REPORT: ISCRAES 2020

The First International Symposium on Climate-Resilient Agri-Environmental Systems

(ISCRAES 2020)

Virtual Interactive, 4-6 November 2020

Introduction

Globally climate change is one of the most important issues facing the agricultural sector and could exacerbate already elevated greenhouse gas (GHG) emissions. Other environmental concerns associated with agriculture include increased water, air and soil pollution. Minimising the environmental impacts of agriculture represents a big challenge for the agri-food sector, given the need to significantly enhance food production. To meet the dual challenge of enhancing food production whilst minimising the environmental impact in line with the UN-SDGs goals, requires cooperation with stakeholders from both the public and private sectors. This will also require significant improvements in the development and adoption of technologies with a low carbon/GHG footprint throughout the lifecycle/supply chain.

Focusing on the above, the ISCRAES 2020 conference, with the theme "Contributing to the United Nations Sustainable Development Goals (UN-SDGs) through the Development of Climate-Resilient Agri-Environmental Systems" was the first of its kind to take place virtually. The main objectives of the symposium were to share experiences, inspire people, build networks among academics, researchers, stakeholders and policymakers in order to discuss the appropriate measures to fill knowledge gaps, develop policies and identify the steps required for their implementation. The symposium served as a platform for discussing and sharing scientific knowledge, experimental evidence, and technological applications including cross-cutting issues associated with the environmental impact of agricultural, including public perception, regulatory and socio-economic factors.

The symposium was organised through opening speeches, plenary talks, two parallel sessions consisting of six themes, one workshop and one panel discussion and provided a basis for the testing and subsequent adoption of strategic ways for implementing sustainable mitigation actions for dealing with GHG emissions and other environmental problems. An emphasis was placed on a systems-based approach, that provided economically viable and socially acceptable options, and how the information could be incorporated into a decision-support tool for on-farm reporting. The contributions were presented and discussed under six themes: (i) Arable cropping systems, (ii) Grassland systems, (iii) Agro-Silvo-Pastoral Systems, (iv) Socio-Economic Costing, (v) Decision Support Tools and (vi) Agrometeorology.

Participation

The symposium brought together over 130 participants from 34 countries representing academics, researchers, students, government agencies, civil society, stakeholders, and policy makers. The meeting provided a forum for participants to share their experiences, knowledge and technologies and to learn from each other while disseminating their ideas more widely.

Opening Speeches

The symposium was opened following an introduction of CRAES and the future of ISCARES and their key roles in achieving progress towards climate-smart agriculture by Dr. Ibrahim Khalil of Prudence College Dublin (PCD) and University College Dublin (UCD), the Coordinator (CRAES) and Convenor

(ISCRAES 2020), respectively. This included a proposal for a follow-up meeting, ISCRAES 2022, to be held in Dublin in two years' time and the potential for forming an international platform with a focus on system-based approaches that could contribute to improved climate-resilient agri-environmental systems.

Prof. Mark Rogers, Registrar and Deputy President/Vice President for Academic Affairs of UCD welcomed the participants and reiterated the importance of the symposium in dealing with key global issues: Climate Change, Environmental Pollution and the agriculture.

In the first opening speech, Mr. Eamon Ryan, Minister for Environment, Climate and Communication, highlighted the role of land use planning in mitigating climate change, indicating the real possibility of meeting climate targets, as well as reducing environmental pollution and enhancing biodiversity through improvements in the management of agriculture, forestry and peatlands.

He was followed by Prof. Takashi Kosaki, President of the International Union of Soil Sciences, who emphasised the need to build climate resilience agricultural systems and the importance of soils in achieving many aspects of the Sustainable Development Goals.

Prof. Roslyn Gleadow, President of Global Plant Council, in her opening remarks reiterated that we are all connected and that global efforts are needed to generate the knowledge and technologies that are essential to sustain agriculture and the associated farming systems.

Plenary Speeches

Dr. Federica Matteoli, Leader of the Climate-Smart Agriculture (CSA) Team in the Office of Climate Change, Biodiversity and Environment (OCB) at FAO delivered the first plenary speech on "Global Perspectives and Inter-linkages of FAO's Climate-Smart Agriculture with UN SDGs"**.** She discussed a multitude of potential synergies and trade-offs between CSA objectives and targets across all 17 SDGs, as well as the integration of opportunities associated with CSA implementation with SDG and NDC related goals. Corresponding key aspects of CSA implementation are expanding the evidence base; supporting enabling policy frameworks; strengthening national and local institutions; enhancing financing options; implementing practices in the field; and monitoring, evaluating and reporting.

Prof. Nina Buchmann, Professor of Grassland Sciences at ETH Zurich, Switzerland delivered an opening speech on "Agroecosystems today and in the future: Drivers of or driven by climate change". She pointed out the importance of agroecosystem management for both arable and grassland systems for the provisioning of ecosystem services and sustainable development globally. Her research has found that management strongly affects the climate regulation service provided by grassland, offering potential win-win solutions to attain sustainable, and climate-resilient agriculture.

Prof. Alan Matthews, Professor Emeritus of European Agricultural Policy at Trinity College, Dublin, Ireland in his opening speech "Promoting Climate-Resilient Agri-Environmental Systems in the EU's Common Agricultural Policy" envisaged that agricultural emissions should be halved by 2050, as opposed to the EU Commission roadmap to a net zero emissions economy, sequestering additional carbon in the LULUCF sector. He emphasised two key targets for the new CAP should be climate-relevant and natural resource conservation, biodiversity protection and climate change.

Invited Talk

Ms. Giappichelli Laura, EASME, European Commission, Belgium delivered a talk on "LIFE and Climate Action in Agriculture" and emphasised the contribution of the LIFE programme to the implementation of the EU's climate commitments, including those under the Paris Agreement, the 2030 climate and energy package, the EU adaptation strategy and the Green Deal and the recently unveiled

Farm to Fork Strategy, as well as raising awareness of climate change adaptation and mitigation measures in agriculture.

Parallel Sessions

Over the 2 days, 6 keynote speeches and 82 papers as orals and flash talks were presented under various themes (detailed information are available in the book of Abstracts) including:

Arable cropping systems

Chair: Prof. Kazuyuki Inubushi (Chiba Univ., Japan) and Co-Chair: Prof. Pascal Boeckx (Ghent University, Belgium)

Keynote address: Prof. Jørgen E. Olesen, Aarhus University, Denmark entitled "What does it take to realize sustainable arable cropping systems?"

These were followed by 8 oral and 7 flash talks.

Grassland systems

Chair: Dr. Katja Klumpp (INRAE, France) and Dr. Mhairi Coyle (James Hutton Institute, United Kingdom)

Keynote address: Prof. Klaus Butterbach-Bahl, Karlsruhe Institute of Technology, Germany entitled "Drivers of greenhouse gas footprints in grassland production systems".

Followed by 8 oral and 7 flash talks.

Agro-Silvo-Pastoral Systems

Chair: Prof. Gerardo Moreno (Univ. de Extremadura, Spain) and Co-Chair: Dr. Narindra H. Rakotovao (Univ. Antananarivo, Madagascar)

Keynote address: Prof. Jim McAdam OBE, AFBI, NI, UK entitled "The potential of agro-silvo-pastoral systems to address climate resilience and mitigation".

Followed by 6 oral and 5 flash talks.

Socio-Economic Costing,

Chair: : Dr. Laurence Shalloo (Teagasc, Ireland) and Co-Chair: Dr. Joanne Fitzgerald (IT Carlow, Ireland)

Keynote address: Dr. Stephane De Cara, INRA-AgroParisTech, France entitled "Mitigation of greenhouse gas emissions from agriculture: An economist's perspective".

Followed by 4 oral and 4 flash talks.

Decision Support Tools

Chair: Prof. Christoph Müller (J-L Univ. Giessen, Germany) **and** Co-Chair: Dr. Inge Jonckheere (FAO, Italy)

Keynote address: Dr. Jon Hillier, Edinburgh University, Scotland, UK entitled "Decision support tools for environmentally sustainable farming: How do they help?"

Followed by 8 oral and 10 flash talks.

Agrometeorology

Chair: Dr. Klara Finkele (Met Eireann, Ireland) and Co-Chair: Prof. Owen Fenton (Teagasc, Ireland))

Keynote address: Dr. David Boorman, Centre for Ecology & Hydrology, UK entitled "Establishing a national soil moisture monitoring network for the UK – the good, the bad and the completely unexpected".

Followed by 7 oral and 8 flash talks.

Workshop Outcomes

Theme: Land use mosaics and greenhouse gas mitigation

Facilitators: Jon Yearsley, Matt Saunders, Ken Byrne, Jagadeesh Yeluripati and Klara Finkele (Summary: Ibrahim Khalil).

Themed Question 1: Which agricultural incentives to landowners might be needed to implement a range of crops with a reduced greenhouse gas footprint?

There is a need for a complete commercial agricultural supply chain, with the farmer in the middle, and going from seed breeders, machinery and chemical suppliers, and advice services, together with appropriate markets, outlets, and food processors that supports all involved. Farmers largely think of short to medium term incomes and monetary advantage rather than longer term profits that might initially result in lost income. Consideration should be given to whether farmers are receiving money from carbon trading schemes in line with the EU policies, FAO GSOC protocols, or C Farming, where there are already commercial interests. Payments for the other ecosystem services that farmers an provide not just meat and milk production, should also be included and these must be socio-culturally attractive as consumers are still looking for the cheapest product. Demonstration farms/sites could help farmers adopt to new ideas and technologies.

In Japan, the government has introduced incentives to reduce fertilizer applications combined with enhanced soil testing. Similar moves in Ireland in relation to nutrient management planning and derogations such as the Nitrates Directive to support field/local/regional scale soil analysis to match nutrient management appropriately are in place. Incentives are the best way to motivate a practice to be adopted by farmers. The first goal should be to support farming incomes and to provide training. Solutions need to be bottom up and give farmers 'ownership' for changes in agricultural practices.

In Ireland, a baseline data of soil carbon to evaluate its loss or gain over time has been created. The GHG-manage project is focused on providing the scientific platform for farmers to measure their own emission factors. It is important to work at the farm level to provide an incentive for farmers to reduce their carbon footprint. If the farmers have a very simple system this will improve the development and use of on farm mitigation practices. Forward thinking farmers are keen on adopting best practices.

It will be very important to have good incentives for the farmers to grow crops that reduce GHGs. There will, however, have to be market options for them and rewards for environmentally friendly farming practices. Certification of any commodities will not be enough; the label must be accepted by the buyers who can use this to build a close relationship with the farmers. Win-win situations will also promote

the adoption of any mitigation practice. Farmers will be guided by what policies are in place, and they will have to comply with regulations if there are strict penalties.

Policy incentives have often been wrong in the past particularly in the EU and have led to environmental degradation. An example is the removal of the milk quota system, this incentivized farmers to go into more intensive and larger scale milk production and led to huge investment in the dairy sector that is now difficult to roll back. The enforcement any regulation might be difficult because solutions need to be at the local level, so a national scale blanket approach to policy will not work.

The definition of 'sustainability' is very different for different people. Example – a small-scale farmer who switched to no-till in Germany in 2007 has had a huge success in terms of maintaining crop yields under drought situations, as the last few years have been characterized by low precipitation. However, policy incentives are favouring large commercial farms compared to family farms that require assurance of an income every year to become resilient.

On the other hand, minimum-till is generally cheaper for farmers, but there is still the perception that the yield would decrease with a move away from conventional ploughing. At the moment, only the products are rewarded commercially without giving enough incentives to farmers to maintain soil health, for instance. This is related to lack of any payment for public goods or environmental resources. For maintaining soil health some incentives are required coupled with robust indicators for soil or land quality.

Among a variety of crops and management options for reducing GHG emissions/enhancing C sequestration, some tare better than others. One way to sequester C is to use a cover crop system, but this might have other impacts, such as an increase in N_2O emissions and that a holistic approach is needed. and all parts of the agricultural sector need to play a role in climate mitigation. Other solutions within the landscape, such as hedgerows should also be considered but mechanisms are required to quantify their role and it is difficult to incorporate this in inventories due to data requirements.

Reduction of nitrogen fertilizers and their efficient use are important, including CO_2 efficient fertilizers, using less energy like in EU. Emission factors that are used at the national scale are often quite inappropriate for use at the local scale. Obviously, some farmers benefit from this, but others are losing out.

In Ireland, the landscape is dominated by grass and livestock, which production is inefficient, but tillage is being converted to grassland. Efficiency is assessed in per kg output but loosing tillage ground to grassland because dairy is most profitable. A dairy farmer can afford to pay more for the renting of land. This is a big challenge, with the current 300,000 ha of arable land projected to decrease substantially over the next decade so incentives need to be put in place to try and prevent this. The New CAP is more focused on the environment but policies to help the arable and horticulture sectors will be essential.

In addition to afforestation, agroforestry is a relatively easier approach increase carbon sequestration, but it is difficult to increase this further in permanent grasslands and afforestation may also have little impact given that many grasslands are high in soil C. Tree planting is not beneficial on peatlands in terms of the carbon balance. It is essential to first decide what ecosystem services we need from the land before we can decide if afforestation which locks land for a longer-term, is a good idea. Also, we need to look closely at how much land is afforested. Other options are available, such as hedgerows, agro-forestry (silvo-pasture), bioenergy crops. Mixed farm approaches have many advantages, and there is an appetite for this in the farming community, but the incentives must be available and appropriate to change the system. It is difficult to assess and quantify other ecosystem services such as carbon sequestration and thereby implementation of relevant policies.

Taxation to consumers is linked with incentives to farmers to contribute to the CAP budget and this is a roundabout way of doing it. For example, the biogas sector in Germany is declining though everyone contributes to the fund. The is unsatisfactory as the farmers continue to make money with little or no benefit for the wider taxpayer. A similar argument applies at the fuel pump where consumers are paying a carbon tax, but farmers are not paid according to the carbon footprint of the products they produce. Despite availability of online information in selecting high value crops to attain sustainable agriculture with less carbon footprint, we need to find out whether incentives or legislation is better for policies to be effective.

Themed Question 2: What is the added value of quantifying GHG emissions at a fine scale, as opposed to large (national) scale?

Fine scale is important to identify hotspots of C and N emissions. For example, New Zealand are telling farmers how much an agricultural activity will reduce GHG emissions, by considering insights on the management and other possible improvement options. Fine scale measurements could also give an early warning of problems that could impact at the national scale and the information is more relevant for managers/farmers. Farmers may report yield along with fine scale GHG emissions (GHG emission/ton yield). But we may need to be careful because emission/ton is not valuing total emissions. Large scale is generally a national scale. Emission factors that are used at the national scale are often quite different to what is happening at the local scale. Obviously, some farmers benefit from this, but others are losing out Landscape scale values will however be needed to address land use changes.

Data is aggregated at a national scale for reporting and it is difficult to reflect this in regional/local/field scale activities. To move to this requires a huge data production and mining task. Data is, however, starting to become available and a few reporting parties have managed to come up with spatial inventories (UK and USA are good examples with the UK at 10*10km scale). Ireland is working on a national land cover map that could contribute to finer levels of information.

It is important to realize that this is not just about obtaining activity data or mapping, as research is required to identify field scale/regional specific factors (climate, soils, management, etc.). Undertaking this work will also help to identify emission loss pathways providing more integrated information for a range of uses. In future, measurements may be targeted in areas focused on particular issues (e.g. water quality). Life cycle analysis should also be included, which could avoid the possibility of a farmer persecution complex. This should include yield per kg N (also the form of nitrogen applied is important in relation to GHG production) or yield per kg crude protein.

The role of technology in providing data, including the use of low-cost sensors across communication platforms, will be important, but limitations in suitable low-cost sensors/approaches exist including their link with modelling approaches. Low-cost approaches could be useful if data quality is aligned with field and lab-based validation. Use of sensors and data products could develop our understanding of processes and drivers. There is a need to better link measurements to models and to reporting processes.

Tools are coming on stream to facilitate more detailed CO_2 monitoring and assessment at farm scale. Satellite based systems are being developed to assess carbon, linking more to biomass than soil carbon. Integration of soil moisture, soil type, N, P, K at the whole farm scale would be useful including the AI approach to quantify carbon in soils. Short term research funding is an important consideration for developing bottom-up data-driven approaches, as they limit long-term data/measurements.

Themed Question 3: What are the potential options to mitigate and compensate GHG emissions at the landscape scale?

Farmers are realizing that diversification has several advantages as a cropping scheme and a better a solution to minimize GHGs and environmental pollution. Wealthier countries have the ability to

develop new solutions that can be adopted elsewhere in the world. However, there might be concerns about how effective these are at local levels for example agroforestry is a good incentive for Africa but may not be so effective elsewhere. Similarly, a large proportion of N_2O or CO_2 emissions can occur in small areas or hot spots.

We need to think about increases in extreme events (multiple dry/wet events) and the effects that they might have, such as cattle on too wet soil will increase emissions. Farmers and foresters have economic burdens requiring financial support before they can adopt a mitigation measure. Quick win measures will not be enough to solve climate change.

Mitigation and adaptation usually go hand in hand, for example, planting trees and the use of solar panels in combination with grazing. If a mitigation measure doesn't work then it is an ethical issue, and a livelihood issue for the farmers.

Increasingly we will need to consider C farming and GHG emissions abatement at a farm scale, which are not directly driven by inventory compilations, but we need to be able to capture this information to reflect this in national reporting schemes. Consideration of zero-C farming will have beneficial effects on inventory figures, but it is important to reduce emissions first and then to consider offsetting. However, there is concern about the applicability of GHG reduction at the first place linking to national/global policy-oriented desires/need.

Data should be available to farmers to support and ensure the use of verifiable reduction/offsetting decisions in maximizing emission reductions and the amount of land to be spared to offset/negate these emissions. Projects in Ireland are looking at this from a range of approaches (SOC, pH of soils) but we need widespread adoption at national scale to drive this forward. Teagasc's idea of signpost farms to promote knowledge transfer may be effective to some extent. However, there are many important examples that do not get public recognition. It is important to consider the suitability of implementation of any option for maximizing mitigation options.

Themed Question 4: Which is more important: mitigation or adaptation to climate change at a landscape scale?

Adaptation measures are easier to do if they are farm-based, depending on the type of farm and it is easier to understand any benefits at this scale. Carbon budget policy decisions are done at the national level and often difficult for farmers to understand. System change is often associated with additional costs and a long transition time (e.g. to transition to agro-forestry). If mitigation is seen as a benefit that adapts the system to climate change it may help a smoother uptake of the measures. Incentives for bioenergy production as a mitigation option need to address the full supply chain and not just production.

General Meeting

A virtual general meeting, convened by Dr. Ibrahim Khalil, was also held alongside the ISCARES 2020 on the 6th November during the lunch break. After a through discussion on the agenda mainly on the next ISCRAES and the formation of an international platform, it was decided to hold the next symposium (ISCRAES 2022) in Dublin in-person attendance and explore the possibility of formation of the proposed forum in consultation with academics and researchers attended.

Panel Discussion

Theme: Agricultural Systems as a Holistic Approach to Mitigate Climate Change and Environmental Pressures

Key points

- Agricultural systems can make a significant contribution to emissions reductions, soil carbon sequestration and climate change mitigation.
- Zero emissions agriculture is highly unlikely, although significant reductions in relation to EU 2030 targets are possible.
- Most climate change mitigation efforts will continue to be focused on conventional agricultural systems.
- Many mitigation activities are potentially win-win for the farmer.
- On-farm afforestation together with hedgerows and agroforestry has potentially important roles.
- Many mitigation actions are dependent on the available markets for agricultural commodities.
- Appropriate incentives are required to support mitigation activities.
- Further research is required to support wider on-farm afforestation/tree-planting strategies, carbon farming, nature-based mitigation solutions and their verification.

Facilitator: Bruce Osborne

Panel Members: Frank O'Mara (Teagasc), Andy Doyle (Farmers Journal), Helene Chambaut (French Livestock Institute)), Bernard Hyde (EPA), Bill Callanan (DAFM), Andreas Pacholski (Thunen Institute for Climate-Smart Agriculture),

Rapporteurs: Mary-Kelly-Quinn, Sinead McGinley and Brian Tobin.

Preamble: Whilst agriculture is a major contributor to atmospheric greenhouse gas emissions and environmental pollution there is still considerable potential to utilize managed land for mitigation purposes given that there is very little unmanaged land left and land will still be required for food and fibre production. The question is how, what and to what extent, any mitigation efforts focused on agricultural activities can be addressed?

Following a brief introduction by the facilitator and introductions from the panel members the following questions were tabled, and these are included below together with a summary of the major responses: -

1. **What are the prospects for zero emissions agriculture?**
   - This will be difficult and may depend on how methane is treated as a GHG and how its warming effect is determined. Stabilizing methane emissions would make a significant contribution but there is a challenge in the application of any mitigation measures and their adoption. Further research is required on the technologies that are needed, largely based on existing land uses and how carbon sequestration can be enhanced in mineral soils.
   - This presents a big challenge for farmers and a realistic target is required. Clearly there are a number of soils that are low in C where sequestration could be improved. Few farmers in Ireland have directly attempted to improve their soil for the purposes of enhancing C sequestration.

- Although farmers may not fully appreciate the added benefits of many mitigation measures. Improving soil C sequestration could, for instance, improve soil fertility and water holding capacity but the situation is changing. Whilst a high rainfall is often the problem, two droughts in recent years has had significant economic consequences. Climate change is giving farmers messages about things that are often hidden that may have benefits for both crop yields and GHG mitigation.

- Might be relatively easy in the beginning with a 20% target (The EU has a target of a 40% reduction in emissions by 2030 based on 1990 levels, although in September 2020 under the new European Green Deal proposed that this be increased to 55%) but going to zero emissions is a much bigger challenge. Would also need income supports and the political will to address this.

- Unlikely we could go to zero emissions, as there will always be residual emissions. Additional carbon removal technologies will be required to bring emissions down to zero. We should also look at the multiple benefits of any agricultural mitigation strategy as this could be a win-win situation for farmers.

- This is clearly going to be difficult although the EU has set a deadline of 2050 for achieving zero emissions. There are, however, several opportunities for nature-based solutions for removing CO_2 and the scientific basis for this needs further attention. In Ireland, the minister is also sponsoring a Climate Bill to achieve the EU 2050 target. To support any initiatives a regulatory framework is required and there is a growing consumer expectation for commodities that have been produced with a low GHG footprint that might be harnessed. In the future we need to identify opportunities for sequestration, and this should be firmly based on the science with agriculture having a significant role if the proper incentives are introduced.

- The scale of the emissions reductions needs to be considered but this will be a difficult target to reach without significant changes in our production systems and the implementation of the appropriate incentives and stimulus.

2. Does organic farming have a role in a more environmentally friendly agriculture?

- Whilst organic farming is likely to have lower emissions than conventional farming the output is also likely to be lower, which could stimulate more food production in other countries, with an uncertain impact on global emissions. The overall impact is therefore unclear.

- May play a role particularly where there is a niche market for the products, but the major dependence will still be on conventional farming. There is not much of a role for organic farming in Germany and this has declined over recent years. There are also likely to be cost issues with organic farming which might make it more difficult for the farmer.

- The EU has significant ambition to increase organic farming, so it is likely to become more prevalent but must become aligned with market demands. There is still a deficit in meeting the market demands for some organically produced foods but in others the production is higher than the demand. Reductions in the inputs to conventional farming systems, such as beef production, are already aligning them more closely with organic systems.

- The main issue here could be the availability of land and generally more land is required for organic production systems. Increased urbanisation and an increased demand for land for food and raw materials will put more pressure on increasing agricultural productivity per unit area.

- Farmers will generally follow the better financial option, so there must be a demand for organically produced food. Organic food is also generally more expensive.

3. **Should Agriculture be subsidised and is there a role for Carbon farming?**

- This comes back to the market. This will drive what the farmer does. In terms of carbon farming this does have a potential role (new initiatives within the EU are focussing on carbon farming). However, there is a long way to go before a proper system is established and how the research can be translated to practitioners on the ground.

- Carbon farming would probably not be attractive to farmers at present and there is a gap between sustainable practices and sustainable prices; sustainable practices come at a cost that needs to be considered. Currently, there is a negative response to large afforestation schemes, which might limit carbon farming opportunities.

- Subsidies will be required, and food prices should reflect the true costs of food. Better payments and incentives are required for farmers who are addressing environmental issues, such as offsetting GHG emissions. In turn, robust measures are needed to support offsetting requirements and their costs.

- The carbon market is there for exploiting carbon farming and industry is looking at opportunities to offset GHG emissions. There could, however, be difficulties in quantifying and monitoring any offsetting measure and research on this is needed.

- We need to find ways of enhancing carbon capture/reducing GHG emissions while still producing as much, if not more, food. We also need to be able to accurately measure how much carbon has been captured/GHG emissions reduced by any action to translate this into a financial payment.

4. **What role will afforestation play in all of this?**

- Afforestation has a leading role in mitigating GHG emissions under national policies. The levels of afforestation that currently exist represents an overall sink for C, but we will benefit from increased rates of afforestation. Currently afforestation in Ireland is low compared to the European average and more tree planting is required in the longer term but this needs to be done without compromising agricultural production or impacting on essential ecosystem services.

- Afforestation has an important role, but this should be seen as part of a suite of measures that are required. There are also limitations associated with a sole dependence on afforestation as the C sequestration capability is not maintained throughout the growth cycle and is low during early growth and establishment and declines with stand age. Tree planting has also declined in recent years and mechanisms are required to increase the rate of afforestation. We also need to take more consideration of what the most appropriate tree species might be and what areas might be most suitable for afforestation with minimum environmental impact.

- Opportunities also exist for agroforestry systems including those combined with livestock production. Hedgerows could also serve an important role, but we need to find mechanisms whereby any investment in forestry or hedgerows is rewarded, and this is likely to be market-driven.

- There is an important role for forestry, and this could, in some cases, be an asset to the landscape through enhanced biodiversity. We need, however, to consider how forests are managed and their multifunctional role for both wood production and GHG mitigation. The approach where small on-farm plantings are used rather than a blanket coverage of trees may meet with less resistance by farmers and this has good potential for inclusion in agricultural schemes. Such an approach is supported by recent results that show that relatively small areas of woodland can offset whole farm emissions. Importantly there must be markets for the wood produced. In Germany there are also major projects to encourage hedgerow development.

- Farmers often have a negative view of afforestation, which has probably influenced its uptake in Ireland (in contrast to the situation in Germany). Clear incentives and markets would be required to improve the situation.

The panel then responded to questions from the audience:

1. Should we be trying to reduce demand for high emission foods and encourage a move towards low emission diets and then producing the food consistent with this? Could government policies help with this?

   The panel agreed that there was no easy answer to this question. Other aspects related to food production may be important. Meat is often considered 'bad' but ruminant production systems are associated with grasslands with a high C sink. People also look at food from different perspectives not just on whether their production is associated with high or low GHG emissions. Other impacts of food production also need to be considered, such as the impacts on biodiversity, air and water quality. Support for food production systems with a low environmental footprint are required as well as markets for the food produced.

2. Surely there is a role for agroforestry? Reports suggest that a farm with 26% in agroforestry can support a carbon neutral beef production system without compromising productivity.

   Most panellists agreed that Agro-Forestry can play a role, increasing the resources that can be produced from agro-ecosystems, as well as enhancing biodiversity, whilst also increasing C sequestration. Some doubts were expressed, however, about the widespread use of agroforestry; in Germany it has been in decline in recent years. Agro-forestry systems may also be difficult to manage, requiring new approaches and technologies.

3. There are several carbon calculators around, but these are not standardised. Would it be possible to provide a common tool that could be used across different landscapes and regions?

   The use of a common carbon calculator may be difficult as this may have limited utility when used in different regions. The model used for international C reporting might be a basis for a common tool, but there are limitations with any general model including its appropriateness for use at the farm scale, where there is considerable pressure to make C more profitable.

   There has been some effort to standardise such calculators by the EU/FAO, but more research is required to understand how these can be applied at different scales.

4. Should political strategies be more focused on low carbon footprints rather than supporting the cutting of national emissions? As far as I have understood your arguments, we should do so to avoid leakage?

   Leakage- an increase in emissions in one country due to emissions reduction in another, due to a range of factors-is clearly a problem, but all countries must report on their national emissions so politically a reduction in emissions is important. Estimates of leakage are also problematic and dependent on premium payments and the costs associated with any emissions reduction policy.

   Reducing the carbon footprint of agriculture will also need incremental improvements across the whole agricultural supply chain, from producer to consumer. What the farmer does in terms of their carbon footprint will also depend on consumer demands and expectations.

Closing Speech

The conference was closed by Prof. Tasman Crowe, Director, UCD Earth Institute. During his closing remarks, he thanked to organizing committee and the participants and emphasized the importance of ISCRAES 2020 and its continuation, to generate a knowledge base for mitigating climate change and environmental pollution.

Way Forward

The conference provided a number of opportunities to academics, researchers, students, stakeholders, and policy makers to present their research and discuss the role of agricultural systems in mitigating climate change and environmental pollution. In addition to evidence-based scientific and technological solutions, a number of experts reiterated that the main enabling factors for effective policy development and their implementation should be based on a sound scientific basis but also requires political will, together with the appropriate legislative and policy frameworks and financial incentives. The importance of involving all stakeholders, as well as institutional and policy makers together with the wider use of information and communication technologies and agricultural extension services to put the science into practice, was also widely acknowledged.

During the workshop and panel discussions, participants discussed policy-related issues, and key success factors that have helped to achieve best practice in the mitigation actions utilized in different agricultural systems globally. Given the success of this meeting and to encourage further progress in the development of sustainable of climate-resilient, low-emissions, agricultural systems for improved food security, it is proposed to continue this meeting as a biannual event and the next ISCRAES 2022 will be held in Dublin.

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