Funding the EU transition to more sustainable agriculture: discussion paper

December 2023

Funding the EU transition to more sustainable agriculture: discussion paper

FoodDrinkEurope commissioned Anthesis Group to write this discussion paper to continue the important dialogue around the future of agriculture and sustainable food systems in Europe. With this paper FoodDrinkEurope hopes to engage with all stakeholders to build out firm recommendations to help meet our collective ambitions to maintain productive and profitable agriculture, that also delivers for the environment and society.

Disclaimer

Prepared for:

FoodDrinkEurope
Avenue des Nerviens 9-31
1040
Brussels
Belgium

Prepared by:

Anthesis Group
355 Euston Road
London
NW1 3AL

Report written by:

Mary Whittow, Giacomo Ranalli, Simon Davis, Lucy Noon

Analysts:

Krister Mars

Website: www.fooddrinkeurope.eu
Email: info@fooddrinkeurope.eu
Website: www.anthesisgroup.com

Email: contact@anthesisgroup.com

Tel: +44 (0)1865 250 818

This research paper has been put together with the support of all participants involved, and the authors wish to thank the following for their contributions during interviews, discussions and workshops: The Directorate-General for Agriculture and Rural Development (DG AGRI) (European Commission), Rabobank, Soil Capital, European Council of Young Farmers (CEJA), Federation of Swedish Farmers, European Investment Bank (EIB), fi-compass, ADM, MACCARESE S.p.A. Soc. Agricola Benefit, Members of the European Dairy Association (EDA) (Danish Dairy Board, Dairy Industry Ireland, NZO - Dutch dairy association), Cargill, Wageningen Economic Research, World Wide Fund for Nature (WWF), The Food Collective, One Planet Business for Biodiversity (OP2B Coalition), Irish Cooperative Organisation Society (ICOS), Ferme Des Lauriers, La Junquera Farm, Climate Farmers, Mateusz Ciasnocha and European Carbon Farmers, Artur Range Metzer, Moschos Dairy, Robert Campbell, Lidia Cabral (Institute of Development Studies).

Table of contents

Glossary of terms

CAP – Common Agricultural Policy

CBAM – Carbon Border Adjustment Mechanism

EEA – European Environment Agency

EAFRD – European Agricultural Fund for Rural Development

EAGF – European Agricultural Guarantee Fund

EC – European Commission

EIB – European Investment Bank

ELM – Environmental Land Management Scheme

EUSO – European Soil Observatory

EU – European Union

EQIP – Environmental Quality Incentives Program

GHG – Greenhouse Gas

JRC – Joint Research Centre

KPI – Key Performance Indicator

NRCS – National Resources Conservation Service

PPPs – Public Private Partnerships

PPP – Purchasing Power Parity

ROI – Return on Investment

R&D – Research and Development

SFI – Sustainable Farming Incentive

TCA – True Cost Accounting

TNFD – Taskforce for Nature related Financial Disclosures

UAA – Utilised Agricultural Area

USDA – US Department of Agriculture

WEF – World Economic Forum

WTA – Willingness to “Attend” or “Adopt”

Executive summary

Modern agriculture is a huge success story and an example of one of the biggest and most impressive feats of human ingenuity[1]. However, to continue to meet the demands of a growing global population, it is widely acknowledged that agricultural production methods must transition to better align with the ecosystems and societies that underpin the agri-food sector, future proofing our entire food system.

There is a cost that comes with this transition though, moving away from production methods that have, in recent history, focused primarily on productivity gains, towards methods that focus on more sustainable agriculture practices that aim to improve environmental outcomes. This discussion paper explores the current state of play across EU agriculture and the potential cost of the transition required. It also considers the question of 'who pays', and what additional policy options could enable action.

Whilst progress has already been made by farmers and the food and drink industry, there is still more to do to transition the whole of EU agriculture to more sustainable agriculture practices. It is a continuous, ongoing effort that requires system-wide collaboration. To address the questions posed, this paper includes quantitative economic analysis as well as qualitative research from first-hand discussions with key stakeholders, including, European farmers and wider agri-food chain actors, such as financiers, food and drink industry stakeholders, academics, NGOs, and policymakers. It also considers practical examples of current best practice to demonstrate the value that could be created in the sector with more investment.

Discussions with stakeholders enabled us to frame what 'sustainable agriculture' means in the context of this paper, and it was concluded that soil health should act as the key performance indicator (KPI) to measure successful outcomes. Soil health acts as a common and measurable theme across agriculture. It is fundamental to the long-term sustainability of the food and farming system and directly impacts the key social, economic, and environmental aspects of farming raised by stakeholders. For example, these include, food security, farmers' livelihoods, nature, and biodiversity, and the impact of climate change. Soil is directly or indirectly responsible for 95% of the food produced in the EU and is highly important for reducing greenhouse gas (GHG) emissions from agriculture, as it is one of the most effective and important carbon sinks on the planet[2]. However, each year, it is estimated that €1.25 billion is lost in European agricultural productivity because of soil erosion[3], indicating an enormous financial opportunity for government and the food and drink industry alike if improved and protected. A focus on soil health has the potential to transition European agriculture into a more sustainable, resilient, productive, and economic system that is fit for the future. With this in mind, we used soil health as a proxy to conduct quantitative analysis of the estimated costs for taking up key sustainable agricultural practices that could deliver improvements.

This research estimates the costs for the first year of an EU-wide transition to more sustainable agricultural production, that considers improved soil health, as in the region of €28-35 billion. However, if the transition

[1] Federico, G. (2005)
[2] WRI (2001)
[3] European Commission (2023a)

is successfully implemented, costs are expected to decrease in the long term and will be lower than the cost of doing nothing.

Encouragingly there are many priority funding opportunities that could accelerate progress, ranging from evolving the Common Agricultural Policy (CAP) payment system, developing a specific climate fund and the European Commission (EC) enabling greater focus to be put on public and private partnerships. Investment is already being directed at supporting farmers deliver more sustainable production systems that ensure longer term resilience, but it needs to be more accessible and de-risked for a wider range of farmers.

Not one current financing mechanism alone will deliver the pace and scale of change required, and EU agricultural policy needs to be developed further, acting as an enabler for improved sustainability accounting, digitisation of farms and development of tools that support collection of harmonised sustainability data. These elements will deliver a credible, on-farm evidence base that can be used to benchmark performance across commodities and geographies, measure, and report sustainability progress, share knowledge and ultimately attract and de-risk investments.

The EU has already made immense progress in pushing forwards this transition, both on the ground and in terms of innovation, research and development (R&D) and financing. The research and insights from this report are designed to build on existing initiatives, exploring greater access to, and development of, financial mechanisms that can support systemic change.

Introduction

In Giovani Federico's book, *Feeding the World, An Economic History of Agriculture, 1800-2000,* he applauds modern agriculture as a huge success story and an example of one of the biggest and most impressive feats of human ingenuity. Over hundreds of years, mankind has tamed and cultivated the natural world to produce enough food to feed billions of people across every continent. Over time, agriculture has become more productive, capitalising on the development of machinery and innovative technologies to increase efficiency. This is most apparent in the post-war era, when global agriculture grew 2.3% annually between 1950 and 2000, in effect tripling production compared to previous years[4].

Productivity has been farming systems' focus for centuries, feeding a growing population and prospering as a result. However, as time has gone on, perspectives have changed. During the 19th and 20th centuries, nature was not always seen as positive for productivity, standing in the way of a blossoming global agri-food sector. In the 21st century, we are beginning to recognise the impact that agri-food production, along the entire value chain, has had on the natural world and, vice versa, the impact a degrading environment has on agri-food production. Agricultural production creates approximately 11% of all GHG emissions emitted in the EU and contributes to biodiversity loss, soil degradation and air pollution[5]. In light of this, we now understand that nature is our greatest asset. Government, and the entire agri-food sector need to work alongside it to protect it, if the future of the agri-food system is to remain intact.

The next agricultural revolution is far overdue, but this time, our priority is to develop a system that not only produces enough food to feed the global population, but also puts nature first, regenerates and protects the land, provides nutrition, ensures a stable and viable income for farmers and is profitable throughout the supply chain. So far, a great body of research has demonstrated the impact of modern farming and climate change on our land and communities, and the changes needed to reduce impacts. Less focus has been put on the cost of this change.

This discussion paper examines the cost to the agri-food sector within the EU for the first year of transitioning to more sustainable agriculture. 'Transition', in the context of this paper, is defined as the large-scale, pan-EU changes made on farms by farmers in 1 year to improve the quality of soil. Figures used in the economic analysis include farmers' perceived costs related to the cost of initial inputs such as seeds for cover crops, reduced energy costs due to reduced tilling, potential reduction in irrigation costs, reduced costs for smaller volumes of pesticide and fertiliser used, as well as costs incurred for yield instability, skilled labour costs, education and training, and new machinery. Once the land has adjusted however, farmers are expected to see cost benefits, as soil health improves, leading to improved yields without the need for artificial plant protection products.

[4] Federico, G. (2005)
[5] European Environment Agency (2023)

As well as the economic analysis, this paper examines the current state of play around EU agriculture, looking at the biggest challenges and barriers that farmers face in relation to implementing more sustainable agricultural practices, the progress that farmers and the food and drink industry have made so far, and what funding mechanisms are available or need to be developed to support this transition. Some of the mechanisms discussed in Chapter 3 exist and are well-established, whereas others will need to be built (which may take some time). The paper highlights the need for a collaborative approach and aims to debunk the idea that this transition can be financially supported by just one major actor, such as national governments or private companies. Finally, the paper proposes a number of EU policy options that could support the ongoing transition and ensure its future success. These options aim to encourage further conversation and debate into this topic. Overall, the paper touches on a broad range of issues, including both environmental and societal, that are relevant to the EU, but may also extend beyond. Some examples are taken from outside the EU, namely the US and UK, to give comparisons of how other countries have tackled this question.

This paper is a mixed methods paper, using existing global datasets for the quantitative economic analysis, combined with qualitative insights from first-hand discussions with a select group of European farmers, financiers, food and drink industry actors, academics, NGOs, and policymakers. These discussions were in the form of two virtual workshops run alongside ten 1:1 interviews. Insights from the stakeholder engagement have been used throughout the paper to shape its focus and give wider context to the economic analysis. Any reference to stakeholder engagement or engagement with specific representatives in this paper refers to the information gathered during these interviews and workshops.

There is no universally accepted definition for 'sustainable agriculture', and therein lies one of the biggest limitations to this area of work. However, it also presents exciting opportunities for future research. This paper has tackled this challenge by looking first at the FAO definition outlined in its 2018 report, 'Sustainable food systems, concept and framework'[6].

"A sustainable food system is one that delivers food security and nutrition for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised. This means that it is profitable throughout, ensuring economic sustainability. It has broad-based benefits for society, securing social sustainability, as well as having a positive or neutral impact on the natural environment, safeguarding the sustainability of the environment overall."

The FAO definition was validated and refined through feedback gained from the first-hand discussions. Farmers in particular saw sustainable agriculture as a long-term means of creating and nurturing a viable livelihood whilst also protecting the land and surrounding ecosystems for the future. They also saw socio-economic levers such as generational renewal and land access as highly important, underlining the importance of creating a system that was attractive and robust for the next generation. The wider group of agri-food chain actors that we engaged with concurred with these points and added that wider and more

[6] FAO (2018)

attractive investment opportunities and food security were also key to the sustainable future of the agri-food sector.

By combining these sustainable agriculture drivers and their interdependencies, the focus of this paper's economic analysis is on soil health. Soil health is a quantifiable metric that provides a robust proxy for sustainable agriculture, as it is fundamental to the long-term sustainability of the food and farming system. It directly impacts the key social, economic, and environmental aspects of farming raised by stakeholders, such as food security, farmers' livelihoods, climate change, nature, and biodiversity. It also resonates with the vast majority of stakeholders we engaged with, and the production systems analysed across the EU, with one corporate representative saying that soil health is intrinsic to this transition and is crucial to almost all aspects of farming.

Soil offers almost 90% of the global potential for reducing GHG emissions from agriculture[7], and hosts 25% of all biodiversity on the planet[8]. 95% of food in the EU is also directly or indirectly produced on soil. Better soil health can prevent the more devastating impacts of global extreme weather phenomenon too. For example, degraded, compacted soils are less able to absorb pollutants in the air, sequester carbon or absorb moisture, resulting in flooding, increased levels of air pollution and global warming. However, currently, 61% of EU soil is deemed 'unhealthy,'[9] and each year, it is estimated that €1.25 billion is lost in European agricultural productivity due to soil erosion.[10] Focusing on improved soil health has the potential to transition EU agriculture into a more sustainable, resilient system that offers economic value, and protects planetary boundaries.

The question of sustainability and what it might cost us is one of the biggest questions we face as mankind today and goes far beyond the realms of agriculture. Trying to calculate a single figure for transitioning all EU farms to a more sustainable system is very difficult, with factors such as the different landscapes and climate of each country, farming type, the current state of agriculture in each country, the willingness to implement these changes and the amount of funding available at national level all having an impact. The cost of this transition also depends on factors such as current EU policy and regulation, technological developments over time and availability per country, availability of skilled labour, local infrastructure and more. The aim of this paper is to offer insights into how to approach this question of cost and contribute to the conversation amongst government, farmers, NGOs, and the food and drink industry, to spark interest and action, as well as highlight where further research is needed. It also aims to highlight the progress that has been made so far, and impress upon readers that this transition is possible, and is already being implemented in many parts of the EU and more globally. This transition is about building on what we have already achieved and creating a joined-up shift in industry strategy, government policy and on the ground

[7] WRI (2001)
[8] European Commission (2022)
[9] European Commission (2023)
[10] European Commission (2023a)

action to enable an agri-food system that promotes long term protection of farming livelihoods, social equality, nature, and planetary health.

Chapter 1: Setting the scene: challenges and solutions within EU farming

Before examining the potential costs associated with this transition, it is important to understand what farmers and the food and drink industry are already doing to improve the long-term sustainability of agriculture and the challenges and barriers that come with implementing this transition further. Farmers are at the forefront of the climate crisis and are more aware than anyone that practices must be adapted to ensure proper focus is being put on the future health of the planet to maintain productivity levels and reduce impacts on the climate. Farmers are not only willing to adapt, but have also made significant progress in this space, working to find long term, sustainable solutions for their farms. Likewise, leading food and drink industry actors are working directly with farmers to build long-term on-farm resilience, investing in new technology and innovation to bring valuable insights into the transition. These changes are not easy though. This chapter also explores the challenges that were discussed by farmers during the workshops and interviews for this paper and what they are doing to mitigate them. With this information, we can better understand the gap that needs filling within the EU and the potential cost of filling it.

CHALLENGES

Geography

The 27 EU Member States cover a broad and varied geographical region, from mountains to seas, to forests, to marshlands and peatlands, to hot arid plains to rocky hills. Despite the different terrains, all 27 Member States have been affected in some way by climate change, which continues to impact farming and the livelihoods of farmers, mostly negatively. The 27 EU Member States cover a land area of over 4 million km^2 with over 448 million inhabitants[11]. Farmland for agricultural production makes up approximately 38% of this land area, totalling 157 million hectares[12]. That land is highly diverse, with different topography, climates, weather patterns and time zones. EU farms also vary in size, farming type, output, production, ownership, and management structure. Creating effective, large-scale, and consistent change over such varied landscapes is extremely difficult and requires trust and strong collaboration at both national and EU level. The EU has clear goals, but how each country gets there is going to be very different and that needs to be accounted for when thinking about this transition.

Many EU farms are also comparatively small, with approximately 64% of the estimated 9.1 million agricultural holdings in 2020 measuring less than 5 hectares in size[13]. Most farms in the EU (94.8% in 2020) are also family run[14]. This has knock-on effects with their ability to access loans, raise funding, take necessary risks, communicate at national or EU level, and therefore implement large-scale change. Even though agriculture is a key part of the EU, making up 1.4% of the EU's GDP and creating approximately

[11] European Union (2023)
[12] Eurostat (2022)
[13] Eurostat (2022)
[14] Eurostat (2022)

€222.3 billion in gross value in 2022,[15] the varied geography across Europe, and the scale at which most farming is conducted, indicate that this transition may not be uniform. Each country will have to consider its own specific geographical nuances and will need to engage fully with their individual farming communities to bring about effective change.

Climate change and maintaining soil health

Farmers spoke about the increasing challenges of climate change during the workshop stage of this paper, notably the increasingly unpredictable and extreme weather patterns that it causes across Europe. The World Meteorological Organisation marked Europe as "the fastest warming continent of the world," as temperatures hit some of the highest on record this year [16]. Extreme heat, cold, flooding, and other weather patterns have huge impacts on agriculture, causing yield loss, livestock mortality, landslides, and soil erosion[17]. With these challenges, farmers struggle to maintain current practices, let alone invest and experiment with new practices; the risks are very high. Farmers also said that maintaining soil organic matter was a big challenge linked to climate change. This was particularly evident in more arid areas of Europe, where soaring temperatures have rendered the soil almost dust-like, losing all ability to retain water, further increasing the risk of soil erosion, flooding, and nutrient run-off. It is a continuous vicious cycle that needs to be addressed further.

Funding, access to capital and lack of compensation

Speaking to different farmers during our research, we ascertained that the biggest barrier faced was the financial risk that came with changing practices. This was combined with the difficulty in accessing capital from banks due to the volatility of farming as a business, uncertainty about the return on investment (ROI), and the lack of guaranteed compensation for any short-term loss in yield or drop in productivity from changing practices. They spoke about their concerns, not only in terms of the up-front costs that they feared would not be reimbursed fully, but some farmers also said they judged making a capital investment into this transition high risk, as there is no tested financial model to compare with at this scale. Combined, these create a difficult environment for farmers to experiment with new farming systems.

Farmers we spoke to also discussed challenges with compensation in the form of insurance. A recent study carried out by the World Economic Forum (WEF), stated that even though weather related challenges are set to increase due to climate change with increased unpredictable weather, extreme weather is often not covered by agricultural insurance offerings or else insurance plans are unaffordable to farmers[18]. During an interview we conducted with a representative of the European Council of Young Farmers (CEJA), lack of insurance was cited as one of the biggest barriers to implementing new practices on farms.

[15] Eurostat (2023)
[16] World Meterological Organisation (2023)
[17] European Parliament AGRI Committee (2023)
[18] World Economic Forum (2022b)

"Research from 2019 shows that the banks are less likely to lend to farmers, and the agricultural sector in general. Young farmers are 2-3 times more likely to have the loan application rejected by the bank, since agriculture is perceived as high risk due to climate aspects, geopolitical issues, and market volatility."

This point was also brought up during an interview with a representative from a Swedish farming group, who said that farmers, *"need some kind of insurance system, which they don't currently have."*

These issues and concerns come with the backdrop that farmers are under increased pressure to maintain productivity and current yields to ensure enough food supply, whilst also reducing on-farm emissions to hit food and drink industry level emission reporting targets. Farmers are willing to change, but those we spoke to expressed reservations, saying there were not enough incentives for farmers to facilitate the transition, especially if they risked losing money in the process, thereby impacting the ability to continue farming and producing food as well as other goods for society.

Demographics

Financial concerns not only affect farmers today, but also transcend different generations. Currently, only 11% of farms in the EU are managed by farmers under the age of 40, as younger people struggle to access affordable land or make an income from the proceeds[19]. This is a serious and growing problem for European food security as well as Europe's competitive advantage when it comes to agriculture[20], as young people continue to move away from agriculture in search of more financially stable professions. Social capital is an important part of this transition. Any change will take time to implement, so it is crucial that the younger generations are supported, as they will be responsible for maintaining the long-term sustainability and prosperity of the agri-food system.

Knowledge, education, and skills gaps

Farmers we engaged with also cited lack of access to knowledge, advice, or education, as well as a shortage of a technically skilled workforce or experts to support in implementing new practices, or who want to commit to living in rural areas. They also cited poor financial literacy, and lack of technical advice as key barriers to implementing this transition.

They also discussed the lack of knowledge sharing, or else the incentive to share their own knowledge. Farmers we spoke to said they would feel more able to implement new practices if there were advice and guidance they could access, and conversely, a way of sharing knowledge that might include a reasonable financial reimbursement for the time and effort taken to do this.

[19] European Commission (2023c)
[20] European Commission (2023c)

Policy and governance

Finally, farmers discussed the political and policy barriers that they encounter. They felt that there was no joined up approach between farmers and government, which delayed the transition. Farmers do not feel listened to or supported, as they are being asked to tackle a problem that goes far beyond the boundaries of their own farms. They are required to maintain yields to support food security whilst also improving nutritional content of food, support public health, protect the land and conserve, and improve nature, whilst all the while maintaining their own livelihoods.

When thinking about the cost of this transition and how it might be funded, we need to take these challenges into account and acknowledge that they span financial, social, geographical, political, and educational themes. We are not starting from scratch though; across the EU, farmers and the food and drink industry are already finding ways to adapt their work and support the supply chain to cope with and adapt to the changing climate and will continue to do so.

SOLUTIONS

Whilst there are a great number of challenges for EU farmers, there is also great resilience and innovation already taking place. Farmers are working hard already to strike an important balance between food security and environmental stewardship. Acknowledging the work that is already being done on farms will lay the foundations for greater change in the future. For years, farmers have worked to improve their on-farm climate resilience, mitigate against key challenges, and find innovative solutions to the climate crisis. From engagement with farmers during this paper, it was clear that their firsthand experience of on-farm climatic changes had impacted their desire to implement sustainable practice. During the project, when asked about their farm's priorities, concerns of sustainability intersected with farmers' objectives, as the idea of long-term sustainable agriculture also enabled the resilience of their business. Engagement with farmers highlighted the farming community to be one of wide-ranging techniques, driven by great admiration and understanding of the needs of their land.

Thomas Moshos, a fifth-generation sheep farmer in Greece. Thomas fertilises his soil with sheep manure and uses cover crops of triticale and animal beans to prevent soil erosion.

To illustrate the diversity of practice and the challenge of implementation, farmers' individual techniques formed a vital part of this paper. During the farmer workshops and interviews, sustainable agriculture practices were discussed, and it became clear that some of these techniques had been implemented on farms for years, despite the concepts only recently gaining wider attention. Farming has challenged the industrial restructuring of agriculture as it arose during the 1950s, with techniques such as organic farming gaining traction across Europe in the 1960s[21]. Organic farming's prevalence has grown and, as part of the EU Farm to Fork Strategy, a goal has been set to achieve 25% of the total used agricultural area by 2030[22]. However, the economic and demographic diversity across the EU's agricultural landscape means the techniques to mitigate farming's impacts are diverse, and their impacts contextual. This is illustrated in figure 1, which is information collected during the initial stages of farmer engagement. It gives a snapshot of practices that our engagement brought to light, showing both what farmers are implementing already and what they believed should be implemented during this transition. Importantly, this formed a critical part of our economic analysis, where we chose key practices from this list to determine the cost of the transition.

Figure 1: Farmer defined practices that enable on-farm sustainability.

[21] Michelsen (2002)
[22] European Commission (2020b)

The central role of soil management

Throughout the farmer workshops and interviews, a recurring theme was their efforts to preserve and regenerate soil quality. While some cite concerns of productivity reductions from the sustainable transition, certain farmers have demonstrated the potential of focusing on soil health to sustain yields. For example, a farmer based in the UK was able to reduce pesticide use by 42% without reducing yields by reintroducing rotation systems, diversifying their crops, and introducing grazing sheep back into arable fields[23]. Because soil type and quality vary vastly across locations, there are a range of different approaches to improve soil health. Some farmers have worked to review cultivation methods, whilst others aim to improve their nutrient balance. Some may have used controlled traffic farming to reduce compaction, whilst others may have focused on reducing waterlogging[24]. A representative of CEJA said that young farmers see soil quality as a first step and make soil testing a priority. This ties in well with the EU Soil Strategy's proposal to issue free soil tests for farmers across the EU[25]. During the farmer engagement carried out for this paper, practices such as minimum tillage, planting cover crops, intercropping, planting of red clover for nitrogen fixation and reducing plant protection products were discussed as techniques already being trialled on

[23] The National Food Strategy (2021)
[24] NFU (2022)
[25] European Commission (2021)

farms to improve soil quality. The rising prevalence of regenerative practices was discussed in relation to the intent of rebuilding soil. Farmers focus on soil because of its ability to sequester carbon, improve biodiversity, reduce the need for plant protection products, clean and better manage water.

Italian farm using mulch to improve moisture of the soil, increase soil organic matter and reduce the need for herbicides or manual weeding.

Energy nutrient balance

Many European farmers have focused on energy nutrient balancing to address the nutrient surplus from industrial techniques such as synthetic fertiliser and pesticide application[26]. Reductions in plant protection products have been supported by the EU's Farm to Fork Strategy, which has a target of 50% reduction in pesticide and fertiliser use by 2030[27]. Approaches to synthetic inputs in Europe range depending on the size of the farm, and contexts. During the farmer workshops, farmers cited the substitution of synthetic fertilisers and pesticides with their organic counterparts (such as packaged organic fertilisers, i.e., pellets, concentrated liquid fertilisers and alternatives such as seaweed extract) or using green manure. This also shows the opportunity for sustainable livestock management, as one farmer discussed their plans to integrate livestock into their arable farming to improve the soil. A dairy farmer in Greece used sheep manure to fertilise his crops naturally, the crops were then fed to the sheep, creating a circular system. Using organic techniques is one possible method to improve energy nutrient balance in the land. Farmers discussed this during the workshop and interviews and spoke about the different motivations for taking it

[26] Serebrennikov et al., (2020)
[27] European Commission (2020)

up as a form of sustainable agriculture, with some taking inspiration from their neighbours to transition, while others sought advisors to aid in rebalancing nutrient inputs. It is already a well-established practice in Europe, and brings many benefits, especially regarding soil health. However, for some farmers, especially small-scale, organic farming can present challenges, such as ensuring they meet specific requirements for organic certification, and the potential loss in yield from pests and diseases.

Harvesting in Greece. The field uses automated irrigation with soil humidity sensors and the crop will be used for sheep feed.

Technological innovation

Larger farms have used new and emerging technologies to improve the productivity and sustainability of their sites. Emerging digital-climate smart practices such as farm management software, satellite, drone monitoring and decision support technology have started to be implemented by farmers across the EU[28]. Technology has and will continue to play a role in boosting productivity whilst reducing emissions; allowing farmers to produce the same quantity of food with fewer inputs. Livestock farmers have been using feed additives to reduce methane emissions from ruminant livestock, while others have started to invest in land-based renewables to deliver GHG savings[29]. Plant breeding has seen tremendous progress in gene sequencing over the last 20 years to allow for the cultivation of climate-resilient crops. However, their application on-farm has been limited.[30] During the workshop, farmers also discussed the desire to use climate adaptative cultivars and selective breeding in an 'ideal farm' scenario, however evidence of their

[28] WEF (2018)
[29] NFU (n.d.)
[30] EASAC (2022)

application was also limited. Nevertheless, in the past year, a new proposal has been written which suggests this is a growing area of interest at EU level. The proposal focuses on plants obtained by certain new genomic techniques (NGT), which could increase plant resilience against ongoing climate change impacts, improve food security and reduce the need for plant protection products, helping reach reduction targets set out in the Farm to Fork Strategy[31].

During an interview, a representative from a Swedish farming group discussed the use of precision agriculture, notably by grain or cereal farmers. Another farmer addressed the use of GPS technology in tractors to optimise field operations, reduce fuel consumption, and improve work efficiency. They also focused on automated watering systems to ensure fresh water for animals or drip irrigation to prevent excess water use. Technology also plays a role in the measurement of key sustainability indicators such as methane and ammonia emissions.

Biodiversity enhancement and preservation

According to the European Environment Agency (EEA), in 2010, 70% of European farmland had an unfavourable conservation status[32]. Since then, agri-environmental schemes have been integrated into European agriculture to promote the application of nature-friendly farming practices[33]. Peatland rewetting, agroforestry, and sustainable livestock management have been shown to enable the protection and diversification of wildlife[34]. Farmer techniques to avoid further biodiversity loss have included the modification of pesticide use, amendments to cropping systems, increasing grazing of grasslands, establishing buffer zones, and planting hedgerows[35]. Biodiversity enhancement was discussed during the farmer workshops and interviews. A representative from a Swedish farming group discussed the adoption of permanent pastureland which has enabled greater storage of carbon. Other techniques employed include land-sharing practices such as agroforestry and intercropping. A representative of CEJA discussed how young farmers have decided to go further than just focusing on organic practices, prioritising biodiversity enhancement and preservation. This is dependent on production type but one example they gave was a wine producer who is implementing better practices in the vines to support better biodiversity. One farmer in the workshop discussed their application of sustainable agriculture across their farm, which included minimum soil disturbance, permanent soil organic cover and species diversification.

[31] European Commission (2023k)
[32] EEA (2010)
[33] Concepcion and Jay (2020)
[34] IEEP (2023)
[35] Andreasen and Andreasen (2011)

An intergenerational farm in the North of France whose farmers participated in the workshop. Pictured in their wheat field which was cultivated with minimal mechanical soil disturbance.

Experimentation and knowledge sharing

Although the lack of knowledge sharing was marked as a key challenge for some farmers, others we spoke to said that it was a key area of improvement, not only in terms of learning about widely used techniques, but also experimentation at local level and with location specific methods. During the farmer interviews, participants discussed the development of their own practice to enable greater sustainability. To support biodiversity, some have started planting flower strips or leaving room for birds to graze in their fields. Others have been adapting their end products to reduce energy consumption, such as a farmer in Greece, who has produced a cheese that requires less heating during its processing. One farming representative discussed experimentation in relation to new farmers. This involved encouraging young or new farmers to understand their land and soil better, and so experimentation with different crops and rotations was seen as a key part of ensuring efficiency and sustainability on their farms. One farmer discussed planting peas alongside other crops and continuously cutting them back to release nitrogen into the soil. Whilst these context-specific actions will not be relevant to all farmers, knowledge-sharing enables greater learning and experience on a peer-to-peer level, increasing local farmer support systems and wider opportunities that are independent of national or EU level governance.

Collaboration along the food chain

The food and drink industry has also played an important role in this transition so far, investing in the support of farmers to help implement sustainable practices on farms across Europe and globally. This

support has grown in recent years, as companies are beginning to understand the positive impact that a sustainable supply chain will have on future productivity and business continuity. Companies are also under more pressure from a regulatory and compliance standpoint to improve transparency and report on Scope 3 emissions. Below are some examples from key food and drink industry companies Unilever, Cargill, Nestlé, and McCain which have invested in the transition. These are just a small sample of companies which are championing this area:

- *Unilever* has been working with suppliers and farmers to incorporate the Sustainable Agriculture Code since 2010. In 2021 they began implementing the Regenerative Agriculture Principles, which focus on improving soil health, biodiversity, water quality and efficiency and carbon reduction and removal. There are nine programmes on the ground with more than 100 in the pipeline. This includes the programme in Spain with tomato farmers which has improved soil health and biodiversity and reduced GHG emissions by 37%[36]. Unilever provides farmers with the financial support and technical expertise required to plant and maintain these crops and has set up farmer-focused support groups to help share knowledge and learn from one another"[37].
- In 2021, *Cargill* launched Cargill RegenConnect in North America and has subsequently launched it in Europe. So far, eligible farmers in Germany, Poland, Romania, and France can enrol. The programme aims to help improve farmers' access to market and provides them with financial incentives and technical support to implement regenerative farming practices on their land. This work supports Cargill's commitment to implement regenerative practices across 10 million acres of farmland across North America by 2030 and provide training and improved access to markets for 10 million farmers by 2030.[38] In its 2023 ESG Report, Cargill stated, as of its fiscal year 2023, that it has advanced regenerative agriculture practices on 880,000 acres of agricultural land in North America since 2020 and more than 870,000 farmer trainings had been delivered in 2023 in the same geography[39].
- *Nestlé*'s commitment is to ensure 50% of its key ingredients are grown and sourced through regenerative agriculture methods by 2030, with the aim to improve soil health, sequester carbon, restore water cycles, and rebuild biodiversity levels. For the past 20 years or so, Nestlé has run its Sustainable Agriculture Initiative, which helps farmers to introduce more sustainable practices on their farmland. In 2022, Nestlé developed the Regenerative Agriculture Framework, guided by agro-ecological principles, to help farmers implement regenerative agriculture practices, such as planting cover crops, using organic fertiliser, minimise tillage, implement crop rotation and agroforestry. Nestlé's regenerative agriculture focus is global, with a growing presence in Europe. Nestlé has been working with farmers in France since 2018, for example, to promote regenerative agriculture as part of the 'sols vivant' (living soils) initiative. This initiative provides technical, financial, and collaborative assistance to farmers to scale-up regenerative agriculture within the

[36] Unilever (2023)
[37] Unilever (2023)
[38] Cargill (2023)
[39] Cargill (2023a)

value-chain. Nestlé had engaged with 180 farmers and 10 suppliers across 15,000 ha of France, resulting in 72,000 tonnes of raw materials. Nestlé is also a founding partners of the Landscape Enterprise Networks (LENs) model. LENs provides a framework for businesses from different sectors to work together to understand and address shared risks in a landscape. This has proven to be an effective solution for scaling up regenerative agricultural practices, and is currently deployed in Poland, Hungary, Italy, as well as the UK[40] .

- *McCain* works with around 3,500 farmers globally to support the implementation of more sustainable agriculture practices to build climate resilience, enhance soil health and improve long term yields[41] . McCain is also setting up local financing partnerships to support the capital investments required for taking up new on-farm practices. This includes access to favourable bank loans for the purchase of specialised equipment needed to carry out this on-farm transition[42]. So far, McCain has established financing partnerships with Crédit Agricole in France, and with Rabobank in The Netherlands. McCain is also in the process of developing further partnerships elsewhere[43] .

These initiatives demonstrate the growing importance that companies put on this transition, investing directly into farmer-focused programmes to bring longevity and robustness to their supply chains. Much of this investment has so far been concentrated in the US, as well as the EU. The US has long been an attractive country to invest in, not only for the food and drink industry, but across a number of markets, with a larger investor base and at times more favourable interest rates[44]. Creating attractive investment opportunities within the EU agri-food system is very important for the long-term success of this transition, enabling companies and other actors to have the confidence to invest more in the EU as well as the US.

Summary

This paper focuses on the future transition to more sustainable agriculture, but it is important to understand that the EU has a deep culture of sustainable agriculture already. The transition must be seen as a continuous process, building on the efforts of farmers and the food and drink industry to replenish resources, rebuild soil health and allow farming to work with nature whilst also being productive. Farmers are experiencing climate change every day, which is making farming conditions more challenging, but is also pushing farmers to change practices and adapt. Sustainable agriculture is already integrated into farmers' work and is gradually becoming a strong focus for businesses' future EU strategies. What we need now is a scaled-up, holistic approach to this transition, with specific focus on the EU, as opposed to the US or more globally. We need to ensure that these practices are embedded into future policy, farming practices, food and drink industry targets, and social norms. The following chapters explore what this

[40] Nestle (2022)
[41] McCain (n.d)
[42] McCain (n.d)
[43] McCain (n.d)
[44] Goldman Sachs (2023)

transition might cost for all 27 EU Member States to go from where we are now to an optimum state, how this might be funded and what future policy options could accelerate change.

Chapter 2: Cost of the transition

Methodology

There are several methodological approaches that could be used to analyse the cost of the current gap in sustainable agriculture in the EU, each having their strengths and limitations. The method outlined below was considered the most appropriate and credible, recognising that the term 'sustainable agriculture' has many connotations, and that the question can be addressed in many ways. It also considers the general availability (or lack of availability in instances) of publicly available data and research on this topic.

Given the level of feedback from stakeholders on the critical importance of soil health in delivering both productivity gains and sustainable agriculture outcomes, it was decided that soil health would be the primary indicator used within this research to quantify the cost of sustainable agriculture in the EU. The method focused firstly on calculating the current condition of the EU's soil, and then estimating optimum soil conditions in the future. From this point, figures from quantitative research of specific sustainable agricultural practices were used to estimate the cost of closing this gap.

The current state of soil health in the EU

The European Soil Observatory (EUSO) has sixteen different parameters for measuring soil health. We have focused on three key metrics, drawing on supporting data from EUSO for this research. These three indicators were the most prevalent areas of focus for stakeholders, reinforced during our wider research and discussions.

Key metrics:

1. Soil erosion due to tillage equal to or above 2 tons/ha/year
2. Nitrogen fertiliser surplus above 50kg/ha, (not taking into consideration nitrogen efficiency), and;
3. Loss of soil biodiversity.

N.b., Soil biodiversity is measured by the EUSO by the concentration of living organisms in the soil. This is based on thirteen different factors, including habitat fragmentation, land use change, soil pollution or soil sealing. For this indicator, the EUSO considers soils to be 'unhealthy' when the threat to biological function reaches 'moderately high' or 'high', which are the two highest classes on a scale of five [45].

[45] European Commission (2023)

Figure 2: Soil erosion due to tillage (data retrieved August 2023)

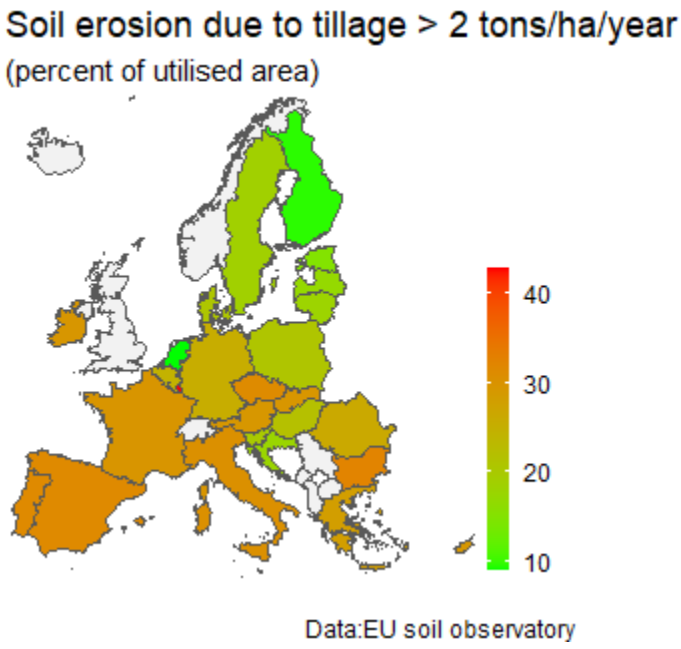


Figure 3: Nitrogen surplus (data retrieved August 2023)

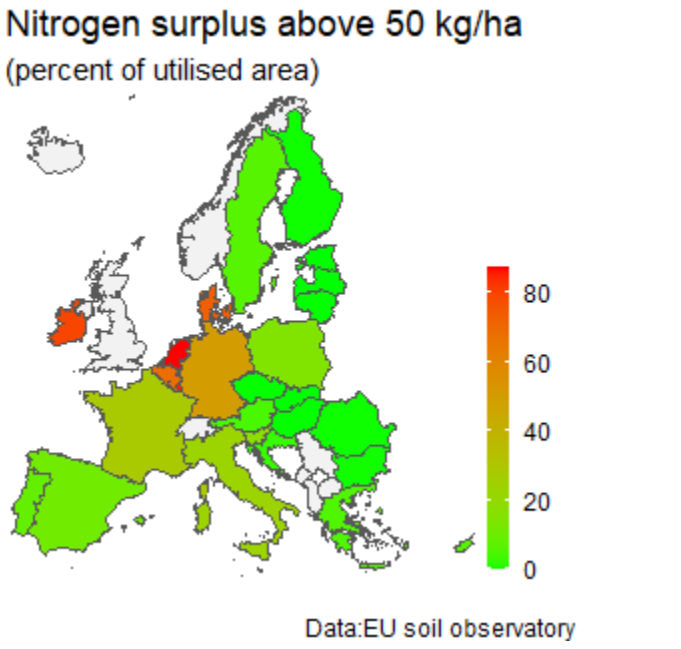
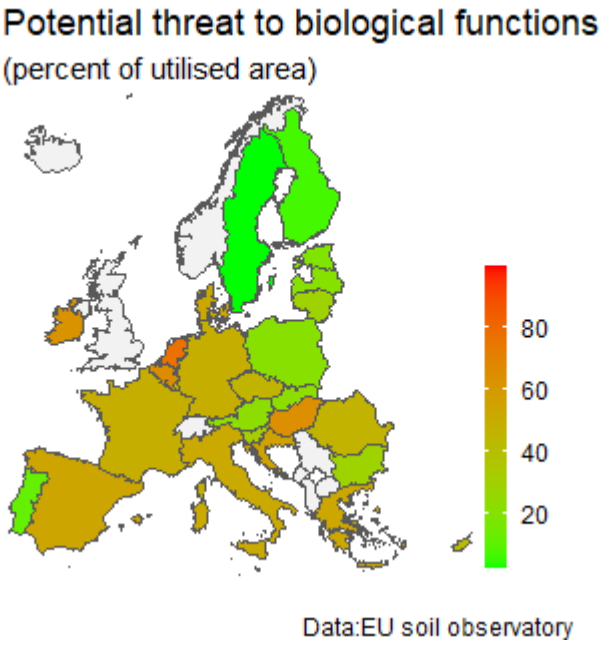


Figure 4: Potential threat to biological functions (data retrieved August 2023)



Figures 2, 3 and **4** show heatmaps of areas that exceed the three chosen thresholds for key metrics. **Figures 5a, 5b and 5c** provide country-by-country level information, including estimations of the land area per country that exceeds the three threshold values according to the EUSO, and therefore the land per country that requires focus for the transition. By converting these three indicators into a percentage of the total agricultural land area per country, we have calculated the current estimated amount of land that is considered 'unsustainable' (i.e., the current 'gap' we need to address during this transition). Costs in this paper are then given as an estimate for the amount needed to bring this area of 'unsustainable' land to a factor of 0 for each of the three chosen indicators.

Figure 5a: Utilised agricultural area (UAA), set out in order of EU-27 country with largest total land area affected by indicator 1: Soil erosion due to tillage equal to or above 2 tons/ha/year.

Country	Utilised Agricultural Area (ha)[46]	Indicator 1: Land area 'unsustainable' due to soil erosion above 2 ton/ha/year	Land area 'unsustainable' due to soil erosion above 2 ton/ha/year (ha)
France	27,364,630	29.80%	8,154,659.74

[46] Eurostat (2023a)

Spain	23,913,680	31.61%	7,559,114.25
Germany	16,595,020	25.56%	4,241,687.11
Italy	12,523,540	30.63%	3,835,960.30
Romania	12,762,830	26.40%	3,369,387.12
Poland	14,784,120	21.05%	3,112,057.26
Bulgaria	4,564,150	32.41%	1,479,241.02
Ireland	4,920,270	29.54%	1,453,447.76
Portugal	3,963,940	31.53%	1,249,830.28
Greece	3,916,640	28.29%	1,108,017.46
Czechia	3,492,570	31.33%	1,094,222.18
Hungary	4,921,740	22.11%	1,088,196.71
Austria	2,602,670	29.43%	765,965.78
Sweden	3,005,810	18.82%	565,693.44
Slovakia	1,862,650	29.59%	551,158.14
Denmark	2,629,930	20.86%	548,603.40
Lithuania	2,914,550	18.17%	529,573.74
Belgium	1,368,120	24.72%	338,199.26
Latvia	1,968,960	17.09%	336,495.26
Croatia	1,505,430	17.86%	268,869.80
Finland	2,281,710	9.66%	220,413.19
The Netherlands	1,817,900	9.05%	164,519.95
Estonia	975,320	15.03%	146,590.60
Slovenia	483,440	20.05%	96,929.72
Luxembourg	132,140	42.87%	56,648.42
Cyprus	134,140	29.37%	39,396.92
Malta	9,800	25.40%	2,489.20

Figure 5b: UAA, set out in order of EU-27 country with largest total land area affected by indicator 2: Nitrogen fertiliser surplus above 50kg/ha.

Country	Utilised agricultural area (ha)	Indicator 2: Land area 'unsustainable' due to nitrogen surplus above 50 kg/ha	Land area 'unsustainable' due to nitrogen surplus above 50 kg/ha (ha)
Germany	16,595,020	50.39%	8,362,231
France	27,364,630	28.45%	7,785,237
Ireland	4,920,270	79.63%	3,918,011
Italy	12,523,540	23.26%	2,912,975
Spain	23,913,680	11.09%	2,652,027
Poland	14,784,120	14.83%	2,192,485

Denmark	2,629,930	72.88%	1,916,693
The Netherlands	1,817,900	87.48%	1,590,299
Belgium	1,368,120	68.69%	939,761.60
Portugal	3,963,940	8.64%	342,484.40
Greece	3,916,640	5.10%	199,748.60
Sweden	3,005,810	6.23%	187,262
Luxembourg	132,140	85.68%	113,217.60
Austria	2,602,670	4.27%	111,134
Slovenia	483,440	17.89%	86,487.42
Croatia	1,505,430	2.48%	37,334.66
Romania	12,762,830	0.27%	34,459.64
Bulgaria	4,564,150	0.34%	15,518.11
Cyprus	134,140	6.09%	8,169.13
Finland	2,281,710	0.31%	7,073.30
Hungary	4,921,740	0.12%	5,906.09
Malta	9,800	50.00%	4,900
Czechia	3,492,570	0.12%	4,191.08
Lithuania	2,914,550	0.10%	2,914.55
Estonia	975,320	0.04%	390.128
Slovakia	1,862,650	0.02%	372.53
Latvia	1,968,960	0.00%	0

Figure 5c: UAA, set out in order of EU-27 country with largest total land area affected by indicator 3: Moderately high or high threat to biological function.

Country	Utilised agricultural area (ha)	Indicator 3: Land area 'unsustainable' due to moderately high or high threat to biological function	Land area 'unsustainable' due to moderately high or high threat to biological function (ha)
France	27,364,630	49.53%	13,553,701.24
Spain	23,913,680	54.13%	12,944,474.98
Germany	16,595,020	49.44%	8,204,577.89
Italy	12,523,540	51.91%	6,500,969.61
Romania	12,762,830	46.57%	5,943,649.93
Hungary	4,921,740	64.91%	3,194,701.43
Poland	14,784,120	21.22%	3,137,190.26
Ireland	4,920,270	62.98%	3,098,786.05
Greece	3,916,640	53.22%	2,084,435.81
Czechia	3,492,570	46.42%	1,621,250.99
The Netherlands	1,817,900	77.50%	1,408,872.50
Denmark	2,629,930	52.28%	1,374,927.40

Bulgaria	4,564,150	29.01%	1,324,059.92
Belgium	1,368,120	65.92%	901,864.70
Lithuania	2,914,550	29.15%	849,591.33
Croatia	1,505,430	55.68%	838,223.42
Austria	2,602,670	23.07%	600,435.96
Portugal	3,963,940	11.82%	468,537.71
Slovakia	1,862,650	22.73%	423,380.00
Latvia	1,968,960	20.86%	410,725.06
Estonia	975,320	19.07%	185,993.52
Slovenia	483,440	32.21%	155,716.02
Finland	2,281,710	6.55%	149,452.01
Sweden	3,005,810	2.33%	70,035.37
Luxembourg	132,140	47.75%	63,096.85
Cyprus	134,140	41.03%	55,037.64
Malta	9,800	99.50%	9,751.00

Economic analysis – overview

Figures that estimate the cost of improving soil health per hectare come from quantitative data based on published willingness to attend surveys (WTA), otherwise known as 'willingness to adopt'. The purpose of these surveys is to demonstrate participants' willingness to adopt a new sustainable agricultural practice or practices. Or, in other words, their willingness to accept a change in practice, on the condition that a certain level of compensation or financial support is provided.

WTA surveys aim to calculate the value of that financial support, which, in this paper, acts as a proxy for how much farmers would need in compensation to adopt new sustainable agricultural practices successfully[47]. In a typical WTA analysis, the participants are faced with a set of different questions (exact questions are not in the public domain) related to different economic scenarios. In each scenario, participants choose the best financial option, and over an entire survey of several different questions, a statistical value can be estimated. WTA studies used for this paper give an estimate for the level of compensation farmers would need to participate freely in a transition to improve soil health across Europe. The assumption is that without this compensation and guaranteed risk mitigation, farmers would not be financially able to carry out this transition.

WTA surveys are a useful cost analysis method, especially when related to changing policies. WTA studies estimate the cost incurred by those implementing the change, and therefore provide a realistic estimate for wide-scale buy-in of a new policy. With this transition, if farmers feel they are being paid a fair level of compensation and being provided the right financial support, they are more likely to adopt new practices. WTA studies ask participants what they need, and therefore tend to result in higher levels of participation.

[47] Boufous et.al., 2023

It is also helpful for estimating costs that have several different variables. Variables in this analysis include factors such as the different landscapes and climate of each country, farming type, existing infrastructure, the current state of agriculture in each EU member state, the level of publicly available and credible data, the willingness to implement changes and the amount of funding available at national level. By focusing on farmers' perceived costs, especially if done with a wide geographical representation, WTA surveys get us closer to the true cost of a transition, as they can consider a range of different factors that might otherwise be extremely difficult to quantify.

Figures in this paper cover the perceived costs of implementing new techniques and take into account all parameters that farmers may consider when taking part in a WTA study. This ranges from perceived cost of seeds for cover crops, reduced energy costs due to reduced tilling, potential reduction in irrigation costs, reduced costs for smaller volumes of pesticide and fertiliser used, as well as costs incurred for yield instability, skilled labour costs, training, and new machinery. These figures show estimates for the first year of the transition but assumes that farmers will need continued support for the following few years as yields stabilise, and soil health gradually improves. After the first year however, figures can be refined and updated as more data is collected.

Economic analysis – three solutions to soil degradation

The economic analysis focuses on three solutions for counteracting the three soil degradation processes (soil erosion, nitrogen surplus and loss in biodiversity) with the aim of reducing the percentage of endangered areas in figure 4 to a factor of 0 for each of the three indicators. These are:

I. Indicator 1: Reducing tillage to decrease soil erosion;
II. Indicator 2: Planting cover crops to help fix nitrogen in the soil.
III. Indicator 3: A combination of sustainable agriculture practices that improve the biological function of the soil. The term 'sustainable agriculture' here is based on the proxy term used in Boufous et.al., which is based on a collection of practices aimed at improving overall soil health. These include organic farming, crop rotation, grazing rotation, cover crops, grassland conservation, conservation tillage, water conservation, and reduction in chemical inputs to reduce soil pollution.[48]

[48] Boufous et.al., 2023 pg.8

Figure 6 – Findings from WTA and cost studies

Sustainable Agricultural Practice(s)	Soil degradation processes	Type of study	Region	Low (€/ha/year 2022 value)	Med (€/ha/year 2022 value)	Hi (€/ha/year 2022 value)	Sources
Reduced tillage	Soil erosion	WTA	Denmark		68.07		Zandersen et.al., 2018[49]
Reduced tillage		WTA	US		183		Conner et.al., 2016[50]
Cover crops	Nitrogen surplus	Costs	EU	180	193	206	European Commission. JRC., 2019[51]
Cover crops		WTA	US			266	Conner et.al., 2016[52]
Combination of sustainable agriculture practices	Loss in soil biodiversity	WTA (meta-analysis)	World	410	462	513	Boufous et.al., 2023[53]

In **figure 6** we see cost estimates from five separate studies showing the expected funding required to gain full cooperation from and provide adequate financial support to farmers in one year. All values have been converted to €/ha/year, with a 2022 € value. Any currency conversion has been made by an initial Purchasing Power Parity (PPP)[54] adjustment to € followed by an inflation adjustment to the year 2022. We have used a PPP adjustment instead of using exchange rates, because the PPP considers the number of goods and services you can buy for your money. This is particularly important when interpreting results from WTA studies, because responders often compare the stated values in the survey to the quantity of goods and services they would get for the same amount of money.

Calculations have been developed using EU data primarily, including Denmark, Romania, Spain, France, and The Netherlands, but also include data from the US and globally. This methodology was chosen acknowledging that there is limited publicly available European data to provide cost estimates for the whole of the EU, and therefore research has had to be broadened to more global, comparable studies. Despite

[49] Zandersen et al (2018)
[50] Conner et al (2016)
[51] European Commission JRC (2019)
[52] Conner et al (2016)
[53] Boufous et al (2023)
[54] *PPP is defined as the rate at which the currency of one country would have to be converted into that of another country to buy the same amount of goods and services in each country,* (IMF, n.d)

being non-EU specific, these data points have been reviewed and judged comparable and well aligned to the EU context, bringing similar insights into this research. Taking a US perspective can increase cost estimates slightly, as US farmers are likely to reflect the higher potential costs incurred for their sustainable practices, or else less social pressure is felt to take up new practices, and therefore cost incentives could be inflated somewhat. We have therefore used the PPP adjustment to balance this. We have also used upper and lower limits to make clear the nuances of perceived cost, and to reflect the range in costs that this transition may take on, depending on the exact geographic context of the research, even within the EU. These upper and lower limits are perhaps broader than if we only had access to European data, but they ensure we have neither under- or over-estimated costs, nor are we representing skewed results that are either too high or too low. Not every study is going to show the same results, and whatever data is used, there will be some variance.

One limitation is that, whilst we have applied the PPP adjustment, we may not have captured all variables between the US and EU cost perceptions, despite analysing similar practices and desired outcomes. However, if we removed the non-European data points, we risk skewing the results in a way that would also be limiting, calculating a figure that is only focused on a small selection of countries.

In the case of cover crops, figures were used from the WTA Conner et.al., 2016 study in addition to the EC Joint Research Centre (JRC) study from 2019. This is because the JRC study, whilst an important resource, is technically a survey, rather than a full WTA study. A full WTA study is where the farmer is asked to choose preferred options amongst a variety of different cost scenarios. It is a more subtle approach and uses the farmers' answers to guide the study. The JRC study, however, is a simpler question and answer approach, where farmers were asked directly how much they would need in compensation to participate in these sustainable agricultural practices. The optimal position would have been to have an EU-only WTA study, but in the absence of this, we have combined the JRC and Conner studies to show upper and lower limits for more accurate and comparable results.

To estimate wider sustainable agricultural practices, we used a meta-analysis by Boufous et.al. of 59 different studies, published in 2023. Figures from this study are 60% European data, with the remaining from the US, Asia, Africa, and Australia. The same methodology applies as above, using PPP adjustments to increase the cost relevance for an EU audience. Given the Boufous et.al. study also covers several different practices to improve soil biodiversity and overall soil health, it was important to include a breadth of data points to ensure we were getting an accurate depiction of overall costs. Together, the surveys were conducted between 2016 and 2021. Despite the time span, figures from 2016 are still valid, as even though there is a gradual difference over time, the effect on soil health is not seen as statistically significant and perceived relative costs remain consistent. A study from 20-30 years ago, however, would be invalid. For the cost of reduced tilling, we have used a study from Zandersen et.al. published in 2016 estimating the cost of reducing tilling in Denmark by 75% to 68,07 €/ha in combination with Conner et.al., 2016.

Economic analysis – total figures

Once we estimated the current total European land area that can be defined as 'unsustainable', the desired level of soil health (i.e., reducing the unsustainable land areas to a factor of 0 for each country), and the cost per hectare per year to reach those desired goals, we estimated the total cost of this transition for all EU-27 Member States. **Figures 7a, 7b** and **7c** show the total lower and upper values per country for each practice. So far, we have made calculations at country level. However, the same method can be used for more granular detail, if required, as the EUSO provides soil health data at both regional and sub-regional levels. The same calculations can be carried out, but for smaller affected areas.

Figure 7a: Total cost (upper and lower) per country associated with implementing practice to mitigate against indicator 1. Ordered by land area exceeding Soil erosion above 2 ton/ha/year.

Country	Utilised agricultural area (ha)	Land area exceeding soil erosion above 2 ton/ha/year	Soil erosion lower value €/year (million)	Soil erosion upper value €/year (million)
Luxembourg	132,140	42.87%	3.86	10.37
Bulgaria	4,564,150	32.41%	100.69	270.7
Spain	23,913,680	31.61%	514.55	1383.32
Portugal	3,963,940	31.53%	85.08	228.72
Czechia	3,492,570	31.33%	74.48	200.24
Italy	12,523,540	30.63%	261.11	701.98
France	27,364,630	29.80%	555.09	1492.3
Slovakia	1,862,650	29.59%	37.52	100.86
Ireland	4,920,270	29.54%	98.94	265.98
Austria	2,602,670	29.43%	52.14	140.17
Cyprus	134,140	29.37%	2.68	7.21
Greece	3,916,640	28.29%	75.42	202.77
Romania	12,762,830	26.40%	229.35	616.6
Germany	16,595,020	25.56%	288.73	776.23
Malta	9,800	25.40%	0.17	0.46
Belgium	1,368,120	24.72%	23.02	61.89
Hungary	4,921,740	22.11%	74.07	199.14
Poland	14,784,120	21.05%	211.84	569.51
Denmark	2,629,930	20.86%	37.34	100.39
Slovenia	483,440	20.05%	6.6	17.74
Sweden	3,005,810	18.82%	38.51	103.52
Lithuania	2,914,550	18.17%	36.05	96.91
Croatia	1,505,430	17.86%	18.3	49.2
Latvia	1,968,960	17.09%	22.91	61.58

Estonia	975,320	15.03%	9.98	26.83
Finland	2,281,710	9.66%	15	40.34
The Netherlands	1,817,900	9.05%	11.2	30.11
Total (billion €/year)			**2.88**	**7.76**

Figure 7b: Total cost (upper and lower) per country associated with implementing practice to mitigate against indicator 2. Ordered by land area with nitrogen surplus above 50 kg/ha.

Country	Utilised agricultural area (ha)	Land area with nitrogen surplus above 50 kg/ha	Nitrogen – lower value €/year (million)	Nitrogen – high value €/year (million)
The Netherlands	1,817,900	87.48%	286.25	423.02
Luxembourg	132,140	85.68%	20.38	30.12
Ireland	4,920,270	79.63%	705.24	1042.19
Denmark	2,629,930	72.88%	345	509.84
Belgium	1,368,120	68.69%	169.16	249.98
Germany	16,595,020	50.39%	1505.2	2224.35
Malta	9,800	50%	0.88	1.3
France	27,364,630	28.45%	1401.34	2070.87
Italy	12,523,540	23.26%	524.34	774.85
Slovenia	483,440	17.89%	15.57	23.01
Poland	14,784,120	14.83%	394.65	583.2
Spain	23,913,680	11.09%	477.36	705.44
Portugal	3,963,940	8.64%	61.65	91.1
Sweden	3,005,810	6.23%	33.71	49.81
Cyprus	134,140	6.09%	1.47	2.17
Greece	3,916,640	5.10%	35.95	53.13
Austria	2,602,670	4.27%	20	29.56
Croatia	1,505,430	2.48%	6.72	9.93
Bulgaria	4,564,150	0.34%	2.79	4.13
Finland	2,281,710	0.31%	1.27	1.88
Romania	12,762,830	0.27%	6.2	9.17
Czechia	3,492,570	0.12%	0.75	1.11
Hungary	4,921,740	0.12%	1.06	1.57
Lithuania	2,914,550	0.10%	0.52	0.78
Estonia	975,320	0.04%	0.07	0.1
Slovakia	1,862,650	0.02%	0.07	0.1
Latvia	1,968,960	0.00%	0	0
Total (billion €/year)			**6.02**	**8.89**

Figure 7c: Total cost (upper and lower) per country associated with implementing practice to mitigate against indicator 3. Ordered by land area classed as moderately high- or high-risk.

Country	Utilised agricultural area (Ha)	Land area classed as Moderately high- or high-risk	Sust. Agri. – Lower value €/year (million)	Sust. Agri. – High value €/year (million)
Malta	9,800	99.50%	4	5
The Netherlands	1,817,900	77.50%	577.64	722.75
Belgium	1,368,120	65.92%	369.76	462.66
Hungary	4,921,740	64.91%	1309.83	1638.88
Ireland	4,920,270	62.98%	1270.5	1589.68
Croatia	1,505,430	55.68%	343.67	430.01
Spain	23,913,680	54.13%	5307.23	6640.52
Greece	3,916,640	53.22%	854.62	1069.32
Denmark	2,629,930	52.28%	563.72	705.34
Italy	12,523,540	51.91%	2665.4	3335
France	27,364,630	49.53%	5557.02	6953.05
Germany	16,595,020	49.44%	3363.88	4208.95
Luxembourg	132,140	47.75%	25.87	32.37
Romania	12,762,830	46.57%	2436.9	3049.09
Czechia	3,492,570	46.42%	664.71	831.7
Cyprus	134,140	41.03%	22.57	28.23
Slovenia	483,440	32.21%	63.84	79.88
Lithuania	2,914,550	29.15%	348.33	435.84
Bulgaria	4,564,150	29.01%	542.86	679.24
Austria	2,602,670	23.07%	246.18	308.02
Slovakia	1,862,650	22.73%	173.59	217.19
Poland	14,784,120	21.22%	1286.25	1609.38
Latvia	1,968,960	20.86%	168.4	210.7
Estonia	975,320	19.07%	76.26	95.41
Portugal	3,963,940	11.82%	192.1	240.36
Finland	2,281,710	6.55%	61.28	76.67
Sweden	3,005,810	2.33%	28.71	35.93
Total (billion €/year)			**28.53**	**35.69**

When we cumulate the estimated costs for all EU-27 Member States, we come to the following costs for the three different practices, as shown in **figure 7**. This shows the potential cost needed to support farmers financially in this transition for the first year. Despite the overlap in practices, these three solutions are

valued separately in this paper, because figures have been sourced from separate studies and have been calculated under slightly different conditions (e.g., country and year). Figures should therefore be viewed separately and not combined. All three are included however, to give a more detailed overview of potential costs and a more accurate view of cost ranges.

Figure 8: Total estimated costs

Sustainable agricultural practice(s)	Lower Limit	Upper Limit
Reduced tilling	2.88 billion €/year	7.76 billion €/year
Cover Crops	6.02 billion €/year	8.89 billion €/year
Combination of sustainable agriculture practices	28.53 billion €/year	35.69 billion €/year

Separate EC led research substantiates our estimates, concluding that the cost of implementing new sustainable soil management practices to align with goals set out in the EU Soil Strategy would be in the region of €28-38 billion per year. However, it is important to note that the EC's cost analysis methodology was based on an impact assessment and 'targeted questionnaires' sent out by the EC to experts. Unlike WTA studies, these calculations were not based on farmers' perceived costs but rather third-party external analysis. Costs in the EC's proposal tackled the implementation of practices to reduce soil degradation and the resulting loss in ecosystem services and focused on options that were most in line with policy options set out in the EU Soil Strategy[55].

Cost of doing nothing

Although figures suggest that this transition will be costly in the short term, the cost of doing nothing is considered far greater. Overall, the EU estimates that soil degradation already costs around €50 billion per year due to the loss of essential services that good quality soil provides[56]. According to the FAO, soil damage also has the potential to reduce crop yields by up to 10% by 2050 if nothing is done[57]. Clearly, doing nothing is not an option and instead the agri-food sector should draw on positive indications of the cost benefit of doing something. For example, a global meta-analysis of the relationship between soil organic matter and crop yields studied the positive effects on yield in maize and wheat when soil organic carbon concentrations were increased to optimum levels. It showed that an increased concentration of soil organic carbon of up to 2% had the potential to increase wheat yields by about 10-11% and maize by 23-27%. Better soil health also has the potential to reduce reliance on nitrogen fertilisers and help close global yield gaps[58]. In the EC's proposal for a Directive on soil monitoring and resilience, it notes that the total estimated cost benefit

[55] European Commission (2023d)
[56] European Commission (2023b)
[57] UN News (2019)
[58] Oldfield et al., (2019)

of its initiatives to improve soil health in Europe could be as much as €74 billion per year[59]. These cost benefits are largely associated with cost savings due to increased efficiencies, effectiveness of policies and synergies in a coordinated effort across all EU Member States. Therefore, improved soil management and better soil health have the potential to reduce costs significantly in the future.

Assumptions and limitations

The method, much like other methodological approaches considered, has a number of associated assumptions and limitations that need to be considered when interpreting the results. We explore some of these limitations further in our conclusions and recommendations for the next phases of research.

Assumptions

- The term 'sustainable agriculture' in this cost analysis is based on the proxy term used in Boufous et.al., which is based on a collection of practices aimed at improving overall soil health. These include organic farming, crop rotation, grazing rotation, cover crops, grassland conservation, conservation tillage, water conservation, and reduction in chemical inputs to reduce soil pollution.
- PPP conversion is more effective than exchange rates for this study, because PPP considers the number of goods and services you can buy for your money, which gives a more accurate comparison for perceived costs, as used in WTA analysis.
- This study shows costs for the first year of the transition. Our assumption is that costs will continue for the first few years after the initial transition, but after that, as yields begin to improve and cost of inputs decrease, on-going costs will gradually decrease.
- Farmers who feel they are being compensated 'fairly' (according to their own perception of costs) are more likely to adopt new changes and participate in this transition.

Limitations

- Quantifying a single overall cost for all farms in Europe to transition to more sustainable agricultural practices is very difficult, given the term 'sustainable agriculture' has many connotations, the fact that the question can be addressed in many ways and given the general availability (or lack of availability in instances) of publicly available data and research on this topic across all EU Member States.
- Whilst we have chosen the theme, soil health, that covers an extremely broad spectrum and has a large-scale direct impact on the majority of the agri-food sector with regard to future resilience to

[59] European Commission (2023d)

climate change and food security, we recognise that the costs do not consider other key proxies for sustainable agriculture. These might include worker livelihoods, human rights, water management, broader impacts on nature and biodiversity, energy consumption and more. More research is required to assess the interdependencies and trade-offs (both positive and negative) between the environmental, social, and economic benefits of sustainable agriculture.

- Cost calculations have been made on total UAA from Eurostat, which was updated on 9 August 2023. UAA, according to Eurostat, includes arable land, permanent grassland, permanent crops, and kitchen gardens[60]. It may however not capture all recent agricultural land use changes across the EU.
- Single WTA studies are specific in what practices are considered as well as the conditions under which they are conducted. In this paper, several studies have been used to give a more reliable estimation of farmers' perceived costs of implementing a variety of sustainable agricultural practices to improve soil health. However, it is recommended that the EU carries out its own WTA studies designed specifically for the practices they wish to implement on farms, and in the specific regions they want to enact this transition to refine cost estimates, specific to chosen policies.
- WTA studies do not consider the potential improvement or increased degradation of future soil health due to changes in climate conditions, therefore this study does not account for the change in costs of future years as the state of soil health changes, thereby changing our baseline figures. However, the same methodology can be used with updated figures on Europe's state of soil health.
- Studies include data that are predominantly European, but also include figures from the US, Asia, Africa, and Australia. As explained under **figure 5**, we acknowledge the lack of European data available publicly, and have used studies from outside the EU that we have judged most similar, and comparable. We have used PPP adjustments to reflect the different perception of cost in the different countries. By only using EU data, we would risk skewing the results in an equally limiting manner, resulting in a figure that was potentially too low, though we understand that PPP adjustments do not account for every difference between EU and global agriculture. To further account for this difference, we have included upper and lower limits to reflect the variance in perceived costs across different locations and to show costs that are neither over nor underestimated.
- It takes a very long time for soil to regenerate. For example, 2.5cm of new topsoil can take around 500 years to make [61]. Practices suggested in this paper aim to maintain or improve soil health and slow down the rate of degradation, we are not calculating the time or cost it would take to develop topsoil.
- Questions used in the various WTA studies used for this paper are not in the public domain. For future studies, it is recommended that questions are made public so that readers can gain more

[60] Eurostat (2023a)
[61] European Commission (2023d)

granular insights into the surveys which can support the funding of high priority best practice initiatives that deliver the greatest return on investment.

Chapter 3: Funding mechanisms

Whilst the need and desire across the entire food chain for accelerated action to deliver a more sustainable agriculture transition is well understood, 'who pays?' is often a question that typically creates a major barrier and inhibits progress at the pace and scale required.

Capital flows need to be directed in ways that both incentivise and de-risk sustainable agricultural best practice, primarily to those that carry the most risk, but also have the most potential to deliver change: farmers. Although the EU is the largest agricultural producer in the world, investments into the EU agri-food sector are on a downward trend, with the financing gap for the unmet loan demand in the sector estimated at €62.3 billion in 2022, 33% higher than in 2017[62].

This chapter explores the types of funding mechanisms that could help cover the cost burden associated with the transition detailed in the economic analysis, whilst also supporting farmers to improve the long-term viability of European agriculture. We are not suggesting that these funding mechanisms are enough to fully finance year one costs, but rather consider how an evolution, and combination of these mechanisms could enable significant progress in this transition. We also consider the opportunities and limitations that these mechanisms present to the agri-food sector, particularly in their capacity to support all types of farming systems.

Mechanisms range from those that already exist and are well-established, to those that can be built (although these may take time).

Common Agricultural Policy (CAP)

One of the most well-established public funding mechanisms currently in place across the EU is the Common Agricultural Policy (CAP), which was set up in January 1962 to support farmers. Originally, the CAP was paid out from a single fund, the European Agricultural Guidance and Guarantee Fund, but in January 2007, this was replaced by the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Fund for Rural Development (EAFRD), respectively Pillar 1, for direct payments and agricultural market measures, and Pillar 2 for rural development measures.[63] For the most recent budget (2021-2027) the total CAP commitment reaches over €386.6 billion, which is around 31% of the EU's total budget[64].

Payments are given to farmers based on area of land farmed (per hectare) and payments are managed at national level across the EU.[65] The CAP is generally intended to support farmers' access to further lending to improve cash flow and loan repayment capacities via direct payments, investments, and start-up

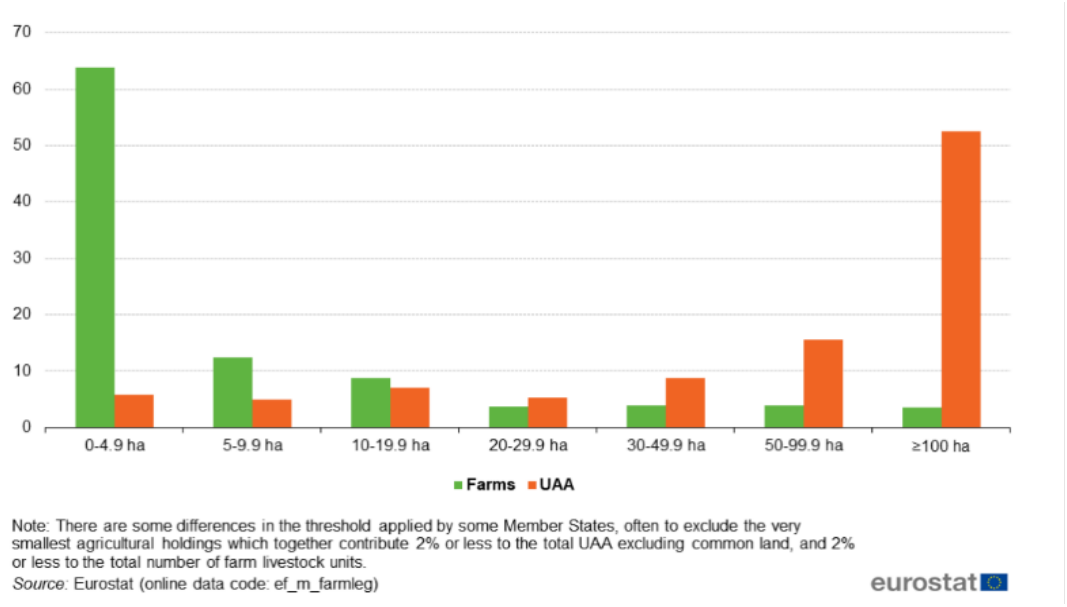
[62] Fi-compass (2023)
[63] European Parliament (2023)
[64] European Parliament (2023)
[65] European Commission (2022a)

support[66]. Whilst it is the main financial support mechanism for many farmers, with the leading form of reimbursement coming from decoupled direct payments, some argue that area-based payments are not well designed to promote environmental performance or to improve livelihoods[67]. When speaking to young farmers during our research, some believed that these direct payments currently preserve the status quo, and do not allow young farmers to get a foothold in the market. Young farmers often have limited land access and are therefore only eligible for a small financial share, despite bearing a large responsibility for the future of farming and the success of these investments. Additionally, given the area-based payment structure, much of this funding is channelled to a very small number of EU farms that measure over 100 hectares. As detailed in **figure 9**, most farms in the EU are less than 5 hectares, whilst only a tiny proportion are above 100 hectares, which means around 80% of the CAP payments go to less than 20% of beneficiaries[68]. In 2019, 74.9% of the CAP beneficiaries in the EU-27 received less than €5,000 in annual payments. Whereas only 1.93% of farms received more than €50,000 each[69]. In 2021, based on size, 0.5% of farms received 16.4% of the CAP direct payments[70]. To illustrate the potential of a more equal payment scheme via the CAP, a modelled scenario in 2018 proposed that if all farmers in the UK received a safety net income set at median level of the CAP subsidy (i.e., the CAP was equally distributed across farmers) such a scheme would still leave around £1.5 billion for targeted support in the UK alone[71] .

[66] European Commission (2023e)

[67] Institute for European Environmental Policy (2023), p.15
[68] Boix-Fayos, C. and de Vente, J. (2023).
[69] European Parliament (2023).
[70] Institute for European Environmental Policy (2023), p.15
[71] Bateman and Balmford (2018)

Figure 9: Distribution of EU farms and utilised agricultural area according to farm size (%, 2020)



An Irish farmer, and member of a prominent Agriculture Cooperative Organisation, engaged through this research raised the point that the true value of the CAP is further impacted by inflationary pressures. 'Farm Europe', a European think tank, forecast that the aggregate 2021-27 real value of the CAP budget, is likely to shrink 21.95% regarding 2020, and 34.12% if compared against 2027[72].

Commissioner Wojciechowski acknowledged in European Parliament in January 2023, the fact that inflation has impacted many different programmes, including the CAP and that the impact is different depending on farm type and size. The Commissioner, however, made clear that the CAP had never had a policy for inflation correction to keep it 'market-orientated' and instead expected farmers to increase the price of agricultural outputs. For example, in 2022, the value of agricultural outputs increased by 19%. Nevertheless, farmers cannot offset all costs by increasing prices. For example, projects planned with rural development funding, allocated under Pillar 2 of the CAP,[73] are not directly linked to agricultural outputs and can therefore become too expensive to implement with "programmed support becoming insufficient[74]." The same issue can be said for costs related to this transition: the full cost of implementation cannot be directly counteracted by increasing the cost of agricultural outputs. Farmers and policymakers therefore need to be aware of the potential impact future inflation may have and decide and how.

During one of the workshops, participants discussed the way the CAP payments are distributed and how this can sometimes deter farmers from taking up more sustainable agricultural practices. A large-scale (1,100 hectares) regenerative farmer operating in Southern Spain noted that the CAP is limiting the

[72] Farm Europe (2022)
[73] European Commission (2022d)
[74] European Commission (2023i)

sustainable transition. On their farm, changing a marginal cereal legume crop into permanent pastureland could promote better soil health leading to higher levels of carbon sequestration. However, transitioning to permanent pasture, the farmer said, was no longer covered by the CAP in that area of Spain. Payments were only valid for land that was converted to permanent pasture 8 years ago or longer. They would either need to forfeit the cereal crop subsidy, or else continue with the cereal crop, which may be less beneficial for long term soil health. Given some of the neighbouring farmers relied on the CAP for around 40% of their income, farmer sentiment was generally that it would be extremely difficult for them to change practices that may put at risk their ability to access CAP subsidies.

CAP latest developments and future reform

The CAP is nevertheless one of the most well-established funding mechanism and there are encouraging signs its strategy is evolving to ensure it is compatible with the goals of the Green Deal, fostering stronger links between agricultural productivity and environmental and social development. The CAP adopted in 2021 aimed to contribute to the transition towards a "smart, sustainable, competitive, resilient and diversified agri-food sector to ensure long-term food security through focus on, amongst others, stepping up climate-action, protecting natural resources and preserving and restoring biodiversity"[75]. Its recent strategic plans for the period of 2023-2027 include some mandatory environmental conditions linked to soil management practices (e.g., minimum tillage, crop rotation and cover crops) that farmers must reach to receive specific income support from the CAP (although, as set out in the previous section, some believe this is not yet designed well enough). In fact, the ambition by 2027 is that half of the EU's UAA will be reinforced by commitments beneficial for soil management to improve soil quality, biodiversity and biota[76]. Encouragingly, the CAP strategic plans also outline a future spend of €98 billion (approx. 32% of total CAP) to deliver environmental benefits across climate, water, soil, air, biodiversity, and animal welfare, and to incentivise farmers to go beyond necessary conditions[77] .

Additionally, plans are in place to offer voluntary eco-schemes, as an update to Pillar 1. A quarter of funding in Pillar 1 will be redirected towards practices that aim to support the specific needs of each Member State and cover at least two of the eight 'areas of action'. These include climate mitigation, climate adaptation, water protection, soil protection, protection of biodiversity, sustainable and reduced use of pesticides, and enhanced welfare or actions addressing antimicrobial resistance[78]. This is a positive step forwards, although some have argued that there is room for improvement. Firstly, Member States, which have flexibility to use the funding according to their needs and objectives, tend to prioritise economic objectives in their implementation choices rather than primarily environmental[79]. Secondly, as reported by a former EC official, a very low level of innovation was seen in the environmental sustainability measures supported by

[75] European Commission - Department of Agriculture and Rural Development (2023c)
[76] European Commission (2023d)
[77] European Commission (Department of Agriculture and Rural Development) (2023)
[78] Runge et al., (2022)
[79] Institute for European Environmental Policy (2023)

eco-schemes in national strategic plans. According to them, this was a missed opportunity by Member States. Finally, the former EC official also reported that KPIs are used to design national strategic plans and their application for evidencing impact through eco-schemes require further development to measure and monitor progress accurately. Future changes to the CAP should shift to more accurate impact measurement and performance-based payments, for payments to be more strongly linked to the environmental objectives that need to be achieved to meet broader sustainability goals.

To move this further, the CAP could consider a more targeted approach, focused on 'public money for public goods' where farmers are paid directly for the public goods they serve through the protection of natural surroundings, rural landscapes, wildlife, air, and water quality. Soil is an essential part of this and requires careful preservation, home to a quarter of the world's biodiversity and essential for carbon storage, water quality, nutrient cycling, drought, flood protection and more[80]. 'Public money for public goods' is the underlying principle of DEFRA's Environmental Land Management Scheme (ELM) and could be taken as an example for future reform of the CAP direct payment scheme. Since Brexit, the UK has focused on reforming the way it supports farming and has focused on policy that places an economic value on public goods delivered through the natural environment (e.g., soil health, climate change mitigation, biodiversity conservation and enhancement). Its main payment scheme for farmers is through the Sustainable Farming Incentive (SFI), which acts as an incentivisation mechanism to reward farmers financially for regenerating, protecting, and enhancing the ecosystem that supports food production. Under SFI for example, farmers can be paid £5.80 per hectare each year (as well as £95 per agreement) to carry out soil tests and create a soil management plan. They can also access funding for planting cover crops (£129 per hectare) and herbal leys (£382 per hectare)[81]. What is important for this transition is that farmers need to be compensated for delivering a public good that would otherwise not deliver an economic return. Public payments need to equate to the public goods delivered.

Another benefit, a public sector representative noted, was the huge potential to support farmers through the sustainable transition under Pillar 2 of the CAP. This individual highlighted the opportunities to create loans or guaranteed funds with favourable conditions, such as longer maturity, lower interest rates or longer gratis periods, where the borrower can delay repaying the loan without penalty fees. The benefits of financial instruments that could be leveraged by Pillar 2 were also confirmed by a representative of the European Investment Bank (EIB)/fi-compass (an advisory services platform on financial instruments provided by the EC in partnership with the EIB). They suggested that with the public sector as a guarantor of the loan, risk can be mitigated and a multiplier effect of 5 or 10 times can be enacted, unlocking greater funding for the agri-food sector. A representative of CEJA also acknowledged that Pillar 2 has the potential to provide an effective risk management tool to young farmers who struggle to access capital.

However, various stakeholders also commented that the CAP lacks a robust, holistic standpoint, which can slow down concerted efforts to accelerate this transition to more sustainable agriculture across the EU. For example, the CAP is operated under shared management between the EC and Member States, including

[80] DEFRA (2019)
[81] GOV UK (2023)

income support, market measures and rural development[82]. The decision for how it is set up, the various financial conditions, and how it is then implemented, sits with national governments. On the one hand, this means more autonomy and more flexibility to meet the very diverse climate and soil quality aspects in each Member State, but it can also lead to a less joined up approach, with the risk that some countries fall behind EU climate goals. It also risks larger disconnect between farmers' actions on the ground and the wider EU administration. In recent years, work to align the CAP more closely with the EU Green Deal has helped slightly, with each Member State required to produce a CAP strategic plan, to be approved individually by the EC and monitored via quantified targets[83].

Linking with other EU regulatory initiatives can also assist this. For example, the EU soil strategy to 2050 aims to ensure that sustainable soil management becomes the new normal. This includes proposing a scheme for farmers to test their soils for free to contribute to evidence for the CAP, knowledge transfer on best practices that lead to scalable improvements,[84] and targets to reduce chemical pesticide use by 50% by 2030 [85]. These steps could have a positive impact on the environment and soil health in the long-term but discussions with stakeholders suggested that more could be done to encourage a more joined up, consistent approach that benefits and takes into consideration work that farmers are already doing, barriers to implementation, and encourages a more open dialogue between both farmers and the EU, and between individual EU Member States. This will hopefully expediate a more successful and effective transition. In recognition of this, Member States must consider the critical role they can play together in influencing changes to the payment structure of the CAP that support integrated productivity and environmental gains on farms.

Climate fund

Several stakeholders engaged in this research believed that the CAP alone will not be sufficient to carry the upfront costs of this transition, with the view that it does not give farmers enough of a safety net, or confidence, to invest further to protect the future viability of their farms. With the CAP funding alone, farmers are likely either to cut spending in other areas to compensate, or simply won't be able to adopt new changes.

One option could be to develop a separate climate fund. A separate fund could not only support with the significant short-term capital investment required for this transition, but also act as an insurance policy both to support farmers with cashflow and develop mitigation and adaptation strategies against potential risks during the transition. For example, one farmer engaged with during the development of this paper spoke about transitioning to a rain-fed irrigation system, which would incur upfront implementation costs, but even more ongoing costs if risks of prolonged drought meant it was defunct for some years. The fund

[82] European Commission (2022c)
[83] European Commission (2020a)
[84] European Commission (2022)
[85] European Commission (2022b)

could even cover the cost of research and access to investments into drought tolerant crops. Farmers generally do not have the capital to cover these types of costs and would need payments over and above those they receive currently through the CAP to support them.

In the US, the Environmental Quality Incentives Program (EQIP) is one of the main funds that is available to farmers, a programme run by the National Resources Conservation Service (NRCS) within the US Department of Agriculture (USDA). Its aim is to support farmers integrate conservation activities on working farms[86], and it provides payments to implement certain practices. It includes a 50% upfront payment to support initial implementation costs (such as buying seeds for planting cover crops) and the remaining 50% is paid out once the practice is completed[87].

A separate climate fund could support others in the value chain. A US-focused food and drink industry specialist that we spoke to saw this fund as a simpler and more direct form of support than the CAP. They proposed that this fund should also be open to the food and drink industry as a form of support, who often work directly with farmers to incentivise the take up and implementation of more sustainable agricultural practices, but don't necessarily have the spare funds to maximise potential positive outcomes.

Private sector funding

According to the EC Strategic Foresight Report 2023, the majority of the investment needed to meet the EU's sustainable objectives of the Green Deal (and RepowerEU, which is the EU plan to improve reliance on fossil fuel energy from outside the EU and safeguard citizens and businesses from energy shortages[88]) will have to come from private funding[89]. The report talks about the growing pressures on public budgets, and the need to secure "sufficient and swift" funding from the private sector,[90] as the full costs and consequences of this climate crisis are growing and are still unknown. Speaking to experts in this sector, we asked what private funding mechanisms might be best for this transition. There were several different suggestions, including funding through private philanthropic institutions, banks, niche markets, crowd funding, direct sales, short chain markets, premium payments based on sustainability outcomes, funding through business-to-business contracts with the food and drink industry, as well as wider funding from industry for farmer training, research and tests and trials.

To date, banks have been amongst the biggest private funders of the agricultural sector in Europe,[91] and continue to give important support to EU farmers. Speaking to a representative from DG AGRI, European Commission, they said that banks can support farmers via various EAFRD-funded financial instruments, such as risk sharing loans that can offer, inter alia, flexibility in repayments and lower interest rates, and/or

[86] USDA (n.d.)
[87] USDA (n.d.a)
[88] EU Commission (2023j)
[89] European Commission (2023h)
[90] European Commission (2023h)
[91] Ficompass EAFRD (2020)

via guarantees, counter-guarantees, and even equity. These instruments can be targeted towards a specific theme or group of farmers, for instance, those joining the transition. They can also be combined with grants and technical assistance, and can provide significant leverage (i.e., attracting additional private resources). Some banks are specifically geared towards the agri-food sector, such as Rabobank or Crédit Agricole. Often cooperatives banks are particularly well set up for this, especially as many have stemmed from the agricultural cooperative system and have a long history of working with farmers[92]. Cooperatives are focused largely on retail banking and guided by their customers, lending predominantly to small and medium-sized businesses. Speaking to a representative from a large European Cooperative bank, they said that they were interested in finding innovative solutions in Europe that help this transition and said they work closely with the sector, government, European Investment Bank (risk sharing) and other financial institutions to provide loans to farmers (such as through a financial instrument). Cooperatives or specialised agricultural banks rely on their proximity to their customers as well as specific agricultural expertise to make an accurate judgement as to the viability of the farming business they are working with[93].

However, many countries lack specialised banking for agricultural systems, or else financing is concentrated in a very small number of banks. This leads to complications in terms of fair market competition, driving the cost of lending up and further limiting farmers' ability to access funding or ability to realise their full potential in supporting or taking part in this transition[94]. Discussions during our stakeholder engagement supported this view, raising concerns that some larger, commercially focused banks with generalised models were not sufficiently set up to handle the complexities of farming businesses, especially with small farms. This is a point that was raised particularly amongst younger farmers, who are more likely to struggle to access financing. Banking portfolios are often not adapted to the agricultural sector, especially with young farmers, as it is seen as too unpredictable to invest in. This negatively impacts young farmers' access to loans.

Farmers we spoke to said that their businesses are often too volatile and unpredictable to present a stable and regular income, so accessing funding from banks is very hard. Large banks may support big farms in this transition, given their more secure business operations and future projections, but they are unlikely to finance small ones. In an interview with a representative from the EIB/fi-compass, this topic was discussed in detail, and the sense was that much of the financial sector needs specific training on sustainable agriculture, farm business models, and farming in general to better assess projects and funding opportunities in this sector.

This is reinforced by the fact that almost two-thirds of the current agricultural funding gap in the EU outlined previously, is due to difficulties in accessing loans, either because they were rejected by banks,[95] or the farmer failed to apply or obtain the loan because they were discouraged or feared rejection[96].

[92] Ficompass EAFRD (2020)
[93] Ficompass EAFRD (2020)
[94] Ficompass EAFRD (2020)
[95] European Commission (2023e)
[96] Fi-compass (2023)

Accessing funding is made worse by the fact that the sector often faces higher than typical interest rates offered by banks given the volatile nature and risks (e.g., narrow or unpredictable profit margins, direct impact of climate change etc.) associated with food production.

The EIB carried out surveys in 2018 and then again in 2022/3 to assess this sector and monitor changes over time. Surveys showed that since 2018, collaboration between banks and farmers has improved, especially amongst young farmers who are seen as more entrepreneurial in their approach to financing. It also demonstrated a higher level of cooperation from banks to support farming as compared to 2018. However, the interviewee made clear that private funding will only work if there is public support to facilitate it. This might come in the form of a guarantee to take away some of the risk, or else a loan from the public sector if liquidity is low. The idea is that public and private funding sectors should share the burden, with the aim of supporting specific investments that are considered strategic for the future, i.e., this transition. To make proper use of this funding source, the EU needs to work more closely with both the private sector (banks and food and drink industry included) and farmers to support better engagement, cross collaborate, and promote better understanding and solutions in the form of lower risk, better access to market, clearer farm business models and stronger investment cases.

Beyond banks, collaborative initiatives amongst the food and drink industry are also effective. In addition to initiatives discussed in chapter 1, the likes of FrieslandCampina, WWF and Rabobank are a good example. They have collectively created their own Biodiversity Monitor to support dairy farmers measure and keep track of sustainability progress through a set of KPIs. These range from amount of GHG emissions emitted to the share of nature and landscape managed[97]. This model could be leveraged or repurposed, where farmers are incentivised to access additional payments in the form of premiums on products sold depending on their score. Working directly between the food and drink industry and farmers may also create more timely access to finance, helping reduce inefficiencies and streamline private funding into specific projects with carefully measured progress and outcomes, which can be used for future training and knowledge building within local farming communities.

Since 2019, Barilla has increased its focus on the use of wheat produced using sustainable agriculture methods under the 'Mulino Charter', in a bid to reduce the level of biodiversity loss. The charter includes ten key rules, setting its standards for what constitutes 'sustainable agriculture', which includes crop rotation every five years, the use of specific wheat varieties and certified seeds, areas left for wildflowers, and specific wheat storage rules with controlled temperatures and atmosphere to reduce post-harvest losses. The project was set up with Barilla, alongside WWF Italy, University of Bologna, Tuscia University and OpenFields. It now has around 2,600 farmers involved and a number of different Italian mills and impacts over 100 of their wheat products[98].

There is also the Arla Foods Sustainability Incentive model, which aims to support farmers reduce their carbon footprint. It is a point-based system that rewards past and future climate and environmental

[97] Friesland Campina (n.d.).
[98] Barilla (2021)

sustainability activities. For every activity, the farmer can collect points if they meet specific criteria. Farmers will receive 1 eurocent per kilo milk for submitting climate check data, which is the prerequisite for receiving the sustainability incentive. The model is designed to reward farmers with up to 3 eurocents per kilo milk. It corresponds to €500 million being earmarked for rewarding on-farm climate and environmental activities.[99]

The role of private funding in this transition could also be an important method to accelerate the development, testing, and uptake of technological innovation. These could include digital monitoring and evaluation solutions, precision agriculture technologies, or even new plant breeding programmes, such as the new proposal for NGT introduced in chapter 1. Developments such as these require high capital investment, but could bring strong ROI, both in terms of the benefit to expediating positive change within this transition, but also in terms of monetisation of solutions, which could be an attractive prospect for private investors.

Although these are very positive steps forward, future food and drink industry initiatives could work to focus more on investing in the full implementation of key sustainable agricultural practices, including on the ground advice, guidance and training, monitoring, and ongoing financial support for farmers. A report by FAIRR investigated 79 agri-food companies with a combined annual revenue of USD $3 trillion. The aim was to explore the growing number of regenerative agriculture commitments, particularly linked to soil health, being made at the food and drink industry level and how that impacted farmers. Of the 79 companies, 63% of them had mentioned regenerative agriculture in various financial disclosures or company initiatives. However, around 40% had no quantified targets. Desired outcomes stated by companies mainly focused on carbon-related outcomes, whereas the least common topics were farmer incomes, ensuring a just transition and other areas of economics.[100] The food and drink industry cannot carry this transition on its own, but they are in a unique position of influence with both government and farmers, as they have financial backing but also have the power to engage directly with their suppliers. The EU need to work more collaboratively with the food and drink industry to facilitate this support further.

"Polluter pays" principle

A key principle of EU Environmental Law is the "polluter pays" principle whereby the polluter, rather than the taxpayer, covers the costs created by pollution. Explicitly, this principle does not yet apply to agriculture and there are no emissions limits prescribed under the CAP. However, it could be expanded and act as an effective principle to establish financial mechanisms that incentivise reduction in emissions from agriculture in the long term. Although this means that the price of goods and services increases in the short term, given the extra cost to the producer, market competition should encourage actors in the food supply

[99] Arla (2023)
[100] FAIRR (2023)

chain to reduce their environmental footprint in the long term to ensure costs to the consumers are kept down.[101]

The EU emissions trading scheme (ETS) is a system that could reflect the polluter pays logic, with a set price on carbon for the energy-intensive industry. A similar system could be explored for the agri-food sector. One issue this poses is that it would be difficult to know how to define and identify the source of pollution related to agriculture without risking an extra cost to farmers[102]. To prevent negative consequences, there needs to be a system whereby all parties are involved and incentivised to push forwards this transition, prioritising support for farmers.

Other emerging mechanisms include, for example, the EU Carbon Border Adjustment Mechanism (CBAM). CBAM aims to put a fair price on the carbon emitted during the production of certain carbon intensive goods that enter the EU. It also encourages cleaner industrial production in non-EU countries. Initially, goods will include cement, iron, aluminium, electricity, hydrogen, and steel as well as fertilisers.[103] Although this mechanism remains to be tested, CBAM is currently in its transitional phase and will fully enter into force in January 2026. It could be a potential approach to learn from in the future.

Consumer pays

The cost of this transition and the question of who pays must take the entire food value chain into account. Across Europe, consumers have been accustomed to readily available food all year round, at prices that may not always reflect the true cost of production. For this transition to be successful in the long term, work is required to change consumers' perception to acknowledge and recognise the true value of food and pay a fair price. If the full cost of transitioning cannot be carried by government, the food and drink industry, private investment, or farmers, then costs will naturally fall to the consumer, paying a premium for more sustainably produced foods. There is evidence to suggest that private capital, including from consumers, is the most influential means to leverage change within the agri-food sector[104].

There is a case to say that if consumers were prepared to pay more for more sustainably produced products, and therefore consumer prices increased in the short term to take some of the burden of this transition, this would create a virtuous cycle of continuous improvement with farmers having more incentives to improve practices and achieve a successful transition in the long term. This may also stabilise costs at affordable levels if changes in practices unlocked reductions in cost of production due to reduced input and operational costs.

Positively in recent years, the growing consumer demand for foods with lower environmental impacts and better animal welfare standards, have started to have a direct influence on agricultural markets, and an

[101] Jans et al., (2008)
[102] Jans et al., (2008)
[103] European Commission (2023a)
[104] FAO (2023a)

indirect influence on farming systems[105]. According to a recent survey, 58% of Europeans consider climate impacts when buying foods and 51% of Europeans are willing to pay more for food produced without fossil fuels[106]. Another survey in the US showed that consumers were willing to pay a premium of as much as 30% - 40% when it came to sustainably produced foods[107].

However, what survey respondents say, compared to what they are willing to pay, can vary. Although most consumers see more sustainably produced food as a good thing, if they are not able to or willing to pay more, then demand drops and the supply of these products into the market is limited. Recent global phenomena such as Covid-19 or major geopolitical conflict, have exacerbated the cost-of-living crisis, driving significant inflationary pressures on the food and drink industry, and exposing the 'just in time' global food supply and demand models. On the one hand these significant global events have exposed consumers to the true cost of food production and the vital need for a more sustainable and robust food system. On the other hand, increased living costs, pushing consumers to cut down their expenditure and buy food that is affordable, can reduce short term consumer focus on the value of sustainability.

Private/Public Partnerships (PPPs)

Private/Public Partnerships (PPPs) are a common instrument used to promote and implement government policy. When it comes to the agri-food sector, PPPs are a common instrument for agriculture, as well as other areas, such as public health. PPPs use the influence that the food and drink industry has on consumers to promote an idea or product and reach government targets. For example, in the case of public health, the food and drink industry could promote certain food items or ingredients, whilst also promoting government targets in obesity rates and non-communicable diseases.

In the case of sustainable agriculture, the Dutch government has recently partnered with Wageningen University & Research, University of Groningen, and Utrecht University along with 54 agri-food chain partners for the Re-Ge-NL innovation programme. The Dutch government has invested €129 million into it, which aims to meet national targets by transitioning 1000 Dutch farmers to more sustainable farming by 2030, whilst also ensuring at least 10,000 farmers and advisors gain knowledge about sustainable agricultural practices[108].

PPPs work because all parties involved have a common goal and can therefore use their shared agenda to push a scheme or idea forward for mutual benefit. They are fairly low risk, although challenges do occur, such as how to create a PPP that does not have any conflict of interest, and making sure the PPP is not being used to increase profit margins or else influence government agenda in a biased way. [109] Usually

[105] Publications Office of the European Union (2022)
[106] YARA (2023)
[107] LEK (2022)
[108] Wageningen University & Research (2023)
[109] Pan American Health Organisation (2013)

though, they are an effective and secure way of accessing non-government funded budgets whilst reaching government targets more quickly.

Voluntary carbon markets

In recent years, growth in technological farming solutions has meant new and attractive opportunities for investors. In particular, the voluntary carbon market has become an increasingly appealing proposition, with many emerging companies offering a financial incentive mechanism for reduction, avoidance, or removal of carbon from key value chains. With so much potential in agriculture, the voluntary carbon market is already being used to reward farmers financially for enhanced soil management practices and, with the right regulatory and market conditions, has the potential to scale significantly and rapidly.

Carbon farming works in a number of ways and is dependent on different regulatory restrictions. In simple terms, it is the process of creating accredited certificates linked to on-farm carbon capture that can then be sold to third parties as a standalone commodity, known as a 'credit'. Farmers can then either take a cut of the sale of the credit or be paid a premium for goods produced on land with certified carbon sequestration. Looking ahead, one of the benefits of carbon markets could be that it can enable greater economic value to remain in the hands of farmers and could give farmers more control over how they are paid and for what benefit.

A representative from an agronomy company specialised in transitions to regenerative agriculture suggested that some of the principles developed in carbon markets could help to provide the right incentive for farmers to find the right knowledge and take the risk to transition. In addition, they saw the long-term viability of this approach, stating that "rather than a simple one-off payment like a grant, credits are something farmers can continue getting value from if they continue to practice more regenerative agriculture that promotes soil health and sequesters carbon".

The challenge, they continued, is that "the carbon market has its roots in offsetting, which people often associate with taking value out of the agricultural value chain and putting it into another, such as an airline, which is totally unconnected with the food system. This can alienate farmers and value chain companies alike. Instead, there is now an emerging focus on producing verified scope 3 reductions, where companies invest in regenerative agriculture that delivers proven carbon reduction on payments for results basis within their own supply chains, thereby offering a solution that remains inside the food value chain and adds tangible value to the farmers' work."

Broader challenges such as the balance between high labour costs and volatile carbon prices (and therefore justification of investing in the market), and fragmented ownership structures of farms have, to date, made land-based projects across Europe the exception rather than the rule.[110] Further feedback from farmers during the research phase identified practical issues too. For example, the lack of information or guidance

[110] UN -WCMC (2022).

around voluntary markets, the volatility of the market and the financial insecurity that presents, the potential asymmetry of power between companies, credit buyers and farmers, and the reality that currently, only large-scale farms (approximately 250 hectares or larger) can viably participate in the carbon market on an individual basis, given the large capital investment needed for certification, verification, and ongoing monitoring. Others would need to collaborate in a cooperative to participate, along with other key barriers to entry.

Nonetheless, carbon farming is now more relevant following the EC's announcement in November 2022 that it has adopted the first EU-wide voluntary framework to certify high-quality carbon removals as part of the Green Deal. Within the EU's Farm to Fork Strategy, it states that new 'eco-schemes will offer a major stream of funding to boost sustainable agricultural practice, such as carbon farming.'[111] With upfront costs attached to carbon farming, it may also be that the EU soil strategy proposal for free soil testing on farms could accelerate the evidence base required to access this funding.

By 2030, it is estimated that the global voluntary carbon market will grow from $2 billion (2021) to between $10-$40 billion,[112] so it is a very attractive proposition. Although it is not seen as the optimal solution, given the narrow lens it puts on sustainability, a representative from Climate Farmers said that the voluntary carbon market is nonetheless currently one of the best tools available to provide direct support and financial incentive to farmers to take up more sustainable agricultural practices. It is likely that this will form a critical part of the funding solution, but not all.

Monetisation of wider eco-system services

Many are starting to look beyond carbon farming, concerned that by focusing solely on carbon reduction, we risk missing opportunities to capitalise fully on the potential for positive ecosystem impacts that come with the wider scope of nature and biodiversity. Since the COP15 UN Biodiversity Conference and the Kunming-Montreal Global Biodiversity Framework, momentum around how to create value from nature and biodiversity has increased[113]. This, coupled with emerging frameworks such as the Taskforce for Nature related Financial Disclosures (TNFD) designed to support organisations report and act on evolving nature-related dependencies, impacts, risks, and opportunities, suggests there is an opportunity to improve understanding of the connection between nature and soil. It could also help quantify the true impact of soil management on the wider ecosystem. Whilst the concept of eco-system services is not new (defined as outputs, conditions, or processes of natural systems that directly or indirectly benefit humans or enhance social welfare)[114], progress is being made in this space and the mix of voluntary guidance, emerging

[111] European Commission (2020b)
[112] BCG (2023)
[113] Net Zero Investor (2023)
[114] Encyclopaedia Britannica (2023)

methods and the food and drink industry pull could make this a viable financing route (beyond the CAP) in the mid to long term.

Although far less advanced than the carbon market, a recent report compared eight current or emerging biodiversity credit schemes, suggesting there is "significant awareness and support for the development of high integrity and technically rigorous biodiversity credit schemes and products all over the world"[115]. This was reinforced through views from a major grain producer, who noted that "carbon farming is definitely a starting point, but farmer engagement needs to broaden beyond carbon to include water and biodiversity." Continuing "[the] carbon [market] should definitely be part of the solution for this transition, but it's not the end goal." Another food and drink industry representative suggested "we need to be wary of becoming overly focused on one indicator." Their point was that this transition is about much more than just carbon, and should include regenerative agriculture, nature, biodiversity, resilience, food security and more.

Monetising a biodiversity credit type system, however, is a growing area of debate. Some see it as a risky step, because unlike carbon, biodiversity is incredibly heterogeneous, meaning it is very varied with no one eco-system the same. Biodiversity is multi-faceted and includes multiple different indicators (be that tree cover, forest distribution, global saltmarsh extent, peatland extent and condition etc.). Depending on where you are in the world, biodiversity takes on different meanings. Some attempts have already been made to create a metric system, such as DEFRA's Biodiversity metric,[116] but there is still a long way to go. Because of that, it is incredibly difficult to create a harmonised metric to inform policy and investment. As a result, valorising biodiversity and accurately quantifying the value that ecosystem services provide across the EU, considering the dynamic and varied nature of agricultural production systems, is extremely complex.

In 2020, WEF estimated that half the world's GDP is "moderately or highly dependent on nature," and those industries that are in this category generate around 15% of global GDP, worth $13 trillion[117]. Like the carbon market, these new markets are good examples of where we can create added value to support this transition and pay farmers more directly for their positive actions to improve areas such as soil health on-farms. However, it will take time, further investment in science, innovation, and harmonised accounting methods, as well as further in-depth analysis on farms to calculate and understand how this payment system could truly support farmers' livelihoods.

Environmental taxes and true cost accounting

As part of a broader policy mix, environmental taxes can be used as tools to support government spending and regulate and reduce negative environmental impacts[118]. Revenues from environmental taxes could support the transition to a climate-neutral economy by 2050 and achieve the objectives of the European

[115] Waterford et al., (2023)
[116] GOV UK (2021)
[117] WEF (2020)
[118] Britannica (2023)

Green Deal of reaching a net reduction of greenhouse gas emissions by 55% by 2030[119]. The Farm to Fork Strategy already suggests the use of tax incentives to help Member States support different practices, such as organic farming. It also suggests using this to reflect the true cost of food related to their impact on the environment.[120]

Going deeper, some advocate for the use of true cost accounting (TCA) assessments to help food and drink industry calculate and better understand their impacts on the agri-food sector, thereby leading to more targeted and effective interventions to mitigate these impacts. TCA is also a useful method for analysing the impact of different approaches to this transition, such as investments, and can support ongoing decision making at EU level to better achieve specific agri-food sustainability goals[121].

[119] EEA (2022)
[120] European Commission (2020b)
[121] FAO 2023a

Chapter 4: Policy considerations

Policy can act as a mechanism to support the agri-food sector both align on, and accelerate action around, sustainable agriculture. Policy can also re-direct capital flows and foster deeper collaboration with the aim of accelerating positive impact. Considering the research findings and the engagement with various stakeholders, this chapter sets out a number of options that can be explored to enhance the policy landscape across the EU that, if implemented, could lead to more effective and impactful economic support for farmers during the transition.

Option 1: CAP evolution to drive sustainable performance

Consider how the CAP can evolve into a more 'outcome based' payment system that incentivises all types and sizes of farms across the EU to drive sustainable performance.

The budget from the current CAP programming period 2023-27 amounts to about €55 billion per year. Yet, as discussed in the previous chapter, a significant part of that is not equally distributed among farmers. It is also still somewhat decoupled from environmental outcomes, indicating that there is a need to restructure the current landscape and allocate greater amounts of funding towards environmental sustainability across more types of farming systems.

One stakeholder proposed the need for a distributed governance structure for the management of the CAP budget at Member State level. This could ensure better cross ministerial and sectoral collaboration, enabling greater collaboration for the achievement of environmental sustainability goals, better alignment of often competing objectives, and foster dialogue between fragmented social groups. With this structure, key departments such as Environment and Agriculture Ministries, could bear equal responsibility for budget management going forward, leading to more integrated decision making, and systemic impact.

Other stakeholders suggested an opportunity to revisit the area-based direct payments of Pillar 1, EAGF to address the related issues raised in Chapter 3. For example, redistributing a large percentage of budget allocated to area-based payments (currently 75% of the whole of the EAGF budget) towards eco-schemes (currently 25%, and deemed underused by Member States), while prioritising preservation of direct payments to support young and small-scale farmers, could catalyse greater cohesion between economic and environmental performance, and improve cashflow to farms with generally smaller margins for error.

Other suggestions for the Pillar 1 improvements included i) developing harmonised accounting frameworks for whole farm sustainability to drive consistency in measurement of environmental outcomes (more in option 2), ii) supporting investment in infrastructure for assessing environmental outcomes and iii) assessing any environmental outcomes with regular frequency so that evidence of progress can be routinely monitored and farmers can be appropriately renumerated, and iv) with regards to eco-schemes,

improving transparency in payments for application of specific practices, and expanding eligibility criteria to make payments accessible to a greater number of land managers.

With regards to Pillar 2, EAFRD, stakeholders recognised this as a powerful instrument to unlock greater capital and funding for the agri-food sector owing to favourable loan conditions for all parties involved. However, this is also considered underused by Member States, and its budget is limited in size. Representatives from the EIB/fi-compass suggested reviewing the potential for an increase in EAFRD budget allocation to financial instruments and review of investments aimed at whole food supply chain projects to maximise social, environmental, and economic benefits. In the longer term this could enable greater collaboration between public and private sector and foster the creation of innovative PPPs.

Option 2: Credible and harmonised whole farm sustainability accounting

Develop and adopt credible, harmonised accounting frameworks that measure whole farm sustainability across the EU.

The lack of existing harmonised approaches to account for on-farm sustainability impact across variable production systems and geographies is inhibiting progress in financing the transition. Harmonised standards can drive development of KPIs, more consistent and higher quality primary data collection and improved benchmarking and progress reporting. This, in turn, ensures investors (whether it be existing or new public/private sector initiatives), have greater confidence that financing mechanisms will deliver impact at scale, and create higher returns on investment, whilst farmers build confidence that they are investing in sustainable agricultural practices that make a tangible difference to the operational and financial performance of their farm business. This can also strengthen the research pool for use in more accurate quantification of the costs required to deliver progress. There are emerging harmonisation frameworks such as the Global Farm Metric[122] that could be considered as viable options to explore further.

Option 3: EU Climate Fund

The EC should consider the development of a specific climate fund as a financing mechanism to catalyse and de-risk the adoption of innovative solutions.

Stakeholders' feedback was clear that the current financing available from public sector sources is not enough, and private sector alone may not plug the financing gap. A range of them pointed out the EC should consider developing an additional climate fund to:

[122] Global Farm Metric (2023)

i. Financially assist farmers to improve their adaptation capacity, supporting them in the adoption of adaptation practices such as purchase of drought resistant varieties of crops / trees, or investment in innovative technologies for more efficient water use that promote soil health.
ii. Support scale of adoption of innovative technologies that help reduce carbon sinks e.g., feed additives to reduce livestock methane emissions. Following the example of the United States Inflation Reduction Act[123], whereby direct grants are paid to companies to incentivise the uptake of sustainable agricultural practices, the responsibility for the distribution of these direct payments could be shared with other actors in the food chain such as input providers, food manufacturers, cooperatives and retailers, as they have an interest in reducing their Scope 3 GHG emissions and who are also well positioned to drive supply chain carbon emissions reduction initiatives. This form of support could therefore enable more impactful PPPs to be forged.
iii. Investment in regenerative agricultural training for the emerging generation of farmers to catalyse conversion of conventional practices towards more sustainable ones.
iv. Invest in carrying out wide scale assessments of on-farm sustainability, leveraging existing technologies such as satellite analysis, and investing in infrastructure to carry out soil testing for carbon and biodiversity, as well as in researching novel ways of assessing on farm sustainability.
v. Support the identification of more accurate hotspots across all EU agriculture, which can in turn facilitate the design of more localised and effective impact reduction strategies.
vi. Support the development of voluntary carbon and biodiversity credits markets, rapidly expanding and playing a crucial role in remunerating farmers for taking up sustainable agricultural practices.
vii. Support Scope 3 GHG emissions quantification and reduction efforts across EU food value chains and tangibly contribute to the ambition for the EU to be the first net zero continent in the world by 2050.

Option 4: EU food systems framework

Develop an EU food systems framework to catalyse and incentivise public/private partnerships.

Stakeholders signalled the need for better coordination across the supply chain to enable farmers and companies to work together towards the achievement of national and wider EU sustainability objectives.

In line with this sentiment, one stakeholder suggested the creation of a framework of commodity based sectoral guidelines and targets to drive whole farm sustainable performance, providing common definitions and expected outcomes for progress. These should be non-prescribing to allow flexibility for differences, yet they should share a common direction of travel to improve sustainable agricultural production.

This proposal could be a powerful enabler of cross supply chain collaboration, as it would empower different actors along the value chain to embed targets in their operations, drive strategic alignment across

[123] US department of the treasury (2023)

the value chain, communicate and report progress transparently and educate consumers around common goals.

Option 5: Digitalisation of EU farms

Digitise farms across the EU to drive greater transparency on land use including surrounding ecosystem health.

At present, there is a lack of transparency about European farming operations and locations. Advancements in remote sensing and related technologies could be leveraged to digitise EU agriculture, establishing an EU wide Digital Agriculture Platform that better links farm and land managers, land use, land use change and sustainability data. The EU can draw on examples such as Agrimetrics[124], who have leveraged technological partnerships to develop field boundaries for UK farms. The platform could also be used for the rollout of outcome-based payments (if coupled with enhanced Monitoring, Reporting and Verification methods that evaluate progress related to emission reduction and carbon sequestration at farm level), as well as to identify key hotspots along European food supply chains and inform strategic decisions for policy development that deliver reduction targets.

Option 6: Online information repository for sustainable food systems

Develop an online information repository for sustainable food systems, sharing knowledge and best practice on soil management and wider sustainable agriculture best practice.

There is limited knowledge among farmers' communities and other stakeholders about the impact of climate change, and limited crossover of information between Member States for best practice insights from implementation of their national strategic plans. Various stakeholders suggested the creation of an online knowledge portal that aims to become an extensive repository of information relevant to the sustainability of the agri-food sector in the EU. This portal could include:

i. Factsheets explaining the risks and potential impacts of climate change on EU agriculture to empower all actors with key information about the current and future climate trends and highlight key intervention areas.
ii. Best practice from national strategic plans' evaluations for all Member States, to provide guidelines for effective measures and alignment on implementation of funding mechanisms.
iii. Knowledge transfer related to emerging innovations and technologies that can bridge the sustainability gap across the next 5-10 years.
iv. Leadership examples and lessons from farms across the EU, categorised by crop type, region, and farm characteristics.

[124] Agrimetrics (n.d)

Option 7: Academic research and primary data collection for sustainable agriculture in the EU

Improve the academic research and primary data related to the cost of transition to more sustainable agriculture across the EU and within Member States.

This research methodology used single WTA studies. Single WTA studies are specific to the practices considered as well as to the conditions under which they are conducted. In this paper, several studies have been used to give a more reliable estimation of farmers' perceived costs of implementing a variety of sustainable agricultural practices to improve soil health. However, EU focused studies themselves were limited in terms of publicly available primary data. For this reason, the EU should consider carrying out its own WTA studies designed specifically for the practices they wish to implement on farms, and in the specific regions they want to enact this transition to obtain further cost estimates, specific to chosen policies.

This option needs to be considered along with option 2, so that the greater wealth of primary data collected on farms over time can in turn play a role in determining the most relevant questions to explore within future research.

Future research should also view the term 'transition' in the wider social and political context of the EU, considering the transition of technology and machinery, transition of labour and workforces, the cost of environmental monitoring and compliance with sustainable practices, the impact of consumers and dietary choices on the future of farming, the importance of education and training as well as continued R&D. These are important factors that will impact overall costs. It is therefore suggested that wider cost analysis is carried out to assess these in greater depth.

Option 8: Review of global best in class examples

Conduct a landscape review of global best in class policies and payment structures that incentivise farmers to adopt sustainable best practice on farm, whilst driving productivity gains.

Whilst this research is predominantly based on EU current state of play and best practice, examples of global incentivisation mechanisms for enhanced sustainable agriculture were used as leadership examples. The EC should continue to develop global knowledge and strategic partnerships across other major agricultural producing markets to integrate leadership examples into EU policy and wider education programmes. The rollout of SFI in the UK by DEFRA and the provision grants and subsidy schemes by USDA via the Inflation Reduction Act are innovative and prominent examples of mechanisms the EC could adapt and adopt.

Conclusion

The transition to more sustainable agriculture in Europe is not a single moment in time, nor will it be achieved by one person or group, government, community, or organisation. It is a continuous effort, a pathway to better resilience and long-term future health, both for people and planet. This paper has looked at an example of this transition, what it might cost the agri-food sector within the EU for the first year, and how it might be funded. The questions of 'how much' or 'who pays' are not simple, and there is no single answer. We have therefore approached these questions by looking at one of the most important aspects of agriculture and a fundamental building block for food production: soil.

Soil is vital for the future of agriculture and is a very good indicator for the state of farming, underpinning 95% of food production in the EU, either directly or indirectly. For the purposes of this paper and future research, it is a very important metric. By improving soil health, we can tackle the long-term sustainability of food production, reduce carbon emissions in the atmosphere, improve biodiversity, improve the commercial viability of farming by mitigating future risk, and improve yields whilst reducing synthetic inputs. Soil health is also measurable and follows a standardised metric system wherever it is in the world. By this merit, it can also be compared, and results analysed year on year to track steady improvement (or decline) depending on the practices implemented by farmers and landowners. Soil health data is also something that is already being collected, soil tests are relatively inexpensive and actionable by farmers. This logic has supported the focus of our economic analysis, concluding that the transition will cost in the region of €28-35 billion for the first year.

How to fund this transition and who pays is an equally important issue. In this paper, several funding mechanisms have been explored, from public government funding to private funding, food and drink industry initiatives, banks, the use of environmental taxes, higher costs to the consumer, the 'polluter pays' principle, and emerging concepts, such as expanding the voluntary carbon market or monetising wider ecosystem services. The exact combination or balance of these mechanisms is yet unclear. Ultimately, this must be a joined-up approach between all actors, including farmers, the food and drink industry, consumers, government, financial institutions, investors and more. They must work together to boost a universal goal that fully supports farmers on the ground and creates attractive markets for banks and the food and drink industry to participate in, supported by key policy that prevent farmers and industry from moving backwards. We also need to foster greater collaboration between the EU, the private sector, and all Member States to ensure standards are met, and targets are hit. Collaboration will also ensure greater influence over future policy to enact change at a greater pace than we are currently seeing.

This paper recognises that this transition impacts several other areas outside the scope of this research that require further attention, including (but not limited to) the role of the consumer, food labelling, the true cost of food, human rights, and worker welfare. A number of key policy areas discussed aim to spark further conversation as well as research, innovation, and development to accelerate this transition. These include evolving the EU payment system, creating improved sustainability accounting, digitisation of farms, development of tools that support collection of harmonised data, delivering credible, on-farm evidence

base that can be used to benchmark performance across commodities and geographies, measuring, and reporting sustainability progress, share knowledge and ultimately attracting and de-risking investments.

This transition is possible with sufficient willingness to adopt new practices and appetite and incentives to absorb a certain level of risk. It is achievable and the EU is already in the process of achieving success. Farmers, and the food and drink industry alike have already achieved impressive amounts to push forwards sustainable agriculture and implement changes both on the ground and in government, particularly with soil health. These findings are by no means exhaustive, and therefore entail huge research areas for future agricultural economists and policymakers. Agriculture is undoubtedly a great success story that has played out over millennia and across the globe. This transition should not be viewed as an impossible task or a great burden on society, but rather as an exciting next step along the path of agricultural and wider sustainable development across Europe over the course of the decisive decade ahead.

Reference list

Agreena (2023) *Regenerative farming can't afford to fail* (online) Available at: https://agreena.com/blog/regenerative-farming-cant-fail/

Andreasen and Andreasen (2011) *Managing farmland flora to promote biodiversity in Europe*. Available at: https://www.cabidigitallibrary.org/doi/abs/10.1079/PAVSNNR20116047Agrimetrics (n.d) *we help you find and use agrifood data, so you can make better products and better decisions* (Online) Available at: https://www.agrimetrics.co.uk/

Arla (2023) *How Arla farmers are rewarded for their sustainability activities* (Online) Available at: https://www.arla.com/sustainability/sustainable-dairy-farming/arlas-sustainability-incentive-model-qa/

Bateman, I.J. and Balmford, B. (2018). Public funding for public goods: A post-Brexit perspective on principles for agricultural policy. *Land Use Policy*, (online) 79, pp.293–300. doi:https://doi.org/10.1016/j.landusepol.2018.08.022.

Barilla (2021) *The 'Carta del Mulino': the Mulino Bianco charter for sustainable soft wheat* (Online) Available at: https://www.barillagroup.com/en/stories/stories-list/carta-del-mulino-for-sustainable-agriculture/

BCG (2023). *The Voluntary Carbon Market Is Thriving. (*online) BCG Global. Available at: https://www.bcg.com/publications/2023/why-the-voluntary-carbon-market-is-thriving.

Boufous, S. Hudson, D. Carpio, C. Malaga, J. (2020) 'Farmers' willingness to accept sustainable practices: A Meta-analysis.' *Agricultural and Applied Economics Association,* Available at: https://www.researchgate.net/publication/342719769_Farmers'_willingness_to_accept_sustainable_practices_A_Meta-analysis

Boix-Fayos, C. and de Vente, J. (2023). 'Challenges and potential pathways towards sustainable agriculture within the European Green Deal. '*Agricultural Systems,* 207, p.103634. Available at: https://doi.org/10.1016/j.agsy.2023.103634

Bowman, M., Verville, T., Cornell, J., Gauthier, V., Sands, L., Grafton, A., & Nichol, J. (2021). 'Conservation Impact On Farm Bottom Line 2021.' *Soil Health Partnership.*

Britannica (2023). *Taxation | Definition, Purpose, Importance, & Types | Britannica Money*. www.britannica.com. Available at: https://www.britannica.com/money/topic/taxation.

Cargill (2023) *Regenerative Agriculture* Available at: https://www.cargill.com/sustainability/regenerative-agriculture

Cargill (2023a) *ESG report* Available at: https://www.cargill.com/sustainability/doc/1432249635993/2023-esg-report.pdf

Concepcion and Jay (2020) 'Optimizing biodiversity gain of European agriculture through regional targeting and adaptive management of conservation tools' *Biological Conservation*, Available at: https://www.researchgate.net/publication/338038688_Optimizing_biodiversity_gain_of_European_agriculture_through_regional_targeting_and_adaptive_management_of_conservation_tools

Connor, D. Miller, J. Zia, A. Darby, H. (2016) 'Conjoint analysis of farmers response to conservation incentives,' *Sustainability,* Available at: https://www.mdpi.com/2071-1050/8/7/684

DEFRA (2019). *Environmental Land Management and Public Money for Public Goods.* Available at: https://assets.publishing.service.gov.uk/media/60104205e90e071434ad0ae5/ELM-evidencepack-28jan21.pdf.

European Commission JRC (2019) Adoption of cover crops for climate change mitigation in the EU Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC116730

European Commission (2020) *Food Farming, Fisheries, Farm to Fork targets – progress* Available at: https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/farm-fork-targets-progress_en

European Commission (2020a) *The CAP reform's compatibility with the Green Deal's ambition* Available at: https://agriculture.ec.europa.eu/news/cap-reforms-compatibility-green-deals-ambition-2020-05-20_en

European Commission (2020b) *Farm to Fork Strategy,* Available at: https://food.ec.europa.eu/system/files/2020-05/f2f_action-plan_2020_strategy-info_en.pdf

European Commission (2021) *Questions and answers on the EU soil strategy,* Available at: https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_5917

European Commission (2022). Soil strategy for 2023*,* Available at: https://environment.ec.europa.eu/topics/soil-and-land/soil-strategy_en#timeline

European Commission (2022a). *CAP at a glance,* Available at: https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en.

European Commission (2022b) *European Green Deal: Commission proposes certification of carbon removals to help reach net zero emissions* , Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7156

European Commission (2022c) *CAP in the EU budget*, Available at: https://agriculture.ec.europa.eu/common-agricultural-policy/financing-cap/cap-funds_en

European Commission (2022d) *Rural Development,* Available at: https://agriculture.ec.europa.eu/common-agricultural-policy/rural-development_en

European Commission (2023). *EU Soil Observatory,* Available at: https://esdac.jrc.ec.europa.eu/esdacviewer/euso-dashboard/.

European Commission (2023a) Factsheet – Soil Monitoring Tools to help Soil Resilience, Available at: https://ec.europa.eu/commission/presscorner/detail/en/fs_23_3638

European Commission (2023b) *Questions and Answers on a Directive on Soil Monitoring and Resilience.* Available at: https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_3637

European Commission (2023c) *Young Farmers* (Available at: https://agriculture.ec.europa.eu/common-agricultural-policy/income-support/young-farmers_en

European Commission (2023d) *Proposal for a directive of the European Parliament and of the Council on Soil Monitoring and Resilience (Soil Monitoring Law).* Available at: https://environment.ec.europa.eu/system/files/2023-07/Proposal%20for%20a%20DIRECTIVE%20OF%20THE%20EUROPEAN%20PARLIAMENT%20AND%20OF%20THE%20COUNCIL%20on%20Soil%20Monitoring%20and%20Resilience_COM_2023_416_final.pdf

European Commission (2023e). *Commission staff working document - drivers of food security.* Available at: https://commission.europa.eu/system/files/2023-01/SWD_2023_4_1_EN_document_travail_service_part1_v2.pdf.

European Commission (2023f). *Carbon Border Adjustment Mechanism.* Available at: https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en.

European Commission (2023g). *European Green Deal: more sustainable use of plant and soil natural resources.* (online) Available at: https://ec.europa.eu/commission/presscorner/detail/%20en/ip_23_3565.

European Commission (2023h) Strategic Foresight Report 2023 , pp.14, Available at: https://www.politico.eu/wp-content/uploads/2023/07/05/Strategic-Foresight-Report.pdf

European Commission (2023i) *Mr Janusz Wojciechowski in the European Parliament, Brussels; contribution to exchange of views with the Committee on Agriculture and Rural Development about the consequences of inflation on the CAP budget.* Available at: https://ec.europa.eu/commission/presscorner/detail/it/speech_23_144

European Commission (2023j) *REPowerEU* (Online) Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en

European Commission (2023k) *on plants obtained by certain new genomic techniques and their food and feed, and amending Regulation (EU) 2017/625,* Available at; https://food.ec.europa.eu/system/files/2023-09/gmo_biotech_ngt_proposal_2023-411_en.pdf

European Court of Auditors (2021) *Common Agricultural Policy and climate.* Available at: https://www.eca.europa.eu/Lists/ECADocuments/SR21_16/SR_CAP-and-Climate_EN.pdf

European Commission - Department of Agriculture and Rural Development (2023) *Approved 28 CAP Strategic Plans (2023-2027) Summary overview for 27 Member States Facts and figures.* Available at: https://agriculture.ec.europa.eu/system/files/2023-06/approved-28-cap-strategic-plans-2023-27.pdf.

European Union (2023). *Life in the EU,* Available at: https://european-union.europa.eu/principles-countries-history/key-facts-and-figures/life-eu_en.

European Parliament (2023). *Financing of the CAP, Fact Sheets on the European Union, European Parliament.* Available at: https://www.europarl.europa.eu/factsheets/en/sheet/106/financing-of-the-cap.

European Parliament Agri Committee (2023) *The impacts of extreme climate events on agricultural production in the EU*. Available at: https://www.europarl.europa.eu/RegData/etudes/STUD/2023/733115/IPOL_STU(2023)733115_EN.pdf

Eurostat (2017) *Agri-environmental indicator - greenhouse gas emissions*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Figure_1_Contribution_of_agriculture_to_total_GHG_emissions_(%25),_EU-28,_2015.png

Eurostat (2022) *Farms and farmland in the European Union - Statistics Explained.* Available at: https://ec.europa.eu/eurostat/statistics-explained/SEPDF/cache/73319.pdf

Eurostat (2023) *performance of the agricultural sector – Statistics Explained*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Performance_of_the_agricultural_sector

Eurostat (2023a) Glossary: *Utilised agricultural area.* Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Utilised_agricultural_area_(UAA)

EASAC (2022) *Regenerative Agriculture*. Available at: https://easac.eu/fileadmin/PDF_s/reports_statements/Regenerative_Agriculture/EASAC_RegAgri_Web_290422.pdf

EEA (2010) *Assessing Biodiversity in Europe – the 2010 Report.* Available at: https://www.eea.europa.eu/publications/assessing-biodiversity-in-europe-84

EEA (2022) *The role of (environmental) taxation in supporting sustainability transitions — European Environment Agency*. Available at: https://www.eea.europa.eu/publications/the-role-of-environmental-taxation.

European Environment Agency (2023) *Agriculture and food system.* Available at: https://www.eea.europa.eu/en/topics/in-depth/agriculture-and-food
Encyclopaedia Britannica (2023). *ecosystem services.* Available at: https://www.britannica.com/science/ecosystem-services

Fairr (2023) *The four labours of regenerative agriculture: paving the way towards meaningful commitments* (Online) Available at: https://www.fairr.org/resources/reports/regenerative-agriculture-four-labours

Farm Europe (2022). *The CAP budget is shrinking fast, removing any leverage for Green Deal investment – Farm Europe.* Available at: https://www.farm-europe.eu/news/the-cap-budget-is-shrinking-fast-removing-any-leverage-for-green-deal-investment%EF%BF%BC/.

FAO (2018). *Sustainable Food Systems Concept and Framework.* Available at: https://www.fao.org/3/ca2079en/CA2079EN.pdf.

FAO (2019). *FAO's work on climate change, pp.4-5.* Available at: https://www.fao.org/3/ca7126en/ca7126en.pdf

FAO (2023). *Soil Carbon Sequestration FAO soils portal,* Available at: https://www.fao.org/soils-portal/soil-management/soil-carbon-sequestration/en/.

FAO (2023a) *The state of food and agriculture.* Available at: https://www.fao.org/3/cc7724en/cc7724en.pdf

Federico, G. (2005), *Feeding the World, An Economic History of Agriculture, 1800-2000,* p. 19.

Fi-compass (2023) *Financing gap in the agriculture and agri-food sectors in the EU factsheet.* Available at: https://www.fi-compass.eu/sites/default/files/publications/FinancingGapAgricultureAgrifood_RTW.pdf

Ficompass EAFRD, *Financial needs in the agriculture and agri-food sectors in the European Union, Summary Report,* November 2020, pp. 30 https://www.fi-compass.eu/sites/default/files/publications/financial_needs_agriculture_agrifood_sectors_eu_summary.pdf

Friesland Campina (n.d.). *Biodiversity.* Available at: https://www.frieslandcampina.com/sustainability/sustainability-on-the-farm/biodiversity/

Global Farm Metric (2023) *A Common Framework.* Available at: https://www.globalfarmmetric.org/

Goldman Sachs (2023) European stocks may give US equities a run for their money (Online) Available at: https://www.goldmansachs.com/intelligence/pages/european-stocks-may-give-us-equities-a-run-for-their-money.html

Gov UK (2021). *Biodiversity metric: calculate the biodiversity net gain of a project or development.* Available at: https://www.gov.uk/guidance/biodiversity-metric-calculate-the-biodiversity-net-gain-of-a-project-or-development.

GOV UK (2023). *Find out what's available in SFI.* Available at: https://www.gov.uk/guidance/find-out-whats-available-in-sfi

Gov UK (2023). *Funding for farmers, growers and land managers.* Available at: https://www.gov.uk/guidance/funding-for-farmers#protect-species-and-habitats-and-support-biodiversity

IEEP (2023*) Carbon Farming co-benefits: approaches to enhance and safeguard biodiversity.* Available at: https://ieep.eu/wp-content/uploads/2023/01/Carbon-farming-co-benefits-Approaches-to-enhance-and-safeguard-biodiversity_IEEP-Ecologic-2023.pdf

IMF (n.d.) *PPP*. Available at: https://www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/Purchasing-Power-Parity-PPP

IMF (2021). *What Are Global Public Goods?* Available at: https://www.imf.org/en/Publications/fandd/issues/2021/12/Global-Public-Goods-Chin-basics.

Institute for European Environmental Policy (2023) *Transforming EU land use and the CAP: a post 2024 vision.* Available at: https://ieep.eu/wp-content/uploads/2023/09/Transforming-EU-land-use-and-the-CAP-a-post-2024-vision-paper-IEEP-2023.pdf

Jans, Jan H. and Vedder, Hans H. B., (2008) *European Environmental Law.* - Available at: https://www.eca.europa.eu/lists/ecadocuments/sr21_12/sr_polluter_pays_principle_en.pdf

LEK (2022). *Consumers Are Willing To Pay More for Sustainable Food Products* Available at: https://www.lek.com/insights/ar/consumers-are-willing-pay-more-sustainable-food-products.

McCain (n.d.) *Smart and sustainable progress score card* Available at: https://www.mccain.com/media/4191/smart-and-sustainable-progress-scorecard.pdf

Michelsen, J. (2002) 'Recent development and political acceptance of organic farming in Europe,' *Sociologia Ruralis* 41(3) Available at: https://www.researchgate.net/publication/229483163_Recent_Development_and_Political_Acceptance_of_Organic_Farming_in_Europe

National Food Strategy (2020) *The Plan.* Available at: https://www.nationalfoodstrategy.org/

NFU (n.d) *Achieving Net Zero; Farming's 2040 Goal.* Available at: https://www.nfuonline.com/media/jq1b2nx5/achieving-net-zero-farming-s-2040-goal.pdf

NFU (2022) *The Foundation of Food.* Available at: https://www.nfuonline.com/media/mibfsfsm/nfu-the-foundation-of-food.pdf

Net Zero Investor (2023): *Nature finance: are biodiversity credits moving too fast?* Available at:. https://www.netzeroinvestor.net/news-and-views/biodiversity-credits-might-be-moving-too-fast

Nestlé (2022) *The Nestlé Agriculture Framework.* Available at: https://www.nestle.com/sites/default/files/2022-07/nestle-agriculture-framework.pdf

Nestlé (2022) *Creating Shared Value and Sustainability Report.* Available at: https://www.nestle.com/sites/default/files/2023-03/creating-shared-value-sustainability-report-2022-en.pdf

Oldfield, E. E., Bradford, M. A., and Wood, S. A. (2019) *Global meta-analysis of the relationship between soil organic matter and crop yields*, SOIL, 5, 15–32,Available at: https://doi.org/10.5194/soil-5-15-2019.

Pan American Health Organisation (2013), *Public-Private Partnerships with the Food Industry*, p. 7, https://www3.paho.org/hq/dmdocuments/2015/ppptg-discussion-paper.PDF

Publications Office of the European Union (2022) *The Future of the European Farming Model,* Available at: The future of the European Farming Model - Publications Office of the EU (europa.eu)

Runge, T. Latacz-Lohmann Schaler, L. Todorova, K. Daugbjerg, C. Termansen, M. Lirra, J. Le Gloux, F. Dupraz, P. Leppanen, J. (2022) 'Implementation of Eco schemes in fifteen European Union member states' *Wiley.* Available at: https://onlinelibrary.wiley.com/doi/full/10.1111/1746-692X.12352

Serebrennikov, D. Thorne, F. Kallas, Z. McCarthy, N. (2020) 'Factors influencing adoption of sustainable farming practices in Europe: a systematic review of empirical literature,' sustainability.

The National Food Strategy (2021) *The National Food Strategy, Independent Review: The Plan.* Available at: https://www.nationalfoodstrategy.org/

The World Bank (2022). *Environmental Taxes.* Available at: https://www.worldbank.org/en/programs/the-global-tax-program/environmental-taxes.

UK Research and Innovation (2022). *Diet and health innovation boosted by new funding partnership.* https://www.ukri.org/news/diet-and-health-innovation-boosted-by-new-funding-partnership/

UN News (2019) *Soil erosion must be stopped 'to save our future', says UN agriculture agency.* Available at: https://news.un.org/en/story/2019/12/1052831

UN -WCMC (2022). *Beyond greenwashing: understanding the challenges, ambition and potential of carbon trading.* Available at: https://www.unep-wcmc.org/en/news/beyond-greenwashing-understanding-the-challenges-ambition-and-potential-of-carbon-trading.

UNEP (2021) *Our global food system is the primary driver of biodiversity loss.* Available at: https://www.unep.org/news-and-stories/press-release/our-global-food-system-primary-driver-biodiversity-loss#:~:text=Year%E2%80%99%20for%20Nature.-,Our%20global%20food%20system%20is%20the%20primary%20driver%20of%20biodiversity,the%20past%2010%20million%20years

Unilever (2023) *Regenerative Agriculture.* Available at: https://www.unilever.com/planet-and-society/protect-and-regenerate-nature/regenerating-nature/

Unilever (2023a) *Impact results from Unilever's first set of regenerative agriculture practice,* Available at: https://www.unilever.com/news/news-search/2023/impact-results-from-unilevers-first-set-of-regenerative-agriculture-projects/

USDA (n.d.). http://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives*Environmental quality incentives programme.* Available at: https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives.

USDA (n.d.a). *EQIP Advance Payment Option.* Available at: https://www.nrcs.usda.gov/resources/guides-and-instructions/eqip-advance-payment-option

US Department of the Treasury (2023) *The inflation reduction act and U.S. business investment* Available at: https://home.treasury.gov/news/featured-stories/the-inflation-reduction-act-and-us-business-investment

Wageningen University and Research (2023) *Regenerative agriculture gets boost from national growth fund,* Available at: https://www.wur.nl/en/research-results/research-institutes/plant-research/show-wpr/regenerative-agriculture-gets-boost-from-national-growth-fund.htm

Waterford, L., FitzSimons, V., Back, O., (2023) *State of Voluntary Biodiversity Credit Markets, A Global Review of Biodiversity Credit Schemes,* , p. 6 https://pollinationgroup.com/wp-content/uploads/2023/10/Global-Review-of-Biodiversity-Credit-Schemes-Pollination-October-2023.pdf

World Bank (2022). *Food Security and Climate Change.* Available at: https://www.worldbank.org/en/news/feature/2022/10/17/what-you-need-to-know-about-food-security-and-climate-change.

World Economic Forum (2022a), *Biodiversity Credits: Unlocking Financial Markets for Nature-Positive Outcomes*. Available at: https://www3.weforum.org/docs/WEF_Biodiversity_Credit_Market_2022.pdf

World Economic Forum (2022b) *Transforming Food Systems with Farmers: A Pathway for the EU.* Available at: https://www.weforum.org/publications/transforming-food-systems-with-farmers-a-pathway-for-the-eu/

World Economic Forum (2018) *Innovation with a purpose: the role of technology innovation in accelerating food system transformation.* Available at: https://www.weforum.org/publications/innovation-with-a-purpose-the-role-of-technology-innovation-in-accelerating-food-systems-transformation/

World Economic Forum (2020). *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy.* Available at: https://www3.weforum.org/docs/WEF_New_Nature_Economy_Report_2020.pdf

World Meteorological Organisation (2023) *Climate change impacts scar Europe, but increase in renewables signals hope for future* Available at: https://public.wmo.int/en/media/press-release/climate-change-impacts-scar-europe-increase-renewables-signals-hope-future

WRI (2001) *GHG Protocol,* pp16 Available at: https://ghgprotocol.org/sites/default/files/2022-12/GHG%20Protocol%20Agricultural%20Guidance%20%28April%2026%29_0.pdf

YARA (2023). Strong European consumer demand for sustainable food (online). Available at: https://www.yara.com/corporate-releases/strong-european-consumer-demand-for-sustainable-food/.

Zandersen, M., Jørgensen, S. L., Nainggolan, D., Gyldenkærne, S., Winding, A., Greve, M. H., & Termansen, M. (2016). Potential and economic efficiency of using reduced tillage to mitigate climate effects in Danish agriculture. *Ecological Economics*, *123*, 14–22. https://doi.org/10.1016/j.ecolecon.2015.12.002