LAND OF PLENTY CYMRU

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Exploring nature friendly pathways to decarbonise Welsh agriculture and cultivate nutritional security

@Aled Llywelyn / WWF Cymru

Executive Summary

Wales is facing a Triple Challenge. How will we achieve net zero, restore lost biodiversity, and secure sustainable and nutritious food, now and in the decades ahead?

Wales has a legally binding target to achieve net zero no later than 2050[1]. While decarbonisation is taking place across the economy the agricultural sector is lagging progress made elsewhere[2]. Over the last decade emissions have shown little change - currently accounting for 16% of domestic emissions. As other sectors make progress, agriculture is expected to become the biggest domestic emitter in Wales by the mid-2030s according to the Climate Change Committee.

Welsh nature is also in rapid decline. Wales and the wider UK have been recognised as among the most nature depleted nations on Earth, with around one in six assessed Welsh species at risk of extinction[3]. As successive State of Nature reports have identified, it is the kind of intensive agricultural practices public policy has supported for decades that is a primary driver of that loss.

Beyond our borders there is also the international impact of the Welsh food system. For example, Wales is dependent on an area equivalent of 40% of its size (823,000 hectares) to produce just eight key commodities each year, such as soy and palm, half of which are products that are used directly in our food system. Much of this is sourced from nations at high risk of deforestation, as is the case of soy which is largely imported into Wales to supplement animal feed[4].

Meanwhile, most of the food and drink produced in Wales is no longer consumed in Wales[5], with Welsh families instead largely dependent on products from outside of Wales for the bulk of their nutritional needs.

These factors combine to highlight the need for change. WWF developed its overarching Land of Plenty report[6] which called for changes to how we farm and use our land across the UK, so it produces more of the food we need, while also being kinder to nature and locking up more carbon to become resilient for future generations.

This report now builds on that Land of Plenty report to look at Wales' specific circumstances as the Welsh Government develops a new farming subsidy regime to replace the Common Agricultural Policy, as well as wider food systems policy. The overall architecture of the pathways was also heavily informed by modelling used in the Sustainable Food Trust's *Feeding Britian* report, the Food, Farming and Countryside Commission, The Institute for Sustainable Development and International Relations (IDDRI) models and the Fable calculator.

The aim of this study was to build on these reports and explore alternative land-use and management scenarios specifically for Wales.

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[1] Welsh Government. 2021. Net Zero Wales: Carbon Budget 2 (2021-2025). https://www.gov.wales/sites/default/files/publications/2021-10/net-zero-wales-carbon-budget-2-2021-25.pdf

[2] StatsWales. 2024. Emissions of Greenhouse Gases by Year. https://statswales.gov.wales/Catalogue/Environment-and-Countryside/Greenhouse-Gas/emissionsofgreenhousegases-by-year

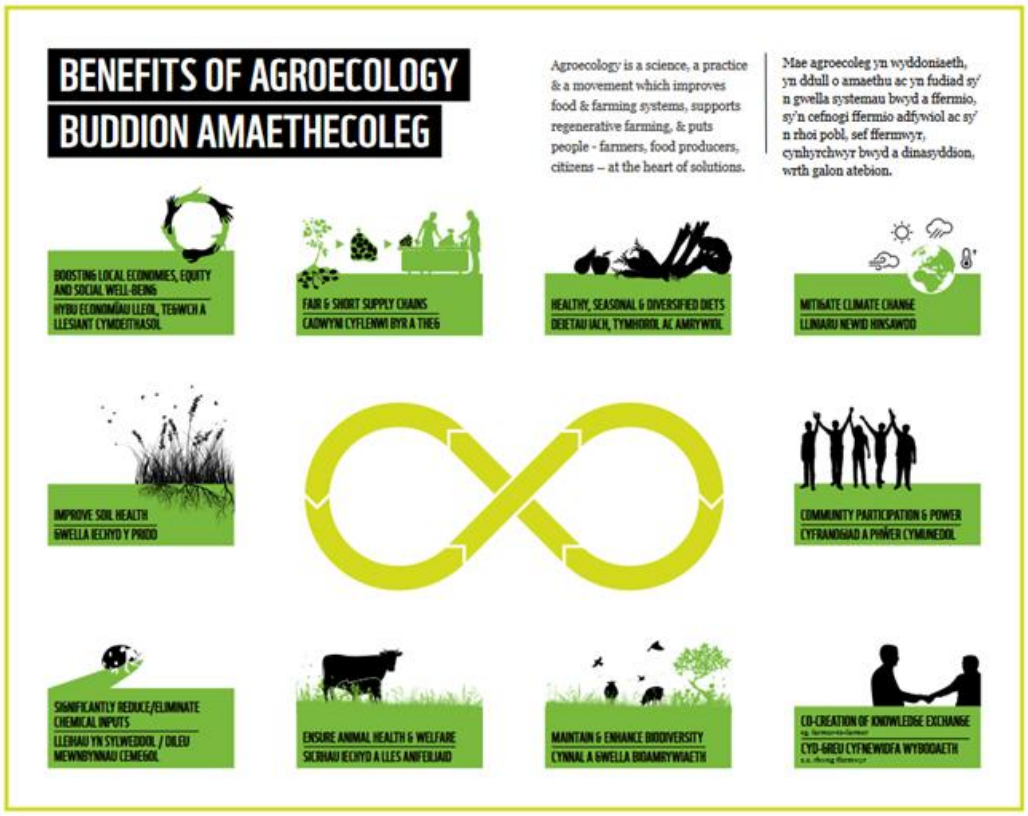
[3] State of Nature – Wales. 2023. National Report. Wales - State of Nature

[4] WWF & Size of Wales. 2021. Wales and Global Responsibility. wwf_risky_b_wales.pdf

[5] Meat Promotion Wales. 2021. Industry Statistics.https://meatpromotion.wales/en/market-intelligence/industry-statistics/

[6] WWF-UK. 2022. Land of Plenty. https://www.wwf.org.uk/sites/default/files/2022-02/WWF_land_of_plenty.pdf

The report argues that this is best achieved by supporting farmers to adopt approaches, which apply agroecological principles to farming practices and embed agroecology throughout the wider food system, from farm to fork.



Adopting these approaches will though lead to significant changes across the Welsh agricultural system, the food system and wider economy. Their implications are explored through an assessment of four pathways based on differing scales of agroecological transition.

WWF Cymru is not explicitly recommending one of the pathways outlined in this report, as all of them have benefits to the environment, whilst maintaining food production levels that meet Wales' nutritional and a sustainable export capacity. Instead, this report is presented as independent research which enables further conversations between farmers, government, and wider stakeholders regarding what such a change has the potential to deliver.

As with all such modelling exercises, there are multiple assumptions and trade-offs. Nonetheless, we are confident that the data will enable an honest conversation about what these pathways may look like in practice. As well as the positives this also includes an exploration of the risks, and where they achieve or fall short of wider ambitions. The risks of not acting are also potentially just as significant as climate change linked extreme weather events are already costing Welsh farmers tens of million each year.[7]

Furthermore, this report aims to identify areas where public resources should be focused to combat weaknesses and foster strengths over the decades ahead. All pathways involve trade-offs determined

[7] Farmlytics. 2024. Extreme weather and its impacts of farming viability in Wales. 5126 - FARMING IN WALES_REPORT_v3.pdf

by policy priorities, local circumstances, and a willingness to act. These need to be considered in an integrated way for Wales to deliver an effective response to the Triple Challenge.

Recommendations

- Crucial to meeting net zero targets, while also reversing the decline of biodiversity and producing nutritious food. This requires leadership from the Welsh Government as the controllers of future subsidy support and regulatory conditions. To enable this, Government must urgently set a new terrestrial and combined GHG emissions reduction target in carbon budget 3 for the agricultural sector to set a glidepath for future support.
- Specific support to encourage the development of organic horticulture at all scales should be developed and integrated with community level engagement to improve connections between production and public consumption.
- Outside of direct farm subsidy support, public policy should focus adding value into the supply chain and the development of better food infrastructure to both improve profitability and enable more Welsh produce to be accessed by the Welsh public.
- Agricultural support should be better recognised and championed within government for its critical potential to deliver a more nutritionally secure, nature-rich, net-zero Wales. Furthermore, investment in it should be increased in future budgets to reflect the scale of need and recognise its preventative value to wider budgets, such as the NHS, flooding, drought and water/air quality.
- Given that a transition to more agroecological farming practices will require a significant number of Welsh farmers to access training and knowledge exchange, current resources should be refocused to provide adequate support.
- Welsh Government must fully assess the impacts of agroecological transitions on the economy as a whole and ensure that current and future generations of farmers are first in line to benefit from any new industries and sectors created.
- Most viable, future public subsidies should require their implementation as part of secure and adequately financed multi-year agreements that support the cost of transition. Farmers already pursuing agroecological practices or transitioning must not be subject to a reduction or gap in support (SFS).
- Where agroecological practices may be less financially viable, future public subsidy regimes should seek to integrate private capital to boost total capacity and better focus resources towards nationally agreed outcomes (particularly nature and climate targets).
- Welsh Government must establish freshwater nutrient pollution reduction targets as part of a new suite of biodiversity metrics. These must be used to foster further investment in agricultural support which enable their obtainment.
- Future public support for an agroecological transition must seek to maximise the benefits to the wider rural economy by supporting new recreation and public health opportunities. These should be based on the creation of secure, skilled jobs which serve to sustain and protect rural communities.

Citation: WWF Cymru (2024) *Land of Plenty Cymru*: *Exploring nature friendly pathways to decarbonise Welsh agriculture and cultivate nutritional security.*

Contents

Executive Summary 1
Recommendations 3
Pathway Development and Summary Infographics 5
RESULTS 8
Biophysical Implications 8
Emissions and Inputs 8
Food Production and Nutritional Security 10
Implications of behaviour change 12
Socio-Economic Implications 15
Public Costs 15
Employment 16
Farm-Level Economics 17
Environmental Impacts 19
Biodiversity 20
Flood Management 21
Water Quality 21
Air Quality 22
Cultural Implications 23
Recreation 23
Physical and Mental Health 24
Welsh Language 24
Annex A - Detailed breakdown of absolute GHG emissions and removals 25

Pathway Development and Summary Infographics

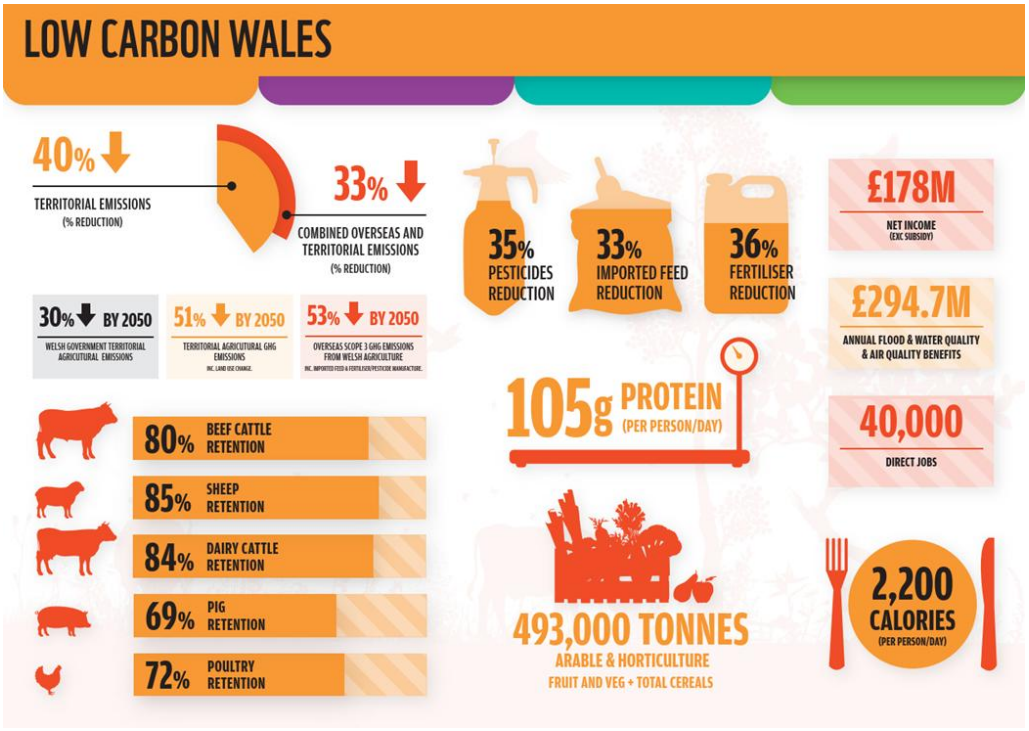
The pathways in this report were developed by environmental consultancies Eunomia and Cumulus for WWF and subjected to independent academic scrutiny. They function to illustrate what a Wales pursuing more agroecological practices could look like in 2050. This was achieved through assumptions which permit an assessment of biophysical, socio-economic, cultural, and environmental metrics, alongside a farm-level financial impact analysis covering six major Wesh farm classifications.

Each pathway is based on a percentage of Welsh agricultural land being managed in agroecological ways as set out in Table 1 below. Remaining land is considered to remain under conventional management.

Assumption	Scenario A – Low Carbon Wales	Scenario B – Land of Plenty (Central)	Scenario C – Land of Plenty (Balanced)	Scenario D – Full Agroecological Transition
Agroecology uptake				
% of total land area in agroecology	33%	75%	75%	100%
% of total land area under conventional farming systems	67%	25%	25%	0%

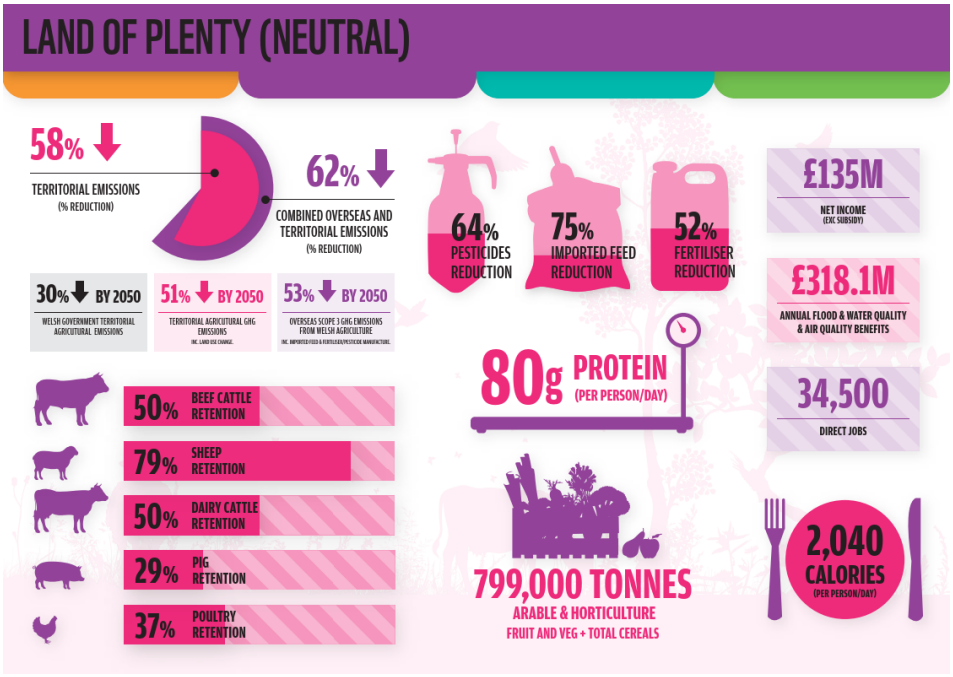
Table 1: Land area under agroecological management

Pathway A: Low Carbon Wales (33% of land in agroecology) – models an agroecological transition that we consider consistent with the Welsh Government's stated policy objectives outlined in the current Low Carbon Plan (2019), Net Zero Budget 2 (2021), the Agriculture (Wales) Act 2023, and the developing Sustainable Farming Scheme (SFS) as it stood in early 2023. Given this, changes to the SFS post the December 2023 public consultation, such as the removal of tree planting requirements, are not considered. As a result, this model is liable to significantly overestimate the level of change likely to be delivered by the SFS. Readers should consider its conclusions appropriately.

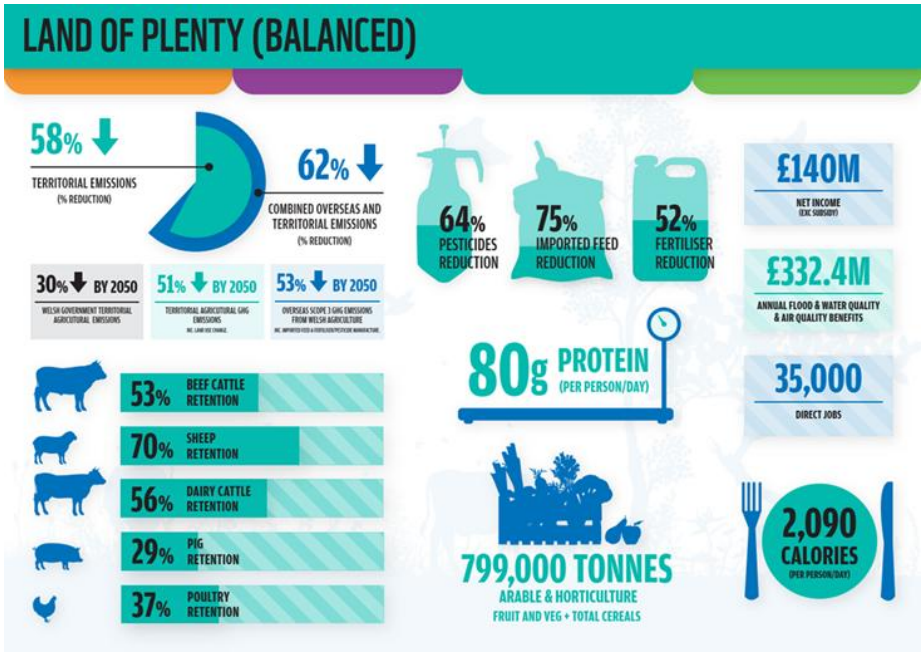


Pathway B: Land of Plenty (Neutral) (75% of land in agroecology) – models an agroecological transition consistent with the UK-wide assessment completed for WWF-UK's Land of Plenty report. These include:

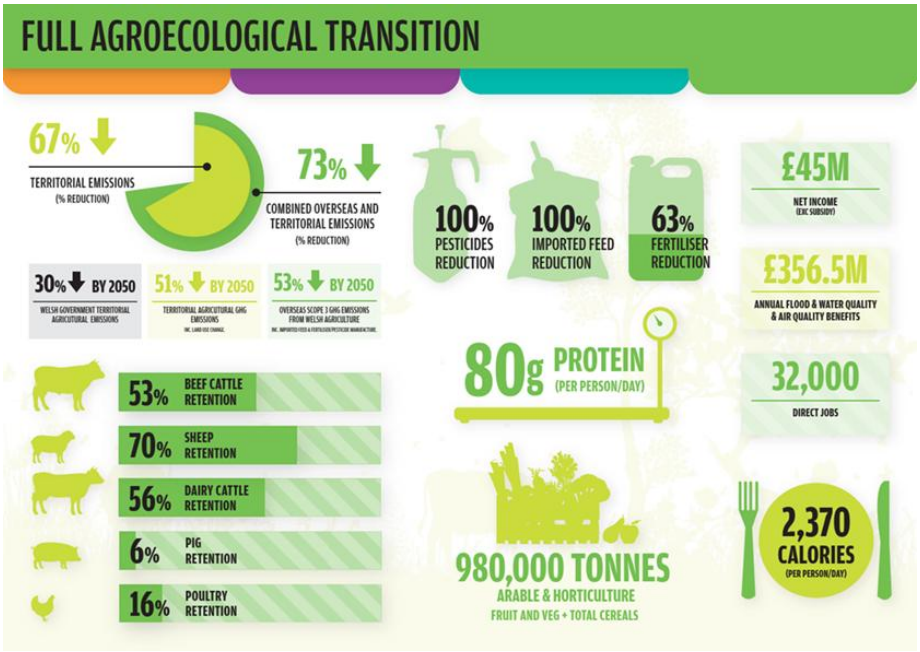
- Reduce UK direct agricultural greenhouse gas (GHG) emissions by 51% by 2050 on 2018 levels
- Switch UK land from a net source of GHG emissions to a net sink by 2040 at the very latest (noting that Wales is already a net sink but would need additional sequestration to support the wider UK)
- Halt and reverse the loss of UK nature by 2030
- Cut UK farming's overseas carbon footprint particularly relating to soy feed and fertiliser inputs by at least 57% by 2050 on 2018 levels.



Pathway C: Land of Plenty (Balanced) (75% of land in agroecology) models an agroecological transition consistent with the UK-wide assessment completed for WWF-UK's Land of Plenty report as detailed above, but further incorporating efforts to balance sheep and cattle numbers and thus show the potential to vary results and still achieve the same high-level impacts.



Pathway D: Full Agroecological Transition (100% of land in agroecology) runs the model in its purest form and presumes a complete transition to agroecological farming practices across all the Welsh agricultural area. There are no ambitions or targets set for this approach other than to see the results at the most extreme and thereby better understand Wales' potential for change.



RESULTS

Biophysical Implications

Emissions and Inputs

Each pathway considers the reduction potential of greenhouse gas emissions (GHG). These are considered both in terms of direct territorial emissions, and then combined with overseas Scope 3 emissions, inclusive of the impact of input reductions (such as fertilisers and imported animal feed).[8]

Impact	Low Carbon Wales	Land of Plenty (Neutral)	Land of Plenty (Balanced)	Full Agroecological Transition
Territorial GHG	40%	58%	58%	67%
Combined Territorial & Overseas GHG (excl. Land Use Change)	33%	62%	62%	73%
Fertiliser	36%	52%	52%	63%
Pesticide	35%	64%	64%	100%
Imported feed	33%	75%	75%	100%

Table 2 – Projected percentage reduction in emissions and input use

Taken together, the findings suggest that there is potential for significant emission reductions through agroecological farming practices. Many of these actions, such as reducing inputs and better management of slurry and waste, are being used by some farmers already, and can offer financial cost-savings and climate adaptation benefits in addition to emissions reduction. For example, across

[8] More detail on emissions reduction potential can be found in Annex A.

the UK, the total cost of nitrogen waste from all agricultural system sources is estimated at £1.1bn (based on November 2023 prices).

Within each pathway there remains a place for a high-welfare, low-input livestock sector in Wales, operating as part of agroecological farming systems. However, given over three quarters of agriculture's emissions (when Scope 3 is included) comes from animal feed, manure management and enteric methane, reductions in these areas should be significant. Methane, for example, is a potent short-term greenhouse gas, and as such any actions that can reduce methane emissions are critically important to take as soon as possible.

There are further options which have a significant mitigation potential but are not modelled due to limited peer reviewed research. These include the use of feed additives in diets, such as seaweed – for which there is a large commercial opportunity in the UK due to our suitability for growing kelp – or replacing some of the soy in animals' diets with novel feedstocks, such as insect-based or microbial protein. These could be UK growth industries of the future should regulation permit and could support the retention of livestock if such technologies prove viable.

Every pathway is successful in meeting the Welsh Government's historic territorial emissions reduction target for the agricultural sector of 30% relative to a 2018 baseline[9][10]. However, Pathway A does not show sufficient reduction to meet the Land of Plenty UK report's conclusion that a 51% reduction by 2050 is needed. Including Overseas emissions, Pathways B, C and D are projected to deliver reductions that are greater than Land of Plenty's recommendation of 53% reductions in both territorial and overseas emissions associated with UK farming by 2050. Pathway A, however, only delivers a 33% reduction because of a smaller transition to agroecological practices.

The Welsh Government is yet to state a target in relation to overseas scope 3 emissions. It is critical that the Welsh Government does set a target given that the footprint of Wales' food production and consumption is not limited to our shores as outlined in the 'Wales and Global Responsibility' report[11]. Welsh carbon budgets currently focus on 'at home' emissions and largely fail to account for the offshore footprint of Wales' food and farming as part of a global food system.

Reducing the demand for imported animal feed and increasing the supply of sustainable alternatives for example will be critical both to achieving our climate goals and ending deforestation abroad in the places this animal feed is produced. Setting only domestic targets risks offshoring harm elsewhere, rather than working to tackle the root causes of climate change and nature loss wherever they occur.

RECOMMENDATION

- A transition to more agroecological practices is a necessary step to achieving net zero by 2050 and reversing the decline of biodiversity. This requires leadership from the Welsh Government as the controllers of future subsidy support and regulatory conditions. To

[9] It should be noted that the Welsh Government's historic target ought to be considered a soft target as it predates the declaration of a Climate Emergency in 2019 and has not been updated. Figures for it in this report have been adjusted from the Welsh Government's original Carbon Budget to create a consistent 2018 baseline across the report.

[10] A 2018 baseline is used throughout this report to maintain consistency with WWF-UK's Land of Plenty. Welsh Government use a 1990 baseline. For example, Welsh Government's historic agricultural emissions reduction target was 28% and 36% by 2030 and 2050 compared to 1990. Where applicable 1990 baselines and associated targets have been converted to 2018 for consistency, making the Welsh Government historic targets 19% by 2030 and 30% by 2050 respectively. Annex A contains raw emissions reduction data which can be used to convert to a 1990 baseline at a reader's convenience.

[11] WWF Cymru et al. 2021. Wales and Global Responsibility : addressing Wales' overseas land footprint. https://www.wwf.org.uk/sites/default/files/2021-11/wwf_risky_b_wales.pdf

enable this, they must urgently set a new terrestrial and combined GHG emissions reduction target for the agricultural sector to set a glidepath for future support.

Food Production and Nutritional Security

Projections surrounding future stocking levels are controversial and provoke strong emotions. As the table below illustrates, each of the pathways projects a reduction in stocking levels as farmers transition to a more agroecological business model. This is a feature common to wider modelling attempts, including the Welsh Government's preliminary assessments of the SFS[12]. Destocking is also happening already due to market conditions.

To aid understanding, the data in this report shows the expected retention of stock compared to current levels, meaning that for Low Carbon Wales the model suggests that 80% of the current beef cattle stock would be retained, and for Full Agroecological Transition the model suggests that 6% of the current pig stock would be retained.

	Low Carbon Wales	Land of Plenty (Central)	Land of Plenty (Balanced)	Full Agroecological Transition
Beef Cattle	80%	50%	53%	31%
Dairy Cattle	84%	50%	56%	69%
Sheep	85%	79%	70%	33%
Pigs	69%	29%	29%	6%
Poultry	72%	37%	37%	16%

Table 3 - Percentage of stock retained

Across all pathways, retention of pigs and poultry are lowest. This is driven by the desire to reduce imported animal feed (agroecological farming uses shorter supply chains and so these pig farms would therefore be limited to feed products grown within Wales. In practice feed would likely be used from across the UK under agroecological practices, which would likely permit higher retention than this model considers).

This reflects that not all meat is produced equally. With ruminants, such as sheep and cattle, requiring a large land area for grazing, yet are well suited to Welsh topography and can exist as part of extensive farming systems with few inputs, and are therefore able to integrate spaces for nature's recovery and carbon sequestration. Non-ruminants, especially pigs and poultry, while appearing to have a lower GHG emission footprint, are often associated with more intensive practices that carry significant environmental risks and costs.

While the bulk of ruminants are retained in most pathways, the reductions still imply a significant impact on farm incomes. While there is now a substantial body of evidence to suggest that such

[12] Welsh Government. 2023. Potential economic effects of the Sustainable Farming Scheme: Phase 4 Universal Actions Modelling Results. https://www.gov.wales/sites/default/files/consultations/2023-12/potential-economic-effects-of-the-scheme-phase-4-universal-actions-modelling-results.pdf

reductions can lead to better farm level financial resilience and profitability[13], the impact on wider supply chains and retaining a critical mass for local supply chains needs to be carefully considered by any government pursuing a more sustainable food system. It could be the case that public money currently going to direct farm level support might be better targeted at the wider supply chain business to help any transition. An obvious example of this is to consider directly supporting small independent abattoirs.

Equally, livestock is only one part of the story from an agroecology perspective. Wales currently produces relatively little of what the public consume, meaning that from a nutritional perspective Wales can be considered as insecure and dependant on other countries for significant dietary needs. The transitions modelled permit the reallocation of suitable land to horticulture. This results in significant increases in the quantities of fruit, vegetables and cereals produced across the country.

The model estimates this could be achieved by using less than 15% of land classified as Grade 1-3a that is currently in agricultural use. For example, Full Agroecological Transition projects that it is possible to deliver 100% of Wales's fruit and vegetable requirements on only 2% of Welsh land[14].

	Low Carbon Wales	Land of Plenty (Central)	Land of Plenty (Balanced)	Full Agroecological Transition
Fruit & Veg	675%	1665%	1665%	2255%
Wheat	-6%	2%	2%	7%
Barley	-5%	3%	3%	8%
Oats	137%	441%	441%	622%
Cereals Combined	6%	40%	40%	60%

Table 4 - Percentage increase in tonnes of Fruit, Vegetables and Cereals production

Some of the percentage increases displayed above are very significant. This is because Wales currently produces very small amounts of these products. It is worth noting that such a significant rise in production would be a challenge to achieve quickly due to the relative lack of existing infrastructure and skills.

Were the Welsh Government wishing to support more domestic production of such products it should focus resources on developing on-farm infrastructure such as polytunnels, seasonal storage and packing sheds, as well as investing in wider supply-chain structures and public procurement that could support a shift to more local fruit and veg distribution.

RECOMMENDATION

- **Specific support to encourage the development of horticulture at all scales should be developed and integrated with community level engagement to improve connections between production and public consumption.**

[13] Wildlife Trusts and Nature Friendly Farming Network. 2023. Farming at the sweet spot – how farming with nature can make you happier, healthier and wealthier. https://www.wildlifetrusts.org/sites/default/files/2023-06/Farming%20at%20the%20Sweet%20Spot_1.pdf

[14] Food Sense Wales. 2024. Put Food at the heart of Welsh Government. Put-Food-and-the-heart-of-Welsh-Government.pdf

Implications of behaviour change

When considering what Welsh food production could look like in the decades ahead it is essential to be cognizant of the changing attitudes and behaviours of the public. This is essential not only to reflect future demand, but also to ensure that the full weight of climate action isn't placed on farmers. Changing the amount and type of food we eat, is as crucial to achieving meaningful improvements for climate and nature as the production methods encouraged and supported by public policy.

Different levels of dietary shift offer differing mitigation potential only if it directly leads to changes in domestic production. Currently very little of Welsh production is consumed in Wales, so it is difficult to make a direct read across without wider food system reform. As well as reducing emissions directly, it can also help create integrated nature recovery networks and carbon-rich habitats for wildlife to thrive. Yet our land constraints mean that switching to more regenerative practices without any shifts in diets to ease demand, risks pushing our impacts to other countries in the short term – something which must be avoided. The more we can make even modest changes to our diets in the right ways, the better it can be for both people and planet.

Recent trends suggest that red meat consumption in the UK is declining[15], and those changing consumption patterns should go hand in hand with support for farmers to change approaches to production, incorporating higher quality meat production into regenerative systems that enhance biodiversity by farming with nature and fix carbon and nitrogen into soils. Meanwhile, pork and chicken consumption are increasing, often produced in highly intensive and potentially polluting circumstances.

All the good work by Welsh farmers to shift towards nature-positive ways of reducing emissions, with high standards of production, will be for nothing if they are undercut by food produced to lower standards abroad. These diet shifts and the corresponding changes to food production therefore need to be considered extremely carefully.

	Calories (kcal)	Protein (g)
Government Dietary Recommendations (male)	2,500	56
Government Dietary Recommendations (female)	2,000	45
Low Carbon Wales	2,200	105
Land of Plenty (Central)	2,040	80
Land of Plenty (Balanced)	2,090	80
Full Agroecological Transition	2,370	80

Table 5 - Calories and protein produced by each pathway

The above table illustrates how each pathway would provide for a projected 2050 Welsh population. In doing so there are two important caveats. First, despite this report aiming to better link production and consumption in Wales, it is not advocating for Welsh self-sufficiency. Nonetheless, modelling relative to the population and nutritional need is a useful measure of production and will help

[15] Stewart, C. et al. 2021. Trends in UK meat consumption: analysis of data from years 1–11 (2008–09 to 2018–19) of the National Diet and Nutrition Survey rolling programme. The Lancet. https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(21)00228-X/fulltext

identify what is practical and sustainable, and where the potential exists for excess produce to continue to be sold outside of Wales. Second, this model does not include all food sources with significant protein sources such as fish and seafood excluded from the model. As a result, each model underestimates the total domestic food production.

Despite this underestimate each pathway greatly exceeds the daily protein requirement that Wales needs to supply a future population. It is important to note that the pathways do not supply all food groups necessary for a balanced diet. As a result, some imports would be required to plug these nutritional gaps. This highlights that not achieving 2500 daily calories is not a significant limitation.

Furthermore, given that self-sufficiency is not the goal, it could be argued that significant overproduction of protein-rich produce - relative to need - would ensure a healthy excess to be traded into the wider UK/European/Global food system in exchange for produce less easily produced in Wales that would fill dietary gaps. In other words, were Wales to embark on the scale of transitions highlighted by these pathways, it would be essential for the nation to maintain a calculated overproduction of protein rich products (red meat and dairy) to enable that trade.

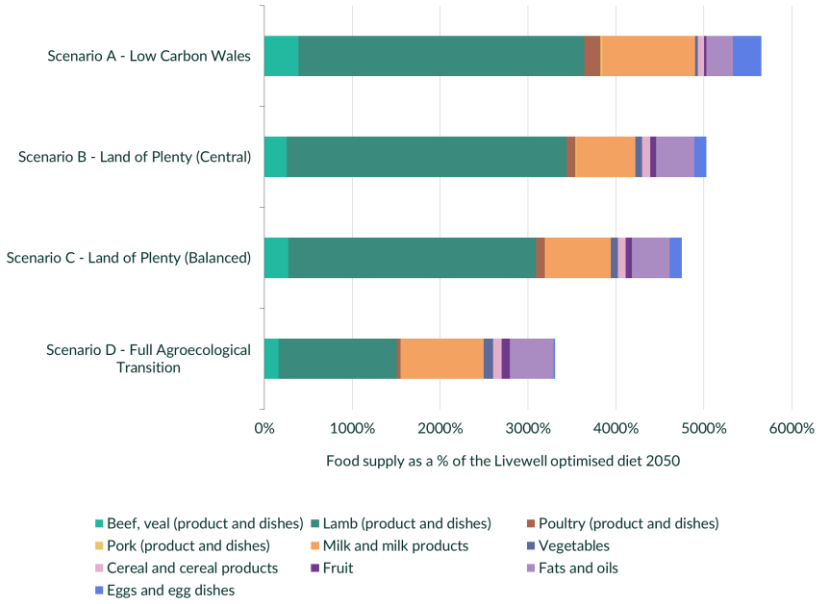


Figure 1 – Comparison of food supply to WWF LiveWell diet

Taking this analysis further and projecting an optimised WWF LiveWell diet that is good for both people and planet[16], total food supply generated in Wales is shown above. Under each pathway, despite some reductions in livestock production, total food supply generated is predicted to far exceed Welsh dietary demands under each scenario. Taking Land of Plenty (Balanced) as an example, Wales would be producing enough lamb to feed around 100 million people and enough milk for around 20 million people. These findings indicate that there will still be a significant export capacity available even with the stocking reductions highlighted previously.

[16] WWF-UK. 2023. Eating for Net Zero: how diet shift can enable a nature positive net-zero transition in the UK. https://www.wwf.org.uk/sites/default/files/2023-05/Eating_For_Net_Zero_Full_Report.pdf

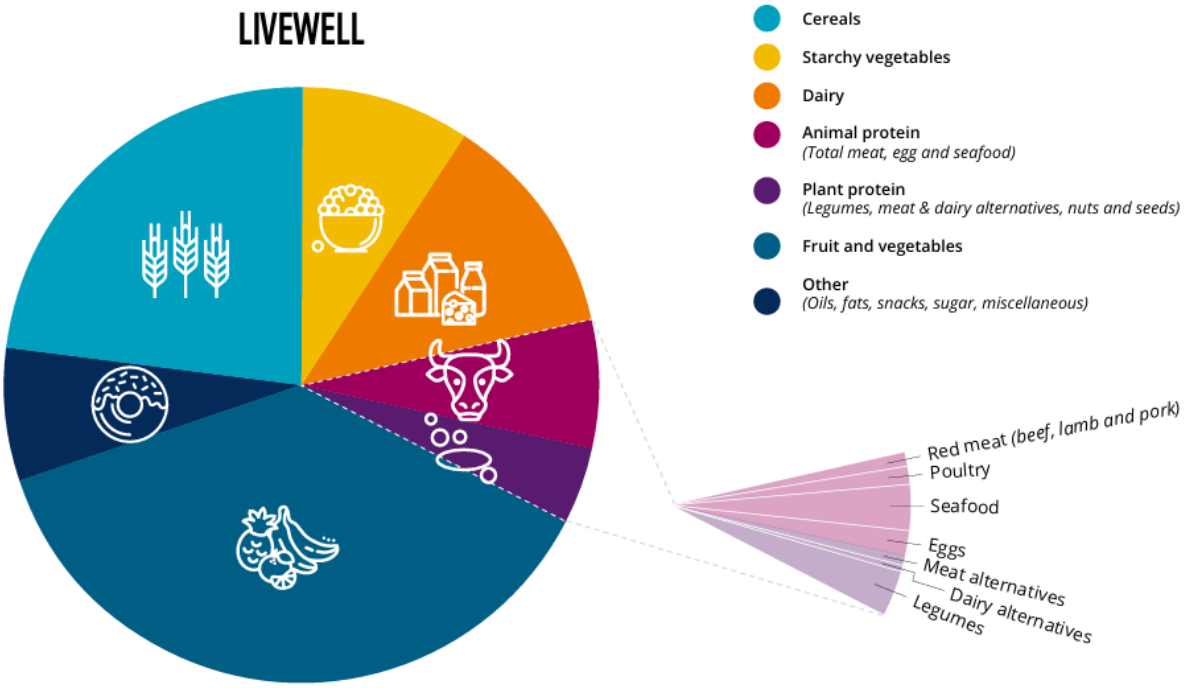


Figure 2 – WWF LiveWell diet

The overall conclusion is that these pathways are well suited to meet Wales' dietary requirements compared to the current Welsh food system - highlighting a significant increase in nutritional security. The agroecological scenarios also have the potential to supply the Welsh population with a more balanced range of foods than the current red meat and dairy dominated system. If this were combined with successful health policies that encouraged healthier diets, this could generate significant cost savings for Wales' healthcare system.

Detailed analysis of expected cost savings was beyond the scope of this report, but a 2019 document from the Welsh Government's *Healthy Weight: Healthy Wales* strategy reported that illnesses associated with obesity are projected to cost the Welsh NHS more than £465 million per year by 2050, with a cost to society and the economy of £2.4 billion.[17] Such improvements stem from the reality that just 30% of adults and 20% of children eat five or more portions of fruit and veg per day.[18] Wales has the highest level of diabetes in the UK, with over 200,000 people in Wales (8% of adults) diagnosed and an estimated 65,500 people, undiagnosed[19] with treatment for diabetes currently costing NHS Wales £500m per year.[20]

[17] Welsh Government. (2019). Healthy Weight: Healthy Wales, available at https://www.gov.wales/sites/default/files/consultations/2019-01/consultaton-document_0.pdf
[18] https://www.foodsensewales.org.uk/app/uploads/2023/02/Veg-Power-Eat-Them-to-Defeat-Them-Report-2022-in-Wales-Sept-2022.pdf
[19] https://research.senedd.wales/research-articles/can-we-stop-the-rise-in-diabetes/#:~:text=Wales%20has%20the%20highest%20rate,type%202%20diabetes%20in%20Wales.
[20] Senedd Research. 2023. Can we stop the rise in diabetes? https://research.senedd.wales/research-articles/can-we-stop-the-rise-in-diabetes/

RECOMMENDATION

- **Outside of direct farm subsidy support, public policy should focus on adding value into the supply chain and the development of better food infrastructure to both improve profitability and enable more Welsh produce to be accessed by the Welsh public.**

Socio-Economic Implications

Public Costs

Historically the public cost of agricultural support has been borne by the European Union. Going forward, Welsh farmers no longer have access to those funds and the burden will instead fall on the Welsh Government budget. As a result, public funding for agriculture will be in direct competition with other Welsh Government priorities such as the NHS and schools.

This means we should expect more stringent requirements to be placed upon agricultural spending and rising pressures on the budget in the face of wider spending priorities. This is already being seen in the recent funding cut to the Habitats Wales Scheme relative to historic schemes, and the development of the SFS – which is now based upon the legal requirement for future payments to support four intertwined Sustainable Land Management Objectives. Actions such as tree planting that are designed to support these objectives have already proven controversial, with several farmer led protests across the country that led to changes which risk a future failure to meet Welsh Government targets.

Yet these requirements in the SFS should result in more money entering Welsh agriculture if the environmental asks are sufficiently strong enough to justify it. Economist Matt Rayment estimated that the Scale of Need for the Welsh environment equates to £519m/y for the next decade[21]. This is significantly more than historic budgets. Given the overlap between agroecological practices and the ambitions of Rayment's analysis, we consider it to be a reasonable proxy for the cost of an ambitious future transition.

Included within this figure is the need for training. All pathways presume the continuation and expansion of existing training mechanisms such as Farming Connect and the Farm Liaison Service. Current budgets are in the region of £8.4m/y with the expectation that they will rise to more than £12m under the SFS. Given that what is mostly likely to change under each pathway is the content of this advice rather than the structures which provide it, it is not expected that the cost of providing such training will vary significantly, especially when transitions take place over multiple years.

This said, it is reasonable to assume that the more ambitious the transition, the more it is likely to cost to achieve it. Given this, while the Low Carbon Wales pathway can be assumed to match the indicated Welsh Government estimate of at least £238m[22]. In contrast a Full Agroecological Transition has the potential to use all funds allocated towards it. As such, it is reasonable to estimate that the cost of all modelled pathways will be between £238m and £519m per year, with the recognition that the upper end cost would reduce post transition.

[21] Rayment, M. (2024). For farming, nature and climate. https://www.wildlifetrusts.org/sites/default/files/2024-07/Scale%20of%20Need%20Report%20July%202024%20FINAL.pdf

[22] Senedd Research (2024) Sustainable Farming Scheme: your questions answered. https://research.senedd.wales/research-articles/sustainable-farming-scheme-your-questions-answered/

RECOMMENDATION

- **Agricultural support must be better recognised and championed within government for its critical role in delivering a more nutritionally secure, nature-rich, net zero Wales. Furthermore, investment in it must be increased in future budgets to reflect the scale of need and recognise its preventative value to wider budgets, such as the NHS, flooding, and water/air quality.**
- **Given that a transition to more agroecological farming practices will require a significant number of Welsh farmers to access training, current training resources should be refocused to provide adequate support.**

Employment

Employment across the Welsh agricultural sector has declined over the long term given improving efficiency, mechanisation, diversification, and low farm profitability under conventional farming practices. Between 2011 and 2022 the total Welsh agricultural labour force (including farmers and spouses) dropped from 58,415 to 49,876[23] - representing a percentage reduction of 14.6%. This is a greater reduction than was predicted an early impact analysis of the SFS which projected a further 5,500 losses were every farmer in Wales to participate in only the most basic elements of the scheme. While this suggests that the SFS would constitute an improvement on the status-quo in terms of the rate of decline, each pathway suggests that there will continue to be decreases in direct agricultural jobs in the future.

This reduction is despite the greater number of jobs required through agroecological practices, expanded forestry and recreation jobs, and an increase in horticulture. This assessment is supported by the work undertaken by the CCC which has identified changes in livestock farming as a risk to employment as we move towards a net zero economy[24]. While a decrease in direct agricultural jobs represents a significant, yet seemingly unavoidable negative under all outcomes, the greater financial viability of many farms operating under agroecological models suggest that those who remain could have a more resilient farm business if public support is correctly designed.

Yet, outside of direct agricultural jobs, significant potential for job creation exists in areas such as conservation, building local infrastructure, supply chains (e.g. food hubs), sustainable land management jobs (e.g. sustainable land management advisers), nature education, and community engagement. For example, an RSPB Cymru report estimated a job creation potential of almost 7,000 jobs over the next 10 years - with about half of those being nature-based tourism jobs[25].

Given this, it is essential that discussions around jobs are not limited to direct agricultural jobs alone, and instead include a wide-ranging assessment of the potential for agriculture adjacent jobs and the wider rural supply chain jobs when assessing the employment impact of agroecological transitions. While much of this is beyond the reach of this report, it should form a central pillar of further Welsh Government analysis. Alongside this should be efforts to ensure that the farming community are the first to benefit from any new employment opportunities created through the targeted funding of training and professional development programmes.

[23] Welsh Government (2023) Agricultural Statistics. https://www.gov.uk/government/statistical-data-sets/agricultural-workforce-in-the-united-kingdom-at-1-june

[24] Climate Change Committee (2023) A Net Zero workforce. https://www.theccc.org.uk/publication/a-net-zero-workforce/

[25] RSPB (2020) Developing a Greener Workforce in Wales. Developing a Green Workforce in Wales

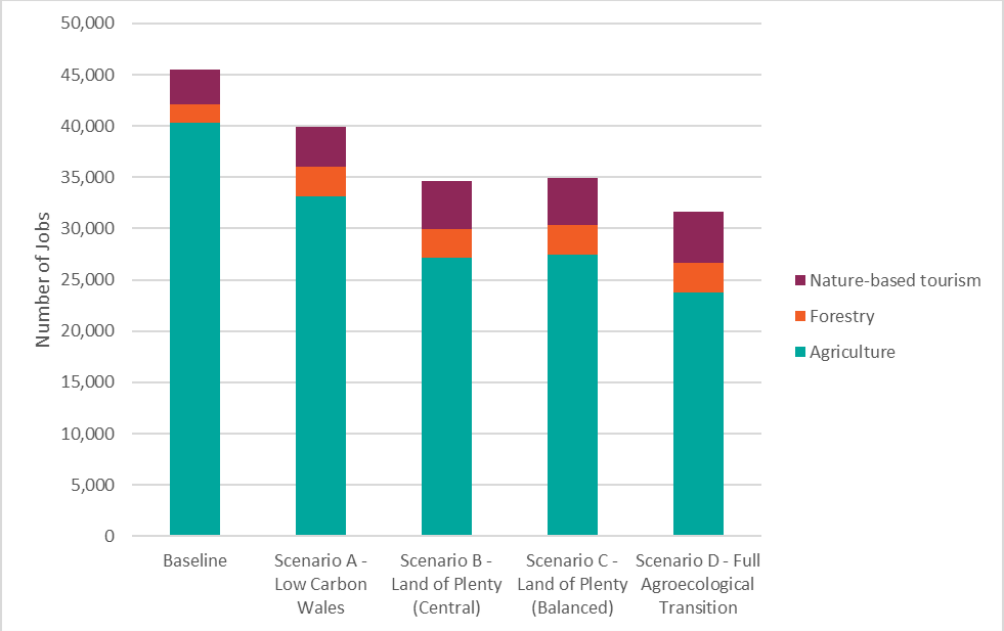


Figure 3 - Overall Direct Jobs across pathways

RECOMMENDATION

- **Welsh Government must fully assess the impacts of agroecological transitions on the economy as a whole and ensure that current and future generations of farmers are first in line to benefit from any new industries and sectors created.**

Farm-Level Economics

Farm Business Survey in Wales[26] data has been used to explore the economics of agroecology at a farm level. Results have been designed to show a 'worst case scenario' and were developed by the Cumulus consultancy.

This is achieved in four ways. First, the data is absent of any public subsidy. Second, no price premiums have been applied for agroecologically produced goods. Third, productivity is not projected to improve over time following the natural regeneration of soils. And fourth, where possible, the conventional baseline is given an optimistic outlook - this is achieved by not including fluctuating input costs (e.g. fertilisers and animal feeds), or the likely financial impact of extreme weather events which are currently causing the farming sector in Wales tens of millions of pounds each year[27].

It is highly probable that agroecological farms would be able to benefit from all the above, meaning that their economic outlook would be significantly more positive than these figures initially suggest. This farm level assessment is consistent to all pathways.

[26]Aberystwyth University. 2022. Farm Business Survey in Wales. https://www.aber.ac.uk/en/media/departmental/ibers/farmbusinesssurvey/Booklet_22_Eng_Web.pdf

[27] Farmlytics. 2024. Extreme weather and its impacts on farming viability in Wales. https://www.wwf.org.uk/sites/default/files/2024-03/5126%20-%20FARMING%20IN%20WALES_REPORT_v3.pdf

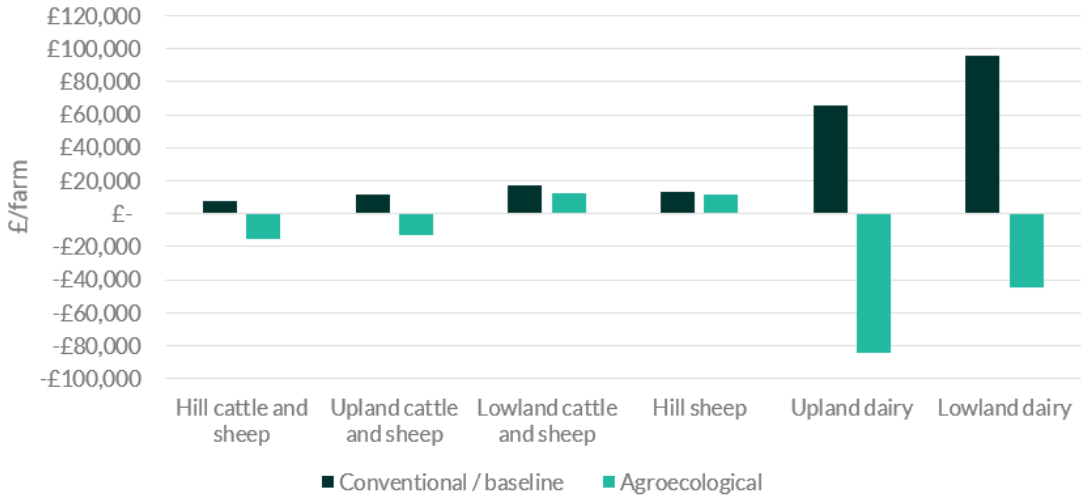


Figure 4 - Average Net Income (without BPS) conventional vs. agroecological

The results are very different depending on the type of farm considered (noting that types such as horticulture are excluded entirely due to the limited Wales specific data). At this level it is visible that two of the six farm types (Hill Sheep and Lowland Cattle and Sheep) are projected to maintain a positive net income when operating agroecologically. This strongly suggests that such an approach maintains farm viability.

Hill Sheep are projected to have a 12% lower net income compared to conventional with the assumption of a 33% drop in outputs (stocking levels) and a 38% drop in variables costs (e.g. imported feeds and synthetic fertilisers). The change in income at a sector level is a reduction of just £8/ha equivalent. The reintroduction of a market premium of just 2% would make agroecological Hill Sheep farms more profitable than their conventional equivalents.

The story is similar for Lowland Cattle and Sheep which remains positive despite an equivalent income reduction £48/ha. It is estimated that a market premium of just 3% would result in profits higher than their conventional equivalents.

Hill/Upland Cattle and Sheep farms fair less well under this analysis with their net income falling into the negative at -£15.6k and -£13.2k respectively. Despite this negativity, the figures for Upland/Lowland Dairy are significantly worse compared to their conventional equivalents. This will be unsurprising to many readers given the dependency of many Welsh dairy farms on the use of synthetic fertiliser and imported feed given that a grass diet alone does not produce the desired milk yield. As a result, while variable costs would be significantly reduced under a more agroecological model, reduced yield and stocking numbers result in substantial negative outcomes to net income.

Given these three broad groups it is worth considering how these results would now play out in the real world where subsidies, price premiums and productivity changes exist. As noted above, price premiums as low as 3% would be sufficient to make Hill Sheep and Lowland Cattle & Sheep farms more profitable than their conventional equivalents.

The difference between conventional and agroecological incomes for Hill/Upland Cattle & Sheep are likely too large to be addressed by price premiums alone. However, productivity improvement, lower input costs and targeted public subsidies for additional ecosystem services and diversification could be sufficient to return these farms to profit.

For both Upland and Lowland Dairy, the picture is significantly more challenging with more than a 24% price premium required to return the most advantageous farms to profit – a level of premium that is likely unachievable in the mass marketplace. Indeed, the difference is likely too large for many farms to overcome with additional public subsidies for ecosystem services and diversification, unless those payments were significantly larger than historic levels. More detailed dairy specific work outside of this report completed by WWF-UK and NatWest[28] has suggested that profitability can be improved over a multi-annual period, which does offer some positive outlook for the sector under an agroecological approach.

It is therefore reasonable to suggest that were the Welsh Government wishing to promote more sustainable practices from the dairy sector it should also explore bespoke support, and the leverage of additional private finance for ecosystem services. This should include additional direct investment in adding value into the supply chain to enable such farms to access better prices for products other than the raw milk market such as cheeses.

An alternative approach would be to permit conventional dairy farming to continue without public subsidies and to take a strong regulatory approach to prevent associated negative environmental and animal welfare issues from persisting. This would be possible under Pathways A, B, & C, which assume that between 25% and 66% of Welsh agricultural land remains conventionally farmed.

Yet presuming the desire remains to include dairy in future public support schemes, these results serve to demonstrate the severe challenges facing the sector in Wales. These farms tend to be structured for yield maximisation and have high fixed costs that are difficult to offset with agroecological management. Farm intensification has also driven conventional milk prices down, which fails to reflect the additional environmental, animal welfare and nutritional value agroecological dairy farms can provide.

Taken together these results suggest that outside of dairy, an agroecological transition is within reach for Welsh cattle and sheep farms with the correct application of public policy and a dependable and appropriately funded public subsidy regime.

RECOMMENDATION

- **Where agroecological practices are most viable, future public subsidies should require their implementation as part of secure and adequately financed multi-year agreements that support the cost of transition. Farmers already pursuing agroecological practices or transitioning must not be subject to a reduction or gap in support as Wales transitions to the Sustainable Farming Scheme (SFS).**
- **Where agroecological practices are less financially viable (such as dairy), future public subsidy regimes should seek to integrate private capital to boost total capacity and better focus resources towards nationally agreed outcomes (particularly nature and climate targets).**

Environmental Impacts

Given the intention of an agroecological transition to foster more regenerative, nature-friendly practices, it is unsurprising that each pathway provides additionalities when compared to conventional farming, including biodiversity, flood water storage, water and air quality benefits. However, they do vary significantly. Each pathway is expected to deliver substantial benefits to

[28] Fallow Years (2024).

society relative to current practices, with a value of between £305.4 million - £455.2 million per year, increasing according to the likely uptake of agroecology. Table XX provides a summary of these results and subsequent sections have attributed monetary values where possible.

	Pathway A – Low Carbon Wales	Pathway B – Land of Plenty (Neutral)	Pathway C – Land of Plenty (Balanced)	Pathway D– Full Agroecological Transition
Biodiversity	+ +	+ +	+ +	+ + +
Flood management	+ + +	+ +	+ + +	+ + +
Water quality	+	+ +	+ +	+ + +
Air quality	+ + +	+ +	+ + +	+ + +

Table 6 - Environmental Impacts Summary

Biodiversity

Biodiversity loss in Wales has been well documented, including the 2023 State of Nature Report[29]. Given the challenges around quantifying the impacts of different land use and management changes at the national level on biodiversity, the benefit in this study has been assessed qualitatively, looking across both on farm and off farm (i.e. land managed for nature) practices in terms of the likely direction of impact.

All pathways involve integrating and managing agricultural land for woodland planting or nature more generally. Roughly 16% of agricultural land (276,700-287,700ha) across all pathways is assumed to be taken out of production to meet woodland creation targets as well as non-food priorities to meet national level climate goals[30]. Overall, this is likely to have a significant impact on reversing biodiversity loss in Wales and helping to meet its 30x30 target[31]

It should be noted that the eventual impact on biodiversity will depend on how it is factored into decision-making with respect to other environmental benefits. Monocultures of conifers will likely be the most effective solution for maximising carbon sequestration; however, this could have a detrimental effect on biodiversity. Instead, a diverse mix of tree species are needed to enable diversity for nature. Similarly, there are trade-offs with flood management, whereby certain habitats may be best suited for specific locations due to their flood mitigation potential, however these are not optimal for promoting biodiversity or the connectivity of habitats. This underlines the

[29] State of Nature report. 2023. https://stateofnature.org.uk/countries/wales/

[30] It should be noted that due to SFS requirements, land from all land grades has been managed for woodland planting and nature, allowing for the maximum range of species to flourish. To minimise the impact on food production, additional land set aside to meet the CCC requirements has been prioritised from lower land grades (4 and 5).

[31] Welsh Government (2022). Written Statement: Biodiversity Deep Dive, available at https://www.gov.wales/written-statement-biodiversity-deep-dive

importance of developing a robust quantitative measure for biodiversity to allow for a comprehensive comparison of the trade-offs to inform decision-making.

Flood Management

While all natural habitats intercept rainfall and slow the speed of water run-off to some extent, robust quantitative data is only available for the impact of woodlands. The flood management benefits have been estimated based on the extent of new woodland planted in each scenario relative to the status quo. The benefit has been assessed through the additional volume of rainfall intercepted and stored by created woodland, reducing the demands on both the wastewater treatment system and the need for building and maintaining traditional floodwater storage. For both benefits, Welsh specific metrics in the literature have been applied.

Since expected future woodland planting is similar for the four scenarios, so too are the total benefit values. These fall in the range of £92m to £98m of benefit per year. These represent significant savings for bodies such as Welsh Water which are likely to affect the prices the public pay. It is also likely that these efforts will have additional savings to bodies such as NRW and ultimately Welsh Government through reduced flooding impacts, but we have not been able to model them explicitly.

	Pathway A – Low Carbon Wales	Pathway B – Land of Plenty (Neutral)	Pathway C – Land of Plenty (Balanced)	Pathway D – Full Agroecological Transition
Woodland planted	179,900 ha	168,500 ha	179,900 ha	179,900 ha
Avoided wastewater treatment (£/year – 2023 prices)	£81.3m	£76.1m	£81.3m	£81.3m
Avoided storage building (£/year – 2023 prices)	£17.0m	£15.9m	£17.0m	£17.0m
Total flood management benefit (£/year – 2023 prices)	£98.2m	£92.0m	£98.2m	£98.2m

Table 7 – Flood Management Impact

Water Quality

A large proportion of the synthetic nitrate and phosphate fertilisers used on conventionally farmed land leach into water bodies: typically, between 55% and 70% of nitrogen, and 80% of phosphorus in fertilisers is not taken up and instead leaches or runs off into the environment[32]. This is also true for natural sources of fertiliser such as animal manure, especially if applied near watercourses. The benefits to water quality under each pathway has been calculated based on the estimated reduction in average fertiliser use due to changes in land use and are displayed in Table 8.

[32] Umar W et al (2020). Nitrogen and Phosphorus Use Efficiency in Agroecosystems, available at https://link.springer.com/chapter/10.1007/978-981-15-6953-1_7

Since the reduction in average fertiliser use vary somewhat between the different pathways, the benefits to water quality similarly vary between £84 million and £145 million, with the greatest benefit seen under Pathway D due to the quantity of fertiliser used decreasing by 63%.

It should be noted that the values for the baseline quantity of fertiliser used, and the cost of wastewater treatment are general to the UK as opposed to Wales specific, and so the overall values should be seen as indicative. However, it is possible that the benefits may be greater than estimated, as the reduction in fertiliser use does not reflect any possible additional decrease due to improved land management practices including precision application and nitrogen fixing.

	Pathway A – Low Carbon Wales	Pathway B – Land of Plenty (Neutral)	Pathway C – Land of Plenty (Balanced)	Pathway D – Full Agroecological Transition
Arable farmland (ha)	110,200	162,400	162,200	193,200
Pasture farmland (ha)	1,333,000	1,291,500	1,280,900	1,250,000
Reduction in fertiliser use	36%	52%	52%	63%
Water quality benefit (£/year – 2023 prices)	£83.5m	£120.1m	£121.2m	£145.3m

Table 8 – Water Quality Impacts

Air Quality

Natural habitats remove pollutants from the air, improving human health and wellbeing, productivity, and the environment. While all natural habitats filter pollutants, quantitative data is most robust for the impact of woodlands.

The benefits have been assessed through the amount of particulate matter 2.5 ($PM_{2.5}$), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) captured by newly planted woodland, applying Welsh specific pollutant removal factors from Defra's recent paper on Valuing Non-Woodland Trees (Defra, 2022)[33]. The impact of this removal was then valued through applying the most recent UK air quality damage costs (Defra, 2023)[34] based on the avoided healthcare costs from reduced human exposure to the pollutants. The low sensitivity range was applied to reflect that the new woodlands will predominantly be planted in rural areas where both the background concentrations of air pollutants are low (and hence the trees have a more limited impact) as well as the number of people exposed to the improvement.

Since expected future woodland planting is similar for the four scenarios, as are the total benefit values. These fall in the range of £106m to £113m of benefit per year, again significant benefits

[33] Defra (2022). Valuing Non-Woodland Trees, available at https://cdn.forestresearch.gov.uk/2022/09/Valuing-our-Non-Woodland-Trees_Final-Report_2022-09-07.pdf

[34] Defra (2023). Air quality appraisal: damage cost guidance, available at https://www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-damage-cost-guidance#annex-a

which should be considered for decision making as they are liable to affect wider Welsh Government budgets over time, such as the NHS.

It should also be noted that only woodland is being picked up under this methodology as opposed to land managed for nature more broadly due to the lack of robust evidence, and so the true values for air pollution removal across all scenarios are likely to be underestimated.

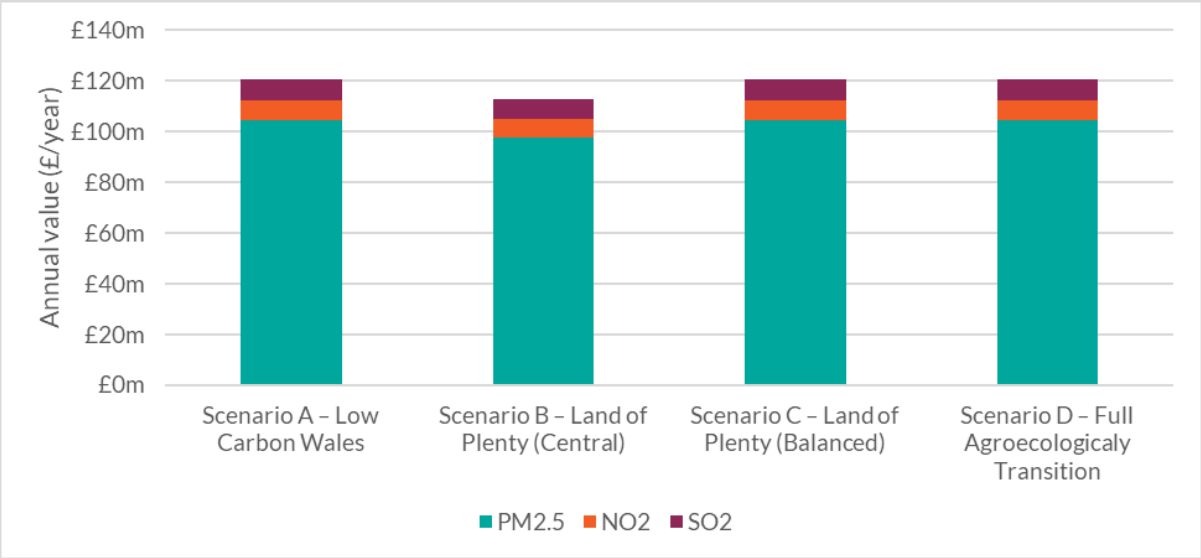


Figure 5 – Air Quality Impacts

RECOMMENDATION

- **Welsh Government must establish nitrogen, methane, and freshwater pollution reduction targets as part of a new suite of biodiversity metrics. These must be used to foster further investment in agricultural support which enable their obtainment.**

Cultural Implications

Recreation

Recreational benefits have been assessed based on the welfare gained by those using open access greenspaces, proxied in this report by the amount of land managed for nature and woodland planting in each of the pathways[35]. To model the estimated number of visits to these natural spaces, a study of a moorland restoration project in Powys[36] was used as a benchmark, where additional recreational visits relative to the current land use were assessed using the Outdoor Recreational Valuation Tool (ORVal).[37] This tool predicts visitor numbers to greenspaces based on a number of factors including the quality of the greenspace, the availability of alternative recreational spaces and proximity to urban areas. For the purposes of this report, we have assumed that the welfare values from each visit is broadly like the Powys study and apply across Wales, and as such, the values should

[35] It should be noted that the analysis does not account for changes to recreational visits resulting from land management change (i.e. shifting from conventional to nature-rich agroecological farming) due to a lack of robust quantitative data. The recreation figures presented above relate solely to those resulting from the additional land managed specifically for nature and woodland.

[36] Powys Moorland Partnership (2018). Powys Moors Natural Capital Report, available at https://powysmoorlands.cymru/powys-moors-natural-capital-report/

[37] Day B, Smith G (2018). ORVal – The Outdoor Recreation Valuation Tool. https://www.leep.exeter.ac.uk/orval/documents

be seen as indicative. It should also be noted that ORVal only accounts for short local trips, excluding day trips and domestic tourism, and therefore these estimates may underestimate the full impact.

Given that the total area of land prioritised for (open access) nature is modelled to be broadly similar across the pathways (276,700-287,700ha), as are the predicted visitor numbers and welfare values. In particular, the creation of natural spaces is expected to promote an additional 2.2-2.3 million visits to nature in Wales, with an expected welfare gain to these visitors in the region of £7.5-8.0m.

Physical and Mental Health

Spending time in nature has direct benefits to visitors' physical and mental health beyond those assessed under recreation, with implications for savings to the healthcare system in Wales. In particular, active use of the natural environment is associated with lower rates of cardiovascular disease, diabetes and mental health issues, and therefore less frequent treatment is required. The benefits have been estimated based on proxy values included in Defra's ENCA Services' Databook. It should be noted however that they are generalisable to the UK level as opposed to Wales.

Furthermore, there is likely to be some level of overlap between these benefits and those presented under recreation and so when used they should be presented separately and not aggregated. As with recreation above, given the visitor numbers are broadly consistent across the four pathways, as are the physical and mental health benefits, which are estimated to be around £3.4-3.5 million and £0.9-1.0 million respectively.

Finally, it's important to stress that the health benefits from improved diets have not been modelled, nor the impact from changes to income and employment patterns as a result of the transition. **The figures presented above should therefore be seen as an underestimate of the true impact on physical and mental health.**

Welsh Language

The agricultural sector in Wales makes an important contribution to maintaining the Welsh language, employing a large number of Welsh speakers relative to its size. Due to this the continued reduction of permanent employment in each pathway yields negative results for all pathways.

However, since many Welsh-speaking farmers are upland farmers, the potential of agroecological hill sheep farming to be more profitable under a supported agroecological system could have a positive influence on the preservation of the Welsh language. The job creation potential in sectors such as forestry and nature-based tourism could also help to counteract the decline of the Welsh language, by providing alternative employment opportunities in rural areas, thereby encouraging young people to stay in rural, Welsh-speaking communities.

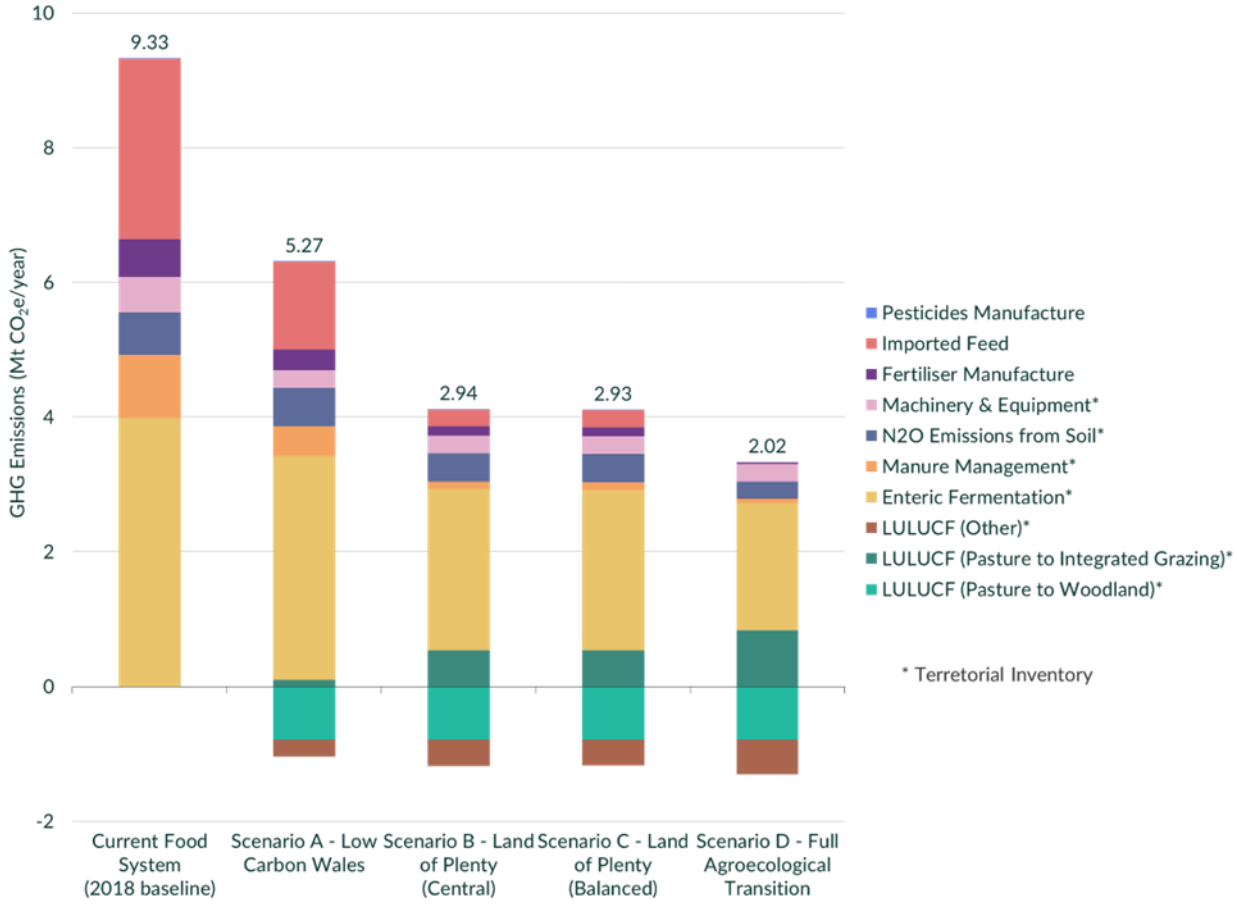
RECOMMENDATION

- **Future public support for an agroecological transition must seek to maximise the benefits to the wider rural economy by supporting new recreation and public health opportunities. These should be based on the creation of secure, skilled jobs which serve to sustain and protect rural communities.**

Annex A- Detailed breakdown of absolute GHG emissions and removals

GHG Source	$MtCO_2e$/year				
	Current	Scenario A	Scenario B	Scenario C	Scenario D
Territorial Emissions (excluding LUC)					
Enteric Fermentation	3.99	3.32	2.40	2.39	1.89
Manure Management	0.94	0.44	0.10	0.11	0.06
N_2O Emissions from Soil	0.63	0.58	0.42	0.42	0.26
Machinery & Equipment	0.53	0.26	0.26	0.26	0.26
Overseas Scope 3 Emissions					
Fertiliser Manufacture	0.56	0.30	0.13	0.13	0.02
Imported Feed	2.68	1.31	0.25	0.25	0.00
Pesticides Manufacture	0.01	0.01	0.00	0.00	0.00
Territorial Emissions (LUC)					
LULUCF (Pasture to Woodland)	0.00	-0.78	-0.79	-0.78	-0.78
LULUCF (Pasture to Integrated Grazing)	0.00	0.10	0.53	0.53	0.83
LULUCF (Other)*	0.00	-0.25	-0.39	-0.39	-0.52
Total Territorial Emissions (incl. LUC)	6.08	3.66	2.55	2.55	2.00
Total Territorial and Overseas Scope 3 Emissions (excl. LUC)	9.33	6.21	3.58	3.57	2.49
Total Territorial and Overseas Scope 3 Emissions (incl. LUC)	9.33	5.27	2.94	2.93	2.02

***** LULUCF (Other)' includes sequestration from integrated crop-livestock and cover cropping.


10
8
6
4
2
0
-2
GHG Emissions (Mt CO_2e/year)
9.33
5.27
2.94
2.93
2.02
Current Food System (2018 baseline)
Scenario A - Low Carbon Wales
Scenario B - Land of Plenty (Central)
Scenario C - Land of Plenty (Balanced)
Scenario D - Full Agroecological Transition
Pesticides Manufacture
Imported Feed
Fertiliser Manufacture
Machinery & Equipment*
N2O Emissions from Soil*
Manure Management*
Enteric Fermentation*
LULUCF (Other)*
LULUCF (Pasture to Integrated Grazing)*
LULUCF (Pasture to Woodland)*
* Terretorial Inventory