A Nuffield Farming Scholarships Trust Report

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AHDB Potatoes

The future of the UK Potato Industry:
exploring the supply chain challenges

Rufus Pilgrim

July 2017

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A
Nuffield (UK) Farming Scholarships Trust Report

Date of report: July 2017

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

Title	The future of the UK Potato Industry – exploring the supply chain challenges
Scholar	Rufus Pilgrim
Sponsor	AHDB Potatoes
Objectives of Study Tour	• Identifying the key factors that affect Supply Chain performance. • Examining each factor relative to the UK Industry, highlighting those most relevant. • Comparing the UK Analysis with the equivalent findings in overseas potato markets.
Countries Visited	Belgium, Germany, Netherlands, Czech Republic, Poland, Hungary, Kenya, South Africa, United States and Canada.
Messages	• Relationships within the supply chain are crucial. Stakeholders need to think longer term and collaboratively to build confidence, encourage investment and trust. • A greater need to control volatility by the UK potato supply chain will necessitate the increased use of contracting mechanisms. For some this will require a recalibration of their expectations on returns. • Improving productivity, with a target of self-sufficiency is the key objective. Over time, as consumption habits change, and production efficiencies and crop utilisation improves, it is likely that the area for fresh potato production will need to reduce.

Executive Summary

Globally potato consumption is rising, driven primarily by the increasing demand for French fries in the developing world. Global production has now surpassed 385 million tonnes; an increase of 18% since 2005. In the UK, potatoes are still seen as a healthy and nutritious staple of the shopping basket, but also a value product positioned to entice consumers in the intense retail battle. Competition from imported processed products and falling fresh consumption have contributed towards increased pressure on margins throughout the domestic supply chain. In addition, exchange rate uncertainty, market volatility, short term commitments and a widening disparity in cost assumptions have made for a very turbulent operating environment.

The objective of my report was to identify the factors that contribute to achieving a thriving potato supply chain in a competitive market. To do this I visited Central and Northern Europe, Kenya, South Africa, Canada and the United States. I wanted to examine production under differing climates, relationships between participants, how supply chain sustainability was approached at both a micro and macro-economic level, and the local environmental, political and social factors that influence it.

Meeting potato growers, packers and processors, government bodies, NGOs, levy boards, and research organisations, I found that successful supply models display some of the following characteristics:

- Strong investment in relationships and partnerships that build trust and deliver mutual benefits - an ethos of collaboration over confrontation.
- Unilateral recognition of other stakeholder challenges and objectives that, once recognised, allowed the creation of robust and stable supply platforms.
- Recognition of an ongoing need to increase returns by raising productivity levels through simplified processes, adoption of precision technology and differentiated product offerings.

Looking ahead, domestic supply chain relationships and interdependency will become ever more important. Our highly productive neighbours in Northern Europe have the potential to become an even greater threat. Their ongoing pursuit of creating efficiencies in their own supply chain will continue to put pressure on our domestic marketplace if there is no impetus on our industry's part to change.

Consumption trends are changing at a pace; consumers are turning their attention to prepared products that satisfy convenience, health and quality criteria. While they respect provenance and quality, the current retail dynamic clearly indicates that value is just as critical. A 'GB only' initiative from some of the major buyers should not be relied upon to support our industry.

Supply chain customers are looking for price and quality consistency. This can only be achieved by an increased adoption of contracts and tools that bring about stability. For some growers this will necessitate a recalibration on their expectations of returns. To bring about the confidence required to invest in the future of the UK potato industry, requires commitment and support from the processors and retailers higher up the supply chain.

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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.

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1. Introduction

I am not from a farming background, but grew up in the rural Vale of York. It was while working on a mixed farm in the school holidays that my passion for agriculture blossomed. I spent three years studying for an HND in Agriculture at Shuttleworth College. My initial focus was to remain in practical farming, but the intensity of the fresh produce industry appealed more. I wrote to thirty packing businesses looking for a foothold, and after a short period farming, my potato career began.

I started working as a buyer for a potato prepacker in North Lincolnshire: the role combined my enthusiasm for practical farming, the opportunity to take the product to the next stage, and to add value. It was the mid-1990s and the big retailers were in their ascendancy, but by the end of the decade the rationalisation boom had begun. My next move was to the cauldron of the UK fresh produce industry: South Lincolnshire.

Initially involved in procurement for QV Foods' Tesco operation, in 2005 I moved over to a joint venture operation supplying Marks & Spencer's with vegetables. At Manor Fresh my responsibilities widened considerably, but it was my exposure to this retailer's enthusiasm for innovation and doing things differently that I really enjoyed.

My career path has brought me back to Yorkshire. I am now a Commercial Director for R S Cockerill, a family owned crisping potato, and fresh packing business based near York. My challenge here is to deliver consistency, quality and value, supplying the rapidly growing discount retail sector.

Outside work, as well as family life I have also taken on additional challenges, studying with the Open University to gain further management qualifications. A few years ago I was Chairman of the Governors at our local school, eventually federating it with a neighbouring one.

Constantly 'firefighting' does not allow you to develop and give much consideration to what lies ahead. I was looking for the next challenge that would enable me to develop a breadth of knowledge to navigate turbulent times, and build something for the future. Applying for a Nuffield Farming Scholarship at my age meant it was now or never.

Figure 1: The author, Rufus Pilgrim

2. Background to my study

2a.i. The Structure of the Potato Industry in the UK

The potato industry in the UK has a number of inter related activities as shown in the diagram below. This study focuses on those business activities that connect the ware potato grower to their customers. Ware potatoes are those destined for human consumption, as opposed to seed potatoes. However, full consideration has also been given to the ware customer's product needs which are almost entirely defined by the ultimate customer, *The Consumer*.

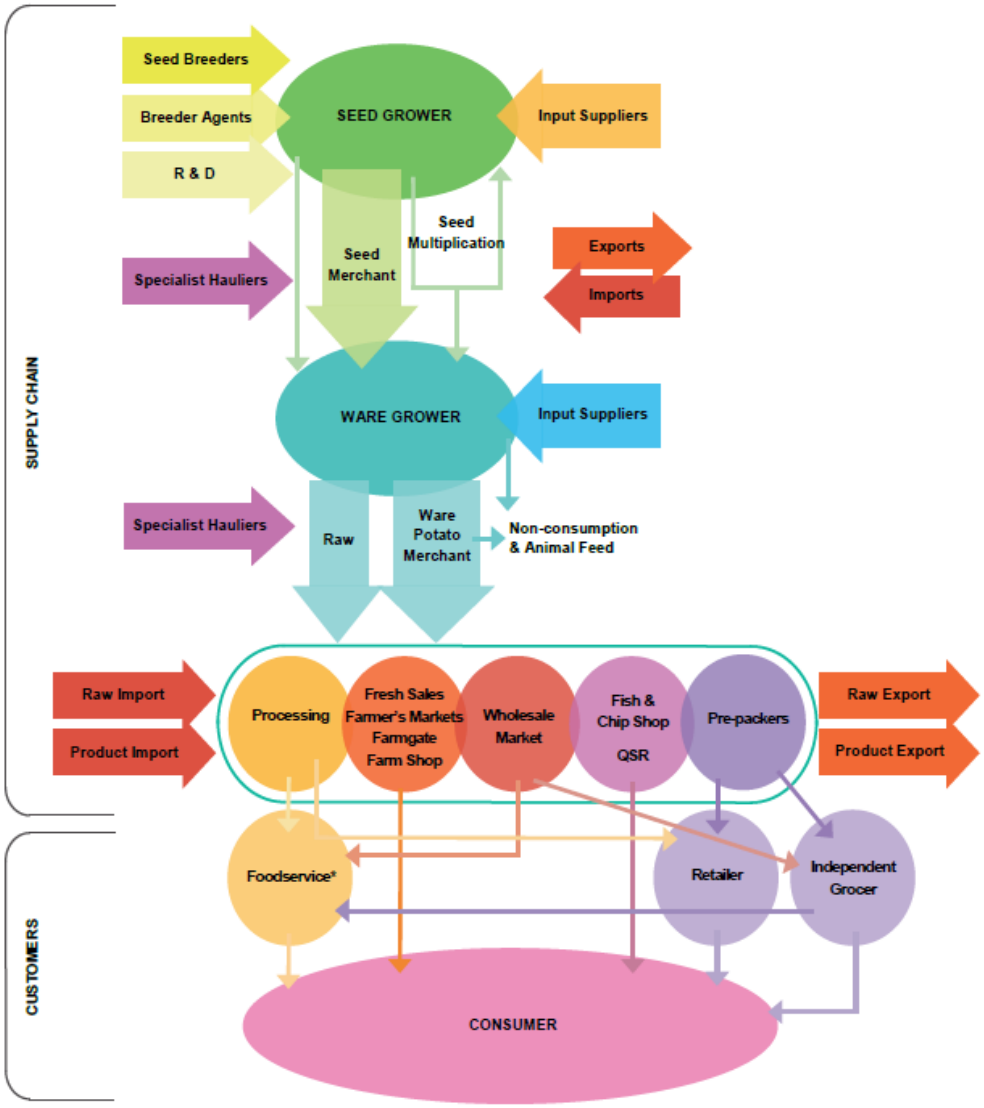

Figure 2: Potato Supply Chain flowchart (Source: AHDB Market Intelligence 2016/17)

2a.ii. UK market dynamics

Growing potatoes is arguably one of the most speculative of arable crops. Throughout the last 40 years there have been varying periods of volatility and uncertainty in the potato industry, but never so much as there are now. For our own business, the pressure to appease customer and supplier has never been greater. We are fortunate to work with customers whose market share is increasing, but matching supplier and customer value expectations is becoming harder. We are a well-established business with good people and strong values, but suffering in an industry rationalising and becoming increasingly dominated by the larger players. It would be much harder now to find thirty potato packers to write to looking for a job!

Global potato production and consumption is increasing as a result of:

- Global population growth.
- Far East Regions adopting a more Western diet.
- Potatoes increasingly being seen as the basis for food and nutritional security in the developing world.
- Potatoes offer a gluten and fat-free source of carbohydrate, with many recognised health and nutritional benefits.

However, potato consumption per capita in the UK has declined by 20% in the last 10 years, to 101 Kg/capita. Pressure from competing carbohydrate sources such as rice and pasta, recent health scares like the potentially carcinogenic effect of acrylamide in starchy foods, and the trend for low carbohydrate diets, have all taken their toll on fresh potato sales.

2a.iii. Key market facts

The facts outlined below reflect the UK potato market in 2016:

- Worth £4.1 billion.
- 116,230 Ha area under potato cultivation.
- Grown by 2,000 registered growers.
- 50% of the area is grown by 14% of the growers.
- 5.22 million tonnes.

However, it also continues to be a very sensitive market, not only dictated by local environmental factors, but is also heavily influenced by market conditions and exchange rates in Northern Europe.

See charts on next page

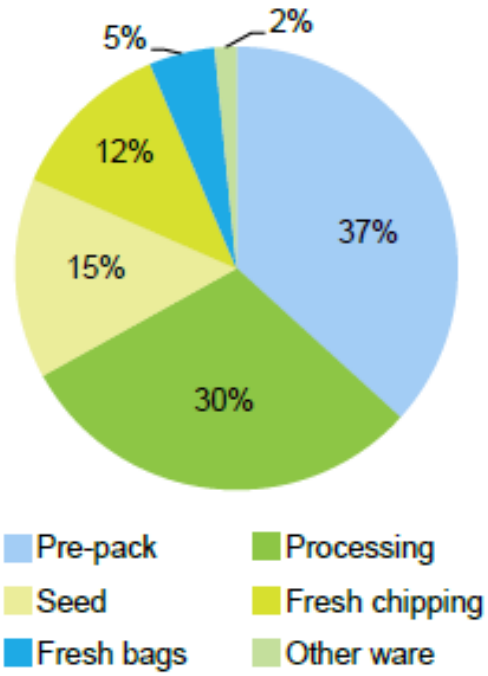

Figure 3: Proportion of planted area by intended market sector 2016 (Source: AHDB Market Intelligence 2016/17)

Source: AHDB Potatoes Planting Returns
† Totals may not tally exactly due to rounding

Market sector	2012	2013	2014	2015	2016
Fresh bags	6,920	7,040	7,030	6,110	5,580
Fresh chipping	14,540	14,380	13,940	12,900	14,000
Pre-pack	44,960	46,030	43,030	38,630	42,710
Processing	34,630	33,790	34,320	34,440	35,100
Other ware	4,750	5,180	6,260	4,820	1,830
Seed	16,040	16,030	16,490	15,140	17,010
Total †	**121,820**	**122,440**	**121,070**	**112,040**	**116,230**

Table 1: Historical planted area by intended market sector 2012 – 2016 (Source: AHDB Market Intelligence 2016/17)

As Table 1 above indicates the area for pre-pack potatoes has fluctuated considerably following volatile prices in this sector, while other areas have been relatively stable; especially that for the heavily contract priced processing sector.

2a.iv. Market trends

The United Kingdom is unique in the developed world in still having a strong fresh market, but consumer purchasing habits are changing. Consumption of potatoes in the traditional formats: fresh, frozen and crisps are, at best, static. However, consumption of potatoes in a variety of prepared formats, especially chilled dishes, is growing rapidly, with over a third of households now regularly purchasing them. This sector is now worth £266 million; over the last year (52 weeks to w/e 23rd April 2017) the value increasing by 8.1%, and the volume by 4.7%.

Table 2. Potato purchases (Source: Kantar Worldpanel 52 weeks up to W/e 23rd April 2017)

52 w/e 23 Apr 17				
Produce Type	Value (£000s)	% Chg YOY	Volume (Tonnes)	% Chg YOY
Total Fresh	1,050,754	-4.1	1,293,906	-0.4
Loose	134,743	-17.7	117,072	-9.8
Pre-pack	916,011	-1.7	1,176,835	0.7
Total Organic	12,125	18.0	10,211	22.6
Total Frozen	710,080	3.7	467,134	-0.4
Frozen Chips	444,684	3.7	316,820	-0.6
Frozen Potato Products	265,397	3.6	150,313	N/C
Chilled Potatoes	265,596	8.1	73,522	4.7
Canned Potatoes	11,598	15.9	16,316	4.0
Crisps	879,607	-3.2	135,410	-0.5
Snacks	966,225	1.6	136,212	3.3
Recon. & Conv.	29,704	10.5	15,262	20.1
Total Reported*	3,913,565	-0.2	2,137,761	0.1

The choice and quality in our retail scene, in fresh potatoes especially, is arguably one of the most sophisticated in the world. The growth of the discount retailers in the UK has been phenomenal: Aldi recently having moved into fifth place behind Tesco, ASDA, Morrison's and Sainsbury's. Theirs and Lidl's value share of the grocery market in recent years has grown considerably, way exceeding the competition's. Both still have ambitious expansion plans for their smaller, conveniently sized store formats. Consumer purchasing habits are changing; shopping far more frequently, with an increasing trend towards smaller pack sizes. Both factors reducing domestic waste levels. UK consumers are looking convenience, quality, and above all value.

Table 3: Retail share (Source: Kantar Worldpanel 52 weeks up to w/e 23rd April 2017)

Retailer	Value share of grocery sector (%)	Change in value share over 52 weeks (%)	Value share of fresh potatoes (%)
Tesco	24.0%	2.3%	25.4%
Asda	13.2%	0.2%	13.4%
Sainsbury's	14.2%	0.8%	15.7%
Morrison's	9.7%	1.5%	11.5%
Aldi	6.0%	17.8%	8.1%
Lidl	4.4%	17.6%	4.8%

The UK is largely a self-sufficient potato producer, with the exception of processed products. Demand way exceeds our domestic supply. In 2016 we imported over 522,000 tonnes of fries, the vast majority from Belgium and the Netherlands.

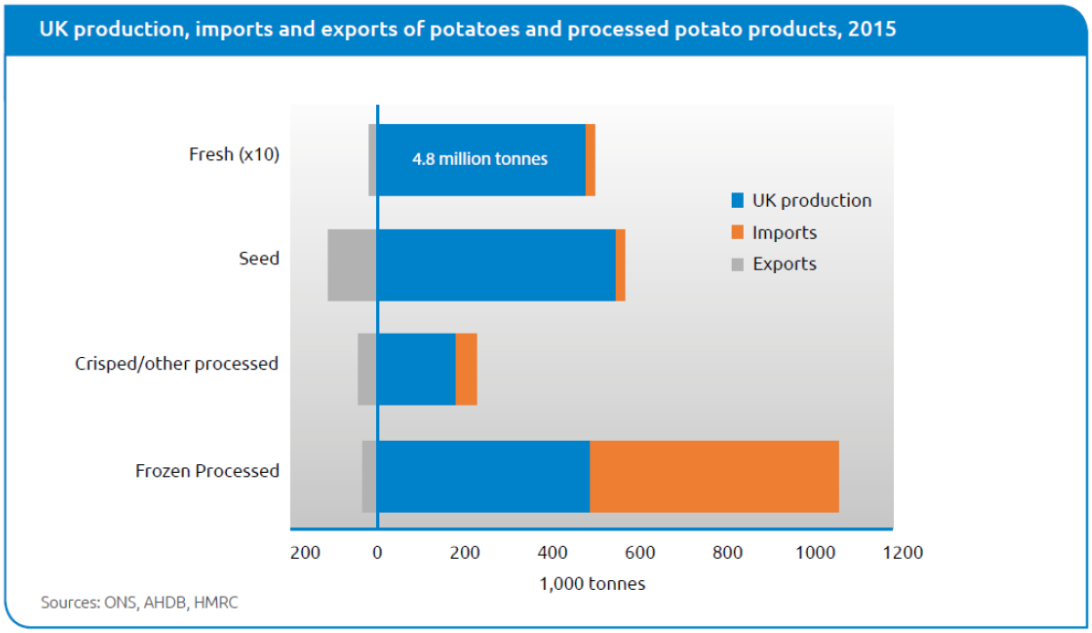

Figure 5: Compares UK production in all sectors, including seed, and clearly indicates our reliance on processed potato product imports (*Source: AHDB Potatoes*).

We have a healthy seed export industry, 73% of the volume going outside the EU, predominantly to Egypt, who in the 2015/16 season took 49,500t. Our exports of consumable products are primarily to the high value sector, premium snack products especially.

Outside the traditional fresh and processed product ranges, there are thriving dehydrated and organic industries. While these are showing impressive growth they are still very modest volumes.

Please see chart on next page

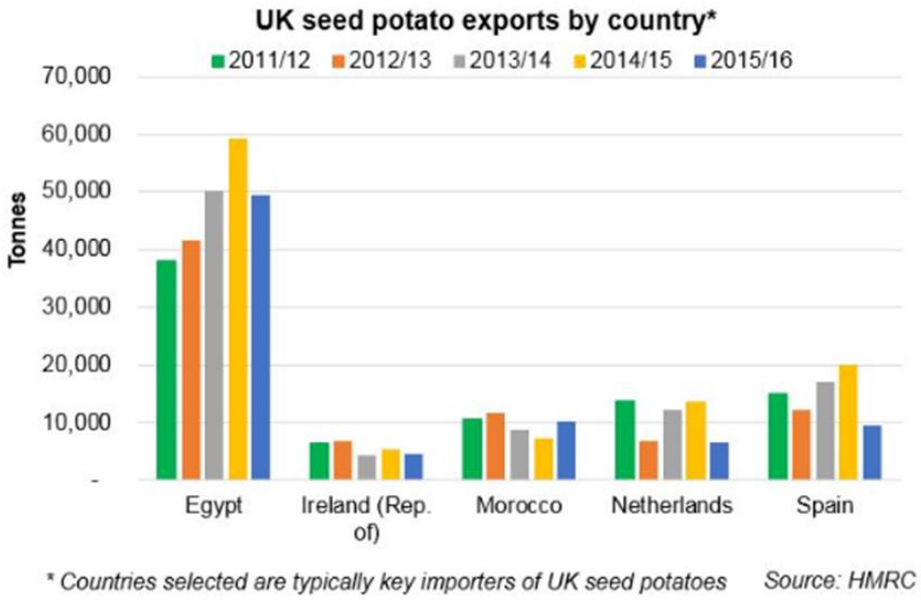

Figure 6: UK seed potato exports are predominantly to countries outside the EU (*Source: AHDB Potatoes*).

2b. Challenges to the UK Industry

The ware potato grower provides the base material for both the fresh and processing sectors, although there are some sector specific challenges. However, there are a number of common ones that also tend to dominate. These are:

- Potato Cyst nematode (PCN) is the nemesis of UK potato growers. The legacy of years of over production and tight rotations has left vast tracks of suitable soils with unviable nematode levels.
- The availability of both skilled and unskilled labour has been an issue for some time; exacerbated by the referendum decision in June 2016. The fresh sector especially relies heavily on unskilled foreign labour.
- Abstraction licenses for irrigation are under constant review by the Environment Agency, due to the pressures on water supplies from increasing urbanisation and climate change.
- The use of a range of chemicals commonly used in potato production is under review; Glyphosate, various nematicides, and CIPC (Chlorpropham).

2b.i. Sector specific issues

For the fresh potato sector, addressing the issues of a decline in consumption and changing consumer patterns, are the greatest challenge. A younger generation is fueling a gradual shift towards processed and chilled products as consumers look for convenience, turning away from the time-consuming preparation duties of fresh potatoes.

The key challenge for the processing industry is achieving a cost of production to compete successfully with imports of processed product from North Western Europe. In 2015 we imported 600,000 tonnes of processed potato products into the UK, predominantly French fries

As the example in Table 4 below indicates, UK production is at a yield disadvantage compared to the Dutch especially; our high depreciation and labour costs are the most significant factors. Our challenge is competing with very low overhead Belgian producers, many of whom are small family farmers.

It is widely accepted that the UK has some of the highest standards for accreditation, but is also a leader in agricultural innovation and research. This is being promoted by the AHDB's SPot Farm programme to demonstrate new, cutting edge practices for growers and agronomists to help improve productivity in their own businesses.

Table 4: Comparison of typical Cost of Production across North Western European potato producing countries (Source: Jay Wootton – Andersons Eastern)

Country	Netherlands		Belgium		France		United Kingdom	
	€/Ha	€/t	€/Ha	€/t	€/Ha	€/t	€/Ha	€/t
T/Ha	55.0		45.5		45.0		45.0	
Direct costs	2,400 €	44 €	1,550 €	34 €	2,000 €	44 €	2,600 €	58 €
Fixed costs	2,375 €	43 €	2,000 €	44 €	1,750 €	39 €	3,000 €	67 €
Cash cost	**4,775 €**	**87 €**	**3,550 €**	**78 €**	**3,750 €**	**83 €**	**5,600 €**	**124 €**
Depreciation, Rent, Finance, Management								
Sub total	**2,800 €**	**51 €**	**1,800 €**	**40€**	**1,600 €**	**36 €**	**2,400 €**	**53 €**
Full cost	**7,575 €**	**138 €**	**5,350 €**	**118 €**	**5,350 €**	**119 €**	**8,000 €**	**178 €**

*Assumption £1 = 0.71 €

2b.ii. Contracted supply

Contracted supply agreements have been common practice in the processing sectors for some time; however, they are a more recent development in the fresh sector. Contract mechanisms vary: fixed price agreements, indexation models, shared risk, pooling models; all have a degree of positive effect in delivering stability for producers and retailers.

Although competition is such that supply and contracting arrangements invariably come to similar commercial conclusions, contractual arrangements tend to bring a little discipline to the markets with the effect of reducing some volatility.

For both the prepack and processing sectors matching the value expectations of a highly competitive retail scene adds complexity to the situation.

2c. Key factors

The challenges highlighted appear to be familiar the world over. They encompass industry issues at both the micro level of the individual grower/company, as well as at the macro international/Governmental level. Local as well as international factors certainly differentiate the various markets to a degree, but my travel experience and research shows that there are a few dominant factors that are common at the global level.

There are a large number of relevant factors that influence the industry, some of the main ones include:

- Climate
- Stakeholder relationships
- Soil types and maturity of agricultural service sector
- Market maturity and intelligence
- Proximity to and size of potential market
- Local population dynamics
- Consumer focus
- Exchange rates
- Productivity
- National and regional socio-economic structures

3. My study tour

During pre-study research it became clear that all the factors highlighted in previous chapter have a part to play. However, at the planning stage, analysis showed that there are essentially four primary factors that dominate the industry in the UK. Each of these four were also influenced by the secondary factors highlighted. These are:

1. Consumer focus
2. Stakeholder relationships
3. Market intelligence
4. Productivity

It was also assumed that these dominant factors had a similar influence on the overseas potato industries as they had in the UK. However, it was felt that secondary factors were likely to have a greater or lesser influence from country to country. These dominant factors formed the framework upon which the Nuffield Farming study investigation was carried out.

My travel selection criteria was based on three thoughts:

- Which regions are of greatest direct threat to our industry?
- Understand how a region far removed from ours in location and methodology works.
- Take learnings from existing, well established supply chains and understand their industry sustainability initiatives.

Additionally, I conducted extensive research within the UK, talking to industry leaders, trade bodies, research centres and growers.

I wanted to see what lessons could be learnt from looking at the same or similar situations in other overseas markets and seeing if it were possible to identify any common factors, and to study the alternative solutions that were found that could be implemented into our own industry.

My study tour is summarised in chart form overleaf

Location	Date	Reasoning
Belgium, Germany, Netherlands	February 2016	Central and Northern Europe have similar growing conditions and markets to the UK. Aware of the lower costs of production in these countries, I wanted to understand how this was achievable, and to get a measure of the influences these regions can have on the UK market.
Czech Republic, Poland, Hungary	May 2016	
South Africa, Kenya	June 2016	Looking at the potato industry in developing countries: the climate, production systems, marketing and consumer dynamics far removed from our own. An opportunity to see supply chains in their infancy, their development potential and the social impact they can have.
Canada, United States	November 2016	Well developed and established supply chains in action, but on a huge scale. How does the North American market vary from ours, and how does this impact on the offering to consumers? I was also looking at the effectiveness of grower and industry representation bodies, of which there are many.

4. Study objectives

Overall the aim of the study has been to determine where the UK potato industry sits within a global context, to compare the key industry success factors, and identify where possible how the UK Industry might learn from best grower/company practice internationally, whilst also identifying any particular political and economic factors that provide an uplift to the various national potato markets. This has been carried out by:

- Identifying the key factors that affect supply chain performance.
- Examining each factor relative to the UK industry, highlighting those most relevant.
- Comparing the UK analysis with the equivalent findings in overseas potato markets.

The study then starts to pull together the alternative options open to the UK Industry at both the grower/company level and at the UK Government/Trade Association level. The Conclusions and Recommendations are then a distillation of the findings to determine how the various sectors of a sustainable potato industry can optimise their individual outcomes within an efficient national framework.

5. Key factor analysis

The various factors do not operate independently or in isolation, they are both complex within themselves and interrelated at a number of levels. For example, productivity cannot be independent of consumer needs nor can it be isolated from all other stakeholder demands. However, to allow us to identify, measure and study the broad impact of these key factors on the various Supply Chains, I have initially treated them independently.

5a. Consumer focus

Customer focus is critical in all global markets – however, how it manifests itself is very dependent on the geographic and maturity of the national markets. In broad terms it is a question of how much and at what rate can the regional supply chain change or adapt to the changing demands and tastes of its consumer base.

5a.i. Africa

For example, Kenya has a growing population where there is a very basic desire to ensure the long term availability of food and nutritional security. Improving productivity and building a logistics infrastructure are the primary factors at this stage in the country's development.

Figure 7: Kenya - over 50% of potatoes are sold through the 'informal' market. Even vegetable leaves have a value – making basic maize dishes more palatable.

Table 5: Comparison of the most prominent potato varieties planted in South Africa in 2007 with those of 2015 – having fluctuated, the area planted is very similar (*Source: Potatoes South Africa).*

Variety	Most prominent varieties **2007**	Most prominent varieties **2015**
Mondial	33%	42%
Sifra	-	14%
Valor	-	6%
Fianna	3%	6%
Up To Date	10%	4%
Pentland Dell	5%	-
Lady Rosetta	5%	-
Darius	4%	-
BP13	3%	-
FL2108	-	3%
Markies	-	3%
BP1	21%	3%
Avalanche	-	3%
Hertha	-	2%
Fabula	2%	-
Hermes	2%	-
Other	12%	14%
Total Planted Area (Ha)	**54,037**	**53,933**

Similarly, South Africa has very high levels of poverty and unemployment; the paradox being that there is a strongly emerging middle class, where poverty sits alongside the various levels of wealth and *Consumer* sophistication. The buying criteria for the poorest elements is cost alone – consumer needs can be simply defined. Indeed, potatoes compete with maize to be the daily carbohydrate of choice, the purchase decision based around whatever is cheapest on the day. This supply chain has therefore evolved to satisfy this more complex spectrum of customer demand by using some much higher yielding, low dry matter potato varieties (such as Mondial and Sifra) to extract maximum value for the poorer consumers. As Figure 6 indicates, superseding some of the higher Dry Matter, more flavoursome traditional varieties like BP1 and Up To Date; a case of quantity over quality.

The South African supply chain is therefore concentrating its supply efforts on both the poor to provide a basic carbohydrate food and on those with much greater spending power. This need to satisfy such a diverse market lead one South African retailer I met to quote:

"The poor *need* a bargain; the rich *want* a bargain"

A developing processing market (currently 20%) is seeing a growth in European processing varieties such as Fianna, Markies and FL2108.

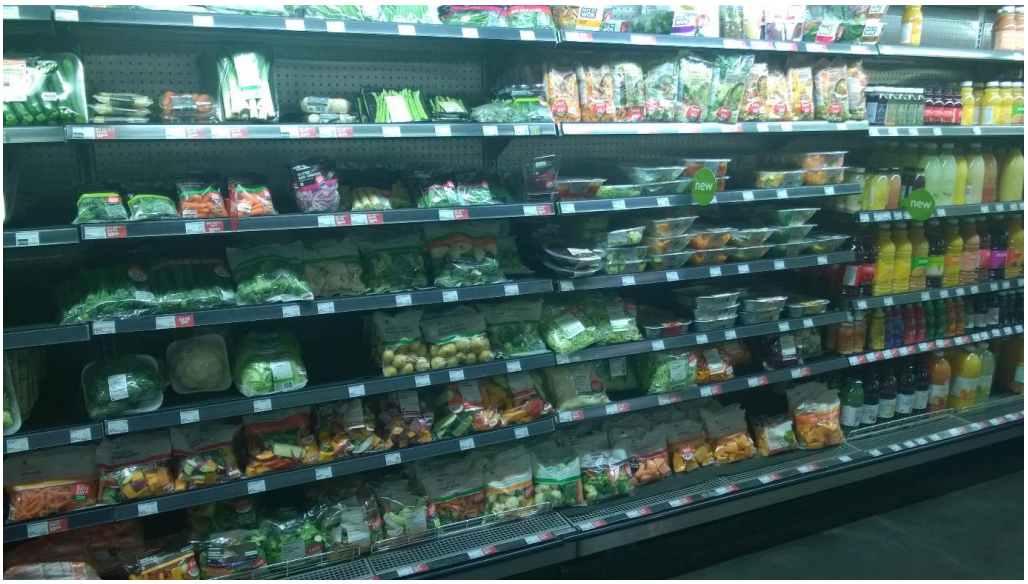

Figure 8: An emerging middle class is looking for a greater level of sophistication, like the prepared vegetable products seen here in Woolworths, South Africa.

5a.ii. North America

The Russet range of potato varieties has been meeting the needs of the processing and fresh sectors of the supply chain for several decades. However, customer tastes are changing; indifferent quality standards (by UK industry standards) are leading to decreasing sales of Russet type potatoes. Some North American consumers are becoming more discerning in their choice; there is an emerging market in the US for something different. Standard and traditional offerings are slowly being accompanied by colour variants and niche varieties, providing more diversity.

It is interesting to note that this is succeeding in a market normally dominated by brands. Rapid sales growth of these novel varieties follows a heavy promotional emphasis on the health and nutritional aspects of potatoes, reinforced by provenance and quality messages.

Fresh sales volumes of Russet varieties have dropped by 13% since 2012, but processed sales of the variety have increased by 2.3% in the same period. Since 2009 sales of Fingerlings like this example in Figure 11 have grown by 24%.

The Little Potato Company (based in Edmonton, Alberta) sell a range of niche varieties in small pack sizes, collectively known as 'creamers': premium quality, often exclusive varieties, bred in house, with a strong emphasis on the nutritional.

I visited their production partner from Vanco Farms on Prince Edward Island, Canada. Rit Van Nieuwenhuyzen grows specialist, niche potato varieties for them in strategic sites all over North America.

Figure 9: (right) The Little Potato company production at Vanco Farms, Prince Edward Island, Canada

Figure 10: Russet varieties are the staple for fresh and processing in the US.

Figure 11: Sales of niche products like Purples/Blues and fingerlings (seen here) have increased considerably.

Albert Bartlett is a successful potato brand in the UK, now exporting its business model to the US. This focuses on the consumer by applying strict disciplines on standards and presentation. Visiting Steve Barker at the headquarters of their US operation in Denver, Colorado, he defined their rules on consumer focus:

Figure 12: Steve Barker with a bin of Rooster packs at CostCo, Denver, Colorado.

- Reinforce messages with strong marketing. Bartlett's have spent over £40 million in the last 10 years on this.
- Promotional collaborations with popular films have been used to engage younger generations.
- Collaborations with seed houses and suppliers have built a robust and secure supply chain.
- Attract an emotional engagement with consumers. They can identify with Albert Bartlett being a real individual, not a fictional character.
- Share values and provenance with the consumer; using growers to help advertise - knowledge of source adds credibility.
- While brands are about building up an emotional value and a premium, a balance must be had in not making this so great as to start damaging sales.
- Entering a new market has not been without its challenges, but by sticking to the principles established in the UK market, sales are slowly increasing.

5a.iii. Europe

The focus in the more developed markets of Northern Europe especially, is on the 'added benefits' of potato products: convenience, provenance and the health agenda, with more emphasis on the aesthetics. Retail offerings in fresh potatoes across Northern Europe are far simpler than in the UK: a narrower range, sold primarily on taste and texture attributes, with an indication towards intended usage.

In the more developed markets more emphasis is increasingly being placed on the consumer's desire to gain a greater understanding of where their food is sourced from, and to reassure consumers of the provenance of what they are eating. This is evidenced by the various national accreditation schemes such as Red Tractor, LEAF and Global Gap, as well as a range of secondary proprietary schemes seen in the UK. As markets mature, demand for similarly recognisable schemes is developing worldwide.

5b. Stakeholder relationships

A competitive global retail environment has required the processors and retailers to make commitments to their consumers that have to be fulfilled. Traditional transactional relationships have been superseded by more strategic ones.

5b.i. Mature markets

For supply chain relationships to thrive in the more mature markets, there needs to be a recognition of all the upstream and downstream challenges in order to build a degree of interdependency, and eventually mutual respect and trust. This discipline can also be applied on a broader scale, as evidenced in the more specialist processing supply chains in Belgium.

The value of strong supply chain relationships was brought home to me by a meeting with Allison McCain, Chairman of McCain's, based in Florenceville, Bristol, in New Brunswick, Canada. McCain's fully recognise that business success requires stakeholder interdependency. Allison's views could be summarised:

> Customers and Consumers
>
> The relationship with customers and consumers is imperative. Consumers buy into the quality standard and the provenance of a trusted brand. This trust should not be broken or abused, by complacency, compromises or excessive premiums. Consumers are not fools, and will quickly recognise any indiscretion and desert the brand. Once they have created an emotional tie into a brand that they trust, they will buy more of it.
>
> *continued on next page*

Suppliers

Commitments must have a support strategy behind them. To deliver their consistency, provenance and quality promises to its consumers, McCain's need a consistent supply of the best raw material. It is important to them that they reward and recognise their best and most progressive producers; without them they're compromised.

Figure 13: For Allison McCain (right), protecting the integrity of the brand is paramount.

Similarly, Nina Pritchard, Head of Agriculture for McDonald's in the UK, stressed their commitment to UK producers - which is entirely based around maintaining provenance and quality. They regularly meet supply groups covering all their key ingredients to better understand their respective challenges. By discussing and sharing issues in advance, many challenges can be resolved before they become costly to rectify. Short termism is invariably painful:

"Volatility has a cost"

Needless to say I found many examples of intermediate level strategic partnerships and collaboration; in most instances the most successful relationships were between organisations with a compatible culture and values. Many delivered the normal commercial benefits and marketing strengths; however occasionally there were some unexpected but positive and less common benefits. I found an example when I met Randy Hardy, Chairman of Sun Valley Potatoes in Rupert, Idaho (Appendix E).

McCain's, like much of the North American processed potato industry has a very vertically integrated supply chain. Having complete control of the supply chain from crop inputs through to distribution networks, puts it in a strong negotiating position with suppliers and reinforces the security of the supply chain with its customers.

Figure 14: Randy Hardy from Sun Valley Potatoes, Rupert, Idaho. It is mandatory to indicate that potatoes have been 'Grown in Idaho' on the packaging.

Figure 15: Jeremy Blake of Hill Spring Farms, New Brunswick, rarely discusses prices with his customers, preferring to concentrate his efforts on service and quality, on the assumption that they wanted to be working with the best producers.

See more photos on next page

Figure 16: Vertically integrated supply chains are a common feature of the North American potato industry. Cavendish Farms on Prince Edward Island is now the only remaining major processor on the island.

Figure 17: Contract holders are supplied with all the inputs required for their crops through their Cavendish Agri-Services division; like fertiliser from this plant at Kensington.

Figure 18: Contracts are negotiated with the Prince Edward Island Potato Board, working on behalf of their growers.
Control of the complete supply chain gives Cavendish a strong negotiating position.

Figure 19: As well as owning their own transport operation to distribute their products, Cavendish provide a lot of their own energy requirements from anaerobic digesters.

An often overlooked consideration in contract negotiations is the need for timescales. Negotiating on behalf of their growers, Scott Howatt from the PEI Potato Board highlighted the importance of concluding contract discussions before planting.

5b.ii. Developing countries

In the developing countries I visited relationships are predominantly transactional, only for short term gain, and open to widespread abuse of the weakest. To counteract this, the National Potato Council of Kenya (NPCK) are looking to develop structured marketing initiatives for small producers to introduce them to potential customers in the growing added value sector.

Droughts caused by the effect of El Nino had a severe impact on yields in South Africa. Free market prices doubled in response. To compensate its suppliers McCain awarded 20-30% drought compensation to its suppliers to make up the shortfall, when their preferred European varieties had not delivered adequate returns, thus developing the long term security of its supply base.

McCain's two-decade presence in South Africa is on the back of a strong relationship with McDonald's whose brand is seen throughout the country; the two companies have worked together since 1968. They coordinate strategic growth around the world using a 'beachhead strategy'. Planned excess capacity in one country will be used to establish a presence in another. Once a market has been created, McCain will then invest in facilities there.

5b.iii. Common features

A degree of transparency between stakeholders is essential for the development of all supply chains. It relies heavily on the integrity of the participants where trust is the key ingredient. Success is entirely based on the attitude and perspective of individual participants:

> *"Short term thinkers will obsess about price and opportunism. Long term participants will care more for their return on investment, both emotionally and commercially, and a determination to make it work".*

5c. Market intelligence

Market intelligence is the lifeblood of effective decision making and strategy development: the ability to understand material availability, market demands and trends. It involves collation, interpretation and dissemination work usually performed by professional trade bodies and organisations. The primary information factors that the potato supply chain need to consider are:

- Planted area; potential availability by variety/sector.
- Current consumption levels and developing trends.
- Available stock levels by sector.

It is often the measurement of this national stock figure that is most contentious. The accurate collation and integrity of the source data is a common challenge. These figures dictate confidence in the markets, especially so in the Northern Hemisphere where only one crop can be grown per season. With a climate that enables multiple crops to be grown across the year on the African continent, there is a great deal more opportunity for flexibility to meet market demand throughout the year.

The role of most professional bodies is to direct information towards industry stakeholders to enable them to engage in increasing potato consumption. With the population of Africa set to double to over 2.5 billion (according to UN 2015 World Population Prospects) by 2050, the challenge of the NPCK is to develop a secure supply chain for willing consumers, contrary to more mature markets.

The marked difference between European and North American markets was the complexity of collating, analysing, and disseminating this information. Throughout European countries data tends to be collected by one industry-levy funded organisation. In North America, market data is collected by the USDA and Statistics Canada, then 'fine-tuned' by the levy-funded state and provincial boards - those that wanted to get involved.

Participation varied considerably; from grower through to provincial level. Those that did not want to take part saw little need for such a depth of detail, preferring to let market forces prevail. Incomplete participation in information sharing brings into question the validity of market intelligence.

A large wholesale market system enables Potatoes SA to obtain and quickly share daily pricing information with the supply chain, within a few hours. This would be very difficult to achieve in a more diverse market like our own.

Outside the UK, I found pricing in the fresh sector is largely still negotiated weekly; retailers appear much more prepared to accept volatility. The UK has matured considerably on this front, with a wide range of price agreements and mechanisms reducing the need for regular negotiation. However, for the proportion still subject to the open market, quality, accuracy and timeliness of information is crucial, with stock availability driving sentiment.

While I found the North American model of market intelligence confusing and complex, the opportunity to add a local perspective and detail to centrally collated data through the provincial board system is something we miss in the fragmented and diverse UK market.

5d. Productivity

Understandably productivity varied considerably from region to region. In this instance we define "Productivity" not just in terms of yield but embracing all inputs that are required to provide an optimal return on investment over the longer term. Needless to say the variations were due to a variety and complex mix of cultural, political, environmental and social factors that were nearly always a function of the local region.

Most notable have been considerable advances in seed breeding that have lifted average yields to greatly affect productivity, but at the same time deliver beneficial traits towards pest and disease resistance and tolerance.

5d.i. Climate

Understandably, climatic conditions bought both challenges and opportunities:

- Climate supports year-round potato production across South Africa. Production is geographically spread and seasonal: some areas like the Sandveld on the Western Cape can maintain a year-round supply.
- Sitting on the equator, Kenya has a year-round fixed day length, enabling two crops a year to be grown.
- Harsh winters mean only a very short growing window for Canadian growers. Crops are planted later, and need to be harvested quickly.

5d.ii. Soil type

While agricultural practices in Kenya do not meet developed world expectations, there are some environmental factors that benefit production:

- Soil types vary: there are many highly productive volcanic soils and, with much of the land previously forest floor, high levels of organic matter.
- Highly favourable climate and altitude for seed production especially.
- Soil erosion is a big issue in Eastern Canada. Soil banks are used to prevent slippage, and on PEI potato crops are undersown with grass and oats just before harvesting. This operation uniformly spreads seeds to stabilise and provide structure to the soil, to combat the effects of high wind erosion.
- The combination of (currently) reasonable access to water and free draining volcanic soils in Idaho greatly enhances productivity.

Figure 20: Volcanic soils, rich in organic matter at the foot of Mount Kenya

Figure 21: Soil banks and harvested potato fields on PEI, undersown with grass and oats.

Figure 22: The undulating terrain and erosion banks in New Brunswick do not lend themselves to effective centre pivot irrigation systems. When irrigation is permitted, alternative application methods are used.

5d.iii. Good agricultural practice

Productivity was lowest in Kenya where average yields are only 10 t/Ha, and 800,000 small farmers grow 150,000 Ha of potatoes (cf. 45 t/Ha in the UK). The low yield is largely due to poor agricultural practices:

- Little emphasis placed on the importance of rotation (continuous growing).
- Poor hygiene; volunteer potato plants are used as a food source, and not cleared, potentially harbouring pests and diseases.
- Continually replanting diseased ware as seed, leading to heavy bacterial wilt infestation.
- Little variation in fertiliser regime according to cropping.
- Very little use of agrochemicals.
- High storage losses; the climate is unsuited to ambient potato storage. There is no grading out of rotten potatoes.

5d.iv. Crop rotation

In the UK concerns over high levels of PCN have resulted in producers adopting integrated crop management techniques, including widening rotations, bio-fumigation crops and the adoption of resistant varieties. The current challenge is to gain widespread acceptance for varieties that combine resistance to both *Globodera rostochiensis* and *Globodera pallida* (Nematode species), with the beneficial market traits for which they were bred.

Throughout North America and Northern Europe, it was common to find rotations at 1 year in 3, and less; especially so in areas that have relied on tight rotations to increase productivity. Experience on the ground was beginning to suggest that this practice was increasing the PCN population to potentially damaging levels. It is a matter of getting the balance right between long-term sustainably, productivity and local resource exploitation.

Dwayne McNeill from Cavendish Foods on Prince Edward Island pointed out that there is heavy reliance on potatoes to support the profitability of the whole rotation. It is important that intermediate crops provide a profit also.

Figure 23: Waste and small potatoes left after the harvester at Worms, Germany. Historically rotations have been as tight as 1 in 2 years

5d.v. Access to basic resources

Access to basic resources is important in all regions. However it was perhaps best illustrated during my visit to South Africa, where cultural and societal regulation hindered the availability of water, investment and land itself. The key issues involve:

- Broad based Black Economic Empowerment laws designed to spread wealth across a wider section of South African society - stifling economic investment, therefore negating its initial aim.
- Land cannot be brought into commercial agricultural use without a very costly environmental impact audit that makes it prohibitive to do so.
- Entitlement: 'land grab' legislation to allow the seizure of white owned land without compensation – a disincentive to investment in infrastructure or focus on food production.
- Variability of yield in South Africa: yields varied from 30t/Ha for dry land, unirrigated crops, up to 80t/Ha for those with irrigation. (Droughts caused by El Nino had a severe impact on yields in South Africa over the past few years).

Figure 24: Joos Englebrecht of Lamberts Bay Potatoes, Western Cape, South Africa, explained many of the challenges of trying to farm sustainably in the current environment.

With support from the US Farm Bill, access to water and heavy investment in centre pivot systems has greatly benefited growers in the Western potato production states of the US. To extract maximum productivity from the land, some growers were using trickle tape and sprinklers in the previously uncropped areas between centre pivots. Strong environmental objection to drilling for irrigation water in Eastern Canada was a contributory factor to the comparatively poorer yields.

Figure 25: Centre pivot irrigation systems dominate the landscape of the Snake River Basin in Idaho.

5d.vi. Production complexity

Throughout my travels I found less sophisticated product and marketing demands enabled simple, high capacity and large-scale production, harvesting and storage systems, benefiting growers in the US especially.

Simplicity was key in Northern Europe. Many producers are small farmers, growing on their own land, many having second jobs, and reliant on family labour for most production operations, and contractors for harvesting. Machinery is owner-driven, well maintained and expected to have a long working life. Potatoes are either loaded straight into bulkers in the field, or hauled to central grading stations for onward movement to processors. A network of intermediaries co-ordinates delivery programmes, negating the need for growers to own complex grading equipment.

In Northern Europe, most processing contracts are based on a minimum 40mm screen. Process customers take on the task of grading and splitting into various size fractions at centralised grading stations, thus optimising crop utilisation.

The diverse and fragmented nature of the UK potato industry does not help, but I found that we appear to have a more complex supply chain than many others. Much of our systems are geared towards preserving skin finish; much less of an issue in a processing-dominated market which is less concerned about cosmetics.

5d.vii. Technology

The implementation of precision farming techniques to fine tune activities and inputs is becoming increasingly employed across the world. Deployment of technology was most noticeable in:

- Precision water utilisation, variable irrigation scheduling and application.
- Use of drone and satellite imagery to note field variability, and requisite variable application technology.
- Intensive soil sampling to establish variability, to address nutrient and organic matter status.

While there are many collaborative examples of industry and research institutions developing precision farming models, I met Shawn Paget in New Brunswick who was using his own initiatives to improve productivity (Appendix F). His strategy to self-improvement was:

> *"Get the quality right, then go for quantity and yield"*

Productivity improvements are not confined to potato growing. A conversation with John Toaspern from Potatoes USA was typical of many I had with packers and processors I visited. He highlighted that the processors, retail and foodservice sectors have all done a great deal to reduce waste and be more efficient. Where previously it had taken 2 lbs of raw material to make 1 lbs of finished frozen product, this is now down to 1.5 lbs. Similarly the dehydrated potato sector was now only using 5.5 lbs to make 1 lbs of finished product, having previously needed 7 lbs. These examples of increased efficiencies were having a marked effect on the volume of potatoes required.

Potato processing plants in Belgium are now highly automated, and employ some of the most advanced processing technology, considerably improving factory efficiencies. In 2016 alone, €310 million was invested in production equipment across the industry.

Other investment decisions were driven through necessity. Concerns over the availability and cost of labour are increasing throughout the supply chain in the developed world, were leading to wide spread adoption of optical sorting technology.

Figure 26: Developments in monitoring and control systems have greatly reduced storage losses. Omnivent at Zeewolde, Netherlands, are world leaders in storage technology.

Figure 27: When combined with 6-row windrowers, harvesters like this at Rollo Bay Holdings on Prince Edward Island can harvest over 8 Acres/hour.

Figure 28: Simple bulk storage systems, controlled by laterals going off from central plenums between stores, help keep storage costs low (Robison Farms, Idaho Falls).

6. Regional sustainability initiatives

Market sustainability and security of supply is a global concern. I wanted to understand some of the strategies being adopted by various regions, and here I have briefly outlined their aims, and the take-home messages from each.

6a. The collaborative approach

The Canadian potato industry is not so dissimilar from that of the UK. The forecasted yield for 2017 (2017 World Potato Markets) is expected to be around 4.76 million tonnes. However, this is from a harvested area of 138,000 Ha.

Canadian potato production cannot compete with the much higher yielding US Western state producers, with superior soils and access to water. Average yields for the two countries in 2015 were:

- Canada 33.62t/Ha (*Source: National Statistics*)
- United States 46.87t/Ha (*Source: FAO*)

It is acknowledged that an acceptable yield to make a viable processing industry is 40t/Ha. Canada contradicts this argument based on its proximity to the densely populated cities and ports of the Eastern seaboard, as well as a beneficial exchange rate enabling it to keep growing and processing potatoes at below conventionally viable yield levels.

Potato production and processing is crucial to the local economy. An initiative created by the local supply chain, The New Brunswick Potato Industry Transformation Initiative was put together after realisation that beneficial exchange rates and heritage cannot be relied upon to support an industry: this can only be achieved by improving productivity.

I met Joe Brennan, a retired potato grower who is leading a project to promote sustainable potato production in New Brunswick. There are four partners in the initiative:

1. McCain Foods.
2. Potatoes New Brunswick – Regional potato board.
3. Provincial Government (NBDAAF)
4. Federal Government (AAFC) - Agri-food Canada

Funding is coming from an economic development programme of the provincial government. They have set themselves a goal to increase yields by 5.66t/Ha over the next 4 years.

Having identified the factors that they believe are limiting their potential, they have established three key ‘working groups’ that meet bi-monthly.

See chart/diagram on next page

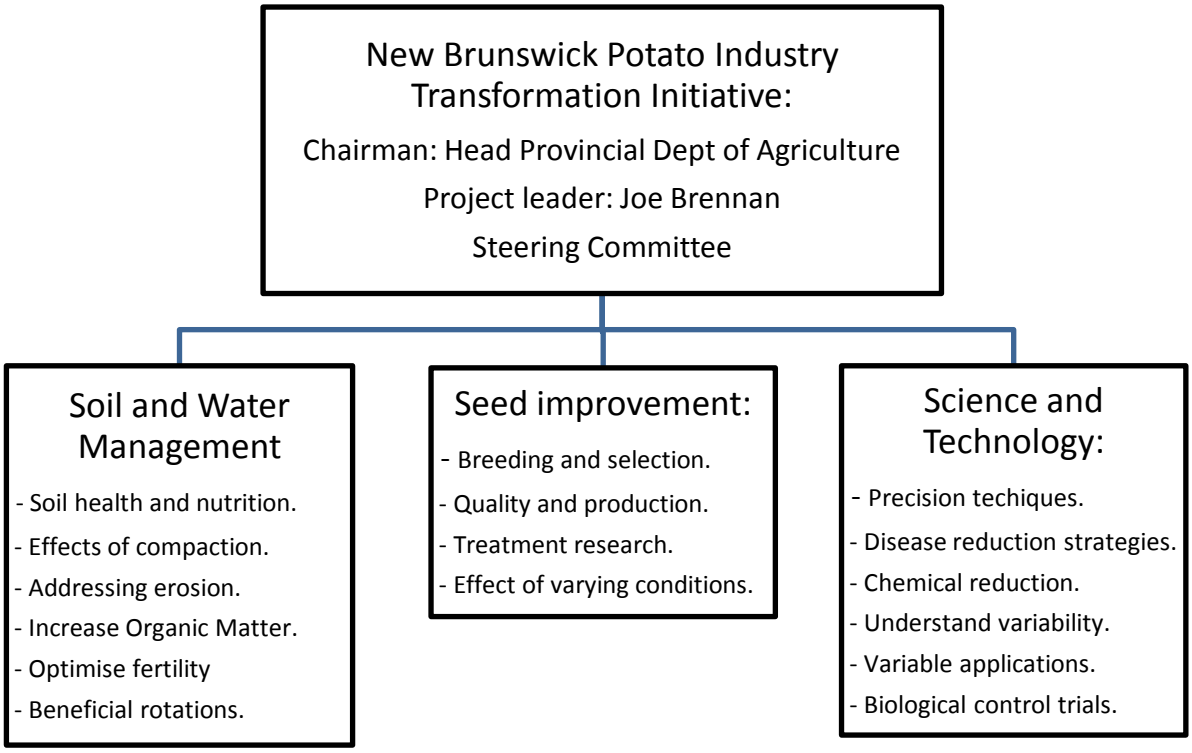

Figure 29: Organisational chart of the New Brunswick Potato Industry Transformation Initiative.

The working groups have input from all partners, grower and academic representation from Dalhousie University, Faculty of Agriculture.

Additional specific expertise is brought in as required: for example with precision agricultural techniques. There is a project underway with the Engineering School at the University of PEI to determine management zones, and they are encouraging the use of yield monitors on potato harvesters to measure outcomes.

There is very little irrigation available; there is sufficient rainfall, but it is sporadic. It is felt that the high capital cost of infrastructure and environmental concerns, outweigh the potential benefits for the time being. The inconsistent topography doesn't suit linear systems.

Research has identified the need to improve organic matter is of crucial importance to manage a variable moisture supply. There is ongoing work looking at the most beneficial rotation crops to achieve this. Widening the rotation from the current standard of 1 year in 3, will also benefit soil health.

Joe commented that this level of collaboration between industry stakeholders has reached a level not seen before. The inclusion of growers in many traditionally academic research projects has been hugely beneficial.

> *"All parties are currently very optimistic. The last three seasons have been reasonably good. Growers are more engaged, and prepared to try new things, the attention to detail is improving. Paying attention to the details they disregarded in the past, and are more receptive to new products and practices."*

6b. Back to basics

Potato production is proving vital for the economic and social development of rural communities, and national food and nutritional security in Kenya. Impeding the development of a robust potato supply chain has been the availability of suitable quality seed stock, and the consequences of continual replanting of diseased ware into the same ground. In some areas the effects of PCN are starting to be felt also.

Kenya is recognised as one of the most stable countries in East Africa, with a growing economy and population. However, their industry is currently ill equipped to satisfy this need; 95% of farms are less than 2 Ha.

Average yields are only 10t/Ha. Given the right inputs and practices, many believe that 25t/Ha is achievable. Meeting Wachira Kaguonga and Sarah Kuria from the NPCK I heard how they have ambitious plans to develop the supply chain. They are hoping to improve yields and quality and generate fairer returns for small farmers.

This initiative involves working with the Ministry of Agriculture, County Governments, and the Kenya Agricultural and Livestock Research Organisation (KALRO), as well as collaborations with outside organisations:

- Centre for International Potato Research (CIP)
- European seed breeders (Joint venture between Agrico and NL government).
- Kisima Farms – large scale seed multiplication.

Currently Kenya's certified seed potato need is only being satisfied to the tune of 1% of that required, much of it produced by Kisima Farms, Timau, near Nanyuki. Privately owned and run by the Dyer family, they have invested heavily in building a certified seed business into their existing operation, implementing developed world ideas and technology (Appendix B).

This collaboration is producing mini-tubers aeroponically (Appendix C). Some are a multiplication of local varieties like Shangi, others are European ones suited to local conditions. Convincing small farmers to invest in new seed is difficult; they also need to be educated as to how to grow and manage the crop effectively.

The NPCK have set a number of objectives to help develop a more robust and equitable supply chain:

- Communicate the benefits of good agricultural practice and marketing through:
    - Demonstration plots.
    - Outreach centres.
    - Use of lead farmers in rural communities to educate others.
    - County and national conferences.
    - Training and agronomic advice via SMS and television programmes.
    - Encourage co-operation and collaboration between growers.
- Improve confidence in certification, quality and traceability systems.
- Promotion of good agronomy, for example offering vouchers for advice, and chemical and fertiliser discounts, supported by industry partners.
- Encourage more private investment in seed multiplication initiatives.
- Bringing together Kenyan potato industry stakeholders to initiate added value businesses.
- Farm Inputs Accessibility Initiative to co-ordinate strategic partnerships between key input providers (such as Bayer and Syngenta) to encourage and improve accessibility to primary inputs.

Figure 30 (above): Here early generation field samples *are* being taken by KEPHIS, the Kenya Plant Health Inspection Service for virus testing.

Figure 31 (left) : Shangi is a variety that has proliferated in Kenya. No one knows how it was introduced. A very robust variety, it now represents 70% of the potato growing area.

6c. Good information

I was invited to a Supply/Demand meeting held by the United Potato Growers of America (UPGA) in Salt Lake City, Utah. This is a monthly meeting where national stock levels and demand patterns are reviewed across the potato producing states and provinces of North America by local board representatives from each of the fourteen potato growing states, and one representing the combined

provinces of Canada. The results are then used to provide strategic direction at a local level. With much of the processing tonnage contracted, this is predominantly a tool for the fresh market.

The objectives of the UPGA can be found in Appendix F.

The Supply/Demand meetings are used to analyse current stock availability information supplied by the USDA and Agri-Food Canada, and amend it according to contributions from members, noting any local trends. These can be verified by overlaying sales figures from regional growers/shippers associations.

The UPGA employ a statistician to forecast likely monthly demand over the season, based on historical averages. A weighted availability level is then spread across the remainder of the season. Actual clearances to date are charted against the 'estimated' availability level, and given the variance, a prediction made if sales are likely to outstrip available product, or vice versa. This is repeated across the membership boards. Collectively a decision is then made on the next course of action for that member.

Given the scenario of sales trailing forecasted demand, board members are tasked to encourage their own membership to sell more. Selling above forecasted requirement, and with the likelihood of a shortfall, growers and shippers are advised to slow sales down. Invariably these factors have an influence on price. Very general cost-of-production data is then used to make an approximate assessment of potential grower profitability.

Not everyone sees the value in this system; Kevin McIssac from the United Potato Growers of Canada admitted the reluctance by some provinces to share information. Saskatchewan and Ontario had dropped out of the scheme. While it may set out with the best of intentions, its effectiveness is diluted without complete participation. An admirable depth of detail and timeliness, but for our market system a concerning level of intervention.

6d. Maintaining momentum

The growth in the Belgium potato industry over the last 20 years has been staggering, fuelled principally by the export of fries around the world:

- Processing volumes have risen from 800,000 tonnes in 1994 to 4.4 million tonnes in 2016.
- In the same period, its domestic growing area has gone from 52,000 Ha, to 90,700 Ha.
- Paradoxically, in 2016 Belgium was the largest exporter of fries in the world at 2.06 million tonnes, but also the largest ware importer. Much of its processing shortfall is fulfilled by imports from France, Germany and the Netherlands.
- Provisional figures indicate that Belgian growers have planted 94,709 Ha this season; 6.1% more than previous. Last season total yield was 4.04 million tonnes; likely to exceed 4.5 million this.
- Belgium consistently tops the list of the highest potato yields in the world, and the lowest costs of production in North Western Europe.

I went to meet Romain Cools, head of Belgapom, the trade organisation representing the Belgian potato industry to understand how they have got to their current position, and hear their plans for the future.

To achieve this objective and maintain their global position as the number one exporter of fries, Belgapom are focusing heavily on the future sustainability in their industry:

- Establishing a marketing campaign for Belgian French Fries, based around a fictional ambassador for the Belgian industry: James Bint. Opening up new markets in Asia especially.
- Due to limited land availability and PCN pressures in Belgium, processing production is displacing fresh production in Northern France.
- Increasing research and utilisation of PCN - resistant and tolerant potato varieties to avoid unsustainable levels of nematode populations.
- Increasing the use of low residue sprout suppressants; Reskia is a project launched by Flanders Food and IWT (Innovation for Science and Technology), to find alternatives to CIPC.
- Introducing 'Watch it grow', a multi-disciplinary precision agriculture project launched by BELSPO (Belgian Federal Science Policy Office), that combines data from weather stations, soil analysis and crop development using drone and satellite imagery to measure in field crop variability to give as accurate yield prediction as possible.

Figure 32: : The author, James Bint and Romain Cools from Belgapom.

- Currently over 70% of supply into the processors is contracted. This trend is set to continue; one proposal is to move away from weight-based, to area-based contracts, utilising knowledge from the 'Watch it grow' programme.
- While 2-year contracts are already in use, there are proposals to consider 3-5 year contracts to tighten the relationship between grower and processor.
- Progressive, long term contractual arrangements directly with growers are allowing an opportunity to shorten the supply chain, consolidate and add some professionalism after the rapid expansion of recent years.
- 'Bintje Plus' programme has been established to use cisgenesis to make the traditional variety resistant to *Phytophthora infestans* (potato blight).

Belgapom still have ambitious plans for growth. To satisfy forecasted demand for their potato products they need to be producing 5 million tonnes; they do not want to settle into complacency.

7. Challenges identified

At the beginning of this report, I highlighted a number of factors that I believe affect the performance of any potato industry supply chain:

- Climate, soil type and proximity to markets give certain regions a uniqueness that cannot be replicated.
- Exchange rates, population dynamic and socio-economic status are influenced by a great many other variables.
- Customer focus, market intelligence, stakeholder relationships and productivity we can control to benefit the performance of the potato supply chain.

Solutions should be derived from a combination of the factors that we can control, but with greater emphasis placed on some than others.

7a. If we don't do anything?

The first option to consider is to do nothing: maintain the status quo.

For those groups aged 44 and under, current demand for frozen potato products exceeds that for fresh (Figure 31 below). Consideration should be given as to whether this trend continues as these age groups mature. Fresh potato purchases are not going to disappear overnight; the potato's broader versatility and the prepared products sector will still see a demand. Wastage is already falling due to the trend to more regular 'little and often' shopping patterns and smaller pack sizes.

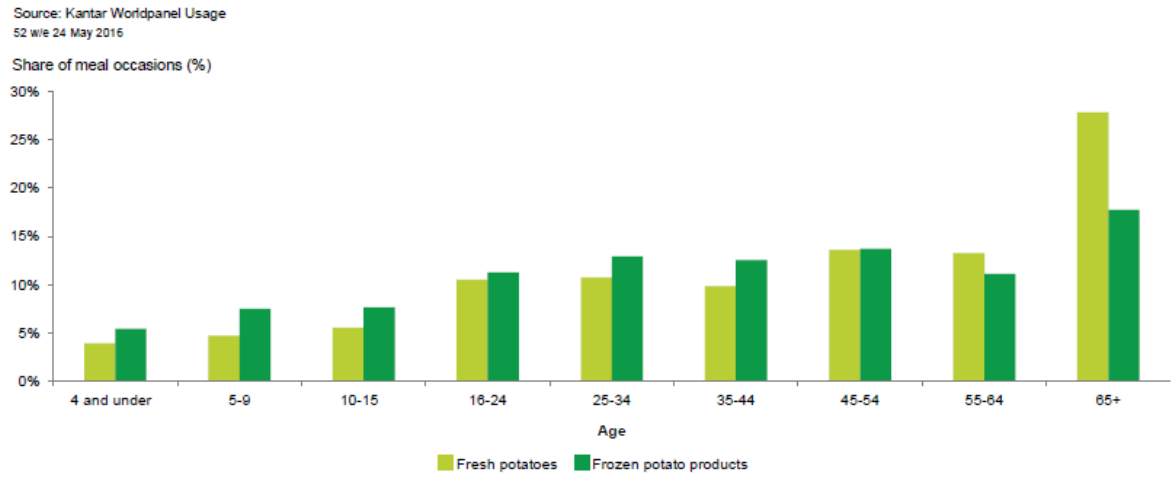

Figure 33: Consumer profile – fresh potatoes and frozen potato products (Source: AHDB Market Intelligence 2016/17)

There can be no compromises; the breadth of choice and heavy emphasis on aesthetic quality, has resulted in consumer expectations in the UK that must be maintained:

> *"Quality is remembered long after price is forgotten"*

Given current consumer trends and value perceptions, there are two potential scenarios to consider if the potato supply chain does not adjust from current behaviours:

1. Increased migration from fresh potatoes towards alternative carbohydrate sources and improved utilisation are likely to necessitate a drop in fresh potato production.
2. The increased demand for frozen processed products met by price-beneficial European imports.

7b. Why do we need to change?

There is no getting away from the domestic demand for French fries and similar products. This sector is still growing; primarily being driven by growth in Quick Service Restaurants (QSR), where potato servings have increased by 0.6% up to the year ending March 2017 (*AHDB Potatoes*). The UK potato industry comfortably satisfies the demand for premium fresh and processing demands, but costs itself out of satisfying the value end.

The value and size in our market is attractive to our near European neighbours. They see the UK as a market with huge potential, with over 65 million quality- and value-conscious consumers. Northern European competitors are encouraging initiatives that reduce the necessity for free market purchasing by moving towards area based contracts, similar to the example in Belgium.

Recognition of the true costs of potato production will retain the confidence of the better, more progressive growers, who can see a sustainable return on investment. Correspondingly this should attract investment in the industry, both in terms of outside capital and attracting the next generation of participants.

7c. Key factors to consider

Accepting that the UK has one of the most customer-focused markets in the world, it is effective changes within the remaining factors that could dictate the evolution of the UK potato supply chain going forward.

7c.i. Productivity

The common factor throughout all the regions I visited, regardless of market maturity, was the need to raise productivity. There were different drivers, but the overriding one in the developed world was to improve competitiveness; price inflation is not a politically acceptable option, all it does is stifle initiative and investment.

Concerns over rising levels of PCN are only just becoming majorly apparent elsewhere, exacerbated by historically tight rotations. While there is widespread acceptance that seed breeding, biological and chemical means could deliver partial long term solutions, there is no getting away from the benefits of a wider rotation. This is something we accepted in the UK a long time ago.

> *"If you don't go looking for a problem,*
>
> *you won't necessarily find it before it is too late"*

Production systems and supply chains outside the UK appear to have evolved into far more basic models. For processing-potato production the shortest and most simplistic supply chains were the large scale producers of North America, with high capacity machinery and bulk storage systems; logistically difficult to replicate in the UK. These were closely seconded by those in Northern Europe, Belgium especially. Interestingly the economies of scale argument does not hold up here, but the co-ordinating and collaborative approach of small family farms does. Producers under these regimes have learned to operate with more consistent, modest margins: adaptation through necessity.

By comparison I did consider that we in the UK may be over-complicating some of our operations, and have become stuck in traditional methodology; having a more 'travelling circus' approach to potato production.

The simpler retail offering outside the UK has meant that the barriers to entry for the fresh potato packer are not as high. The more basic offering in North America and South Africa has allowed a proliferation, albeit now rationalising also, of grower-owned packhouses serving retailers directly. The complexity and breadth of our fresh potato retail offering has necessitated more sophisticated procurement and operational requirements that few growers can replicate alone. However, if we continue to follow the simpler, value-led example of the discounter retailers, there is nothing to stop some of the larger, more progressive fresh growers from establishing direct supply operations, with year-round consistency, similar to those of the fresh vegetable industry.

For producers and packers the cost and availability of labour was a global issue in the developing world; a dual need, to automate processes, and a commercial one to reduce the reliance on manual labour. An increasing concern in both the UK and the US on the political stance on migrant labour is initiating change:

> *"The more progressive packers are making automation an investment priority."*

7c.ii. Stakeholder relationships

Much of what I have established about supply chain relationships is very subjective, ultimately common sense, and established through conversation:

- Cultivating and nurturing strong relationships with all stakeholders is important; neighbours, suppliers, employees and customers; communicate well and get everyone on board.
- Try to sit closer to the customer and understand what they want; not what you think they want.
- For businesses that have developed strategic alliances, it is important to collaborate with organisations with a similar culture and values.
- Short term thinking is not conducive to building up trust and loyalty; a long term strategy delivers a message of confidence to all stakeholders.
- Respect of organisational goals and objectives initiates better quality conversations and promotes loyalty.

> *"Relationships that had built up a mutual dependency can concentrate on increasing productivity and business improvement, rather than the distraction of negotiation and perceived inequalities".*

I think above all else, integrity and mutual respect govern the quality of any relationship, an understanding that everyone has to make a living, and make a respectable return on their investment. I am drawn to a quote from Terry Curley on Prince Edward Island, Canada (Appendix D), who after a particularly challenging period with one customer commented that:

> *"Buyers never understand a reliable supplier until they try an unreliable one".*
> Terry Curley, Prince Edward Island, Canada

I have highlighted several examples of supply chain collaboration elsewhere in this report. The appetite seems greater abroad; not just as a means to reduce costs and the more practical aspects, like sharing machinery, but sharing problems and potential solutions.

7c.iii. Market Intelligence

Accurate market intelligence was a challenge the world over. On a local scale it was achievable to a degree in either the physical and well-regulated provincial markets of South Africa, or the independence of Prince Edward Island, but on a broader scale it was a challenge.

The depth of detail and accuracy regarding remaining stocks and usage was a universal problem, especially in markets still with a substantial proportion of product sold outside contracts. Across North

America there are multiple levy-funded bodies representing the interests of different elements of the supply chain and, while this situation appeared complex and confusing, it instigated a greater interrogation into stock levels. However, not everyone saw the benefits in this, and without unilateral participation, its effectiveness was somewhat diluted. For the majority that did participate, I appreciated the opportunity for a monthly review of remaining stock levels by the UPGA, and the depth of detail involved. The timeliness and regularity of this meeting was useful. In a market seemingly divergent from demand, any lag in market knowledge can be crucial.

> *"Supply situations can be turned into opportunities".*

There is a balance to be had between the depth of detail desired, and the cost of acquiring the information. Ultimately it comes down to who pays, and how much are they prepared to pay for market knowledge. Whether the potato supply chain would be prepared to pay any more in a market becoming increasingly contract focused?

The option to buy into as much information as you felt was needed is available for the supply chain in North America, but the dilemma for an all-encompassing professional body like the AHDB is prioritising spending: how much emphasis to place on market intelligence over other demands?

Promotional activity took place on a variety of levels throughout the world. Campaign styles varied, but there were two distinct themes:

1. Those promoting the health and nutritional benefits of potatoes, looking to drive consumption, and promote a healthier lifestyle.
2. Those promoting their industry, for example the Idaho Potato Commission with their giant potato touring the US.

Many had adopted a similar campaign strategy to that of the AHDB; one of advocacy and 'influencing the influencers', a redefined target audience. This campaign should continue to evolve to promote greater patriotism amongst consumers post Brexit.

Whether the potato supply chain has an appetite for providing additional funding for promotion, given that some participants already spend considerable sums on their own brands, is open to conjecture. On a broader scale the AHDB has benefited considerably from a 50% co-funded promotional campaign from the EU. Post Brexit, it is imperative that government, at the very minimum, replicates this type of funding, plus any for innovation, that currently comes from Europe.

7d. Long term developments

Much of the analysis in this report has been towards current issues affecting the UK potato supply chain, but there are some that will have a longer term impact, revolutionising productivity, necessitating further supply chain evolution.

7d.i. Brexit

At the time of writing (July 2017) the Brexit details are still an unknown, and negotiations likely to be very complex. If no deal is reached, and we end up operating under World Trade Organisation rules, as a net importer of potato products we could potentially benefit. If the exchange rate differential and any logistics and productivity gains can equal or better any tariffs, we significantly improve our competitiveness. Currently the bulk of the UK potato industry's exports are outside the EU, and are higher value products; principally potato seed and premium crisp lines.

Of greatest concern to the UK food industry is the availability of labour. Much of the fresh produce industry especially relies very heavily on EU workers, and any restrictions on their status will impact on production costs and competitiveness.

7d.ii. Genetic Modification

The technology already exists to make a significant difference to potato production around the world, and solve many global food and nutritional security issues. Potential economic and environmental savings can be derived from improvements in pest and disease resistance, such as Colorado Beetle and Late Blight infections: multiple resistance genes negating the need for blight control fungicides.

It is important that any solution remains with the genotype, and the benefits are consumer-orientated. Examples include a reduction in the susceptibility to bruising, and less production of asparagine to reduce acrylamide levels when cooking at high temperatures.

In the US, I did find examples of J R Simplot's 'Innate' potato for sale under the White Russet brand; its GM credentials were much understated. Currently no major brand will take any public relations risk in placing GM ingredients in their range until it receives greater consumer acceptance.

7d.iii. True Potato seed

The use of True Potato seed has the potential to solve many of issues associated with seed potato tuber cultivation. Only 150g is required to plant 1 Ha of potatoes, compared with the current average of 2000 Kg of conventional seed potato tubers. Current research and development aims to improve consistency and uniformity in all aspects; from plant establishment through to resultant crop quality. It is only a matter of time before the challenges of unreliable germination and lack of uniformity are overcome.

See Table 6 on next page.

Table 6: A comparison of the merits of conventional Solanum tuberosum seed potatoes and True Potato Seed.

	Advantages	Disadvantages
Solanum tuberosum	• Easy to plant. • Plants grow quickly and vigorously. • Harvested tubers are uniform in size and appearance. • Potentially high yielding.	• Can carry many pests and diseases. • Bulky to transport. • Easily perishable. • Require temperature controlled storage to keep until the following season.
True Potato Seed	• Carries fewer pathogens. • Easy to transport. • Can be stored for longer periods, conveniently and inexpensively. • Flexible planting time; not dependent upon sprouting of seed tubers. • Opens up the opportunity for growing in new areas; especially in developing regions. • Production cycle much shorter, enabling faster reaction to changing consumption patterns and customer specifications.	• Germination and establishment is unreliable. • May necessitate initial growth into a seedling, then transplanting on a field scale. • Tetraploid nature of the potato means that there is no uniformity in the resultant crop.

7d.iv. James Hutton Institute

I spent some time with the James Hutton Institute to find out the latest developments in UK research. Currently there is much work going into genetic fingerprinting to identify the genes that impact on all aspects of the quality, dormancy and abiotic stresses that affect potato crops. Through the use of markers in genetic selection the Institute is looking to breed varieties that deliver positive environmental, health and nutritional traits into potato production.

The latest research is going into the potential to harvest hydro carbons called Solanesols. Extracted from the foliage, these are primarily used to make pharmaceutical products, potentially generating more value above the ground than below.

Currently under construction in Dundee, the Institute is building Scotland's first vertical farm. Entirely automated, and on multiple levels, they are looking at utilising this technology to create an artificial environment for seed potato production. This has the potential to have a significant effect on field production, and if successful, would allow seed production to take place much closer to where it is needed.

All the technical solutions have the potential to reduce cost and waste in the supply chain. Technology has the ability to deliver environmental and social benefits globally; improving health and nutrition, and reducing the environmental impact of potato production.

8. Conclusions

1. We have much to be positive about in our industry; having the climate, marketplace, resources, knowledge but few of the environmental, political and social challenges that affect other potato producing regions.
2. Improving productivity, with a target of self-sufficiency is the key objective. Over time, as consumption habits change, and efficiencies and crop utilisation improves, it is likely that the area for fresh potato production will need to reduce.
3. Volatility has cost the industry; our competitors with much lower cost structures based around contracted supplies and more productive operating systems, are capitalising on this.
4. Industry stakeholders that have invested in infrastructure and relationships have prospered.
5. A greater need to control volatility by the UK potato supply chain will necessitate the increased use of contracting mechanisms. For some this will require a recalibration of their expectations on returns.
6. While we may celebrate our quality standards, provenance and patriotism, we should not be complacent. We cannot rely on 'GB only' policies to maintain our industry. Respected and trusted brands have a place, but the rise of the hard discounters should be indicative that our consumers are still chasing value.
7. Back to basics – The pursuit of productivity through tight rotations is doing nothing to reduce PCN levels across the world.

9. Recommendations

1. While the UK potato supply chain continues to evolve, the Market Intelligence information disseminated by AHDB Potatoes needs to reflect this changing trading environment. Especially so the regularity and detail around sector specific stock figures to reflect the diversity and sophistication of our market.
2. Brexit should initiate a patriotic promotion of UK potatoes to stimulate a drive towards self-sufficiency by all industry stakeholders.
3. The UK is a leader in agricultural innovation and technology. This should be embraced to improve domestic productivity and as an export opportunity.
4. Consideration should be given by some growers to either reducing their fresh potato area or transitioning into process potato production, if the opportunity allows.
5. Relationships within the supply chain are crucial. All stakeholders need to think longer term and collaboratively to build confidence, encourage investment and build trust. Communication and co-operation up and down the supply chain is vital.

10. After my study tour

I applied for a Nuffield Farming Scholarship during a period of considerable industry and business uncertainty. Over my Nuffield Farming study period the situation has improved, but it's still challenging. We have been able to negotiate more favourable terms with some of our core customers that have enabled us to invest, and to secure more meaningful supply agreements.

My post Nuffield study tour intentions:

- As somewhat of a technophobe, I am inspired and enthused by some of the applications of technology I have seen, especially those that could automate and streamline some of our processes.
- I want to devote more attention to business development and direction. To date we have largely gone with the flow, but having seen the strengths of strong brands and differentiated product offerings, I want to explore these in more detail.
- Some of the developments I have seen in seed potato production have the potential to change the industry. I would like to understand more about these, and capitalise on them.
- My Nuffield journey does not stop here. It has inspired me to travel more, and further afield. While my trip to Kenya had minimal direct contribution to factors that could influence the UK potato industry, it was the one that had the most effect on me personally. I will endeavour to look for opportunities for involvement with improving potato production and the supply chain in Africa.
- Work with AHDB Potatoes on adapting Market Intelligence to reflect the needs of the current potato supply chain.

Figure 34: I spent some time visiting McCain plants in Maine and New Brunswick with Eric Ritchie (Nuffield Farming Scholar 2005 pictured). Florenceville Bristol is the home of McCain's; their recent announcement of a £100 million investment in their plant in Scarborough, UK, is a positive boost for the UK potato industry.

Rufus Pilgrim

July 2017

Glossary

Acrylamide	Acrylamide is a chemical compound that can form in some foods during high-temperature cooking processes, such as frying, roasting, and baking, from sugars and an amino acid that are naturally present in food.
AHDB SPot Farm initiative	Strategic Potato farm initiative was introduced in Spring 2015. It is a demonstration of the latest, independent best practice in a commercial, field-scale environment. Growers and agronomist are able to take the latest researched-based thinking to take back to their own organisations (Appendix G).
CIPC	Chlorpropham (active ingredient) is a post-harvest sprout suppressant.
Cisgenesis	Cisgenesis is genetic modification of plants with cisgenes only. A cisgene is a natural gene from the crop plant itself or from a sexually compatible donor plant that can be used in conventional breeding. The gene belongs to the conventional breeder's gene pool. (Source: www.cisgenesis.com)
Fresh bags	Ware potatoes destined for wholesale/farm shop outlets.
Fresh chipping	Ware potatoes grown for use in fish and chip shops.
Prepack	Ware potatoes grown and packed for Fresh retail sale.
Processing	Ware potatoes grown for processing into frozen potato products, including French fries, canning, crisps and starch production.
Tetraploid	Have four times the number of regular chromosomes.
UPGA	United Potato Growers of America (Appendix F).

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Terence Brown - Potatoes South Africa
Joos Englebrecht – Lamberts Bay Potatoes
Raymond Da Costa – Farmwise

Appendices

Appendix A - Shaun Paget, Riverview Farms, New Brunswick, Canada.

Riverview Farms, Hartland, New Brunswick was underperforming as a supplier to McCain's in nearby Florenceville when Shaun took it over from a relative. It regularly featured close to the bottom of the McCain's scorecard results. He worked through his production processes individually, reviewing and improving, and through incremental gains he had lifted his farm from 58/63 suppliers 10 years ago, to now regularly featuring in the top 10 producers.

To learn how to maximise yield, he had targeted an area of comparatively recently acquired land (Field H15) with the intention of learning as much about it as possible; looking at root depth and compaction, nutrient status, natural water courses, even going to the extent of soil sampling every 2.5m to form a very detailed map. Overlaying yield maps, measuring the topography, he was trying to build a precise picture of how best to capitalise on the most productive areas. Big data was overwhelming him, and he was suffering from 'paralysis by analysis'; discovering there can be an overload of information.

His latest research is in soil sampling the high and low yielding areas in the field to try and find some correlation.

Figure 35: The author and Shaun Paget touring the farm, including the 'emergency' sluice to clear out sections of the bulk store in the event of a problem – only used once.

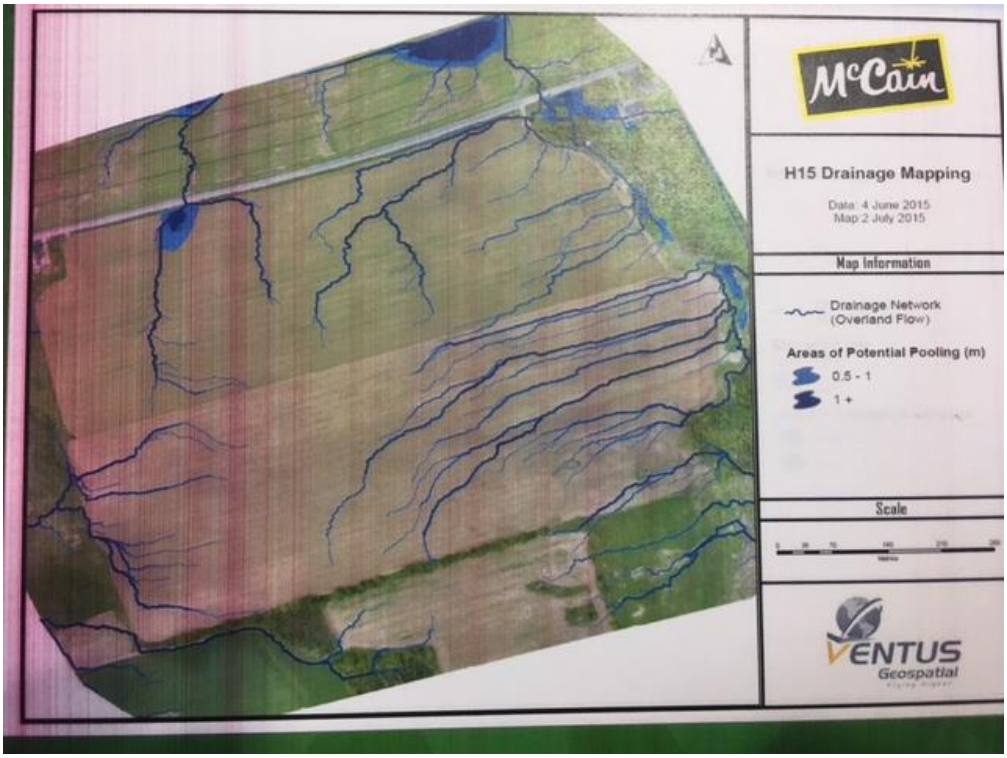

Figure 37: Natural water course and drainage mapping of Field H15.

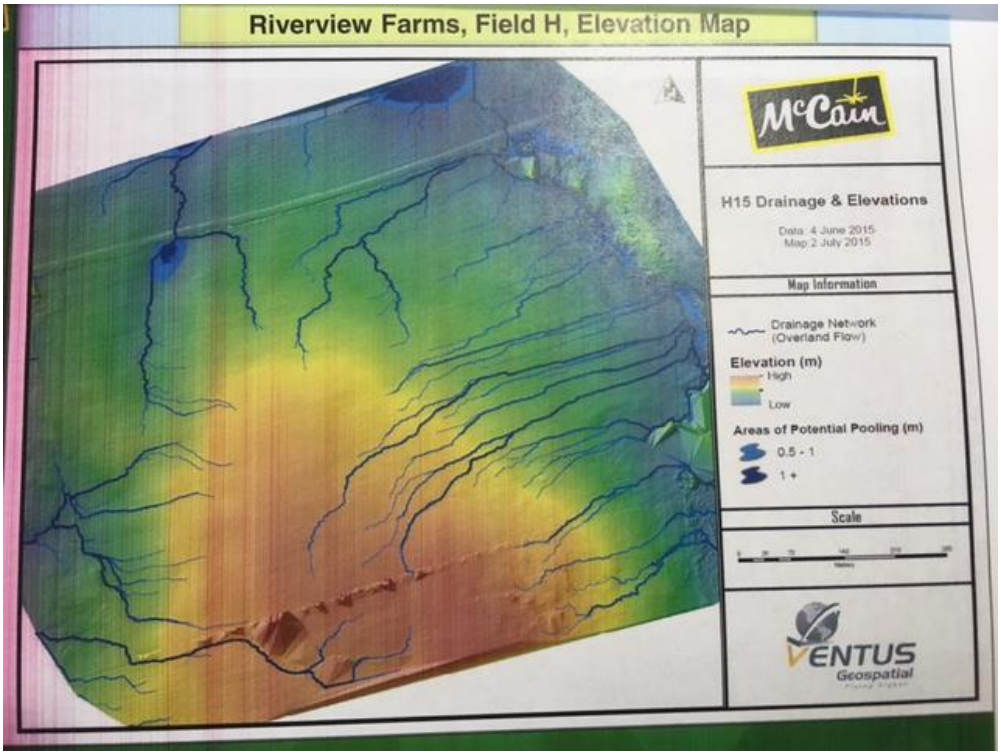

Figure 36: Natural water course and drainage mapping overlaid with a relief map.

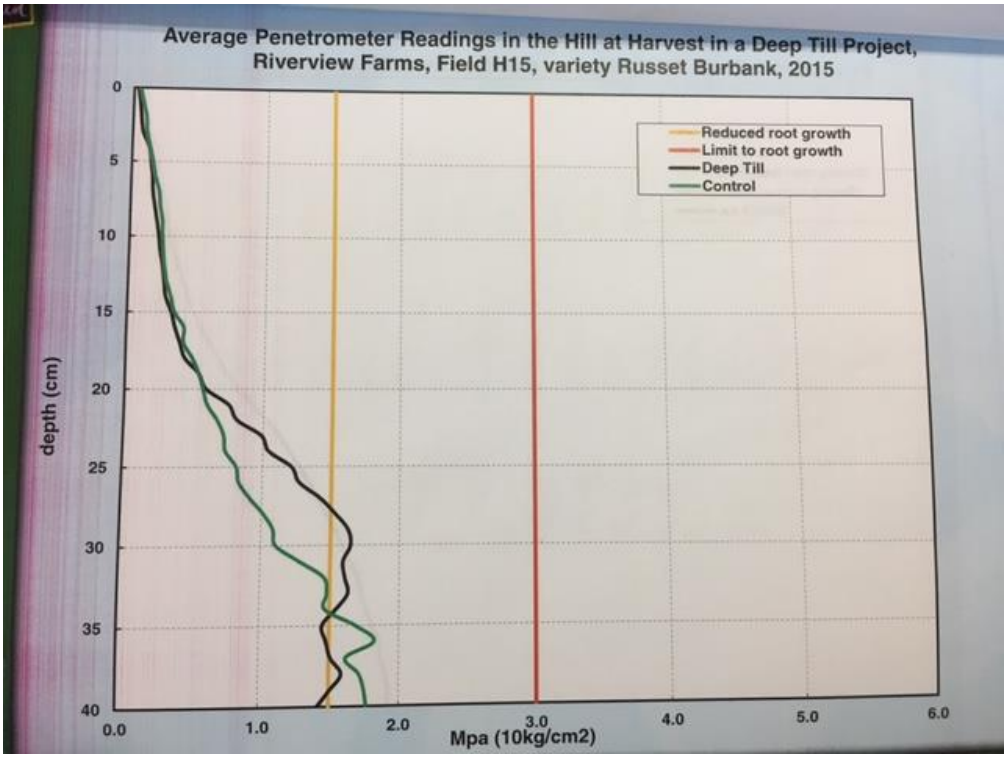

Figure 38: Average Penetrometer readings at harvest in 2015.

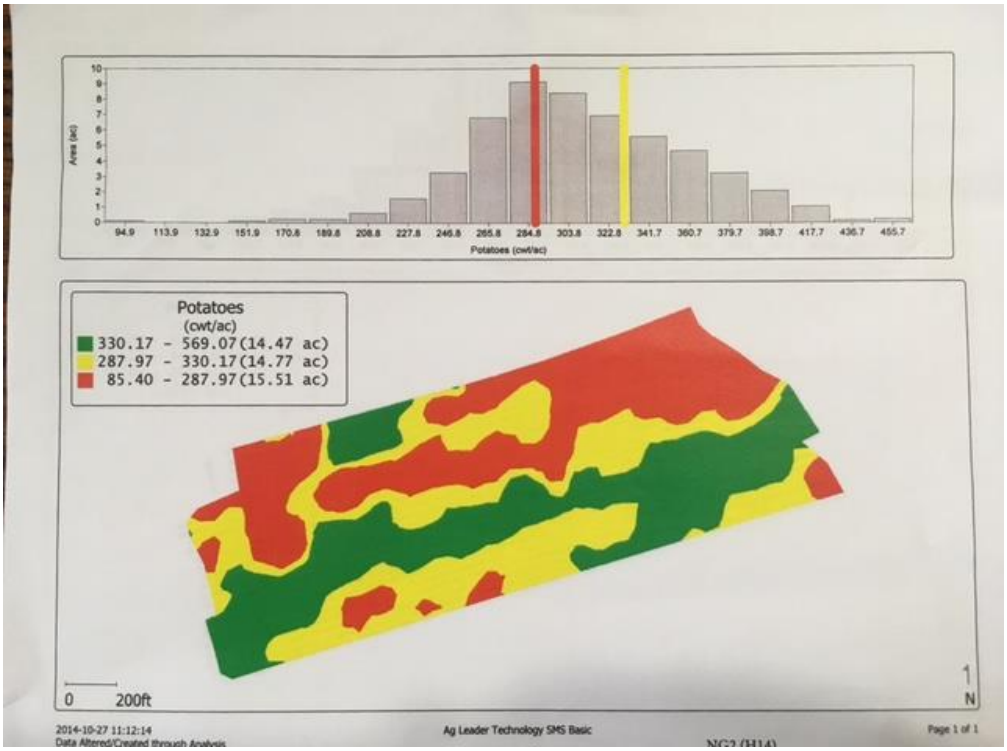

Figure 39: Yield mapping has highlighted the extreme variability in the field.

Appendix B - Kisima Farms, Timau, near Nanyuki, Kenya

Some background details on Kisima Farms:

- Located at the foot of Mount Kenya 2500m above sea level.
- Sits on the equator; fixed day length allows two 70 Ha potato crops a year.
- Potatoes rotation 1 year in 10, with wheat, barley, canola and sunflowers.
- Glasshouse rose production for the European market.
- Well mechanised; planting, spraying, harvesting, grading and cold storage, but still a considerable manual labour force.
- Certified seed sales are followed up with an educational programme at their Agri-information centre.

Figure 40: Kisima Farms have introduced European standards of grading and handling into their certified seed operation.

Figure 41: One of the few cold stores in Kenya. The climate is not conducive for ambient seed potato storage for any length of time.

Appendix C - Aeroponic seed production at Kisima Farms, Timau, Kenya

Imported *invitro* plant material is inserted in a small tube, and held in place using sponge. The tube embedded in a polystyrene table.

Roots form, and are fed with a water and nutrient rich mist. During the day, this is 1 min in 5, moving out to 1 min in 15 at night. Solution is recycled, and changed weekly.

The multiplication rate is 50 x. This compares with conventional mini tuber production at 15 x fold. Without issues, breakeven occurs at around 20 x.

Harvesting generally starts after 3 months when tubers get to 10/15mm. They are harvested through curtains in the plastic under the growing table.

The mini-tubers are then multiplied up to breeder's stock in open ground, before going to pre-basic, and then for further field generation multiplication. Crops are regularly inspected and certified by government inspectorate KEPHIS.

Seed is sold to customers as part of a package that includes agronomic education and vouchers to be spent with input partners for fertiliser and pesticides.

Kisima have been trialling horizontal growing tables. The roots are more robust, but the yield is poorer.

Hygiene is paramount. Very soft plant tissues are prone to diseases, and must be continually fed.

The farm has its own 'Agri-information Centre' to give growers agronomy and marketing advice.

Appendix D - Terry Curley, Monaghan Farms, Prince Edward Island, Canada

Terry grows 1500 Ac himself, and oversees another 1500 Ac of crisping potatoes on contract to Pepsico. He grows for export markets only, which he says is bureaucratic, but worth it, exporting to Indonesia, Vietnam, Guatemala, Thailand, Columbia and the Dominican Republic. His specialism is growing for programmed domestic shortfalls around the world. He makes a habit of visiting all of customers once a year to review the season, and make changes for the future if necessary.

Appendix E - Sun Valley Potatoes, Rupert, Idaho, US

Like many US potato shippers, Sun Valley is owned and run by a group of growers.

Collaboration with another local shipper who specialises in growing and packing specialist fingerling potatoes; thereby diversifying the offering to their respective customers, as well as for the logistical gains.

All growers are paid in weekly increments, regardless of if the crop has been moved or not. The price is determined by deducting packing and business expenses from the weekly sales revenue, and the remainder distributed to the growers on a pro rata'd tonnage basis. A proportion of the surplus is held back to cover exceptional circumstances; any deterioration in quality, and volume shortfalls. This system does not guarantee a production profit, but it greatly benefits their member's cashflows.

Appendix F - The United Potato Growers of America

The UPGA was created in 2005 under the provisions of the Capper-Volstead Act (Enacted in 1922 by US Congress) that allows growers to work collectively to market their products. It was established to represent the interests of growers to positively affect their profitability. Their mission statement is:

> "*United Potato Growers of America is a federated cooperative made up of local farmer cooperatives, whose objective is to advance grower sustainability by tracking and assessing supply/price relationships for major varieties in major fresh-potato varieties in major potato-producing regions".*

Please see Appendix G on next page

Appendix G – AHDB SPot Farms programme

The objective of the AHDB SPot Farms programme is to inform growers and agronomists of the latest research and technology to help them increase productivity in their own businesses and those of their clients.

Each site has its own theme, but the subject matter covers:

- Developments in the control of PCN including bio fumigation in action.
- Best practice in soil management and cultivations to increase yield and reduce cost.
- Store assessment and best practice.
- Informing understanding of Free Living nematodes.
- The latest understanding of crop nutrition put into practice.
- Getting the most out of the water you apply and what happens to it in the soil profile.
- Seed management for improved uniformity.
- Putting precision into practice.
- Improved understanding of soil mechanics.
- Demonstrations of practical measures to protect the environment.

Source: AHDB Potatoes