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AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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GROWER SUMMARY

Headline

This project aims to identify the sources of innovation in the fresh produce industry, determine what factors contribute to, or impede, successful innovation and how we might build further innovation capacity into horticulture in the UK.

Background

The UK fresh produce industry faces a number of challenges: exotic pests and diseases, input prices for oil, foreign competition, limitations in water abstraction, and restrictions on seasonal labour from overseas (National Horticultural Forum, 2011).

Innovation – the successful introduction of new growing methods, products or organisational forms – has been promoted to help meet these challenges. However, there are a range of barriers, both upstream and downstream, that slow or prevent new knowledge and innovations from making impact.

The aim of this project is to identify sources of innovation in the fresh produce industry – where it comes from, where it goes and how it is adapted – and the barriers that exist to its creation, spread and implementation.

By the completion of the project, we will have a better understanding of innovation in the fresh produce industry; it should be possible to provide recommendations on how to improve innovation capacity, and relevant knowledge generation and exchange. In turn, this could provide industry with more timely and relevant interventions and foster a more innovative sector.

Summary

Literature Review

In the first year of the project, a detailed review of available literature was conducted; due to the nature of the topic, this was a particularly large review that included fields such as: economics, innovation studies, agricultural systems analysis, business and communications. A literature review is an essential first step in determining what is already known about a given topic. While ‘innovation’ itself has been studied extensively, and although we see a lot of publications related to horticultural science, there are very few that combine the two subjects in an analytical manner. In fact, it is only the HDC’s own reports that discuss innovation in the industry in such a way (such as *A New Vision for Horticulture R&D* (2011)), which is perhaps unsurprising.

In general, there has been a rejection of the view that innovation proceeds in a straightforward, controlled or even predictable way (Kline & Rosenberg, 2000; Leeuwis, 2004). This makes it difficult to study innovation in the UK fresh produce industry, but not impossible: there are examples of new ways of doing things that have had big impacts. The introduction of polytunnels in soft-fruit, for example, led to a doubling of output and value in UK strawberry production over a 20 year period (Calleja, Ilbery, & Mills, 2012; National Horticultural Forum, 2011). Direct-sales strategies, "veg-box schemes" (particularly for the organics market) and farm-shops have also revolutionised the way consumers interact with growers. It is important to capture what made these 'new ways of doing things' work, so case studies will play a major role in on-going research for this project.

An important theme of this project is to determine what barriers prevent innovation; unfortunately, there is very little published literature in this area with regards to horticulture. One approach would be to look to other industries, however, to see how they have approached the issue of barriers to innovation.

Biomedical Research

In the last few decades, there has been a concerted effort in the medical research industry to find, analyse and unblock so-called "blockages" in the medical research 'pipeline'. The medical research environment resembles the agricultural research environment: government departments and agencies who support research through grants and investment, research centres and universities, and private businesses such as pharmaceutical companies all play a role in the development of new drugs, interventions and equipment.

What researchers found was that there are barriers to innovation at all points along the research 'pipeline'. Applied science – those who take basic scientific principles and turn them into products – is generally underfunded, for instance. At the other end of the pipeline, doctors do not always have the time to learn about all the new research going on that might be relevant to them. Replace 'doctors' with 'farmers', and you'll notice that the same is true in agriculture.

A paper as part of this project was recently presented at the annual 'Innovation through Knowledge Transfer' conference at Staffordshire University, exploring more of these analogies.

Dutch Glasshouse Horticulture

There have been successes in horticulture elsewhere in the world. Dutch glasshouse horticulture has remained competitive despite stiff competition from growers in southern Europe operating in a low-tech manner but with cheaper labour and lower energy costs.

This was achieved through cooperation: growers invest in the generation, mutual exchange and application of new knowledge (Leeuwis, 2004, p. 10).

Interviews with industry experts are now being undertaken as part of this project to get better insight into perceptions of how we might improve our own innovative capacity in UK fresh produce.

Extension and Communication

The theory and practice of extension – the approach to getting agricultural research into practice at farm level – has changed over time. With the privatisation of ADAS, there are now a multitude of organisations offering agronomic advice (often with specific agendas).

The reasons for, and ways in which, agri-research is funded have changed (and some would argue not for the better). Industrial needs, some claim, are now seen as less important than other needs (environmental, for instance). While few question the importance of the wider environment to farming and society, the relevance of research to the farmer – especially its ability to give him or her an economic advantage – often determines its use. Making research more relevant for farmers and growers will therefore make the task of ensuring its use easier. Since relevance is a subjective concept, the interviews undertaken in this project will help explore what is seen as relevant for growers, as well as assessing how they communicate their needs.

Next steps

Moving forward into the second year of the project a series of interviews will be undertaken with those involved in the fresh produce industry at a number of levels: 1) research, 2) policy, 3) levy-body, 4) growers/farmers and 5) retail and 6) other appropriate individuals identified as belonging to the wider fresh produce industry. This will inform future research design, particularly with regards to a proposed survey of growers' needs and perceptions of innovation in winter 2015/16 and whether there is need for a social network analysis in future.

Other research is likely to include case studies of certain sectors in the industry; it would make sense to examine the use of polytunnels in strawberry production (given the impact this had on soft-fruit growing in the UK). The Potato Council also supports this project and a case study focussed on innovation in potato production – the specific topic to be determined

through the interviewing process – is also desirable. Recent knowledge exchange projects, such as the Soil Association's Field Labs, and knowledge transfer projects such as the VALERIE program (VALorising European Research for Innovation in agriculturE and forestry), which aims to put farmers in touch with the best possible formal research on a given farming-related issue (of which ADAS UK is a partner) (see http://cordis.europa.eu/project/rcn/111331_en.html) may also be topics for case studies.

Conclusions

Although in its early stages of primary-data collection, this project has laid the groundwork for future academic study of the fresh produce industry in the UK; a number of fields have direct bearing on innovation in UK horticulture, and other industries may also provide good models for further developing our innovative capacity. Likewise, the horticultural sectors of other countries may be used as examples to compare with our own.

Key references

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Financial Benefits

At this point, we cannot determine the financial benefit of a given method or policy recommendation: however, the value of improving the innovative capacity of UK Fresh Produce stands to be large.

SCIENCE SECTION

Introduction

This project seeks to explore the sources of innovation in the fresh produce – or horticultural – industry in the UK. It will do so through a mixed-methods approach, making use of a number of theoretical and applied frameworks such as agricultural knowledge and innovations system analysis (closely related to national systems of innovation analysis), as well as drawing upon literature from rural sociology, innovation studies, agricultural economics, medical research translation and extension science. The research undertaken so far suggests that these are the correct academic frameworks to eventually provide industry with timely policy recommendations.

Methods

Initially, extensive literature reviews have been undertaken to synthesise the wide range of topics relevant to the project. Fields consulted include: extension science, innovation studies and technological change, medical translation/implementation science, agricultural economics, and agricultural knowledge and innovation systems (AKIS, or AIS). It is this latter area of research that seems to provide the most appropriate academic framework for analysing innovation in the fresh produce industry in the UK.

Systems approaches seek to delineate components that constitute a system, be they individuals, firms, research organisations or universities, or institutions in the broadest sense of the term: legislative artefacts such as regulatory laws, traditions and social norms (Carlsson, Jacobsson, Holmen, & Rickne, 2002). Both the European Union and OECD have used AKIS/AIS approaches to understand and measure innovative performance.

In addition to consulting published literature, horticultural data were compiled using the Defra Horticultural Statistics publications from 1945/6 to 2011, taking account of area under cultivation, gross output and subsequent productivity (across a range of horticultural sectors). These data were then plotted in a time series to provide a graphical representation of productivity over time in the fresh produce industry (see below). The data have also been used to highlight other trends, such as value and imports/exports.

Moving onwards, a combination of qualitative methods (interviews and case studies) and quantitative methods (surveys, systematic reviews and horticultural production data) will be used to triangulate on the sources of innovation in the fresh produce industry, subsequent adaptation and implementation.

Results

UK Horticulture Today

Today, the fresh produce industry faces a number of challenges. Innovation has been promoted as a solution to these issues. However, we must understand the nature of innovation – and specifically innovation in the industry itself – in order to best improve its innovative capacity.

Innovation takes many forms. We see examples of disruptive, revolutionary and market-altering innovations in fresh produce (polytunnels used in soft fruit production being one) and more evolutionary, gradual innovation (through varietal improvement in crops, for instance). In either case, we might wish to call this 'change', and the sources of such technological change are many: from the formal, administered architecture of research institutes – generally supported by funding bodies such as levy bodies like the HDC and Research Councils like BBSRC – to less predictable, but no less important, informal innovation that is developed by farmers and agronomists. Seed companies, the biotechnology industry and major retailers also contribute significantly to different forms of innovation; taken together, these actors represent the Agricultural Knowledge and Innovation System of UK Fresh Produce.

It is possible to say with some certainty that, while the industry faces challenges, at the level of production, fresh produce has maintained steady growth in productivity (see Figure 1).

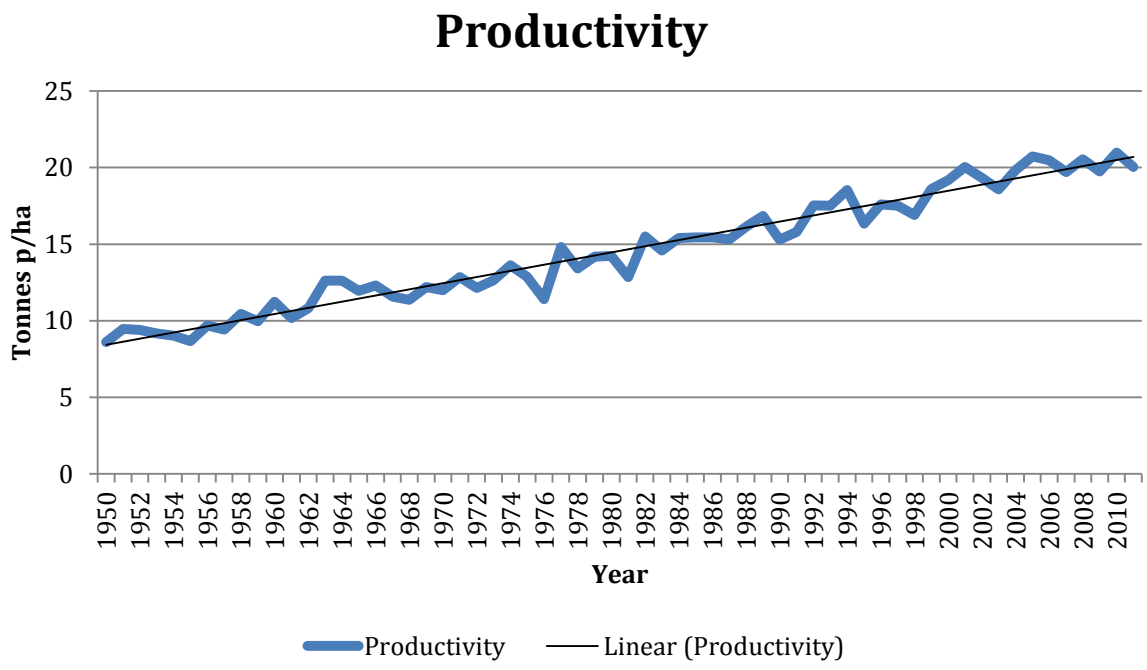

Figure 1. Horticultural productivity 1950 - 2011: data derived from Basic Horticultural Statistics datasets, productivity equals cultivated area/output (excl. potatoes).

Although overall output has remained fairly constant, reaching a peak in the mid-1970s and declining slowly since then, the amount of land area required to maintain that tonnage has actually fallen at a rate consistent with improved productivity (see Figure 2).

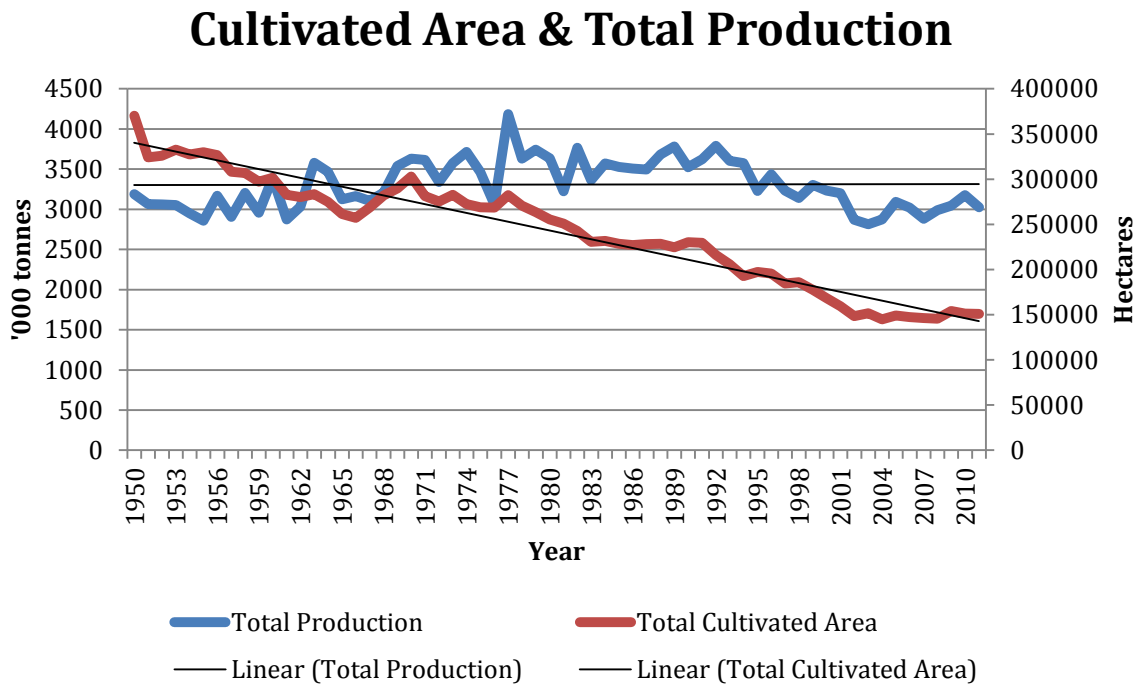

Figure 2. Cultivated area & total production 1950 - 2011: data derived from Basic Horticultural Statistics datasets.

The same can be said for the value of fruit and vegetable production marketed in the UK (see Figure 3). Since the amount of cultivated land for horticultural production has fallen steadily since 1950, we can assume that innovation – such as improved cultivation practices or varietal selection – has been responsible for the simultaneous and constant gains in productivity. It is not clear if the same is true for the value of horticultural produce over the same time period, though it has certainly been true in the case of strawberries (National Horticultural Forum, 2011).

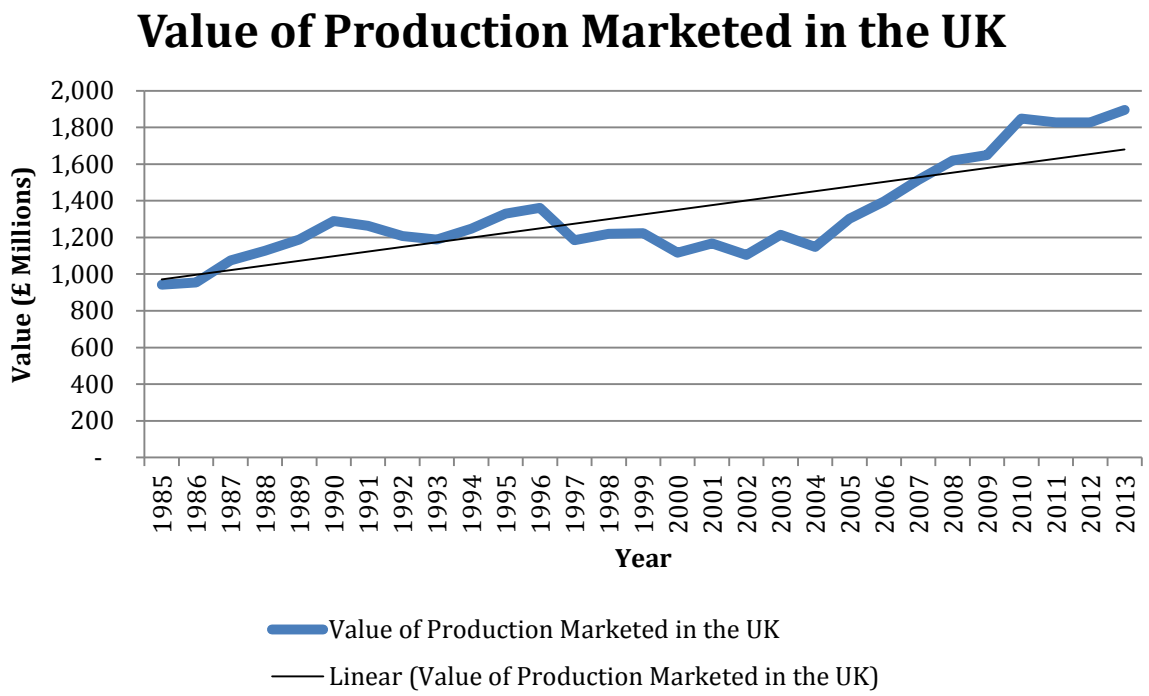

Figure 3. Value of Fruit and Vegetable Production Marketed in the UK 1985 - 2013 (provisional): data derived from 2014 Basic Horticultural Statistics dataset.

The data on imports and exports suggests that, given steady domestic production (gross output), the UK has turned to imports to ensure a regular supply of fresh fruit and vegetables (see Figure 4).

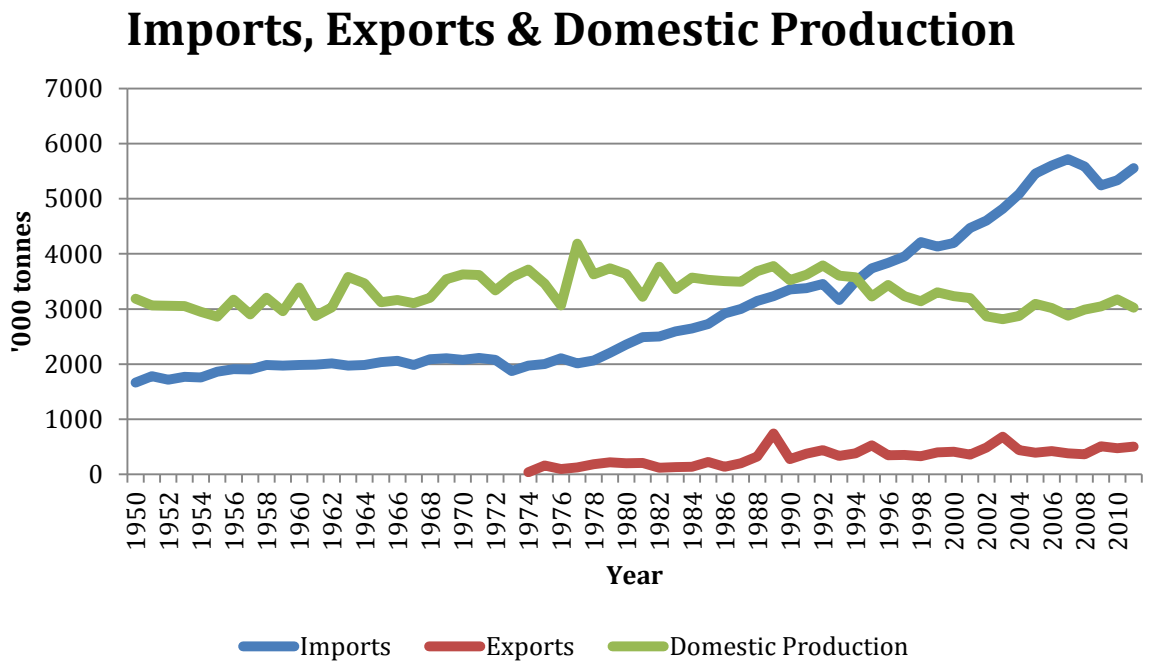

Figure 4. Imports, exports & (total) domestic production 1950 – 2011: data derived from Basic Horticultural Statistics datasets.

As Figure 4 shows, domestic output of horticultural goods has fallen since the 1970s relative to imports, suggesting that competition from other countries (likely other EU member states (British entry to the European Union occurring in 1973), consumer demands and labour costs) has driven down output resulting in the remaining production being more highly productive; another explanation may lie in the changing attitudes towards 'productivist' models of agriculture in favour of more 'sustainable' systems (Calleja et al., 2012).

Agricultural Research Today

Pollock identifies this shift in attitude as directly affecting research uptake at farm-level; the success of the productivist model, with its linkages between all actors in the pipeline, enabled us to eradicate food shortages in the developed world (Pollock, 2012). In consequence, the aims of agricultural research began to change; the wider environment was at the heart of this new regime, rather than industrial need. However, research relevance has been noted as the most significant factor for research uptake at the farm level (Garforth & Usher, 1997) (and as the most significant factor for research use in other industries, such as public health (Zardo & Collie, 2014)). Rahn notes that growers – in practice – will only use research that provides them with a commercial advantage (Rahn, 2010), suggesting that we can promote research uptake and technological change in the way we design research: by making it industry-relevant, we can expect better uptake at the farm level.

However, the horticultural market is relatively small: fruit and vegetables providing almost £2 billion to the UK economy. Some have noted that this makes the industry an unattractive business environment for formalised innovation, which is perhaps why we see levy-bodies and research councils funding the majority of formalised research

More work needs to be done to determine what other, formalised R&D is being undertaken in the fresh produce industry, as well as what informal innovation is happening, and what impact that has on the innovation system as a whole.

Sources of, and barriers to, innovation

Organisations offering advice have proliferated following the privatisation of the formerly publically funded extension service, ADAS (Sutherland et al., 2013).

There have been innovations of many types and varying degrees of disruption, from methods of production such as the introduction of polytunnels in soft-fruit (which resulted a doubling of production and value in UK strawberry growing, for example (Calleja et al., 2012; National Horticultural Forum, 2011)) to business models such as direct-sales strategies, e.g. "veg-box schemes" (particularly for the organics market) and farm-shops.

However, there are a number of perceived barriers to innovation in the industry, both structural (belonging to the wider industry) and personal (belonging to farmers, agronomists agricultural scientists themselves). Table 1 highlights some of these barriers.

Table 1. Structural and personal barriers to the development and implementation of agricultural innovation: adapted from Wamae *et al.* (Wamae et al., 2011), Pollock (Pollock, 2012), Rahn (Rahn, 2013) and project interviews.

Structural Barriers to Innovation	**Personal Barriers to Innovation**
Social 'distance' between research scientists and industry – do they speak the same language? Academic excellence – more important than real-world impact? Price volatility – an unattractive market for innovation Market size – limited size of horticultural market makes it an unattractive option for innovation Regulation – bans on certain substances/techniques hampering new science 'Gaps' in research infrastructure – lack of public extension service, multitude of advisory organisations, skills gap	Frozen behaviour – why change what has worked for years? Risk – will change negatively affect operations? Education – lack of understanding the message Cost – inability to afford change, no access to lines of credit Trust – is there trust in the provider of information? Career disincentives – applied research less appealing than fundamental science, less prestige, lower financial remuneration Lifestyle – farming is a way of life, no obligation to change/implement best practice

Given the range of barriers outlined above, there will not be a one-size-fits-all solution to improving innovative capacity in UK fresh produce industry. Further work, through the use of research interviews, national statistics on R&D investment, and case studies, will provide a clearer picture of horticulture-specific innovation in the UK.

Extension Science

Our understanding of extension has changed dramatically over the last 30 years, as has the delivery of, and rationale for, funding agricultural research. For example, there has been a proliferation in the range and purpose of agricultural advisory services (Sutherland et al., 2013). Determining what channels information passes through will be a key component of this project. How industry reports its own needs, too, will be addressed.

The key currency of extension – knowledge – is the most fundamental resource in the modern economy (Lundvall, 1995, p. 1). Our understanding of knowledge in agriculture, and, indeed, many other industries and realms of life, is constantly changing. Due to many fundamental changes in the purpose and practice of key actors in many economies around the world, knowledge and the rationale for knowledge development have gone through acute changes since the 1980s. The purpose of universities, for example, is no longer 'two-fold' (teaching and research) but 'three-fold': the modern university now has a role in the 'productive sector', delivering effective research translation and contribution to the local or national economy (see Etzkowitz & Leydesdorff, 1997; Suth, 1997). Like 'innovation', 'research translation' has become a word synonymous with the most recent imaginings of both knowledge and the place of knowledge in the economy, exemplified by the rhetoric of 'fixing' broken 'pipelines' (of research) (Pollock, 2012), ensuring "effective translation" or "effective flows" of scientific evidence (BIS, 2013; UK Government, 2014b; Wamae et al., 2011) and "bridging gaps" between lab and marketplace (UK Government, 2014a).

The impetus for this project, too, stems from a desire to see the "strong research base" in the UK deliver greater rates innovation for the fresh produce industry, as well as capturing the origins of innovation, be they formal (university-driven) or informal (farmer-driven) (this distinction is elaborated on later in the report). Before discussing what impact these changes have had with regards to agriculture more explicitly, a brief overview of what has driven these changes is required.

A common thread amongst research focusing on the changing face of agricultural R&D provision is the globalisation of agricultural research and the need for all research organisations to "… develop strategies to keep abreast of global advances in knowledge." (Byerlee, 1998, p. 1053). Participation in what Byerlee calls the global agricultural research system maintains a competitive agricultural sector; the development of a strong national capacity for agricultural research – both public and private – is necessary for countries to exploit such advances. Indeed, it is likely that the realities of globalisation, and arguably neoliberalism, have led to the political emphasis on national competitiveness, and while the study of economic growth is nothing new, there has been a renewed focus on growth

economics from just after the mid-1980s (Barro & Sala-i-Martin, 2004, p. 19) which coincides with the shift in thinking about the role of science and technology in the economy and in society.

The rationale, structure and delivery of R&D funding for agricultural research has also changed dramatically since the 1980s (and not only for the UK) (OECD, 2012; Pardey, Beintema, Dehmer, & Wood, 2006; Sumberg, 2005). Although the links between agricultural R&D spend and agricultural productivity are already well established (Alston, Beddow, & Pardey, 2009), England and Wales witnessed the privatisation of bodies such as ADAS, and the gradual shrinking of public funding for agricultural research; what public funding remains is today mainly competitively tendered by the UK Research Councils. This has led to a proliferation of different public-private sector providers of agricultural information and advice since the state transition away from direct involvement in the provision of advice (Sutherland et al., 2013). While some have bemoaned the loss of state-sponsored intermediaries, others believe that the linearity of this former system is no longer appropriate: “Responding to demands for transformed farming practices requires new forms of knowledge. Given their scale and complexity, agricultural problems can no longer be solved by linear transfers in which technology developed by specialists passes to farmers by way of extension intermediaries” (B. A. Wood et al., 2014).

Input from international development, rural sociological and anthropological literatures have simultaneously encouraged us to re-consider since the mid-1980s the role of farmers in innovative activity (Byerlee, 1998; Chambers, Pacey, & Thrupp, 1993; Ingram, 2014). It has been noted that innovations themselves spurn science (Kline & Rosenberg, 2000), a common example being the invention of the wing leading to what we now call aerodynamics (the science developed to understand the phenomenon of flight made possible by the wing). The same can be seen in farming: Indian farmers have been key in developing and spreading certain varieties of rice, maize and cotton, the popularity of which forced the Government of India to recognise previously ‘unofficial’ crops; a method of potato storage – the diffused light method – used in places as far apart as Kenya, Nepal and Peru was first developed separately by farmers in those countries *then* modified by agricultural scientists. Most interestingly, adoption of what we might think of as the improved method did not spread as predicted, but was ‘adapted’ by farmers to suit their own situations in 98% of cases. These examples, of many documented by Chambers *et al.* (1993), highlight a key facet of innovation: it does not only occur in laboratories, funded primarily by government or business, and exclusively published in journals. It is an activity that can occur at any point within an industry or society, and when it comes to farming, it is clear there is a particularly dynamic dichotomy at work (particularly when it comes to the fresh produce - as opposed to arable – industry).

An example of this in action is the Soil Association's Field Lab scheme, which provides funding for farmers and growers to cooperate in developing solutions for common problems 'on-farm'; this scheme also has elements of social networking, which is a recent and increasingly important way of understanding agricultural innovation systems (Ramirez, 2013; B. A. Wood et al., 2014). As Wood et al. (2014) note:

"…farmers are now routinely called upon to begin practising new forms of knowledge. The prevailing approach to agricultural learning identifies this new knowledge as something that farmers do not possess and that therefore must somehow be transferred to them. Knowledge is typically equated with objective content and its movement accordingly reduced to the one-way transfer of technology. In the linear model, research problems are set and resolved by scientists who develop technologies in laboratories and research stations; these technologies are then passed on to extension agents for transfer to farmers. Whatever its successes may have been in the past, it is generally agreed that the technology transfer model is poorly equipped to deal with the complexity and riskiness of the problems now faced by farmers."

With this in mind, we can identify two 'spheres' of innovation: the formal, funded and targeted kind (that we might call *experimental* or *codified*) and the informal, but no less targeted kind (that we might call *experiential* or *tacit*). It is worth noting that while formal research, the type conducted at universities, large firms and research institutes is by nature a scientific, experimental process, informal innovation is not necessarily any less experimental than its formal counterpart, with some farmers being actively involved in agricultural experimentation (Sumberg & Okali, 1993). It appears possible to bolster both types of innovation, and foster their complementarity: the Soil Association's Field Labs are an example of local-scale, farmer-driven innovation, whilst the FP7 EU-funded, continent-wide VALERIE program (VALorising European Research for Innovation in agriculturE and forestry) aims to put farmers in touch with the best possible formal research on a given farming-related issue (of which ADAS UK is a partner) (see http://cordis.europa.eu/project/rcn/111331_en.html).

The acceptance of tacit forms of knowledge as legitimate is challenging the previous dominance of a top-down and unilinear approach; Ingram (2014) argues that unilinear models of innovation fail to capture the diverse sources of knowledge in agriculture and promote the perception that innovation leaders should be esteemed, whilst those who do not adopt certain innovations (or perhaps reject them) are laggards (see Aoki, 2009; Kloppenburg, 1991). It was certainly the view of the NHF that 'Traditionalists' – those growers reluctant to adopt new

innovations or take part in their development – would face the gravest challenges in the 'new' economy (Promar International, 2006).

How do these distinctions help us understand the sources of innovation in the fresh produce industry? For one, the idea that farmers are passive recipients of new processes and technologies - rather than innovators in their own right - is incorrect, and is a misrepresentation of the 'pipeline' in which innovation takes place in the fresh produce industry: theory and practice of knowledge exchange in farming is moving from a linear model of innovation to an integrated one encompassing multiple actors – through facilitation and participation – and emphasizing learning in a social context (Ingram, 2014, p. 1) Indeed, models that depict innovation "…as a smooth, well-behaved linear process badly mis-specify the nature and direction of the causal factors at work" (Kline & Rosenberg, 2000, p. 3). Secondly, accepting that farmers have been responsible for many of the innovations seen in agriculture since farming first began, allows us to envision new (innovative, even) ways of structuring the research environment so that it best utilises, and cooperates with, informal farmer innovation.

With nothing like the large-scale funding seen in arable farming available for horticultural research (particularly with regards to pesticides), the fresh produce industry will inevitably have to rely on the ingenuity of all its actors, including growers. The greater emphasis on public-private partnerships (PPPs) that has accompanied the changes in the rationale and delivery of funding for agricultural R&D complements this need; it also supports taking a *systems* approach to understand the inter-linkages of actors, capturing the diverse sources of innovation, as well as the capabilities and infrastructure of the industry as a whole.

Innovation in Agriculture

There are competing views as to what is the correct level of analysis for innovation studies (Ryan, Phillips, Karwandy, & Webb, 2013, p. 3). However, given the focus away from linear understandings of knowledge transfer as detailed above, it makes sense to evolve the initial research questions that shaped the early stages of this project: namely, the assumption of a on one-way research pipeline. Instead, a systems approach is recommended as being of more value academically and to the industry: agricultural knowledge and innovation systems (AKIS) approaches – now dominant explanatory devices in agriculture for some time - enable us to account for both the formal and informal actors of the UK fresh produce industry with regards to innovation; the components that constitute a system can be individuals, firms, research organisations and universities, but also institutions in the broadest sense of the term: legislative artefacts such as regulatory laws, traditions and social norms (Carlsson et al., 2002, p. 234). Indeed, fruit and vegetable production in the UK includes to a greater or lesser

extent all of these components, and the delineation of these structures will illuminate the industry's performance (the ultimate goal of a systems approach). A systems approach also allows us to move away from unilinear models of innovation and capture the diversity of information sources available to users and knowledge generators (see Garforth & Usher, 1997)) as well as identifying who contributes knowledge and relationships amongst these actors (Van Den Ban, 1993).

In response to these changes in the philosophy of extension, Cees Leeuwis has charted the gradual shift towards professional 'communication for innovation' – rather than extension – as both a practical and conceptual framework for facilitating technological change (Leeuwis, 2004). As Leeuwis notes: "when challenges change, the organisations which are supposed to support farmers in dealing with them will have to change as well." (ibid. p. 11).

In the past, extension has been focussed on supporting individual farm management, promoting farm-level innovation; many challenges facing farmers today "transcend" the level of the farm household, such as managing collective natural resources, organisational building and venturing into new markets (which require coordination and cooperation) (ibid. p. 11). According to Leeuwis the Dutch glass-house horticulture sector competes with sub-tropical areas and southern Europe (despite higher costs) due to a willingness to invest in the generation, mutual exchange and application of new insights (ibid. p. 10).

Moving forward, the project will identify what barriers exist to both innovation and knowledge transfer/exchange at the upstream end (of formalised research endeavour) and the downstream end (end-user uptake, communication of needs), and will seek to shed light on the "middle ground" between where innovation originates, and where it arrives.

By doing this, it should indicate how the industry could develop a better position to work towards improving its capacity for innovation, both in research development and sharing of knowledge.

Discussion

The changing shape of the agricultural research environment, and ideas about extension, have evolved over the last several decades. As well as providing context for this study, these changes suggest that the UK – and specifically the UK fresh produce industry – is not alone in assessing its innovation 'system'. Agricultural Innovation Systems analysis has been used by others to elucidate the 'innovation system' of agricultural industries all over the world (including in the European Union), and offers us an academic framework through which to assess 1) the sources of innovation – for various actors in the system – of innovation, and 2)

identify barriers to innovation, be they upstream (at the 'research' end of the pipeline) or downstream (at the 'farming' end of the pipeline).

Next steps

Moving forward into the second year of the project – and following on from a training module conducted by Warwick Medical School on qualitative methodologies, and prior ethical approval for the project – a series of interviews will be undertaken with those involved in the fresh produce industry at a number of levels: 1) research, 2) policy, 3) levy-body, 4) growers/farmers and 5) retail and 6) other appropriate individuals identified as belonging to the wider European AKIS. This will inform future research design, particularly with regards to a proposed winter 2015/16 survey of growers' needs and perceptions of innovation and whether there is need for a social network analysis in future.

Other research will include case studies of the two emerging projects mentioned (Field Labs and VALERIE), as well as more detailed examinations of individual horticultural sectors such as strawberry production (see Calleja et al., 2012) and potato production (since one of the project's industry partners is the Potato Council). However, further research is required to identify how best to conduct an analysis of the fresh produce industry AKIS – this is likely to be an ongoing process throughout the project.

Conclusions

The UK fresh produce industry has seen steady growth in productivity since the end of the Second World War. This was seen to be a product of good linkages between all actors in the 'pipeline' of agricultural research; a pipeline that now some have dubbed "fractured".

In response to a range of extant and emergent challenges, innovation for agriculture has been promoted in the UK; yet in the context of the UK fresh produce industry, there has been little academic work focussed on improving innovative capacity or identifying sources of innovation; even less on identifying and removing barriers to innovation.

This project seeks to identify sources and barriers of innovation in the Industry, and will do so using a mixed-methods approach, utilising qualitative and quantitative tools and is guided by AKIS/AIS as an academic framework.

Knowledge and Technology Transfer

- As part of the project, a paper on *Agricultural Innovation: Lessons from Medicine* was presented at the annual KES 'Innovation through Knowledge Transfer' conference held at Staffordshire University, April 2015. The paper examined what lessons the agricultural innovation system (AIS) in the UK could learn from its equivalent in biomedical research.

- A separate paper on the evolution of extension theory and practice will be presented at the AAB 'Knowledge Exchange: from research to the food supply chain' conference at the University of Lancaster, in June 2015.

Glossary

AKIS/AIS – Agricultural (Knowledge) and Information/Innovation Systems (form of systems analysis)

Downstream – near market research activities, farm-level implementation of research

Upstream – basic research, translation of research

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