

# Farming at *The Sweet Spot*

How farming with nature can make  
you happier, healthier, and wealthier



## Foreword

Farming matters. For the food we eat, the water we drink, the air we breathe and the landscapes we cherish. For centuries, farming has sustained us while serving as the bedrock of our rural communities. But over time, our food system has narrowed its fixation on productivity and output, knocking off-kilter the balance between farming and our natural environment. As a result, agriculture has become vulnerable to risks and shocks and more reliant on external inputs to maintain production levels. In the process, we are eroding the ecosystem functions we rely on for sustainable and cost-effective production, creating a paradigm of cause-and-effect where the more we degrade our landscape's natural assets, the more we rely on extensive inputs and the less profit we see which drives further production, and the cycle continues, much to the detriment of farmer livelihoods.

The environmental consequences of production-at-all-costs have been long known, but as recent years have shown us, the impacts on farm businesses are becoming increasingly apparent. Declining soil health makes us more susceptible to flooding and drought. As biodiversity disappears from our farmed landscapes, we deprive farming of valuable ecosystem services, such as pollination and pest control. Farm businesses absorb the rising costs of environmental damage, resulting in dependency on expensive artificial inputs to substitute the landscape's natural fertility. Our reliance on chemical solutions brings eye-watering bills to farming's balance sheet and reduces our ability to weather the unpredictable.

Against the backdrop of a volatile and changing marketplace, climate change and biodiversity loss, farming is precariously placed to weather the extremes on all fronts. The true cost of this has been hidden from view for decades, but it is now writ large on our balance sheet. With declining profitability and greater fragility emerging in our

food system, we need to rethink how we farm for greater commercial return and improved farm environments. The Nature Friendly Farming Network is delighted to publish this report with The Wildlife Trusts and Nethergill Associates in recognition of a shift away from a farming system that fuels vulnerability to one that is part of the solution.

In this report, we examine a business approach that measures individual farms' financial and environmental sustainability and the potential for improving farm viability without subsidy. This concept, coined the Maximum Sustainable Output, identifies a balance point between farm outputs, commercial return and nature to generate greater profitability and overall environmental resilience.

This report demonstrates how moving to nature-friendly farming can be productive and financially robust for farm businesses across the sector. The evidence shows how putting nature at the forefront of decision-making can release farms from the vice grip of input dependency without undermining nature and the climate – a prerequisite for our long-term security.



**Martin Lines**  
UK Chair,  
Nature Friendly Farming Network

## Foreword

It is no secret that increasingly intensive agricultural practices have had a huge impact on the natural world and have arguably been the most destructive force against nature over the past century. For a sector which sees itself as custodian of the countryside, this is a difficult reality to face up to, but the evidence is clear.

This is not the fault of farmers, but rather the result of a broken food system. A system which follows a doctrine of maximising output and fails to properly account for the value of nature. A system which is overly reliant on vast quantities of toxic pesticides and synthetic fertilisers, most of which ends up in our soils and rivers polluting our wildlife. A system which uses huge areas of high-quality agricultural land to grow food to feed to animals.

### *The system is broken. We need change.*

We need a radical transformation of our food and farming systems. Years of agri-environment and stewardship schemes have failed to stem the declines of nature, with 1 in 9 species in the UK now facing extinction. We will not put nature in recovery by continuing business as usual, with a token gesture towards nature by improving our hedgerows and wildflower margins – we need a more fundamental shift in our attitudes to farming and nature.

Crucially, this change must not be done to farmers, but with farmers. They are the backbone of our food production systems, stewards of the land, and custodians of our shared natural resources. Their invaluable expertise, experience, and dedication are vital to shaping a sustainable future. The Wildlife Trusts are excited to launch this report with the Nature Friendly Farming Network and Nethergill Associates, recognising the key role of farmers and growers and working to empower them to be agents of change.

In this report, we propose a new model for farming systems which represents a paradigm shift in food production systems. By shifting the metric of success away from traditional output and instead looking to optimise farmer profitability, working with nature, and improving business resilience, there is huge potential to transform our rural economies and put nature's recovery in the fast lane.

Our report draws on new evidence that reveals producing food using the naturally available resources of the land, without the additional use of pesticides and synthetic fertilisers, is not only better for nature but is actually more profitable. This concept of the Maximum Sustainable Output has been shown to apply across the agricultural sector, from upland sheep farming to lowland arable businesses.

This report offers a roadmap to an alternative future. It shows that change is possible and is already happening, with many farmers looking for a new model for farming. By embracing this approach, we can revolutionise our relationship with the land, bring nature back, mitigate climate change, and secure a prosperous future for our farmers.



**Craig Bennett**  
Chief Executive,  
The Wildlife Trusts



# 1 Introduction

A significant change is underway for agriculture in the UK. The UK's withdrawal from the European Union has sparked a national conversation on the role of public funding for farming, along with far-reaching changes in trade policy and wider regulation. At the same time, farmers are being buffeted by the increasingly tangible impacts of a changing climate, with a record breaking heatwave in 2022 along with more extreme rainfall patterns and even wildfire becoming an increasing risk for farmers. With nature in continuing – and well documented – decline, the problems created by climate change are intensified by degraded habitats, poor soils, and declines in beneficial insect populations.

Global events such as Covid-19 and the war in Ukraine have exposed the fragility of our modern food system and its heavy reliance on 'just-in-time' global supply chains<sup>1</sup>, not just for food but for the industrial inputs which many modern farm systems depend on. The sky-high inflation that's driving energy and fuel costs through the roof is piling further pressure on farm businesses which are doing their best to stay afloat.

It is understandable that many farmers look to respond to these pressures by investing more and more inputs into their current farm system to squeeze every last ounce of productivity out of their farm – but this approach is doomed to fail.

Intensive agricultural practices in the UK are a major driver of nature loss – they are the most significant polluter of watercourses, have led to soil degradation and the loss of soil organic carbon<sup>2</sup>, and account for around 10% of the UK's greenhouse gas emissions<sup>3</sup>. At the same time, food production is increasingly exposed to changing climate and extreme weather events<sup>4</sup>. Paradoxically the way land is currently managed to produce food is contributing to the very biodiversity and climate crises that undermine its long-term viability, and undermine the basis of farm profitability.

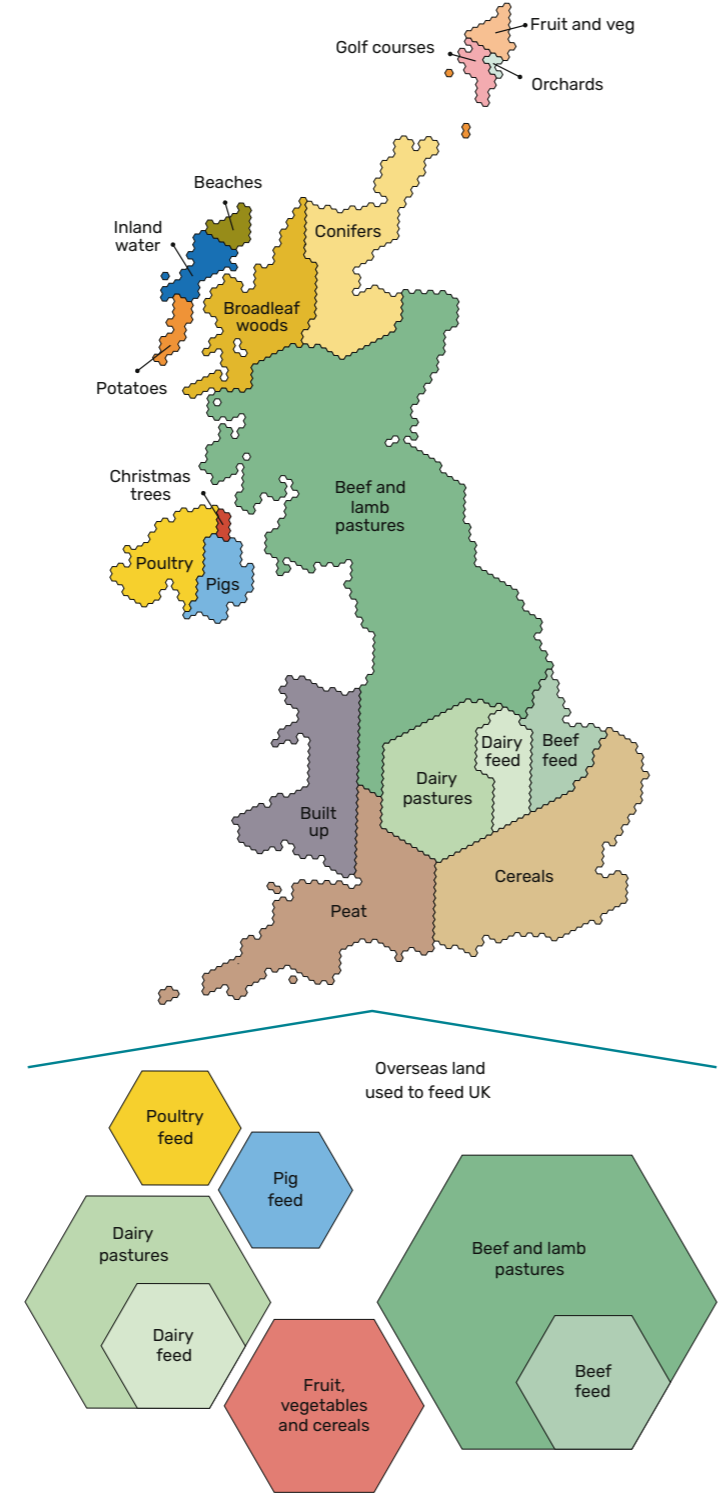
*Tackling the nature and climate crises is critical to UK economic prosperity and food security. A fundamental shift in farming practises is essential to meet this dual crisis.*

For many decades, the agricultural sector has been dominated by a dogmatic focus on greater productivity by increasing yields through increasing inputs such as fertiliser and pesticides. This has led to an industrial intensification of the farmed environment, accompanied by an increasing reliance on artificial inputs such as fertilisers and feed concentrates. Although this has led to greater availability of food at a lower price for consumers, this has come at a cost – greater food waste, growing malnutrition, and environmental degradation such as polluted rivers. This has been called the 'productivity paradox'<sup>5</sup>.

This has led to calls for a serious rethink of the way we produce food, moving away from a focus only on 'high inputs, high yields' towards one that focuses on the overall

sustainability of farming systems. We need a food system that is resilient to future shocks (economic and climatic) and that operates in harmony with the natural environment, and where profitability of farm businesses is improved.

Agriculture can be part of the solution. Farmers and land managers play a central role in determining the health of the UK's natural environment, with agricultural land making up 71% of the UK's total area<sup>6</sup>.



**Fig 1:** Representative map of land Use for Food and Farming in the UK (taken from National Food Strategy Independent Review, 2021)



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The way in which the land is managed has significant impacts on the environment and plays a critical role in delivering the Government's environmental and climate objectives, such as the 2050 Net Zero target and the legally binding targets under the Environment Act 2021<sup>7</sup> that require action to address species decline, improve soil health, and restore the health of aquatic environments by reducing pollution. In addition, a healthy and thriving natural world is essential for supporting a resilient food system and enabling long-term food security.

*Farmers must be supported to transition towards methods of food production which are compatible with restoring and improving nature, and that mitigate climate change.*

Many farmers are already starting to demonstrate that this is feasible and that farming in a way that harnesses nature can also be more profitable, through reducing their dependence on inputs and adopting more sustainable agriculture methods.

This report explores the concept of a "sweet spot", where farming can help contribute to nature recovery and increase profitability at the same time, offering farmers a lifeline during this time of immense turmoil. Analysis on the financial sustainability of 165 farm businesses<sup>8</sup> by Nethergill Associates shows that maximising production at the expense of the environment is both economically and environmentally unsustainable.

The analysis demonstrates that moving towards an approach to farming that works in harmony with nature would help farm businesses become more profitable, increase their resilience to external shocks and stressors<sup>9,10</sup>, and reduce reliance on inputs such as fossil fuels, fertilisers and animal feed.

*By farming at the 'sweet spot', producing food using the naturally available resources of the land without the use of pesticides and synthetic fertilisers, farmers can increase their resilience to climate change and help restore nature whilst also becoming more profitable.*

The report builds upon previous research in the uplands<sup>11</sup> to show that this approach to farming is also applicable to the lowlands. If adopted more widely, this could help achieve a transition to more profitable and sustainable farming systems over large areas of the countryside, while delivering key environmental benefits.

## 2 Improving farm profitability and restoring nature

Over the past five years, Nethergill Associates have worked with 165 farmers, carrying out detailed financial analyses of their business accounts, to look at how the agricultural parts of the business can be made more profitable before support payments and other revenue streams are taken into account. These farm businesses cover mainly beef, sheep, dairy and mixed enterprises in both upland and lowland situations. The analysis also showed positive results for arable farms but along with pig, poultry and horticultural production, further work is required to identify and quantify respective opportunities for improved profitability from input reduction in this sector.

The results of the study show that farm businesses improve their commercial returns<sup>1</sup> if outputs are reduced to a level where production relies on the farm's naturally available resources and other essential costs of production (see below), so that the costs of inputs drop dramatically. Put simply, eliminating costly inputs such as artificial fertilisers and imported feed concentrate was found to make farmers significantly better off across all farm systems studied.

The analysis employs an approach developed specifically for this purpose ('the Nethergill approach'), which applies standard micro-economic theory to farm accounts in a way that farmers can relate to. The central concept of this approach is to identify the point where commercial returns are maximised for the farm business, which they have called the **'Maximum Sustainable Output'** or MSO. While the calculations are modelled estimates and the MSO point is not static as it depends on a range of physical factors, it ultimately provides an indication of a direction of travel for improving commercial returns. This approach is described in detail in the 2019 'Less is More' report, a summary of which is provided in the Technical Annex to this report.

To identify the MSO point, the revenue, variable and fixed costs associated with the farming activities are assessed to understand the underlying dynamics of the business. The MSO point is always calculated before any support payments are taken into account. Since variable costs are not linear, they separate these into two categories which are considered to be sequential:

- **Productive Variable Costs (PVC)** – these are the essential or unavoidable costs incurred when producing within the confines of the naturally available resources – this includes seed, bedding, contract labour, essential vet and medication costs, etc.
- **Corrective Variable Costs (CVC)** – these are avoidable or non-essential costs associated with production above what is possible to be produced using the naturally available resources (e.g. artificial fertilisers, plant protection products, or bought in feed – inputs with an industrial energy content).

Farm businesses are also subject to **Fixed Costs**. These are the costs incurred even if no output is produced (e.g. rent, utilities, labour, machinery, bank interest & charges).

Fixed costs may fall into different categories: Essential and unavoidable (no business possible without these costs); Mandatory (e.g. to adhere to regulations); Unnecessary (e.g. over specified equipment).

Through discussions with farmers, Nethergill Associates found that many farm businesses were making decisions based on the assumption that their variable costs were linear and that their output would increase in proportion to increases in inputs. On closer inspection, it became clear that the point at which their commercial returns were greatest would be achieved with a lower volume of output and inputs. This point (the MSO point) is always modelled as the point at which CVCs have been eliminated as these are always greater than the loss of revenue associated with lower levels of output.

*"This approach changes the yardstick for success away from the volume of production, to one that focuses on maximising commercial returns (before support payments) and leads to a way of farming that is much more aligned to farming in balance with the natural resources available"*

Chris Clark, Nethergill Associates

### Example 1: Arable

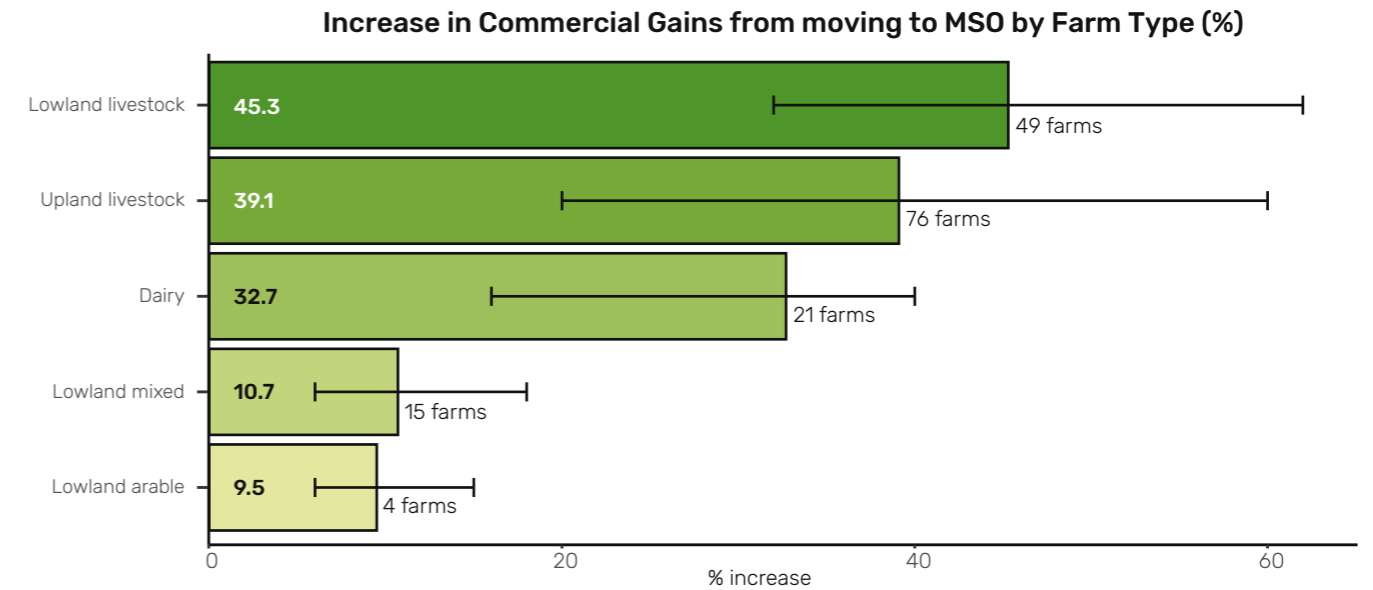
A 750 ha arable farm on the North East Essex Coast on mostly clay soils, using diverse crop rotations, cover cropping and direct drilling to reduce inputs and improve biodiversity. Most of the land farmed is in Countryside Stewardship and SFI.

*"MSO gives me the ability to measure the financial and environmental sustainability of my farm business over time, to assess how nature farming practices benefit my profitability as I reduce my reliance on artificial fertiliser. It is the only method I have come across that includes the naturally available resources when looking at farm efficiency and as such provides an exciting new measurement for farmers to benchmark against"*

*"Our regenerative farming journey continues... every year shows us new challenges and more opportunities to learn, but farming with nature is rewarding in many different ways – not just financially!"*



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**Graph 1:** Impacts of moving to MSO on outputs and commercial returns, based on the sample of farm accounts assessed (commercial returns is taken to mean revenues before support less variable and fixed costs). Source: Nethergill Associates

**Graph 1** shows that the effects of moving to MSO vary between farm types in terms of the benefits achieved through increases in commercial returns. It is important to note that each situation is different as the changes required to move to MSO will depend on the characteristics of the land, but an average increase of between 10%-45% in commercial returns was found across the different farm types, alongside a reduction of artificial inputs to zero.

It should be noted that the improvements in revenues are calculated before any potential support payments are taken into account. Moving to MSO will require shifts in farm practice (e.g. reducing artificial inputs) which put these farms in a much better position to apply for future agricultural support, the focus of which is moving towards supporting sustainable production methods. Indeed, in England future support is now focussed on the delivery of public goods through the new Environmental Land Management schemes. Over time, the level of output that is possible at MSO often starts to increase as soil health improves, thereby increasing commercial returns.

Moving farm businesses to operate at the MSO has been shown to help farms to become more profitable, whilst at the same time reducing pressures on the environment, benefitting biodiversity and enabling farms to become more resilient to external economic and climatic shocks. The importance of this has been thrown into sharp focus by the Government's most recent UK Climate Change Risk Assessment which has highlighted agriculture as one of the most exposed sectors to climate change, due to a lack of policy and action to promote resilience across the sector<sup>12</sup>.

### Example 2: Upland livestock

A 450 hectare farm in Wharfedale rising from 800 to nearly 2000 metres. It now runs 300 Swaledale ewes and 70 Belted Galloway breeding cows and followers to finish, down from over 1000 ewes previously.

*"Our move to explore the merits of moving to MSO began 3 years ago by deciding to move towards a predominantly cattle grazing system."*

*"It is surprising how the grass yield and quality has improved over the whole farm in a short period, notably by the removal of Malinia (on the top ground) and the change in flora. The land is now more productive allowing livestock grazing units to increase over the holding. As a result, we are seeing an increase in profit from the livestock element of the business with reduced labour input, which has led to a better quality of life for me and the family. Although there were a few teething problems with cash flow, the profitability of the cattle enterprise is increasing year on year."*



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<sup>1</sup> Commercial returns here is taken to be revenue from the sale of outputs less variable and fixed costs, before any farm support is taken into account.

### Box 1: Dry matter production in North Wales, with and without fertiliser

Four farms were selected from the Farming Connect 'Prosper from Pasture' programme to determine the point of Maximum Sustainable Output for their individual businesses (MSO) and assess the financial benefits of moving towards MSO. The work was aided considerably by data supplied to Nethergill Associates by the Prosper from Pasture Group in Wales, of which the four study farms are members. Each of the four farms were selected on their ability to provide robust grass dry matter production data.

In addition, Nethergill Associates analysed data from 37 livestock farms (sheep only and sheep and cattle) that were part of the Prosper from Pasture programme in Wales. Data was collected over a 10-year period on dry matter yield of grass from farms using a) artificial fertiliser; and b) no artificial fertiliser inputs (just farmyard manure). All farms practised the principles of rotational grazing to varying extents. The size of the farms ranged from 39 to 506 ha with an average size of 153 ha. Soil type and climate varied from farm to farm.

The study found that farms using no artificial fertiliser over the 10-year time period studied had very similar levels of output as farms that were using artificial fertiliser. The results showed no statistical difference in dry matter yields, with the production of grass remaining around 8,500 kg/ha (+/- 20%) irrespective of fertiliser use.

Therefore, increased use of artificial fertilisers was found to not correlate with increased production of dry matter per hectare on these farms. The ability of the low/no input farms to achieve similar or better grass growing performance than the fertiliser users was accredited to grazing management. Implementing rotational grazing allowed farms to meet their grass production targets with minimal inputs.

It should be noted that this parity of yield is only achieved if fertiliser is gradually removed over a period of time and grazing management improves. If the farms currently using artificial fertiliser were to stop doing so and did not change their grazing management, their grass yield would decline.

Moving towards MSO can also help to reduce the impacts of volatility in the international markets that intensive forms of farming depend on through their reliance on chemical fertilisers, plant protection products, and feed concentrates. This is essential to provide farm businesses with stability and is becoming an increasingly important factor as evidenced by the dramatic rise in fertiliser prices in 2022 which resulted in part from the conflict in Ukraine and placed significant financial pressures on farm businesses. Climate change is expected to have an increasingly significant impact on global trade and supply chains in the coming years<sup>15</sup>.

Moving towards MSO in theory leads to a reduction in productive output from the farm, but in reality, these reductions in output are unlikely to be as significant as modelled. For example, a ten-year study in North Wales found no significant difference in the dry matter yield of grass between farms using artificial fertiliser and those treated with no artificial inputs (see Box 1). While removing artificial inputs as part of the transition to MSO may lead to a dip in production initially, the evidence suggests that this is temporary and yields start to recover over time as soil health improves, and therefore liveweight of livestock supported per hectare also starts to increase.

When farmers are asked about their experience of making this transition towards using fewer inputs and reducing outputs, whether that be number of livestock, milk yields or crop yields, not only do they comment on the financial benefits, but also the changes this has made to their quality of life. Often, farmers remark on the fact that by working with nature, the stressors of managing a profitable farm business are reduced.



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### Example 3: Upland sheep and dairy

An isolated hill farm comprising 490 acres of severely disadvantaged meadow, pasture and moorland on the Middlesmoor Estate in Upper Nidderdale within an Area of Outstanding Natural Beauty (AONB). The climate is harsh and the growing season short, with long winters and high rainfall.

Originally they set out to increase profitability by increasing productivity and at one point kept over 400 ewes. However, this didn't work: *"We increased inputs, and improved genetics but by 2010 it was apparent that no matter how good the genetics or the management or the output, the farm's financial situation did not improve and was entirely reliant on subsidy. Effectively there was no economic response to either fertiliser or feed inputs or re-seeding"*.

By examining the farm accounts, looking at the natural resources available on the farm and the geographical constraints applying to it, the concept of MSO appealed. They realised that to make a profit and become less dependent on support they needed to: minimise or eliminate bought-in inputs, maximise output value, maximise biological efficiency through selling milk rather than meat, and work within a seasonal framework making optimal use of the grazed grass – this means high quality spring summer and autumn grass for lactating cows (April–Sept) and deferred grazing for dry cows (Oct–January).

As a result, three years ago, they decided to move towards a predominantly cattle grazing system and now keep 30 cows (Northern Dairy Shorthorn) and followers with 60 ewes on a regenerative and deferred grazing system with very low inputs, including no fertiliser use for the last two seasons. Because of the seasonal nature of grass growth and quality they knew that lactation quantity, quality and duration would be more limited and therefore opted for a native, dual-purpose cow that could produce a modest milk yield from grass alone, had a low body weight (therefore low maintenance requirement) and could live outside for much of the winter. Since they cannot compete as a commodity meat or milk producer on such a small scale, they decided to 'add value' through producing a traditional Wensleydale cheese.

*"Reducing sheep numbers has had the impact of releasing our meadows from being grazed in spring, increasing hay yield, floral diversity and drought tolerance significantly. We have also noticed that as we have reduced our sheep numbers and allowed our grass to have rest periods during the growing season the carrying capacity of our farm has remained stable, despite the elimination of fertiliser and a 75% reduction in concentrate feed inputs."*

In terms of the economic impact, they are currently halfway to their target production goal, but the farm cheese output value has already far exceeded the total subsidy payment received. The aim is for the farm/cheese business to be viable without subsidy inputs. The taxable surplus from the business has increased significantly over the last 3 years and is projected to continue to increase, while over the same period their direct payments have decreased.

As well as improving the floral diversity of the grass swards, this change in approach has allowed biodiversity to flourish – the farm is host to a whole range of birds: lapwing, oystercatcher, curlew, snipe, woodcock, golden plover, redshank, black grouse, grey partridge, red grouse but has also enabled trees to regenerate naturally and provided space for more to be planted.

Since 2013 the farm has been in a 10-year Higher Level Stewardship agreement.



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## 2.1 IMPLICATIONS FOR THE ENVIRONMENT

The transition to MSO involves farming in keeping with the natural resources available on the farm and the removal of artificial inputs, which has been shown to lead to environmental benefits. Although no empirical evidence has been collected so far on the environmental changes that have taken place on farms that have started the shift to MSO, there is a wealth of scientific evidence which supports the theory that moving to MSO reduces environmental pressures and contributes to the following benefits:

- Increases in insect populations, which play a critically important role in pollination and pest control<sup>14</sup>. Insect declines have been linked to the widespread use of pesticides in agriculture<sup>15</sup>.
- Improvements in the quality of aquatic and marine ecosystems, which are currently negatively impacted by excess nutrients from fertilisers and manures, as well as from soil erosion and plant protection products which flow into watercourses and out to sea far from the original source<sup>16</sup>. It is estimated that 40% of nitrogen fertiliser in the UK is left unused or leaks into the environment<sup>17</sup>, contributing to soil erosion and exacerbating climate change by evaporating into the environment, and is one of the leading reasons agriculture in the UK is the biggest polluter of waterways.
- The recovery of soil health, the degradation of which is associated with a number of intensive farming practices. The removal of soil carbon and the addition of large amounts of chemical inputs, such as pesticides and fertilisers, can alter the chemical attributes of soils in ways that undermine soil health and affect biodiversity by destabilising the balance of the wider ecosystem<sup>18,19,20</sup>.
- Reductions in the release of ammonia into the atmosphere, which has significant effects not just on the environment, but also on human health. Agriculture is responsible for around 88% of ammonia emissions in the UK, predominantly from organic manures and artificial fertilisers when they come into contact with the air<sup>21</sup>.
- Reductions in GHG emissions due to decreased reliance on chemical fertilisers and reduction in livestock numbers. In 2020, agriculture accounted for 69% of total nitrous oxide emissions and 48% of all methane emissions. The majority of agricultural nitrous oxide emissions come from soils, particularly as a result of nitrogen fertiliser application, manure and leaching/run off<sup>22</sup>. GHG emissions from fertiliser production are also high, and reducing total livestock numbers in turn reduces the methane emissions caused by enteric fermentation.

However, shifting farm systems towards MSO alone will not be enough to put nature into recovery. Restoring pollinator populations and improving biodiversity will also require the creation and appropriate management of habitats, restoring precious wetlands will require targeted support and management, and improving water quality and soil health will require ambitious changes to overall management. By combining a shift in farm systems towards an MSO approach with sufficient public funding for nature and climate, it is possible to both reverse recent declines in wildlife and increase the profitability of farm businesses.



## 2.2 IMPLICATIONS FOR FARMING SYSTEMS

Since the key to achieving a transition to MSO is the removal of 'corrective variable costs', the majority of which are associated with artificial inputs, including fertilisers and feed concentrate, this has implications for the farming enterprises concerned. This is illustrated in the examples shown.

Moving livestock systems towards operating at MSO will require increasingly pasture-based systems where the livestock are fed on the grass produced and the use of bought-in feed concentrates are eliminated, or significantly reduced. In these grass-based systems, livestock are grazed on the grass to the extent possible. Some grass can be cut to produce hay or silage to feed to the animals. Selective breeding for livestock has resulted in some commercial breeds having an increased dependence on bought-in cereals and feed concentrates. Therefore, the shift to MSO may require a change in the breeds of livestock used, so as to focus on breeds that are suited to the local environment and do not require feed concentrates as part of their diets. These may produce fewer offspring / less milk per livestock unit, but they will increase overall profitability due to the reduction of inputs needed to sustain them. Although it is more challenging to eliminate CVCs in dairy systems than it is for sheep and beef, it is still feasible to reduce the use of fertilisers and feed concentrates, thereby increasing the margin received



### Example 4: Lowland dairy

A lowland dairy farm in the South-West is considering a shift in its practices to move towards MSO. Shifting the 265 ha farm, of which 100 ha are field crops and the remaining 165 ha improved grass with 150 dairy cattle, to an MSO approach would result in an estimated 13% reduction in output, but a 15% increase in commercial returns.

Discussions with the farmer highlight that addressing the cashflow issues arising from this shift is key to decision making.

per unit of milk produced, by optimising the milk output per cow over the number of lactations in its lifetime. Hardier breeds will also mean that winter housing costs can be kept to a minimum or eliminated completely since the livestock will be more suited to being kept outside for as much of the year as possible and housing will only be used where necessary, according to the soil and weather conditions. Nethergill Associates have also found that a favourable cattle to sheep mix results in a higher production of dry matter yield (Kgs/ha). Cattle have lower vet and medication costs compared to sheep, and are associated with being less demanding of human intervention. This helps with achieving MSO levels of production and greater profitability.

Implementing these actions will often require broader changes in farm management practices and a transition to alternative farm systems. Through changing farm management practices, farmers can support their transition to MSO, and contribute to reductions in artificial inputs such as fertilisers, feed concentrate, and veterinary medicines. For arable farms, the move towards MSO involves a move away from highly specialised (monoculture) systems. Arable-only systems can work if there are a significant number of crops in rotation, including fallow fields with 'green manures', as well as the adoption of practices which promote soil health to support the regeneration of the soil. However, mixed farming systems, incorporating both livestock and cropping, will make the transition easier.

In these calculations, fixed costs are taken to be those existing at the time of the analysis. However, these also play an important role in the profitability of the farm business. Over all farms investigated to date, on average fixed costs represent 65% of revenue, before support payments. Finding ways to reduce fixed costs would therefore also help increase profitability. The exact impact of fixed costs will vary significantly between farm businesses, so the benefits of reducing fixed costs will depend on the farm business. However, actions which address operational fixed costs such as sharing farm machinery through joint contracts or in agreements with neighbouring farmers can have universal benefits for profitability.

### 2.3 IMPLICATIONS FOR FOOD SECURITY

Questions about the implications for food security are bound to be asked of any approach that proposes shifting to systems where the volume of agricultural outputs produced is reduced (if only temporarily).

The UK Food Security Report 2021<sup>23</sup> acknowledges that climate change and the biodiversity crisis are existential threats to the long term capacity of the land to produce food. It states that “Sustainable production methods ensure the UK’s long term food security by protecting the natural capital embedded in healthy soil, water, and biodiverse ecosystems. Food security rests ultimately not on maximising domestic production (which is market driven), but on making best use of land types”. Therefore, continuing to employ intensive agricultural practices which are eroding our ability to produce food is not an option. It has been found that soil degradation, erosion, and compaction alone result in losses of about £1.2 billion each year and reduce the capacity of UK soils to produce food<sup>24</sup>. Shifts to farm systems which work with nature are fundamental to ensuring future food security.

The predictions, based on an assessment of farm businesses’ accounts by Nethergill Associates, suggest that the shift to MSO implies a reduction in output of on average between 23-29% depending on farm type. However, in reality this level of reduction is unlikely to be reached. This is due to improved natural assets on farm, such as soil fertility, which can often make up for yield penalties due to reductions in inputs over time (see **Box 1** for the example of grass dry matter production).

Further evidence also shows that systems that work in conjunction with nature are cost-effective and can increase yields, while creating more resilient farm businesses:

- A study found that removing up to 8% of land from agricultural production to promote habitat for wildlife led to a maintenance of yield at the field scale, and even improved yield for some crops<sup>25</sup>. In contrast, a 30% decline in pollinator numbers over 10 years would cost more than £188m per year in lost crop yield<sup>26</sup>.
- A UK-wide field study found that planting legumes helped to naturally fix over 400kg of nitrogen per hectare, reducing the need for costly synthetic nitrogen fertilisers<sup>27</sup>.
- A study of 946 farms in France found that a 42% reduction in use of plant protection products was achieved without negative effects on crops yields or profitability in 59% of the farms investigated<sup>28</sup> – this figure is comprised of an average reduction of 37% in herbicides, 47% in fungicides and 60% in insecticides.

A shift to more pasture-based livestock systems in the UK could also free up much of the 40% of cropland currently used to grow crops for animal feed (around two million hectares)<sup>29</sup>. This land could then be used to produce crops and vegetables for human consumption instead, while also freeing up land that could be used to restore nature. One estimate, quoted in WWF-UK (2022)<sup>30</sup> found that “if all edible crops were consumed by humans instead of some being fed to livestock, enough extra calories would be available to feed an additional 4 billion people globally”.

Ultimately, in order for a farm to produce food effectively it must be underpinned by a sustainable and profitable farm business. In the face of current pressures, many businesses are increasingly at risk of simply not being financially viable enough to maintain food production. Moving towards an approach based on Maximum Sustainable Output will increase farm profitability, enabling farmers to run viable businesses and continue to produce healthy and nutritious food into the long term.

Just 0.09% of farmland has been proposed to use for nature’s recovery



**Fig 2:** Comparison of end-use of crops grown in the UK with land proposed to be taken out of agricultural production for nature

## 3 Conclusions

Tackling the nature and climate crises are critical to the nation’s economic prosperity and food security. A fundamental shift in the nature of farming is essential to meet the multiple challenges faced. This must lead to methods of food production which are compatible with restoring and improving nature, and that mitigate climate change. This report shows that this is possible and that it can be profitable for farms to do so.

*The approach taken by Nethergill Associates has shown that farming at the level of MSO improves commercial returns for farm businesses.*

This involves removing ‘corrective variable costs’ from the business, namely costs used to increase production beyond what is possible using the naturally available resources (e.g. artificial fertilisers, plant protection products or bought in feed). There are multiple other factors which would help increase profitability further and should be considered alongside moving towards a MSO model. These include addressing operational fixed costs such as machinery, but also reforming supply chains and food processing systems to ensure producers receive greater value from the food they produce.

The MSO approach was found to apply across all farm types studied in both upland and lowland situations. The only farming systems for which this approach has not yet been assessed (and therefore evidence is lacking) are pigs and poultry and horticulture.

The economic assessment of the farm accounts predicts an average increase in commercial returns (before farm support payments) of between 10-45%. While the approach models a reduction in productive output of between 23-29%, in reality this is not seen in practice due to the positive impacts on yield of improved soil health and recovery of other natural assets such as beneficial insects and pollinators.

The staged reduction of artificial inputs (mainly fertilisers and feed concentrate for livestock, but also pesticides in arable systems) will often require significant changes in farming systems. The evidence base to support practical solutions that enable these significant changes is building, and implementation is already gathering pace<sup>31,32,33</sup>. This transition is essential to achieve sustainable and profitable food production with reduced pressures on the environment, and providing space for nature to recover whilst allowing farm businesses and rural communities to thrive.

### In summary, it would...

- 1 Strengthen farm business resilience by helping to reduce reliance on expensive fossil fuel and artificial inputs, and recover natural on-farm assets which can mitigate the impacts of climate change;
- 2 Help drive the delivery of the Government’s environmental commitments, including those relating to achieving net zero emissions, nature recovery, and improving water quality;
- 3 Enable a shift towards more sustainable food production which underpins long-term UK food security;
- 4 Facilitate land use change in the UK to support the delivery of nature and climate outcomes, whilst also improving food security. For example, through repurposing arable land used to grow feedstocks to instead grow food for people;
- 5 Puts farmers in a position to take advantage of a new era of farm support that is increasingly focused on the provision of public goods.



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Chris is a Partner in Nethergill Associates (NA), a business management consultancy currently assisting with the conjecturing and management of future farming uncertainties in all four countries within the UK as well as overseas. He and his NA team, as of June 2023 have analysed over 200 farms. With all these farms he has advised them how to move their business towards Maximum Sustainable Output (MSO) and hence achieve maximum profitability without compromising nature. He is co-author of *The Less is More* report commissioned by the RSPB, National Trust and The Wildlife Trusts. Previously he owned and managed Nethergill Farm with his wife Fiona in the Yorkshire Dales. They built an eco-hill farm business with a sustainable added-value meat activity, an educational and field study facility and eco-tourism holiday lets. They moved to Devon in 2020 to be close to family, a new challenge involving ancient woodland recreation, hay meadow restoration and creation of wildlife ponds.

#### Brian Scanlon

After degrees in Physics and Operations Research, Brian joined British Steel Corporation in the corporate planning function and then became Development Manager responsible for global logistics. Subsequently he spent over ten years as a management consultant with AT Kearney where he became responsible for the Strategy and Marketing practice in the UK before joining Costain Group as Marketing Director. His work at Costain included heading its new Ventures Division which took equity positions in major projects around the world. Over the past 20 years or so, Brian has run his own company as a vehicle to undertake consultancy and project development work where he has served over 70 companies across most sectors of the economy in the fields of strategy development, marketing, logistics, operational improvements, and new venture development. He has held, and still holds, a number of positions as Chairman, CEO or NED of fast growth SMEs. More recently, Brian moved to a client and became Vice President of Treasury Services with JP Morgan Chase Bank, the largest clearer of US\$ funds in the world.

#### Kaley Hart

Kaley Hart is Director at the Institute for European Environmental Policy, UK (IEEP UK). She has over 25 years' experience of carrying out research and advising on agricultural and environmental policy in the UK and Europe. She is actively involved in the debates surrounding the future of agriculture policies to achieve sustainable land use and assessing the implementation and environmental and climate impacts of existing policies in the UK and the EU. Previously, she has worked at Natural England and the Countryside Agency as a Senior Specialist on land management policy, the Countryside Charity CPRE and as a researcher at Kings College and Wye College, University of London.



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