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LINKING ENVIRONMENT AND FARMING

INFORMATION SHEET:

Climate Change Adaptation and Mitigation

The Impact of Farming Systems on Climate Change

Agriculture both contributes to and is affected by climate change. In 2012, Greenhouse Gas (GHG) emissions accounting for a total of 471 million tons of CO_2 equivalent were cited as resulting from agricultural sources in 28 EU member states[1]. The agricultural industry produces methane from livestock digestion processes and stored animal manure, nitrous oxide from organic and mineral N fertilisers and increases CO_2 emissions through deforestation.

Average temperatures have risen by approximately 1˚C over the last decade[2]. Climate change is already affecting the Earth's temperature, precipitation and hydrological cycles. This has resulted in a significant impact on agricultural production through decreases in crop yields affected by compound climate factors.

The intergovernmental Panel on Climate Change (IPCC) published its Special Report in 2018, outlining the impacts of a global average temperature rise of 1.5˚C, and possible routes to limiting increase to that level[3]. Agriculture has the potential to contribute to climate change mitigation by reducing GHG emissions and sequestering carbon in soils, whilst sustainably increasing productivity and income, in line with the United Nations Sustainable Development Goals[4].

Through incorporating ecologically based management strategies into farming practices, agriculture has the potential to improve environmental performance through sustainable production methods alongside adapting to challenges arising from climate change. Addressing production efficiency, increasing and managing carbon storage and renewable energy and carbon capture are important in sustainable farming

Different farming systems are not environmental solutions themselves but options that producers can choose from to achieve environmental targets. Each farming system presents the opportunity to contribute to resource efficiency, lower carbon emissions and generate a climate resilient economy in agriculture.

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[1] European Commission; *EU Agriculture and Climate Change.* (2015). Available from: https://ec.europa.eu/agriculture/sites/agriculture/files/climate-change/factsheet_en.pdf

[2] HM Government. *UK Climate Change Risk Assessment 2017.* (2017) Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf

[3] IPCC. *Global Warming of 1.5˚C Special Report.* (2018). Available from: https://www.ipcc.ch/sr15/

[4] United Nations. *The Sustainable Development Goals Report.* (2018). Available from: https://unstats.un.org/sdgs/files/report/2018/TheSustainableDevelopmentGoalsReport2018-EN.pdf

"Intensive" Agriculture and Climate Change

What is intensive agriculture…

Intensive farming is a farming method that uses higher inputs, such as capital and labour, and advanced agricultural techniques to increase the overall yield, gaining higher crop yields per cubic unit land area.

Increased food production is essential in contributing to long-term global food security. Industrial agriculture or the "Green Revolution", has contributed considerably to addressing food security issues through increasing productivity of main agricultural crops whilst reducing the further conversion of environmental land into agricultural land[5]. However, commitments to food security do not grant permission for greater levels of intensified, industrialised agriculture. The higher demand for food places greater pressure on natural resources and it is important to note that a stable climate, clean air and water, healthy soils and biodiversity are also essential for human survival.

Expressed per unit area, intensive food systems can generate high levels of GHG and nutrient losses. This is due to increased energy-intensive practices dependence on chemical and fossil fuels which often cannot be sustained long-term. However, a recent study suggests that intensive, high-yielding agriculture may still be the most appropriate option to meet growing food demand, through conserving remaining natural habitats[6]. Although the study does not consider the negative effects of high energy and chemical inputs, or the geographical variations that make intensive systems unsuitable for all farms.

Organic agriculture and Climate Change

What is organic farming…

In organic farming, natural methods are relied upon to control pests and disease. These include well-designed crop rotations, encouraging natural predators, and developing good soil and healthy crops which have natural resistance to pests and diseases. Organic farming standards do not allow any artificial fertilisers, synthetic pesticides or manufactured herbicides such as Glyphosate. Organic farmers are permitted to use just 20 pesticides, derived from natural ingredients including citronella and clove oil, but only under very restricted circumstances.

Organic agriculture can include climate change mitigation strategies. The area of organic land has recently grown by 2 million hectares according to latest Eurostat data[7]. Organic farms have been reported to generally emit fewer GHG, use less energy and to store more carbon in soil per hectare than conventional farms. A recent report by IFOAM EU Group suggested that conversion to 50% of

[5] Therond, O., Duru, M., Roger-Estrade, J. and Richard, G. A New Analytical Framework of Farming System and Agriculture Model Diversities. A Review. (2017) *Agronomy for Sustainable Development.* Available from: https://link.springer.com/article/10.1007/s13593-017-0429-7#Sec1

[6] Balmford, A.*et al.,* The Environmental Costs and Benefits of high-yield Farming. *Nature.* (2018). Available from: https://www.nature.com/articles/s41893-018-0138-5.epdf?referrer_access_token=oRTsjSBtMogEt 7GLybbHk9RgN0jAjWel9jnR3ZoTv0MmCO8_bu5Iynj0k-Maa1_klWm5MzDLu64pvdjKGBhCKOUzUh18Or8w Csq4mc4zbP_k4UCinUoaugs6wkVYVcDQQuQ9iB-pfHhnqVr55ALQx8r7_kKYc3WxHDOW1ZXrdz Zv6DjZcg74qT3 DDiNUm4OSyoV0sw8IKgoVxfrnNjdtMMQPFcctCWzJpEczvu2RCnA%3D&tracking_referrer=www.bbc.co.uk

[7] European Commission. *Organic Farming.* Available from: https://ec.europa.eu/info/food-farming-fisheries/farming/organic-farming

EU land under organic farming by 2030 would equate to a 23% reduction in agricultural GHG emissions by increased carbon storage in soil and reduced N application[8].

However, the cited main benefits of organic agriculture can be achieved without converting to an entirely organic system, instead through taking a more site-specific approach to the farm business that considers potential environmental impacts. Benefits from these approaches include: providing healthy, fertile soils enabling better resilience against extreme weather and resistance to pests, alongside reduction in chemical usage and wildlife conservation methods resulting in increased biodiversity and biological control.

In addition, organic farms offer significantly lower yields than conventional counterparts. Organically produce alone cannot meet the food demands that humanity requires, especially with an expanding population. This can lead to trade-offs such as more land being required for production.

It is also worth noting that, contrary to popular opinion, there is no evidence to suggest that organic meat is any healthier than conventionally produced meat - evidence shows that the nutrient levels are similar in food produced by both organic and conventional agriculture[9].

Conservation agriculture and climate change

What is conservation agriculture…

Conservation agriculture is a resource saving system that regenerates degraded soils through the three key areas of promoting permanent soil cover, no or minimum soil disturbance and diversity of cropping systems.

Conservation agriculture aims to sustainably increase yields, alleviate poverty and conserve biodiversity while safeguarding ecosystem services. It is based on three practices promoted as a means for sustainable intensification; minimum tillage, permanent organic soil cover and diversification of species grown in rotation, alongside balanced application of chemical inputs.

Similarly to organic agriculture, the system claims to mitigate climate change through soil carbon sequestration and improving resilience. However, similarly to other farming systems discussed, whilst it may contribute to increased sustainability and climate change adaption, applicability to different farming contexts to improve yield is debatable.

Integrated Farm Management and Climate Change

What is Integrated Farm Management…

[8] IFOAM EU Group. *Organic Farming, Climate Change Mitigation and Beyond.* (2016). Available from: https://www.ifoam-eu.org/sites/default/files/ifoameu_advocacy_climate_change_report_2016.pdf

[9] NOAH. *Animal Medicines – what you should know.* Available from: https://www.noah.co.uk/briefingdocument/animal-medicines-what-you-should-know/#Q1

Integrated Farm Management (IFM) is a site-specific farm business approach that uses modern technology and traditional methods to increase productivity whilst protecting valuable resources. This is achieved through nine sections which address the entire farm business; organisation and planning, soil management and fertility, crop health and protection, pollution control and by-product management, animal husbandry, energy efficiency, water management, landscape and nature conservation and community engagement.

Integrated Farm Management (IFM) may provide a solution that delivers a holistic whole business approach to farming and addresses individual farms at a site-specific level. IFM aims to shape this transition of sustainable development into a continuous process, through setting objectives, choosing measures, measuring results and then further adapting practices based on those results. This enables bespoke solutions to the negative effects of climate change that are not specific to an exclusive farming system and can be applied on organic farms as successfully as conventional or intensive systems.

A recent report published by Defra promotes the significant benefits of management techniques widely applied on organic farms to have potential for application in non-organic farming systems[10]. The report highlights how LEAF farmers practicing IFM are already applying organic management techniques in the non-organic sector, such as mechanical weed control, manure use, biological pest control and use of cover crops.

The research also suggests that primary barriers to sustainable practice uptake relate to current producer attitudes, lack of adequate information and demonstration, and agronomic and financial constraints. IFM and the work of LEAF aim to contribute to knowledge facilitation and exchange through farmer-led workshops, community engagement and practical on-farm demonstration, enabling producers to make informed decisions that implement environmental management practices.

Greenhouse Gas Mitigation Strategies

An important opportunity within agriculture for GHG mitigation is through storing carbon in plant biomass and soils and preserving existing carbon. This can be achieved through management practices such as reducing tillage, applying organic matter and including legumes in the crop rotation. Building soil organic matter enables plants to be more resistant to drought and disease and soils less prone to erosion.

Further strategies include reducing methane emissions from livestock manure processing, targeting manure and nutrient applications and improving livestock health plans and feeding strategies.

Improving energy efficiency through using more energy efficient equipment, reducing fuel use and investing in renewable energy also contributes to reducing emissions produced in the agricultural sector.

Conclusion

Integrated agricultural production systems that use efficient climate-smart practices to emit fewer GHG whilst enhancing productivity and resilience, are better able to respond to climate change and

[10] DEFRA; The Organic Research Centre. *Reviewing the Opportunities, Barriers and Constraints for Organic Management Techniques to Improve Sustainability in conventional Farming – Final Project Report.* (2018). Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=20252&FromSearch=Y&Publisher=1&SearchText=OF03101&SortString=ProjectCode&SortOrder=Asc&Paging=10

associated global environmental challenges. This opportunity is non-specific to whether the system is exclusively practicing conservation agriculture, intensive agriculture, IFM or another standard production system. It is instead more reliant on the improvement of environmental performance through more sustainable production methods, alongside adapting to the challenges arising from climate change. Practices which promote continued innovation of appropriate methods and technologies and can be applied to all farming systems, have the potential to make best use of natural processes whilst mitigating the harmful effects of climate change.

Discussion Points

- Does any system offer significant and consistent benefits over others?
- Conservation agriculture – is it a sustainable farming system if it doesn't reliably improve crop yields?
- How can intensive agriculture be adapted to mitigate climate change?
- What actions are needed now to reduce agriculture's contribution to climate change?
- How can we achieve these?

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