



# Digital Knowledge Transfer Platforms to Initiate On-farm Change

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## Executive summary

The objective of this report is to identify effective knowledge transfer platforms to initiate on-farm change of practice to ensure farm viability.

The agricultural industry in Ireland is facing a period of challenges and opportunities. These include the age profile of farmers, the abolition of milk quotas, farm scale and fragmentation, the ambitious Food Harvest 2020 targets, economic austerity, market volatility, and the restructuring of CAP to name but a few. The Irish family farm is no longer operating in a protected environment with relatively stable income and low risk, but is now competing in the global market against farmers that have operated in an 'unprotected' environment for decades, most notably Australian, New Zealand and American farmers. While the author strongly believes the raw materials for Ireland to become a world leader in sustainable food production are present, we must first provide the resources to unlock the human potential that exists within our industry.

*'An investment in Knowledge pays the best interest'*

- Benjamin Franklin

Traditional extension methods (print, face to face, etc.) have been shown to be resource inefficient and are over reliant on an ineffective top-down information-push model to initiate change. The rapid advances in information and communications technology have laid the foundations for moving agricultural research and extension into the digital age.

Industry stakeholders must coordinate their efforts to develop a web-based knowledge management system that would compile information from all the relevant sources and act as a single point of contact to farmers. This digital resource would have the capability of personalising and targeting content for every user, organising and storing user specific information, and enhancing knowledge transfer by using more interactive and engaging media. The benefit to the farmer is simplicity and convenience by making targeted information available in a timely manner and in a format that best aids adoption. The benefit to the industry is more effective use of information and resources, opening up direct channels of communication to farmers and complementing the existing extension services.

Global agriculture is undergoing a technological revolution known as precision farming. Evolving technologies (phone apps, GPS, micro-sensors, satellite imaging, and wireless networks) enable recording, analysis and interpretation of on-farm data. This datification of agriculture provides farmers with quantifiable information to make timely decisions and monitor the outcomes of those decisions. It enables farmers to continuously measure, react, and monitor.

There is a need for the Irish agricultural industry to take a leadership role and develop a strategic plan to incorporate these technologies into farming practices. Industry guidelines must be established regarding standardising data formats to enable universal data storage and sharing capabilities. There is a requirement to develop an industry good online database that has the capability of storing and exchanging farm data from multiple sources. This database would be an evolution of the CMMS/ICBF database that currently is responsible for capturing animal specific data for compliance and genetic evaluation purposes. Expanding the capabilities of this database to capture all available precision agriculture data (GPS, Satellite imagery, Micro-Sensor, etc.) creates a comprehensive dataset for analysis and interpretation. Integrating and coordinating; data capture (precision Agriculture suppliers), data storage (Online database), and data interpretation (Knowledge Hub), enables robust data analysis/modelling to deliver quality decision support systems to farmers. By developing an industry good database, data is controlled by farmers. This ownership enables sharing of data to other agricultural applications or extension services, which encourages competition, innovation and added value to the raw data.

# Introduction

Farming is one of the most challenging professions that exists. To succeed, one must exploit favourable climatic conditions and be fully prepared for unfavourable climatic conditions, manipulate biological processes, produce high quality, wholesome and safe foods for consumers, while returning a profit for your endeavour. At any one time a farmer requires the skills of a veterinarian, nutritionist, agronomist, meteorologist, botanist, engineer, financier, psychologist, among many more.

The knowledge required to master these skills may have been obtained as early as one could walk or carry a bucket. As history has shown, one can never stop learning and re-learning because farming is forever evolving. This is especially true in Ireland where changes in the CAP, the abolition of milk quotas, and the lofty targets of the Food Harvest 2020 report will force Irish farmers to up-skill in all facets of their business in order to grow. It is this necessity to unlock the human potential that will define this era of opportunity in Irish agriculture as a success or failure.

*'Today's best is not good enough for tomorrow'* <sup>1</sup>

From my own experience, the ability to make informed decisions gives you control over where you want to take your life. As a dairy farmer, my education started on my home farm, where the everyday skills that could easily be taken for granted were developed. The practical was married with theory when I studied Agricultural Science in University College Dublin and later completed a PhD in Teagasc Moorepark, before returning home to farm. It is said that travel broadens the mind, and Nuffield not only gave me the opportunity to travel but also to meet so many inspirational people and share such great experiences. A recurring message from the people I have met is that farming, like any other business is centred around people. The industry will thrive when the individuals thrive, but our industry has neglected personal development. As a full time dairy farmer who has previously carried out research and extension, I have experienced both sides of knowledge transfer, as a provider and as an end user. This report is the accumulation of what I have learned over

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<sup>1</sup> Franklin Roosevelt's Annual Address to Congress - The "Four Freedoms" January 6, 1941

the course of my career and how it has been reshaped and refined due to my Nuffield experience.



# Report Objectives

The core objectives of this report are:

1. to summarise and interpret the expert opinion and services of global agricultural extension providers and industry leaders;
2. to identify novel ways to improve the creation and flow of knowledge within the Irish Agri-Food industry;
3. to provide ideas and a vision for the future direction of agri-extension and knowledge management systems that will help Irish farmers fulfil their potential.

With a view of achieving these objectives this report aims to:

- Outline the characteristics of the Irish Agri-Food industry. Establish its contribution to the wider economy and identify the challenges and opportunities for the industry going forward.
- Summarise the provision of research, development and extension programs being carried out in Ireland. Evaluate the role of the various service providers in transferring knowledge and identify their use of web-based services.
- Identify the constraints to best practice adoption by farmers. Highlight the importance of knowledge transfer method, message and source in initiating on-farm change. Suggest ways to overcome barriers.
- Evaluate the use of digital technology in enabling knowledge flow. Identify how this technology could operate within an Irish context and establish the level of industry coordination to maximise the potential benefits of these technologies.
- Discuss the role and implications of precision agriculture and the datification of farming. Provide ideas regarding the development of a

high level industry strategy to encourage innovation and harness the potential of precision agriculture.

## Methodology

My study topic was ‘effective knowledge transfer platforms’, which comprised seven months of travel, research and reflection. The author travelled to Holland, Australia, New Zealand and Taiwan. On these trips, interviews with agricultural industry representatives, research and extension service providers, and farmers were conducted. The purpose of these interviews was to identify novel methods of disseminating information, both currently practiced and future technologies in development, and discussing their merits and limitations. In addition, by giving an overview of the Irish agricultural sector, it was discussed how best these technologies could be incorporated within an Irish context. No one country or organisation has an exact blueprint for knowledge transfer that could be replicated in Ireland. This report attempts to combine the some of their strengths, to provide innovative ideas and provoke further debate on the future direction of agricultural knowledge transfer in Ireland.

Below is a brief summary of the organisations visited, their role and a guide to the services they provide.

### Ireland

**Teagasc** is the agriculture and food development authority in Ireland. Its mission is to support science-based innovation in the agri-food sector. Link: [www.teagasc.ie](http://www.teagasc.ie)

**Irish Farmers Journal** is the only Agricultural publication that operates as a legal Trust. The only mandate is to provide the best possible technical support, market information and news to the Irish agri – sector. Link: [www.farmersjournal.ie](http://www.farmersjournal.ie)

### Holland

**Wageningen University and Research (WUR)** is a world class research and education institute specialising in the field of food production and healthy living. Wageningen UR occupies a prominent ranking in the international rankings and citation indexes. Link: [www.wageningenur.nl](http://www.wageningenur.nl)

**Progis Software** is a software developer of geographic information systems (GIS). Services include the development of applications for precision and virtual farming. Link: [www.progis.com](http://www.progis.com)

## **Australia**

**Dairy Australia** is an industry owned research and development organisation, equally funded by farmer levies and government supports. It is an investment arm of the dairy industry. Its extension and change management unit provides programs such as Countdown and Incalf, and is also involved in developing focus farms and dairy business networks. Link: [www.dairyaustralia.com.au](http://www.dairyaustralia.com.au)

**Agworld** is a global leader in farm management software. They specialise in web-based data capture, decision support systems and communication technologies for farmers. Link: [www.agworld.com.au](http://www.agworld.com.au)

**GippsDairy** is a not-for-profit research, development and extension service operating in Gippsland, Victoria. It provides on the ground extension, hosts conferences and publishes newsletters. Link: [www.gippsdairy.com.au](http://www.gippsdairy.com.au)

**The University of Melbourne** offers third level teaching and research to the agricultural industry through the department of Agriculture and Food Systems Link: [www.unimelb.edu.au](http://www.unimelb.edu.au)

**Grains Development and Research Corporation (GDRC)** is responsible for planning, investing and overseeing RD&E to deliver services to the Australian grains industry. GDRC is funded by grower levies and the Australian government. They provide a comprehensive extension program with growing emphasis on digital delivery platforms. Link: [www.gdrc.com.au](http://www.gdrc.com.au)

**The Department of Environment and Primary Industries** is a government agency responsible for the coordinated management of the state of Victoria's natural resources. Within agriculture the DEPI provides research and extension services through its many research centres. Ellinbank is the research centre for dairy production. Link: [www.depi.vic.gov.au](http://www.depi.vic.gov.au)

**The Futurebeef, eExtension Unit** is a collaboration between government departments and Meat and Livestock Australia to support profitable productivity gains for beef farmers. It focuses on initiating on-farm change

through use of workshops, demonstration sites, forums, videos and publications. Link: [www.futurebeef.com.au](http://www.futurebeef.com.au)

**Plan2Profit Agri** is a privately owned company offering hands on and cloud based farm business management training, software and advisory services. Link: [www.plan2profitagri.com.au](http://www.plan2profitagri.com.au)

## **New Zealand**

**Massy University** offers undergraduate and postgraduate courses and performs leading-edge research through the department of Veterinary, Animal and Biomedical Sciences offers. Link: [www.massey.ac.nz](http://www.massey.ac.nz)

**One Farm** is a joint venture between industry partners, and is the centre of research and education for farm business management. It provides traditional forms of knowledge transfer, but has developed multiple digital mechanisms to engage with farmers. Link: [www.onefarm.ac.nz](http://www.onefarm.ac.nz)

**Livestock Improvement Corporation** is New Zealand's leading dairy breeding company. They deliver genetic gain, research, and farm management solutions to dairy farmers. Their extension services range from in the field advisors (Farmwise) to farm management technology (MINDA, Farmkeeper). Link: [www.lic.co.nz](http://www.lic.co.nz)

**DairyNZ** is an industry good research and extension organisation, funded by farmers and government support. Their purpose is to enhance the sustainable profitability of New Zealand dairy farmers. They provide an array of extension services from face to face to web-based tools and resources. Link: [www.dairynz.co.nz](http://www.dairynz.co.nz)

**Agresearch** is a state owned research and development company, whose purpose is the enhance New Zealand's Agri-Food sector through the provision of research and extension in partnership with industry stakeholders. Link: [www.agresearch.co.nz](http://www.agresearch.co.nz)

## **Taiwan**

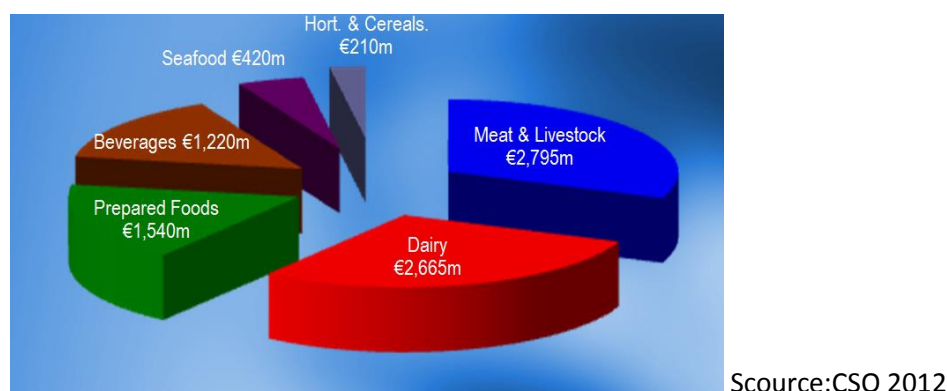
I attended the **Asian Federation for Information Technology in Agriculture / World Conference on Computers in Agriculture 2012**. The three day event covered topics such as eAgriculture, data sharing, precision agriculture, remote

micro sensing, and developing decision support systems for farmers. Link:  
[www.afita.org](http://www.afita.org)

# Chapter 1: Overview of the Irish Agri-Food Industry

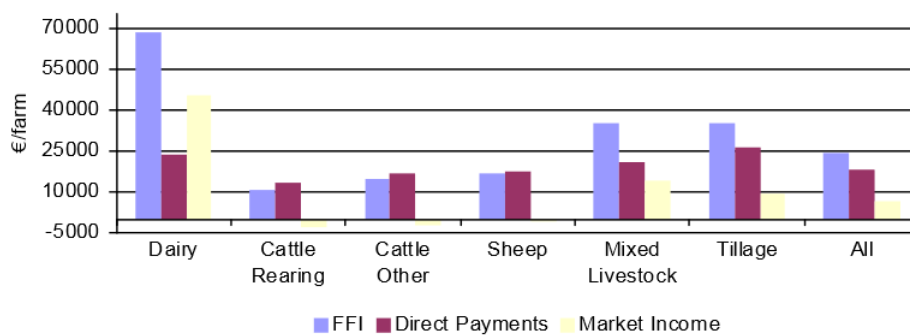
## 1.1 Current Position and Future Direction

The Agri-food sector is Ireland's largest indigenous manufacturing sector, representing 8% of GDP, exporting 85% of produce to 160 countries worldwide. It contributes €24 billion to the national economy, 25% of net foreign earnings and 10% of Ireland's exports and employment. The breakdown of the main outputs from the Agri-Food sector are summarised in Figure 1. The main markets for Irish food are the United Kingdom (43%) and continental Europe (34%). The Agri-food industry is well positioned to meet growing global demand for food and is seen as having a key role in the country's export-led recovery.



**Figure 1.** Breakdown of output from the Irish Agri-food sector

Ireland has 128,000 farm holdings on 4.6m hectares of land, of which 91% is in permanent pasture and 9% devoted to crops. With 6.5 million cattle, dairy and beef accounts for 58% of agricultural output. Based on 2011 National Farm survey data, the average family farm had an income of €24,461, of which 73% was composed of EU subsidies, highlighting the dependency on farm supports. These average figures, however, conceal the profitability of the different enterprises. The contributions of direct payments and market income to family farm income (FFI) for different enterprises are illustrated in Figure 2. It is apparent that dairy, mixed livestock and tillage farms are most profitable.



**Figure 2.** Family farm Income, Direct Payments and Market Income by Farm System. Source: National Farm Survey 2011

The Food Harvest 2020 report outlines an ambitious vision of ‘Smart, Green, Growth’ for the Irish agricultural sector. The report was compiled by a committee of 31 representatives from industry, state agencies and the farm bodies. It sets out sustainable growth targets for the industry to be achieved by the year 2020. Some of the key targets are as follows: increase in primary output by 33% equating to €1.5 billion; increase in value-added by 40% or €3 billion; achieve an export target of €12 billion, representing a 42% increase on current levels. Given Ireland's pre-existing strength in food production, these targets are realistic and achievable. The Food Harvest 2020 report clearly outlines the requirements for this potential to be realised. One of the core requirements for the Irish Agri-food industry is to become ‘smart’. To achieve this, investment must be targeted to developing knowledge, skills and ideas that drive innovation and enhance productivity and competitiveness. Some of the specific recommendations outlined in the report are:

1. Improvements in levels of dissemination and adoption of best practice
2. Encouragement of inter-institutional and institute-industry collaboration
3. Promote international research collaboration
4. More primary agricultural input into research programmes

The necessity to invest in up-skilling farmers is a clear priority for the Irish Agri-food industry. This is not, however, a uniquely Irish problem. In fact, many countries invest large resources to provide knowledge support to their farmers. Because of the contribution of the FBD Trust in sponsoring my Nuffield scholarship, I wish to draw on the lessons I have learned from visiting these countries and add some information and ideas to the debate.



## 1.2 The Current State of Knowledge Transfer in Ireland

Farmers obtain information from numerous sources. In an effort to be concise, I will cover the main bodies; Teagasc, members of the Agricultural Consultants Association, Animal Health Ireland, Irish Cattle Breeding Federation, and the Irish Farmers Journal.

The state body Teagasc is the main provider of agricultural research, education and advisory services in Ireland, employing 1,200 staff at 52 locations. It has an operating annual budget of €160 million, of which 75% is government and EU funded and the remainder generated from earned income. The allocation of funds is 40% devoted to research and 30% to both education and advisory. The two main modes of extension practiced by Teagasc are through: (1) research publications, conferences and open days; and (2) their advisory network carrying out face to face consultations and discussion group meetings. Teagasc currently offers a sample of basic online extension services. Due to on-going public sector reform and budget cuts, Teagasc staff numbers have been reduced by 33%, placing pressure on frontline services. Table 1 highlights this trend and marks the shift in extension services from being one on one to more group activities.

**Table 1.** Teagasc adviser's activities summary for 2009, 2010, and 2011

	2009	2010	2011
No. of advisers	355	278	263
No. of clients	46,554	45,447	43,286
No. of clients/adviser	131	164	165
Total no. of visits and consults to clients	100,930	97,389	99,734
No. of visits and consults per adviser	284	341	379
No. of discussion groups	405	501	506
Total income €	€15.1m	€12.0m	€10.4m
Income per adviser €	€42,740	€43,298	€39,569

Source: Teagasc Annual report 2011

In Ireland, advisory services are not limited to just Teagasc. There is also a large private agri-consultancy industry represented by the Agricultural Consultants Association, which is made up of 340 accredited advisors operating

nationwide. The reduction in Teagasc's one to one services is being taken up by these independent advisors.

Animal Health Ireland (AHI) is an industry led partnership that was launched in 2009 to promote improvement in animal health standards in Irish livestock. AHI are responsible for co-ordinating disease control programs and providing knowledge and education to farmers through their various publications, workshops and participation in open-days. AHI provides online versions of publications, tools and videos for farmer use.

The Irish Cattle Breeders Federation (ICBF) was established in 2001 with the responsibility of maximising the rate of genetic gain of the national herd. The collection and analysis of animal event data enable the ICBF to run genetic evaluations, and also to provide detailed performance reports to farmers. This information improves farmer decision making and monitors progress. The development of a web based breeding information service known as Herdplus offers farmers a range of farm management aids and reports.

The Irish Farmers Journal (IFJ) is an agricultural publication that operates as a trust. Its objectives are to enhance the competitiveness of Irish farming by providing news, technical support and commentary. The IFJ is by far the largest agricultural publication in Ireland with a weekly readership of 231,000<sup>2</sup>. The print publication is available online, accompanied by historical articles, and videos.

It is important to note that the quality of the services provided by the organisations mentioned above are at the highest level, and there is a great deal of collaboration between Teagasc, AHI, ICBF and the IFJ along with the various dairy co-ops, in promoting best practice to farmers. Internationally these organisations are hugely respected and are a great resource for the industry. That said, the objective of this report is how to make them more effective at communicating with farmers to bring about change.

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<sup>2</sup> Joint National Readership Survey 2011

### **1.3 Conclusion**

Irish agriculture is the back bone of the Irish economy. It is entering in to a period of change that has not been seen since Ireland's accession into the EU. There is an immediate need to invest in up-skilling Irish farmers to meet the challenges and opportunities that they will face if the targets of the Food Harvest 2020 targets are to be met. The responsibility for delivering on this 'Smart' Agri-Food sector rests with a number of farmer/government funded organisations. The methods of extension practiced tend to be reliant on traditional face to face and print as a means for knowledge dissemination. There is a real need to complement the traditional forms of knowledge transfer with an investment in information and communication technologies. The potential to move into the digital age is very real and it is this opportunity that must be developed to provide extension to farmers. The objective of this report is to help do so.

## Chapter 2: Why Farmers Fail to Adopt Best Practice

*"Extension is an Information Age idea with an Industrial-Colonial Age organisational structure and an Agricultural Age mentality" <sup>3</sup>*

### 2.1 Misunderstanding the Target Audience, the Farmer.

A common shortcoming in agricultural science and extension services is the preconception that farming is a technical activity, carried out by uniform individuals, that are motivated by financial reward. Farming is however a socio-cultural practice, a way of life, which not only has the responsibility for the stewardship of our planets natural resources, but also the nutrition and health of its inhabitants<sup>4</sup>. As a result, farming tends to be a vocation, with farmers having a far deeper purpose/motivation than any other occupation. There is an onus on research and extension services to gain a greater understanding of the motivations of family farm businesses and deliver services to meet their needs.

'It is the practices of the farmer that you want to change, and to do so you must fully understanding what are their barriers to change; if you know those you can tailor your messages to address those barriers'<sup>5</sup>

The most common motivation for farmers is sustainability. Sustainability is generally seen in an environmental or economic sense, but a farmer's view of sustainability is for the farm to remain as a viable unit, providing opportunity for themselves and for future generations to earn a living from the farm. Research and extension must develop technologies that not only deliver profits but also improve farmer lifestyle and likelihood for farm succession. It is also important to note that within Irish agriculture there is a huge diversity of farm businesses (type, size), farmers (life stage, education, world views) and their

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<sup>3</sup> Quinn Patton, M. (1993). Keynote address, in Proceedings of the APEN Conference, Gold Coast Australia

<sup>4</sup> F Vanclay. Social principles for agricultural extension to assist in the promotion of natural resource management. 2004

<sup>5</sup> Jenny Jago. Senior Scientist, DairyNZ. Previously worked in Teagasc Moorepark.

overriding motivation to adopt change. The challenge for research and extension services to meet the needs of this diverse population is not trivial. Use of new technologies will make this more achievable, and this report will address how this can be achieved.

## **2.2 Dis-incentivising Government Policy**

Over the last three decades in Ireland, the Common Agricultural Policy (CAP) has incentivised inefficiency and eroded competitiveness. There has been a disconnection between farm viability and technical proficiency due to an over-reliance on EU direct payments as income supports. In enterprises (sheep and beef) that have a high reliance on direct payments the technical proficiency has in fact been lessened over the period<sup>6</sup>. The motivation to maximise EU farm subsidy payments outweighed any obvious advantages in adopting new technologies. It is widely accepted that this failure to innovate and adopt best practices is undermining the ability of Irish agriculture to compete on a world market, and leaves large portions of our industry vulnerable to input price inflation and world market price volatility. The current reform of the CAP, to a standardised area based payment system and the abolition of milk quotas signals a new dawn for Irish agriculture. This will quickly refocus farmer's attentions towards adopting best practice procedures. It would be of great benefit to our industry if CAP funding was used to incentivise best practice adoption. This has a two-fold benefit: (1) it encourages farmers to adopt technologies that would improve competitiveness, which would have a compounding effect on farm viability thus eventually removing the need for direct payments; (2) it incentivises the adoption of technologies that are proven to give an economic return. For example, improvements in grassland management or breeding practices offers a guaranteed return on invested government funds in comparison to direct income support that is at the farmer's discretion how it is used.

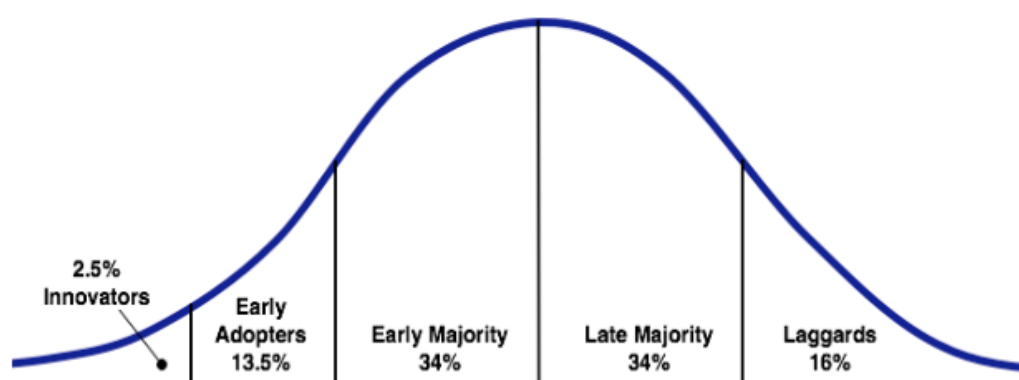
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<sup>6</sup> S O'Neill. Measuring Productivity Change and Efficiency on Irish Farms. 2001

### 2.3 The Type of Knowledge being Transferred is Ineffective

Two types of knowledge exist. Explicit knowledge is formally expressed in text, images, etc. It is factual and originates from recording and analysing data. It is this knowledge that extension and science predominantly disseminates, in a top down approach. Filtering down from leading science researchers to extension officers, and finally to farmers themselves. This type of knowledge has a key role in developing technologies, determining best practice and the future direction of the industry. But its role in initiating on-farm change is limited and is often over-relied upon. The dissemination of technical science based information is at best taken upon by innovative farmers, however these farmers are only a small percentage of the farming population.

**Figure 3. Adoption Curve**



Source. Rogers, E.M., Shoemaker, F.F. (1971)<sup>7</sup>.

The innovators are those who are willing to take risks and have a keen mind for recording and analysing data. For this reason, they will use explicit knowledge transfer better than the majority.<sup>8</sup> The majority of farmers, however, fail to record or measure information and therefore cannot quantify the perceived difference that adopting a particular technology will make. For science based information to be interpreted by farmers to initiate on-farm change, there needs to be a complete culture change regarding data recording by farmers. The old adage 'if you can't measure it, you can't manage it' holds true. Precision farming and automated data capture through robotics and sensor

<sup>7</sup> Rogers, E.M., Shoemaker, F.F. (1971). Communication of Innovations. The Free Press, New York.

<sup>8</sup> Paul Diederer. Wageningen University and Research Centre, Agricultural Economics Research Institute

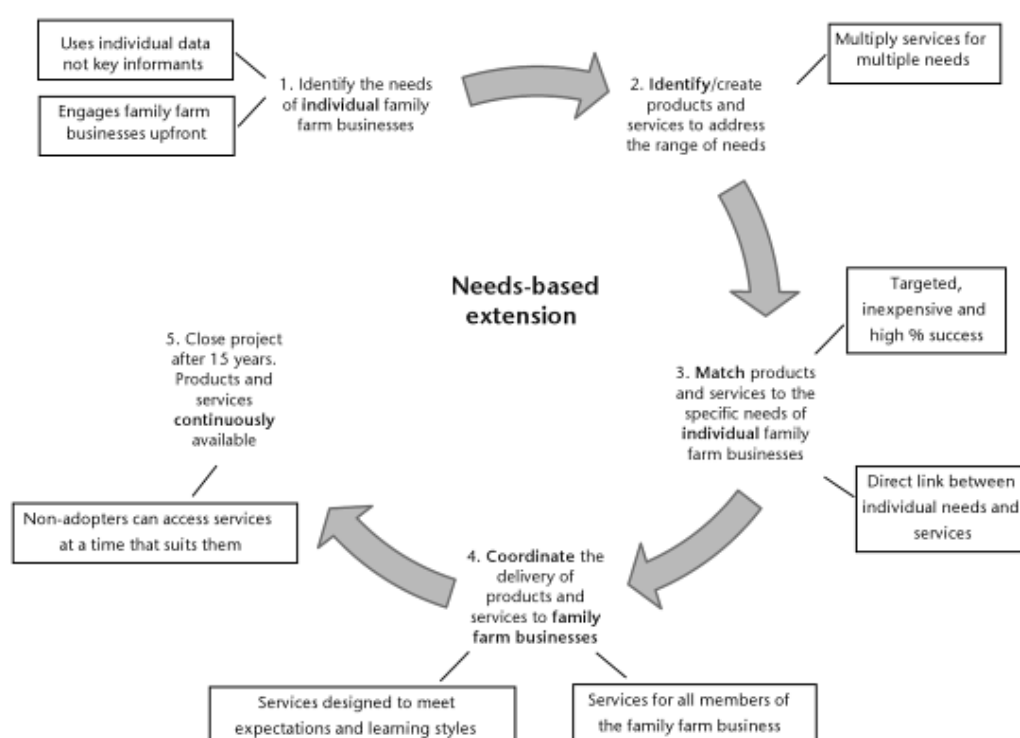
technology is a field that will have an ever increasing role in Ireland. This automated data capture will enable farmers to measure and more importantly monitor quantitative improvements from implementing new technologies. The second type of knowledge is personal knowledge that is intuitive or subjective in nature. This knowledge is a person's natural ability/talent or disposition to perform tasks. It is derived from experience, and in an Irish context is a great resource that is hugely underutilised. There is enormous potential to initiate on-farm change using personal knowledge. Discussion groups are a great example of how sharing of personal knowledge is very effective in bringing about on-farm change. Farm discussion groups formalised what farmers have been doing for generations: sharing views and opinions with their peers. Farmers themselves are evaluating new technologies, through dipping their toes to develop their own opinion or discussing it with someone who has experience with the technology. In Ireland, there are potentially 128,000 researchers and extension officers and between them they have 7 million years' experience in farming. By tapping into this source of knowledge you create a bottom up flow of information. Identifying the best farmers and using them as an example to be followed has been successful through the Teagasc/IFJ better farmer program. These programmes can be further developed.

## **2.4 The Method of Knowledge Transferred is Suboptimal**

On-farm adoption of best practice is not as a result of a lack of information; if anything there is a case for information overload. There is however an issue with how the information is transmitted. For example, face to face dissemination is the most powerful at initiating change; however, it is time and resource dependent. As a result there tends to be an over-reliance on text as a medium for information transfer. The lack of engagement, interaction and follow up support limits the effectiveness of this medium. There needs to be a transition from the traditional push model (top down) of information dissemination, to a more favourable information pull model (bottom up). In this scenario, farmers actively seek out information, thus demonstrating the level of interest and commitment necessary to initiate change. To develop an information pull model, information must be easily accessible, highly relevant

and concise, timely and from a reliable source. To create this quality of information, research and extension must operate a needs-based extension program. This targeted solutions based approach operates by identifying the needs of the individual and creating and coordinating services to address their needs (Figure 3).

**Figure 3.** The process of needs based extension (Source Fulton 2011<sup>9</sup>)



The process starts by engaging directly with the end user to identify their needs. By tailoring services to meet these needs the level of adoption is greatly increased. The key difference in this type of extension is that farmer engagement is carried on throughout the service development process. Engagement over an extended time increases farmer trust and the credibility of the extension provider. This form of extension is dependent upon one on one consultation and places huge demands on resources. Advancing communication technology can optimise farmer engagement and deliver a needs driven extension service at a reduced cost.

<sup>9</sup> Amabel Fulton Enabling change in family farm businesses 2011



## **2.5 Conclusion**

To maximise adoption of best practice, we must understand the characteristics of the target audience, the farmer. To meet the needs of the wide range of farmer and farming businesses presents a great challenge for traditional extension services. The redistribution of CAP payments from direct income support to encouraging best practice adoption puts Irish agriculture on a stronger footing. The Beef Data Programme, Suckler Welfare Scheme and Dairy Efficiency Program, are perfect examples of how effective targeting of resources can change farmer habits. There is an over reliance on the top down approach and every effort needs to be made to tap into the on-farm knowledge that exists in Irish agriculture. The advent of new technologies will open up opportunities for the existing extension services to be improved and optimised for individual farmer needs.

## Chapter 3: Moving Digital by Developing a Knowledge Hub

### 3.1 Information and Communication Technology in Agriculture

The internet has transformed modern living. It has changed how we do everyday things such as shop and travel, and it will change how we farm. While the impact of the internet in agricultural sector has been more gradual, this leaves greater potential to be exploited. There is an ever increasing role for web-based information and communication technology (ICT) in agriculture. ICT in agriculture is rapidly evolving, and creates the potential for innovative and novel ways to use and share information. A CUITA report<sup>10</sup> commissioned in 2010 to accelerate the use of ICT in Irish agriculture identified that 96% of farms have access to a PC and 70% of farmers use the internet as a decision support system for their business. In addition, the rise of online applications for the 2013 single farm payment scheme to over 56% is further evidence of the shift to online services. The barriers highlighted by farmers for using web-based services were identified in a survey conducted by Connolly in 2010<sup>11</sup>; the level of exposure and the frequency of use of the technology limit farmer confidence to perform tasks. Reliable access to broadband and having the time to access a PC was seen as another barrier. There was a general consensus that services provided through mobile devices (phones, tablets) might offer more practical on-farm use. Advances in mobile technology in the preceding years have seen smartphone sales exceed PC's by 6:1. Currently more than 1.8 billion smartphones have been sold globally (Gartner Inc. 2013)<sup>12</sup>. Within Ireland, smart phone usage has increased from 49% to 71% in 2012<sup>13</sup>. The flexibility of mobile technology, be it tablet or smartphone, offers farmers an opportunity to access information in their own time and in a location of their choice. The steady increase in broadband speed and the rise in popularity of mobile

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<sup>10</sup> CUITA. The Committee on the Uptake of IT in Agriculture and Rural Communities

<sup>11</sup> Connolly and Woods (2010) 'AN EXAMINATION OF TECHNOLOGY ADOPTION & USAGE BY FARMERS IN IRELAND'

<sup>12</sup> Gartner Inc. information technology research and advisory company

<sup>13</sup> RedC poll

technology provide the platform for moving extension services into the digital age.

### **3.2 The Concept of a Knowledge Hub**

Numerous industry stakeholders, such as Teagasc, ICBF, AHI, IFA, milk co-ops, and IFJ provide an excellent service to farmers regarding information and extension. These organisations may be diverse in nature; however, they deliver information to the same audience (the farmer) through a plethora of formats (print, face to face, conferences etc.). The majority also have websites with content specific to their area. As the traditional sources of knowledge transfer moves to a digital medium, it is not surprising that these organisations are developing how and what they communicate online. They are investing large amounts of time and money to create effective websites, but this duplication is both wasteful and inefficient. Given the required investment and the similarity of target audience, it would be highly beneficial for industry stakeholders to pool resources and collaborate on developing a single point of contact for farmers.

‘A knowledge hub is a one stop shop where farmers can harvest all the information needed on a certain topic’ Janet Sloan DPIV

This web-based knowledge management system or knowledge hub would host all the major online resources that a farmer would require, but in one place. While examples of a centralised knowledge platform are common in the field of education, they are rare as tools in agriculture. The DPIV have a platform under development based on a US model known as eXtension<sup>14</sup>

‘eXtension is an interactive learning environment delivering the best researched knowledge from the best land-grant university minds across America. eXtension connects knowledge consumers with knowledge providers’<sup>14</sup>

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<sup>14</sup> [www.extension.org](http://www.extension.org)

Below it is discussed how an adaptation of the eXtension model could be used in Ireland.

To assemble teams of national experts, a dash board formatted web page would be populated with information from ICBF, The Department of Agriculture's Agfood, Teagasc, AHI, IFA, dairy co-ops, IFJ, etc. thus providing an invaluable resource for the farmer. While maintaining their institutional independence, this collective approach of dissemination compared to having numerous separate entities offers simplicity and convenience for farmers. Given web-based dissemination is a relatively new concept for agriculture, simplicity and convenience are two fundamental factors to maximise farmer buy-in and thus market penetration. The impact of such a platform would move agri-extension from an information push model to develop an information sourcing (pull) ethos among Irish farmers. They would be empowered to broker their own information.

The information push model reminds me of the old adage 'You can take a horse to water but you can't make it drink', meaning the information is there but people still won't change practice. The creation of a digital resource that can be accessed through a PC, tablet, or mobile phone gives farmers the chance to gain information if and when they need it most, such as out in the field performing tasks. This creates a situation that the horse has a bucket of water with them 24/7 making it as easy as possible to drink.

The demand from farmers for online resources to run their business is in its infancy. This then creates the valid argument that if there is little farmer demand, why use up scarce resources and develop the knowledge hub concept?

In Henry Ford's words 'If I had asked people what they wanted, they would have said faster horses'.

The novelty of such a technology means that farmers may struggle to see the potential until they are using it. There is an onus on industry leaders to look to the future, and put Irish farmers on the front foot. The industry stakeholders have to create the demand by developing a resource that farmers can't live without. Create something that a farmer feels the need to log into every day. For any one stakeholder that is an impossible task, but by joining together and

providing small pieces of a wide range of services and information then a farmer will buy into it.

To prevent any potential power struggles and overcome any institutional boundaries or organisation structures, an independent organisation should be created with the responsibility for the development and running of the Hub. Its core objective should be to facilitate the flow of knowledge within the industry. The various stakeholders and the Department of Agriculture would make up a steering committee. Once the portal is in place it creates great opportunities for the online development of networks, data collection, research and the facilitation of technological integration.

### **3.3 Conclusion**

The agricultural industry has recognised the ever increasing role information and communication technology plays in the extension and transfer of knowledge. Coupling the growth in internet accessibility and the functionality of mobile technology has enabled the development of novel ways of interacting with farmers. There is a fundamental requirement for a coordinated approach to ICT development by industry stakeholders. There is an onus on the industry to collaborate and develop a comprehensive knowledge management system that operates as a single point of contact for farmers to access information.

## Chapter 4. Digital Knowledge Sharing

This chapter focuses on the potential technologies that would be incorporated into a knowledge management system. The focus is placed on enhancing the flow of knowledge and information between the field, farmer, advisor, and researcher. Digital technology is evolving and diversifying at a rapid speed, and in the immediate future no one technology will dominate but a combination of many. The benefits of incorporating these technologies into the Agri-Food sector are discussed below.

### 4.1 Targeted Timely Information

DairyNZ carry out detailed segmentation of their client's business and personal goals. This then enables targeted information to provide for their specific needs. Moving away from a 'one size fits all' blanket approach of disseminating information to the masses, the knowledge hub has the capability of being personalised for every farmer. This gives the farmer an opportunity to select their preferences and identify specific areas of interest. By customising the content on the farmer's homepage, information overload is prevented and only relevant and up to date information specific for that farmer are provided, addressing their specific needs, questions and issues in a non-duplicative, aggregated approach. The source of this information is also of the farmers choice, for example a beef farmer might chose to have information on his own herd from ICBF herd plus, Pasturebase grass growth rates, updates from the better farms program, IFA beef price updates, and Met Eireann weather forecasting.

Similarly, if a farmer is operating a spring calving system, information would be only relevant depending on the time of year. By farmers actively choosing the sources of information, it creates an information pull effect and targets the information to the people that want it and also when they want it.

The speed at which information is disseminated to the end user will affect the possible response to a changing environment, be it market price, weather,

disease threat etc. The capability to instant update information gives farmers on-demand information helping more timely decisions.

## 4.2 Information Repository

There is a wealth of printed publications on offer to Irish farmers, be it from Teagasc open days, manuals and news letters to AHI leaflets. However, once read they are discarded or stored on a dusty shelf never to see the light of day again. Most of the printed publications provided by the various industry stakeholders are now in digital format. The knowledge hub gives opportunity to create an information repository for the online storage and collation of digital publications.

*‘Having content readily available gives farmers an opportunity to review areas that they do not fully understand which is a key component in getting information embedded’<sup>15</sup>*

Through a carefully designed content management system, using tags and keywords, farmers could search through past and current publications locating topics of interest. This resource would better utilise the information being published by extending its presence in the public domain. There is also a potential for farmer feedback by enabling farmers to rate publications for clarity, content, etc. For extension services, this feedback coupled with a prolonged shelf life would emphasise the importance of publication quality over quantity. Another benefit of an information repository is identifying on-farm issues as they happen. Through monitoring farmers search behaviour, industry stakeholders can identify the most popular topics that farmers are seeking information on. The identification of ‘hot topics’ enables research and extension services to prioritise resources to meet the demand from farmers. This bottom up approach ensures research and extension is constantly targeted towards addressing on-farm issues as demanded by farmers.

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<sup>15</sup> Janet Sloan Department of Primary Industries Victoria

### **4.3 The use of More Effective Media**

It is very difficult for technology to replicate the influence of face to face knowledge transfer. However, moving to a digital space can enhance these traditional formats and offer an opportunity to use communication mediums that were previously not possible. Multiple learning formats can be used together. For example, the use of demonstration videos, webinars, podcasts, narrating text or interactive tools. The main advantage of these techniques over more traditional text is the ease at which end users can engage and acquire the information. As farming is a relatively hands-on profession, the visual effect of seeing a technique or technology makes it easier to understand, evaluate and thus replicate. Short concise video demonstrations have the capability of communicating detailed information in a user friendly way. This is demonstrated by Shedmeeting, where innovation is diffused through video to Australian sugar cane farmers ([www.shedmeeting.com.au](http://www.shedmeeting.com.au) project funded by the Sugar Research and Development Corporation). Another effective use of video is through video conferencing and webinars, offering all the benefits of attending a seminar but at the convenience of your own home. Queensland Government's Animal Science department offer a great example of creating an interactive webinar, where viewers can ask questions and vote throughout the presentation. This is hosted on [www.enablingchangeandinnovation.com.au](http://www.enablingchangeandinnovation.com.au). These webinars are also recorded giving people an opportunity to view at their convenience and re-view as they wish.

Broadcast radio has the potential to reach large audiences. This is also its downfall, however, as to cater for this diverse audience information transmitted is generally at an entry level and is of little use to farmers. There is, however, a real need for a technical farming series that is targeted solely for farmers. While a broadcast radio station may not justify such a specialised show, these could be provided in podcast format. Radio podcasts require a low level of engagement by farmers thus providing the flexibility to listen to information while performing routine farming tasks. The GDRC regard their Driving Agronomy series of podcasts as giving the greatest return on investment of any extension service they provide.



#### 4.4 The Dissemination of Personal Knowledge

As previously stated, personal knowledge is derived from expertise gained over a number of years. Within every tier of our industry there are some of the finest agricultural experts in the world. A universal knowledge management system provides a platform for these individuals to share their knowledge directly. Be it leading farmers, advisors or researchers, gaining direct access to one's target audience limits misinterpretation and personalises their message. These experts could communicate through social media, by some of the previously mentioned methods (video, podcast, etc.) or through Twitter, Facebook, etc. Existing social media platforms such as Twitter, Facebook, etc. have the ability to create an online community of practice, with like-minded farmers sharing information and discussing topics. The provision of expert opinion is crucial for the successful transfer of knowledge through social media. There is a responsibility on industry stakeholders to provide this expert opinion and have a greater engagement with farmers through these networks. By providing snippets of information and direct dialog, stakeholders can facilitate online discussions not too dissimilar to a current discussion group meeting. This 'ask an expert' technology gives farmers the opportunity to engage directly with an expert, which not only helps inform, but dispel myths and strengthen the connection between farmer and industry.

Commonly there are differences between farmer's personal knowledge and research/extensions explicit knowledge. It is this contradiction that limits technology adoption by farmers, due to a distrust of explicit knowledge (Vanclay 2004)<sup>16</sup>. An effective way to overcome farmers distrust is through healthy debate. Providing a sounding board for farmers to voice their concerns about a recommended practice, highlighting obstacles to adoption and enabling extension services an opportunity to address their concerns directly. This direct interaction not only aids farmer understanding but also help breaks down potential barriers limiting adoption. From a stakeholder's point of view, shortening the channels of communication has the effect of making them more accountable and exposing them to the vast personal knowledge that exists on-

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<sup>16</sup> F Vanclay. Social principles for agricultural extension to assist in the promotion of natural resource management. 2004

farm. Challenging different opinions will provide new ideas and alternative views to research and advisory services. Through online questionnaires, votes, discussions, or debates, stakeholders can directly obtain farmer feedback and opinion. This form of agricultural 'crowdsourcing' taps into the collective intelligence of the masses to find innovative ideas and solutions to existing problems.

#### **4.5 Conclusion**

While there is no substitute for face to face extension, digital technology can complement these existing services. The evolution of digital technology creates ways of sharing information that were previously impossible. The ability to personalise content, store and organise information, and use more interactive and engaging media helps farmers gain knowledge in a more effective way. By allowing farmers to choose the source, content and timing of information assists them to be brokers of their own knowledge. The use of a content management system allows farmers to store and archive information relevant to them. This shifts the focus of research and extension to quality of information rather than quantity. By opening a direct line of communication between farmer and industry, it provides a sounding board for robust debate forcing accountability in all aspects of our industry.

# Chapter 5: Precision Agriculture

## 5.1 The Evolution of Farm Management

The practice of precision agriculture describes the use of technology to capture and interpret farm data, resulting in more informed farmer decision making. These tools offer quantifiable information, leaving less reliance on individual farmer intuition. It is seen as the evolution of farm management. The concept has been widely adopted on large-scale arable farms. Through advances in micro-sensor technology, automation and robotics, however, the 'datification' of farms is occurring in all agricultural systems. The modern farm will operate similarly to how your brain pulls in information through your six senses, processes the data and enables you to make an informed decision. Where data will be capture through multiple sensors (inline milk sensors, walk over weighers, GPS cow tags, activity monitors, soil moisture and nutrient sensors, satellite imaging, etc.) This data will be uploaded onto a cloud based server where it will be analysed and interpreted to provide the farmer with the relevant information to make targeted and strategic decisions. Much of this technology has been adopted from other industries to service agriculture and as a result of a highly competitive market, is becoming a viable option for Irish farmers. A farm is a complex biological system, being able to accurately quantify important variables will enable more informed, educated decision making and to evaluate the quality of these decisions. Precision agriculture makes the old adage 'if you can measure it, you can manage it' possible. The incorporation of this technology has wide ranging benefits at farm and industry level, and every effort needs to be made to encourage its development.

## 5.2 High level Industry Strategic plan

Before precision farming becomes common place, there is an onus on the industry to develop a strategy to fully maximise its potential. The industry needs to take a coordination and leadership role in the use and implementation of precision technology. See the opportunity, recognise the challenges and redirect the resources. There are three unique aspects to be

considered; technology development and data capture, data integration, and interpretation and decision support systems.

### **5.2.1 Data Capture**

The main methods of capturing data are by automated sensor technology or through direct farmer input, the former being most favourable. The field of automation, robotics and sensor technology is highly specialised and requires a large investment into research and development. It would be inefficient to redirect industry funding towards the development of this level of technology, but rather evaluating the technologies that are there would give farmers an independent assessment on the technology. More effective industry funding would be targeted towards facilitating direct farmer data inputting. The development of phone applications (apps) for on the move data inputting and real time decision support systems has been extremely effective for LIC. Their Minda software not only provides their farmers with valuable information, but enables data entry for gaining progeny data necessary for running genetic evaluations. The resources must be made available for the ICBF to develop ways to record traits of significance but also to add value to the data that they currently store.

### **5.2.2 Data integration and interpretation**

There are a growing number of companies offering precision farming technology and data capture through phone apps, sensors, satellites, etc. The capture of data is getting easier and easier. The area of greatest requirement for industry investment is the integration and analysis of this data to give meaningful information to farmers. The real power of data is when data from multiple related variables are combined for analysis to give a farmer a comprehensive idea of what is happening on his farm.

*'Well organised information can fast track the development of knowledge and wisdom. The objective is to add value to the captured data, the greater the integration the greater the potential to add value'*<sup>17</sup>

This level of data integration is key. For example, individual dairy cow data from a walk-over weighing system might highlight a drop in live-weight, but if this data is combined with milk constituent measurements then a drop in weight and a drop in protein may indicate inadequate nutrition for that specific animal. The barrier to achieving complete integration is when different/rival companies supply various technologies and data is stored on individual servers in various formats (CSV, XML files), making it difficult to integrate and share data. Masayuki Hirafuji from Japans Hokkaido Agricultural Research Centre recommends a Cloud Open Platform for the sharing and exchange of data sets among agricultural applications, an industry good online database that has the capability of capturing, storing and sharing farmer data. With farmer permission, technology companies can access farmer data in exchange for uploading additional captured data. Also data collected by one provider would be available to another provider at no cost if it was to be a benefit to the farmer. The benefit to technology companies is the ability to add value to their existing technology by having a complete set of farm data for their client. This resource would lessen start-up costs and provide opportunities for software, sensor technology or app providers, thus creating more competition and innovation. The ownership and control of the database would be for industry good, and the industry must now outline the storage and format requirements for data sharing. The cost of storing this data would then be borne by the industry. The advantages of data integration for farmers are limited double entry, flexibility around technology used and comprehensive decision support systems based on multiple variables. The industry wide benefit of having the centralised database is that data can be analysed by industry stakeholders (The Department of Agriculture, Co-ops, Teagasc, ICBF, nutritionists, accountants, veterinarians) for research, extension and policy purposes. Data collected, stored and analysed on a national scale makes Irish agriculture operate similar

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<sup>17</sup> Ian Mule, Professor of Precision Agriculture Massey University

to a research trial, where you can measure, model and predict on-farm variables, providing Irish farmers greater control over their businesses.

### **5.3 Conclusion**

Global agriculture is undergoing a technological revolution known as precision agriculture. The use of robotics and remote micro sensor technology has led to the 'datification' of agriculture, enabling the capture, storage and analysis of farm data. In optimising the management of the countries natural resources these tools help farmers make informed and timely decisions. There is a need for the Irish agricultural industry to take a leadership role and develop a strategic plan to incorporate this technology into farming practices, with special reference to the importance of encouraging technology integration and innovation.

## **Chapter 6: Conclusions and Recommendations**

As a result of EU policy, Irish Agriculture has been in a state of hibernation for many decades. Operating within a protected environment insulated farmers from the cold face of market forces. This disconnect from the reality of operating an export driven industry created a situation where at every level of the supply chain efficiency was not rewarded nor inefficiency punished, at least not to the level required for best practice adoption. This was not only seen at farm level, but throughout research, extension, processing, marketing, etc. On-going rounds of trade negotiations and EU policy reform have to a large degree removed this level of protectionism and market distortion. As a result Irish agriculture is undergoing a period of transition, and must now compete and win on a world stage. By maximising the competitive advantage arising from our geographical location, climatic advantage, and green image, Ireland has an opportunity to become a world leader in sustainable food production. We must, however, prioritise investment into developing the human potential that exists within our industry. By supporting the enhancement of farmer technical efficiency, we will better equip them to grow viable farming businesses.

### **6.1 Initiating On-farm change**

The CAP has undermined our ability to run viable farm businesses; CAP supports in the form of area based payments is doing nothing to address this situation. By supporting best practice adoption, CAP funding supports not only active farmers but efficient farmers. The Dairy Efficiency and Beef Data Programs are examples of how effective targeting of resources can aid best practice adoption. An evolution of these concepts must be encouraged.

While Irish research, extension and education organisations (Teagasc, ICBF, IFJ, AHI etc.) are highly regarded internationally, there is scope for much improvement. The disparity between best practice and common practice highlights the deficiencies that exist.

*‘The challenge is to reinvigorate the extension and farm change sector to make it effective, focused and delivering good outcomes to farmers’<sup>18</sup>*

There needs to be a move away from a ‘blanket’ information push approach. Greater emphasis must be placed on segregation of the target audience, assessing their specific needs, understanding their barriers to change and tailoring a targeted message to meet their needs. This undertaking is nearly impossible without a coordinated investment into ICT by service providers. This investment into ICT would not only aid the flow of knowledge from research to farmer, but would enable the sharing of personal knowledge from farmer to researcher and farmer to farmer.

## **6.2 Developing a Knowledge Management System**

Improvements in internet connectivity and functionality of mobile technology have paved the way for an increasing role of ICT in the field of agri-extension. In recognition of this, many extension providers have developed websites and digital technologies to communicate directly with farmers. This has led to unnecessary duplication of cost and content. Given that the target audience for extension providers is the same, the farmer, it is recommended that a coordinated approach of developing a web-based knowledge management system would best serve the needs of the industry. By developing a single point of contact for farmers, an online knowledge hub would host relevant information from the various sources that farmers use to run their business. This would provide simplicity and convenience to farmers, and gives stakeholders a meaningful online presence to disseminate information.

In the same way that AHI was established through a partnership of farmers, processors, animal health advisers and government to develop a coordinated programme to improve animal health in Ireland, a similar organisation should be created to coordinate e-extension by developing a knowledge management system for Irish agriculture. This organisation would be responsible for application of future technologies in agriculture. Once put in place, the

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<sup>18</sup> Neil Webster, leader of Extension & Change Management program, Dairy Australia



knowledge hub would be a valuable resource that creates opportunities for future technologies to be incorporated into Irish agriculture.

### **6.3 Opportunities of Digital Media**

There is a wide variety of evolving techniques and technologies that could be incorporated into a knowledge management system to assist in the flow of knowledge throughout the industry. Digital technology can enhance knowledge transfer by enabling personalised content (farmer specific homepage), information organisation and storage (information repository), and the use of more interactive and engaging media (video, webinar, etc.). Coupled with social media, these tools offer new communication channels to farmers, establish online communities of practice, and direct access to industry experts. The establishment of a direct channel of communication from industry to farmer and from farmer to industry will not only give farmers access to the key holders of knowledge but also provide a sounding board for farmer opinion. This channel of communication is fundamental in strengthening links between research, extension and farmers, and enhancing accountability of farmer/Government funded services. Industry stakeholders must develop a digital strategy and incorporate these technologies into their current services.

### **6.4 The Datification of Agriculture**

Precision agriculture is the use of micro-sensor technology, robotics and wireless networks, to capture and interpret on-farm data. This technological evolution of farm management away from intuitive decision making to basing decisions on quantifiable information is set to revolutionise global agriculture. The use of this technology on Irish farms is in its infancy, but this is slowly changing. Before precision agriculture becomes widely established, it is vital that the industry takes a leadership role in the use and implementation of such technology. The technology suppliers will be many and varied, meaning on-farm data will be stored in several formats and on independent servers. It is recommended that an industry-good database be established to standardise, store, share and interpret all forms of farm data. By integrating on-farm data

from multiple sources, a complete dataset for every farm will be generated, thus enhancing how the data is interpreted and the quality of information disseminated to farmers. On a national level, the capture and integration of previously unrecorded data provides opportunities for research, extension and policy purposes.

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