WHAT COULD CLIMATE NEUTRALITY LOOK LIKE FOR IRELAND'S LAND SECTOR?

The RDS, in partnership with the EPA/DAFM-funded SeQUEsTER project

Livestreamed November 17, 2022

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SeQUEsTER

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Report on RDS-SeQUEsTER Climate Smart Agriculture Series Livestream – 17 November 2022

Executive Summary

The discussion of how the Irish agriculture, forestry, and other land use (AFOLU) sector might achieve climate neutrality by 2050, as per national environmental target commitments, was the focus of the live event held by the RDS and the SeQUEsTER project in November 2022. The SeQUEsTER project is a transdisciplinary research project that combines bioeconomic modelling and life cycle assessment to identify promising pathways towards climate neutrality in Ireland's AFOLU sector. The take-home messages from the project included:

- Achieving climate neutrality in the AFOLU sector **is possible**, but will require at a minimum:
    - Modest destocking and abatement across cattle sector
    - Extensive "rewetting" of organic soils
    - 500kha new forest by 2050
- Reaching net zero will require decades of action, but action needs to happen **now** to get the sinks in place to achieve neutrality by 2050
- Diversification of farms will be critical
- Land use policies need to be linked with downstream construction, energy, and industrial policies
- Long term, forward-looking, and integrated vision needed which will take resolute leadership and carefully designed policies

"Despite various uncertainties, there is absolutely no doubt that Ireland's agriculture and wider land sector will look very different in 2050 if the imperative of climate neutrality is achieved. Diversification carries with it many opportunities, alongside an urgent need for strategic vision and leadership to ensure a just transition for farmers" – Dr. David Styles

Opening Address

Professor Cathal O'Donoghue, RDS Foundation Board and Established Chair of Social and Public Policy at the University of Galway

In his introduction, Prof. Cathal O'Donoghue welcomed the audience to the latest webinar in the RDS Climate-Smart Agriculture Series. He explained how this series addresses the main factors in influencing the sustainable development of agriculture in Ireland, and considers how to marry our climate responsibilities with future agriculture policy.

The event on November 17th, 2022, was organised in partnership with the EPA and DAFM funded Sequester project, which has employed a back-casting modelling approach to generate indicative scenarios of climate neutral agriculture activities and land use from 2050. Prof. O'Donoghue relayed that Ireland has committed to becoming a climate neutral country by 2050, and stated that from the online seminar, they hoped to "present a vision for what a climate neutral agriculture system in Ireland could look like and how to achieve it".

Prof. O'Donoghue welcomed and introduced journalist and broadcaster Helen Carroll who hosted the discussions, and gave a thanks on behalf of the RDS to all those involved who made the event possible. Special thanks were given to Dr. David Styles (University of Galway), Prof. Mary Ryan (Teagasc), and Marie Donnelly (Climate Change Advisory Council) for their contribution to this important and timely discussion.

Welcome and Introduction to Polls

Helen Carroll, Journalist and Broadcaster, Host of this RDS event

Helen Carroll welcomed everyone to this event and invited the viewers of the livestream to participate in the discussion. She revealed there will be a series of questions put to the audience throughout the event and asked the audience to consider the questions carefully. The watchers were asked to answer these polls as honestly as possible so that that a proper overview about how the audience feels about the future of agriculture in Ireland could be ascertained. The questions were put to the audience through Slido Polls and were all answered anonymously.

Poll 1: What is your background?

31% - Other

25% - Policy Maker

19% - Academic/Researcher

19% - Industry

6% - Farmer

Poll 2: Ireland must achieve climate neutrality by 2050 to tackle the climate emergency?

93% - Strongly Agree

7% - Somewhat Agree

0% - Somewhat Disagree

0% - Strongly Disagree

Agriculture, Climate Change, and the Future

Marie Donnelly, Chair of Climate Change Advisory Council

In her keynote address, Marie Donnelly began with some Irish context, stating how the agriculture sector represents 34% of national emissions, and land use and land use change represents an additional 11%. Therefore, the agriculture, forestry, and other land use (AFOLU) sector represents 45% of our emissions here in Ireland, dominated by methane and nitrous oxide, thus demonstrating a "really steep challenge before us in terms of taking the measures and actions necessary to reduce our emissions."

There is currently a target of reducing nitrous oxide emissions by 25%. Ms. Donnelly explained that a reduction in use and a shift in use into protected urea will account for half of this target, whilst also being economically fruitful for farmers. She expressed how a big challenge with these actions are awareness and deployment. She made it clear that, to reduce nitrous oxide emissions, we will also need to accompany this with farming practices such as low emission slurry spreading, mixed sword planting, and liming of our land.

Ms. Donnelly stated that methane emissions in Ireland are not dropping. Saying that we have a real challenge as the dairy herd is continuing to increase, meaning that our emissions profile from our cattle is continuing to stay high. She described how work to reduce emissions is being undertaken by exploring genetics, improving the production profile of our animals, introducing methane inhibitors, improving the efficiency of their outputs, and looking at the age of slaughter for some of the beef herd. She stated that perhaps the most important area to reduce methane emissions will arise from additional income sources for farmers who choose to diversify from their commercial operations into new areas – e.g., organic farming of animals, forestry, and/or energy (biomass, solar, wind). Again, expressing how the big challenge is awareness raising, knowledge transfer, support for farmers, and then implementation at the farm level across the country. The importance (and challenge) of re-wetting the bogs was also detailed.

It was relayed that Ireland land sector is a source of emissions, not a sink. Forestry in Ireland is a significant outlier vis-a-vis the rest of Europe, explained Ms. Donnelly, describing how plantation rates have really fallen off a cliff over the last 20 years. She explained how improvements are being introduced, such as a rollout of supports, even for small stands, with reduced licensing requirements. It was described how getting the notion of forestry as part and parcel of farming is critical.

"Reducing emissions in the agricultural sector by 5 to 6 million tonnes of CO_2 equivalent is not going to be easy, but it is achievable. We have the technologies and the pathways available to us today" – Marie Donnelly

Poll 3: Failure to meet climate targets is likely to undermine "green marketing" of Ireland's agri-food exports?

81% - Strongly Agree

19% - Somewhat Agree

0% - Somewhat Disagree

0% - Strongly Disagree

Poll 4: Diversification is necessary to improve the resilience and sustainability of Ireland's agricultural sector?

73% - Strongly Agree

28% - Somewhat Agree

0% - Somewhat Disagree

0% - Strongly Disagree

Economic Implications

Professor Cathal O'Donoghue, Established Chair of Social and Public Policy at the University of Galway

Prof. O'Donoghue presented some work on the economic analysis that is fed into the SeQUEsTER project. He began by demonstrating that substantial changes in cattle numbers within the last century have been driven by implemented policy, and that there has been a net increase of 903,200 cattle since 2011, to almost an all-time high. This expansion will continue for the foreseeable future, relayed Prof. O'Donoghue, as the number of female calves is the highest ever.

Prof. O'Donoghue shared a 2019 Teagasc roadmap showing how we could reduce emissions in the agricultural sector by classifying measures into four potential sources of savings. These sources included: land use (which accounted for 45% of potential reductions); energy on farms (27% of potential reductions), agricultural technical measures such as fertiliser formulation, crude protein, slurry spreading, etc. (17.5% of potential reductions); and agricultural efficiency measures such as reducing number of animals required to produce a given amount of output (11% of potential reductions).

It was shared how emissions per unit output have fallen as agriculture in Ireland has become more efficient. However, animal numbers are growing at a faster rate than we're improving the efficiency of the sector, which is a challenge in in realising emissions targets. Prof. O'Donoghue questioned that even if we can deliver lower missions with the same amount of food, do we have the levers to realise those gains from efficiency? This is because by making more per animal, there would be a pressure to have more animals.

Whilst displaying a sectoral share over time, it was shown that methane emitting sectors have risen from about 50% of the share of output in the 1950's to about 75% today. Pigs, poultry, and cereals were more important in the past, which leads to another question about whether a different mix should be part of the solution?

Prof. O'Donoghue ended this presentation by discussing whether we can use novel instruments like emissions trading to facilitate just transitions and a more balanced benefit, and cost, across the sector.

"Instead of thinking purely in terms of animal changes, should we think of diversifying – using lessons we have learnt from the past?" – Prof. Cathal O'Donoghue

Poll 5: Select your preferred option from four possible climate neutral combinations

52% - High rate of afforestation + high rate of organic soil rewetting + modestly lower milk production + modestly lower beef production

30% - High rate of afforestation + high rate of organic soil rewetting + similar milk production + much lower beef production

9% - High rate of afforestation + high rate of organic soil rewetting + similar beef production + much lower milk production

9% - Low/modest rate of afforestation + low/modest rate of organic soil rewetting + much lower milk production + much lower beef production

Poll 6: How would you rank priorities for meeting climate neutrality?

Most important

Least important

1. Plant new native forests
2. Implement technical mitigation options
3. Move towards more diversified mixed farming systems and alternative livestock mix
4. Rewet organic soils
5. Diversify use of grass as a bioeconomy feedstock (anaerobic digestion, protein, starch, packaging fibres, or bioplastics, etc.)
6. Expand high nature value grassland management (low stocking rates)
7. Organic Farming
8. Plant new commercial conifer forests
9. Improve cattle genetics
10. Prioritise dairy production and reduce suckler-beef production

Role of Forestry in Climate Neutrality

Professor Cathal O'Donoghue, on behalf of Professor Mary Ryan, Environmental Economics and Rural Development Programme Coordinator, Teagasc

As context, Prof. Cathal O'Donoghue showed that afforestation policy has been a success. In 1922, forestry covered 1% of land area, but now that value is 11% of land area – the largest land-use change since the foundation of the state. However, the area planted has declined substantially in recent years. Because of the decline in forestry planting, Prof. O'Donoghue warned that there will be a carbon cliff, where sequestration reduces substantially. The more we plant now, the lower this cliff will be. Prof. O'Donoghue went on to say that the economic proposition of planting forestry is good. He showed that more than half (and up to 70 or 80%) of beef and sheep farmers will be better off with forestry.

From the SeQUEsTER project (more results and methodologies described below), they found that, of the scenarios which achieved climate neutrality, the mean land area required for forestry was 18%, which is very similar to the DAFM target of planting 18% of the land area by 2046. This equates to an equivalent of 20,000 hectares planted per year. He continued to explain how if Ireland had met the forestry targets from the Food Harvest 2020 Strategy, the dairy expansion Ireland has seen would essentially have been climate neutral.

Carbon in forestry represents an opportunity. Prof O'Donoghue explained how the state places a value on the carbon emissions we produce. In the same way, you can argue that there is a positive value in the carbon we sequester in trees. It was shown that if carbon incentives replaced current afforestation incentives, forestry generates a higher return than all other land types. "This effectively means a radical change to the economics of forestry versus agriculture if you can fact find a way to factor that carbon value in", explained Prof. O'Donoghue.

When discussing strategy, it was stated that we need short-term carbon sequestration delivered by fast-growing conifers, which can deliver carbon quickly and provide the timber to decarbonise the construction sector. However, we also need broadleaves. They sequester carbon (although more slowly) to be good carbon sinks, and they're better for biodiversity and recreation. As such, having both forest types is critical as they deliver different ecosystem services. Other recommendations included multiple strategic, behavioral, and organisational implementations necessary to deliver on new forestry requirements.

> "If we delay implementing forest strategy, it will seriously impact our capacity to deliver climate neutrality by 2050" – Prof. Cathal O'Donoghue

Poll 7: Strategic long-term decision making requires a re-imagining of what a climate-neutral, resilient AFOLU sector could look like?

77% - Strongly Agree

23% - Somewhat Agree

0% - Somewhat Disagree

0% - Strongly Disagree

Poll 8: Who should be most responsible for driving climate action in AFOLU?

74% - Policy Makers

9% - Farmers

9% - Consumers

4% - Food Processors

4% - Investors

0% - Retailers

SeQUEsTER Project Conclusions

Dr. David Styles, Associate Professor in Agri-Sustainability, School of Biological & Chemical Sciences and Ryan Institute, University of Galway

Dr. David Styles explained how the SeQUEsTER project utilised a back-casting approach to reimagine different configurations that are possible in the land and agricultural sector by 2050, assessing which combinations comply with climate neutrality. To do this, a model – GOBLIN (see Dr. Duffy's presentation, below) – was created which reconfigures the land use sectors in a randomised way, so that different combinations of milk and beef production, forestry, organic soil re-wetting, extensification of grasslands, maintaining grasslands without cattle, etc. can be explored.

A considerable finding from the work was presented by Dr. Styles, showing that even under different definitions of climate neutrality (see Dr. Bishop's presentation, below), there's no easy way to get to neutrality without reducing the number of cattle. It was shown that it is possible to maintain milk production in some scenarios, but we have to drastically reduce beef production; or we can maintain beef production in some scenarios, but we have to drastically reduce milk production. However, Dr. Styles explained that it was very clear from the work done that a reduction in cattle numbers will be necessary to achieve climate neutrality.

It was them conveyed that a climate neutral Ireland will look very different in 2050 regarding its land use. Future land use configurations will require considerably higher levels of afforestation and rewetting of organic soils, where the definition of neutrality adjusts the levels of afforestation and rewetting required, although still necessary for all definitions. Dr. Styles explained how significant forest planting must start soon in order to achieve neutrality by 2050 as we are limited in the rate of planting and the amount of sequestration that can be achieved. He explained how it will be difficult to become climate neutral by 2050, but it will be even harder to maintain neutrality beyond then. It was described how trees will reach a saturation point over time and if we stop planting in 2050, we'll get to a point in time towards the end of the century where we have another carbon cliff. The long-term climate mitigation from forestry, Dr. Styles explained, happens downstream after we harvest the wood, cascading the use first through high value uses such as building material. Then, after it's come out of the buildings, utilising the wood for lower grade products, and then eventually (potentially 50 or 100 years from now) into technology like bioenergy with carbon capture and storage. He stated how the key thing about forestry is that it provides us a lot of time to get that technology working, of at least the time that the trees are in the ground but probably beyond that the time, during which the wood is in different products after we have harvested those trees.

"We need a long-term, forward-looking, and integrated vision and that's going to take really resolute leadership. There's no easy way out of this, but there are pathways" – Dr. David Styles

Armchair Discussion

Helen Carroll and Dr. David Styles

A Q&A between Helen Carroll and David Styles then occurred, with Ms. Carroll relaying questions from the audience. A selection of highlights from this discussion are shared, with questions asked by Ms. Carroll in bold, and answers from Dr. Styles beneath.

"A lot of the focus at the moment is on 2030 which is really only seven years away. You're taking a much longer view of things, and for you 2050 is what we should be focused on?"

We definitely need some intermediate targets, but for us we had a very clear focus on 2050 because we're looking at that very ambitious target of climate neutrality. Some actions we need to get in place in the land use sector are going to take a long time to get significant sinks in place. Even though we might not see the fruit of the action immediately, if we don't start taking that action right now, we will delay the effects further down the road, past 2050.

There's talk about either/or for commercial woodland and native woodland. Which is best?

We need a mix of both because we are going to have to deliver biodiversity as well as carbon sinks. Commercial forestry has a particular role to play for a very long-term sink of carbon into the future, whilst also supporting a bioeconomy (with industries to be developed simultaneously). However, we do need the large biodiversity benefits of native woodlands as well.

"Do we favour a selective reduction of the dairy herd since it's the biggest emitter of greenhouse gases?"

These are policy choices. Some of the arguments in favour of milk production is that it is more profitable, there is an important role for dairy products in diet, and we need to consume less meat to have a planetary sustainable diet. But that's not really for us to decide, we can show what combinations are possible and the next job is for policy makers to engage with the sector on the possibilities of climate neutrality to see which "flavour" of those definitions is more palatable and more attractive.

"Can climate smart agriculture deliver a fair share of emission reductions relative to the sector's overall greenhouse gas output?"

Climate smart agriculture is going to be very important, and we are likely going to be throwing a lot of technologies at agriculture. Teagasc is doing really good work and showing leadership here about how to reduce emissions intensity, how to implement abated urea, low emission slurry spreading, additives that we can put in feed to reduce methane emissions, etc., which are all really important and they're going to have to be done. The more we can

do that, the smaller the animal herd reduction is going to need to be. However, we can't do that in isolation – we're never going to get to neutrality without that big sink being put in place and that requires ambitious action in the land sector through the rewetting of organic soils and afforestation.

"Have you considered hedgerows as a sink?"

They are an important source of carbon, much like grass and soils. However, because that store is not increasing, it is not a year-on-year sink which is what we need to offset emissions. Hedgerows are really valuable for biodiversity purposes and farmers should absolutely be rewarded for maintaining hedgerows and keeping that biodiversity in place, and not releasing that carbon by removing them, but the reality is that they're not going to be a big sink in our accounts.

"Without increased supports for the very extensive low-income sheep and beef sectors will that lead to a massive transfer of land to intensive dairy?"

We can't allow that to happen if we want to meet our climate neutrality targets because we certainly can't have a lot more animal numbers and more dairy production, especially as dairy animals are higher emitting per head than beef and sheep. However, there is the potential to convert that very low profitability land. As Prof. O'Donoghue showed, there are many examples where converting land to forestry could be more economically attractive for farmers, and that's what we need to encourage because that is going to be part of the solution to get to climate neutrality. That will then enable other farms, such as successful dairy farms, to maintain their production. It will also allow Irish exports to be able to market products internationally as sustainable produce.

"A positive message from today is that between now and 2050 there is a lot we can do"

Absolutely. We have got 28 years to get there, and we do need to reimagine what it looks like, but as Prof. O'Donoghue showed, the sector has changed a lot through time and often in response to policy levers. Farmers will have to do a lot of work and sometimes farmers feel unfairly vilified for the fact that the sector is a big emitter. However, farmers are 100% a part of the solution, and the ball is largely in the policymakers' court to design those policies to incentivise farmers to take those actions that we as a society need them to take to get us to climate neutrality. It's a collective action and it's not just the agriculture sector. We need to do it across all sectors of the economy, but that also creates opportunities – we need more wood for construction, we need more biomaterials, we need more biodiversity and carbon sinks to be in place. This is something we're going to have to pay farmers to do, it involves diversification, but there are opportunities there as well.

– EVENT END –

Online: Randomised Land Management Scenario Modelling with GOBLIN

Dr. Colm Duffy, EPA Fellow, University of Limerick

Dr. Colm Duffy began by detailing the GOBLIN modeling framework. The GOBLIN model (**G**eneral **O**verview for a **B**ack-casting approach of **L**ivestock **IN**tensification) is an integrated land use emission model for Ireland that enables pathways to net-zero to be objectively identified using back-casting. The model links the main sources of AFOLU greenhouse gas emissions and randomly varies key parameters to identify combinations compatible with a net-zero flux. Dr. Duffy explained how the model is completely open-source and available online. It was explained how GOBLIN is structured: it starts off by generating our scenarios and randomly varying key input parameters. The model then generates the national herd for sheep, dairy, and beef for each one of the scenarios. Following this, grassland area and spared area are produced utilising the energy requirements for the national herd and inorganic and organic fertiliser inputs. The spared area is divided out among the alternative land uses, and emissions and removals are calculated using the livestock, forest, and land use modules. Finally, the final outputs then generated using the GOBLIN module.

Dr. Duffy revealed the results from the first set of scenarios run. 850 unique scenarios were generated and were assessed to 2050 using the GWP_{100} metric. 666 scenarios were classified as failing to meet neutrality, which was defined as exceeding 2.5 MT of CO_2 equivalent; 146 were classified as being AFOLU neutral, which was defined as being between -2.5 and 2.5 MT of CO_2 equivalent; and 38 scenarios were classified as being nationally neutral, which was defined as an emissions flux below -2.5 MT of CO_2 equivalent.

From the results it was shown how there was significant between group differences in some of the key parameters in the model. The most significant of these variables were the reduction in dairy and beef population, and the increase in spared area, forest area, and wetland area. Relative to the 2015 baseline, there was a 40 – 50% emissions reduction within the scenarios which achieve climate neutrality, based on current or modestly improved productivity per animal without the inclusion of future abatement options. Without mitigation and under the current accounting rules for methane, the average reduction for dairy and beef was 42% and 39% for the AFOLU group and 52% and 44% for the national group.

When the study moved the target year out to 2100, Dr. Duffy explained how only 8 of the 146 scenarios in the AFOLU group remained climate neutral, with 32 of the 38 in the national group remaining neutral. However, only one scenario maintained the national neutrality status, with the rest related to the AFOLU neutral group.

Online: Land use under different definitions of neutrality

Dr. George Bishop, Post-doc Researcher, University of Galway

In his presentation, Dr. George Bishop discussed the latest SeQUEsTER study which explored the consequences of applying various contemporary definitions of climate neutrality on potential "climate neutral" target configurations of agricultural production and land use within Ireland's AFOLU sector. 3000 randomised scenarios were generated by GOBLIN, with animal population numbers set between one and values in 2021. A second set of 3000 scenarios were also produced with an optimistic 30% reduction in agriculture emissions. He explained how ten different definitions of climate neutrality were explored, with the changes ultimately relating to how the methane emissions (prominent in the national emissions profile) were accounted for. These definitions (explained in greater detail online) included carbon neutrality, GWP_{100} to 2050, GWP* to 2050, and a methane target to limit global warming to 1.5°C based on grand-parenting (meaning equal percentage reductions across countries) to achieve this. Variations of these metrics included two long-term interpretations of climate neutrality into the second half of the century, and introducing international fairness for methane allocation rules relating to equal per capita emissions and emissions proportionate to animal protein production.

Overall, Dr. Bishop communicated how the successful scenarios had considerably higher levels of new forest area and rewetted organic soils in the scenarios which were able to achieve neutrality compared to the scenarios which failed neutrality, across all ten definitions explored. Although the levels of new forest area, and new wetland area varied depending on the definition of climate neutrality.

He explained how it was not possible for the original successful neutrality scenarios to simultaneously achieve 2021 population levels for both adult suckler beef and dairy cow numbers. All definitions (except methane target population) were able to generate successful scenarios which maintained 2021 levels of suckler beef population numbers. However, the scenarios which modelled larger dairy cow populations were unable to continue to maintain 2021 levels of suckler beef numbers for each realistic definition. Only carbon neutrality and GWP* were able to successfully maintain 2021 levels of dairy cow population numbers from the 3000 scenarios.

Dr. Bishop summarised by saying that "defining national 'climate neutrality' is critical to determine sustainable land use configurations, but transformative configurations of agricultural production and land use within Ireland's AFOLU sector may be unavoidable to achieve neutrality by 2050 and beyond for **all** realistic definitions. Technical abatement, livestock reduction, organic soil wetting, and afforestation will all be needed. The specific definition of climate neutrality will influence the balance of these action."