



Agrecalc Report - Agricultural Resource Efficiency

Farm: Harper Adams University Farm (ID: 4201)

Report reference: Copy of 2022 inputs (ID: 35642)

Sectors: Beef, Sheep, Dairy, Pigs

Region: West Midlands

Year calculation relates: End Dec 2022

Reporting date: 10th May 2024

Resource use and Emissions

A summary of emissions from carbon dioxide, methane and nitrous oxide for the whole farm and per enterprise is presented below. Total emissions are also expressed per unit of output, per hectare and per livestock unit equivalent to allow comparisons to be made. Per unit of output is the most common way to express emissions associated with the production of food products.

Examples of practical measures to improve efficiency and reduce emissions are shown after the table.

		Whole Farm kg CO ₂ e	Beef kg CO ₂ e	Sheep kg CO ₂ e	Dairy kg CO ₂ e	Pigs kg CO ₂ e
CARBON DIOXIDE						
Direct Emissions	Diesel ⁽¹⁾	153,425	16,632	10,151	124,829	1,814
	Electricity ⁽¹⁾	92,099	0	0	21,085	71,014
	Other fuels ⁽¹⁾	17,158	0	9,260	5,396	2,502
	Renewable electricity ⁽¹⁾	0	0	0	0	0
	Renewable heat ⁽¹⁾	0	0	0	0	0
	Direct CO₂	262,682	16,632	19,411	151,310	75,330
Direct & Indirect emissions (embedded in purchased inputs)	Fertiliser	97,917	0	5,914	92,003	0
	Lime	0	0	0	0	0
	Feed	2,387,412	27,027	30,120	1,121,892	1,208,373
	Bedding	128,852	726	0	99,086	29,040
	Pesticides	216	0	1	215	0
	Waste plastic / packaging	1,630	319	34	1,201	77
	Disposal of carcasses	10,376	76	506	3,162	6,632
	Transport	0	0	0	0	0
	Indirect CO₂	2,626,403	28,147	36,575	1,317,559	1,244,122
	Total CO₂ from energy & waste	2,889,085	44,779	55,985	1,468,869	1,319,452
METHANE						
Enteric	Fermentation (feed digestion)	2,649,401	53,753	474,337	1,989,024	132,287
	Manure mgmt	1,261,062	1,605	12,284	419,080	828,093
	Total CO_{2e} from methane	3,910,464	55,359	486,621	2,408,104	960,380
NITROUS OXIDE						
Volatilisation, leaching & run-off	Inorganic and imported organic manure input to soil	39,340	0	2,650	36,690	0
	Grazing deposition, manure management and organic manure input to soil	658,049	5,627	133,261	380,153	139,007
Vegetation, stubble & roots	Crop N residues	103,514	0	1,195	102,305	0
	Total CO_{2e} from nitrous oxide	800,903	5,627	137,107	519,148	139,007
CARBON SEQUESTRATION - Hedges						
Sequestration by hedges (allocated by land area)	(kg CO_{2e})	-13,165	0	-2,268	-10,773	0
Total CO_{2e} emissions from farming		7,587,287	105,764	677,446	4,385,347	2,418,839
Sequestration by forestry	(kg CO_{2e})	417,740				
Net emissions from land use		7,169,546				
Whole farm CO₂e emissions per kg of farm output	(KgCO₂e/kg output) ⁽²⁾	1.71				

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		Whole Farm	Beef	Sheep	Dairy	Pigs
Product CO₂e emissions						
Meat	Total KgCO₂e		105,764	644,122	120,721	2,418,839
	(KgCO ₂ e/kg lwt)		12.30	11.89	2.32	2.98
	(KgCO ₂ e/kg dwt)		23.20	26.43	4.38	4.03
Wool	Total KgCO₂e			33,324		
	(KgCO ₂ e/kg wool)			10.11		
Milk	Total KgCO₂e				4,264,626	
	(KgCO ₂ e/kg FPC milk) ⁽³⁾				1.13	
Eggs	Total KgCO₂e					
	(KgCO ₂ e/kg eggs)					
Forage, grain, seeds, roots	Total KgCO₂e					
	(KgCO ₂ e/kg crop)					
Straw	Total KgCO₂e					
	(KgCO ₂ e/kg straw)					
Emissions per LU equivalent	(KgCO₂e/LU)	0	10,545	5,227	9,006	0
Emissions per hectare	(KgCO₂e/ha)	16,242	0	9,176	12,502	
Farm and enterprise output	(Kg)	4,427,457	4,558	27,670	3,794,693	600,535

(1) - Power for farming activity (excludes personal and household demand)

(2) - Beef, sheep, dairy, pig & poultry meat expressed per net kg dwt of cold carcase; milk expressed per kg FPC milk, poultry eggs expressed per kg, crops and straw expressed per kg

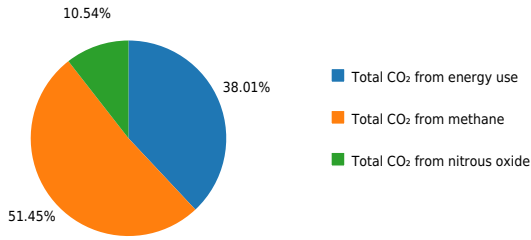
(3) - Fat protein corrected (FPC) milk

Resource use and Emissions Charts

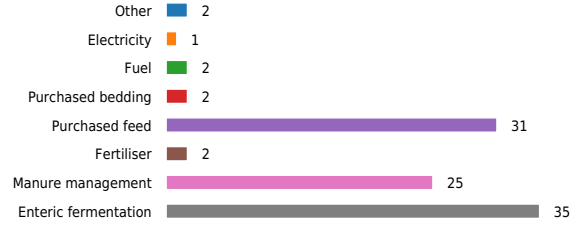
Emissions by gas and by source for the whole farm and per enterprise are presented below.

Copy of 2022 inputs (Harper Adams University Farm 2022)

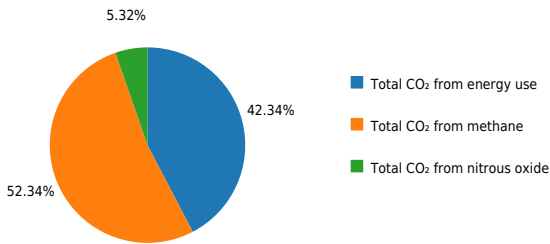
Whole farm emissions by gas (%)



Whole farm emissions by source (%)

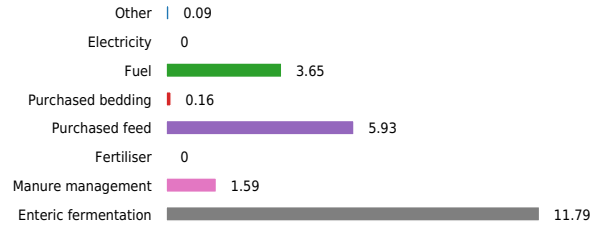


Beef emissions by gas (%)

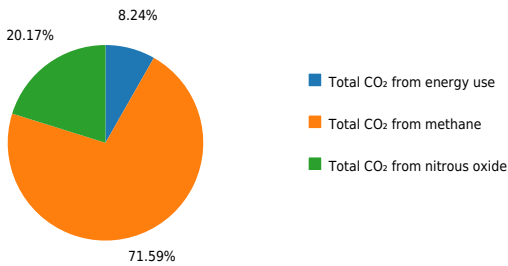


Beef emissions by source

(kg CO₂e/kg dwt)

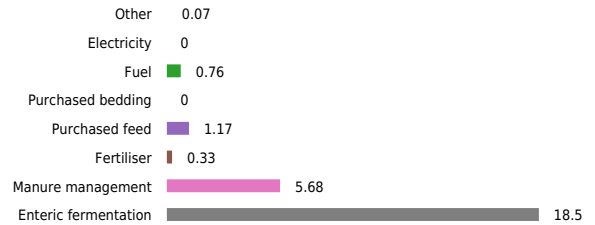


Sheep emissions by gas (%)

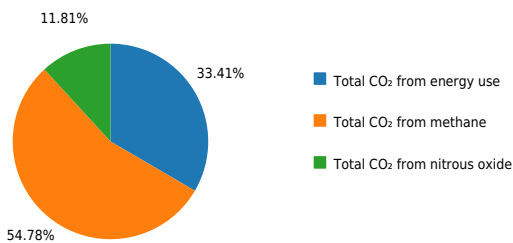


Sheep emissions by source

(kg CO₂e/kg dwt)

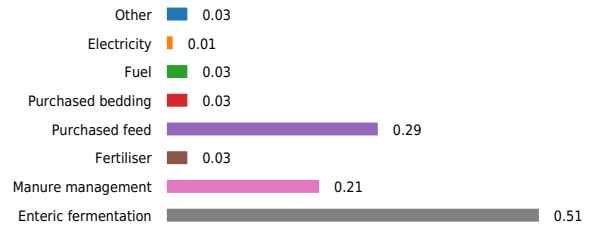


Dairy emissions by gas (%)

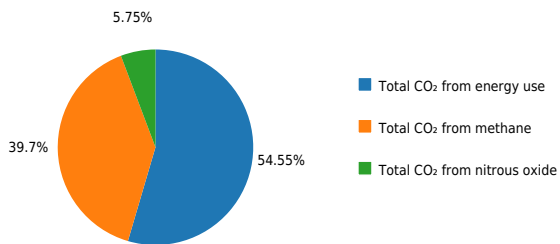


Dairy emissions by source

(kg CO₂e/kg FPC milk)

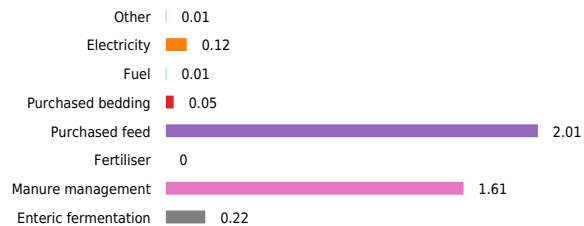


Pigs emissions by gas (%)



Pigs emissions by source

(kg CO₂e/kg dwt)



Agrecalc Report - Beef

Sector: Beef
 Enterprise type: Finishing of dairy - beef cross calves
 System: Finisher
 Group:
 Producer:
 Farm: Harper Adams University Farm

Region: West Midlands
 Year calc relates: End Dec 2022
 Reporting date: 10th May 2024
 Report reference: Copy of 2022 inputs
 Compared to: Beef Enterprises (system specific) 2020 to 2024 (606) reports

Quick glance enterprise emissions

	* kg CO ₂ e/ kg dwt	Opportunity Level	Comparison
Enteric fermentation	11.79	Low	11.86
Manure management	1.59	Low	3.70
Fertiliser	0	Low	2.86
Purchased feed	5.93	High	2.95
Purchased bedding	0.16	Low	0.51
Fuel	3.65	High	0.77
Electricity	0	Low	0.05
Other	0.09	Low	0.55
Total emissions **	23.20	Medium	23.18

Other: crop residues, lime, transport and waste

Physical performance of enterprise

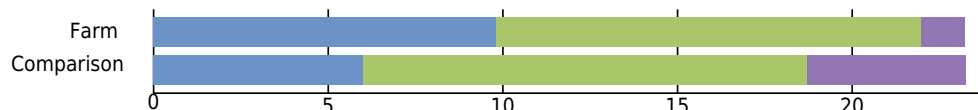
	Value	Comparison
Area of land utilised (ha)	0	82
Female breeding stock (no)	0	1
Heifer sale weight (kg lwt/head)	0	535
Steer sale weight (kg lwt/head)	520	570
Young bulls sale weight (kg lwt)	0	537
Purchased feed use (kg/head)	950	938
Homegrown fodder use (kg/head)	0	5,849
Live weight gain (kg/day)	1.42	0.95
Mortality (%)	3	3
Calving percentage (%)	0	8
Cow cull rate (%)	0	6
Enterprise net output (kgs)	4,558	45,781

Whole farm sustainability indicators

Nitrogen Use	0	kg/ha	Water use	50,592,000.00	litres
Phosphate Use	0	kg/ha	Stocking density	1.63	LU/ha
Potash Use	0	kg/ha	Sequestration	417.74	tCO ₂ e
Waste	9,705.00	kg	Renewable energy used	5,922.00	kWh

Emissions by gas and benchmark comparison

CO₂ : 9.82 kg CO₂e/unit output
 CH₄ : 12.15 kg CO₂e/unit output
 N₂O : 1.23 kg CO₂e/unit output



* Your carbon footprint is expressed in units of CO₂ equivalents (CO₂e) per unit of output e.g. kg CO₂e per kg dwt of cold carcass. This allows the efficiency of the enterprise to be compared. The main greenhouse gases emitted by agriculture are CH₄ = Methane (Predominantly from animal digestion); N₂O = Nitrous oxide (Predominantly from manure and fertiliser); CO₂ = Carbon dioxide (Predominantly from burning of fossil fuels).

** Total emissions may differ due to rounding. Emissions may be skewed on a year to year basis due to timing of sales therefore results are best monitored over a three year (minimum) period.

Agrecalc Report - Sheep

Sector: Sheep
 Enterprise type: Early lambing ewe flock
 System: Finisher
 Group:
 Producer:
 Farm: Harper Adams University Farm

Region: West Midlands
 Year calc relates: End Dec 2022
 Reporting date: 10th May 2024
 Report reference: Copy of 2022 inputs
 Compared to: Sheep Enterprises (system specific) 2020 to 2024 (263) reports

Quick glance enterprise emissions

	* kg CO ₂ e/ kg dwt	Opportunity Level	Comparison
Enteric fermentation	18.50	Medium	18.08
Manure management	5.68	Medium	5.14
Fertiliser	0.33	Low	3.61
Purchased feed	1.17	Low	2.40
Purchased bedding	0	Low	0.19
Fuel	0.76	Low	1.18
Electricity	0	Low	0.06
Other	0.07	Low	0.89
Total emissions **	26.51	Low	31.41

Other: crop residues, lime, transport and waste

Physical performance of enterprise

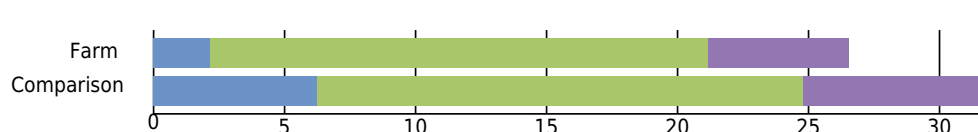
	Value	Comparison
Area of land utilised (ha)	74	57
Female breeding stock (no)	1,020	347
Lamb sale weight (kg lwt/head)	42.00	42.63
Lamb sale weight (kg dwt/head)	18.90	19.51
Wool sales (kg)	3,296	782
Purchased feed use (kg/ewe)	34	103
Homegrown feed use (kg/ewe)	0	964
Mortality (%)	3	6
Lambing percentage (%)	188	160
Ewe cull rate (%)	10	30
Enterprise net output (kgs)	27,670	11,777

Whole farm sustainability indicators

Nitrogen Use	26.97	kg/ha	Water use	50,592,000.00	litres
Phosphate Use	9.66	kg/ha	Stocking density	1.63	LU/ha
Potash Use	0	kg/ha	Sequestration	417.74	tCO ₂ e
Waste	9,705.00	kg	Renewable energy used	5,922.00	kWh

Emissions by gas and benchmark comparison

CO₂ : 2.18 kg CO₂e/unit output
 CH₄ : 18.98 kg CO₂e/unit output
 N₂O : 5.35 kg CO₂e/unit output



* Your carbon footprint is expressed in units of CO₂ equivalents (CO₂e) per unit of output e.g. kg CO₂e per kg dwt of cold carcase. This allows the efficiency of the enterprise to be compared. The main greenhouse gases emitted by agriculture are CH₄ = Methane (Predominantly from animal digestion); N₂O = Nitrous oxide (Predominantly from manure and fertiliser); CO₂ = Carbon dioxide (Predominantly from burning of fossil fuels).

** Total emissions may differ due to rounding. Emissions may be skewed on a year to year basis due to timing of sales therefore results are best monitored over a three year (minimum) period.

Agrecalc Report - Dairy

Sector: Dairy
 Enterprise type: All year round calving, 9,500l typical annual yield
 System: not specified
 Group:
 Producer:
 Farm: Harper Adams University Farm

Region: West Midlands
 Year calc relates: End Dec 2022
 Reporting date: 10th May 2024
 Report reference: Copy of 2022 inputs
 Compared to: Dairy Enterprises (system specific) 2020 to 2024 (348) reports

Quick glance enterprise emissions

	* kg CO ₂ e/ kg FPC milk	Opportunity Level	Comparison
Enteric fermentation	0.51	Medium	0.51
Manure management	0.21	Medium	0.20
Fertiliser	0.03	Low	0.13
Purchased feed	0.29	Low	0.31
Purchased bedding	0.03	High	0.01
Fuel	0.03	Medium	0.03
Electricity	0.01	Low	0.01
Other	0.03	Medium	0.02
Total emissions **	1.13	Low	1.24

Other: crop residues, lime, transport and waste

Physical performance of enterprise

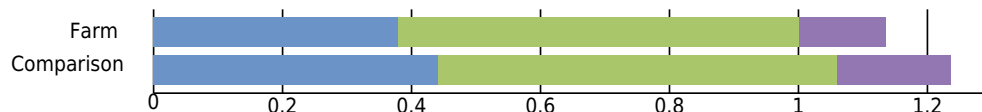
	Value	Comparison
Area of land utilised (ha)	351	164
Female breeding stock (no)	342	257
Cattle sales (kg lwt/head)	423	382
Milk production (l/cow)	10,616	9,689
Purchased feed use (kg/cow)	5,409	4,665
Homegrown fodder (kg/cow)	25,059	15,075
Electricity use (kWh/cow)	337	492
Red diesel use (l/cow)	135	123
Mortality (%)	4	5
Calving percentage (%)	93	92
Cow cull rate (%)	24	31
Enterprise net output (kgs)	3,794,693	2,684,375

Whole farm sustainability indicators

Nitrogen Use	26.97	kg/ha	Water use	50,592,000.00	litres
Phosphate Use	9.66	kg/ha	Stocking density	1.63	LU/ha
Potash Use	0	kg/ha	Sequestration	417.74	tCO ₂ e
Waste	9,705.00	kg	Renewable energy used	5,922.00	kWh

Emissions by gas and benchmark comparison

CO₂ : 0.38 kg CO₂e/unit output
 CH₄ : 0.62 kg CO₂e/unit output
 N₂O : 0.13 kg CO₂e/unit output



* Your carbon footprint is expressed in units of CO₂ equivalents (CO₂e) per unit of output e.g. kg CO₂e per kg fat protein corrected milk. This allows the efficiency of the enterprise to be compared. The main greenhouse gases emitted by agriculture are CH₄ = Methane (Predominantly from animal digestion); N₂O = Nitrous oxide (Predominantly from manure and fertiliser); CO₂ = Carbon dioxide (Predominantly from burning of fossil fuels).

** Total emissions may differ due to rounding. Emissions may be skewed on a year to year basis due to timing of sales therefore results are best monitored over a three year (minimum) period.

Agrecalc Report - Pigs

Sector: Pigs
 Enterprise type: Indoor breeding/finishing
 System: not specified
 Group:
 Producer:
 Farm: Harper Adams University Farm

Region: West Midlands
 Year calc relates: End Dec 2022
 Reporting date: 10th May 2024
 Report reference: Copy of 2022 inputs
 Compared to: Pigs Enterprises (system specific) 2020 to 2024 (36) reports

Quick glance enterprise emissions

	* kg CO ₂ e/ kg dwt	Opportunity Level	Comparison
Enteric fermentation	0.22	Low	0.28
Manure management	1.61	Low	2.05
Fertiliser	0	Low	0.28
Purchased feed	2.01	Medium	1.92
Purchased bedding	0.05	Medium	0.05
Fuel	0.01	Low	0.15
Electricity	0.12	High	0.05
Other	0.01	Low	0.10
Total emissions **	4.03	Low	4.88

Other: crop residues, lime, transport and waste

Physical performance of enterprise

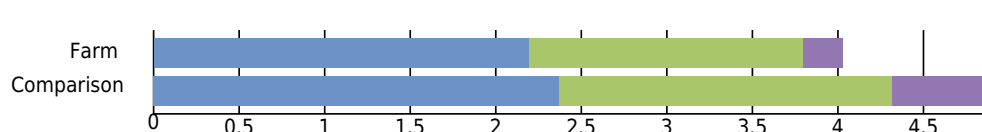
	Value	Comparison
Area of land utilised (ha)	0	76
Female breeding stock (no)	284	364
Weaner sale weight (kg lwt/head)	0	40.60
Grower sale weight (kg lwt/head)	0	49.17
Finisher sale weight (kg lwt/head)	115.00	109.71
Growers % of sales	0	3
Finishers % of sales	96	89
Purchased feed use (kg/head)	296	237
Enterprise net output (kgs)	600,535	567,380

Whole farm sustainability indicators

Nitrogen Use	0	kg/ha	Water use	50,592,000.00	litres
Phosphate Use	0	kg/ha	Stocking density	1.63	LU/ha
Potash Use	0	kg/ha	Sequestration	417.74	tCO ₂ e
Waste	9,705.00	kg	Renewable energy used	5,922.00	kWh

Emissions by gas and benchmark comparison

- CO₂ : 2.20 kg CO₂e/unit output
- CH₄ : 1.60 kg CO₂e/unit output
- N₂O : 0.23 kg CO₂e/unit output



* Your carbon footprint is expressed in units of CO₂ equivalents (CO₂e) per unit of output e.g. kg CO₂e per kg dwt of cold carcase. This allows the efficiency of the enterprise to be compared. The main greenhouse gases emitted by agriculture are CH₄ = Methane (Predominantly from animal digestion); N₂O = Nitrous oxide (Predominantly from manure and fertiliser); CO₂ = Carbon dioxide (Predominantly from burning of fossil fuels).

** Other: crop residues, lime, transport and waste

*** Total emissions may differ due to rounding. Emissions may be skewed on a year to year basis due to timing of sales therefore results are best monitored over a three year (minimum) period.

Improve efficiency and environmental credentials

What does a carbon footprint actually tell you?

There is a strong correlation between efficiency, profitability and low carbon emissions. The lower your carbon footprint the more effective inputs have been at generating saleable product i.e. increased utilisation of costly inputs. Each farm and system have natural limitations but, within this context, the process can identify carbon 'hotspots' on farm and is therefore a steer to improve efficiency and reduce greenhouse gas emissions.

How accurate does the information need to be?

The more accurate the information entered, the more meaningful the output. Where possible on farm records should be used to provide accurate farm-level data.

AgreCalc report guide

A: Quick glance enterprise emissions The 'opportunity level' (high, medium or low) is the likelihood for improvement gauged against other farms in that sector.

B: Physical performance of enterprise It is much easier to relate to performance indicators, actual sales, feeds and other inputs used. This becomes particularly useful when comparing years and for group comparisons.

C. Whole farm sustainability indicators Sustainability is the ability to deliver a product the customer wants year after year without adversely impacting the environment. Carbon is, however, only one part of the wider sustainability 'formula', some wider indicators are shown in this section.

D. Whole farm emissions by gas and benchmarking comparison Carbon footprinting similar farm types allows a business to benchmark environmental performance against a group average.

E. Potential actions to reduce emissions Examples of practical measures that could reduce emissions are shown below. Technical advice should be sought before making any business changes.

Mitigation area	Actions
Energy and fuels	<ul style="list-style-type: none"> • Install smart meter to monitor electricity use - assess efficiency of equipment and activities. Use thermostats, time clocks, motion sensors and low energy bulbs, increase lagging on hot water pipes, reduce number of hot washes in dairy and renew milk pump or other equipment • Record fuel use per tractor and activity - assess efficiency of vehicles and operations. Undertake regular machinery checks and maintenance, use correct tyre pressure, improve journey planning
Renewable energy	<ul style="list-style-type: none"> • Undertake a renewable energy feasibility study. Consider installing a wind turbine, an anaerobic digester, developing farm-scale micro hydro electricity, using a combined heat and power plant, growing trees as biomass fuel, using solar panels, ground source heat pumps or woodchip burners
Fertiliser and manure	<ul style="list-style-type: none"> • Analyse soil and organic manure - ensure efficient use of organic and inorganic fertiliser. Apply nitrogen at optimum rate and timing for crops, maintain clover content of swards, consider covering slurry stores and injecting slurry
Livestock management	<ul style="list-style-type: none"> • Increase livestock productivity. Improve feed conversion efficiency, increase calving or lambing percentage, reduce mortalities, increase weaning percentage, reduce age of calving, regularly review animal health plans, analyse silage or other homegrown forage
Locking carbon into the soil	<ul style="list-style-type: none"> • Create carbon sinks. Protect peatland and moorland from damage by avoiding over grazing, consider reduced tillage and ploughing in stubble and other crop residues, control soil erosion, create wildlife corridors along water margins, field margins and headlands, retain and conserve semi-natural grasslands, manage existing woodlands on farm and create new ones.

Any questions regarding this report or to discuss other financial and carbon efficiency measures please contact your local SRUC office or the Rural Business Unit.

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