Farm Advisory Service

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Profitable Farming in a Changing Climate

Monday 12 December 2016
At Tillyrie Farm, Milnathort, Nr Kinross KY13 0RW
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The European Agricultural Fund for Rural Development
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Carbon footprinting and the benefits

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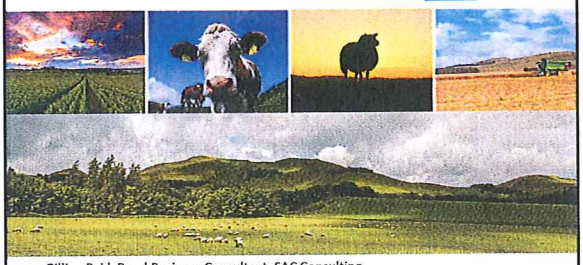

Gillian Reid, Rural Business Consultant, SAC Consulting

What is a farm carbon footprint?

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- Estimate of carbon emissions i.e. greenhouse gases (GHG) produced from a farm, enterprise or product

- GHG emissions calculated include:
  - Carbon dioxide (CO_2)
  - Methane (CH_4)
  - Nitrous oxide (N_2O)

Sources of GHGs

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Greenhouse gas (GHG)	Where from on the farm?	
Carbon dioxide CO_2	Burning fossil fuels. Use of oil, diesel and electricity on farm. Can make up around 10% of the farms emissions. Lifetime in atmosphere; 20 to 200 years.	
Methane CH_4	Natural bi-product of enteric fermentation. Can make up around 40% of emissions depending on farm type. Methane is **25 times more potent** than CO_2. Approx. 12 yrs in atmosphere.	
Nitrous oxide N_2O	Soils naturally produce nitrous oxide but levels can be increased by cultivation and N fertiliser. Can make up around 50%+ emissions depending on farm activities. Nitrous oxide is **289 times more potent** than CO_2. Approx. 115 yrs in atmosphere.	

Methane Myth!

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How are GHG emissions calculated?

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- Farm specific information about the land, crops, livestock, energy and waste converted into CO_2, CH_4 and N_2O
- Emissions from CO_2, CH_4 and N_2O are converted to carbon dioxide equivalents (CO_2e) and are expressed per unit of saleable product i.e.
  - Beef , sheep, pigs, broilers - kg CO_2e / kg dwt
  - Crops - kg CO_2e / kg grain, etc
- Whole process is commonly known as carbon footprinting or carbon auditing

Measure of efficiency

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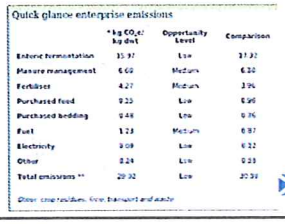
- Carbon footprint results can be benchmarked against similar enterprises
- Highlights areas where emissions are higher, hence improvements can potentially be made, improving efficiency



Measure of efficiency cont.

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E£€iciency

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Farm business benefits

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- Increased efficiency
- Increased costs savings
- Reduced emissions
- Potential for producers to gain higher prices and/or better contract terms from their suppliers
- Win:Win's

Cost savings & CCFFs

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- Demonstrated by the Climate Change Focus Farmers who participated in the Farming For A Better Climate Initiative
- Baseline carbon footprints helped to identify areas where savings could be made
- Working with SRUC and industry specialist management changes are implemented
- Footprints are re-assessed and savings quantified

Savings on Glenkilrie

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- David and Morag Houstoun
- Upland beef and sheep farm
- Saved £11,000, reduced carbon footprint by 10%
- Key measures included:
  - Condition scoring to aid rations
  - Silage analyses
  - Maximising herd performance
  - Calving at 24 rather than 36 months
  - Reduced straw use – bedding cattle on recycled wood chips

Savings on Upper Nisbet

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- Arable and beef farm
- Saved £19,000, reduced carbon footprint by 19%
- Key measures included:
  - Manure analysis and GPS
  - Improved fuel management
  - Increased crop yields
  - Increased clover in grass leys

Mitigation - 5 Key Action Areas

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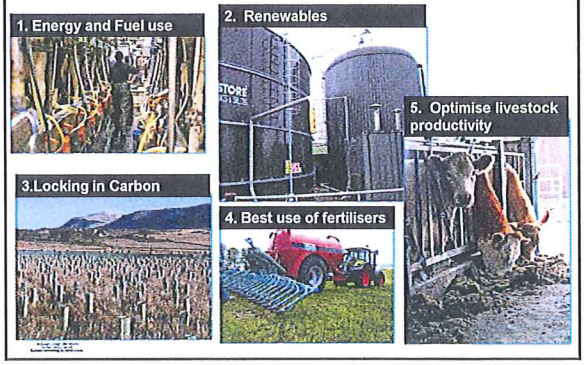

Action areas and measures

- **Best use of fertilisers**
  - Prepare nutrient management plans
  - Analyse soils and manures
  - Target nutrient applications according to time, conditions and amount required
  - Maintain and check calibration of fertilisers and manure spreaders
  - Consider precision farming technologies
- Example of savings on an arable farm:
  - Reducing bagged N use by 8%, saved £3,120 and reduced carbon footprint by 11% per kg grain sold

Action areas and measures cont.

- **Optimising productivity**
  - Good livestock and crop husbandry practices
  - Improved health of livestock and crops
  - Reducing soil compaction and improved land drainage
- Example of savings on a beef farm:
  - Silage analysis and sheep rationing reduced purchased pre-lambing concentrates 13.5 tonnes, saving just under £3,000 and 4.84 tonnes of CO_2e
- Example of savings on an arable farm:
  - Increasing yields by 0.4t/ha (5%) increased crop sales and reduced emissions by 6% per kg grain sold

Action areas and measures cont.

- **Energy and fuel use**
  - Monitoring of electricity and fuel use
  - Switching off machines when not in use
  - Planning work to minimise journeys
- Example of savings on a beef farm:
  - A daily 15 min reduction in operation time of tractor and feeder waggon reduced fuel use by 600 litres, saving £450 and 1.9 tonnes of CO_2 per year
- Example of savings on an arable farm:
  - Assuming 105 litres used per ha, 10% reduction in red diesel saved £2,500 and reduced carbon footprint by 2% per kg grain sold

Carbon footprinting

- Opportunity to take a second look at inputs being used
- Signposting - is there scope for improvements compared to benchmarks?
- Take advantage of the FAS funded carbon audits
- Remember the Win:Win's

Questions

Soil Management

Practical Guide

Scottish soils are a valuable store of carbon, particularly the peat soils of the uplands and islands.

In Scotland, more than 60x more carbon is stored in our soils than vegetation and between them, these carbon stores hold about 125x the total amount of CO_2 emitted each year in Scotland. It is essential that we protect soil carbon reserves and play our part in meeting Scotland's greenhouse gas (GHG) reduction targets .

Soil carbon can be lost in a variety of ways including :

- Ploughing and other cultivations expose soil organic matter to oxygen - this breaks the soil carbon down to carbon dioxide - a greenhouse gas.
- Water-logging of plant material can cause it to rot in the absence of air causing the release of methane, another powerful greenhouse gas.
- Higher overall temperatures speed up the various soil carbon breakdown processes.

Soil carbon increases when the soil organic matter (SOM) accumulates faster than it is being lost. And SOM is one of the keys to soil health and fertility and is worth maximising to **boost the soils' productive capacity and crop yields**.

Soil management for carbon, therefore, matters to all farmers, whether organic or conventional.

Top tips for EVERY farm

- **Keep off wet soils** - working wet soils causes compaction and reduces yields.
- **Dig to assess soil structures** - structure will change over time.
- **Soil test** regularly - particularly for pH and P.
- Maintain **soil organic matter.**
- Take steps to **prevent erosion.**
- **Irrigate** to the crop's requirements and not more.
- Maintain field **drains.**

This Practical Guide highlights tips for managing farm soils to preserve and boost soil carbon, reduce GHG emissions and benefit the farm business.

Farming for a Better Climate

There are five sets of Practical Guides covering :

Use energy and fuels efficiently

Develop renewable energy

Lock carbon into soils and vegetation

Optimise the application of fertilisers and manures

Optimise livestock management and the storage of manure and slurry

Find further information, including links to other Practical Guides and Case Studies, at

www.farmingforabetterclimate.org

Funded by the Scottish Government as part of their Climate Change Advisory Activity

Websites

www.farmingforabetterclimate.org

www.soilassociation.org

www.scotland.gov.uk

www.ipcc.ch

www.carbontrust.co.uk

www.sorp.org

www.sruc.ac.uk/info/120062/crop_and_soils_systems/412/visual_evaluation_of_soil_structure

www.agrecalc.com

2015 International Year of Soils

SRUC

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Soil Management

Key Facts:

- Soil and soil organic matter is being lost much faster than it can be made. Minimise soil erosion and keep soils in the field where they can work for you and reduce carbon emissions too.
- It can take up to 500 years to create 1cm of topsoil - and only moments to lose it in erosion.
- More than half the world's known species live in the soil - there can be up to 5 tonnes of animal life in one hectare's soil.
- Worldwide, soils may have lost 60% of their original soil organic matter since settled agriculture began.
- Healthy soil is 25% water and 25% air - both air and water need pore spaces.

Designing a rotation

When designing a crop rotation think about :

- varying rooting depths
- maintaining soil cover
- grass leys
- nitrogen fixing crops
- weed suppression
- cover crops, green manures
- shared pests and diseases
- spring or autumn sowing
- speed of establishment
- forage vs cash crops
- irrigation requirements

Managing Soils to boost Soil Carbon

- **Reduced tillage** drastically cuts down on soil carbon losses. It won't work for every farm in every year. Note it can also reduce on-farm fuel use, cutting costs.
- **Minimising soil erosion** keeps soil in the field.
- **Incorporating crop residues** after harvest returns much of their carbon to the soil. This boosts soil fertility directly through the residue's nutrients as well as providing better water holding capacity and boosting activity of soil biota.
- Where straw is required for bedding, returning it later as **manure** helps to maintain SOM.
- Growing **cover crops**, particularly legumes, on otherwise bare ground can benefit soil carbon as well as perhaps "soaking up" excess nutrients
- Good **irrigation practice** helps avoid waterlogging and boosts SOM.
- Nutrient management using long-term **manure applications** boosts soil carbon whilst making good use of resources
- **Crop rotations** with a variety of plant families helps SOM through a variation in rooting depths and styles from year to year. In particular, including **grass** in the rotation is helpful.
- **Improving grazed pasture** through drainage, soil aeration, compaction reduction and improved diversity of forage species can all help SOM.
- **Afforesting** highly degraded or marginal soils will significantly improve carbon sequestration compared to sub-optimal grazing or arable use of those soils.

The **hidden carbon** in the manufacture, transport and application of pesticides and fertilisers and the employment of tillage and irrigation must be taken into account when determining the case for land use change.

Carbon Storage is long-term

Accumulating carbon in the soil is a long-term process. The life-time of stable soil organic matter is 250-1900 years but it can be lost in a moment, for instance through erosion.

To speed up sequestration either :

- INCREASE the rate at which you apply organic matter particularly from off-farm (e.g. composts) **or**
- DECREASE the rate of oxidation of soil carbon and decomposition of soil organic matter, for instance by using reduced tillage systems

Soil Quality Improvement

In a trial comparing soils that had a diverse rotation including grass, or had significant manure additions or were in continuous wheat, after five years the soils in diverse rotation and the manure-amended soils had :

- increased levels of organic matter
- more fungal activity
- better porosity
- greater compaction resistance

Higher soil carbon and better soil structure will be critical for soils to be able to cope with increased climate variability with, for instance better drainage and drought resistance.

See the other Practical Guides in this series including ***Assessing Soil Structure, Improving Soil Quality*** and ***Field Drainage***.

Maximising Livestock Performance:

how can you improve the efficiency of your beef & sheep enterprise ?




(Dr Jimmy Hyslop, SAC Beef Specialist)

SAC Consulting is a division of SRUC

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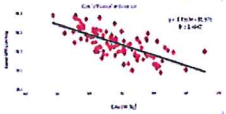
1

Efficiency in beef businesses – Key features

Animal based efficiency measures

- Maximise calf output / 100 cows mated
- Minimise animal health problem / losses
- Minimise time to slaughter in finishing cattle



Beef business based efficiency measures

- How do I get my fixed costs to produce more ?
  (Land, labour, buildings, machinery, capital)
- How do I maximise use of my building space / costs ?
- How do I produce more whilst making my life easier ?

2

Efficiency in suckler beef production

What is it ? – the input:output relationship

- We often focus on reducing costs to improve efficiency
- Increasing output is often much more important

- How can I keep more cows for the same fixed costs
- Reduced subsidy means more focus on income from sales
- More & better quality calves that leave greater profit

(More profit usually needs increased output)

3

Efficiency in beef production (the basics)

What is it ? – the input:output relationship

Better conversion of feed into meat (FCR)

Net Feed Efficiency (RFI)

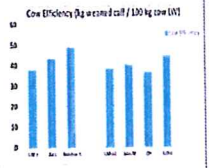
Lower Greenhouse Gas Emissions (Carbon Footprint)

Also

More calves / 100 cows mated (fertility)

Improved animal health (more calves to sell)

More output / £ spent on fixed costs



(More profit & lower environmental impact / kg beef)

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Feed conversion in beef

Feed Conversion Ratio (FCR) – lower is better

FCR better in younger cattle (can we get them ?)

FCR better in bulls *vs* steers *vs* heifers

FCR better for high quality (conc) diets, lower in forages

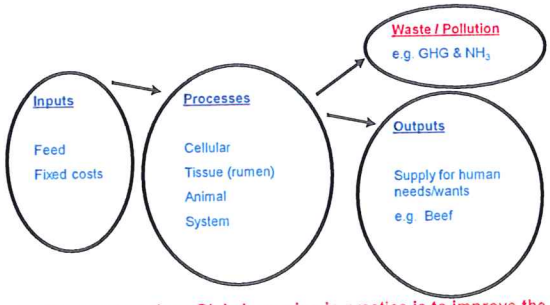
Health problems disastrous for FCR

FCR slightly better with higher fat rations (by-products)

FCR best when VFI is kept high & no checks in growth

(All of these issues are important to a beef farmer)

Implications for beef systems - EFFICIENCY IS KEY



- The way to reduce Global warming in practice is to improve the efficiency of the processes that we use to turn raw inputs into a supply of human needs/wants

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Technical efficiency & GHG emissions

- Reducing GHG and improving efficiency of beef production are the same thing !
  - The farmer gains the feed & fixed cost efficiency (win)
  - Govt objectives to reduced GHG emissions are achieved (win)

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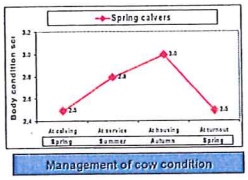
Technical efficiency in suckler herds

(same basic principles for sheep flocks)

Herd Fertility - 5 key principles



Management of cow condition

Bulls - soundness, fertility and calving ease

Avoiding difficult calvings

Heifers - hit target bulling weight

Herd health - keep out disease

Monitoring fertility

- FertBench available
- Set targets & monitor
  - Cows calving
  - Calving pattern
  - Calf mortality
  - Calves reared
- Helps identify problem areas & practical steps to improve fertility and profit

Spring Calvers 2008				
	Combined		Target	2007
Per cow/heifer mated			%	%
	Number	%		
Cows/heifers to bull	134			
Cows/heifers calving	112	83.6%	95%	84%
Cows/heifers barren	16	11.9%	5%	12%
Cows/heifers aborting	3	2.2%		
Cows/heifers mortality (mate-calv))	1	0.7%		
Cows in calf but culled	2	1.5%		
Check total cows	134			
Calves reared	113	84.3%	84%	85%
Per cow heifer calving				
	Number	%		
Cows/heifers calving 1st cycle	58	51.8%	65%	50%
Cows/heifers calving 2nd cycle	28	25.0%	25%	27%
Cows/heifers calving 3rd cycle	13	11.6%	7%	7%
Cows/heifers calving 4th cycle	6	5.4%	3%	7%
Cows/heifers calving 5th cycle	7	6.3%		5%
Cows/heifers calving later	0	0.0%		4%
Total calving	112			118
Per calf born alive				
	Number	%		
Cows/heifers with stillborn calves*	0			
Twin births (live twins only)	4			
Total born alive	116			
Dead calves (birth-48 hours)	2	1.7%	2%	
Dead calves (48 hrs - weaning)	1	0.9%	combined	5.70%
Calves reared	113	97.4%	96%	

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Weaning % targets for UK Herds

- Weaned calves per cow bulled 95%
  - Cow fertility
  - Animal health (cows & calves)
  - Calf survival
- Scottish average is currently 84%
  - We can improve
- 60-70 % of beef system GHG emissions is with the cow herd
- Improving weaning % from 84 to 95 % would:-
  - Increase the economic sustainability of suckler herds
  - Reduce the GHG emissions / kg beef produced by ~7 %

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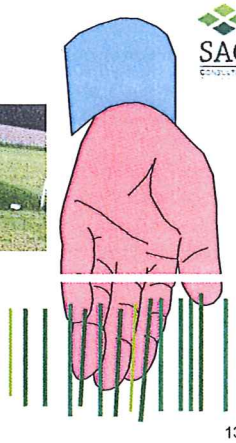
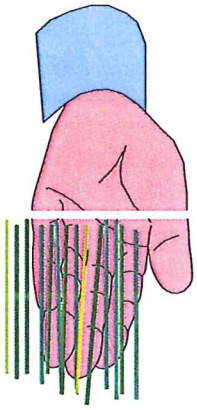
TARGET GRASS HEIGHTS FOR BEEF CATTLE (cm)

	Spring calving	Autumn calving	Dry cows
Spring - July	7 - 9	7 - 9	6 - 7
July-housing	8 - 10	9 - 11	7 - 8



7 cms

13



12 cms

14

Herd health - keeping out disease

Suckler cows	Suckled calves
• BVD	Respiratory disease
• IBR	Etc
• Johnes	
• Leptospirosis / TB	

(know your problems and address them to increase output)

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Finishing systems

- What are the options ?
  - Should we be finishing cattle sooner ?

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What finishing system ? - FIXED COSTS

(2nd BSP payment not there any more)
Keeping cattle indoors for 2 winters or more is a costly option
Fixed costs = labour, machinery, buildings, capital, other

		Winter						Winter			
System		Spr	Sum	Aut	Win	Spr	Sum	Aut	Win	Spr	Sum
12 mths	Suckler	Sucking		ad lib conc							
	Dairy	Milk	ad lib conc								
18 mths	Suckler	Sucking		For:conc		Grazing:conc					
	Dairy	Milk	Grazing	For:conc		Grazing:conc					
24 mths	Suckler	Sucking		Forage		Grazing		For:conc			
	Dairy	Milk	Grazing	Forage		Grazing		For:conc			
30 mths	Suckler	Sucking		Forage		Grazing		Forage		Grazing	
	Dairy	Milk	Grazing	Forage		Grazing		Forage		Grazing	

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Typical finishing systems

Feed conversion ratio & costs

	Time to finish (months)			
	12	18	24	30
FCR (kg LWG/kg DMI)	5-7	12	16	20
Feed costs (per tonne)	High	Med	Low	Low
Feed costs (over lifetime)	Low/ Med	Med	Med	High
Fixed costs (over lifetime)	Low	Med	Med	High

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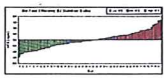
Wold Farm NFE project results – Steers *vs* Bulls



NB: @ feed cost of £155/t DM - 12 weeks on Wold farm NFE test

	Steers	Bulls
Mean LW (kg)	578	591
DLWG (kg/d)	1.47	1.84
Fat depth	7.4	5.2
DMI (kg/d)	12.81	12.80
FCR (DMI:LWG)	8.8	7.1
Cost difference		
p/kg LWG	135	108 (20 % less for bulls)

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Make fixed costs work harder & produce more

Finishing unit (Feed lot)

24 months system (2 winters) Output = 100 finished cattle

100 stores @ 4 m^2 each = 400 m^2

100 finishers @ 6 m^2 each = 600 m^2

1000 m^2

13-15 months system (1 winter) Output = 167 finished cattle

167 finishers @ 6 m^2 each = 1000 m^2

Same, building, labour, machinery & land costs (i.e. **reduced fixed costs/head**)
BSP not there anymore **(finish cattle sooner)**

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What should we put into silage pits ?

Options

Grass silage – are cereals a better option for the land ?

Wholecrop (barley or wheat) - " "

Crimped or urea treated cereals - " "

Draff – is it cheap enough to deal with storage losses (workload)

Other perishable products

potatoes, veg waste, grainbeet, etc

Straw and other feeds (covered pits) ?

(Think about your system next year)

Improving efficiency in beef production

- Strategies to improve efficiency in livestock (beef) systems
- Choose to finish weaned animals using efficient, short duration finishing systems
- Minimise animal productivity losses due to adverse animal health problems
- Adopt measures to ensure high fertility rates in the breeding herds/flocks
- Manage cow (ewe) BCS to minimise use of winter feed
- Calve heifers for the 1st time at 2 rather than 3 years of age
- Use creep feed to minimise performance checks at weaning
- Ration animals according to feed quality and animal requirements

Three Key Points to think about

Beef business based efficiency measures

(1) How do I get my fixed costs to produce more ?
(Land, labour, buildings, machinery, capital)

(2) How do I maximise use of my building space / costs ?

(3) How do I produce more whilst making my life easier ?

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Efficiency will always be key to a profitable beef business

in both animal factors
and
fixed cost usage in generating profit
(& it cuts the GHG as well !!)

Farming for a Better Climate

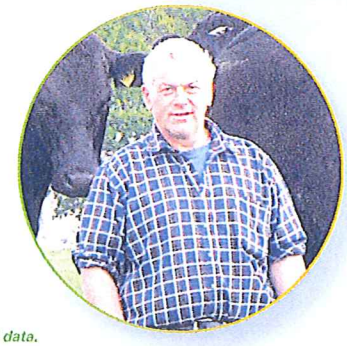
With experienced farm consultants and up to the minute scientific advice, we are working with farmers across Scotland to identify and share *practical and realistic* ways to *improve farm efficiency, increase profitability* and at the same time, reduce the carbon footprint.

Focusing on key action areas, previous focus farmers have saved money and cut their carbon footprint through taking a second look at routine tasks. For example:

Ross Paton at Torr
Reduced electricity and fuel use through a range of measures such as fitting a variable speed milk pump and better use of the farm fleet giving a saving of around £8,500.

Neil and Linsey Butler at Stewart Tower
Installed a 100kW wind turbine saving them on average, £12,000 a year on electricity costs for their dairy, ice cream production and farm shop.

Robert and Jac Neill at Upper Nisbet
Saved over £10,000 from knowing the nutrient value in manure and using GPS soil analyses to accurately target fertiliser.



David Houstoun at Glenkilrie
Saved just under £3,000 on concentrates through knowing the feed value in pit silage and feeding ewes accordingly.

Savings accrued as a host climate change focus farm based on comparison of 2010/11 to 2013/14 data.

www.farmingforabetterclimate.org **@sacfarm4climate**

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Leading the way in Agriculture and Rural Research, Education and Consulting

Funded by the Scottish Government as part of its Climate Change Advisory Activity.

SRUC

Farming for a Better Climate

SRUC is working with volunteer host climate change focus farms and their discussion groups to investigate and share practical ideas to improve farm efficiency, increase profitability and at the same time, reduce the carbon footprint.

Stephen, Sheena and Donald MacKenzie, Auchmore
Beef and Sheep

Jason and Victoria Ballantyne
Clynelish
Beef and Sheep

David and Morag Houstoun
Glenkilrie
Beef and Sheep

David Girvan and Family
Corrimony
Beef and Sheep

David and Nicola Barron
Nether Aden
Beef and Arable

Neil and Linsey Butler
Stewart Tower
Dairy

Willie Officer and Family
Ardoch of Gallery
Arable, Potatoes and Daffodils

Ross Logan and Family
Hillend
Dairy

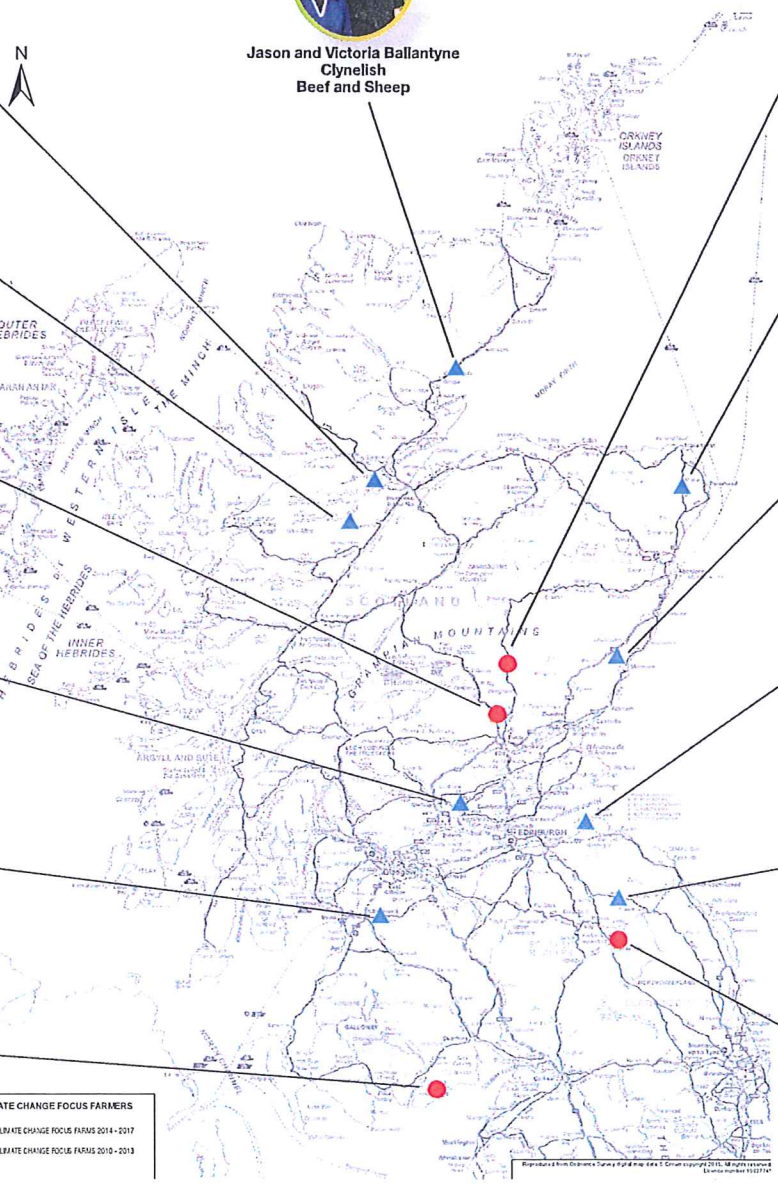
Bob Simpson
Castlemains
Arable and potatoes

John Kerr and Family
Woodhead
Dairy

John and Rhona Mitchell
Rumbletonrig
Arable, Beef and Sheep

Ross Paton and Family
Torr
Dairy

Robert and Jac Neill
Upper Nisbet
Arable and Beef



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Alleviating Soil Compaction

Farming for a Better Climate

Practical Guide

The demands of modern farming coupled with heavier machinery and increasingly wet weather conditions increase the risk of compaction in farm soils.

Compaction occurs when the soil has been compressed into a solid layer within the soil profile. This could be easily done by trafficking or livestock poaching.

The compacted layer acts as a barrier, restricting the movement of air, water and nutrients within the soil profile. Compaction can lead to impeded drainage, reduce crop yields and increase emissions of Nitrous Oxide (N_2O) and Carbon Dioxide (CO_2), both greenhouse gases implicated in climate change.

This Practical Guide gives some ideas on how to alleviate soil compaction.

See also the Practical Guides on soils and soil structure.

There are five sets of Practical Guides covering :

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Benefiting the farm business

Healthy soils are key to maximising productivity. However, factors sometimes dictate that farm operations go ahead in less than ideal conditions, damaging farm soils both at the surface and down through the soil profile.

Early identification and remediation of soil problems is key to maximising both productivity and profitability from soils. For example, removing compacted layers will help root development, improving access to nutrients and benefitting crop growth. Soil health is crucial to maintaining productive grass leys, meaning the time between reseeds can be extended. Inclusion of clover within a grass sward will also reduce the need for bought in nitrogen fertiliser and make best use of nutrients on the farm.

Protecting and improving soil structure and quality will help to improve business resilience to changing weather patterns, benefit farm profitability and make best use of resources. These steps can also contribute towards a lower carbon footprint, further benefitting the farms green credentials.

Websites

www.farmingforabetterclimate.org

www.farmingfutures.org.uk

www.soilassociation.org

www.planet4farmers.co.uk

www.sruc.ac.uk/info/120062/crop_and_soils_systems/412/visual_evaluation_of_soil_structure

www.agrecalc.com

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Alleviating Soil Compaction

Avoiding soil compaction

1. Sow cereal or grass seed into a seedbed that is dry to below the depth at which the cultivation machinery operates. If this is not the case on silty or clay loams, the cultivator will destroy the soil structure and work the lower depths of the seedbed into an impervious layer. This leads to impeded drainage, surface ponding and reduced crop yields.

2. Showing some restraint and patience at sowing could well reduce the effects of soil compaction at depth. If there are wetter areas in a field sow the dry areas and leave the wetter areas for a few more days since you will only sow them to reap a lower yield.

3. Shutting off silage fields and applying fertiliser early will bring forward cutting dates to give a longer weather window in which to wait for a spell of dry weather. Yield losses from cutting earlier in a forecast dry spell can compensate for the losses associated with weather delayed cutting dates.

4. Grow grass/clover swards. More clover leaf in a sward leads to slower deterioration in quality and the grower can afford to wait longer for a suitable weather window.

5. Sacrifice yield for forecast dry weather. Possibly higher quality, wet, poorly fermented, low intake silage sacrificed for lower energy, lower protein well fermented, high intake silage which can be capable of supporting a higher level of animal performance than material cut earlier in wet conditions.

Repairing the damage

In soil conditioning its important that the machine dealing with the problem must get to the bottom of things, i.e. reach below the impervious layer. The operation must be carried out when the soil is dry enough to give the shatter effect and break up the compacted layer.

Grass swards should be renewed based on production potential rather than age of sward. If a young grass sward has been trashed and is run out due to waterlogging following soil structural damage, it should be the candidate for reseeding and improved future management. As soon as soil conditions allow, the field should be subsoiled and followed by ploughing. The seedbed should be prepared when soil conditions are dry to below the working depth of the cultivation machinery. Where low lime, phosphate and potash levels have been taken care of, a productive grass sward should result. Miss out on any one of these operations and you could be back at square one in two to three years, costing you money and creating more emissions.

Next steps

Assess farm soils. Identify any compaction or soil structural issues. Plan remediation and put steps in place to avoid subsequent soil damage. When planning how to remediate any compaction, remember nature's message is to subsoil in dry soil conditions. If the conditions are too wet, any type of soil conditioning whether it be based around subsoiling, aeration or sward lifting will be a waste of time and fuel.

Coping with wet weather at ensilage

1. Move to half loads to reduce tracking effects

2. Gates are often located at bottom of the slope where fields are wet by nature. Can gates be re-sited up the slope?

3. Run on endriggs to avoid crisscrossing the field. This helps to restrict damage to single area of field

4. Bale silage down hill

5. Avoid uphill operations when machinery is under load

6. Localise guttered areas to allow targeting of subsoiling and reseeding

Gutters and surface ponding of water = soil structure damage.

Coping with wet weather at grazing

1. Graze driest fields to reduce poaching risks

2. Build up silage reserve which allows livestock to be fed on drier fields at higher stocking rates (or inside) until ground conditions improve.

3. Graze heavier fields with sheep.

4. Set up a farm management system that takes full account of soil drainage characteristics.

Carbon Footprinting on the Beef Farm

Practical Guide

Carbon footprinting helps you to quantify the farms greenhouse gas emissions.

Acting on this information not only helps minimise emissions but can also provide significant efficiency and economic benefits at farm level.

Improving on-farm efficiencies through better use of inputs strongly correlates with **reduced production costs per kg of beef** sold meaning improved profitability for the farm business.

Rather than a burden, lowering greenhouse gas emissions represents a challenge with clear opportunities.

This Practical Guide concentrates on some of the opportunities that could come from carrying out a carbon footprint on the beef farm.

Where do the key agricultural emissions come from?

Emissions from livestock farming include carbon dioxide (CO_2) produced by burning fossil fuels, methane (CH_4) as a natural by-product of animal digestion and nitrous oxide (N_2O) from soils, manure and nutrient management. Changes in land use and vegetation can also have an impact on greenhouse gas emissions from the farm.

How is a carbon footprint calculated?

To establish a starting point baseline information on available land area and type, livestock numbers, and weight of livestock sold is recorded along with feed, fertiliser and fuel use. The carbon footprint is expressed on a *'per net unit of food product leaving the farm'* basis. For a beef unit, this would be in kg of greenhouse gas (normally a measure of all greenhouse gases but expressed as a ***carbon dioxide equivalent*** **CO_2e**) per kg cold carcase weight of beef sold.

What's the point of a carbon footprint for my business?

The carbon footprint shows how much greenhouse gas is being produced through routine activities on your farm. It highlights areas of the business where greenhouse gas emissions seem high and allows you to compare your farm performance against other similar enterprise types (benchmarking like for like). High farm emissions reflect poor utilisation of costly inputs, highlighting scope to implement efficiency savings - benefiting both the farm business and the wider environment. Some supermarkets already ask suppliers to provide this information.

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www.agrecalc.com
www2.cplan.org.uk
www.calm.cla.org.uk
www.planet4farmers.co.uk
www.fertbench.com
www.soilassociation.org.uk
www.renewableenergyonfarms.co.uk

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Carbon Footprinting on the Beef Farm

How do you improve efficiency on a beef farm?

The key measures of a farms performance with regard to greenhouse gas minimisation are broadly similar to already familiar performance indicators used by the industry today (see box). **Improvement in productive efficiency** is the most important factor that farmers have within their control to reduce emissions and positively **steer profit.** The following three example measures are based on actual farm data and indicative of what could be expected in specific scenarios. It also broadly illustrates that greenhouse gas emission reductions are achievable, even on already technically efficient farms, **and** compatible with maximising farm profits.

Key 'Performance Indicators'

Number of calves born to females bred

- ✓ Age at first calving
- ✓ Replacement rate
- ✓ Calf mortality
- ✓ Weaning percentage
- ✓ Disease level/challenge
- ✓ Feed conversion efficiency
- ✓ Days from birth to weaning weight
- ✓ Liveweight gain to 400 days (or similar)
- ✓ Forage quality
- ✓ Stocking rate/forage yield per hectare
- ✓ Fertiliser requirements
- ✓ Red diesel use

Example efficiency measure 1 — Increase calf sales

Ensuring suckler cow fertility is not unduly compromised is an essential aspect of maximising live calf numbers. This includes good husbandry practices such as selecting replacements from fertile stock, use of EBV's, bull fertility checks, condition scoring cows, good grassland management, biosecurity measures, health planning and many other small but cumulatively significant practices.

Using SAC farm data it was shown that achieving 5% greater calf numbers (reducing barren cows and calf mortality by 5 in 100 cows bred) could improve finisher cattle sales by **over 3t liveweight per 100 cows** and reduce greenhouse gas emissions by 10% per kg carcase weight.

Example efficiency measure 2 — Improve nutrient use

Targeting and applying manure and fertiliser to crop requirements is an effective method of reducing purchased fertiliser cost and increasing nutrient utilisation (minimising nutrients lost to the environment) without compromising crop yield. A 10% reduction in fertiliser purchase could reduce the carbon footprint by 2% per kg carcase weight.

Example efficiency measure 3 — Improve forage quality

Unimpaired field drainage, modern grass varieties and timely field operations presents an opportunity to increase forage quality without necessarily compromising yield. Improved forage quality will encourage intakes, promoting young stock growth-rates or off-set purchased feed use.

Improving grass silage energy content by 1MJ/kg DM over six-month feeding period is equivalent to around **90kg barley or an additional 35kg live weight in a growing beef ration**. In this scenario, selling 2.5% additional carcase weight reduced emissions by around 6% per kg carcase weight.

Next steps?

Undertaking a farm carbon footprint will help establish a starting point and an action plan to improve business resource efficiencies and assess year on year change; it could also compare your performance with like businesses. Regular assessment can help quantify progress and positively direct efforts to make the most of inputs whilst reducing farm greenhouse gas losses. An action plan based on technical performance targets should aim to take one step at a time towards a more efficient, lower cost system with a reduced carbon footprint.

Field Drainage

Practical Guide

Scottish agricultural land has been drained using various methods since the 1700's, with major investment from the 1950's to 1980's encouraged by grant schemes. Currently, the majority of drainage schemes are between 20 and 50 years with some schemes up to 100 years old.

With climate change predictions signalling increasing and more intense rainfall events, effective drainage systems on the farm are going to become even more important.

Although difficult to quantify, farm drainage systems will have an impact on farm emissions; wetter soils are prone to greater Nitrous Oxide (N_2O) emissions compared to drier soils. N_2O is a key greenhouse gas implicated in driving climate change.

This Practical Guide looks at field drainage systems.

Benefiting the farm business

Good drainage through natural or manmade systems provides a number of benefits to both the farm business and the environment, for example:

- An accessible soil profile allowing a better root system and improved nutrient uptake, benefitting crop yields
- Crops are less prone to a range of common diseases
- Warmer and drier soils increase the length of growing or grazing season, improving the efficient use of your land
- Soils are more resistant to drought due to deeper root systems accessing more available water
- Less poaching of soil surface from machinery or livestock, reducing risk of soil structural damage; drier soils are more resistant to pressures acting on them
- Better animal health due to reduced risk of waterborne diseases and parasites
- Well drained soils are easier to work requiring fewer cultivations (reducing fuel use) to create a seedbed
- An increase in the number of available work days and soil recovers more quickly after heavy rain .

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Field Drainage

Drainage problems

Poor field drainage can be due to a number of problems both natural and manmade. In Scotland, these can be roughly split into 3 main problem areas:

- Surface water
- Ground water
- Springs and seepage lines

Drainage issue	% of problems (Scotland)
Water table	25
Impermeable subsoil	20
Springs	12
Failure of old drains	39
Other	4

As the table shows, during the late 1970's, drainage problems were mainly due to the failure of old drains, followed by water table and impermeable soil problems.

It is essential that before any drainage work is carried out, the cause of the drainage problem is identified. Different problems have different solutions and as drainage installations are expensive, it is imperative that the correct solution is installed.

Drainage installation

New drainage systems can be installed using a number of methods:

- Mechanical excavator - either wheeled or tracked plus a good operator. Suits small to moderate schemes.
- Trencher based system - professional drainage contractors can install 1,000 – 1,500 metres of drain per day. Not suited to soils with high stone or rock content.
- Trenchless based systems - up to 2,000 metres of drain installed per day. Suited to site with no existing drainage system (can be problems connecting existing drains if no plans are available).

Permeable backfill is an expensive element of the drainage scheme but is essential, especially on sites with impermeable subsoil. Depending on trench width and depth, the amount of gravel required per 20 metres of installed drain can vary from 1.5 tonnes using a trenchless system to 16 tonnes plus using a mechanical excavator.

What next if you identify a drainage problem on the farm?

Investigate any existing drainage systems to ensure that these are functioning properly. If no obvious faults are found, an experienced and competent drainage consultant should carry out further investigations. Test excavations and a level survey to determine the most appropriate system to alleviate drainage problems on your site should be undertaken. Your adviser should create a plan, including a bill of quantities which can be supplied to a contractor for pricing. A post construction plan of the system should be prepared to ensure that the drains can be located for future maintenance or repair.

Specialist drainage problems

Iron ochre, an orange slime, which coats the inside of drainage pipes is a problem for organic soils. It will block pipes if not controlled by regular jetting of the drainage system. Drainage schemes need to be designed to allow pipes to be easily rodded or jetted where iron ochre is present.

Running sand is another problem; ground water flows through a sandy soil turning the soil liquid. There are various methods to overcome this problem depending on the limitations of the site.

Managing floodplains

Flood plains are a major benefit to the whole community in that they store flood water and release it back to the river as levels recede, helping prevent flooding of towns and villages downstream.

Flood plains have some of the most productive farmland in Scotland and it is essential that they have good drainage to allow them to recover quickly after a flood event to maintain their productivity.