

The Climate-Energy-Food Security Nexus

Report on multi-stakeholder scenario planning
workshops in Northern Ireland



Wayne Foord, John Barry & Sally Shortall

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Executive summary

This project addressed the potential impacts of climate change and future energy availability on food and farming in Northern Ireland. Interviews and multi-stakeholder scenario planning workshops explored different perceptions of food system sustainability in Northern Ireland. Issues of concern were identified during interviews, and proposals were suggested for policy innovation and resilience building initiatives. A more detailed strategic transition plan was then developed by participants in the scenario planning workshops.

The interviews, with a wide range of stakeholders within the food and farming sector, indicated a shift in thinking, across all sectors, towards greater strategic emphasis on quality of produce and environmental standards, and away from production growth and economies of scale. Key concerns, expressed by interviewees and workshop participants, included:

- risks and uncertainties associated with Brexit, in particular, the possible loss or reduction of farm subsidies, competition with cheap non-EU imports, increased intensification and farm abandonment, and a decline in food quality standards and environmental protection;
- A perceived lack of political leadership in Northern Ireland and weak environmental governance, exemplified by the failure to adequately address climate change risks, and by the Renewable Heat Initiative (RHI) scandal and subsequent dissolution of the Northern Ireland Assembly;
- Increasing incidence extreme weather events, impacting locally through flooding and severe unseasonal weather, and globally through indirect, economic impacts, such as feed grain price volatility;
- Rising levels of food poverty in Northern Ireland, evidenced by the spread of foodbanks, and rising incidence of diet-related, non-communicable diseases.

Proposals from interviewees and workshop participants included:

- Post-Brexit farm subsidies focussed on environmental protection – the idea of a ‘Green Brexit’;
- A shift to non-intensive farming methods and local supply chains;
- Diversification of the farm sector to promote greater resilience to environmental and economic shocks;
- Regional development of district combined heat and power (CHP) fuelled by indigenous biomass crops and agroforestry wastes, to enhance regional energy security, alleviate household fuel poverty, encourage farm diversification, sequester carbon, improve air and water quality, and promote biodiversity;
- Adoption of a rights-based approach to food, similar to that proposed by the Scottish Good Food Nation Bill, with the ‘right to food’ enshrined in legislation, and underpinning all food and agriculture policy;
- A more joined-up, inclusive approach to food policy-making and governance, integrating agriculture, environment, health, household and regional food security, energy security, and waste/resource management.

1. Background and context

The Nexus project was a year-long, ESRC-funded, research project carried out between September 2016 and October 2017. It addressed the potential impacts of climate change and future energy availability on food and farming in Northern Ireland. The research took place amid concerns about the potential impact of Brexit on Northern Ireland, including uncertainties about farm support, and future cross-border trading arrangements. It also coincided with the ongoing dissolution of the devolved power-sharing executive and the assembly in Northern Ireland, precipitated by the resignation, in January 2017, of deputy First Minister Martin McGuinness, in protest over the Renewable Heat Incentive scandal.

This section describes the contribution of the food system to climate change, and the impacts of climate change on the food system. It highlights the dependency of the global food and farming system on fossil energy, and the specific dependency of Northern Ireland on imported fossil energy. Additionally, the section addresses two other topics, namely the existing *Going for Growth* agrifood strategy for Northern Ireland, and Brexit and its potential impacts on the food and energy systems in Northern Ireland. These came up regularly in interviews and workshop discussions, and provided significant local context within which the nexus challenges of climate change, energy security and food security were addressed.

Climate change and the food system

Agriculture and land-use change account for an estimated 26-33% of greenhouse gas (GHG) emissions globally. The industrial food system as a whole is responsible for 47-57% of global emissions. Sources of GHG emissions include: fossil fuel inputs for farm machinery; release of carbon into the atmosphere through deforestation or conversion of pasture land to arable; methane from rice cultivation, ruminants and manure management; fertilizer manufacture; food manufacturing, packaging, transportation, refrigeration, and retail; home related; and waste disposal. Meat and dairy production alone contributes an estimated 8% of the GHG total¹.

The food system not only contributes to climate change, but in turn, is subject to climate change impacts itself. Potential impacts on food supply include: increased rainfall/flooding resulting in disruption of pollination, waterlogging, reduced crop yields, and increased cost of keeping livestock indoors or loss of livestock; drought, causing heat stress to crops and livestock, loss of forage, and increased costs of imported feed; and more favourable conditions for pests and diseases.

The changing climate will affect what can be grown, where it is grown, and who will be at risk of hunger. High latitude regions, such as North America and Northern Europe may

¹ Garnett, T. (2007) *Meat and dairy production & consumption: Exploring the livestock sector's contribution to the UK's greenhouse gas emissions*. Working paper produced a part of the work of the Food Climate Research Network, Centre for Environmental Strategy, University of Surrey.

initially benefit from temperature rises. For the next two decades, warmer weather may increase productivity and allow commercial cultivation of crops not currently viable. However, towards 2050, the harmful impacts – excessively high temperatures and drought – may negate previous gains. For cotton, soy, maize, and wheat there is evidence of sharp declines in yield above threshold temperatures of about 30°C. Therefore, a temperature increase of 4°C or more would present severe risks to global food security.

There is also the increasing risk of extreme weather events, such as, droughts, flooding, unseasonal frosts and snowfall, and hurricanes that could affect production, transportation and storage. Extreme weather events, associated with climate change, such as droughts and floods, are already impacting on global food security, and increasing in frequency and intensity. A US drought in 2012 led to an increase in the price of soya to £400/ton, up from £295 at the end of 2011. This resulted in an estimated 25% of UK pig farmers leaving the industry by the end of 2012². In August 2017, flash-floods in the north-west of Northern Ireland caused heavy livestock losses and damage to crops and farm property.

Fossil energy dependency and the food system

The global food and farming system is also critically dependent on the availability of affordable, fossil energy (oil and gas) for production of agrichemicals, plastics, on-farm energy and fuel, food processing, transportation, marketing, and waste management. All EU countries are now net importers of energy. 54% of the EU's energy consumption in 2015 came from imported sources, with Russia as the main supplier of crude oil and natural gas. In 2015, Russia's share of EU crude oil imports was 27.7 %, and its share of natural gas stood at 30%³. UK North Sea oil production peaked in 1999 and by 2016, 36% of energy used in the UK was imported⁴. For Northern Ireland, 96% of energy used in 2010 was imported, mainly oil and gas⁵. As noted in the 2010 Northern Ireland Strategic Energy Framework:

'Our position on the western periphery of Europe with few fossil fuel sources creates a near 100% dependence on imports to meet our energy needs. This dependency creates uncertainty in terms of security of supply and exposes Northern Ireland to the volatility of world energy prices'⁶.

² Benton et al (2012) *Severe Weather and UK Food Chain Resilience: Detailed Appendix to Synthesis Report*, at <http://www.foodsecurity.ac.uk/assets/pdfs/frp-severe-weather-uk-food-chain-resilience.pdf>.

³ Eurostat (June 2017) *Energy production and imports*. http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_production_and_imports.

⁴ Department of Business, Energy and Industrial Strategy (2017) *UK Energy in Brief 2017*. National Statistics. Available at: www.gov.uk/government/collections/uk-energy-in-brief.

⁵ Department of Trade and Industry (2013) *Envisioning the Future: Considering Energy in Northern Ireland to 2050*, DETI. The new Dept. for Economy (DfE) was contacted for more recent figures, but the author was informed that no new figures were available, and that there had been no significant changes since 2010.

⁶ Department for the Economy, *Strategic Energy Framework* (July 2010), p.6. Available at: <https://www.economy-ni.gov.uk/publications/energy-strategic-framework-northern-ireland>.

'Going for Growth' agrifood strategy for Northern Ireland⁷

The *Going for Growth* agrifood strategy was adopted by the Northern Ireland Executive in 2013. The key features of the *Going for Growth* strategy, are as follows:

- A strategic approach to the agrifood sector, led by government, and in close partnership with the agrifood industry;
- A 60% expansion of turnover and a 15% increase in employment, within the agrifood industry, by 2020;
- An export-oriented strategy geared towards meeting consumer demand in emerging markets, such as China, for meat and dairy produce;
- Government-led incentives to encourage economies of scale at producer and processor levels – i.e. bigger, fewer farms and agrifood processing businesses;
- Greater integration of the food supply chain, including farm producers, food processors, wholesalers, retailers and export businesses, and more uniformity of farm produce.

Ecological sustainability has been addressed more recently through the supplementary report from the Expert Working Group on Sustainable Land Management⁸. *The Sustainable Agricultural Land Management Strategy*, produced in 2016, is yet to be formally adopted by the Northern Ireland Executive. The strategy aims to outline how the ambition of *Going for Growth* could be achieved in a way that improves farm incomes and environmental performance simultaneously. Recommendations include

- GPS soil analysis to support precision application of nutrient within fields
- Application of lime to optimise pH of agricultural land
- More efficient application of slurries and manures
- Aerial survey to support targeted water quality interventions and quantify carbon sequestered by above-ground biomass
- More diverse swards to improve soil structure, carbon and biology
- Woody riparian strips to reduce nutrient run-off and improve water quality
- Agroforestry to improve biodiversity, sequester carbon, provide renewable fuel, and create biosecurity barriers between farms.
- Tree planting around intensive livestock units to reduce ammonia drift and nitrogen deposition on sensitive environmental sites.

⁷ Agri-Food Strategy Board (2013) *Going for Growth: A strategic action plan in support of the Northern Ireland agri-food industry*. Belfast: Agri-Food Strategy Board/DARD. Available at: <http://www.agrifoodstrategyboard.org.uk/pages/33/going-for-growth-report>.

Brexit risks and uncertainties

This research project took place against the backdrop of the UK's decision to exit the European Union. Hence, the implications of Brexit for agriculture and food policy in Northern Ireland were inevitably intertwined with discussions about food system sustainability. Some of the key risks and uncertainties identified, in the course of the project and in other public fora, include:

- Potential loss or reduction of farm sector subsidies, currently provided under the EU Common Agricultural Policy (CAP)⁹;
- Risks of increasing intensification of farmland if subsidies are lost, and abandonment of less productive farmland;
- Potential restrictions on access to established export markets in Europe;
- Increased cost of EU food imports, in particular fruit and vegetables, due to potential decline in sterling-euro exchange rate;
- Potential lowering of food quality standards through cheaper imports from the world market, and uncertainty regarding the transfer of EU regulatory institutions and infrastructure;
- Uncertainty regarding continued implementation of EU environmental legislation;
- Loss of migrant workforce, of particular importance to Northern Ireland food processing sector.

Within the context of these more immediate risks and uncertainties created by Brexit, the Nexus project sought the views of different stakeholders, within food and farming sectors, regarding climate change and energy challenges, and explored options for transitioning to a sustainable food system.

The report is divided into the following sections: **Section 2** provides a project description, including research design and methodology; **Section 3** presents an analysis of stakeholder interviews, identifying key themes and issues; **Section 4** gives an account of the scenario planning workshop; **Section 5** offers some reflections on the implications of the research findings, as well as proposals for further research; and **Section 6** concludes.

2. Project description

The Nexus project is funded by the ESRC through the [Nexus Network](#), and the research was led by Prof. Sally Shortall (Newcastle University) and Prof. John Barry (Queen's University Belfast). Project research partners included the Institute for Global Food Security, the Department of Agriculture, Environment and Rural Affairs (DAERA), the Agri-Food and Biosciences Institute (AFBI), Friends of the Earth NI, and Belfast Food Network.

⁹ Based on 2014-15 data, direct payment subsidies represented 103% of the value of average farm business income within Northern Ireland. See Allen, M. (2016) *Northern Ireland's Agri-food Sector: Background and possible 'Brexit' considerations*, Research and Information Service Briefing Paper 1 Paper 66/16, 22nd September 2016, NIAR 345-16.

The project addressed the following research questions:

- *How might global climate change and future fossil energy depletion impact on food and agriculture systems in Northern Ireland?*
- *What are the different ways that food system sustainability is framed by different stakeholders?*
- *And what opportunities are there for developing new, shared understandings and options for action?*

The project combined an engaged, action research methodology with multi-stakeholder scenario planning. Scenario planning methodology is appropriate to contexts involving uncertainty. It does not aim to predict the future, but explores plausible futures, facilitating adaptive responses and contingency planning. It lends itself to multi-actor participation, encourages ‘thinking about the unthinkable’¹⁰ and strategic policy innovation. Scenario planning is a well-established policy and strategy making tool. It has been used in the global South to address local and regional energy-climate-food security challenges¹¹, and also more recently in the global North¹².

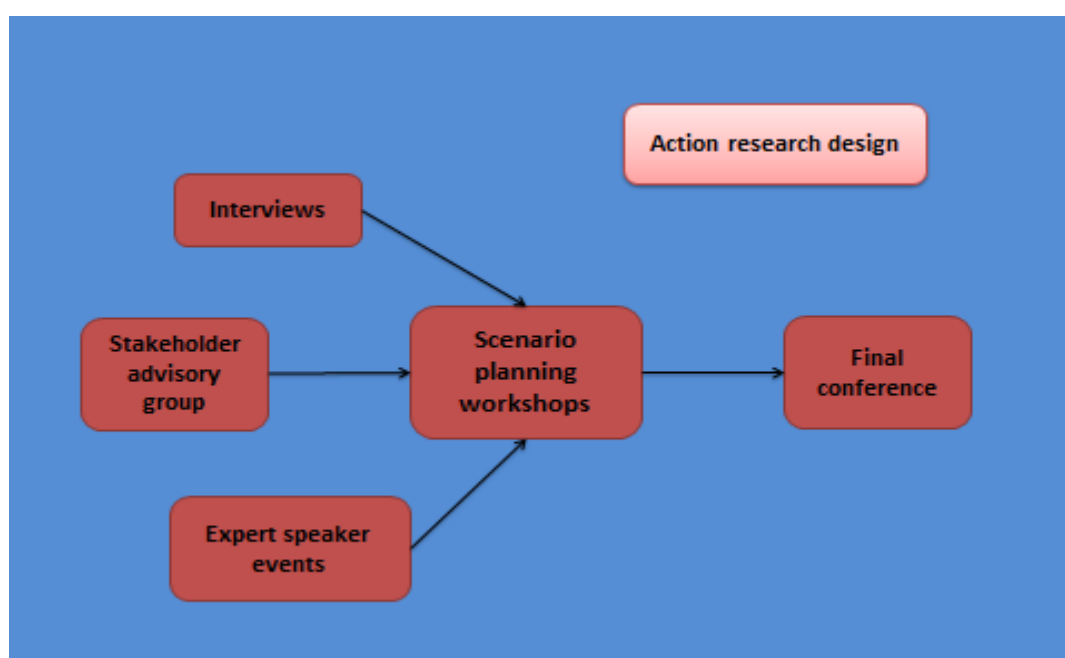
The project engaged a wide range of stakeholders, including representatives from government agencies, NGOs, the agri-food industry and farm sector. Scenario planning provides a framework for deliberative and on-going dialogue between differing perspectives and interests within the food system, and offers a process for developing a broader, more integrated understanding of the food system. It allows opportunities to consider alternative futures, encourages reflection on the different ways that food system sustainability is framed by different stakeholders, and helps identify opportunities for developing new, shared understandings and options for action. The methodology also presents opportunities to test and adapt existing policy and strategies, and to develop preferred transition pathways. While scenario planning was a core feature of the project, it also included a number of other complementary elements. Figure 1 provides a schematic outline of the project.

¹⁰ Kahn H, (1962) *Thinking about the Unthinkable*, Horizon Press, New York.

¹¹ For example, Addison, a, & Ibrahim, M. (2013) *Participatory scenario planning for community resilience – planning tool*, World Vision, UK; and Vervoort, J. et al (2014) Challenges to scenario-guided adaptive action on food security under climate change, *Global Environmental Change* 28: 383–394.

¹² For example, Galli, F., et al (2016) Exploring scenario guided pathways for food assistance in Tuscany, in *2016 Fifth AIEAA Congress, June 16-17, 2016, Bologna, Italy* (No. 242439). Italian Association of Agricultural and Applied Economics (AIEAA); and Carroll, B. et al (2016) *Towards a fairer, healthier, more secure and sustainable food system in Cork, Ireland*, TRANSMANGO Scenarios Workshop Report, Dublin City University.

Figure 1: Nexus project process model



The **stakeholder advisory group** provided advice and help with research design, stakeholder engagement, and research impact. The group was composed of representatives from government agencies, academia, and environmental NGOs, including: Department of Agriculture, Environment, and Rural Affairs (DAERA); the Agri-Food and Biosciences Institute (AFBI); the Institute for Global Food Security (IGFS); Friends of the Earth Northern Ireland; and Belfast Food Network. **Expert speaker events**¹³ included presentations on agroecology, climate tipping points and food system dynamics, and the Cuban experience of fossil energy scarcity during the 'Special Period'. These events were public and provided further opportunities for networking between project participants, as well as other academic, and non-academic attendees. Semi-structured **interviews with stakeholders** identified the range of perspectives held in relation to food and farming sustainability, and explored obstacles to, and options for, strategic, cross-sectoral initiatives. The interview findings helped inform the subsequent **scenario planning workshops**. The project concluded with a final conference that took up the issues and proposals put forward in both the interviews and workshops, and adopted an 'open space' format to facilitate development of collaborative initiatives. It was explicitly intended that the project would help build and extend policy learning networks of practitioners, policy-makers and academics addressing regional food security, as well as being a catalyst for policy initiatives or practical action.

To sum up, the project sought to complement scenario planning methodology with an engaged action research approach, encouraging the co-creation of knowledge between different stakeholders, and actively supporting the development of collaborative initiatives and actions.

¹³ See Appendix A for further details of expert speaker events.

3. Interviews

15 individuals and representatives of organisations with involvement in policy development and advocacy in the farming and agrifood sectors were interviewed¹⁴. Interviews were semi-structured, with questions providing a broad guide for discussion and seeking to establish interviewees' views about the following:

- Climate and energy challenges in relation to the food system;
- Government and non-government efforts to address these challenges;
- How policy-making processes and governance might be improved;
- Models of good practice in relation to food system sustainability that might be adapted to, or scaled up within, the Northern Ireland context;
- Options for policy innovation or strategic initiatives addressing food and farming sustainability.

The aim was to identify the range of perspectives held in relation to food and farming sustainability, and explore options for policy or practical initiatives. The interviews were recorded, transcribed and coded using qualitative data analysis software (NVivo 11). Thematic areas were constructed both inductively through the process of interviewing and data analysis, and were also derived deductively from the 'nexus' framing of global challenges. Primary coding categories included: *food system contribution to climate change and mitigation; climate change impacts on the food system and adaptation; fossil energy availability and the food system; Brexit; NI 'Going for Growth' agrifood strategy; green marketing strategy; alternative food system proposals; social policy and the food system; sustainable land management; renewable energy; farm business structure and economics; models of sustainable practice; governance and policy process*. *Collaboration* was a sub-code within governance and policy process, along with related sub-codes, such as, *stakeholder participation* and *joined-up governance*. All findings presented below reflect these thematic areas of interest, and quotes used are representative examples of the coded interview data.

The following sections cover: the range of positions held in relation to food issues and food system sustainability; perspectives on climate change and energy security; governance issues; and proposals for policy innovation, strategic initiatives and models of good practice.

Range of positions regarding food issues and sustainability

Three broad positions on food sustainability emerged from the interviews and workshops, as follows:

- **'Green marketing strategy'** - A majority view advocating a genuinely green agrifood marketing strategy for Northern Ireland, with the emphasis on food quality, and high

¹⁴ See Appendix B: Interview Schedule; and Appendix C for list of interviewee organisations.

standards of environmental protection and animal welfare, as well as an emphasis on 'win-win' resource efficiency, rather than export-oriented growth.

- **'Alternative food system'** - A minority grouping, advocating an alternative food system that is based on small-scale, organic or non-intensive food production, and relocalised supply chains. These respondents also tended to refer to social aspects of food policy, such as, food poverty, the right to food, and diet-related illnesses.
- **'Going for Growth'** - A minority of one favouring a continued export-oriented, growth strategy, scaling up farms and agrifood businesses, and mitigating environmental harms with 'sustainable intensification'¹⁵.

The boundaries between these positions are blurred, and the differences are, to some extent, a matter of emphasis, rather than qualitative. All interviewees, without exception, expressed positive views about the need to protect the environment, at the same time as promoting a viable farming sector. Almost all interviewees expressed concerns about the regulatory and economic uncertainty surrounding the Brexit vote on agriculture in Northern Ireland, and what several described as a **'race to the bottom'** in terms of quality and environmental standards, if the UK attempts to compete on price. Post-Brexit risks to farm businesses, with the potential loss of subsidies, was also a recurring theme, as the following quote exemplifies:

'If UK farmers suddenly had to compete with America or Brazil or Uruguay, they couldn't. It's as simple as that. So, the potential damage to the UK food production system could be pretty catastrophic'.

A perceived lack of political leadership and vision in Northern Ireland was also a common theme, and is discussed further below. The three alternative positions are presented in Figure 2.

¹⁵ 'Sustainable intensification', according to the Royal Society (2009: ix), is a form of agricultural production whereby 'yields are increased without adverse environmental impact and without the cultivation of more land'.

Figure 2: Alternative positions on agrifood sustainability



The *Going for Growth* position, supported by only one interviewee, placed emphasis on production growth, efficiency, and economies of scale, but also acknowledged the need to maintain quality of produce and environmental standards. This is to be achieved by 'sustainable intensification'. Environmental harm would be mitigated by a combination of agroecological and technical solutions.

The largest grouping, advocating a *green marketing strategy*, was sceptical about the Northern Ireland *Going for Growth* agrifood strategy, and its stated aspirations to tackle world hunger and food¹⁶. As one interviewee put it,

'Northern Ireland, it could fit into a decent sized field in Poland or Brazil ... let's get away from the notion that we're going to feed the rest of the world because that's completely unrealistic'.

There was a repeated view that there was too much emphasis on sector growth within the strategy, to the detriment of other goals, such as environmental protection, or viability of small family farms, exemplified in the following quote:

'...it does seem to be "grow the industry and the devil take the hindmost"'

Hence, the emphasis on quality and environmental standards, in the context of a continuing close trading relationship with the EU. This position also advocated pragmatic, '*win-win*' solutions to productivity and environmental sustainability, and was associated with a

¹⁶ Note 7, *Going for Growth*, p.20.

proposal to base post-Brexit farm subsidies on environmental stewardship of the land, framed as ***'public money for public goods'***¹⁷, summed up by the following comment,

'We're going to have to come up with a new way of marketing, and our food is going to have to be of an improving standard, and it's going to have an improved environmental welfare. What that means is, support agriculture here so that it gives better quality food, greener, better environment ... that's what I think money should go for here ... for public good, otherwise, in Northern Ireland, you're paying farmers to be farmers and why would you do that?'

A third position, advocated an *alternative food system*, characterised by local food supply chains, and small-scale, organic or non-intensive production. Proponents of this position also expressed concerns about food poverty and diet-related health issues, as well as food security, food waste and the regional food footprint.

One or two referred to the contradiction between the current export-oriented *Going for Growth* agrifood strategy, and the increasing number of food banks in Northern Ireland. They highlighted the paradox of Northern Ireland currently exporting 70% of its agricultural produce, yet pushing for more productivity and growth, while there are increasing levels of food poverty in the region, especially in urban areas. The diversion of waste food from supermarkets to food banks was not seen as an adequate response to either food poverty or food waste, as the following comment illustrates:

'Food poverty, by some politicians, is now viewed as being addressed because those food banks are in place which doesn't actually change anything at all. It doesn't look at the system creating the waste food; it doesn't look at why people are in poverty.'

Instead, a rights-based approach to food, similar to the Good Food Nation Bill being considered in Scotland, was proposed¹⁸.

Perspectives on climate change and energy security

Climate change and the food system

All interviewees expressed views on this subject. Some focussed on mitigation of agriculture's contribution to GHG emissions; others on adaptation issues, such as, the impacts of extreme weather events. Some remarked on the increasing evidence of climate

¹⁷ This proposal was initially put forward by the National Trust in August 2016. See <http://www.countryfile.com/article/farming-subsidies-need-complete-reform-says-national-trust>.

¹⁸ The Good Food Nation Bill aims to enshrine the right to food in legislation, create cross-departmental policy coherence and responsibility, with independent monitoring of statutory targets, and establish a minimum income standard.

change happening now. Two interviewees expressed the belief that global warming would benefit food production here, giving Northern Ireland a competitive advantage. Several discussed the issue of communicating with farmers about climate change.

Firstly, the topic of extreme weather events came up frequently in relation to disruptive and unseasonal weather in Ireland. One respondent, who was a part-time farmer, stated,

'... whether the world is getting warm or not I will let the climatologists tell you that. What I am able to say, is the frequency of extreme weather events is getting an awful lot worse. As a farmer that's what absolutely screws me ...'

Furthermore, a number of interviewees highlighted the impact of extreme weather events, in other parts of the world, on global commodity prices, especially feed grain. The implications for livestock farmers in Northern Ireland is articulated by a second interviewee, also a part-time farmer,

'So, the effect of weather changes, or whether it be water changes, or whether it's a drought or a fire, as the case may be, does ripple across the world very quickly. And it clearly affects Ireland in particular because we import the commodities to feed our livestock and all the rest of it.'

Finally, as mentioned above, a number of interviewees stressed the need to communicate climate change to farmers in a less abstract way, to ground it in their actual experience of changing and disruptive weather, and to promote better practice on the basis of cost-saving and efficiency, as exemplified in the following quote,

'They believe in climate change and they'll believe in the fact that the weather is not the way it was ... but I'm not sure a lot of them actually ... think about their enterprise in terms of what it does, how it's affected, by climate change, or what they can do to lower the effects of climate change, so mitigation and adaptation. But at the same time, you can still talk about saving money, and often saving money is an easier sell.'

Energy security and the food system

In contrast to the issue of climate change, most interviewees opted not to comment on the issue of energy security, typically because of perceived lack of knowledge, or because it was not a priority, as one interviewee candidly stated,

'I wouldn't really have an in-depth understanding of it to be honest ... It's not something I deal with; I'll be honest with you ... I don't think the sector's overly focussed on global fossil fuel issues, to be honest. Perhaps that's wrong, but it's just when there are so many other challenges, it's just not high up on the list of priorities.'

Some related it back to greenhouse gas emissions and climate change, rather than considering potential energy scarcity as a separate issue, exemplified in the following quote:

'An area I would have limited experience of. My understanding is all based around the idea that, not so much the areas that you've highlighted, but more a case of "hang on, we need to shift off fossil fuels if we are to meet anywhere near the 2-degree requirement"'.

Of those interviewees who did offer opinions, two expressed confidence that technical solutions would be found to future fossil energy depletion, as one stated,

'Maybe I'm an optimist, but I think that people will find solutions, so I don't subscribe to the doom, "it's all going to run out"'.

Another three respondents offered more cautionary views regarding the dependency of the food and farming system on fossil energy. One person situated the challenge of energy security within the context of other emerging economic uncertainties associated with Brexit:

'We are still a very oil-reliant global economy. It's been a yo-yo over the last decade. It's made remarkable ups and downs that would suggest that especially with Brexit, with inflation, with the de-valuing of the pound that when you are heavily reliant on an energy commodity that you have no ability to make yourselves ... that's a very precarious situation to find yourself in, to keep banking on a reasonable affordability of an energy commodity that is never going to be stable again'.

The other two interviewees expressed concern about the dependence of Northern Ireland (and the Republic of Ireland) on imported oil and gas, with one highlighting the geopolitical risks of this dependence:

'I think this island is bonkers. We export 80% of the food we produce and we import 90% of all the energy we consume'.

'Whatever way you look at it, Russia turns the tap on to Europe ... So, you don't have a sustainable infrastructure; you don't have security of supply, and most of these things can and will be used as weapons against you at some time. It may be tomorrow. It might be 30 years' time.'

Governance issues

A range of issues was discussed in relation to food, farming, environmental governance and policy processes. As mentioned above, a repeated theme was the need for, or lack of, political leadership and vision in Northern Ireland, in relation to environmental governance, illustrated by the following

'Public agencies have to provide a level of leadership ... to help society adapt to climate change or mitigate the negative impacts of climate change. In Northern Ireland, there hasn't been that level of leadership with regards to climate change and environmental governance in general'.

'The frustration I have is the political process has such a short circular life, that leadership is just non-existent. Their only "Why" is, "I want to be re-elected again", rather than, "I want to leave the place a better place for my children and my children's children, and their children"'

The controversy associated with the Renewable Heat Initiative (RHI) was used by several respondents as an illustration of poor political leadership, and a shared view was that the scandal had set back efforts to progress a sustainability agenda in Northern Ireland, as expressed in the following comment:

'We have done ourselves untold damage with the mess, the political mess, with the Renewable Heat Incentive in Northern Ireland because no politician or policy maker will now stick their head out and say, "We need to go back and support green energy"'

The lack of legislation on climate change, specific to Northern Ireland, as well as the lack of an independent Northern Ireland Environment Agency, was also seen as further evidence of failing political leadership:

'Northern Ireland is probably a bit of a basket case when it comes to environmental governance. We're the only part really, one of the only parts of Europe that doesn't have an independent Environmental Protection Agency. We're the only part of the UK and Ireland that doesn't have legislation on climate change'.

Furthermore, the process of policy development and implementation was seen as too slow, and therefore failing to respond in a timely fashion to emerging needs and challenges. Policy making was viewed as too closed, with some industry stakeholders having disproportionate influence, as described in the following two quotes:

'... it goes back to potentially who lobbies the loudest, ... which group is going to say, "We want this. We want that. We want ..." and if that is the case, then the vision goes out the window and it's more of a free-for-all'.

'There's some people ... big producers, influential people, who can be quite forceful in their views and table-thumping, and there's still the chance ... that they are just given their way, particularly at departmental level, and particularly when politicians get involved'.

There was a perception among some within the environmental sector that they had in the past been marginalised and excluded from policy-making. The consultation around the development of the *Going for Growth* agrifood strategy was cited as evidence by more than one respondent:

‘So, I suspect that that [the Going for Growth] consultation was probably directed at a select enclosed group of people representing [the environment] sector’.

‘We highlighted the fact that they hadn’t talked to any NGOs, or people who were interested in the environment, in the lead up to the actual Going for Growth strategy being developed’.

One interviewee, with considerable experience of policy advocacy and participation in public consultations, observed that policy decisions are often, in effect, made prior to public consultation, and that the process of public consultation is, in many cases, a tokenistic ‘box-ticking’ exercise. They added that attempting to influence policy development before the consultation phase is unlikely to be successful, due to a history of closed bureaucratic decision-making in Northern Ireland, as described below:

‘... if a policy is going to be created by the time the consultation has come around they’ve essentially already decided what the policy is going to be. ... It’s very much “OK we’ve taken on your views but we’re going to do what we said we’d do anyway in the consultation”. So unless people want to influence that policy they need to be influencing that policy before the policy is made so they need to be engaging with decision makers, policy writers, civil servants before that actual policy is, is written into the consultation ... but I don’t think the institutions are open enough for people to engage them in that way before it becomes policy, and I think it’s probably the legacy of years of direct rule where civil servants were mostly in charge ...’

Finally, on the subject of governance, a number of interviewees commented on the need for more joined up policy-making and governance in relation to food and farming. While there are numerous temporary working groups and fora addressing separate food and farming issues, it was felt by some that ***‘a better holistic, strategic view of food production is needed’*** or a ***‘much more joined up approach’***.

Proposals for policy innovation, strategic initiatives and models of good practice

It was an explicit aim throughout the project to be a catalyst for, and provide support to, collaborative initiatives that would address nexus challenges in Northern Ireland. Interviewees were asked to identify models of good practice that could be introduced or disseminated in Northern Ireland, and to propose ideas for policy development or strategic collaborative initiatives. The list is as follows:

Policy innovation and strategic initiatives

- A campaign for **'Right to Food' legislation** in Northern Ireland, similar to the Good Food Nation Bill under consideration by the Scottish parliament¹⁹.
- An independent, **Northern Ireland regional food policy forum** with broad stakeholder representation, and research support, modelled on Food Policy Councils in North America.
- Closer **agricultural research collaboration** between the College of Agriculture, Food and Rural Enterprise (CAFRE), AFBI, and the two Northern Ireland universities.
- A **Northern Ireland soil network**, linked to the EU 'People4Soil' network²⁰, to promote safeguarding of soil as a shared heritage, and to advocate a legally binding framework covering the main soil threats: erosion, sealing, organic matter decline, biodiversity loss and contamination.
- A network of **community-supported agriculture (CSA)**²¹ schemes around Belfast and other urban centres, particularly linking marginalised communities and urban 'food deserts' with local producers, including collaborative partnership of local government and communities, in relation to building food security and food system resilience to future shocks.

Other examples of good practice identified and proposed as models for Northern Ireland included the following:

- Agricultural colleges in the Netherlands teaching sustainable farming as mainstream practice.
- FareShare and Bia's more holistic model of addressing food poverty by supporting charities that address poverty more generally, and/or teach food growing and cooking skills.
- Climate NI's engagement with non-government stakeholders in relation to addressing climate change adaptation.
- Energy self-sufficient/exporting towns in Austria²² and Sweden²³.

Some of these ideas were further explored and developed with individual stakeholders in subsequent informal meetings. A list of proposals from interviewees was presented to participants at the second scenario planning workshop for discussion. Some of these proposals were reflected in the transition plan developed during the workshop, and are discussed below in Section 4.

¹⁹ See <http://www.nourishscotland.org/food-summit-happened/>;
<http://www.nourishscotland.org/campaigns/right-to-food/>.

²⁰ See <https://www.people4soil.eu/en>

²¹ For further information see <https://communitysupportedagriculture.org.uk/what-is-csa/>

²² See <https://cleantechnica.com/2013/10/16/renewable-energy-powered-austrian-town-gussing/>

²³ See <https://www.theguardian.com/sustainable-business/2015/may/01/leftover-industrial-heat-to-warm-swedens-chilly-northern-city>

4. Scenario planning workshops

This section describes the aims, methodology, and results of two one-day scenario planning workshops. The workshops were based on a similar, but simplified methodological approach adopted by the EU TRANSMANGO research project which focused on resilience of European food systems in the context of new global challenges linked to resource scarcity, environmental degradation and climate change²⁴. The TRANSMANGO project has used scenario planning in multi-stakeholder contexts to promote collaboration and development of adaptation pathways and long-term strategic capacity²⁵. Following this approach, with some modifications, the Nexus project held two one-day scenario planning workshops. These workshops gave participants opportunities to engage with other stakeholders in the food system, to develop a more integrated perspective of the food system, and provide a basis for collaborative action. A total of 12 participants attended the workshops, with 9 at the first workshop and 7 at the second (including 3 new participants)²⁶. Attendance was, approximately, a third of the target number of participants invited. Those participants who did attend, included farmers, environmental NGOs, local food activists, and representatives from Northern Ireland government research institutions, and academia. They brought multiple perspectives to group discussions and scenario planning exercises. Workshop exercises included:

- Envisioning an ideal future food system and ‘back-casting’ to create a strategic transition pathway;
- Downscaling global climate and energy scenarios to produce Northern Ireland regional food system scenarios;
- ‘Wind-tunnelling’ (i.e. resilience testing) the envisioned transition plan within the downscaled scenarios, and fortifying the plan accordingly;
- Further group discussion to develop specific strategic initiatives to support the plan.

Workshop One

Envisioning and backcasting exercise

The first stage in the workshop was to envision the achievement of an ideal future food and farming system by 2030. Participants were divided into two groups and ‘brainstormed’ the features and elements of this food system using post-it notes. They then clustered the post-it notes around key themes. Three themes were prioritized by participants’ marking ticks on their preferred themes.

²⁴ <http://www.transmango.eu/index.html>

²⁵ Dr Wayne Foord, co-author of this report, assisted with a TRANSMANGO scenarios workshop exercises in Cork. See Carroll, B. et al (2016) *Towards a fairer, healthier, more secure and sustainable food system in Cork, Ireland*, TRANSMANGO Scenarios Workshop Report, Dublin City University.

²⁶ See Appendix C for list of organisations represented at the scenario planning workshops.

Priorities for Group 1 included the following key themes or elements:

- **Food sovereignty** – ensuring equal access to fresh, locally produced, affordable food; and zero food waste and food poverty.
- **Diversification, fair pricing & farm viability** – supporting an independent, strong agri-food industry.
- **Agriculture, environment, land use & responsive policy** - environmental management is the priority in land use management.

Group 2 opted for the following key elements:

- **Political/institutional** – including all-island harmonisation of food and farming policies; cross-party consensus; and a broad, independent stakeholder forum with access to research expertise, supporting transition to sustainability.
- **Ecology stupid** - ecologically literate farming is the norm.
- **Diverse agriculture** – diversity of production, and farm type.

These key themes or elements represented a summary description of the ideal food and farming system existing in 2030. Participants, in their 2 groups, using flipchart paper and post-its, then ‘backcast’ from the future to the present, to identify the strategic steps, or transition pathway, needed to achieve this vision. The rationale for this process is that it opens up opportunities and options that may not be considered if one moves from the present to the future. The latter approach tends to constrain thinking within current limitations and challenges.

Key features and strategic steps identified by both groups within their transition pathways included:

- Diversification of farming;
- Reduction in intensive farming, and prioritisation of environmental management;
- Removal of direct subsidies, in favour of subsidies explicitly rewarding environmental stewardship, and diversification of subsidies beyond grass-based meat and dairy production;

- Support for exemplars or models of best sustainable practice in farming;
- Fair farm gate prices to support farm business viability;
- A strengthened *Sustainable Agricultural Land Management Strategy*²⁷ with emphasis on active support for development of sustainable, non-intensive farming; not mitigation of the environmental harms of intensive farming;
- Government policy and training provision to support transition to sustainable farming;
- Strengthening of research base and closer collaboration between DAERA, AFBI and universities;
- Creation of a broad, independent stakeholder forum bringing together government agencies, environmental NGOs, universities, agrifood business, and farming sectors.

Box 1: Downscaled climate scenario: extreme weather events & multiple 'breadbasket' failures

Northern Ireland would face high food and feed grain prices. Cereal growers will benefit from higher grain prices. Livestock and dairy farmers will suffer. Beef finishers would struggle to finish continental breeds on a more grass-based diet, and may stop buying. Dairy farmers would rely more on grass than feed grain, resulting in weight loss, less milk output, decline in fertility, and more calves lost.

There would be risks of panic buying, increased food poverty, decline in calorie intake, looting, social disorder and sectarian tensions, but also potential for community solidarity, supported by government, e.g. a wartime 'Dig for Victory' style response.

Longer-term there would be a shift to more cereal growing, particularly oats, and more people willing to work in agriculture and horticulture.

Box 2: Downscaled energy scenario: converging crises in the Middle East

For Northern Ireland, this would entail rising costs of fuel, food, feed, and all other agricultural inputs. Many farms have some form of renewable energy, but all are still very dependent on fossil energy for machinery and tractors. They would be unable to harvest crops or feed livestock.

Other impacts and risks may include: general price inflation; queueing at the petrol pumps; panic buying; food shortages; looting, social disorder. People living in rural residential estates, with oil-dependent lifestyles, would be stranded. Again, there is also the potential for positive community-based responses, including: urban/peri-urban food growing initiatives; community supported agriculture; and occupations of unused land. There may be a decline in environmental standards as food production is prioritised, e.g. dumping of slurry in waterways and the sea.

In the longer-term, this would force transition to low-carbon farming, including: more labour-intensive methods; shorter supply chains; reintroduction of animal traction, along with a shift to electrification and renewables. There would be a return to mixed farming, economic localisation and greater farm self-provisioning.

agencies, environmental NGOs, universities, agrifood business, and farming sectors.

In Workshop 2, participants opted to merge the two transition pathways created by the separate groups in Workshop (see Figure.3 below).

Downscaling climate change and energy scenarios

The second task undertaken by participants in Workshop 1 was to consider how global climate change and future energy security scenarios might impact on the food and farming system in Northern Ireland, thus 'downscaling' the global scenarios to the regional level²⁸. The two global scenarios used in the workshops described: (1) *multiple extreme weather events* impacting on global food and feed grain markets, and

(2) *converging resource, ecological, and geopolitical crises in the Middle East* disrupting global energy supply. The scenarios are based on recent academic work²⁹, and emphasise

²⁷ See Gilliland, J. et al (2016) *Delivering Our Future, Valuing Our Soils: A Sustainable Agricultural Land Management Strategy for Northern Ireland*, Expert Working Group on Sustainable Land Management.

the risks of disruptive shocks. They were developed with a view to creating narratives that would be plausible to workshop participants. For example, the global climate scenario is resonant with interviewee concerns about the increase in extreme weather events. The energy scenario, in light of current scepticism regarding imminent peak oil (as expressed by some interviewees), built an alternative narrative of energy scarcity based on actual and emerging events in the Middle East region. Workshop participants translated these global scenarios into Northern Ireland regional scenarios, as summarised in Boxes 1 and 2.

Workshop Two

Review of vision and transition pathway

Participants began this workshop by reviewing the visions, key elements, and pathways developed in Workshop 1. This was to allow for further revisions, and to help familiarise new participants. Given the similarities and common themes evident in both transition pathways, it was agreed to merge them into one combined vision and pathway, with the following three central themes: **Food security & sustainability; Diversification, fair pricing and farm viability; Agriculture, environment, land use and responsive policy**. The revised vision and transition pathway is shown in Figure 3.

Figure 3: Visioning and backcasting exercise

← Backcasting		Vision for 2035
Strategic actions	Institutional/legislative/societal infrastructure support	Description of ideal food system & key themes
70% food production self-sufficiency target adopted by government. 'Right to food' campaign launched. Council areas adopt Hackney's 'food zone' planning. Allotments made available to all. Sell by dates are eradicated. Popularise 'nutritional value' of food over calorie content or tonnage per acre. All GPs are better trained re diet and health.	Overarching governmental & social understanding of sustainable food. 'Right to food' is accepted societal norm and enshrined in legislation. Food waste is banned through new legislation and enforced with fines. New council & government structures in place for food system planning. Farmers & other stakeholders are equal partners in policy making.	Theme 1: Food security & sustainability <ul style="list-style-type: none"> Everyone has equal access to fresh, nutritional, locally produced, affordable & sustainable food. Zero food waste or poverty. Food waste recycled to produce energy, agricultural fertilizer or compost, & industrial feedstock chemicals. Education for sustainable food at all levels including formal & informal education. Living wage in place. Every child has access to 3

²⁸ See Appendices D and E for global climate and energy scenarios.

²⁹ Bailey, R. et al (2015) *Extreme weather and resilience of the global food system: Final Project Report from the UK-US Taskforce on Extreme Weather and Global Food System Resilience*, The Global Food Security programme, UK; and, Ahmed, N.M. (2017) *Failing States, Collapsing Systems: BioPhysical triggers of political violence*. Switzerland: Springer International Publishing.

Probiotics prescribed with anti-biotics to aid recovery of gut bacteria.		healthy meals per day.
<p>'Going for Growth' strategy refocussed on relocalised & circular economies - economic re-education of civil service, accordingly.</p> <p>Farmers are rewarded for sustainable practices & supported with skills training.</p> <p>Establish NI Landworkers Alliance to support small producers.</p> <p>Short-term land leasing via Conacre is banned³⁰</p> <p>Accelerate restructuring of farm sector - farm size is optimised³¹</p>	<p>Active government support for diversification, environmental protection (soil, water, air) & fair prices, as part of 5 year plan - DAERA policies rewritten accordingly.</p> <p>Land use strategy is a living, implemented policy that supports farm diversification via sustainable land use.</p> <p>Cooperative arrangements between farms to promote mixed farming, crop rotations, energy production, and shared resources.</p>	<p>Theme 2: Diversification, fair pricing & farm viability</p> <ul style="list-style-type: none"> • Diversification to meet local food/non-food production needs • Livestock & crops are adapted to NI environment. • Independent, strong, confident industry.
<p>Establish network to promote soil health as foundation for grass/crop/livestock productivity & quality.</p> <p>Farmers to conduct soil testing as prerequisite for subsidy.</p> <p>Farm pilots set up to demonstrate viability & profitability of sustainable farming.</p> <p>Sustainable land management demo'd at Greenmount & AFBI</p> <p>Targeted support for farmers that are willing to adopt sustainable practices.</p> <p>Targets for reduction in use of agri-chemicals.</p> <p>Younger members of farming families encouraged to experiment with diversification.</p> <p>Farmers are supported through the process of transition to sustainable & diversified farming, with environmental protection, using advanced technology to monitor biodiversity & land productivity.</p> <p>Localised 'business development</p>	<p>Post-Brexit subsidies restricted to rewarding sustainable practices, decoupled from land ownership, & related to measurable biodiversity.</p> <p>Sustainable Land Management Strategy extended to proactively support development of sustainable, non-intensive farming</p> <p>Centralised, accessible online data resource established to support & monitor development of sustainable farming.</p> <p>Integrated research base established, restoring/developing links between AFBI, CAFRE, universities & eNGOs.</p> <p>Independent regional stakeholder forum established with access to research expertise.</p> <p>Agroforestry supported by post-Brexit subsidy.</p> <p>Wildlife & biodiversity strategy agreed.</p> <p>Active, responsive government support mechanisms in place for farmers.</p>	<p>Theme 3: Agriculture, environment, land use & responsive policy</p> <ul style="list-style-type: none"> • Environmental management is the priority in land use management & linked to subsidies. • Political and agri-sector consensus on benefits of biodiversity • Soil health and water quality is central to agri-food strategy. • Closer links between consumers and producers.

³⁰ A minority view proposing a positive approach to conacre is presented section below, 'Disputed issues'.

³¹ The issue of optimum farm size was not resolved by the group. See section below, 'Disputed issues'.

<p>groups' to share best practice.</p> <p>Agri-wastes valorised into the circular bioeconomy (converted to energy, fertilizer, manufacturing chemicals & materials)</p> <p>Encouragement of marginal land use for environmental protection & bioeconomy.</p>	<p>Government policy supports skills & training education</p> <p>Compulsory & voluntary farm work schemes/apprenticeships</p>	
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Wind-tunnelling exercise

The main aim of Workshop 2 was to use the climate and energy scenarios as a context within which to 'wind-tunnel', or resilience test, the visions and transition pathways created in Workshop 1. Additional steps were then added to fortify the transition pathway in light of the potential challenges posed within the downscaled scenarios. The 8 participants, again using flipchart, worked as one group, fortified the transition plan, where necessary, in response to the scenarios. The fortified transition plan is represented in Figure 4. The vision and transition strategy with three key themes is displayed vertically in the first column, and fortifications are displayed under each scenario in the second and third columns.

Figure 4: Fortified transition strategy

Theme: Food security & sustainability	Climate scenario – fortifications	Energy scenario – fortifications
<p>Description:</p> <p>Everyone has equal access to fresh, nutritional, locally produced, affordable & sustainable food.</p> <p>Zero food waste or poverty.</p> <p>‘Right to food’ is accepted societal norm.</p> <p>Food waste recycled to produce energy, fertilizer or industrial chemicals & materials.</p> <p>Education for sustainable food at all levels including formal & informal education.</p>	<p>Farms grow more diversified range of crops & varieties that are resilient to weather extremes (drought & intensified rainfall).</p> <p>Crops & agroforestry are strategically located on the landscape to protect water quality (nutrient runoff) & air quality (ammonia & nitrous oxide from fertilized soil).</p>	<p>Regional development of Combined Heat & Power (CHP) with district heating, to meet energy needs of agriculture and other sectors, and provide low-cost energy & heat, thus addressing rural fuel poverty.</p>
<p>Institutional/legislative support infrastructure:</p> <p>Overarching governmental & social understanding of sustainable food.</p> <p>‘Right to food’ is accepted societal norm and enshrined in legislation.</p> <p>Food waste is banned.</p> <p>Food planning integrated into local development planning and Community Planning</p> <p>Farmers & other stakeholders are equal partners in policy making.</p>	<p>Community emergency planning is the norm.</p> <p>Councils, producers, and local communities meet regularly to monitor and plan for food security.</p> <p>Contingency plans to include compulsory vesting of land and purchase of food.</p>	<p>Contingency plans, including food security, in place for NI, and council areas, fully communicated to the public.</p> <p>Govt & council support for community food hubs, including provision of urban land & buildings</p> <p>Nutrition & Sustainability Officers in each council.</p> <p>Emergency response protocols developed through participatory planning with community food hubs.</p> <p>Creation of emergency food & feed grain stocks.</p>
<p>Strategic actions:</p> <p>70% food production self-sufficiency target adopted by government.</p> <p>‘Right to food’ campaign launched.</p> <p>Popularise ‘nutritional value’ of food over calorie content or tonnage per acre via labelling and marketing campaigns.</p> <p>Council areas adopt Hackney’s ‘food zone’ planning.</p>	<p>Consumer-led shift to secure, local food supply, away from globalised, just-in-time system</p> <p>Community-based focus on nutrition and diet.</p> <p>Local community barter systems and resource sharing encouraged.</p>	<p>Network of community food hubs & CSA created around Belfast & other urban centres.</p> <p>Electricity grid improved to integrate renewable energy supply.</p> <p>Development of alternative energy sources for farm machinery, e.g. electric, hydrogen, methane, etc.</p> <p>Energy conservation encouraged at individual/family level</p>

<p>Allotments made available to all.</p> <p>Sell by dates are eradicated.</p> <p>All GPs are better trained re diet and health.</p> <p>Probiotics prescribed with antibiotics to aid recovery of gut bacteria.</p>	<p>Food production introduced into schools' Home Economics syllabus.</p>	
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Theme: <i>Diversification, fair pricing & farm viability</i>	Climate scenario – adaptation & fortification	Energy scenario – adaptation & fortification
<p>Description:</p> <p>Independent, strong, confident industry.</p> <p>Livestock & crops are adapted to NI environment.</p>		<p>Increased production of lignocellulosic (woody) energy crops grown as biomass fuel, including crops with multifunctionality, eg. short-rotation coppiced willow providing localised energy, biomaterials production, biodiversity, water & soil protection, and carbon sequestration.</p>
<p>Institutional/legislative support infrastructure:</p> <p>Active government support for farm & sector diversification, & fair prices as part of 5 year plan - DAERA policies rewritten accordingly.</p> <p>Land use strategy is a living, implemented policy that supports farm & sector diversification.</p> <p>Cooperative arrangements between farms to promote mixed farming, crop rotations, energy production, and shared resources.</p> <p>'Land banks' of conacre established (or ban conacre entirely)³²</p> <p>Farm size is optimised.</p>	<p>Adoption of protectionist measures to support local production of essential staple foods.</p> <p>Govt investment to incentivise diversification that enhances resilience.</p> <p>Active government support & planning to ensure development of cooperative arrangements between farms.</p>	<p>Each council area has target of 75% energy independence</p> <p>Each council to create local farmers market plan.</p> <p>Decentralised, distributed energy supply (electricity & heat).</p> <p>District heating implemented from indigenously fuelled Combined Heat & Power (CHP)</p> <p>Deregulation of renewable energy development.</p> <p>Govt incentives to small farms for bio-energy production.</p>
<p>Strategic actions:</p> <p>'Going for Growth' strategy refocussed on relocalised & circular economies - economic re-education</p>	<p>Expansion & support for horticulture.</p>	<p>Encourage 'reuse mindset' regarding indigenous & under-utilised biomass materials for CHP,</p>

³² See footnote 29

<p>of civil service, accordingly.</p> <p>Farmers are rewarded for sustainable practices & supported with skills training.</p> <p>Establish NI Landworkers Alliance to support small producers.</p> <p>Accelerate restructuring of farm sector - farm size is optimised.</p>	<p>Production for human consumption prioritised on arable land.</p> <p>Greater sharing of best practice between farmers using business development groups.</p> <p>Agriculture redefined to include self-provisioning as well as commercial production.</p> <p>Contingency plans developed based on risk assessment, review of govt regulations, prioritisation & capacity.</p>	<p>including: agri-wastes, arboricultural arisings, energy crops, virgin waste wood, oversize compost, fast digest materials.</p> <p>Government-funded incentive for farms & SME's to develop large-scale CHP, with community district heating to utilise the heat by-product³³.</p> <p>Establish large-scale CHP/district heating pilot project to demonstrate potential benefits: low-cost, low-carbon energy; alleviation of fuel poverty; enhanced energy security; rural connectivity.</p> <p>Specific regional acreage devoted to biomass, and providing multifunctional benefits, eg. water quality, biodiversity improvements.</p> <p>Greater no. of trees planted, than harvested for energy, esp. birch & ash.</p> <p>Effective insulation of all homes.</p>
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Theme: <i>Agriculture, environment, land use & responsive policy</i>	Climate scenario – adaptation & fortification	Energy scenario – adaptation & fortification
<p>Description:</p> <p>Environmental management is the priority in land use management.</p> <p>Political and agri-sector consensus on benefits of biodiversity</p> <p>Soil fertility and biological health is central to agrifood strategy.</p> <p>Closer links between consumers and producers.</p>		<p>Sustainable Land Management Strategy to focus on biomass biofiltration blocks and riparian protection using increased agroforestry and fast-growing, multifunctional, biomass crops eg. SRC willow that can also provide fuel for CHP.</p>

³³ The emphasis is on large-scale and provision of community district heating contrasts with individualised, small-scale heat generation facilities, such as those supported by the controversial RHI scheme.

<p>Institutional/legislative support infrastructure:</p> <p>Post-Brexit subsidies restricted to rewarding sustainable practices, decoupled from land ownership, & related to measurable biodiversity.</p> <p>Sustainable Land Management Strategy extended to proactively support development of sustainable, non-intensive farming</p> <p>Centralised, accessible online data resource established to support & monitor development of sustainable farming.</p> <p>Integrated research base established, restoring/developing links between AFBI, CAFRE, universities & eNGOs.</p> <p>Independent stakeholder forum established with access to research expertise.</p> <p>Agroforestry supported by post-Brexit subsidy.</p> <p>Wildlife & biodiversity strategy agreed.</p> <p>Active, responsive government support mechanisms in place for farmers.</p> <p>Government policy supports skills & training education</p> <p>Compulsory & voluntary farm work schemes/apprenticeships</p>	<p>'Land army' created with volunteer youth, community, & church groups, plus 'national service'.</p> <p>Farming apprenticeships for unemployed.</p> <p>Councils to maintain food stocks.</p>	<p>Spare capacity maintained in production.</p> <p>Coherent, shared land management strategy adopted across all depts. & councils.</p>
<p>Strategic actions:</p> <p>Popularise understanding of soil quality as foundation for grass/crop/livestock productivity & quality.</p> <p>Farmers conduct soil testing as prerequisite for subsidy.</p> <p>Farm pilots set up to demonstrate viability & profitability of sustainable farming.</p>	<p>Councils promote allotment uptake</p> <p>Local schools provide training in cooking skills to community.</p> <p>Greater emphasis in CAFRE syllabi on soil quality.</p> <p>Measurable targets established for soil organic content & biological indicators of soil</p>	

<p>Sustainable land management demo'd at Greenmount</p> <p>Targeted support for farmers that are willing to adopt sustainable practices.</p> <p>Targets for reduction in use of agri-chemicals.</p> <p>Younger members of farming families encouraged to experiment.</p> <p>Farmers are supported through the process of transition to sustainable farming using advanced technology to monitor biodiversity & land productivity.</p> <p>Localised 'business development groups' to share best practice.</p> <p>Agri-waste converted to energy.</p>	<p>quality.</p> <p>NI database & monitoring of soil quality created.</p>	
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Figure 5: Scenario planning workshop



To sum up, the key strategic proposals agreed on by participants, and incorporated into their transition plan, are as follows:

- **The right to food** as a guiding principle for food and farm policy, a societal norm, and enshrined in legislation similar to Scotland's Good Food Nation Bill.
- **Government-led diversification of agricultural production** both across the farm sector and within farm enterprises, i.e. greater sector diversity, and an increase in mixed farming and self-reliance. This would include increased indigenous production of feed grain and bioenergy crops. The former to build resilience to climate change, volatility of global markets and economic shocks; and the latter to support regional energy security, as well as enhancing water quality and biodiversity.
- **Relocalisation of supply chains and creation of circular bioeconomy** including: local food system planning to re-establish local markets and food processing; use of indigenous and under-utilised agricultural and arboricultural wastes, food wastes, and fast digest materials to produce biomass energy, fertilizer, industrial chemicals and materials.
- **Environmental protection established as a leading priority in land management**, not an 'added extra', including: protection of water, air, soil, and biodiversity. Measures to achieve this include: post-Brexit subsidies restricted to rewarding sustainable practices, decoupled from land ownership, and related to measurable biodiversity; a strengthened *Sustainable Agricultural Land Management Strategy*; integration of agroforestry and biomass crops into farm production; soil quality determined primarily in relation to biological health and organic content, and not just chemical composition.
- **Regional distributed energy supply** based on larger-scale CHP plants, providing district heating, and fuelled with indigenous biomass crops, agricultural and arboricultural wastes, and food waste. Potential benefits include: low-cost, low-carbon energy; alleviation of fuel poverty; enhanced energy security; and rural connectivity. To be achieved by an effective government-funded incentive scheme for farms and SME's to develop *large-scale* CHP, with community district heating to utilise the heat by-product. The emphasis on large-scale and provision of community district heating contrasts with the individualised, small-scale heat generation facilities typically supported by the controversial RHI scheme.
- **Integrated food system planning** at regional government and council levels, joining-up food policy areas, including: sustainable agrifood strategy and land management; energy security; circular bioeconomy (waste/resource management); regional and household food security. With regard to food security, this would also involve supporting the development of a network of community food hubs, and community emergency planning capacity.

- **Reinvigoration of research capacity and collaboration**, linking research and farmer support functions of AFBI, CAFRE and the universities.
- **An independent, regional stakeholder forum**, or food policy council, contributing to food system planning and policy development. The forum could be a significant locus of collaboration and networking between AFBI, CAFRE, and the universities.

Disputed issues

There were a number of issues discussed, and ideas proposed or explored, which did not garner full or majority support of the group, or which were in some way unresolved. These were not therefore included in the transition plan, and are discussed below.

Appropriate farm size was debated with some favouring small-scale, family farms, and others advocating a mix of small and large-scale farms, including industrial-scale factory farms. The latter position was associated with a belief that small-scale farms are not economically viable without subsidy³⁴. Regardless of scale, the consensus was that environmental protection should nonetheless be a priority.

The consensus view within the group was that the practice of short-term leasing of farmland through ‘conacre’³⁵ should be banned because it disincentivises long-term investment in, or improvement of, agricultural land. One participant advocated a more positive approach entailing the creation of ‘banks’ of conacre land. Owners would register their land with a bank, and farmers would deal with the bank for rental of the land. This could regulate the rental agreements of conacre land, which can be by word of mouth, or within local farming groups. Conacre, it was suggested, could be better managed with knowledge of land availability, history of cropping, and recent soil tests. It could also indicate land which could be long-term leased rather than annually. It would also be beneficial for farmers wanting land, to be listed along with their locality and farming preference.

One participant proposed that the contribution of GM technology should be considered in addressing food and farming sustainability. There was however no support for this from any other participants. Another participant did not support the proposal for mixed farming, and was the sole advocate for specialisation. Other issues discussed and explored which did not result in any agreed action included: the potential of national parks for food production; and finding a balance between food production and countryside management for heritage or recreational purposes.

³⁴ A recent study of 69 small-scale, agroecological farms in the UK, carried out by Coventry University, found that compared to average UK farm incomes ‘the sample were performing well financially. 78% were receiving no farm subsidies, and subsidies made up less than 20% of the income for 19% of those who were receiving subsidies’ (Laughton, 2017, p.ii).

³⁵ Conacre is the letting of land, in Ireland, for a season or 11 months.

Feedback on workshop process

The final part of Workshop 2 was an open feedback session where participants shared their views on how effective the two scenario planning workshops had been. There was general agreement that the workshop exercises and discussions had been interesting, and the final project report could provide useful material for engaging other organisations in addressing food policy and nexus-related issues. Participants enjoyed the opportunity to dialogue with others from different sectors and backgrounds. They would have welcomed an even wider range of expertise and experience, with more people representing the same specialist expertise in order to get more in-depth discussion and networking opportunities.

The final part of Workshop 2 was an open feedback session where participants shared their views on how effective the two scenario planning workshops had been. The consensus was that the workshop exercises and discussions were interesting, and the final project report could provide useful material for engaging other organisations in addressing similar issues. The backcasting technique had worked surprisingly well, but some of the themes chosen, such as, 'food sovereignty' and 'diversification' were a bit vague and ill-defined. The attempt to have multiple, sequenced stages in the backcasting process did not work. It was confusing and unclear where to place different ideas chronologically. Instead, it was proposed that the transition plan be kept simple with only three stages, as follows:

Beginning	Middle	End
Strategic actions needed to create support infrastructure	Institutional & legislative support infrastructure required	Description of ideal food system

Accordingly, the original and fortified versions of the transition plan created by the group have been presented following this structure in Figures 3 and 4.

One participant felt that the workshops would have benefitted from more focussed and clearer objectives, given that people came with such diverse aims and interpretations. For example, some focussed on urban food growing, and others on rural-based, intensive agriculture. He also added that the scenario planning workshops should identify priority risks to the food and farming system.

Participants enjoyed the opportunity to engage with others from different sectors and backgrounds. They nonetheless, would have welcomed a wider range of expertise and experience, and more people representing the same specialist expertise in order to get more in-depth discussion and networking opportunities.

5. Discussion

Over the course of the two scenario planning workshops, there was a clear convergence of two positions identified from analysis of the interviews (see Section 3), namely, the green/quality marketing strategy, and the alternative, relocalised food system. The third

position, in favour of the existing *Going for Growth* agrifood strategy, was effectively rejected as a sustainable and viable pathway. *The Sustainable Agricultural Land Management Strategy* was nonetheless seen as an important exercise which could be further developed and re-oriented exclusively towards non-intensive, diversified farming.

By the second workshop, a strong consensus had developed for a new agrifood strategy emphasising quality, environmental protection, and shifting towards a more relocalised food system, based on non-intensive production methods. This new strategy would entail a post-Brexit 'public money for public goods' approach to farm subsidies that would reward sustainable practice and environmental protection. Additionally, there was strong support for a rights-based approach to food, including the right to food as a principle underpinning all food and farming policy, and enshrined in legislation.

The need for more integrated food policy and governance was a strong theme in both the interviews and workshops, culminating in proposals for integrated food system planning at regional and council levels, and the creation of an independent, regional food forum. Initially, many interviewees or participants saw food policy integration primarily in terms of agricultural policy and environmental policy. With the merger of agriculture and environment policy briefs within the new Department of Agriculture, Environment and Rural Affairs (DAERA), combined with Brexit uncertainties about future farm subsidies and environmental regulation, there are the beginnings of joined-up debate about agriculture and environment policy in Northern Ireland. However, health and food poverty issues in Northern Ireland do not feature in this debate. Therefore, a further step that is needed is the integration of social aspects of food policy into policy development and debates about agrifood strategy. Proposals for further research into this issue are outlined below.

A few interviewees observed that the decline of mixed farming had made the farm sector less resilient to environmental and economic shocks. The present predominance of meat and dairy farming was viewed as a relatively large contributor to GHG emissions, and also vulnerable to economic shocks, such as global feed grain scarcity caused by extreme weather events. It was during the workshops that the idea for government-led diversification emerged in more detail. Diversification of both individual farms, and the farm sector as a whole, was seen as critical to food system resilience, environmental sustainability and economic viability.

A further resilience-building measure proposed was for the creation of a regional distributed energy supply based on combined heat and power (CHP) plants, providing district heating, and fuelled with indigenous biomass crops, agricultural, arboricultural, and food wastes. These CHP plants, as noted in Section 4, would be relatively large-scale compared to the smaller-scale units typical of the failed RHI scheme. Hence, this proposal represents a more visionary and strategic approach addressing regional energy security, fuel poverty, and farm business diversification. The increased production of biomass crops and agroforestry also

has multiple environmental benefits including: control of nutrient runoff, air and water quality, carbon sequestration, soil enrichment, and biodiversity conservation.

With regards to perspectives on climate change and the food system, it was notable that there was a high level of awareness and concern about the impacts of extreme weather events on farm production in Northern Ireland, both directly, through localised impacts such as flooding, and indirectly, through volatility of feed grain prices, as a result of extreme weather events in cereal producing regions of the world. This indicates a potential shift in perceptions and discourse around climate change, from contested debates about projected future warming scenarios, to a more immediate focus on extreme weather events that are being experienced currently, with increasing regularity and severity.

This awareness of, and concern about, the indirect, economic impacts of climate-related extreme weather, was also expressed by respondents to an all-Ireland survey of the dairy industry commissioned by Safefood in 2017³⁶. The impact of extreme weather events, and implications for availability and price of animal feeds were the most serious threats identified by industry stakeholders. It is also worth noting that the *UK Climate Change Risk Assessment 2017 Evidence Report – Summary for Northern Ireland*³⁷ addresses the risks from weather-related shocks to international food production and trade, and makes the following observation:

‘The increasing global interconnectedness of food systems via trade increases the susceptibility of the food system to propagation and amplification of weather-related production shocks via price volatility’ (p.73).

The report identifies the potential impacts on access to food for lower income households and on the farming sector through feed prices. Nonetheless, it also reveals that, ‘there is no food security strategy at Northern Ireland or UK level that links domestic and international food production and imports’ (p.74). Given that Northern Ireland is embedded in a highly connected, interdependent global economy, development of adaptation responses to globalised risks, such as extreme weather events in other parts of the world³⁸, need to be prioritised, along with efforts to mitigate GHG emissions. This is exacerbated by Northern Ireland’s dependence on and vulnerability to imported oil and gas supplies.

In relation to energy security and the food system, it was notable during interviews how many respondents expressed a perceived lack of knowledge, and preferred not to comment (although, as we have seen, workshop discussions led to proposals for a regional energy

³⁶ Safefood (2017) *The Impact of Climate Change on Dairy Production: The potential food safety, economic and environmental impacts of climate change on the dairy production chain on the island of Ireland*, Little Island, Co. Cork: Safefood.

³⁷ ASC (2016) *UK Climate Change Risk Assessment 2017 Evidence Report – Summary for Northern Ireland*. Adaptation Sub-Committee of the Committee on Climate Change, London.

³⁸ Regarding the risks to global cereal and feed grain production see Bailey, R. et al (2015) *Extreme weather and resilience of the global food system: Final Project Report from the UK-US Taskforce on Extreme Weather and Global Food System Resilience*, The Global Food Security programme, UK.

supply based on CHP). The reticence of interviewees on this subject would appear to contrast with the period immediately following the 2008 oil and food price spikes, when there was a significant amount of media and public attention to the issues of energy and food security, and the connections between them. Specifically, there was public awareness of the contribution of biofuel production to higher food prices, the growing risks of geopolitical instability in oil producing regions, and increasing energy and food demand from emerging economies. Within the farm sector, concerns were frequently voiced about the rising cost of the '3 F's' (fuel, feed and fertilizer) associated with the oil price spike. This suggests a correlation between public/media awareness (including policy attention) and the existence of current, direct impacts affecting people's lives and businesses. By contrast, interviewees were consistently forthcoming in their views about climate change, and specifically about extreme weather events, arguably due to increasing media reports of impacts on the Northern Ireland farm sector. Similarly, almost all respondents expressed concerns about the implications of Brexit, a subject that dominates public discourse, and which poses a wide range of risks to food and farming in Northern Ireland.

It is worth observing that, notwithstanding the stated focus of the research project on climate change, energy and food security, most interviewees actually appeared more concerned about the more immediate risks associated with Brexit. They did nonetheless engage with the climate and energy issues, especially those who participated in the scenario planning workshops. A few respondents also commented that Brexit was an opportunity to address farm sector sustainability effectively. Thus, the Brexit issue became a bridging concept to address the longer-term, and more global, sustainability challenges, and to encourage alliances between farmers and environmentalists.

Similarly, for a small number of interviewees, rising poverty and the spread of foodbanks, appeared to be a more dominant issue than global climate and energy challenges. However, the direct awareness of food poverty in Northern Ireland, gave a sense of realism and urgency to scenario planning exercises that considered the risks of future food supply shocks. One key lesson from this research project has been the need to recognise, and work with, more immediate, foreground issues which provide an immediate context and bridge for addressing the longer-term, global challenges.

Further research

The research project highlighted a perceived need for more integrated and inclusive approach to policy-making and food system. Beyond NGO lobbying, advocacy and *ad hoc* working groups, how can broader participation and joined-up governance be institutionalised? To help address this question, firstly, it would be useful to investigate existing and emerging international models, focussing on institutionalised policy and governance processes that entail government and civil society partnerships, and which integrate a range of policy areas, including agriculture, environment, and social policy.

Possible examples might include: Scotland's proposed Good Food Nation Bill³⁹; Wales' Wellbeing of Future Generations Act⁴⁰; Brazil's National Food and Nutritional Security Policy⁴¹; North American municipal 'food policy councils'⁴²; and the proposed National Food Policy for Canada⁴³. Secondly, it would be important to map the food policy landscape in Northern Ireland, including post-Brexit uncertainties and opportunities, as well as identifying good 'niche level' practices that demonstrate multi-dimensional benefits, and have the potential to be scaled up, or scaled out. The third stage would be to explore, with key informants across the food system, the potential for integrated food policy and governance in Northern Ireland, and to develop recommendations for regional policy and governance development, and for scaling up/out niche level good practice.

6. Conclusion

Strong, definitive conclusions would not be supported from the small sample interviewed, and the limited scale of the scenario planning exercise, however, the findings do indicate a possible shift in thinking, across different sectors of the food system in Northern Ireland, towards greater strategic emphasis on quality of produce and environmental standards, and favouring less emphasis on production growth, global export and economies of scale. This suggests a growing consensus preferring an alternative to the existing *Going for Growth* agrifood strategy.

Analysis of interview data identified three positions on the food system sustainability: preference for the existing *Going for Growth* strategy; advocacy for a green marketing strategy with a post-Brexit 'public money for public goods' approach to farm subsidies; and support for an alternative food system based on non-intensive food production and relocalised supply chains. In the course of the two scenario planning workshops, the latter two positions converged, and effectively rejected *Going for Growth* as a sustainable or viable pathway.

Key concerns expressed by interviewees and workshop participants, included: Brexit uncertainties, risks and opportunities; the lack of political leadership and weak environmental governance in Northern Ireland; lack of joined up policy-making on food and energy; the impact of extreme weather events, both regionally and globally, on the Northern Ireland farm sector; and rising levels of food poverty in Northern Ireland.

³⁹ For further information see <http://www.nourishscotland.org/campaigns/good-food-nation-bill/>

⁴⁰ For further information see *Well-being of Future Generations (Wales) Act 2015: The Essentials*. Available at: <http://gov.wales/docs/dsijg/publications/150623-guide-to-the-fg-act-en.pdf>

⁴¹ Constantine, J. and Santarelli, M. (2016) *Tackling Hunger Through Sustainable Food Policies: Learning from Brazil*, Food Foundation-IDS Policy Briefing, Institute of Development Studies. Available at: https://foodfoundation.org.uk/wp-content/uploads/2017/07/4-Briefing-Brazil_vF.pdf

⁴² Harper, A., Shattuck, A., Holt-Giménez, E., Alkon, A. and Lambrick F. (2009) *Food Policy Councils: Lessons learned*. Oakland, CA: Food First.

⁴³ For further information see <https://foodsecurecanada.org/resources-news/news-media/national-food-policy-primer>.

Proposals from project participants, for policy innovation and strategic initiatives, included: post-Brexit farm subsidies focussed on environmental protection; a shift to non-intensive farming methods and local supply chains; diversification of the farm sector to promote resilience to environmental and economic shocks; the regional development of district combined heat and power (CHP) fuelled by indigenous biomass; adoption of a rights-based approach to food; and development of a more joined-up, inclusive and democratised approach to food policy-making and governance that integrates agriculture, environment, health, household and regional food security, energy security, and waste/resource management.

Further research could address the issue of integrated food policy and governance by investigating existing and emerging international models, mapping the regional food policy landscape (in light of Brexit uncertainties), and explore the potential for more integrated, inclusive food policy processes and governance in Northern Ireland.

Appendices

Appendix A: Expert speaker events

Prof. Emile Frison, IPES-Food – 'Transforming food systems: towards diversified agroecological systems', 14th March 2017

Presentation of the IPES-Food report [From Uniformity to Diversity](#)⁴⁴. The report presents evidence that systems based around diversified agroecological farming are succeeding, where current systems are failing, in addressing the problems of food security, environmental protection, nutritional adequacy, social equity and locally-led development. The lecture also addressed systemic 'lock-ins' that represent strong obstacles to change, and presented emerging opportunities for supporting the shift towards diversified agroecological systems.

Prof. Frison is a member of International Panel of Experts on Sustainable Food Systems (IPES-Food)

Prof. Tim Benton, Leeds University – 'Environmental tipping points and food system dynamics', 11th May 2017

Presentation of the report [Environmental Tipping Points and Food System Dynamics](#)⁴⁵. The report provides evidence for the existence of environmental tipping points, highlights the need to give greater consideration to potential step-changes in food systems as part of risk management, and explores potential consequences for global food security.

Tim Benton is UK Champion for Global Food Security, and Professor of Population Ecology in the School of Biology, University of Leeds.

Dr. Julia Wright, CAWR, Coventry University – 'Post petroleum or petroleum scarce? The experiences of the Cuban farming and food system toward sustainability', 26th May 2017

This lecture described, firstly, the backdrop to the food crisis that hit Cuba in the early 1990's, and the coping strategies of the food and farming sector as they struggled to deal with this. Secondly, it charted the ups and downs of undertaking research in a context of uncertainty. The widely held perspective that Cuba turned to organic farming was questioned, and the implications of the Cuban experience for food security in other countries was explored, particularly in relation to notions of future fossil energy scarcity.

Dr Julia Wright is Senior Research Fellow in Agroecological Futures in the Centre for Agroecology, Water and Resilience, Coventry University, and author of *Sustainable Agriculture and Food Security in an Era of Oil Scarcity: Lessons from Cuba*⁴⁶.

⁴⁴ Frison, E. et al (2016) *From Uniformity to Diversity: a paradigm shift from industrial agriculture to diversified agroecological systems*, IPES-Food.

⁴⁵ Benton, T. et al (2017) *Environmental tipping points and food system dynamics: Main Report*, The Global Food Security programme, UK.

⁴⁶ Wright, J. (2012). *Sustainable agriculture and food security in an era of oil scarcity: lessons from Cuba*. Routledge.

Appendix B: Nexus project interview schedule

Questions:

1. What specific interests does *[participant's organisation]* have in the food system or agricultural sector?
 - *Are these related to any environmental sustainability issues?*
2. Are you engaged in any policy development or advocacy regarding food and/or sustainability issues?
 - *Please specify issues*
 - *Are you part of any formal or informal policy networks?*
 - *Who are your network partners*
 - *What specific policy initiatives have you been engaged in, and with what outcomes?*
 - *Are there any policy initiatives or developments you think are needed but are not currently happening?*
3. What is your understanding of global climate change and its relation to the food system?
 - *What is your understanding of the contribution of food & farming to climate change?*
 - *What do you think should be done to address food-related climate change in NI?*
 - *What is your understanding of how climate change, in turn, impacts on food and farming?*
 - *What do you think should be done to address these impacts in Northern Ireland?*
4. What is your understanding of the relationship between global fossil energy availability and the food system?
 - *What do you think should be done to address the dependency of the food system on fossil energy?*
5. What opportunities are there to address the climate and energy challenges with regard to the food system?
 - *How might public agencies, with responsibility for different aspects of the food system, work and if need be change, to meet these challenges?*
 - *How might civil society organisations (business & non-profit sectors) meet these challenges?*
 - *Can you suggest any models of good practice or specific initiatives, in NI or from other countries or regions addressing food system sustainability that could have potential for cross-sectoral collaboration in NI?*
6. Do current policy making processes have the capacity to address these challenges?
 - *How might they be improved?*
 - *What are the factors that constrain or promote successful policy learning and development, with regard to food, farming and sustainability?*
 - *Can you suggest any ways that policy learning and development, in this area, could be improved?*
7. Do you have any further information to add, or any questions?

Appendix C: List of organisations represented in interviews and workshops

Interviews

- Agri-Food & Biosciences Institute (AFBI)
- Belfast Food Network
- Climate NI
- Department of Agriculture, Environment & Rural Affairs (DAERA)
- Devenish Nutrition
- Dunbia
- Fareshare
- Food NI
- Friends of the Earth NI
- Lakeland Dairies Co-operative
- Northern Ireland Environment Link (NIEL)
- RSPB
- Ulster Farmers Union

Scenario planning workshops

- Agri-Food & Biosciences Institute (AFBI)
- Belfast Food Network
- Climate NI
- Department of Agriculture, Environment & Rural Affairs (DAERA)
- Friends of the Earth NI
- Queens University Belfast, Institute for Global Food Security
- Queens University Belfast, School of History, Anthropology, Philosophy and Politics
- 4 unaffiliated individuals associated with the food and farming sectors.

Appendix D: Global climate change scenario - multiple 'bread basket' failures⁴⁷

This scenario assumes an emissions pathway exceeding 2°C, and entails extreme weather events disrupting global food and feed grain supply. Production of the main commodity crops (maize, soybean, wheat and rice) is concentrated in a small number of 'bread basket' regions, posing systemic risks for global food security.

Early warning signs

Droughts in 1988/89 lead to global production of maize falling by 12%, and soybean production by 8.5%. In 2002/3, droughts in Europe, Russia, India, and China, result in global wheat production decreasing by 6%, and rice by 4%. In 2010, droughts occur in Russia, Ukraine, China and Argentina, coinciding with severe storms in Canada, Australia and Brazil. The price of wheat doubles, exacerbating socio-political tensions in the Middle East and contributing to the Arab Spring uprisings⁴⁸. Over the next decade, a number of trends combine to drive down global food stocks below crisis thresholds by 2026. At the global level, declining yield growth means production struggles to keep pace with demand, driven by increasing consumption of animal products, increasing biofuel use, and population growth. Isolated extreme weather events in 2024 and 2025 lead to disappointing global harvests and see stock-to-use ratios fall below 20%. In China, soil depletion, pollution and constraints on land availability cause production to fall behind demand. The government allows imports to rise, increasing demand on international markets.

Crop failures in multiple 'breadbasket' regions

In 2026, extreme weather events disrupt production in multiple breadbasket regions. A poor monsoon the previous year reduces the wheat crop in India and China. An early Spring thaw and refreeze in the Black Sea area affects the wheat crop, and a Summer drought in North America affects maize, wheat and soybean forecasts. A heat wave and drought in Europe affects the wheat crop, leading to further price rises across all cereals. US president Trump Jr, refuses to waive the biofuels mandate, despite international pressure.

Global interdependencies amplify the shocks. As cereal prices climb, export restrictions or bans are imposed, import tariffs are reduced, and consumption subsidies introduced. Major importers place orders far in excess of normal levels in a bid to pacify domestic markets. These panic responses escalate the crisis, driving global food prices higher. International commitments to coordinate trade are abandoned under the pressure.

The FAO Food Price Index hits 250⁴⁹ as prices of affected grains triple. Economic impacts include inflation, deteriorations in the balance of payments, and fiscal pressures arising from higher food

⁴⁷ This scenario is adapted from Bailey, R. et al (2015) *Extreme weather and resilience of the global food system: Final Project Report from the UK-US Taskforce on Extreme Weather and Global Food System Resilience*, The Global Food Security programme, UK.

⁴⁸ Werz, M., & Conley, L. (2012) *Climate Change, Migration, and Conflict: Addressing complex crisis scenarios in the 21st century*, Center for American Progress & Heinrich Böll Stiftung.

⁴⁹ This compares to approx. 171 at the time of writing. The FAO Food Price Index reached 201 and 230 during the 2008 and 2011 food price spikes, respectively.

subsidies and social transfers. Import dependent countries, particularly in Sub-Saharan Africa and the Middle East, experience pronounced deteriorations in poverty rates and food security. Civil unrest and political violence become endemic. The instability of the Middle East is of great concern internationally, due to potential interruption of energy exports.

Chinese consumers are buffered from food price inflation through use of strategic reserves and price controls. China, the US and UK, and other powerful states with large overseas investments in agriculture, resort to both soft and hard political power to enforce supply commitments, further weakening the food security of producer countries. Consumers in large industrialised countries, such as the US and EU, where food represents a smaller share of household expenditures, are relatively unaffected, but there is increased food poverty among those on low incomes. The crop sectors of these economies benefit from higher prices, though other sectors, in particular, livestock and dairy, suffer from higher feed grain costs, causing large numbers of farms to go out of business⁵⁰.

⁵⁰ A US drought in 2012 led to an increase in the price of soya to £400/ton, up from £295 at the end of 2011. It is estimated up to 25% of UK pig farmers left the industry by the end of 2012. See Benton et al (2012) *Severe Weather and UK Food Chain Resilience: Detailed Appendix to Synthesis Report*, at <http://www.foodsecurity.ac.uk/assets/pdfs/frp-severe-weather-uk-food-chain-resilience.pdf>.

Appendix E: Global energy scenario – converging political and environmental crises in the MENA region

This scenario draws on the more pessimistic literature regarding future energy availability and describes disruption of global energy supplies arising from political instability and armed conflict in the Middle East and North Africa (MENA), following decline in national oil and gas revenues, combined with converging climate, water, and food crises. It highlights the interconnected challenges of the energy-climate-water-food nexus⁵¹.

Pre-2020: context & early warning signs

Global production of conventional oil and gas peaks in 2006⁵². There is increasing evidence that accelerating production of non-conventional sources is failing to keep pace with the depletion of conventional oil and gas, due to declining energy return on energy invested in production (EROI)⁵³. Overall European oil production is in decline since 1999, and by 2020, the European Union is dependent on imports for 92% of its supply. Both Russian and Central Asian production peak by 2020⁵⁴. At the same time, energy demand from China and India is increasing, and projected to double by 2030⁵⁵ and 2040⁵⁶, respectively.

Converging climate change, resource crises, and demographic pressures in MENA oil producing countries present a pattern of destabilisation that spreads to other countries and regions.

Egypt's oil production peaks in 1993, followed by a decline in export revenues and state capacity to provide fuel and food subsidies for its burgeoning population. Droughts in the US, Russia, and China during 2010/11, double the price of wheat imports. This coincides with water shortages in Egypt. Subsequent protests lead to the fall of President Mubarak in 2011, and eventual shift to authoritarian government under El-Sisi.

In **Syria**, oil production peaks in 1996. With declining export revenue, the Aasad regime is also forced to cut fuel subsidies in 2008, tripling petrol prices, which impact on the price of food. This situation is compounded by an intensifying drought cycle linked to climate change. Crop failures lead to mass migration from Sunni rural areas into coastal cities dominated by the Alawite

⁵¹ The energy scenario is primarily adapted from Ahmed, N.M. (2017) *Failing States, Collapsing Systems: BioPhysical triggers of political violence*. Switzerland: Springer International Publishing.

⁵² International Energy Agency (2010) *World Energy Outlook 2010*. Paris: International Energy Agency.

⁵³ Del Castillo-Mussot, M., et al (2016) 'Impact of Global Energy Resources Based on Energy Return on Their Investment (EROI) Parameters' *Perspectives on Global Development and Technology* 15(1– 2): 290– 299; Hall, C.A.S., et al (2014) 'EROI of Different Fuels and the Implications for Society' *Energy Policy* 64: 141– 152.

⁵⁴ Dittmar, M. (2016) 'Regional Oil Extraction and Consumption: A Simple Production Model for the Next 35 Years Part I', *BioPhysical Economics and Resource Quality* 1(1): 7.

⁵⁵ ICEF (2016) *Growing Chinese Middle Class Projected to Spend Heavily on Education through 2030*. ICEF Monitor. Available at: <http://monitor.icef.com/2016/04/growing-chinese-middle-class-projected-spend-heavily-education-2030/>

⁵⁶ IEA (2015) *India Energy Outlook: World Energy Outlook Special Report*. International Energy Agency.

minority, exacerbating sectarian tensions. Wheat prices double in 2010/11, caused by extreme weather events. Protests at food price increases meet with brutal state violence, and develop into an armed rebellion which is further inflamed by the intervention of competing superpowers and jihadist insurgents. In 2020, the Syrian state collapses and its former territory is divided among Turkish and Russian occupying forces, and Islamist militants.

Yemen reaches peak oil production around 2001, and by 2017 production falls to zero. The eventual collapse of the country follows the same pattern of declining oil exports and state revenues, and inability to meet the needs of its rapidly growing population. Converging energy, water and food crises lead to fuel and food riots, and the emergence of separatist movements. Civil war culminates in state collapse, and division of its territory among Saudi occupying forces and separatist militants backed by Iran.

Post-2020: Collapse of Saudi Arabia, precipitating global energy crisis

Saudi Arabia, with an estimated 18% of global petroleum reserves, and ranked as the largest oil exporter, is critical to the stability of the global economy. Like Egypt, Syria, and Yemen, Saudi Arabia faces the same converging crises: climate related water and food scarcity, demographic expansion, and fiscal crisis arising from declining oil export revenue. Saudi oil production was projected to peak in 2028⁵⁷, but the combination of its high production strategy to undermine competitors, and a 70% overstatement of its reserves, leads to an earlier peak in 2020. Thereafter, with declining export revenues, the kingdom is increasingly unable to maintain social expenditure and basic needs, including fuel subsidies, food imports, and provision of water supplies. Desalination plants provide 70% of Saudi Arabia's water supplies, and account for over half of domestic oil consumption. Intensifying droughts in the Middle East and Gulf region, during the early 2020's, lead to violent food and water riots in Saudi Arabia. A brutal civil war erupts in 2026, as Wahhabi militants seek to overthrow the ruling monarchy. Hundreds of thousands of Saudi refugees migrate northwards and across the Mediterranean to Europe. The contagion of political destabilisation and armed conflict spreads throughout the MENA region, and beyond.

US President Trump Jr, who took a non-interventionist stance during the unfolding crisis in Saudi Arabia, now rapidly secures exclusive bilateral trade deals with Canada and the military dictatorship in Venezuela, for supply of oil. He also reinstates the ban on crude oil exports from the US. In 2028, Saudi oil exports fall abruptly to zero, precipitating a global energy crisis and permanent economic recession. Oil prices exceed the level of all previous spikes, with price-transmission to food and all other commodities, including agricultural inputs (feed, agrichemicals, plastics, machinery). Industrialized farming and globalized food distribution systems are no longer sustainable.

⁵⁷ Ebrahimi, M., and Nahid, G. (2015) 'Forecasting OPEC Crude Oil Production Using a Variant Multicyclic Hubbert Model', *Journal of Petroleum Science and Engineering* 133: 818– 823.