

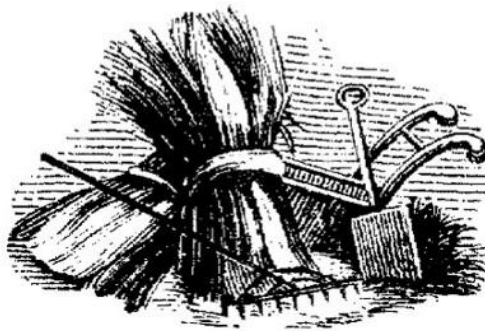


# **Nuffield Farming Scholarships Trust Report**

*Award sponsored by*

**Thomas Henry Foundation**

The  
Thomas Henry  
Foundation.



**Opportunities for UK farmers to grow  
wealth in the 4<sup>th</sup> Industrial revolution.**

**Barry J O'Boyle**

**Date report submitted 30<sup>th</sup> June 2020**

**NUFFIELD UK**

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Southill Farm, Staple Fitzpaine, Taunton, TA3 5SH  
Tel: 01460 234012  
Email: [director@nuffieldscholar.org](mailto:director@nuffieldscholar.org)  
[www.nuffieldscholar.org](http://www.nuffieldscholar.org)

# A

## Nuffield (UK) Farming Scholarships Trust Report

Date of report: June 2020



*"Leading positive change in agriculture.  
Inspiring passion and potential in people."*

Title	Opportunities for UK farmers to grow wealth in the 4th Industrial revolution
Scholar	Mr Barry J O'Boyle
Sponsor	Thomas Henry Foundation
Objectives of Study Tour	<ul style="list-style-type: none"> <li>• Identify how financially sustainable the UK will be in paying its farmers subsidies like that of the EU, medium to long term.</li> <li>• Identify at least one alternative way that UK farmers can at least maintain their income through more innovative methods, backed by government policy.</li> <li>• Understand missed opportunities within the current strategy with regards to growing the UK Agri-tech sector.</li> </ul>
Countries Visited	<p>Global focus program - 18<sup>th</sup> March to 28 April 2018 : Netherlands, Ireland, United States (Washington &amp; California), Mexico, Brazil New Zealand.</p> <p>United States – 16<sup>th</sup> October to 12<sup>th</sup> November 2018</p> <p>Chile - 5<sup>th</sup> December 18<sup>th</sup> to December 2018</p> <p>China - 5<sup>th</sup> January to 21<sup>st</sup> 2019</p> <p>Germany, Denmark, Sweden &amp; Netherlands 26<sup>th</sup> May to 3<sup>rd</sup> June 2019</p>
Messages	<ul style="list-style-type: none"> <li>• The current subsidy model can no longer be relied upon as a main source of income by UK farmers in the medium to long term.</li> <li>• Innovation, return on investment and entrepreneurship should be the guiding principles of any new UK subsidy policy.</li> <li>• Innovation has been key to overcoming great disruption within other industries: agriculture will need to do the same and harness the opportunities of the fourth industrial revolution.</li> <li>• Farmers will need to embrace technology and the role that they can play in developing the Agri-Tech sector into an important sector within the UK economy.</li> <li>• For Agritech to become a strong manufacturing sector and economic driver within the UK, all stakeholders must find a common strategy to integrate further to increase the ability to create wealth for farmers.</li> </ul>

## EXECUTIVE SUMMARY

Farmers throughout the UK have never faced a period of so much uncertainty in generations. Brexit, the future of subsidies, climate change and the many other challenges are all common concern among the agriculture community. Agriculture and indeed the global economy are undergoing rapid change, economies globally have been badly hit by the cost of the COVID-19 pandemic. This has led a sovereign debt crisis not seen since World War II. This Nuffield report examines how UK public funds will come under extreme pressure in the next few years as the UK government will struggle to fund agriculture subsidies at the same level as today, whilst also covering the already growing costs of running other public services. It is no understatement that many UK farmers, big and small, rely heavily on subsidies to survive and keep their businesses afloat.

For the first time in generations, the UK government along with other key stakeholders within the agriculture industry will have the opportunity to reshape the agriculture subsidy system that will support UK farmers in the future. Brexit has been divisive in many ways even among the farming community, however, now is the time to examine the resources which should be available to UK agriculture and how best to exploit and leverage this in a global context.

During my Nuffield travels, the common theme gained from the people I met was that one of the greatest opportunities to emerge, not only for agriculture but for the UK economy in general in the next few years, is the positive impacts of the 4th industrial revolution which is in its early stages in the world economy. The rise of “the internet of things” such as artificial intelligence, drones, robotics etc. are all fusing to create new products, new processes and provide the opportunity to improve or eliminate problem areas of agriculture that cost farmers either loss of income or production. It became clear that, globally, Agri-tech was lacking development input from farmers themselves even though they are the end customers of new Agri-tech products. Further, farms are a valuable testing ground for new products which is currently under-utilised in comparison to research and development within other industries. Farmers are central to developing new Agri-tech products and there remain many innovative ways which the government and all stakeholders could explore to incentivise farmers to become more involved. With this involvement, farmers and the general economy will benefit financially.

A clear concluding message, also in terms of the current UK government strategy on Agri-tech, is that the UK is a world leader in research and development. However, there remain many opportunities to better commercialise and financially monetise the Agri-tech sector that could greatly benefit UK farmers. Farmers will need to adapt to a more entrepreneurial focused support system and Agri-tech can offer one solution to a changing landscape of farm subsidy policy.

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## **DISCLAIMER**

The opinions expressed in this report are my own and not necessarily those of the Nuffield Farming Scholarships Trust, or of my sponsor, or of any other sponsoring body.

Please note that the content of this report is up to date and believed to be correct as at the date shown on the front cover

## **CONTACT DETAILS**

Barry O'Boyle

20 Portlee road

Randalstown

Co.Antrim

BT41 3LX

Mobile : 07749595713

Landline: 02879650864

Email: [oboyleni@gmail.com](mailto:oboyleni@gmail.com)

LinkedIn: <https://www.linkedin.com/in/barry-o-boyle-.com>

Nuffield Farming Scholars are available to speak to NFU Branches, Agricultural Discussion Groups and similar organisations

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Southill Farmhouse, Staple Fitzpaine, Taunton TA3 5SH  
Tel : 01460 234012  
email : [director@nuffieldscholar.org](mailto:director@nuffieldscholar.org)  
[www.nuffieldscholar.org](http://www.nuffieldscholar.org)*



## 1. Introduction

The first person to introduce me to Nuffield was the Somerset businessman and Nuffield scholar John Alvis senior. I visited the Alvis family when I was completing the Henry Plumb Foundation scholar programme in 2013. I was inspired by the growth of the Alvis business, and I knew that in later years I too wanted to embark on a Nuffield scholarship journey of my own.

I have always known from a very young age, that agriculture would be a career that I would embark on. I have been involved in my family's 5<sup>th</sup> generation dairy farm located on the shores on Lough Neagh Co. Antrim for over 15 years. The farm has radically changed over this period from very humble beginnings, the dairy herd is now converted to a low input grazing spring system, farm infrastructure has been modernised and the size of the dairy herd has been doubled.

I never enjoyed formal education but at the age of 22, I decided that if I really wanted to grow the family business, then going back into 3<sup>rd</sup> level education would have to be part of a wider strategy. In the autumn of 2012, I was accepted onto the MSc Business Development and Innovation at the University of Ulster Business School. This was huge learning curve for me as individual and a period of great personal growth. It was at Ulster, that I gained a greater understanding of how the corporate business world operates. I gained invaluable knowledge about strategy, innovation, entrepreneurship and many more skills. It is safe to say that knowledge is power, if you want to succeed in business and life. I have set about utilising all the skills that I had learned and implementing them into my own farm, creating a new business growth strategy which I continue to follow today.

I often asked previous Nuffield scholars, “when is the best time to do a Scholarship?” The common answer I got, was that “there is never a good time”, but the reason for doing a scholarship should be “when you feel you are not growing as a person, or you feel your business has reached its growth potential and it needs a new kick”.

I can safely say that with the current pressures in agriculture, there has never been a better time to get out of your surroundings and see the world. Having talked to many farmers, businesspeople, politicians and industry leaders over the past 3 years, never has the world faced many problems especially on so many fronts, but also there have never been so many opportunities if we all have the courage to grasp them.





## 2. Background to my study

As a self-employed dairy farmer, I am acutely aware of the role that EU subsidies have had on my farm business over the years. Like many farmers across the UK, subsidies continue to account for a significant amount of farm income and, in recent times with the volatility of commodities, they can be the difference in a farm business between making a profit or not making one, depending on the macroeconomics that dictate much of farm profitability.

With the UK leaving the EU it became apparent that the UK government continues to lack any real strategy to replace farm subsidies to that of the level of current EU CAP support. The sole objective of my Nuffield topic is to understand what will replace that significant slice of income for not just my own farm business but for farmers up and down the UK: I quickly realised that there are many opportunities for UK agriculture, especially within the growing Agri-tech sector, which will be discussed further within this report.

It became clear once I had started my research that I would need to focus my project on what I as a farmer could control and what was realistically achievable with the time and resources that I had to carry out the research to get a brief answer. Some of the limitations that I recognised early in the project were:

1. I had not the time nor resources to completely answer such a broad question in a 10,000 report.
2. There are many components, which make up an entire subsidy policy system, so I needed to research an area that I felt would have the greatest impact.
3. As a farmer and someone who has little influence at policy level, I knew that I would need to focus as much attention as possible on what could be achieved as an individual farmer or by groups of farmers.
4. I knew I had to not just look within agriculture to find the answer but rather look to other industries that have had to adapt to less government financial support.
5. I could not visit every country in the world, so there was a need to find countries that have been innovators and leaders, not just in agriculture but other industries also.
6. There were individuals who I had tried to contact that I would have liked to talk with face to face but for one or many reasons it would not be possible.

The foundation research that guided my final Nuffield project was as follows:

### Group learning

- I was fortunate enough to visit the Netherlands as part of the Contemporary Scholar's Conference (CSC). I would say this was the first time that I had come into contact with so many people from right across the agricultural sector from every corner of the globe. It was a great learning experience to hear about the various challenges that they each faced but also the opportunities that they recognised. It became clear that climate change, debt,



environmental laws, commodities prices were problems that all farmers are dealing with, but the lack of subsidies was not one of them. It is still very much an EU mentality that you cannot run a successful farm without subsidies. The striking aspect, that all 100 farming scholars recognised about the Netherlands, is that while it is a small EU country, it has become one of the most efficient and productive food producer in the world. I found that innovation, entrepreneurship, succession, lean thinking and the need to continue to develop management skillset to adapt to a changing macro environment were themes that came through time and time again visiting some incredible enterprises.

- At the end of the CSC in early March 2018, I had also been chosen to complete the Global Focus Programme (Brazil tour). This would consist of travelling for 7 weeks, with 10 other international scholars, to Ireland, California, Mexico, Brazil, New Zealand. This global view of agriculture was the invaluable to the early stages of my research. I could see that innovation was the key message if farmers wanted to gain competitive advantage and overcome the many similar challenges faced in different countries. It was also a great insight into farm subsidies; farmers in the USA viewed the renewal of a strong “farm bill” as being crucial for their survival as they were in crossfire from President Trump’s trade wars; farmers in South America looked to their farming colleagues in the USA and EU with envy at the subsidy support they receive; in New Zealand farmers saw the EU subsidy system as an obstacle to growing the scale and efficiency of EU farms: the Kiwi farmers’ viewpoint is that the abrupt end to subsidies in the country in the late 1980’s was a shock at the time but led to the liberation for the agriculture sector. It is also worth adding that the changing end-consumer trends are worth paying attention to by the global farming community, as consumers demand food that is kind to animal welfare and the environment.

#### Personal learning

- Online research was undertaken throughout my Nuffield project, I read widely from various journals, farm newspapers, history books, peer reviewed articles, academics. I watched many YouTube videos from business school professors, economists, politicians and media commentators. I undertook this kind of qualitative research to gain an all-round view of the current macro and micro environmental pressures that farmers are facing but also the opportunities there are for the agricultural sector in the future. Agri-tech is one theme that continued to come up as an important and wealth creating sector for agriculture. I also had many email exchanges with many people as well as being in contact with new contacts through social media such as LinkedIn.



### 3. Countries I visited and overall insights

Outside remote learning, I visited many countries as part of the scholarship. My personal travel global research lasted around 8 weeks. This mainly involved visiting many businesses, factories, government enterprise initiatives and carrying out face to face interviews with as many relevant people as possible.

**USA** – from early research the USA has always been a leader in innovation and the early adoption of technology. I had meetings with Irish owned Agri-tech company Alltec in Kentucky. I visited Deere & Co headquarters in Maine. The two highlights of the USA trip were a meeting and tour of the University of Illinois Agri-tech innovation hub. I also visited Silicon Valley where I visited many factories and tech companies including Google, meeting with companies outside agriculture which gave me a better understand why Silicon Valley is a hub for start-ups, creativity and innovation. I also visited one of world's top rated agri-related venture capital firms, Thrive Accelerator (more information on accelerators in chapter 6) in San Jose. I had meetings with academics at Berkeley University to understand the crucial stakeholder role that universities play in the success of Silicon Valley and to learn how they are fusing the tech industry with agriculture.

**Chile** - I visited Santiago to visit one of the world's top ten rated accelerator programmes, fully funded by the Chilean government, called (start-up Chile) as Chile is well recognised globally as the Silicon Valley of South America. Here I met with programme coordinators and Agri-Tech start-up founders participating in the programme. I also met with universities that helped develop the programme, with food manufacturers in southern Chile as well as dairy farmers. It was surprising to see how many farms lacked adopting technology and their reasons varied from poor internet connectivity, high investment costs and not practical for farmers to use.

**China** – I wanted to visit China to understand how the country had transformed itself from a poor economy to a prosperous smart economy. I visited many factories but also met British embassy staff, as well as the British Chamber of Commerce to better understand the Chinese business environment for UK companies. I met several individuals who had set up businesses within the agricultural sector in China. I was impressed by the technological advancement of the country, from their bullet train networks to their smart cities and clever online sale channels for food retail. I also visited a few agri-related accelerator programs that work with start-up companies to learn more about what qualities Chinese consumers look for in food products. I visited a few food retailers and asked questions to passing customers on their understanding of many of the imported dairy products. I wanted to meet and interview farmers however this was difficult to arrange.

**Denmark and Sweden**- I visited both of these Nordic countries as they are some of the most productive farmers in the world with limited and challenging farmland, especially Sweden as forestry is the country's biggest sector. The culture of innovation, creativity and entrepreneurship was evident across much of both countries. Both countries are also recipients of EU CAP funding but, meeting with some dairy farmers, they were confident that their businesses could survive outside subsidies as they had invested in other diversification projects. I



also visited the De Laval factory which manufactures milking equipment which is sold globally. This is one of Sweden's best examples of a farmer who went on to develop technology that could be turned into a global corporation. It was the fusion of his farming knowledge with his innovative engineering capabilities that created the world's first milk fat separator. I also visited Vaderstad and Sulky machinery manufacturers- again these were innovative farmers who utilised their knowledge of agriculture and turned it into creating innovative solutions in the form of Agri-tech and machinery implements.

**New Zealand** – I spent 3 days of personal travel on the North Island of New Zealand at the end of my GFP. During this period, I visited a few well established Agri-tech companies, many of whom were exporting globally and gained a good reputation with local farmers. One company that stood out was Novel Ideas Ltd: the owner manufactured innovative timer gates for grazing farms. It was small operation, which employed a small number of people. The aspect that stood out to me about New Zealand was that it has embraced subsidy free farming by putting innovative thinking throughout their entire industry: this is likely the main reason why companies like Frontera, Gallaghers etc. have become global corporations. I also met with a number of dairy farmers, many of whom agreed that the growth of their dairy industry could not have happened without the subsidy liberation in 1984.

**Great Britain** - I completed a short tour of England, Scotland and Wales in the UK to gain a better understanding of the viewpoints of farmers. Most of the dairy farmers interviewed said they had no faith in the UK government paying subsidies at the same rate as the EU in the medium to long term and they had no plan in place to replace the lost income. I also visited two of the UK Agri-tech centres to gain a better understanding of the current strategy to grow the Agri-tech sector after the UK government invested more than £90 million into research and development projects. Although it is in its Infancy, it was evident that there is too much focus on research and development, with not enough focus on financially monetizing the research. There also appears to be very little focus on supporting entrepreneurship or encouragement of start-up companies.

**Northern Ireland** – Of all the regions I visited within the UK, Northern Ireland lacked a clear strategy for making Agri-Tech a major economic contributor to the agricultural sector. I interviewed a few Agri-Tech start-ups who complained about the lack of research and development capabilities, especially around prototyping. Many also claimed that to get this expertise they usually had to travel to other parts of the UK or even further afield to make the projects work.

After travelling through almost 40 countries including the GFP focus countries, providing in-depth global perspective of a rich tapestry for my research and findings and through online Zoom interviews and face to face interviews I drew the following themes so that I could then start to conceptualise the findings for the Nuffield report.

- Global understanding of farm subsidies and their future role for farmers.



- Global pressures on farm competitiveness, with many common themes of climate change, threats from animal welfare groups, alternative diets, agriculture's demise as a proportion in Gross Domestic Product in many countries.
- The global public perception of agriculture, through the lenses of media, politics and environmental, activist.
- The emerging opportunities such as Agri-tech and how farmers could benefit.
- Understanding that innovation, entrepreneurship, strategic planning is key to long term viability to UK agriculture.
- The importance of scientists, universities and engineers within agriculture.

The next chapter explores the context within which agriculture is now working.



## 4. Context: Brexit a crisis or opportunity

### 4.1 Introduction

One aspect of agriculture that all farmers have experienced is “economic crisis” in one form or another. For decades agriculture has long been accustomed to boom to bust. That being said, farm subsidies have always been an important element of most farm business income and usually make up a large proportion of profit at the end of the accounting year and thus their survival.

In recent times, perhaps more so through globalization, agriculture commodities have been subject to the volatility of global markets, the reasons for this vary greatly, from examples of climate change, economic recessions, supply outstripping demand causing prices to collapse.

Whether a Remainer or Brexiter, it is hard to fault the EU, in their toolbox range of protectionist policies that for many farmers have been an economic safety net, whether intervention schemes for dairy products or the Single Farm Payment which encompassed so much of the CAP support that farmers have received. It is debatable whether EU farm support stifled innovation, entrepreneurship and productivity or whether it has ended up with those working the land, because the CAP payment system was designed to support small farm holdings, which in turn preserved rural economies and rural society: either way the EU policy towards agriculture had many flaws.

However British farmers will find great uncertainty in what lies ahead in terms of how caring the British government will be, not just in relation to subsidy supports but also how new trade deals will be negotiated with other countries and the ramifications this will have for British food and farming.

One certainty is clear, that UK agriculture will have to deal with a period of vast change in farm support policy, not seen for generations. Although the uncertainty brings its own challenges, the chance to reshape farm subsidy policy should be seen by many as a great opportunity. The theme that came to the fore throughout my travels was that in the absence of subsidies, it was innovation and entrepreneurship that could provide the route to achieving better returns, including adapting current production methods using Agri-tech.

### 4.2 The global government debt crisis.

One striking aspect from my travels was the concern from industry leaders about the sustainability of both government and private debt within the global economy. This led me to people who also shared a perspective that the high levels of government debt is a major concern for many developed and developing economies at a time when many western economies are grappling with weak economic growth, ageing demographics among taxpayers and ever-increasing demands on public services. This has since been compounded by the recent global outbreak of Covid-19, resulting in mass stimulus packages introduced by global governments to stave off a global economic depression but Covid-19 has also further slowed economic growth and further fueled government debt.

The UK economy has, of June 2020, racked up a sovereign debt of over 100% of GDP. This debt level has not been seen since World War II. It is clear from the graph below, that cuts to government spending will need to take effect at some point in the near future, which will have many ramifications for agriculture going forward. Figure 1 below illustrates that even before Covid-19 UK sovereign debt continued to soar since the Great Recession of 2008.

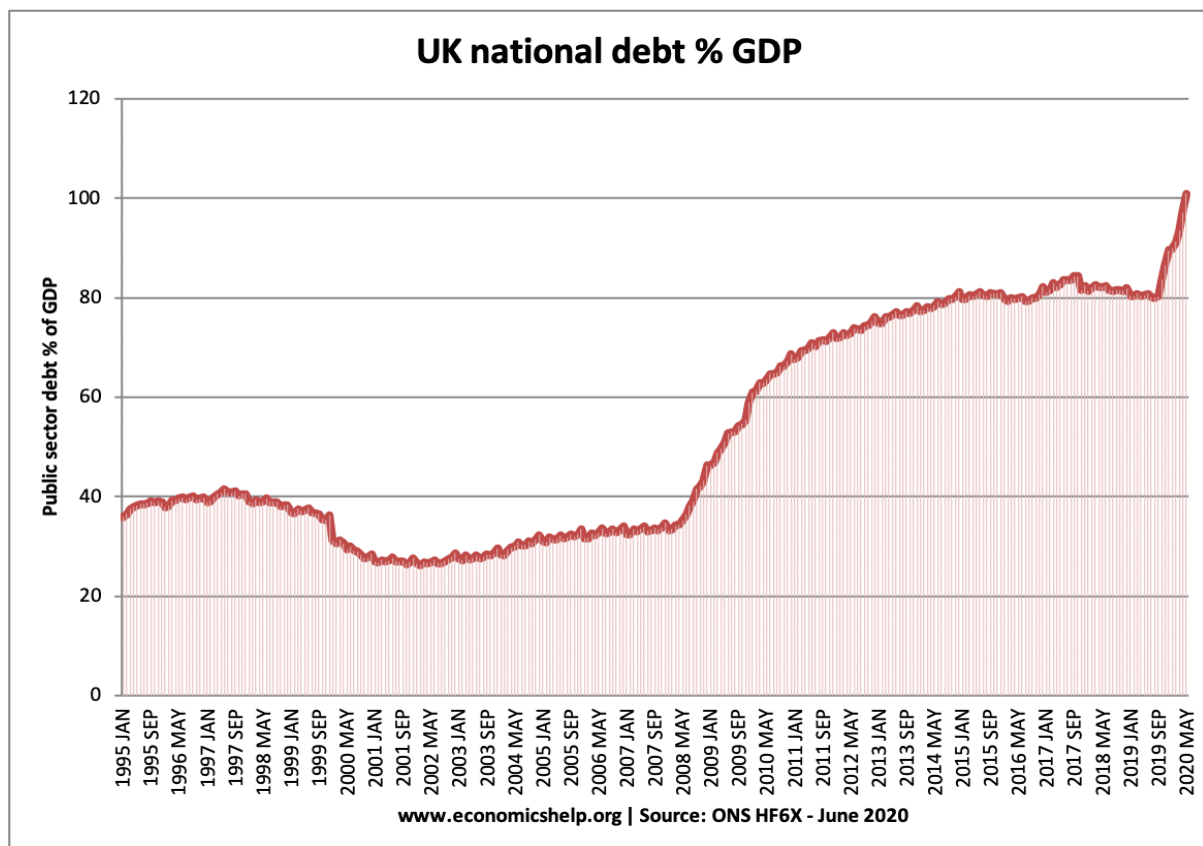


Figure 1: UK national debt %GDP

Source: Office of National Statistics

Agriculture makes up less than 1% of UK GDP, yet the current level of subsidies paid to UK farmers averaged £2.88 Billion per annum. This equates to an average income of £22,700 per farm in the UK.

For many UK farms, subsidies are the difference between making a healthy profit or making a loss. However, the financial fundamentals are no longer sustainable, in terms of the cost to taxpayers, record high sovereign debt and the value that the current subsidies system benefit to the wider UK economy. It could be argued that the UK government will need to make some very difficult decisions in terms of how much money is allocated to agriculture in the medium to long term. Agriculture subsidies will need to be targeted to sectors of agriculture that will give the greatest return on investment in terms of generating new income for farmers, whilst improving the positive environmental role that agriculture can have on UK agriculture.

My report aims to discuss how the UK government could support and incentivise farmers to take advantage of Agri-tech and its role in the 4th industrial revolution, which from my research travels proves one of the greatest opportunities for UK agriculture in decades.



### 4.3 The global micro and macro challenges facing farmers

Throughout my travels many common themes emerged within each country:

#### United States of America US (North America)

- Poor commodity prices - mainly linked to oversupply, lack of development of new export markets and the disruption caused by trade wars.
- Climate change – this is one of the main threats to US agriculture, increased frequency of extreme weather, drought, new pests and diseases both in crops and animals due to rise in temperatures.
- Availability of water as a resource - mainly due to increased population on the west and east coasts.
- Rise in alternative diets such as veganism – mainly from east and west coast.
- Rising government debt near 24 trillion dollars, highest in debt country in the world– major concern about how the country will afford to fund public services and farm subsidies in future.
- Emergence of Agri-tech as an economic driver in rural economy. Entrepreneurs using skillset and knowledge from Silicon Valley to advance start-ups and innovation in agriculture. Individual states pioneering new support measures to back Agri-tech to establish new companies.

#### Chile (South America)

- Chile has continued to develop its agriculture industry, with a strong focus on inward investment and expertise from overseas, especially New Zealand.
- Investment by Chilean government into start-up companies, accelerator programs, entrepreneur visas etc. to try and attract talent from across the world.
- Dairy industry very competitive and profitable on world markets, strong focus on growing export markets.
- Farmers operate with no subsidies but receive schemes that focus on return on investment for both the taxpayer and farming industry.

#### New Zealand (South Pacific)

- Strong industry and government backed strategy to make agriculture a key economic contributor.
- All subsidy support has been eliminated since the country faced economic ruin 1984.
- Dairy industry worth \$7.8 billion to NZ GDP.
- Clear strategic direction from both industry leaders and politicians to build a globally competitive and sustainable agriculture industry.



- High farmland values, making shared farming agreements the only viable way for youngsters to get into the industry.
- Increased government regulation to protect water quality from nitrates pollution and initiatives to protect the wider environment.
- Debt levels on farms are at record highs, making farms financially vulnerable
- Agri-tech emerging as a key growth sector for New Zealand economy - many established Agri-tech companies are within the livestock and pasture management sectors.
- Climate change affecting both North and South Islands, costs and installation of irrigation adding to cost of producing food in the years ahead.

### China (Asia)

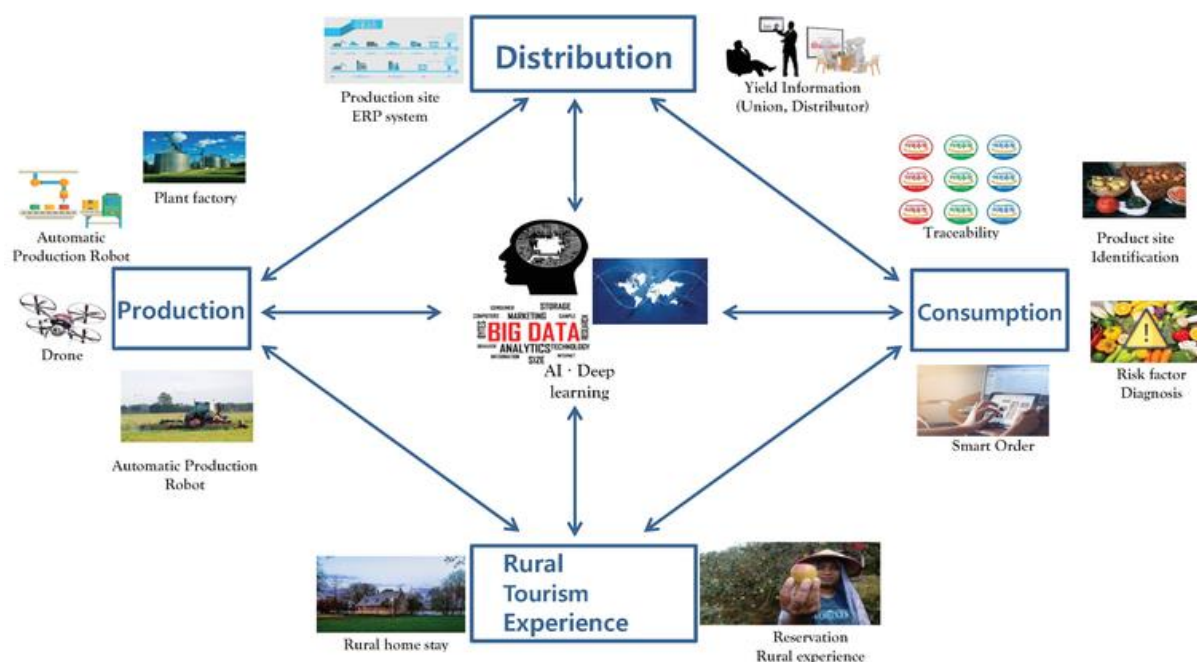
- Surging economic growth that has driven global demand for almost all commodities.
- Massive migration from rural areas into new and existing urban areas, with 90% of Chinese population predicted to live in urban centres by 2025.
- Environmental sector booming in China, as investment is pumped into cleaning up land, air and water quality from decades of unregulated pollution.
- 10 years ahead of many western economies with e-commerce of food sales the fastest growth of any other country in the world.
- The communist party continues to hold power over all government policy, diplomacy with countries around the world.
- Chinese agriculture income backed by large government subsidies, as opposed to being a competitive industry by global standards.
- Clean and reliable source of water now a huge issue for the Chinese population.

## 4.4 The 4<sup>th</sup> Industrial revolution (4IR) - Opportunities for UK farmers

The 4th industrial revolution(4IR) is described by the World Economic Forum as building upon the 3rd industrial revolution and is often referred to as the “internet of things”. The 4th revolution is characterised by the fusion of technologies, that is blurring the lines between the physical, digital and biological spheres. The World Economic Forum also suggests that the 4IR is emerging at a pace much faster than the previous three revolutions making it difficult for industry, governments and regulators to keep up with its development. (Klaus Schwab founder of World Economic Forum). The 4IR encompasses emerging and disruptive technologies such as artificial intelligence, smart technologies, blockchain to name just a few.



If the 4IR can be positively adopted within agriculture, it can have many positive benefits for every business throughout the agriculture supply chain. The technologies within the 4IR can help mitigate some of the challenges described in previous chapters in this report, particularly likely of which are reduction in agricultural support and the many marketing and trade, environmental, climate change and changing consumer tastes, whilst also providing new methods or processes for problem points within agriculture, both now and in the future. Figure 2 below illustrates this below.



**Figure 2 : Illustration of future agriculture with the Fourth Industrial Revolution**

(source: *Fourth Industrial Revolution and Agriculture*, Korea institute of planning and evaluation for technology in food, agriculture and forestry, 2016) [4].

When I started out on my travels, I wanted to be open to ideas and changes taking place within other parts of the global economy. I visited a diverse group of bodies, institutions, people and businesses, listed below.

- The world's top business schools, such as Berkeley and Stanford.
- The world's top tech companies such as Google, Microsoft etc.
- Talked with politicians, academics, economists, entrepreneurs.
- Global agriculture corporations, such as Alltech, John Deere, De Laval.
- Visited venture capitalists etc.
- Start-up companies.



- Accelerator business programmes.
- Agricultural universities.
- Food companies from artisan producers to global food corporations.

I believe that this approach of looking outside the traditional Nuffield box, has led me to a much better conclusion about my study. It became clear that innovation was the key to success of every other industry that I investigated, that industries that do not innovate either decline or disappear. It also became apparent that all industries are being disrupted by new technologies and that in many ways agriculture is still lagging behind in adopting them, in comparison to other industries. This approach led me to people who see that the 4IR as one of the best opportunities in generations to create new jobs, wealth and economic prosperity, whilst also advancing the living standards of the world population.

*“The fourth industrial revolution, a term coined by Klaus Schwab, founder and executive chairman of the World Economic Forum, describes a world where individuals move between digital domains and offline reality with the use of connected technology to enable and manage their lives.” (Miller 2015, 3)*

Almost every industry has had to innovate to stay relevant in today’s globalised economy. The industries or businesses that do not innovate are either slowly disappearing or no longer exist. A good example is the car industry, with companies such as Tesla, completely disrupting the traditional combustion engine car market with faster, environmentally friendly electric vehicles, so that many established car manufacturers have had to follow Tesla’s lead.

Agriculture has been described by many as a sunset industry, however another view is

the ***‘farmers who view the 4<sup>th</sup> industrial revolution as an opportunity will be the great disruptors that will define their industry for generations to come’.*** (Tom Shelby, California).

#### 4.5 Agri-Tech investment in the UK

Agri-tech contributes £14.3 billion to the UK economy, mainly in the form of computer aided cropping, e.g. drones, software, robotics etc. with over 500,000 people employed in the sector. The location in the UK with the most established success which I have seen during my travels within the Agri-tech sector is the Cambridge area and neighbouring counties in England. This is mainly due to the region being a highly productive cereal region and also home to several of the world’s leading agricultural research institutes in crop science, such as Rothamsted (Harpenden) where recent innovation includes crop disease mapping using drones. This has enabled the area to become world leading within the cereal sector, on new research within crop protection and development, thus becoming a cluster for Agri-tech entrepreneurs, farmers, scientists and innovators collaboratively working together to create new methods and technologies. Norwich Research Park is another great example of innovation combined with research, with recent projects such as genomic sequences of crop varieties to be more resistance to extreme weather such as drought. There also have been a number of business focused innovation hubs established in the region such as Agri-tech East located in Cambridge to further develop and facilitate new and existing Agri-tech companies and further develop the Agri-tech ecosystem through collaboration.



The UK Government has recognised the growth potential of the sector and in 2018 committed to investing £90 million. The aim of the investment is to:

- Develop Agri-tech innovation centres across the UK
- Harness research and development with universities and research institutions
- Encourage start-ups and entrepreneurialism within farming
- Develop new technologies and techniques within livestock, cereals, fruit and vegetable sectors
- Grow the wealth and number of employments within the Agri-tech sector.

The urgency for further investment to facilitate new innovations within UK agriculture has also become more important with recent shortages of key workers in the sector due to Brexit and the Covid pandemic. It is also worth pointing out that the Department of Agriculture (DEFRA) also clearly state that efficiency within UK agriculture is still lagging behind other parts of the UK economy. Tim Mordan, a deputy director of DEFRA recently said that “UK agriculture is 3 times less efficient than in other sectors of the UK economy”. This clearly makes the argument that there remains tremendous scope to further develop productivity through innovation within UK agriculture.

## Conclusions to Chapter 4

Chapter 4 outlined some of the key challenges facing agriculture, whilst also outlining the opportunities for agriculture within the 4<sup>th</sup> industrial revolution. UK Agri-tech has developed in parts of the country which have the most fertile land mainly cereal growing regions such as Cambridge; I believe there is now greater scope to adopt parts of the Cambridge model into other regions and farming sectors that are suited to for example livestock and the role that new Agri-tech solutions can be developed for.

Chapter 5 will examine successful Agri-Tech models that I learned about during my travels. It will also discuss the greater role that policy makers can make in providing the right conditions to incentivise more farmers to get involved within the 4IR, whilst also outlining current failures in the current UK approach to Agri-tech strategy.



## 5. Agri-tech around the world and in the UK

### 5.1. Introduction

Agriculture has never faced so many challenges, yet the solutions to these challenges will bring many new opportunities and will be found through innovation and the entrepreneurial spirit of the farming industry. This chapter will examine the approaches to Agri-tech in several of the countries I visited.

### 5.2 United States perspective: Illinois University model.

The United States has always been a leader when it comes to innovation. The culture of entrepreneurship is one of the most striking aspects about American culture. One of the highlights of my trip to the States was my visit to University of Illinois Urbana Champagne Research Park.

The Research Park comprises a University, Incubator, research and design facilities, corporate innovation centres and start-up Agri-Tech companies, all located on the same 200 acre site. The site has created over 2000 new jobs and continues to be at the forefront of economic growth in the state of Illinois and at the cutting edge of open innovation within Agri-tech.

The aim of the Research Park project was to build an ecosystem that would encourage the development through:

- New Agri-Tech start-ups,
- World class prototype facilities to benefit both start-ups and corporates.
- Harnessing the skills of research University staff.
- Creating new opportunities for graduates, with 70% of college graduates remaining in the state.
- Attracting global corporate partners to bring their research and development innovation centres to the park.
- Having all the facilities needed on campus for prototype development.

The results after 10 years of development is that it has become the third largest employer within the state of Illinois. It has also positioned itself as being among the best destinations in the USA for developing new Agri-Tech solutions. It is one of the best examples in the world with regards to the benefits of corporations, academia, start-ups and graduates all working in collaboration with each other to maximise the generation of innovative solutions. A few examples of the above points include companies such as Air-scout, which is a start-up company specialising in photographic sensors to improve crop feeding and spraying strategies, another is Agri-Water, a company which uses electrolysis that electrifies slurry manure into clean water.

With more than 120 companies attracted to the park, it is fast becoming a business cluster for corporates as the benefits of open innovation have enabled greater collaboration, idea generation and innovation of new products and processes that happens at a much faster rate than working in



isolation within the corporate world. Many companies that I talked with, acknowledged that large corporations have become slow to innovate in a globalised economy, mainly because they are simply too big to see disruptions in new technology, or changing customer trends. The research park with its innovation model, lets companies innovate much faster than if they were to complete R&D solely within their own organisations. There has also been a benefit for start-ups as more corporates have invested in graduates' technology, by investing or collaborating with the start-up founders on campus.

The university has also benefited by attracting over 50% of their students from countries outside the USA especially from India, South America and China. The cultural and knowledge expertise that they bring to the campus has also greatly benefited networking opportunities for exports from both the start-up Agri-tech companies and corporates. It is also worth noting that the corporate partners on campus are now able to benefit from a constant supply of highly educated graduates, whilst creating 700 new internships on site.

The interviews carried out with a number of start-ups on campus who did not wish to be identified, cited that they feel that they could not find better research expertise, prototyping facilities and the opportunity to partner with corporate partners anywhere else in the USA.

In conclusion, it is clear that the directors that have grown the research park have got the correct mix of innovation, collaboration and entrepreneurship to allow the park to flourish in the years ahead. When asked to sum up how they see the project develop in the near future, they commented "attracting more overseas students and continuing to build strong relationships with Agro corporates would be key to its sustainability".

### 5.3 Nordic countries' perspective

The main take home message from visiting the Nordic countries has been the ability of ordinary farmers to innovate by creating solutions to problems that they had experience of on their own farms. The Nordic countries have many examples of how farmers turned their ideas into small companies, while others build their businesses into global corporations.

#### 5.3.1 Aarhus Agro Food Park (Denmark)

The Agro Food Park in Aarhus, Denmark, is the Danish answer to innovate their agricultural industry, founded in 2009 by the Danish government. It has grown to over 75 companies, 25 of which are start-ups. The Park has also created over 1000 new jobs since its inception. The mission is to work with the academic community throughout Denmark to further develop their Agri-tech sector. The strategy for the future of the park is to further encourage more Start-up companies from across the EU to base their companies on site. The Park has developed and incubator with all the R and D facilities including office space for a very small monthly fee. The Park has decided not to invest in start-ups directly but instead provides a match making service, matching investors with the right start-ups.

Directors at the Park hope to attract more corporate tenants to the site in the near future. Companies such as Coopex genetics and Arla foods, have already based their global innovation centres on site and have said they are already seeing the benefits, as corporates have developed



synergies and collaborative relationships with start-ups to develop new products, of conducting open processes and idea formations with smaller start-up Agri-tech entrepreneurs.

### 5.3.2 Vaderstad Tillage manufacture (Denmark)

Vaderstad is a cultivation manufacturing company founded by the Stark family in the early 1960's. Rune Stark founded the company on his small 30 hectare farm. He began by manufacturing spring tine harrows and the company, which is still privately owned by the same company, has moved into a full product range for cultivation machinery.

The ethos from the Stark family is still to work closely with farmers in order to innovate their products. The company headquarters and factory are still located on the family farm. The efficiency of the factory floor is one best that I have ever seen. Although I was not allowed to take photographs touring the factory, the company had many examples of innovation and process improvement that are key to developing great innovative products. All research and development work is mainly completed within the company, however some academic staff from Danish universities help to fine tune or come up with new methods for products or product improvement.

### 5.3.3 De Laval (Sweden)

De Laval was founded 130 years ago by the visionary Gustaf de Laval who was a Swedish engineer. The company has been at the forefront of innovating the dairy industry and are leaders in the development of robotic milking. Today the company employs 4600 people, with a net sale of 1.1 billion euro.

Central to the Innovation of the De Laval range of products is Hamra farm. It was purchased in 1894 by the founder Gustaf De Laval. Gustaf recognised that to create brilliant products they had to be trialed and tested on a working dairy farm. This ethos remains today, and the Hamra farm is De Laval's global centre for research and development. It's fair to say that innovation remains at the heart of why De Laval is a global leader on Agri-tech within the livestock sector.

I spent one day visiting the De Laval factory, which manufactures their robotic milking range, however the highlight was the visit to Hamra farm, located a field length from the factory. It remains the finest examples in the planet that, if you want to create a successful Agri-tech company, then the close relationship with farms is crucial. As one of the factory tour guides told me "You cannot develop products for a dairy farm in an office, the trials and research on Hamra Farm is where the real innovation happens."

### 5.4 Livestock Agri-Tech Entrepreneur based in UK

I interviewed a young Agri-Tech entrepreneur from the UK, who asked me to keep his identity anonymous, so for the purpose of the report he will be identified as AB. I asked AB, what his experience was with trialing his product with farmers "I don't have the luxury of trialing my product on my own farm as I don't come from a farming background. I find farmers can be very dismissive of new technology even before they try it out". AB went on to comment that there should be more incentives for farmers in the UK to buy into start-up companies.

AB also said that there remains "too strong a focus on research and development within the new four Agri-Tech innovation centres and not enough on commercialising the work carried out into spin-



out companies". AB also was asked if he felt if the four new Agri-tech centres had been of benefit to developing his product: he commented there was "too much focus within England and much more needs to be done to spread the benefits of the £90 million investment infrastructure to other regions of the UK, especially in the livestock sectors".

I discovered from talking with a number of other Agri-tech start-ups based in Scotland, Wales and Northern Ireland that better access is needed for research and development of prototype products. A similar answer also came up that better access to academic and design expertise within the Agri-tech sector is needed to help innovate new products or processes. From talking with a few Agri-tech start-ups in England they were reasonably content with the access to both Agri-tech knowledge for both design and technical support, mainly delivered through the Agri-tech Innovation centres. Most of these individuals asked to remain anonymous giving their views for reasons that I am unaware of.

### 5.5 Agri-Tech - is the UK an innovator?

The UK has long been known for being an innovator in agriculture. The country has established itself as a leader in cutting edge research, especially in crop and animal science.

According to Agfunder Data, "the UK was the third most active country for agri-food and Agri tech start-up funding in 2017 as start-ups raised over \$500 million in 2017 across 69 deals."

As mentioned, the UK government has also invested in the sector with the 4 new Agri-tech centres and a total investment of £90 million. The new Agri-tech centres offer many opportunities for start-ups to trial, create and design new products and techniques.

It is however disappointing to see that although much investment has been made in research and infrastructure to carry the research out, very little emphasis has been placed on commercialising this intellectual property into new products or services. It is fair to also point out that much more could be done to encourage investors and entrepreneurs in the UK to exploit the establishment of new spin-out companies that would better monetise the results of the research that has already been undertaken by agricultural research facilities from around the UK. I found that there is also a much less involvement in the sector from farmers compared to other countries I had visited: there are clear opportunities for farmers to become more entrepreneurial within the sector as they have a grassroots understanding of the real issues holding back UK farm productivity.

### 5.6 Conclusions from Chapter 5

To summarise there are many ways which Agri-Tech has already benefitted agriculture. Innovation, collaboration and entrepreneurial spirit are the recurring themes from talking with many individuals about what is needed to build a flourishing Agri-Tech sector. It is also worth saying that no two countries are the same in their approach to growing their Agri-Tech sector.

It is clear however, that there are many opportunities for farmers to collaborate with Agri-Tech start-ups that would be mutually beneficial. This will be discussed further in Chapter 6.



## 6. Discussion: How can farmers play a key role in Agri-tech in the UK?

### 6.1 Introduction

The previous chapter discussed what is taking place globally from within Agri-Tech development within various countries. It's clear from my Nuffield trip that many countries are following similar strategies, with regards to developing the Agri-Tech sector. The similar strategy has been for innovation hubs to be established to allow for the collaboration to take place between researchers, start-ups, corporate partners all in one location. This seems to be the case in many western economies, with the model being imitated from similar cluster models in other industries in North America and Northern Europe. The inclusion of Accelerator programmes (see 6.3) and incubators has been a more recent strategy to enable companies with the best chance of surviving to go on to bid for investment.

### 6.2 Farmer Involvement in Agri-Tech start-ups

Throughout my travels, the most successful Agri-Tech companies that survived were formed by people who were farmers or had a member of their family farming. The main benefits to this were:

1. It gives privacy to protect the intellectual property of a new idea or product, which has been a major legal issue for many tech start-ups within other sectors.
2. They can leverage their 'grassroots' knowledge of the problems in the agri sector whilst utilising their farm asset as a way of perfecting and trialing a prototype product or process at a much cheaper cost than someone from a non-farming background.
3. It gives the founder the opportunity to protect a product's reputation before launching it into the market, by ensuring it is fit for market. As one entrepreneur in New Zealand said "Farmers usually buy new products based on recommendations from other farmers. If a product is good, they tell a few other farmers, if a product is bad, they tell everyone"

The actual practicality of new Agri-Tech products being useable by farmers remains the major issue to the survival of new companies. This is mainly due to the founders of companies coming from outside agriculture and failing to understand how the product works on farm. As Tim Garrison, a USA Agri-tech entrepreneur, commented "You have to build a new Agri-Tech product from the farm up if you want to succeed".

It's clear from my Nuffield travels that many countries have yet to realise the opportunities of Agri-Tech. Many Agri-Tech start-ups were founded by people without any farming background. This has made their task of creating a practical product and defining their concept much harder. It was also clear from talking with start-ups in the USA, that they found it difficult to sell their product to farmers. This can be a daunting task to break into a new market as farmers buy products mainly on recommendations from other farmers.

### 6.3 Accelerator programmes and Venture capitalists.

**6.3.1** The role of accelerator programmes cannot be underestimated in helping to establish successful Agri-Tech start-ups. Accelerator programmes aim to select competitively the most viable



business ideas and put their founders through intense training and address the rationalisation of their product or service and how it will work in the marketplace. Such programmes also prepare start-ups on how to pitch their business to potential investors and the programme which can last 12 months. The Programme organisers have found that venture capitalists are much more likely to invest in an Agri-Tech that has completed the programme.

I visited several accelerators in Silicon Valley (California USA), which has many successful models, as well as one in Chile and one in Denmark. It emerged from my travels that the USA had the most progressive and innovative accelerators, especially in the Silicon Valley area mainly because of the entrepreneur and start-up culture that exists in the locality which has been built on during the tech boom throughout this past 25 years.

**6.3.2.USA** The most progressive and most sought-after programme is the Thrive programme run by SVG ventures, based in San Jose area of southern California. The accelerator is solely specialised within Agri-Tech and Food-Tech sectors and has built up a reputation as a world leader within the sector. The programme takes in applicants from around the globe to take part in their programme: from the many hundreds of applicants that apply to get onto the programme each year, just 3% are accepted into the yearly cohort. SVG ventures has successfully closed the loop within Agri-Tech by bringing start-ups, corporate partners, universities and venture capitalists into one platform that can grow as one. The main attraction for overseas start-ups is the access that they have to tech companies in Silicon Valley, as well as SVG'S technical expertise and access to investors. Thrive has also built up a vast global ecosystem within Agri-tech which they have established over the last decade.

*Case study:* Mika Jha, founder and CEO of Agshift has taken part in the Thrive programme. Agshift is a leading artificial intelligence automation platform for food quality assessment. Mika says "It was through Thrive we got a key introduction to Driscolls - the world's largest berry organisation. This connection to Driscolls was key to us as Driscolls validated Agshift's value proposition for the food supply chain." In essence Driscolls, by using AGshift's artificial intelligence technology, showed that it improved the overall quality of food products by taking poor quality goods out of the line, as well as reducing human labour requirements for production line inspections and doing inspections more quickly and accurately.

**6.3.3 Chile** When I travelled to Santiago, Chile, I visited an incubator/accelerator called Start-up Chile, which had many Agri-Tech start-ups: out of nearly 2000 start-up companies across many industries, 54% of these companies are actively trading. It is widely recognised as the Silicon Valley of South America. The programme director explained to me that the project was 100% funded by the Chilean government, with the equity remaining 100% with the start-up founders. The programme has been established for over 10 years and has a total valuation of \$2 Billion.

The platform had many co-working spaces, prototype labs and accelerator courses, all free of charge to the participants. The programme also had attracted applicants globally from 83 countries, with the chance to gain an entrepreneur visa, if they set their company up within Chile. The main aim for the Chilean government was to create a culture where innovation could flourish through entrepreneurship.



Although the 100% government backed initiative had people involved in start-ups from various industries, it was of interest to my Nuffield research as it was the only example that I had seen globally of various industries working in the same location. This had collaborative and knowledge transfer benefits as, from speaking to an Agri-tech company at the facility, they commented that if they had a problem about, for example, designing an electrical component there would likely be someone within the area that could be asked for advice or guidance to help them solve their problem and also vice versa. It was however worth noting that many of these companies were already well past the research and development stage and were very much ready to launch their product to the market, which greatly reduced the risk for both the government and start-ups.

The conclusion to take from the Chilean model is that Agri-tech cannot work in isolation and more initiatives in the UK should look to how knowledge and expertise can be better shared across all industries for the benefit of the entire UK economy.

## Conclusions for Chapter 6

It's clear that many opportunities still exist for the UK to further innovate their Agri-Tech sector. The UK has got a good variety of farming sectors and a long history within agriculture, compared with other countries. The UK also has a world class research and scientific community with some of the most respected and highest ranked universities globally.

It's also clear from my travels that the global economy is undergoing major macro and micro environmental changes. Almost every industry is undergoing major innovation disruption and agriculture will undoubtedly be no different. The Covid-19 crisis has further pushed the world economy into the realm of the 4<sup>th</sup> industrial revolution. It is the responsibility of all stakeholders within UK agriculture to seize the opportunity to make the UK Agri-Tech sector a leader in this new era, through innovation and technology.

This opportunity comes at a time when the world population continues to increase, pressures on public finances continue to build and unemployment continues to rise. The UK government has the first opportunity in generations to redesign agricultural policy that has innovation at its core. Farmers across the UK have become over-reliant on CAP subsidies, at a time when government finances are being stretched to their limit. It is now up to farm leaders, policy makers and politicians to ensure that spending of taxpayers' money on agricultural policies must include making the best opportunities of the 4th industrial revolution by placing Agri-Tech as a key sector growth sector.

While I found that it was felt that farmers could be unresponsive to interesting changes created by outsiders to the sector, I found very few examples where significant steps had been taken to engage farmers in the development of Agri-tech. If the benefits of Agri-tech are to be taken up across the sector, farmers need to have much greater involvement in helping create tools that can be adopted widely. As there is likely to be a cost to farmers for engaging in this without necessarily a guarantee of a return but, positive outcomes would benefit the sector and the nations productivity, Government policy could include financial encouragement for engagement at the development stage of new product ideas.



## 7. Conclusions

Throughout my Nuffield travels, I researched far and wide to try and get a concise answer to one question “what are the key opportunities for farmers in the UK to benefit from the 4th industrial revolution”

1. There is clearly no one answer to the above question; however, one certainty is that the world economy is changing fast and, as I discussed in previous chapters, there are many challenges that will affect farmers income in the near future. The policies of the past 40-50 years of farmers being given subsidies with little or no emphasis on return on investment for the taxpayer are quickly coming to an end. Governments across the globe are now in a precarious situation, with slow to no economic growth, over-leveraged public debt and strain on all publicly funded services.
2. At no point do I want to undervalue the great work farmers do for the UK public, however I firmly believe that farmers’ income dependence on farm subsidies needs to change, especially with the expectation of many in agriculture that farm subsidies should continue at the same level as they were within the EU. I believe that it is clear that this expectation is wishful thinking given the current constraints on public finances. We have to find solutions to this by looking at innovative new approaches as to how new policies can be shaped to allow agriculture to remain valued both in terms of GDP figures and by the British public. I believe that at least 25% of the current farm support budget should be channeled through business start-up grants to those farmers who are willing to innovate new products and processes in collaboration with their farming business that will in turn further grow the value of UK Agri-tech sector.
3. A new strategy that harnesses the opportunities of the 4<sup>th</sup> industrial revolution through the Agri-Tech sector should form a part of any new farming policy, with farmer involvement at its core. This will require a change in culture by every stakeholder within agriculture including farmers, but it will also require a new approach by government and how public funding is invested within agriculture. Further discussion is required about whether there should be a UK wide strategy for a new approach to Agri-Tech or if it should be left a matter for the devolved governments of the Scotland, Wales and Northern Ireland.
4. There is no one Agri-Tech model that any country has developed that is a one size fits all, instead it is about taking the best ideas from around the world and implementing them or improving the existing approach. The lack of farmer involvement has emerged as an issue in all countries I visited. There is an opportunity for the UK to lead the world in this regard. Changing farmer attitudes to adopt a more innovative and entrepreneurial spirit will be two of the key elements required to make UK Agri-Tech world leading, alongside a change in government farm support policy that will incentivise the farmer culture change towards the benefits of Agri-tech.
5. There also emerged a disparity across the regions of the UK with regards to the current strategy for Agri-Tech. All four Innovation Agri-Tech centres are based in England for example. Each UK country should have its own Agri-Tech centre that allows for greater collaboration with start-ups and corporate partners within their region: by not establishing the Agri-tech centres in all regions within



the UK, this is also failing to enable and encourage greater collaboration between the various stakeholders in agriculture, compared with other countries such as the examples in the USA.

**To summarise,** the main areas that have emerged from this Nuffield report are:

- The Agri-Tech sector needs more involvement with farmers, through a more collaborative approach. Many countries I visited have a similar issue to be addressed if they want the Agri-Tech sector to progress.
- Government Policy, either at Westminster level or devolved governments within the UK, must spearhead a new range of policies that will enable investment in Agri-Tech to flourish, while adopting a new subsidy system that will encourage farmers to participate in terms of innovation and entrepreneurship.

The points mentioned above are the main issues that have emerged from my research across many countries.

Chapter 8 will identify the main stakeholders and give recommendations on how they could improve the current Agri-tech strategy within the UK.



## 8.Recommendations

In this chapter the main stakeholders are identified and recommendations for each stakeholder listed.

### 8.1 Government

- Give farmers 100% capital allowance tax relief on innovation projects to create new Agri-Tech products, to encourage more start-ups coming from farmers.
- Allocate a certain percentage of the total subsidy spend to the Agri-Tech innovation vouchers, again to encourage more farmers to establish start-up Agri-Tech companies. This would encourage more innovation and entrepreneurship.
- Develop a scheme that would give farmers tax incentives to collaborate through open innovation with Agri-Tech entrepreneurs, who may not come from farming backgrounds or have the farm infrastructure to trial new technologies.
- Each country of the UK should have its own Agri-Tech Innovation centre, this would give start-ups and corporate partners better access to the facilities and expertise they need in their locality, the University of Illinois example is a successful example of farmer involvement.
- Develop four special economic special zones (one in each UK country) with a 10% corporate tax rate dedicated to Agri-Tech. This would encourage global corporates to establish in the UK, encourage open innovation with start-ups and provide thousands of new high skilled jobs. It would also boost investment within the scientific and research community in our universities.

### 8.2 Farmers

- Farm organisations such as the Farmers' Union, should establish a working group to discuss a strategy for more collaboration between farmers and within the Agri-Tech sector.
- Farmers should be encouraged to take advantage of opportunities of any new government policies that exist within the Agri-Tech sector and within the 4<sup>th</sup> Industrial revolution.
- Farmers need to recognise that farm subsidies policies of the past 40 years will be unsustainable in the current or future economic climate. There needs to be a shift to move towards taxpayer's money being invested for the long-term return on investment
- Farmers need to be more open to working collaboratively with new Agri-Tech companies, research institutions, universities etc. The main benefits to farmers are innovating current farming methods that in turn enhance productivity and profitability, whilst also having the opportunities to invest in potential start-up companies either in their own product idea or through collaboration with others.



- Development of a farmer-led venture capital fund that would invest in Agri-Tech companies, and this could make up any future shortfall in income from subsidies, through income from dividends etc.

### 8.3 Universities and research institutions

- The role of universities is crucial to the Agri-Tech sector, the expertise and knowledge they provide remain a vital component of growing the sector. Access to knowledge and commercialising of existing research should be a top priority.
- A more collaborative approach is required to work with farmers, corporates, Agri-tech start-ups and other research institutions both in the UK and globally.
- Work with government both at Westminster level and devolved, to establish innovation centres that can be used to benefit the academic research sector and the other stakeholders mentioned.
- The role of a business school to the Agri-tech sector emerged as an issue within other countries as well as within the UK. The UK's top ranked business schools should be part of training farmers and start-ups with the skills required.
- Dedicated Agri-Tech courses designed to skill students to study artificial intelligence, robotics etc.

### 8.4 Venture capitalists and accelerator programmes

- The role of venture capitalists is vital, however there are few dedicated Agri-Tech funds from within the UK.
- Establishment of a dedicated fund could be farmer-led, through a similar model to the co-operative movement, where farmers could share in dividends as start-up companies grow into mature corporations.
- It is vital for the development of the sector to have access to credit.
- Establishment of a dedicated Agri-Tech accelerator that is integrated with Venture capitalists such as the Thrive/SVG ventures example, should be encouraged within the UK.

### 8.5 Corporates

- The role of corporates developing Agri-Tech through open innovation cannot be underestimated. They bring expertise, knowledge and experience that can be vital to start-up entrepreneurs.
- Corporates should be encouraged to dedicate more of their research and design budget towards open innovation projects similar to that mention earlier in the report.



## 9. After my scholarship

My life has changed so much from I started out on this incredible journey, I have gained an in depth knowledge of global agriculture, the opportunities and the challenges. I would say it has given me a 10 year leap with regards to the knowledge that I have gained.

I believe that Nuffield has exceeded my expectations, I know that the skills I have learned will ensure that my farming business will continue on a fast growth trajectory in the years ahead, whilst also helping my community and hopefully adding in a small way back to my industry. The experience has also added to personal growth, I have learned to build resilience and to never take life for granted.

I would also add, I now see the world very differently to before my scholarship. It has been invaluable learning about the many cultures, races, religions, politics and economic and social policies that make the world such a dynamic and enjoyable place to live in today. For the kindness, humility and knowledge that people have shown me throughout my travels I will be eternally grateful.

My farming continues to grow and expand with a very clear strategy for further growth, I have also gone on to set up a second company that will create Agri-Tech products, whilst utilising the asset of having my own farm to trial it on.

I have also been asked to speak throughout the UK and indeed the world to talk and share what I have learned. I hope that this can influence in a small way the direction that UK farm policy will take after Brexit.

I feel incredibly grateful to have had the opportunity to complete a Nuffield scholarship and I believe that what I have learned will shape the rest of life and fulfil my full potential.



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Barry O'Boyle



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Southill Farm, Staple Fitzpaine, Taunton, TA3 5SH  
T: 01460 234012 | E: [director@nuffieldscholar.org](mailto:director@nuffieldscholar.org)

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