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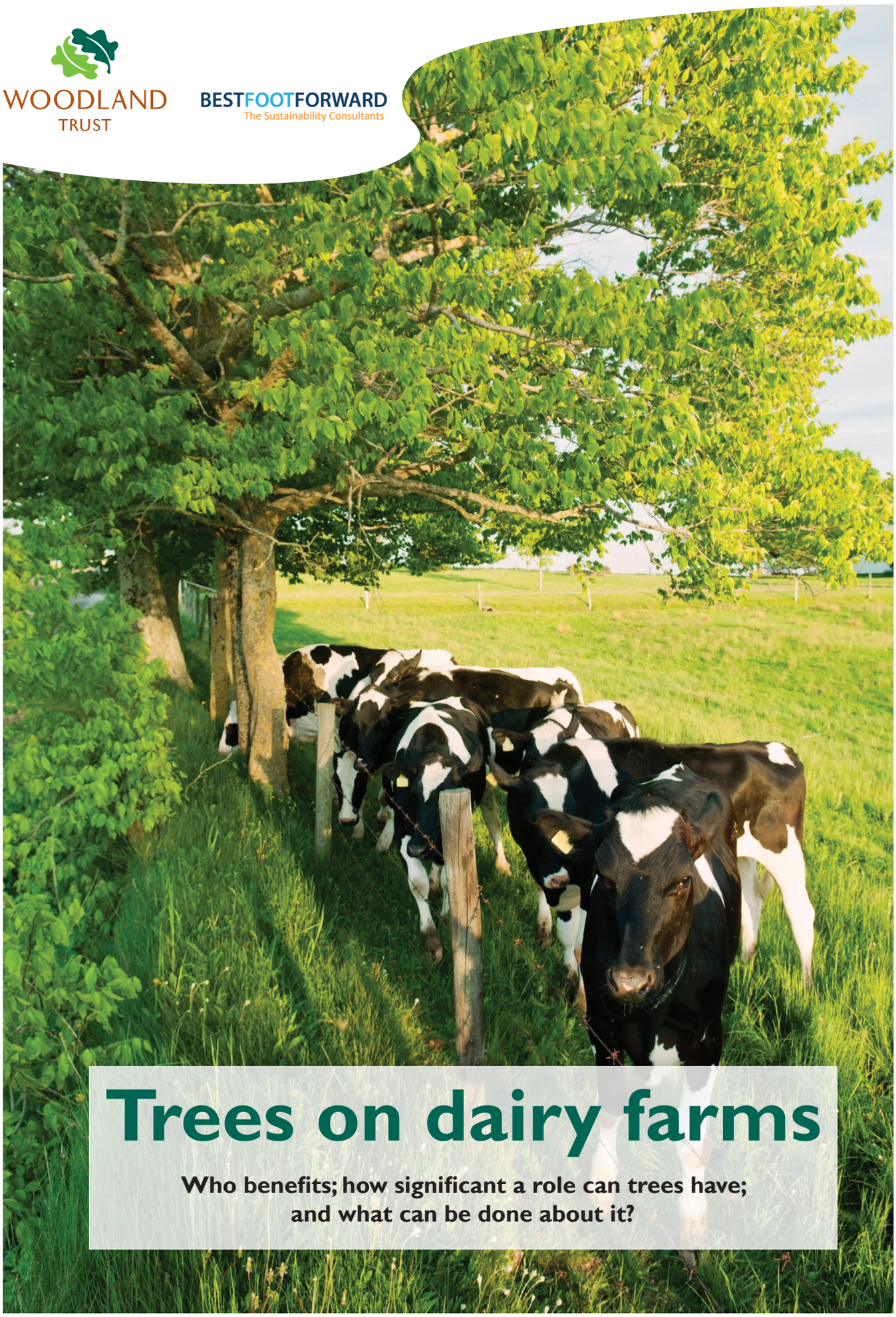
The Sustainability Consultants



Trees on dairy farms

Who benefits; how significant a role can trees have; and what can be done about it?

Report produced by sustainability consultants Best Foot Forward, commissioned by the Woodland Trust.

November 2013

Trees on Dairy Farms

An evaluation of the use of trees on dairy farms: what benefits can they bring; how significant are those benefits; and who is in a position to do something about it?

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Background

Dairy farming is the single largest agricultural sector in the UK, valued at £3billion per annum. The dairy herd consists of 1.8 million cows, and the industry produces and delivers almost all liquid milk in the UK, and a significant proportion of processed dairy products. An industry operating at this scale is clearly interested in its sustainability, both in terms of its impact on the environment, and its own long term viability.

There is growing interest from companies operating in the UK's food system in understanding and reporting the benefits of sustainable practice on farms. Food retailers and manufacturers are keen to achieve and communicate enhanced performance, and they may wish to do this in a distinctive manner. The promotion of trees on dairy farms, linked to credible sustainability outcomes, could be a distinctive practice-based intervention tool, and deliver enhanced environmental and welfare outcomes.

Approach

This report is structured around providing the information and resources needed to take effective action. In addition to describing the functions which trees can have on dairy farms salient issues in dairy sustainability are explored. This enables the potential benefits of trees to be put in the context of what matters on dairy farms, and to decide whether trees can make a difference. Stakeholder analysis of the dairy supply chain was undertaken to explore who might have an interest in the sustainability functions that trees can deliver on dairy farms, and how they might influence farm practice in order to use trees to make those functions come about.

Findings

The analysis of the potential for trees to address sustainability on dairy farms provided a number of clear findings:

1. Trees can make a meaningful contribution to a range of important sustainability issues.
2. In particular, the strategic use of trees can make a material difference to the serious risk of pollution from dairy farm activities, especially nutrient run-off.
3. Trees can play a significant role in improving local landscape quality. Though this may be a lower strategic priority for the industry as a whole, it may be important to an individual farmer or community.
4. Trees are relevant to, but of lower significance in the key issue of dairy GHG emissions.
5. Similarly, trees may have a small part to play in helping support overall farm business viability.
6. Trees only have a minor role in the most prominent animal welfare issues.

7. Trees have no position regarding several sustainability issues, for instance: issues relating to the sustainability of feed; the price of milk; some animal welfare issues, and systemic resilience issues in the supply chain.

When the potential uses of trees on dairy farms are compared to the interests of stakeholders involved in or affected by the dairy supply chain, there were three clear 'action themes':

1. **Catchment Partnerships**. The most potent tree sustainability pathways are around **pollution** abatement and **local environment quality**. All of the mechanisms and most of the interested parties are linked geographically, since the processes involved are either ecological or hydrological.
2. **Climate Change Synergies**. While trees have only a minor role to play in the issue of **GHG emissions** from dairy farms, climate change is a powerful policy driver, and is taken seriously by government and across the dairy supply chain. The opportunities here are therefore focused on the supply chain.
3. **Supporting the Industry**. Trees have a small but practical part to play in supporting issues relating to the day to day running and **viability** of dairy farms, from shade for **livestock health**, through to the provision of timber and chip for sale (or use on farm to offset **input costs**). Farmers are clearly the main beneficiary, but it pays their customers to support them in this for both practical (security of supply) and reputational reasons – being seen to deal fairly with farmers is a serious consideration for dairies and retailers.

1. Trees and Dairy Farms

1.1 Dairy Farming in the UK

Dairy farming is the single largest agricultural sector in the UK, valued at £3billion per annum. The collective dairy herd consists of 1.8 million cows, and the industry produces and delivers almost all liquid milk in the UK, and a significant proportion of processed dairy products. Productivity is centred on farms located in the South West, South Wales, West Midlands and Northern Ireland (see Fig.1)

1.11 The main dairy farm systems in the UK

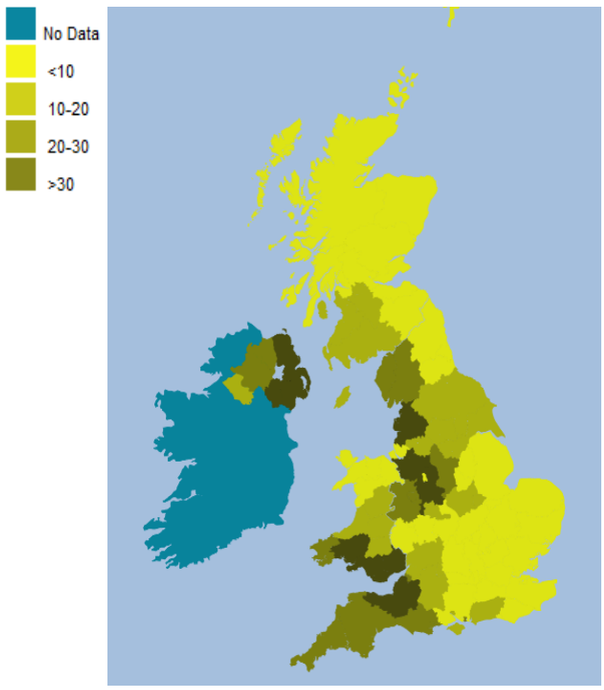
Dairy farming in the UK is typically characterised as 'semi-intensive'. The average UK dairy farm has 120 cows, each producing around 7,500 litres of milk every year. The vast majority of dairy cows are reared using a combination of outdoor and indoor techniques – a 'grass-based system' (NFU, 2010). In the spring and summer months, cows are left to graze on grass with little need for dietary supplements, whereas in winter (up to 6 months), cows are brought inside and fed on a combination of silage and animal feed. Silage is typically produced on the farm, and may be from grass or chopped maize.

DairyCo's 2013 report from Milkbench+[1] identifies three main categories of dairy enterprise:

- **Cows at grass**. Mainly block calving, predominantly grass based and operating at lower yield levels.
- **Composite**. Mostly year-round calving, with maximum use of family labour and a mixed approach to feeding and housing.
- **High-output cows**. Mostly year-round calving with some autumn and multi–block calving patterns, higher yields with intensive use of major inputs.

Fig. 1 Dairy Farming in the UK

Cattle per 100ha land (from AHDB, eFoodChain map)



1.12 Organic dairy farms

Organic dairy production in the UK represents a small but significant part of the industry; accounting for 3.1% of the overall liquid milk market[2]. Organic dairy production has restrictions on dietary balance (grass/fresh forage/concentrates ratios), housing, artificial fertilizers and pesticides, veterinary medicines, and welfare issues such as culling of new-born male calves. However, rather than being defined by their limitations, organic dairy farms are generally coherent systems, characterised by integrated, comparatively extensive farms with a strong emphasis on outdoor grazing using mixed grass and clover leys.

[1] DairyCo MilkBench+ 2013

[2] DairyCo Dairy Statistics – an insider's guide 2011

1.13 'Zero grazing' systems

In contrast to organic, and most current conventional systems, 'zero grazing' systems involve feed, forage and silage being brought to cattle, which are permanently housed or kept in 'sacrifice' areas, or feedlots. The benefits include the ability to closely calibrate feed, energy expenditure, and animal health interventions. Concerns often raised about these sorts of systems include the risk of large point source environmental impacts, and animal welfare concerns.

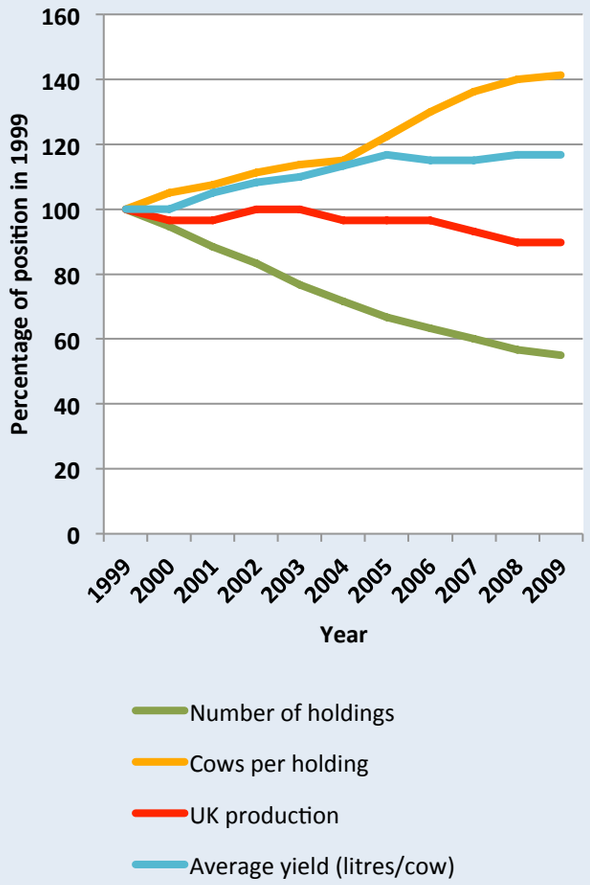
Even larger scale zero grazing systems, sometimes referred to as 'mega-dairies' are usually associated with the US, where large numbers of cows (up to 15,000) are housed indoors for the whole of their lives. In these systems cows are often milking cows three times in 24 hours[3]. These systems have been the subject of controversy in the UK, for local planning and more general animal welfare concerns[4].

1.14 Change in the dairy industry

While 'mega-dairies' have not found favour in the UK and semi-intensive grass based systems remain the norm, dairy farming has seen a significant trend towards expansion and intensification in recent years. This is reflected in a dramatic fall in the numbers of dairy farms since the millennium (from around 20,000 in England and Wales down to fewer than 11,000 in 2011, according to DairyCo statistics), along with a commensurate increase in productivity and herd size (see Fig 2).

This transition has been associated with high profile tensions around the cost of production versus the wholesale price that dairies have been offering farmers. In essence, ever tighter margins create a strong selection pressure on farms, progressively squeezing out those which, for whatever reason, have less favourable ratios of input use compared to their output of milk.

Fig 2. Trends in UK dairy farms, statistics expressed as a percentage of the position in 1999 (data from DEFRA)



[3] Helliar, D., 2012. The successful management of large scale dairy farms. A Nuffield Farming Scholarships Trust Report

[4] Plans for a super-dairy of 3,770 cows to be built in Nocton, Lincolnshire were retracted in early 2011 after an outcry from the general public and strong objection from the Environment Agency[4]. The original proposal made in 2008 was for 8,000 cows. In Powys, Wales the county council rejected plans for a 1,000 cow dairy in October 2012[4]. The reasons for the rejection were over concerns about animal welfare, slurry management and the visual impact of the farm.

Whilst it is tempting to characterise this transition as a simple evolution from small inefficient family farms to large efficient production units, the picture is not so simple. DairyCo's 2013 analysis from Milkbench+ shows that profitability is not necessarily dependent on scale or productivity. They show that the key determinant of profitability is the total cost of production, and this can be managed at very different scales of operation.

1.2 How do trees fit into dairy farms?

Depending on its system and location, a dairy farm will have various combinations of common 'landscape components' into and around which trees might fit. For example: permanent pasture – usually improved, sometimes unimproved; temporary grass leys and arable crops in mixed systems; built infrastructure – cattle sheds, milking parlours, silage clamps etc; field boundaries, and access infrastructure.

1.21 Existing tree cover on dairy farms

Because of the relatively mixed landscape structure and permanent pasture associated with many dairy farms, plus the need for field boundaries and the legacy of historical land use patterns, trees are a common feature in dairying landscapes. Classic locations may be:

- Along lanes, especially long-established access routes.
- Beside watercourses.
- Around farm buildings, often planted for shelter, sometimes for fruit or aesthetics.
- Field trees, sometimes relicts of defunct hedgerows, or less often part of an old wood pasture system.
- In hedgerows and on boundaries.
- As woods and copses – often on poorer ground or on difficult slopes.

1.22 Establishment patterns

In common with UK farms in general, tree establishment already occurs on dairy farms in the UK. Often this is supported through agri-environment payments, or Forestry Commission / Forest Service grants. Trees are often established to create a discrete new wood. This has the effect of taking land out of production, but may make sense to a farmer if the patch of land is poor and/or they can see clear practical benefits in having a wood. Trees are also established in ways which are more closely integrated into the farm system. Examples include:

- Trees in hedgerows; either as part of a new hedge or 'recruited' out of an existing hedge.
- Tree belts around buildings; sometimes stipulated as part of planning consent.
- Trees as 'fill-in' on waney or difficult edges of fields.
- Trees as buffers adjacent to existing woods or next to rivers.
- Individual field trees; only really practical in permanent pasture, these can be expensive. because of the requirement for individual tree protection.

2 Functions of trees on dairy farms

A wide range of functions are claimed for trees on farms, and many of these are relevant to dairy farms. For this study an extensive literature review was undertaken to scope out the range of practical functions which trees might perform, and to test the quality of evidence for their effectiveness.

2.1 Tree functions and mechanisms

Five main categories of tree function are described, and for each the main mechanisms through which they might work are assessed. The five categories of tree functions are:

- Pollution abatement
- Improving animal health and welfare
- Reducing local landscape impacts
- Supporting the farm system
- Wider system benefits

2.12 Pollution abatement

Dairy farms are relatively high input, high output systems. This creates a number of pathways for localised pollution, most notably from fertilizers and agrochemicals applied to land, point source aerial and liquid pollution from nitrogen rich slurries and manures, and sedimentation resulting from soil run-off from churned ground and bare cropping land (especially in the case of maize crops). Trees have the potential to intercept these sources of pollution through the following mechanisms:

1. ***Creating buffers between fields and watercourse.***
   Establishing buffers alongside watercourses is a fairly well-proven way of reducing soil and nutrient run-off into streams[5]. In grazed fields it keeps animals back from the water's edge, reducing soil poaching and preventing mucking directly into the water. In both grazed fields and those in arable cropping, it provides a simple physical buffer, pushing any manure spreading or artificial fertilizer spreading back from the stream side. Establishing trees within the buffer adds to the effect, with the trees themselves enhancing the 'soaking up' nutrients before they can enter the watercourse[6].

2. ***Absorption of nutrients by tree roots***
   Trees and tree roots help increase infiltration of water and slow surface run-off (by changing soil surface and pore structure), and by intercepting, soaking up, and transpiring water[7]. Water soluble nutrients are either slowed in their passage though soil water flow or taken up by the trees. Either way, nutrients have a greater chance of being held back in the system, rather than washing through.

[5] See DEFRA, Protecting water from agricultural run-off: buffer strips (TIN100)
[6] Haycock, N. and Pinay, G., (1993). Groundwater nitrate dynamics in grass and poplar vegetated riparian buffer strips during the winter. Journal of environmental quality, 22(2), pp.273-278.
[7] Eldridge, D. J. & Freudenberger, D. (2005) Ecosystem wicks: Woodland trees enhance water infiltration in a fragmented agricultural landscape in eastern Australia. *Austral Ecology,* **30,** 336-347.

3. Sequestering airborne ammonia

Dairy farms are the biggest emitter of ammonia in the UK, with dairy cows alone accounting for 31% of total ammonia emissions in 2009[8]. Ammonia is emitted from urine and from manure. As well as breaking down into nitrous oxide, a greenhouse gas, it is deposited into the surrounding landscape where it acts as a fertilizer, upsetting the balance in natural habitats such as woods and wetlands[9],[10]. Trees have been found to be effective at intercepting and sequestering ammonia, either at source when trees are planted around slurry pits or livestock sheds, or when planted as buffers around sensitive habitats[11].

4. Stabilizing soils

Tree roots bind soil particles together and help reduce soil erosion[12] and subsequent sedimentation of watercourses[13]. They can also help prevent the formation of runnels and gulley erosion. This prevents the soil, and any nutrients held within it, from being washed out of the farm system. Trees on slopes, in belts or swales along contour lines and those next to watercourses are especially useful in this respect.

2.13 Improving animal health and welfare

Animal health and welfare is an ethical concern. It is also strongly correlated with milk yield, and as a result it is also a key determinant in environmental performance, especially in relation to GHG emissions. Trees can perform three main functions that have a bearing on animal health and welfare:

1. Providing shade

In hot and sunny conditions cattle, like other livestock, will gather under trees for shade. They will do this under field trees, and alongside the shaded side of hedges or boundaries. Studies (e.g. New Zealand[14]) have linked heat stress to reductions in productivity in lactating cows, and have shown the benefits of access to shade. In the UK heat stress in more commonly a concern in housed animals, however peak summer temperatures are also likely to have an impact on those kept outside with no access to shade.

2. Acting as a baffle to wind

Keeping animals warm in cold weather is important for welfare as well as performance issues – a cow which needs to work hard to keep its body warm will have less energy for producing milk. Shelter belts have been shown to cut the average energy use of a typical northern US and

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[8] DEFRA (2011) Inventory of Ammonia Emissions from UK Agriculture 2010

[9] CEH/COST, 2011, Nitrogen Deposition and Natura 2000

[10] DEFRA, 2002, Ammonia in the UK

[11] Dragosits, U *et al* (2006) The potential for spatial planning at the landscape level to mitigate the effects of atmospheric ammonia deposition. *Environmental Science & Policy*, **9**, 7–8, pp 626–638

[12] Reubens, B *et al* (2007) The role of fine and coarse roots in shallow slope stability and soil erosion control with a focus on root system architecture: a review. *Trees*, **21** , 4, pp 385-402

[13] Hussein, Z., 2007. Environmental effects of densely planted willow and poplar in a silvopastoral system: a thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy (Ph.D.) in Agroforestry, Institute of Natural Resources, Massey University, Palmerston North, New Zealand

[14] Kendall, P., Nielson, P., Webster, J., Verkerk, G., Littlejohn, R., Matthews, L., (2006). The effects of providing shade to lactating dairy cows in a temperate climate. *Livestock Science* 103, 148–157.

Canadian farm by 10% to 30%[15]. Field trees and shelter belts also make sense for outdoor grazing animals, especially in exposed spots.

3. Separating out infected stock

Belts of trees can be used to help separate out infected animals within a herd or to create buffers between neighbouring herds. This could help with disease prevention and management, but clearly is dependent on the configuration of fields and boundaries; something which may be a 'moving feast' on mixed systems with temporary grass and crops.

2.14 Reducing local landscape quality impacts

Impacts on landscape quality may not fit with the traditional view of a dairy farm, but as some dairy systems become larger and more intensive they can start to involve larger buildings, more machinery, and extensive infrastructure. All of these can have impact on the local landscape, with knock on effects on the quality of people's experience of the landscape. Most issues will relate to the core buildings of the farm:

1. Obscuring views of intrusive and ugly buildings

Slurry pits, feed stores, and cattle sheds in dairy farm systems can be semi-industrial in scale. Trees reduce visual impacts of such structures, partly though simply obscuring them, but also by 'breaking up' harsh roof and stanchion lines, helping blend buildings into the landscape. Planting trees may assist with planning or permitted development, or it may help with local community relations.

2. Absorbing noise pollution

Dairy farms can be noisy – and although sounds from livestock are an accepted part of the 'rural scene', noise from vehicles, generators, compressors and even clashing gates, can be troublesome in some locations. Strategically placed tree barriers can help baffle noise and reduce the extent to which sounds echo and reverberate[16].

2.15 Supporting the farm system

Trees, as well as being good for a number of environmental or welfare issues, can also be a productive crop. Dairy farms remain relatively mixed systems, with farmers often managing a diverse range of farming activities from arable cropping to sward management, livestock handling, diet planning, milk storage and hygiene.

1. Providing a source of raw materials for use on the farm

Many farmers will log fallen trees for firewood, or even harvest trees on an occasional basis from their woods. Where more substantial plantings are established (either in blocks, or cumulatively as a network of belts and copses) then more systematic cropping can be carried out. If the right processing equipment is to-hand, then the arisings can be used as a more substantial source of heating. Woodchip can also be used as a cost effective source of bedding[17]. Availability and cost of bedding can be a significant issue, especially on farms in livestock areas, with no ready supplies of straw.

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[15] DeWalle, D. R. & Heisler, G. M. (1988) Use of windbreaks for home energy conservation: *Agriculture Ecosystems and Environment,* **22-23,** 243-260.

[16] A comprehensive treatment of acoustic barriers is given in '*Environmental Noise Barriers – a guide to their acoustic and visual design*', by Benz Kotzen and Colin English, Taylor and Francis, 2009

[17] EBLEX, 2011 – Better Returns Programme, Improved Design and Management of Woodchip Pads for Sustainable Overwintering of Livestock

2. Providing additional sources of income

As well as use on the farm, harvested forest products can be a useful source of income. This can reduce some of the logistical and processing complications of using wood products on site, since trees can be sold standing, or as logs at roadside. It also removes the need to engineer a regular harvesting schedule, which means that larger, more occasional parcels of timber can be cut. Sales of materials for fuelwood can still be used to offset input costs, and many landowners with wood-heat systems still trade wood in and out as a means of simplifying feedstock management.

Commercial game shoots are an important source of income on many farms, and the creation of copses and woods can be useful for cover and shoot management. Pheasants are traditionally reared in release pens within woods.

2.16 Wider 'ecosystem services'

Trees can be used to provide a number of wider 'ecosystem services'. While these are not intrinsic to the dairy farm system (they could be achieved independently of dairy activities), like fuelwood sales, they are additional services that trees can be used for in the context of the dairy farm.

1. Providing wildlife habitats

Trees, whether scattered as field trees, copses, in hedgerows, shelterbelts or in woods provide valuable habitats. Young tree plantings provide dense cover and undergrowth for birds and insects. As woods mature they provide habitat and context for successive suites of invertebrates, fungi, plants, birds and mammals to thrive. Scattered trees and smaller groupings of trees provide valuable structural diversity and 'stopping-off points' for other species in otherwise open landscapes[18]. And collectively, a well-treed (rather than wooded) landscape provides a coherent and distinct ecological system in its own right.

2. Flood risk abatement

Trees intercept, slow, soak up and transpire water. They also increase soil infiltration rates and saturated hydraulic conductivity – meaning more water soaks into the soil, rather than rapidly running off[19]. This means that trees can reduce peak flows in water catchments after major rain events. This can be especially effective for reducing localised flooding, as has been shown at Pontbren in the Welsh uplands[20]. The impact can also operate in larger catchments, as is being explored in Pickering in North Yorkshire[21].

3. GHG sequestration

Growing trees sequester CO_2 and because of the strong policy imperative surrounding greenhouse gases, people are keen to see how trees might be used as part of the solution to global warming. It is also seen as a potential source of income. As yet there are only voluntary carbon markets in the UK, but this has not stopped a number of 'offsetting' products from being offered and taken up by organisations keen to find ways of taking practical action. Box 2 on page 23 provides an analysis of the extent to which trees could be used to offset GHG emissions on dairy farms.

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[18] Manning, A *et al* (2006) Scattered trees are keystone structures – implications for conservation, *Biological Conservation* 132, 311-321

[19] Chandler, K. R. & Chappell, N. A. (2008) Influence of individual oak (*Quercus robur*) trees on saturated hydraulic conductivity. *Forest Ecology and Management,* **256,** 1222-1229.

[20] http://www.pontbrenfarmers.co.uk/

[21] http://www.forestry.gov.uk/website/forestresearch.nsf/ByUnique/INFD-7YML5R

Box 1 Woodland Milk?

How far could dairy farms go in incorporating trees into their system?

Much of the analysis in this study is predicated on an incremental approach; addressing individual farm sustainability issues with individual 'tree-based interventions'. This is the most likely way in which trees will get adopted into most farms – in a way that does not fundamentally change the nature of the dairy farm system. However, we explore here some of the dimensions that might be involved in a more thorough 'agroforestry' style integration of trees into a dairy farm system.

Levels of integration:

1. **Tree belts and buffers**. The most straightforward integration of trees into dairy farms is as belts and buffers, established for specific purposes but not combined with in-field production.
2. **Silvo-pasture**. A step up in integration is the use of trees within the context of a grazed field. This can afford benefits to the livestock, and can also provide products from the trees themselves. This is referred to in agroforestry terms as 'silvo-pasture'.
3. **Silvo-arable**. A more technically challenging integration is the integration of trees into arable parts of a dairy system.
4. **Silvo-dairy**. Putting all three parts together could be said to create an integrated 'silvo-dairy' system.

A defining feature of agroforestry systems is that their business model takes into account tree products, as well as the provision of benefits to the agricultural crop. The aim is to get a combined outcome on the same area of land, which is more than the sum of the agricultural and forestry activities. This comparison is expressed as the 'Land Equivalent Ratio'.

Potential forest products may be:

- **Energy** – as log or chip. In silvo-arable systems short rotation forestry or coppice is often employed in alleys.
- **Higher quality timber** – although this can be silviculturally challenging unless trees are grouped.
- **Fruit** – although in a dairy system to avoid browsing these would need to be full standards, as in a traditional orchard.
- **Forage** – traditionally obtained by pollarding or shredding trees, trees can provide excellent forage.

Twin-track economics

Agroforestry economics has to combine two different production systems, which are traditionally accounted for with radically different time horizons. However, when sustainability issues such as long term soil management or even resilience to unpredictable markets are taken into consideration the economics may start to look more compatible. While agroforestry dairies will probably remain a step beyond the plans of most farmers, the economics of agroforestry systems might provide some insights into how land managers can play off long and short term objectives.

2.17 Problems caused by trees

Existing, or newly established trees on farms also have the potential to cause problems:

1. ***Loss of productive area***

   Trees and woods take up space. Many of the applications of trees explored in this report can be done in a way which is complementary to production, and sometimes trees will be established on less productive areas on a farm. But in most cases, farmers will be weighing up the benefits with at least some loss of productive grass-growing or cropping area. Related to this is competition by trees adjacent to crops or grass for light or water.

2. ***Loss of flexibility***

   Trees are a long term proposition, and unlike a grass ley or an arable crop, cannot be simply ploughed up and replaced in the course of a growing season. Scattered trees, for example in pastureland, impose practical restrictions on machinery use.

3. ***Pests and pathogens***

   Trees have the potential, in some situations, to exacerbate certain pest or pathogen problems. For example, where animals aggregate under trees for shade the ground can become churned and muddy; conditions which are a factor in lameness or mastitis. And whilst trees and copses are excellent habitats for wildlife, they may also harbour species which are seen as pests on dairy farms. Badgers are the most high profile example, linked as they are to the transmission of bovine TB. Starlings can also cause economic losses though consumption of bought-in animal feed.

2.2 Evaluation

Analysis 1 categorises the performance of trees for different functions in two ways, as follows:

How easy is it to establish trees for this purpose?	
Very easy to establish trees for this purpose	1
Some technical challenges or conflicts to overcome	2
Requires careful planning to overcome difficulties	3
Very difficult to establish trees for this purpose	4

Is it likely to be effective?	
Trees will definitely deliver benefits	1
Trees are likely to deliver benefits	2
It will be challenging for trees to deliver benefits	3
Unlikely that trees will deliver meaningful benefits	4

Analysis 1 –How well do trees work?

Tree function and mechanisms	How easy is it to establish trees for this purpose?		Is it likely to be effective?	
Pollution abatement				
Creating buffers between fields and watercourses	Establishing trees alongside watercourses is relatively straightforward, in terms of fencing and stock protection	1	Keeping stock and / or cropping activities back from the water's edge is highly likely to have direct benefits	1
Stabilizing soils	Establishing trees in belts, especially on sloping ground is likely to be effective. Establishing trees on arable fields will be challenging	2	While not suitable for all situations, strategic siting of trees is likely to be very effective	1
Absorption of nutrients by tree roots	Getting the right densities of trees in the right patterns requires some site analysis and planning	2	There is good evidence to show trees intercepting nutrients, but trees will need to be part of a wider strategy	2
Sequestering airborne ammonia	Requires technical site analysis and strategic positioning of trees, in areas around buildings which may get in the way of machinery movements etc.	3	There is good evidence to show trees intercepting and reducing ammonia emissions on farms	2
Improving animal health and welfare				
Providing shade for animals	The best configuration is scattered field trees, which require stock protection and are difficult to mix into arable land	3	Trees will undoubtedly be used by animals for shade, and scattered trees will avoid aggregation/pest issues	1
Acting as a baffle to wind	Tree establishment to provide an effective wind break needs careful planning to be effective, and to avoid being counter-productive	3	Use of windbreaks around farm buildings is fairly well proven, and has been shown to reduce winter heating bills	2
Separating out infected stock	It will be difficult to match planting patterns for separating stock with the range of disease possibilities, e.g. pathogen type, infection rates, source	4	In some circumstances trees may prove useful for stock separation, but only in conjunction with other strategies	4
Reducing local landscape quality impacts				
Obscuring views of intrusive and less attractive buildings	Some site analysis and strategic positioning is required, as is avoidance of incongruous species. But this is not a big technical challenge	2	Depending on landscape context, trees are very likely to ameliorate, though not obscure, the visual impact of buildings	2
Absorbing noise pollution	Some site analysis and strategic positioning is required, and attention will need to be paid to vertical structure to get the best results	3	Some livestock noise will inevitably carry, but a degree of muffling of compressors and generators can be expected	2
Growing timber and other wood products				
Product sales providing additional sources of income	Growing merchantable timber is well a proven, if long-term activity. The challenge is produce meaningful volumes without impinging on farm area	3	If sufficient volumes, product assortments and routes to market are in place then it should work	2
Providing a source of raw materials for the farm	Establishing trees for occasional firewood cropping is simple. Establishing sufficient volume for chip is more involved, but technically straightforward	2	The main challenge will be to get regular and reliable supplies, e.g. for bedding. Trading on and off site may prove simpler	3
Wider ecosystem services				
Providing wildlife habitats	It is difficult to avoid delivering at least some wildlife benefits from establishing trees, though enhanced benefits will require some planning	1	Trees will provide structural diversity in the landscape, and habitats for birds, mammals, insects, fungi, and plants	1
Flood risk abatement	Fairly straightforward strategic planting, plus general increases in tree cover will improve water interception and infiltration rates on a farm	2	The big challenge is to achieve catchment scale results, which is likely to require numerous holdings	3
GHG sequestration	So long as trees are growing effectively they will be absorbing and storing CO_2	1	Effectiveness will depend on the benchmark for success. Set against dairy farm emissions, trees will have a small impact	4

2.21 Which functions are most promising?

The analyses in Table 2.71 provide the basis for a simple categorisation of tree mechanism according to their potential utility. The scores from first, ease of establishment, and second likelihood of effectiveness were used to give four categories in the following 'league table':

Category 1:		Simple to establish and likely to succeed
1	1	Providing wildlife habitats
1	1	Creating buffers between fields and watercourses
2	1	Stabilizing soils
2	2	Obscuring views of intrusive and ugly buildings
2	2	Absorption of nutrients by tree roots

Category 2:		Difficult to establish, but likely to succeed
3	1	Providing shade for animals
3	2	Product sales providing additional sources of income
3	2	Acting as a baffle to wind
3	2	Sequestering airborne ammonia
3	2	Absorbing noise pollution

Category 3:		Easy to establish, less likely to succeed
2	3	Providing a source of raw materials for the farm
2	3	Flood risk abatement
1	4	GHG sequestration

Category 4:		Difficult to establish, less likely to succeed
4	4	Separating out infected stock

3 Putting trees on dairy farms into context

The next part of the analysis looks at the salient sustainability issues on dairy farms, and assesses the extent to which the functions identified for trees on dairy farms can measure up to and address those issues. In essence, (1) are the functions outlined in section 2 relevant to the issues that matter on dairy farms? And (2) if they are relevant are they effective enough to make a difference?

3.1 What are the key sustainability issues on dairy farms?

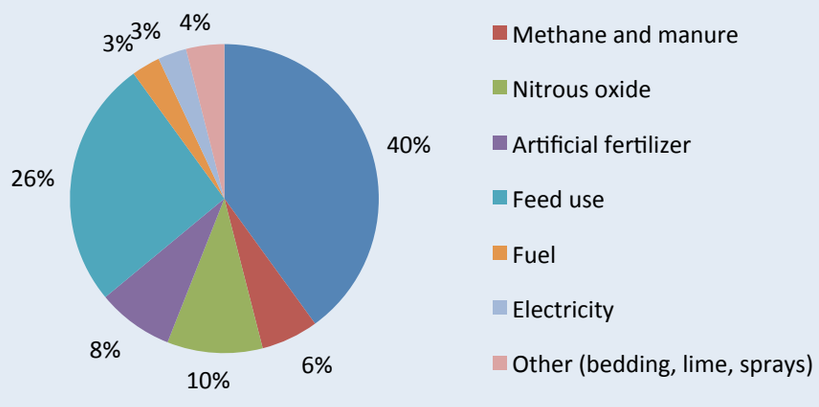
3.11 Environmental Impacts

1. GHG emissions

Dairy farms are the biggest emitter of greenhouse gases in the UK agriculture industry, accounting for 28% of all emissions. Sources of emissions on dairy farms are summarised in Figure 3. Emissions are in the form of methane, nitrous oxide and carbon dioxide:

- **Methane** emissions are predominantly from enteric fermentation – the single largest GHG emissions source on dairy farms, but also from manure. Conventional reduction strategies focus on optimising productivity; getting more milk in less time with fewer inputs. Key factors for success are animal health, feed conversion rates and shortened rearing periods.
- **Nitrous oxide** emissions mostly arise from field applications of artificial fertilizer or manure, and also from urea / ammonia emissions. Reduction strategies relate to targeting the timing and application rates of fertilizers, to ensure maximum uptake by plants, and the use of legumes (clover) in leys to fix nitrogen. Measures to reduce urea and ammonia include regular cleaning of housing with pressure hoses, using straw bedding, extending the grazing period, using effective manure storage areas and injecting manure/fertiliser into the topsoil rather than using superficial splash plates. Regulating protein content in feed can help reduce urea excretion levels.
- **Carbon dioxide (CO_2)** emissions are from some of the less significant emissions sources on dairy farms. However, they can be an attractive prospect for farm efficiency savings, such as reducing tractor diesel or improving the efficiency of milk chillers in bulk storage tanks.

Fig 3: Breakdown of average farm GHG emissions by source (data from DairyCo)



2. Impacts from bought-in feed

Feed carries with it the life cycle burden of crop production – from fertilizer production and use, field diesel, crop processing and logistics. Feed crops, in particular soya, are also linked to direct and indirect land use change, which is a major driver of forest habitat loss, which is in turn a major global source of GHG emissions.

Effective measures to avoid or reduce these impacts include: (1) maximising feeding efficiency (making the most of feed); (2) making more use of home grown forage and silages (although these still carry a theoretical indirect land use change impact), and (3) sourcing concentrates which avoid the inclusion of soya, or at least avoid soya from uncertified sources[22].

3. Pollution

Pollution of watercourses and aquifers by nitrates carries human health and ecological risks, and the biggest culprit in the UK is agricultural run-off from field applications of slurry and nitrogen fertilizer. This is a significant issue for dairy farms, and a range of amelioration practices are promoted through legislation, regulation and advice; in particular relating to Nitrate Vulnerable Zones (NVZs, which cover a high proportion of the UK dairy farms – see DEFRA[23]), and Catchment Sensitive Farming. In addition to nitrates, other agrochemicals such as phosphates and pesticides, and soil erosion create water quality issues. Aerial ammonia pollution, mentioned under GHGs, is also a localised pollutant; deposited into the landscape around farms it acts as a fertilizer, upsetting the balance in natural habitats such as woods and wetlands.

The first lines of defence tend to be secure and adequate slurry storage facilities; good yard and buildings drainage; effective targeting of timing and application rates of slurry and fertilizer; management of livestock movements; good field management of crops to avoid soil erosion, especially in maize crops; and the creation of boundaries and buffers, especially around watercourses.

4. Local landscape quality

As described in section 2.13, landscape quality impacts from dairy farms can be significant, especially where farms are scaling-up and adding new infrastructure. This is a direct sustainability issue in its own right. It is also an issue for dairy viability – since objections to new dairy infrastructure can affect local relationships and planning consents. The most extreme example of this was perhaps the Nocton Dairy, which was strongly opposed by the Campaign to Protect Rural England (CPRE), and eventually refused consents by the environment agency[24].

3.12 Animal Welfare

A study of 58,210 cows in 322 dairy herds by Kite Consulting demonstrated that the average cost of health related issues was £6,741 per 100 cows or just over £67 per cow per year (Kite, 2009). Mastitis and lameness made up 61% and 14% of this cost, respectively.

In addition to these practical financial considerations, animal welfare has an important ethical dimension. There is an expectation from society that businesses involved with livestock animals

[22] The standard for certified soy is set by the Round Table of Certified Soy www.responsiblesoy.org
[23] http://www.defra.gov.uk/food-farm/land-manage/nitrates-watercourses
[24] http://www.cpre.org.uk/media-centre/latest-news-releases/item/801-victory-for-campaigners-as-nocton-mega-dairy-scrapped

have a responsibility to consider their welfare. This expectation creates a consistent background demand for good welfare standards, as well as having the potential to lead to spikes of negative publicity, where a 'welfare scandal' might have a big impact on a particular supply chain. Based on these practical, ethical and 'public relations' dimensions of animal welfare, we identify three categories of issue:

1. ***Livestock health***

   The two most significant livestock health issues that have an impact on dairy cattle and productivity in the UK are mastitis (accounting for 19% of premature culls and a 3.5% reduction in UK milk yield) and lameness[25]. Other key threats to herd welfare and productivity are: infertility, injuries, heat stress and tuberculosis.

2. ***Intensive rearing***

   The development of more intensive systems has brought with it animal welfare concerns (although some contest that welfare can be better monitored and regulated in more controlled systems). Key concerns raised by organisations such as Compassion in World Farming relate to trends away from grazing towards housing; culling of new-born male calves, and stress and disease resulting from increasing yields housing. Standards such as Organic and RSPCA's Freedom Foods respond to these concerns with specific stipulations around access to pasture, and the phasing out of culling of male calves.

3. ***Badger culling***

   A controversial topic, which relates specifically to the dairy industry. Badger culling continues to have the capacity to draw significant negative publicity – although to-date the controversy has focused on the authorities rather than farmers or the supply chain.

3.13 Security of supply

A critical sustainability issue for the dairy supply chain, from farmer through to consumer, is whether the business of producing milk is and will continue to be viable. The risks are disruptions to supply, reduced supply, and increased price and price volatility. **Fig 4** illustrates the first two of four key variables which underlie these risks.

1. ***Input cost volatility***

   Largely driven by cost fluctuations in energy prices (the industrial production of artificial nitrogen fertilizer uses a lot of natural gas).

2. ***Price of milk***

   A very high profile issue, the price that farmers receive for milk from processors (and by extension retailers), set against steep rises and volatility in input costs, is a key factor in recent reductions in profitability in the dairy sector.

3. ***Farm business viability***

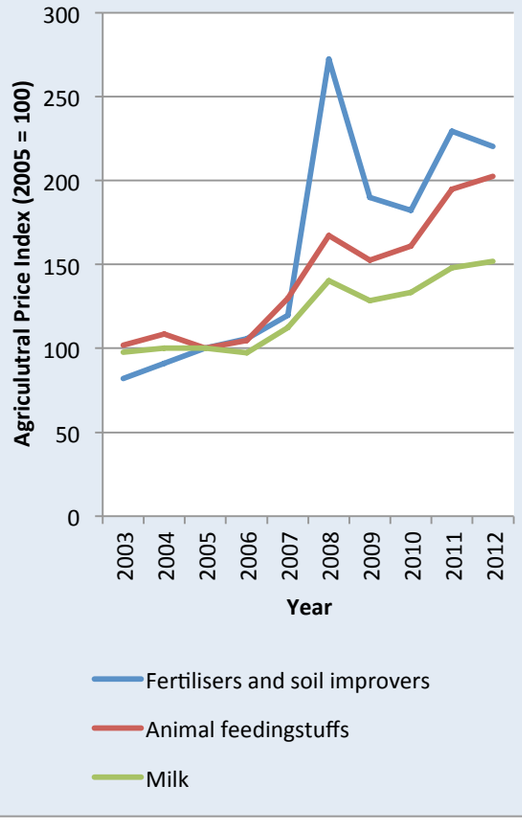
   The challenging differentials between the price of milk and input costs are a source of uncertainly in the dairy supply chain, because they call into question producers' ability to continue doing business. This is compounded by other, more systemic issues such as succession.

[25] Bell, M. J., E. Wall, G. Simm, G. Russell, and D. J. Roberts. (2008). Reducing dairy herd methane emissions through improved health, fertility and management. Pages 123–126 in Proc. Int. Conf. Livestock and Global Climate Change, Hammamet, Tunisia. P. Rowlinson, M. Steele and A. Nefzaoui, ed. Br. Soc. Anim. Sci., UK.

4. Supply chain characteristics

The UK dairy supply chain is well regulated, and has well developed and efficient systems and processes. However it's highly centralised structure, and in the case of liquid milk its total reliance on domestic sources, gives it particular exposure it to low probability, high impact disruptions. Past experiences in the food chain that have been detrimental to the dairy sector include fuel protests or animal disease. Future examples are by their nature difficult to predict.

Fig 4: Dairy input and output price trends (Data from DEFRA)



3.14 Which issues are most important?

Some issues are more pressing than others. The table below gives an assessment of the relative importance of the key sustainability issues, each being given a simple rank of 1 (most pressing) to 4.

Unlike other rankings and scores in this report, which are based on a more systematic approach to definition and grading, these rankings are more subjective; see the rationale column below:.

Sustainability Issue, and ranking		Rationale for ranking
Environmental impacts		
GHG emissions	1	As the biggest source of agricultural GHGs, this is a top issue for the industry
Pollution	2	Dairy systems present a high risk in this sensitive and highly regulated area
Impacts from bought-in feed	3	Dairies can be feed intensive, though avoid serious soy related impacts
Local Environmental quality	3	Major impacts are mainly linked to 'factory' style operations, as yet atypical
Animal Welfare Issues		
Livestock health	2	Mastitis, infertility, lameness, TB are all have big welfare and cost implications
Intensive rearing	4	Issues such as housing and culling of new-born calves are controversial
Badger culling	4	Mainly a risk to the image of the industry
Security of supply		
Input cost volatility	1	The industry remains very vulnerable to feed and fertilizer cost spikes
Price of milk	2	A high profile issue, though mainly because of the price of inputs
Farm business viability	3	The long-term viability of farm businesses poses a strategic risk to supplies
Supply chain characteristics	4	The liquid milk chain is vulnerable to low-probability but high-impact risk

3.2 How do trees measure up?

To what extent can trees address dairy farm sustainability?

3.21 Approach

To assess this question a matrix was created that matches sustainability issues against relevant tree functions and mechanisms. This is used to make an assessment of the extent to which those relevant mechanisms could make a difference to the issue. This assessment was partly based on the 'effectiveness ranking' given in the league table in section 2.22. It was also based on judgement of how the impact would measure up against the magnitude of the issue. The result is a systematically derived grade or score which summarises 'scope for impact'. This analysis is shown in **Analysis 2**. The 'scope for impact' grades are defined in the table below:

Scope for impact	
The potential to substantially address the sustainability issue in question	1
The potential to make an important, but not game-changing contribution to addressing the issue	2
Scope to play a marginal role in addressing the sustainability issue in question	3
Scope to address the sustainability issue to an appreciable but not significant extent, in comparison to the magnitude of the issue	4

3.3 Which tree functions work best against the most important sustainability issues?

A fairly clear picture emerges from our analysis:

1. Trees can make a meaningful contribution to a range of important sustainability issues.
2. In particular, the strategic use of trees can make a material difference to the serious issue of pollution risk from dairy farm activities, especially nutrient run-off.
3. Trees can play a significant role in improving local landscape quality. Though this may be a lower strategic priority for the industry as a whole it may be important to an individual farmer or community.
4. Trees are relevant to, but of lower significance in the key issue of dairy GHG emissions.
5. Similarly, trees may have a small part to play in helping support overall farm business viability.
6. Trees only have a minor part to play in the most prominent animal welfare issues.
7. Trees have no part to play in several sustainability issues, for instance: issues relating to the sustainability of feed; the price of milk; some animal welfare issues, and systemic resilience issues in the supply chain.

Analysis 2 - Tree Sustainability Pathways: matching tree functions to dairy sustainability

Sustainability Issue, and ranking		Relevant mechanisms, and 'league table' category		Scope for impact	
3.11 Environmental impacts					
GHG emissions	1	Sequestering airborne ammonia	2	Trees should not be seen as major players in addressing GHGs on dairy farms. However, in the course of being established for other 'supporting functions' on the farm a significant increase in tree cover could well be achieved. In this case there would be several credible mechanisms (listed left) against which measurable GHG reductions could theoretically be claimed.	3
		GHG sequestration	3		
		Acting as a baffle to wind (and reducing winter fuel use)	2		
		Providing a source of raw materials for the farm	3		
Pollution	2	Creating buffers between fields and watercourses	1	Trees appear well suited to reducing the risk of pollution from farms. In particular, they appear to have a role in facilitating infiltration and uptake of water-borne nutrients, and avoiding run-off into watercourses. But rather than 'making all the difference', we would expect trees to make an appreciable difference, as part of a wider nutrient management strategy.	2
		Stabilizing soils	1		
		Absorption of nutrients by tree roots	1		
		Sequestering airborne ammonia	2		
Impacts from bought-in feed	3	None	x	Neutral – trees may help secure on farm feed production, but could obstruct it.	x
Local environmental quality	3	Obscuring views of intrusive and ugly buildings	1	The strategic use of trees on dairy farms has strong potential to both reduce farm impacts on local environmental quality, and also make positive contributions to it. A number of the mechanisms identified as being relevant to this issue have the scope to make a substantial difference.	1
		Absorbing noise pollution	2		
		Providing wildlife habitats	1		
		Flood risk abatement	3		
3.12 Animal Welfare Issues					
Livestock health	2	Providing shade for animals	2	Trees will address outdoor heat stress, but this is not a major dairy cattle health issue	4
Intensive rearing	4	None	x		x
Badger culling	4	None	x	Tree habitat could conceivably create conflict, bringing badger habitat into the farm system.	x
3.13 Security of supply					
Input cost volatility	1	Providing a source of raw materials for the farm	3	While materials form trees could be helpful, they would not address key input cost exposure	4
Price of milk	2	None	x	Little scope, unless a premium could be paid for milk as part of a special brand	x
Farm business viability	3	Product sales providing additional sources of income	2	Income from the use of trees on dairy farms is unlikely make a significant impact on the principal sources of farm business uncertainty, such as feed and fertilizer costs. However, where there is scope for productive woodland management at scale, fuel wood sales could hedge energy price fluctuations. There is also potential for payments for wider 'ecosystem services', either directly or through a premium on 'woodland milk'.	3
		Providing a source of raw materials for the farm	3		
		Wider system services may have the potential to generate income: Providing wildlife habitats	1		
		Wider system services may have the potential to generate income: Flood risk abatement	3		
		Wider system services may have the potential to generate income: GHG sequestration	3		
Supply chain characteristics	4	None	x	Little scope, other than as an ancillary part of a change to supply chain traceability	x

Box 2 Trees and GHGs on Dairy Farms

Is it possible for a dairy farm to offset its carbon emissions by planting trees?

Greenhouse gas emissions and sequestration in land management systems can be controversial, and methodologies are hotly debated. However, we can use fairly uncontroversial data from DEFRA and DairyCo to estimate the average emissions from milk production on an 'average' UK dairy farm:

Average herd size:	123 cows (DairyCo & ADHB)
Average milk yield per cow:	7,000 litres per cow per year
Average emissions:	1.3 kg CO_2e per litre (DairyCo, 2012)
Estimated emissions per herd:	1,030 tonnes CO_2e per year

Carbon sequestration by trees depends on whether or not the stand of trees is in establishment phase or mature, and on numerous factors relating to rates of growth and decay, such as species, location, climate, and so on. If we simply take the average figure for sequestration of CO_2 for all UK forests and woods (5.4 tonnes CO_2/hectare/year), from the Forestry Commission, then we get a reasonable idea of scale.

This would mean that the average dairy farm in the UK would need to establish around 190 hectares of woodland in order to offset its own on-going GHG emissions.

The average size of a dairy farm in England is 95 hectares. This means that in effect a dairy farmer would need to reduce production by two thirds in order to have space on their farm to establish enough woodland to offset their emissions from producing milk. And it could be argued that taking that dairy land out of production would simply displace production (at least of feed – as the animals could be housed in sheds), shifting it elsewhere. Animal feed production is a major driver of Land Use Change (LUC), and the biggest impact of indirect LUC is forest loss in the tropics. Some sources (WWF) put GHG emissions arising from LUC associated with UK food consumption at 10% of *total overall UK GHG emissions.* So if trees were to replace production, they might actually have a detrimental effect on GHG emissions.

However, if trees were established in a manner which was complementary to dairy production, rather than displacing it, they would not have the same LUC impact. Many of the examples of tree functions described in this report have the potential to complement dairy production activities. In very rough terms, if a farmer was to take this approach and achieve 20% tree cover without compromising production, then we might expect them to be able to offset something in the order of 10% of their emissions.

4. Getting the supply chain to take advantage of the benefits of trees

In section 3.3 we identified a set of fairly clear 'tree sustainability pathways'; the issues that trees are best able to address on dairy farms. But things don't happen because they are a good idea, so in this final part of our analysis we look at who might be interested in making those things happen.

4.1 Structure of the industry – who is influential?

The UK dairy industry is a £3billion/year industry, which produces, processes and delivers virtually all of the UK's liquid milk, and a large proportion of processed products such as cheese, cream, butter and yogurt. Fig. 5 summarises some of the key players, and some of the routes through which they influence one another.

Beside the farmers themselves, three categories of commercial player have most influence in the dairy chain:

1. ***Processors / dairies***, such as Dairy Crest, Arla, Robert Wiseman and First Milk. Processors remain critically influential, accounting for the vast majority of purchases from farm. Even where a retailer has a dedicated supply chain and producer group, it will be managed through one of the large dairies.
2. ***Retailers***, dominated by the big multiples: Tesco, Sainsbury's, Morrisons, Co-op, ASDA, Waitrose and M&S. Customer facing and hugely influential in terms of procurement standards and the management of sensitive issues around 'fair prices for farmers'.
3. ***Input suppliers***. A much more hidden player in the supply chain, feed and fertilizer manufacturers manage perhaps the key variables in dairy farm viability. And there are strikingly few players; BOCM-Paul dominates the ruminant feed market, and fertilizers are supplied by only a small number of manufacturers, e.g. YARA, Omex, Origin, Carrs and GrowHow

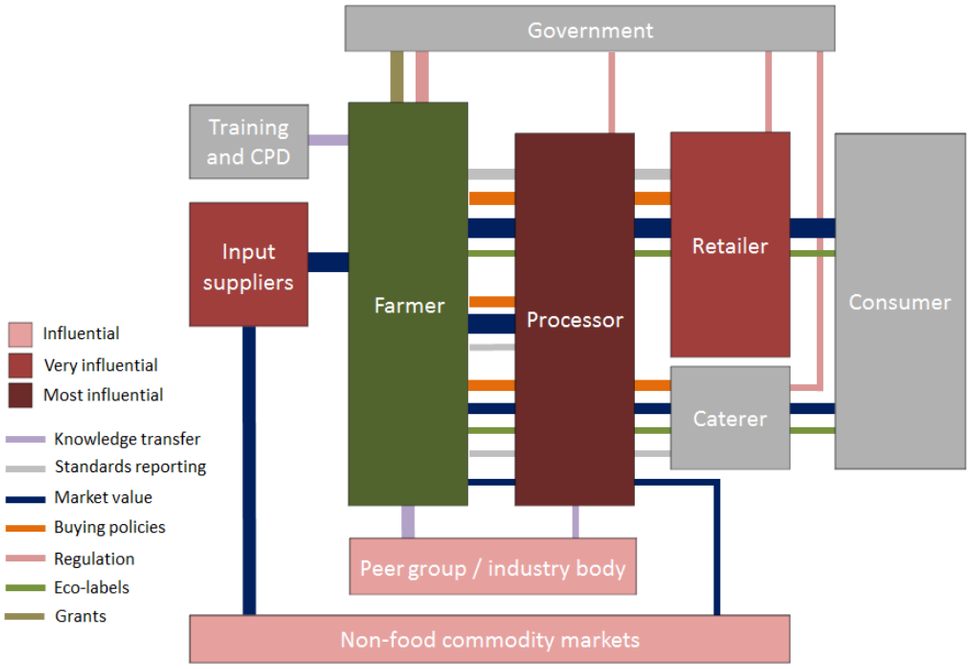


Fig. 5: Schematic diagram of dairy supply chain relationships

4.2 Instruments

How does the supply chain influence what happens on dairy farms?

Dairy sustainability is already an active area, and there are various mechanisms and initiatives through which the supply chain influences farm practices:

1. ***Buying standards and producer groups***

   Most UK retailers have dedicated supplier groups, mediated through their milk processor partner (e.g. Dairy Crest, Arla, Wiseman). These have price, sustainability, welfare policies and contractual arrangements, and are often associated with programmes of best practice sharing workshops and resources. Examples include Tesco's Sustainable Dairy Group[26] and Sainsbury's Dairy Development Group[27].

2. ***Cross industry initiatives and standards***

   The Red Tractor Farm Assurance Dairy Scheme[28] provides the standard for domestic production, and is managed through the industry levy group, DairyCo. Also managed through DairyCo is the Dairy Roadmap[29], which is the dairy industry's practical response to the UK GHG Action plan. Other independently set and audited standards also operate, with organic and LEAF being the most prominent.

3. ***Regulatory influence***

   The regulatory and grants frameworks around dairy are fairly complicated, involving quotas, Single Farm Payment, cross compliance and potential eligibility for various agri-environment schemes (depending on jurisdiction). The key mechanism of influence here is that grant payments are contingent on compliance with standards. In addition to this, farming practices are governed by legal obligations, for instance the Environment Agency oversees compliance with standards relating to water quality, and for example requirements in Nitrate Vulnerable Zones.

4.3 Stakeholder Analysis

To understand who in the supply chain might be interested in the sustainability issues that trees are well placed to address, a 'stakeholder analysis' was carried out. As part of this, the scope was widened beyond those with direct influence on the supply chain, to include local populations and businesses. The analysis focused on the most effective 'tree sustainability pathways' identified in section 3. The extent to which different stakeholders are likely to have an interest in each of these pathways is then considered. The analyses are summarised in **Analysis 3**.

[26] http://realfood.tesco.com/our-food/milk/why.html
[27] http://www.j-sainsbury.co.uk/responsibility/case-studies/2009/sainsburys-dairy-development-group/
[28] http://assurance.redtractor.org.uk/rtassurance/farm/dairy/dr_about.eb
[29] http://www.dairyco.org.uk/resources-library/research-development/environment/dairy-roadmap/

Analysis 3 – Stakeholder analysis. Who has an interest in the benefits that trees can bring?

The table below shows our assessment of key stakeholders' interests in the 'tree sustainability pathways' identified and assessed in Section 3 of this report. Darker shading denotes areas where we judge there to be greater interest.

Tree-sustainability pathways				Stakeholders – why are they interested, or (potentially interested)?						
Issue (and rank)		Mechanism (and scope for impact)		Other industry	Farmers	Local population	Processors	Retailers	Consumers	Government
Environmental impacts										
GHG emissions	1	3	Sequestering airborne ammonia GHG sequestration Acting as a baffle to wind (and reducing winter fuel use) Providing a source of raw materials for the farm		(Supply chain signals)		Brand opportunity	Brand opportunity	(Ethics)	International obligations
Pollution	2	2	Creating buffers between fields and watercourses Stabilizing soils Absorption of nutrients by tree roots Sequestering airborne ammonia	Water industry	Regulations	Health	Brand risk	Brand risk	(Ethics)	Statutory obligations
Local environmental quality	3	1	Obscuring views of intrusive and ugly buildings Absorbing noise pollution Providing wildlife habitats Flood risk abatement	Insurance industry	Relationships Subsidies (Incentives)	Quality of life	Brand opportunity	(Brand opportunity) Brand opportunity (Brand opportunity)	Ethics	Statutory obligations
Animal Welfare Issues										
Livestock health	2	4	Providing shade for animals		Practicalities		Brand risk	Brand risk	Ethics	
Security of supply										
Input cost volatility	1	4	Providing a source of raw materials for the farm		Practicalities		Brand opportunity	Brand opportunity	Price	Good governance
Farm business viability	3	3	Product sales providing additional sources of income Providing a source of raw materials for the farm		Finances					

4.4 Opportunities

The analysis in section 4.3 gives a strong pattern for where stakeholder interests and the most promising tree sustainability pathways coincide. These can be characterised into three action themes:

4.41 Catchment partnerships

The most potent tree sustainability pathways are around **pollution abatement** and **local environment quality**. All of the mechanisms and most of the interested parties are linked geographically, since the processes involved are either ecological or hydrological.

Stakeholders

- **Farmers** – motivated by regulatory obligations, grants, and local relationships.
- **Local population** – concerned about quality of life, and water quality / health.
- **Government** / local authorities - obliged to look after citizen's interests.
- **Water industry** – seeking to reduce water treatment costs.
- **Insurance industry** – seeking to reduce flood risk.
- **Processors and retailer**s - who may be interested in demonstrating more local accountability.

Instruments

- Direct support schemes to farmers, who have an interest themselves in the outcomes. Schemes could be backed by stakeholders such as local authorities and the water and insurance industry.
- Partnerships involving the milk supply chain (retailers or processors) as part of a potential desire to build local accountability. Incentives and support for farmers may be linked to membership of buying groups, adherence to procurement standards, or access to premium markets.
- Third party tree establishment businesses, establishing trees in Land Partnership arrangements with farms, in return for 'ecosystem service' payments from local stakeholders. These would be obvious candidates for social enterprise; raising capital from local private equity, and/or from the interested business stakeholders (water companies, insurance companies, farmers).
- All of these instruments would benefit from the scrutiny and credibility afforded by association with a competent and respected standard-setter.

4.42 Climate Change Synergies

While trees have only a marginal role to play in the issue of **GHG emissions** from dairy farms, climate change is a powerful policy driver, and is taken seriously by government and across the dairy supply chain. The opportunities here are therefore focused on the supply chain.

Stakeholders

- **Processors** – part of industry-wide commitments.
- **Retailers** – sharing in industry wide commitments, and wishing to be seen by their customers to be 'doing the right thing'.

- **Government** – with international obligations to meet.

Instruments

For action under this theme to be credible, trees would need to be used as part of a wider suite of GHG related interventions. The main instruments, therefore relate to getting tree into existing GHG initiatives:

- Incorporation of tree establishment into the suite of recommendations promoted by DairyCo as the industry's part of the UK Greenhouse Gas Action plan.
- Developing tree establishment as a 'totemic' part of a retailer-led supply chain initiative
- Getting tree planting adopted as a favourable 'attribute' as part of climate friendly procurement standards.
- As in the previous action theme, these instruments would benefit from the scrutiny and credibility afforded by association with a competent and respected standard-setter.

4.43 Supporting the industry

Trees have a small but practical part to play in supporting issues relating to the day to day running and **viability** of dairy farms, from shade for **livestock health**, through to the provision of timber and chip for sale, or use on farm to offset **input costs**. Farmers are clearly the main beneficiary, but it pays their customers to support them in this for both practical (security of supply) and reputational reasons – being seen to deal fairly with farmers is a serious consideration for dairies and retailers.

Stakeholders

- **Farmers** – who might see some practical benefits from using trees on their farm.
- **Processors and retailers** – who may benefit from being seen to help support farm business viability.

Instruments

The opportunity here is to link farmer benefits to a supply chain led initiative, where there are identifiable benefits for the processor or retailer. We identify three potential ways of doing this:

- A direct retailer/processor-funded initiative to establish trees on dairy farms, linked to a communication strategy.
- Linking tree establishment to access to premium markets and prices, which can be used by the supply chain in communications, or as part of their commitments to take action on climate change.
- As part of a wider package of 'investment in sustainable infrastructure'. This could be supply chain led, or could conceivably be incorporated into government funding for rural enterprise.

This report was produced for the Woodland Trust by Best Foot Forward, sustainability consultants.

3. Local accountability

Taking care of the landscapes in and around a company's supply catchment makes strategic sense. For orchards the case is straightforward; it helps with local relationships, reputation, and potentially with customers. Companies further along the supply chain are also interested, for all the same reasons. While this might be more the case with companies with a strong regional presence, the need for local accountability and for a 'landscape approach' to sustainable sourcing is starting to be recognised more widely within the food and drink sector[51]. Other types of organisations, such as local authorities and conservation NGOs will also have a potential interest in this agenda – creating scope for valuable partnership working.

The issues that might be addressed under this agenda are:

- Providing wildlife habitats
- Improving landscape quality
- Reducing pesticide drift

The stakeholders who might be most interesting in taking part are:

- Orchards businesses
- Local authorities
- Local and national NGOs (Wildlife Trusts, CPRE, National Trust, Woodland Trust)
- Local communities
- Processors (especially those with a regional focus)
- Retailers

This report was produced for the Woodland Trust by Best Foot Forward, sustainability consultants

[51] See: Kissinger, G., A. Brasser, and L. Gross, 2013. *Reducing Risk: Landscape Approaches to Sustainable Sourcing*. Washington, DC. EcoAgriculture Partners, on behalf of the Landscapes for People, Food and Nature Initiative.

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