of fossil fuels, has significantly increased the levels of carbon in the atmosphere and the warming of the atmosphere. <70% of carbon stored in the soil has been lost to the atmosphere since the industrial revolution (Lal 2007, Zomer 2017) and cultivation has played a significant role in this.

At the global level, the world's soils represent the largest terrestrial carbon reservoir, containing 2,300 Pg. of soil organic carbon (SOC) down to 3m (Jobbágy, 2000). Recent work at the Centre for International Tropical Agriculture (CIAT) concludes that "*There is general agreement that the technical potential for sequestration of carbon in soil is significant, and there is some consensus on the magnitude of that potential. By better managing farmland soil, the amount of carbon stored in the top 30 centimetres of the soil could increase by an extra 0.9 to 1.85 gigatons each year, removing 3-7 billion tonnes of CO_2 from the atmosphere or 26–53% of the target of the "4p1000 Initiative"* (Zomer 2017).

That two thirds of global farmland is pasture, suggests that pasture has a role to play in this process. Recent work involving CIAT and Rothamsted, based on assessments of soil aggregation and microbial activity, concludes that: "*Using improved forages (pastures and legumes) to feed livestock is an approach that addresses the challenge of recovering degraded land and/or conserving the soil, whilst at the same time improving livestock production; this also requires good agronomic management, including practices such as agroforestry, optimal fertilizer application, appropriate grazing density and land-use rotation. These practices allow the soil to develop characteristics of good health such as: the increase of organic matter, good soil structure, deeper water infiltration encouraged by deep rooting grasses, protection against soil erosion, efficient nutrient use and improved biological activity"*[10].

Recent work at Michigan State University (Stanley 2018) comparing beef production from grassland managed under 'short duration, high intensity grazing' (mob grazing or holistic planned grazing) to beef on intensive feedlots, found lower greenhouse gas (GHG) emissions and improved soil organic carbon content (SOC) from grass finishing. This is the first piece of research that has compared these two systems – previous research has looked at continuous grazing or set stocking and assumed a constant level of soil organic carbon. A second paper on "the role of ruminants in reducing agriculture's carbon footprint", also from the US, notes: "*Permanent cover of forage plants is highly effective in reducing soil erosion, whilst ruminants consuming only grazed forages under appropriate management result in more C sequestration than emissions" (Teague et al 2016).*

[10] http://bit.ly/2KeA26X

Work undertaken by O'Brien (2012) looks at the importance of how emissions are measured and suggests that if only gases emitted from the farm site itself are measured, then intensive housed systems have a lower carbon footprint than extensive systems. However, if offsite emissions are included (i.e. from concentrate feed production) extensive systems have a lower carbon footprint. This suggests that assessing how ruminants affect the carbon cycle should be based on whole life-cycle analysis (including both soils/plants and animals) and in the wider context of the ecosystems services provided by grazed pasture.

A recent study from Rothamsted (McAuliffe et al, 2018) notes: "*Using omega-3 content of meat products as a starting example, this paper aims to demonstrate the effect of incorporating product **quality**, as opposed to **quantity**, into the carbon footprinting framework for a range of meat products. Using data from seven livestock production systems encompassing cattle, sheep, pigs, and poultry, this paper proposes a novel framework to incorporate nutritional value of meat products into livestock life cycle analysis. The results of quantitative case studies demonstrate that relative emissions intensities associated with different systems can be dramatically altered when the **nutrient content of meat** replaces the **mass of meat** as the functional unit, with cattle systems outperforming pig and poultry systems in some cases. This finding suggests that the performance of livestock systems should be evaluated under a whole supply chain approach, whereby end products originating from different farm management strategies are treated as competing but separate commodities.*"

The utilisation of pasture, and the general benefits that it brings, is dependent largely upon ruminants. Despite having been present in large numbers for millennia, they have increasingly become a target for criticism because they emit methane into the atmosphere through their anaerobic digestion. The net balance of carbon emitted by ruminants and carbon sequestered by the soil is a continuing debate in which there are disparate views, and its determination is made more difficult by lack of agreement on terminology, methods of measuring it and by the many variables involved. These variables include the soil type and depth, the rainfall, the nature of the pasture (e.g. with more heterogeneous swards [particularly those including wild flowers] potentially reducing methane emissions (Hammond 2014), the presence of methanotrophs[11] and the relationships between the pasture and (a) these bacteria (Smith et al) and (b) the saliva of the grazing animal (Liu, 2012; Li, 2016), the type and age of the grazing animal and how the pasture is managed.

[11] *A review by Dunfield (2007- The Soil Methane Sink) notes that the highest methane oxidation rates have been measured in pristine forests, the record being 13.7 mg/m2/day measured in tropical forests of India (Singh et al., 1997). Other work suggests that pasture can play a role in oxidising methane, albeit considerably less than tropical forest, with the actual level varying with the nature of the soil and pasture, its moisture level, pH etc (K A Smith et al, 2000 – Oxidation of atmospheric nitrogen in Northern European soils).*

A detailed report by the Food Climate Research Network (Confused about Grazing)[12] aims *"to provide clarity to the often highly polarised debate around livestock production and consumption, and the merits or otherwise of different production systems"* – and, in particular, to identify the net benefits (or otherwise) of grass-based production systems **specifically in the context of climate change**. It notes that this is a highly polarised debate, the key elements of which are reflected in the table overleaf. In its conclusions, whilst focusing on the levels of methane produced by farmed ruminants, the report also recognises the wide variation in grazing systems and factors affecting them and acknowledges that: "*well-managed grazing systems can aid the process of soil carbon sequestration…and provide an economic rationale for keeping carbon in the ground*"; and that "*there is some evidence that in some cases grassland can store more carbon than forests"*; whilst also stressing "*the importance of keeping existing carbon in the soil and vegetation"* – a characteristic of pasture. Its overall conclusion, however, is that *"whilst grazing livestock have their place in a sustainable food system, that place is limited"*.

Responding to this report, A Greener World notes[13]: "*as the authors state, the report does* ***not*** *answer the "enormous and difficult question" of whether farmed animals fit in a sustainable food system, nor "which systems and species are to be preferred. Indeed, the authors* ***specifically state this was not their intended purpose****. They also acknowledge they have only considered greenhouse gas (GHG) emissions in the report and not sustainability "in its proper and widest sense," and do not consider the wider health, socio-economic, environmental and animal welfare benefits of grass-fed and pasture-based livestock systems. They note that sustainability is highly complex: there is no single diet solution or 'one-size-fits-all' production model that we can all adopt. Indeed, the necessary solutions will inevitably be highly complex, multi-faceted and* ***specific to place."***

The report suggests that (based on the limited research currently available) the sequestration potential from grazing management is anywhere between 295–800 Mt CO2-eq/year, or around 20-60% of annual average emissions from the grazing ruminant sector. Add this possibility to the wider social and environmental benefits of pasture-based livestock systems that the authors acknowledge, but cannot consider within the purposefully narrow GHG scope of this report, and it is clear that we ignore its potential contribution to sustainable food security at our peril."

[12] https://www.fcrn.org.uk/sites/default/files/project-files/fcrn_gnc_report.pdf
[13] https://agreenerworld.org/a-greener-world/grassfeds-role-greener-world-agws-response-university-oxford-study-grazed-confused/

	Area of contention	Argument	Counterargument
1 (see Chapters 2 & 3)	The balance between greenhouse gas (GHG) emissions and removals.	Ruminants are a major source of GHG emissions, particularly carbon dioxide (CO_2) via land use change, methane (CH_4) and nitrous oxide (N_2O); any soil carbon sequestration arising is small, uncertain, time-limited, reversible and difficult to verify.	Ruminants in well-managed grazing systems can sequester carbon in grasslands, such that this sequestration partially or entirely compensates for the CO_2, CH_4 and N_2O these systems generate.
2 (see Chapter 4)	The importance of methane as a contributor to the climate problem. The role of the nitrogen cycle.	CH_4 is a particularly potent GHG and ruminants are significant contributors Livestock are a source of N_2O, a highly potent GHG. More broadly, efforts to sequester carbon risk incurring increases in nitrous oxide emissions. Livestock do not add any new nutrients to the land, but rather introduce an additional very leaky cycle.	CH_4 has a short life span; CO_2 from burning fossil fuels is a greater concern for permanent warming and shifts the balance of culpability onto CH_4 'efficient' but fossil-fuel dependent intensive systems Historically wild ruminants roamed on many grasslands, producing CH_4. Farmed ruminant emissions need to be seen in the context of this historical baseline count. Livestock play a vital role in recycling nutrients – including nitrogen – and make them more available for plants to take up, thus fostering a new generation of plant growth.
3 (see Chapter 5)	Grazing systems and their role in land use (LU) and land use change (LUC) as compared with intensive monoculture crops and monogastric systems; the historical role of ruminants on the land	Ruminants in grazing systems occupy a large land area and have historically caused LUC and associated above/ below ground carbon release. Plant-based diets and grainfed intensive livestock systems use less land and so cause less damaging land use change.	Many grasslands are the natural climax vegetation and not suited to cropping. Crop production – for human food and intensive animal feed – increasingly drives land use change, and encroaches onto carbon-storing pastures.

Table 4. The bones of the dispute. *From Grazed and Confused – page 12*

The issue of methane emissions and carbon sequestration is also addressed in this referenced article[14] by Young[15] – in which he notes: "*More than all these issues, however, we defend the role of grazing animals, as we know from years of practical farming experience that systems with cattle or sheep at their core are able to remain highly productive, repair degraded soils and avoid the GHG emissions associated with the manufacture of nitrogen fertiliser, equivalent to about 8 tonnes of CO_2 for every tonne of nitrogen used. Farmers growing bread-making wheat and oilseed rape in the UK use up to 250 kg of nitrogen per hectare, meaning that each hectare puts GHGs equivalent to 2 tonnes of CO_2 into the atmosphere, just in relation to nitrogen. About half of this nitrogen is lost to the environment and has a wide range of negative impacts on soils, water, the air and on our health. This diffuse pollution has major negative costs for society, estimated to be 2-3 times higher than the commercial benefits farmers get from using nitrogen fertiliser (Van Grinsven 2013). In contrast, using forage legumes like clover, instead of manufactured fertiliser, allows nitrogen to build up in the soil under grazing swards without any GHG emissions. This can be exploited to grow subsequent crops, before going back to grass and clover. Such grassland systems are almost as productive as those using the highest rates of nitrogen fertiliser."*

That pasture takes carbon out of the atmosphere into its roots and builds the soil's organic matter is not in question. The questions arise as to "for how long" and "to what depth?" In February 2017, frustrated by the lack of scientific progress in developing consistent methods of measuring soil carbon and organic matter, and realising the importance of monitoring a far broader reflection of soil health and productivity, the PFLA organised a meeting of 25 soil/plant scientists and 50 farmers to consider how farmers could simply measure the "pulse" of their soil through monitoring a range of proxy indicators that cost little, or nothing, to measure. A detailed report on that meeting is available[16]. Following the meeting, PFLA members have developed a series of protocols as well as an app[17] that allows farmers to easily record and monitor a range of such indicators - including earthworms, slake, legume nodules, spading ease, sward density, brix, sap and soil pH – that together provide a valuable reflection of the **health** of their soils under pasture. To quote one member – *"We know that our soils are absorbing carbon; science is catching up".*

12.8 An international perspective. At the international level, there is increasing focus and energy being directed at more environmentally and socially benign forms of livestock production. At the UN FAO Second International Symposium on Agroecology, held in Rome in April 2018, the Chairman stated that "*it is time to scale up agroecology to form the basis of a transformative vision of agriculture to be resilient, equitable and socially just*".

[14] https://sustainablefoodtrust.org/articles/claims-against-meat-fail-to-see-bigger-picture/
[15] Research Director of the Sustainable Food Trust and also a farmer
[16] http://bit.ly/2LcRjCf
[17] https://soils.sectormentor.com/soil-tests/

This builds on the UN FAO Sustainable Grasslands Working Paper (2013) which stated that "…*results suggest that a grassland based system of livestock production is a viable proposition. At a global level, calorie and protein supplies would be sufficient to meet the requirements of the official FAO 2015 projections…..**these results support the notion of a grassland-based system of livestock production that is capable of meeting food security demands while imposing a lighter footprint on the environment - positive outcomes for both the human and environmental pillars of sustainability."*** In other words, in the view of the FAO, grass-based livestock production systems can not only be efficient and sustainable but are also capable of meeting our needs.

12.9 In conclusion. The Pasture for Life standards are focused on establishing a system of raising ruminant animals wholly on pasture (which makes up two thirds of UK farmland), in a largely closed loop system using natural capital. With the continuing decline in the health and productivity of the nation's soils, the role that pasture can play within the arable rotation in terms of rebuilding soil fertility and controlling weeds (such as blackgrass) is increasingly being recognised. Whilst the actual environmental benefits arising from a pasture-fed system will vary significantly with the nature of the pasture and with how it is managed, there are some common environmental benefits - which will vary between farms in the degree to which they are expressed. As noted by W R Teague (2018) in the Journal of Animal Science: "*With appropriate management of grazing enterprises, soil function can be regenerated to improve essential ecosystem services and farm profitability. Affected ecosystem services **include carbon sequestration, water infiltration, soil fertility, nutrient cycling, soil formation, biodiversity, wildlife habitat, and increased ecosystem stability and resilience".*** It also provides a natural and unstressed environment within which ruminants can express themselves, whilst also producing nutrient dense meat and milk that has measurable health benefits for those consuming them.

12. Postscript from John Meadley, President and Founding Member of the PFLA

The pressure to produce more food to feed a potential population of 11 billion people is putting extreme pressure on the natural environment. And yet the world already produces enough calories to feed 11 billion people. It makes no sense that humanity **wastes** a third of the food that it produces (and the energy and nutrients that go into it); that it feeds a third of its grain to animals (and increasingly to bio-digesters) - grain that could feed the malnourished; and that much of humanity is becoming obese and suffering from diabetes through over-eating. It makes no sense that exposure to the widely used endocrine-disrupting chemicals could cost the European Union €157 billion a year in actual health care expenses and lost earning potential[18]. Not recognising such damage and distortion cannot continue indefinitely. At some point, common sense will prevail. More of these yield-enhancing products may be rejected by consumers; retail prices may be required to reflect the environmental costs of production, processing and distribution such that consumer prices may increase, demand may fall and wastage may decrease.

Addressing these issues requires political and social measures that are beyond the remit of this report, but it is unrealistic to expect farmers alone to find such global solutions. The current pressure to maximise yield distorts the relationship between farmers and their environment. What we should ask of farmers is that they produce nutrient-dense food that meets the reasonable needs of humanity in a way that sustains the natural environment and its ecosystems. The soil is a living entity. It is full of organisms that have relationships with each other and with the plants growing in it. It is now becoming possible to acoustically measure the growth of roots from the sounds that they make as they move through the soil through *"aggregate rearrangement, friction between aggregates and grains, changes in interfaces between gas and liquid surfaces, and crack formation"* (*Lacoste et al 2018).* As Adam Horovitz notes in his poem "The Soil Never Sleeps"; it is "the rooftop on another world" – a subterranean world on which mankind is totally dependent.

To use an analogy from the financial sector, a farmer can consider his soil as his capital and the crops (including pasture) that it produces as the interest or dividend on that capital. Fundamental to any sustainable business is the reinvestment of part of that interest or dividend to maintain the value of the capital – through the maintenance of fixed assets and the supply of operational needs. The need to replenish the capital of the soil, through rotations that include pasture or through fallowing the land, have been integral to farming systems for centuries. The capacity of grazed pasture, whether permanent or as part of a rotation, to replenish the capital of the soil through rebuilding soil structure and fertility and reducing the incidence of pests and diseases, has been known by farmers since Roman times – if not earlier.

[18] http://bit.ly/2vSezeR

But as farming has become more intensive, more mechanised and more focused on "controlling" nature, the tendency has grown for farmers to prioritise maximising the yield/dividend primarily in cash terms and on replacing only the farm's operational needs - through the application of purchased artificial fertilisers and plant protection chemicals, leaving the biological capital of the soil increasingly devalued. Soil has come to be seen by many as the physical substrate into which seeds are planted and artificially fed. It is only very recently that the health of the soil as a living entity is being recognised again in the mainstream.

Farming is about managing the relationships between the world's (living) soils, the plants that grow in them, the animals that feed on them (often through symbiotic relationships) and the various cycles of carbon and other gases, water and nutrients. The question that we have asked here is: *"How does the raising of ruminants primarily or wholly on pasture contribute to managing and sustaining that relationship? How does this contribute to the environment* ***in the round****?"*

By encouraging farmers to raise their ruminant animals wholly on pasture, we seek to mimic natural grassland systems through closed loop nutrient recycling, the natural cycles of carbon and water, the preservation and reinstatement of natural capital, the encouragement of biodiversity and of the capacity of grazed pasture to regenerate soil.

The Pasture for Life approach seeks to engage in conversation with Nature, to ensure the repayment of interest on its biological capital and to create an environment in which soil, pasture and ruminants can symbiotically thrive. The PFLA continues to be involved in research, to monitor the pulse of soils under pasture and to accumulate knowledge in an accessible way. We welcome farmers, and others, to join us on our continuing journey of discovery and to benefit from the shared knowledge and experience that we see as part of the gift economy.

The Soil Never Sleeps[19]

The soil never sleeps.
In its voids, gas and waters gather,
waiting for thirsty roots to crawl
down motorway tunnels dug by worms.
For the spade. The plough.
The massage-press of hooves.
For the rain to run through its seams
and seeds to push up to the light.

The soil never sleeps.
It banks lives
in its soufflé stomach,
connects them to everything.
Even the dirt beneath fingernails,
the dirt caught in a mole's coat, sings
with a million microbes to the gram
of connections, growth.

The soil never sleeps.
Never slips into ideology or nostalgia.
It is place and purpose,
the perfection of decay.
A story that shifts
from mouth to mouth.
A crucible for rebirth.
A rooftop on another world.

[19] Adam Horovitz is poet-in-residence of the PFLA. Having visited four of our certified farms over the four seasons his book entitled THE SOIL NEVER SLEEPS was launched at the Oxford Real Farming Conference in January 2018. An extract of the launch can be found here and the book is available here.

APPENDIX – SUMMARY OF THE 2018 SURVEY RESULTS

Producers' experience of the animal welfare and environmental benefits of Pasture for Life

Carried out by the Pasture-Fed Livestock Association, 2018

Methods

1. This survey was developed in conjunction with the Pasture-Fed Livestock Association to ascertain producers' experiences of the environmental and animal welfare benefits of pasture-fed farming, as advocated in the Pasture for Life Certification Standards.

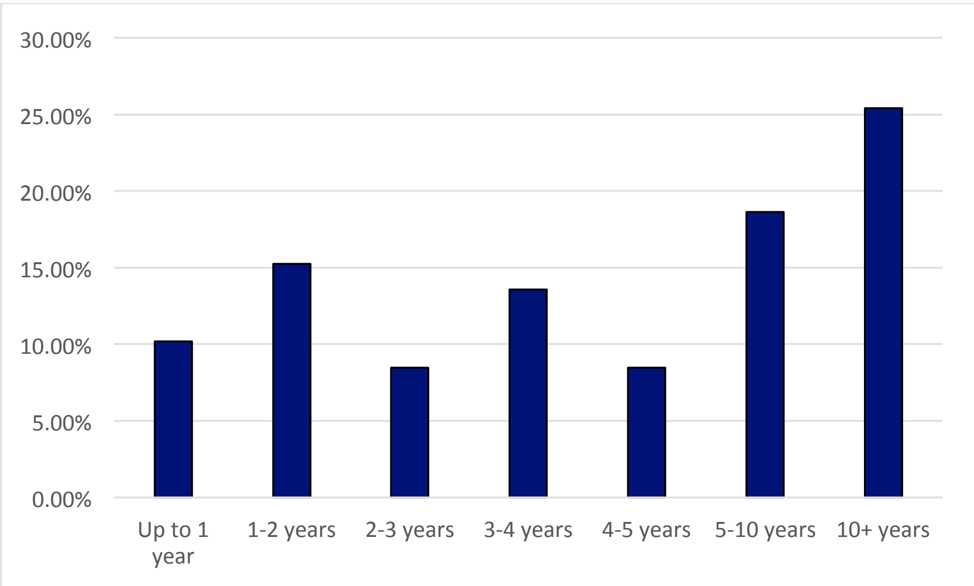
   The survey was created in Survey Monkey and links to the survey were distributed, by the PFLA, to their farmer-members. A total of 59 responses were received between the opening date of 15 December 2017 and the closing date of 30 January 2018. This represents around one-fifth of the Association's farmer members, and half of the PFLA's Pasture for Life certified farmers.

The survey population

2. All respondents were practicing pasture-fed farming, i.e. broadly following the guidelines of Pasture for Life Certification Standards, with no feeding of grains to ruminant livestock. Approximately half (53%) were Pasture for Life certified farmers, with the remainder stating that they were not certified. Only 10% of respondents had been practicing pasture-fed farming for less than one year, whilst 44% had been doing so for five years or more (Figure 1).

3. Forty-six per cent of respondents were farming conventionally prior to becoming pasture-fed and 44% were farming organically. The remainder stated that they were not farming prior to becoming pasture-fed.

Figure 1. Proportion of respondents by the number of years for which they had been practicing pasture-fed farming, whether or not Pasture for Life certified.



Major changes in farming practice resulting from becoming pasture-fed

4. Respondents were asked an open question on the major changes in their farming practice resulting from becoming pasture-fed. Analysis of the answers revealed the following three themes as regards changes in farming practice:

    a. Twenty-nine per cent of respondents cited greater attention to grassland management, with outputs including improved pasture and lower input costs

    b. Fourteen per cent of respondents cited greater attention to and consideration of soil health

    c. Fourteen per cent of respondents cited changes in livestock diets

5. Additionally, respondents highlighted that they had noted improvements in animal health and welfare, in pasture quality and in biodiversity, all of which were attributed to adopting a pasture-fed approach. Some had also remarked that they had changed the breeds of their livestock and others noted lower input costs.

- *"It's driving grassland management"*
- *"Soil health - it's critical to animal health"*
- *"Better pasture management and better understanding of the feed requirements of the flock."*

Animal health and welfare benefits resulting from becoming pasture-fed

6. Respondents were asked an open question on the principal animal health or animal welfare benefits of becoming pasture-fed. Analysis of this questions uncovered the following four key themes:
    a. Ten per cent of respondents cited lower incidence of foot problems and lower worm counts in sheep
    b. Fourteen per cent of respondents cited lower incidences of acidosis, laminitis and respiratory disease in cattle
    c. Fifteen per cent of respondents cited fewer calving or lambing problems, and reduced incidence of twin lamb disease
    d. Fifteen per cent of respondents cited lower veterinary bills

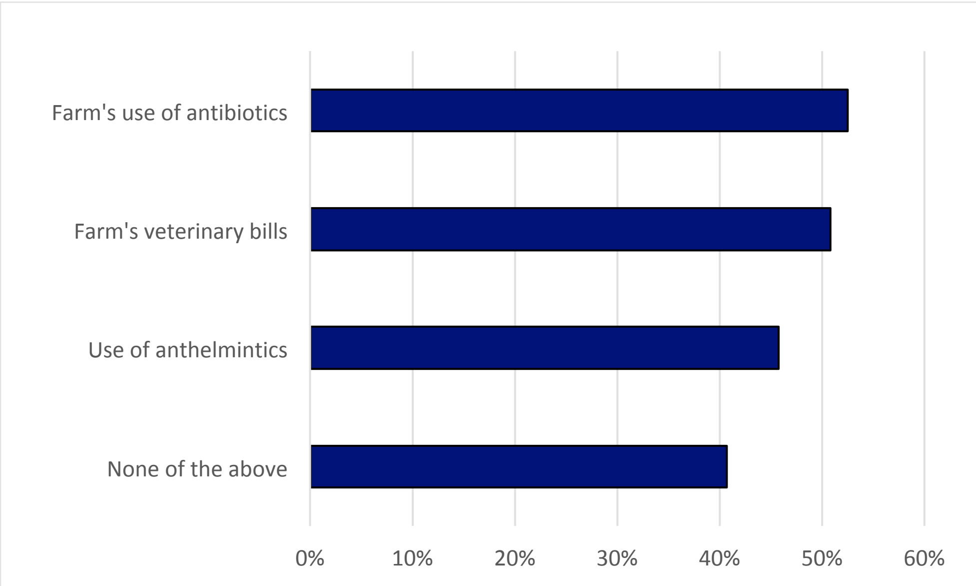
7. It was of note that 10% of respondents stated that they had always been pasture-fed, or close to pasture-fed, and so could not state what difference it had made to their system, and a further 12% of respondents provided neutral responses, i.e. they had seen no change.

    However, of the 78% of respondents who gave a value judgement on the animal health and welfare benefits of pasture-fed, all of these were positive. Respondents also noted that they had reduced their use of antibiotics and anthelmintics, they had extended their grazing systems and that because they could express their natural behaviours, their animals were also calmer.

- *"Reduced stocking has reduced health and welfare issues"*
- *"Now run antibiotic free"*
- *"Animals are more content and lamb mortality is lower"*
- *"Reduced vet bill which reflects healthier animals"*

8. Respondents were asked whether they had noticed any significant changes in three separate areas since becoming pasture-fed - their farm's use of antibiotics, their farm's veterinary bills, and their farm's use of anthelmintics. Fifty nine per cent stated that they had seen a change in at least one of these areas (Figure 2). Respondents were asked to provide additional details so that their answers could be viewed in context. Of the 43 respondents who provided additional details, 26% made statements that change was not possible to show because the farm had always been low-input and/or pasture-fed and the remainder were all firmly positive.

Figure 2. Proportion of respondents reporting changes in indicators of farm animal welfare since adopting a pasture-fed system.

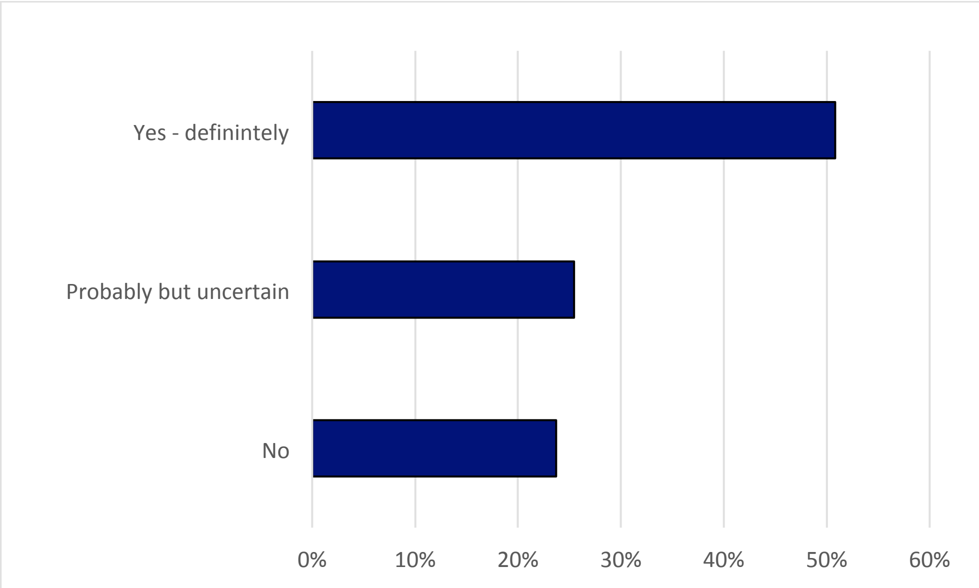


Note: all changes reported in additional information were positive, i.e. reducing antibiotic and anthelmintic use and farms' veterinary bills.

- *"A more natural outdoor system has reduced the need for antibiotics in sheep by over 50%"*
- *"I can't remember the last time we used antibiotics on our farm. It used to be a regular feature!"*
- *"With longer rest periods between grazings the worm burden on the pasture does not build-up"*
- *"Lameness is less due to less feet on the ground"*

9. When asked, 'Are you aware of any significant changes in the overall health of your livestock since becoming pasture-fed,' 66% of respondents answered, 'Yes.' Respondents were also asked whether adopting a pasture-fed approach had any effect on the length of their grazing system. Seventy-six per cent stated either 'yes-definitely' or 'possibly but uncertain' (Figure 3) and additional contextual data provided by 45 respondents indicated clearly that the direction of change was an extension in the grazing system.

Figure 3. Proportion of respondents reporting that a pasture-fed approach had an effect on the length of their grazing season.



Note: all changes reported in additional information were positive, i.e. extending the grazing system

- *"Earlier turnout in spring, later housing in autumn and better root structure giving more resistance to poaching ground and better drainage"*
- *"It has gone from about seven months to twelve months"*
- *"Looking to maximise grass for as long as possible through rotation and following cattle with sheep"*

Grassland management

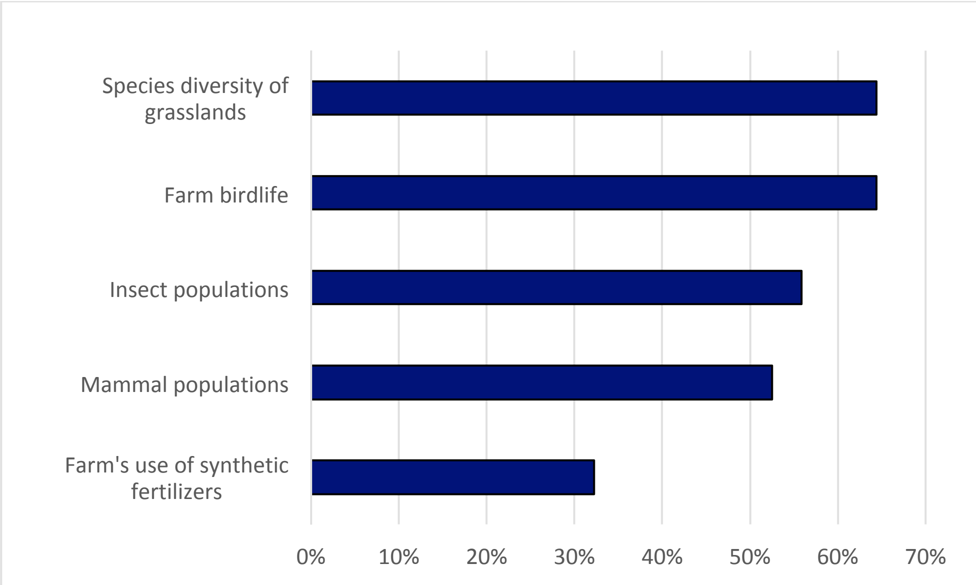
10. Eighty-one per cent of respondents stated that 'being a member of the PFLA had encouraged them to manage their grassland in a different way.' Analysis of the individual answers to this revealed that grazing - mob, rotational or strip and grassland – species and mixes, were the predominant themes.

11. There was a slight shift towards greater proportions of farmland being given over to permanent pasture as respondents compared 'before becoming pasture-fed' to 'after becoming pasture-fed'. To an extent this was the outcome of reduced cereal or vegetable cropping and a corresponding increase in land put down to grass.

12. Respondents were asked whether they had noticed any significant changes in five separate areas since becoming pasture-fed - their farm's use of synthetic fertilizers, the species diversity of their grasslands and the bird life, insect populations and mammal populations on their farm.

Seventy-six per cent stated that they had seen a change in at least one of these areas. Respondents were asked to provide additional detail so that their answers could be viewed in context. Of the 43 respondents who provided additional details, all were in the direction of reduced synthetic fertilizer inputs and/or increase grassland species diversity and/or increase bird, mammal and insect populations.

Figure 4. Proportion of respondents reporting changes in indicators of the farmed environment since adopting a pasture-fed system.



Note: all changes reported in additional information were positive, i.e. improving environmental outcomes

- *"We don't need fertiliser, herbal leys have greatly increased grazing choice, bird life is increasing, and raptor numbers are indicative of greater mammal populations"*
- *"We now have over 100 species of grass and wildflower in the pastures and meadows"*
- *"The permanent pastures are becoming much more interesting"*

13. Pasture-fed farmers undertake a variety of monitoring of their farmed environments, including soil structure, soil fertility and soil carbon and of bird life. Thirty per cent of respondents also stated that they were using tools or apps to monitor the performance of their farm; from plate-meters to measure grass growth, to tools for measuring soil quality to GHG emissions calculators.

Table 1. Summary of changes/activities since becoming pasture-fed

Activity / changes	**%**
Were previously buying or growing cereals for animal feed	**64**
Reduced antibiotic use	**53**
Reduced wormer use	**46**
Reduced vet bills	**51**
Improved health of animals	**66**
Longer grazing season (definitely)	**51**
Longer grazing season (maybe)	**25**
Significant changes to grassland management	**81**
Reduced fertilizer use	**32**
Increased diversity of grassland	**64**
Increased insect populations	**56**
Increased mammal populations	**53**
Increased bird populations	**64**

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