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The Husbandry of Technology: Farm Families' Cultivation of Technological Knowledge under 'Neo-Productivist' Conditions

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Abstract

Issues such as a rising world population, climate change and the economic crisis have led to a questioning of the UK's agricultural sector to maintain a sufficient and reliable food supply. As a result, led by various policy think-tanks, the UK Government is looking to technology to increase sustainable food production. This paper explores the contemporary nature and importance of family farming in the UK, and interrogates how these changes may become reality for these members of the agricultural sector. It is particularly concerned with the processes that surround the introduction, use and maintenance of technology on family farms. To do this, the article draws on six months of ethnographic fieldwork conducted on family farms in Ceredigion, Wales, U.K. The paper makes significant contributions to understandings of the family farming way of life, theorisations of technologies in 'context' and 'culture', and conceptualisations of future 'neo-productivist' agriculture.

Keywords**:** family farming, technology, neo-productivism, ethnography, knowledge-practices

1.0 Introduction

An anticipated culmination of global issues such as climate change, unstable food prices and a rising world population has led to efforts to try and mitigate the potential impacts on food security. In the UK, several sets of recommendations produced by organisations and think-tanks have been submitted to the Government, which argue for the introduction of a new agri-food system. As a way to overcome global issues, this new system is built on the principles of increasing production, in environmentally sustainable ways. Technologies such as genetic modification and methane digesters are considered the key way in which the system will be implemented. Attracting recent interest in agricultural geography, these proposed changes have been described as marking the onset of a new phase of agriculture known as 'neo-productivism'.

This article is concerned with how 'neo-productivism' may be embedded within the day-to-day activities of farm families based in the UK. Drawing on ethnographic fieldwork material collected from an area of Wales, UK, it investigates current practices and interactions centred on technologies, to suggest how these may relate to a future 'neo-productivist' phase. The article is divided into six sections. The first section is concerned with outlining 'neo-productivism' and what it means in terms of re-structuring UK agriculture. Section two explores the nature and dynamics of farm families within the UK, and their significance within the UK agricultural sector and 'neo-productivism'.

Building on this literature, it highlights two areas of research potential concerned with the future relationship between farm families and 'neo-productivism'. Seeking to engage with this potential, section three outlines an appropriate conceptual framework. Section four details the methods used within the study. The fifth section presents some ethnographic fieldwork material which is focused on the ways in which technologies are introduced, used and maintained on family farms, and how this may be related to 'neo-productivism'. Finally, section six concludes with a summary of the key arguments, the contribution they make to debates in agricultural geography, and highlights scope for future research.

2.0 'Neo-Productivism'

The notion of 'neo-productivism' has arisen from anxiety surrounding the capacity and capability of the UK agri-food system to face global challenges such as the uncertain and volatile cost of energy, the extra demand for certain food goods (such as meat and dairy products) resulting from the 'nutrition transition', and an increasing world population. Several reports submitted to the UK Government propose changes to the agri-food system as a way to alleviate these difficulties (e.g. The Royal Society, 2009; Ambler-Edwards et al.., 2009; Foresight, 2011). This involves strengthening the long-term security, sustainability and competitiveness of the agri-food system, while satisfying and managing the expectations of consumers (see Ambler-Edwards et al., 2009). For the UK agricultural sector, these changes are centred on increasing food production, in ways that are environmentally sustainable. For example, in order to increase production, the introduction of subsidy supported minimum levels of production will encourage farmers to intensify, expand and increase their agricultural activity. However, subsidies may only be granted if increases in production have been achieved in environmentally sustainable ways. This will involve the efficient use of resources, minimal or no application of harmful agri-chemicals (e.g. fertilizers) and the effective management of waste.

Implementing these changes is dependent on the introduction and use of new tools, machinery and technology (Ambler-Edwards et al.., 2009). Ambler-Edwards et al. (2009, p. 28) emphasise that this "will be a key determinant of [the] capability" of the new system. Particularly important technologies will be those that aid reductions in the consumption of resources, enable farmers to use their time and labour more effectively, or contribute to the recycling of waste. Examples include precision-applicators (which target the application of fertilizer to precise areas of land where it is most needed), methane digesters (which aid the decomposition of organic material and therefore reduce the emission of greenhouse gases), new controlled-release fertilizer formulas, drip irrigation systems (which reduce water use) and the use of biomass produced from recycled waste (otherwise known as "'green fertilizer'") (Ambler-Edwards et al. (2009, p. 28). In addition, Ambler-Edwards et al. (2009) argue that the debate surrounding genetic modification (GM) must be re-opened. This vociferous and contentious debate is focused on objections concerned with the preservation of biodiversity, the problematic co-existence of GM and non-GM food, traceability and labelling of GM ingredients, the ownership of GM technology and organisms, and human health. Ambler-Edwards et al. (2009) argue that these objections must be overcome, as genetic modification will be a key tool in the reconciliation of increased production and environmental sustainability. For example, disease-resistant GM crops may decrease crop failure and therefore contribute to increased food production, and reduce the use of environmentally harmful fertilisers.

The work of Ambler-Edwards et al. (2009) has attracted some recent interest within academia, as attempts are made to theorise and contextualise this proposed agricultural change in debates surrounding phases of agricultural re-structuring. For example, highlighting the emphasis on increased food production, Ilbery & Maye (2010, p.13) suggest a "re-emphasis back towards productivism." Consequently, they argue that these changes "could be interpreted as the start of a *neo-productivist* phase of agricultural restructuring in the UK" (Ilbery & Maye, 2010, p.1; see also Evans et al., 2002, p.321). However, it is important to recognise that 'neo-productivism' is not a simple return to the agriculture of the post-war years. Rather, it involves the re-casting of productivism in a new context that places emphasis on sustainable, environmentally friendly and competitive food production (Ilbery & Maye, 2010). This may be illustrated in the use of technology to promote "an effective, rather than exploitative, use of resources over a long time period" (Ilbery & Maye, 2010, p.1). Indeed, Evans et al. (2002, p.322) argue that 'neo-productivism' is not a 'tweaking' of post-war productivism, but a "radical break" from it, and other phases of agriculture.

3.0 Farm Families

Defining a farm family has proved a particular challenge for agricultural geographers. For example, while taxonomic or categorical definitions offer clarity and structure, they do not communicate the fluidity and heterogeneity of this complex social group. In contrast, more practical or phenomenologically-guided definitions do account for contingency and diversity, but this tends to be related to a very specific context which the researcher has interpreted following a long-term, in-depth period of fieldwork. For example, as a result of long-term research engagement which involved living and working alongside farmers, Gray (1998) was able to highlight the importance of a mutual and intricate relationship between family and farmland to the way in which farm families defined themselves. So, while it is important to provide a clear and definitive 'starting-point' from which to base studies involving farm families, it is important to note the depth of their identity and diversity. As a result, the definition provided for this study is composed of five inter-related themes that capture the common ethos, fluid nature and dynamic of family farms as discussed in the literature, which provides an appropriate base for further in-depth fieldwork investigation.

The first theme refers to the **control and ownership** of the family farm (including elements such as land, buildings, machinery, farmhouse) usually by related family or kin members who live on the farm (Gasson & Errington, 1993). A patrilineal bias means that men are more likely to hold greater ownership and control than women (O'Hara, 1998). However, owners delegate and work with other family members to complete everyday jobs, tasks and activities on the farm. The second theme is **inheritance and succession**, which is about the legal transfer of the family farm, which usually occurs at the point of the owners' retirement or death. Decisions around inheritance are primarily made to ensure the survival of the family farm, but may also ensure the financial security of inheritors or the fair distribution of inheritance (Symes, 1990). Inheritance usually has a patrilineal bias (so males are more likely to inherit a family farm than females) and the inheritors are expected to succeed and continue the role of owner (Symes, 1990). The third theme is the provision of most of the farm **labour** by farm family members (Gasson & Errington, 1993; Gray, 1998). Roles are usually delegated according to age, gender and ability. For example, the male owner might be concerned with management

and decision-making, while his wife may complete paperwork, take care of the family and engage in diversification activities (such as running a bed and breakfast or taking off-farm employment) (O'Hara, 1998; Evans & Ilbery, 1996). Children are usually introduced to farm life from a young age by running errands and tending to young animals. The fourth theme refers to farm families' **engagements with off-farm entities**. These may involve discussing new technologies or farm techniques with other farmers, buying in feed or fertilizer, receiving money through loans or grants to purchase new farm buildings and selling goods to off-farm processors and retailers. The fifth theme reflects the **productive motivations** of family farmers. While family farmers engage with a wide range of activities which might include agri-environmental schemes and diversification enterprises (such as running a caravan site or holiday cottage), several agricultural geographers have argued that productivism is central to the motivations, activities and ideologies of family farmers (e.g. Burton & Wilson, 2006; Evans et al., 2002; Evans, 2009).

Within the UK agricultural sector, farm families are important for a number of different inter-related reasons. Munton and Marsden (1991) record that family farms account for over 95% of the total number of farms in the UK. Consequently, farm families own a significant amount of agricultural land. As Whatmore et al. (1987, p. 21) noted in 1987, "[UK] farmland remain[s] predominantly owned and managed by individual families." This ownership is unevenly distributed across the UK, with clusters in some of the most harshest and most difficult to farm areas (such as the highlands of Scotland or hilly areas of mid Wales). This means that farm families are considered "advantageous" to corporate or financial interests as they will use their own family labour to farm in environments where agribusinesses will not (Munton & Marsden, 1991, p.109). Economically, farm families generate a very durable form of income, as they are willing to make short-term sacrifices to ensure the survival of the farm (such as accepting a temporarily reduced income). This ensures the long-term secure financial success of family farms, and their important contribution to the agricultural sector as a whole. Farm families are also integral to the cultural, social and rural experience of the UK. Their intricate familial relationships, everyday routines and activities, distinct way of life, and human-animal interactions are integrated within the social values and notions of 'British culture' (see Morris & Evans, 2004). As Gray (1996, p.34) states, "the centrality of the family in farming is one aspect of the rural society that contributes to its idyllic representation in British culture as the place where the values underpinning British society originated and are continually reproduced". In addition, support for family farming was central to the development and subsequent reforms of the Common Agricultural Policy, which indicates their significance within political debates and discussions. Finally, the persistent, flexible and transformative capabilities of farm families suggest that their multi-faceted significance will continue into the future.

It is currently unclear how the significance of farm families will become embedded within a 'neo-productivist phase' of agriculture. The only direct indication comes from Ambler-Edwards et al.'s (2009) suggestion that under the new agri-food system, farm families will need to place greater emphasis on their enterprise as a business, than as a way to support their family's way of life. They suggest that they might also become better connected with local or alternative food networks (Ambler-Edwards et al., 2009). In addition, research concerned with the relationships between farm families and elements of change associated with 'neo-productivism' such as climate change or genetic modification offers some useful insights (see Holloway & Ilbery, 1997; Lane, Oreszczyn & Carr, 2007). For example, Lane et al.'s (2007) investigation into

the attitudes of farmers to genetically modified crops reveals a rather positive outlook with farmers referencing potential increases in production, environmental benefits and improved farming techniques. They also write that 'influencers' such as other farmers, the Department for the Environment, Farming and Rural Affairs (DEFRA), and retailers, which all work to disseminate information, uphold policy and market GM products are integral to these attitudes (Lane et al., 2007). This research is particularly important as it explores the relationship between farm families and technology, which is central to the implementation of 'neo-productivism'. Moreover, it provides a foundation from which to suggest and fulfil two key areas of research potential in this article.

First, while Lane et al. (2007) are concerned with the attitudes and opinions of farmers to the potential of GM crops, it is still unclear how GM and other technologies will fit into the current practices, activities and routines of family farms. For example, will GM dramatically change current practices surrounding seeding, fertiliser application and cultivation? How might precision-applicators change farmers' perceptions of their land and how they use it? Or will farm families highlight current technologies and farming practices that they feel will remain significant under 'neo-productivism'? Second, extending Lane, Oreszczyn and Carr's (2007) notion of 'influencers', how will technologies associated with 'neo-productivism' become known and popular amongst farmers, which will determine their introduction and success in practice? In order to frame this investigation, section 3 is concerned with exploring some theoretical notions surrounding the ways in which technologies are practised, and how these practices are introduced, maintained and disseminated through communities or 'cultures' of knowledge.

4.0 Theory

Objects (including forms of technology) are defined, interpreted and manipulated through the multiple ways in which they are used and practised. Consequently, rather than understanding technology as a functional object, it is more appropriate to understand technology as a form established and maintained through practices. As Anne-Marie Mol (2002, p. 5) argues, rather than "bracketing the practices in which objects are handled" in order to focus on the object, we need to bring practices into the foreground. This line of thinking has great potential, because "reality multiples" and we begin to see the plural, different and fluid practices that bring technologies into being (Mol, 2002, p. 5). In addition, engagements with technologies may also be marked by contestation or resistance. For example, a farmer may refuse to install a precision-applicator on the basis of negative feedback from another farmer, or a computer herd managing program might be installed but never used in favour of 'doing it by hand'. So, as Mol (2002, p. 4; my emphasis) observes, we see how objects "come into being – *and disappear*."

The practices individuals conduct are intrinsically related to factors such as their experience, expertise and identity. For example, Gray (1998, p. 341) describes how hill sheep farmers in an area of the Scottish borders constructed a wooden gate using "rough and ready approximates and experience". When asked whether they were going to use a tape measure" to ensure accuracy, they laughed and said "they were not skilled craftsmen […] [but] 'practical farmers'" (Gray, 1998, p. 341). As a result, Holloway and Morris (2008) use the term 'knowledge-practices' to reflect the inseparable and co-constitutive relationship between knowledge and practice (see Law & Mol, 2002). Knowledge-practices have emerged as an important research focus in

agricultural geography in recent years and this has led to some important insights into the interaction between different 'types' of knowledge-practices that surround technologies including 'lay', 'scientific' and 'expert', and the important interactions between farm and science-based technological knowledge (see Morris & Holloway, 2009; Clark & Murdoch, 1997; Riley, 2008; Wynne, 1996).

Despite the diversity and plurality of knowledge-practices, there are always connections between them. As Mol (2002, p. 5) emphasises, "even if objects differ from one practice to another, there are relations between these practices." Practices seem, somehow, to hang together. Objects or technologies, then, may be seen to exist at the centre of a whole range of inter-connected practices and knowledges. Moreover, as Mol and de Laet (2000, p. 226) argue, this positioning is more likely to occur if an object or technology "transport[s] well", or is successful, popular and useful within many different contexts and by many different individuals. Within UK agriculture, family farmers may connect their knowledge-practices surrounding technologies with a whole array of other individuals, organisations or contexts (or, to use Lane et al.'s (2007) term, 'influencers'). Examples include discussing technology online through forums such as *Farmers Weekly Interactive* or 'in person' with other family farmers, accessing manufacturers' websites for more information or installing a new piece of technology based on the awareness of a good experience on another farm. These connections are usually most significant when considering the introduction of a new technology, and they become strengthened and legitimised if this introduction is successful. This reveals a mutual and intricate relationship: these connections provide a foundation for the introduction of new technology, and new technologies strengthen and emphasise the importance of these connections. Tsouvalis et al.'s (2000) conceptualisation of farm-based engagements with precision-applicators as relating and contributing to 'knowledge-cultures' reflects this relationship well. 'Knowledge-cultures' refer to "socially negotiated structures of meaning that enable and constrain social action[s]" such as the establishment of knowledge-practices surrounding technologies (Tsouvalis et al., 2000, p. 912). Over time, knowledge-cultures become extremely durable as they are institutionalised, embedded in the knowledges and identities of individuals and become a key resource for making decisions (Tsouvalis et al., 2000). Within this study, investigating knowledge-cultures is key to understanding the processes that relate to the practice, introduction and maintenance of technologies on family farms. Moreover, understanding knowledge-practices within the frame of knowledge-cultures provides a foundation from which to investigate, suggest and question future change according to 'neo-productivism'.

5.0 Method

Investigating knowledge-practices surrounding technologies on a family farm, as well as the ways in which these are connected to a broader knowledge-culture lends itself to a multi-scalar ethnographic approach. Ethnography has gained significance in rural and agricultural geography as an approach which subjectively situates the researcher within the everyday activities and experiences of individuals (Hughes et al., 2000). One of the most common methods to be conducted as part of ethnography is participant observation, whereby the researcher becomes part of the activities and practices that he/she is interpreting, analysing and recording (Hughes et al., 2000). Within this study, ethnography and participant observation has meant living and learning on a family farm as a PhD student undertaking a type of advanced 'work

experience'. A variety of activities provided opportunities for participation and observation, which included helping with feeding and checking on animals, weighing lambs ready for slaughter, preparing and packing meat, baling hay and straw and observing TB testing. Alongside this experience, it has been possible to watch, discuss and question uses of technology. For example, being stuck inside due to wet weather enabled a focused discussion on how useful GM crops could be for dealing with unfavourable growing conditions. These experiences were recorded and partially analysed within the field through the completion of a fieldwork diary (see Hughes et al., 2000).

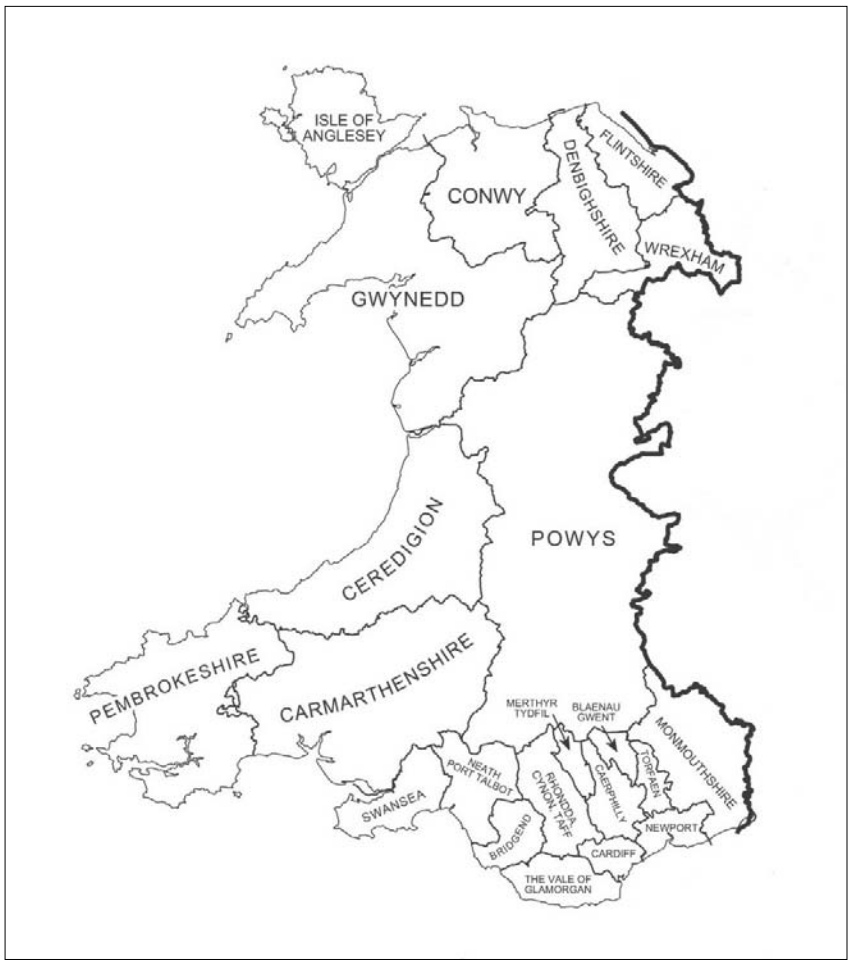
The use of *multi-sited* ethnography has extended this approach to investigate connections, flows and relations with the broader knowledge-culture (cf. Juris, 2000). Within the field, this meant that whilst being primarily situated amongst the activities of one family farm, I have been introduced to additional locations which are connections to their agricultural activity. These included other family farms, the local slaughterhouse, agricultural shows and animal marts. Some of these interactions have been centred on the introduction of new pieces of farm kit or technology. For example, I have investigated the connection between two family farms which was focused on silage pit mats (which will be discussed in due course) and travelled to see and discuss plate meters, herd management software, sheep tag readers and a hydro-electric system.

Agricultural geographers using ethnographic methods seek to reveal rich, detailed and in-depth research material centred on the everyday actions, perceptions and opinions of farmers (e.g. Bennett, 2006). To attain this, there has been a focus on a small number of farms (see Gray, 1998; Riley, 2008). This literature has provided a justification for a concentration on a single farm within this study. In practice, this allowed the researcher to become embedded in the life of the family farm and, more specifically, the day-to-day practices that surround technology. However, in addition to this, through an investigation of the knowledge-culture of the family farm, the researcher has been able to contextualise this research material within the context of the broader agricultural sector (cf. Tsouvalis et al., 2000).

6.0 Technological Engagements, Knowledge-cultures and 'Neo-productivism' in Ceredigion, Wales, UK

The ethnographic experience carried out for this study took place in Ceredigion, a county of mid-Wales in the UK (see Plate 1). It is an area characterised by rolling green hills, sheep and dairy farming, and tourism along the coastline (Jenkins, 2010). There are also long traditions of wool production, pony and cob breeding, and mining for lead and tin. Amongst the local people there is a strong sense of Welsh identity and community. This is displayed in the popularity of competing in eisteddfods and other competitions, helping each other out with jobs such as baling and sheep shearing, and the importance of the Welsh language (see Dyfed Cultural Services Department, 2004; Thomas, 1986). Despite descriptions of the geographical marginality of the area, this combination of arts and music, farming and the Welsh language is said to make Ceredigion the 'heart' of Wales (Benbough-Jackson, 2004). Moreover, in relation to this study, the significance of family farming and the possible effects of the devolved Welsh Assembly Government on agricultural policy, make Wales and this area in particular an appropriate study location. This section draws on two case studies collected from two farms in this area which despite being only 3 miles / 5km apart, illustrate contrasting farming approaches, interesting practical engagements with technology and relations

Plate 1: Map of the counties of Wales.



Source: Ordnance Survey (2013) Modified by the Author

with broader cultures of knowledge. These illustrations also form a foundation from which to understand, question and anticipate future change according to a 'neo-productivist' phase of agriculture.

Farm A is a mixed farm of 136 acres holding approximately 200 breeding ewes, 50 beef sucklers and some arable crops for winter silage. Three generations of family members are currently connected to the farm: a married retired couple in their 70s, their daughter and her husband, and their two teenage children. During fieldwork, I spent most of my time at this farm where I lived, discussed and worked with all three generations. It was evident that their approach to farming was defined by a desire to maintain a good way of life rather than pure financial gain, and this lifestyle was in part supported by off-farm employment.

This approach to farming was described as being behind a lack of technology on the farm, especially compared to other nearby farms which were considered more business-like and technologically 'in tune'. However, there was a daily use of machinery and tools that could be interpreted as broadly technological such as a tractor, quad bike and a hydraulic wheel loader. While this was said to be more necessary and customary than especially technological, some of these uses were significant, imaginative and creative. For example, on arriving at the farm one day, the farmer and I began to discuss the plan for the morning

and his latest innovative idea to convert a slurry tanker into a water carrier to clean the cattle shed ready for storing silage:

> Farmer: "Clare, I have a plan for cleaning the big cattle shed but I'm not sure if it'll work. You know the tank we used for spreading the slurry."
>
> Clare: "Yes..."
>
> Farmer: "Well, we're going to take it up to the lake, fill it with water and bring it to the shed. Then you're going to stand at the bottom and hold the hose while I control the pressure, OK?"
>
> Clare: "OK, but I'm getting my camera, I can safely say no one's thought of doing this before."

This idea illustrates the multiple ways in which everyday or mundane technologies are used or practised to unexpectedly achieve different tasks across the family farm context. It also illustrates substantial farm-based knowledge and expertise defined by 'making do' by being 'good at a bit of everything' such as modifying machinery, carpentry, metalwork and providing some veterinary care for animals (Farm A). Moreover, this connects to a saying that 'the simple technologies are often the best' as they are easily used, modified and fixed on the family farm (Farm A).

Other uses of technologies were surprising as they were hidden within processes or products. For example, while helping to feed the lambs one afternoon, I enquired about the possibility of the feed containing genetically modified ingredients. Uncertain, we checked the packaging and found that certain ingredients such as soya were followed by the symbol (GM*), which we thought might indicate the presence of genetically modified material. Routinely bought from a store about 3 miles / 5km from the farm, this feed is stocked as a well-known and popular national brand. The likely inclusion of GM ingredients within this readily available feed is in stark contrast to the current prohibition of cultivating and using GM to produce food intended for human consumption. As the Department for Environment, Food and Rural Affairs (DEFRA, 2013) states:

> "No GM crops are being grown commercially in the UK, but imported GM commodities, especially soya, are being used mainly for animal feed."

Consequently, the possible use of GM technology in the production of animal feed used on this family farm seems to have had little impact on the farmer's agricultural activity, practice or knowledge.

However, further discussion encouraged the farmer to re-call a past engagement with GM feed, which brought several other issues to the fore:

> Farmer: "Several years ago, our lambs went to *M&S*[1], and they didn't want the lambs to be fed with GM feed. This was OK, we checked the feed, and we moved to non-GM. But then they started saying that they wanted the mother and the father of the lambs to be of specific breeds.

1.Marks and Spencer: A department store that operates around the principles of quality, value and good customer service.

> I saw the breeds, and I didn't like them at all. And I didn't want to be dictated by M&S either. You know, give them an inch. […] So now we sell to *Sainsbury's*[2] and they don't mind about the feed or the breed." (Farm A)

Consequently, the farmer's knowledge-practices around GM feed *have* changed, when they became incorporated in broader concerns surrounding the breeding of sheep, engagements with retailers and the farmer's resistance of subsumption by other elements of the agri-food system. In turn, these concerns relate to much deeper culturally-embedded notions of breeding an 'aesthetically pleasing' flock to be proud of, actively negotiating with retailers and their demands, and maintaining independence. Deeper still, it is interesting to form the connection between the importance of independence and engaging with off-farm entities, and the themes that have been highlighted as definitive to farm families (see section 2). It is therefore useful to think about these concerns and notions within the conceptual framework of a 'knowledge-culture'. For example, the breeding of sheep with particular aesthetics connects to social and cultural notions of 'pedigree' or 'good-looking animals' (see Grasseni, 2004). In addition, it is significant to reflect back on the engagement with GM feed as a nexus for exploring these issues and the knowledge-culture to which they relate.

Facing the prospect of a 'neo-productivist' phase of agriculture, four key points may be drawn from the practices and discussions surrounding technologies at this family farm. First, current technologies will continue to be significant as they are modified, maintained and repaired to last into the future. Second, new technologies will be used in multiple ways, converted and transformed in order to complete different functions in varied contexts (cf. Mol & de Laet, 2000). Moreover and third, technologies that do not easily undergo these processes will not prove as favourable or popular to family farmers (cf. Mol & de Laet, 2000). Fourth, the future significance of genetic modification as a key tool under 'neo-productivism' is partly dependent on retailers, their demands and relations with family farmers.

Farm B is a 240 acre grassland dairy farm with 300 cows and is located approximately 3 miles / 5km from Farm A. On the farm live a husband and wife and their two young children. They also employ one member of staff. I was introduced to this farm early on in fieldwork as they are family friends of Farm A, but also as a farm where I could gain experience of dairy farming, technology and a different approach to farming. As a result, I spent some time at this farm helping out with the 5am milking, discussing the farm set-up and agricultural issues. I also returned later on in fieldwork to conduct a discussion focused on the role of technology within the family farm. In contrast to Farm A, the approach here is more geared towards maintaining an efficient and profitable system for the long-term.

A number of technologies are used on this family farm, including milk meters and clusters, artificial insemination kit, tractors and quad bikes, and a computer. One particular technology, however, stood out as holding particular significance. A plate meter is made up of a metal shaft, a handle, a circular plate which is attached to an inner tube within the metal shaft, and two mechanical counters (see Figure 1 and Plate 2). To operate, the circular plate is gently placed on top of an area of grass within a field, and the handle is pushed down until the inner shaft hits solid ground. The first mechanical counter

2.A supermarket known for low-priced, own-branded goods.

Figure 1: Diagram of a Plate Meter.

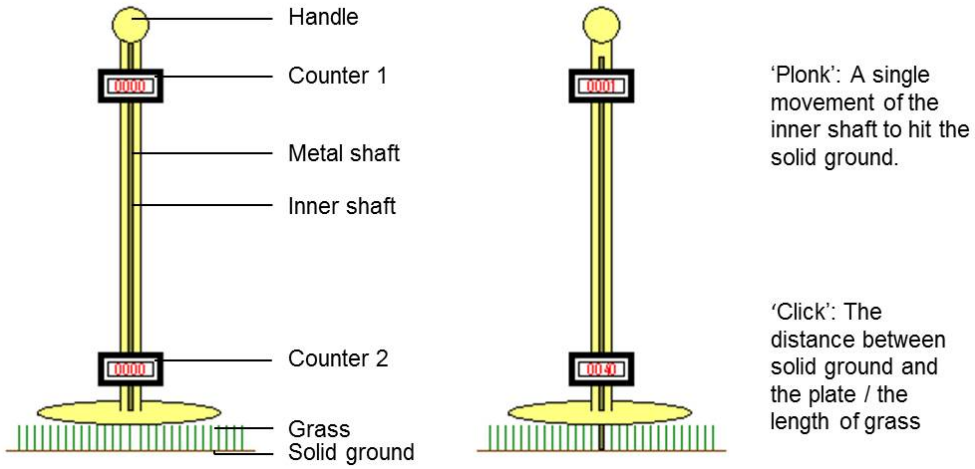


Plate 2: A plate meter.

records this movement or 'plonk' as 'number 1', and the second measures the length of movement of the inner tube up the metal shaft as it hits the ground (this is known as a 'click') (Farmworks Limited, 2006). This is repeated across the field normally between 20 to 40 times or according to the variation in grass cover. When complete, a measurement of the total length of 'clicks' provided by the total number of 'plonks' may be read from the second counter. These figures are then combined into an equation which is selected according to the

type of grazing animal (e.g. cow or sheep) and their agricultural use (e.g. dairy, beef, wool). These equations usually mean dividing the number of 'clicks' by the number of 'plonks' and multiplying the result with figures defined by the particular equation used. What results is an accurate measurement in kilograms of the total amount of dry matter or grass available for grazing animals within the field (see Farmworks Limited, 2006). From this, it is possible to manage the quantity of grazing grass by, for example, applying fertiliser, taking a cut for silage or giving the cows more feed purchased off the farm. This use of technology to measure and then manage grass was epitomised in the farmer's saying: "if you can't measure it, you can't manage it" (Farm B). This saying and the use of technology it implies, lies at the centre of the farmer's employment of a spring block calving system. A block calving system involves the whole herd calving, breeding and drying-off within a set period of several months. So at this farm, calving begins in February, followed by artificial insemination from the beginning of May and drying-off at the beginning of October. This maps out milk yields that average at 18 litres per cow per day in February, increasing to 27 litres in May and decreasing to 15 litres in November before ceasing altogether. The farmer attributed his conversion to block-calving from a traditional all-year-round milking system to advantages such as more efficient use of time and labour due to focusing on one activity at a time (e.g. artificially inseminating cows), the ability to have a break from milking over Christmas to spend time with family, and the significant profit margins (see also Farming Connect, 2011). The success of this system and its profitability is dependent on the coincidence of peak demand for feed by cows (related to the levels of milk produced) and optimum grass growth (Phillips, 2010). For example, during May, when the cows are producing the most amount of milk, grass growth must be at its peak. As a result, the effective management of grass is vital for block-calving systems (Farming Connect, 2011). Consequently, the use of a plate meter is encouraged and perceived as a useful tool by which to measure, predict and manage grass growth (Farmers Guardian, 2011; Farmers Weekly, 2011). Specifically on Farm B, the plate meter provided a reassuring set of grass data from which to plan and manage actions aimed at making the most out of this rich on-farm resource within the block-calving system. This illustrates how the use of a technology which is relatively simple in construction and operation (such as a plate meter) can integrate and maintain elements of knowledge and practice that constitute a whole approach to family farming (cf. Mol & de Laet, 2000).

The approach to farming and the related use of a plate meter on Farm B was described by the farmer as being supported by his connection to other family farmers engaged in block-farming through a 'discussion or benchmark group' (Farm B). This network of farmers and an employed consultant work together to share advice, offer guidance and attempt to solve problems and issues. A key characteristic of the group is its restriction to 'members-only' which promotes absolute confidentiality within the group and a subsequently in-depth approach (for example, financial details may be shared amongst members). This is in contrast to other 'open' groups for farmers which aim to share general ideas around issues such as good agricultural practice, experiences of new technology and advances in animal husbandry techniques (e.g. Farming Connect; see Welsh Government, 2011). The farmer at Farm B described the discussion or steering group as an invaluable source from which to gain knowledge of the system, guidance on problems and concerns, and further advance practice (for example, support from the group encouraged him to conduct soil analysis, which led to an even greater level of grass management). Consequently, it is appropriate to theorise the block-calving approach and

associated uses of technology at Farm B as drawing from, and contributing to, a broader 'culture' of individuals, their practices and knowledge (see Tsouvalis et al., 2000).

This case study of Farm B offers three key points when considering the anticipated onset of 'neo-productivism'. First, as also reflected in the case study of Farm A, technologies that are relatively simple in their operation and function are usually the most effective on family farms. Moreover, Farm B illustrated that it is likely that this will remain the case when new technologies (such as plate meters) may be introduced alongside conversion to different farming approaches (such as block-calving and others that may relate to 'neo-productivism'). Second, there is an interesting similarity between the use of technology (plate meter) to manage on-farm resources (grass) to maintain efficient production on Farm B, and the 'neo-productivist' aim of using technology to increase production in environmentally sustainable ways. This highlights the potential of some current farming approaches (such as block-calving) to the future of agriculture. Third, the presence of Farm B within a discussion or benchmark group indicates the importance of cultures of knowledge to changing and prospective uses of technology and farming approaches.

7.0 Conclusions

This article has explored the practices that surround technologies on family farms, the connections they hold with broader cultures of knowledge, and how this might relate to a 'neo-productivist' agricultural future. From this, three key arguments may be highlighted. First, practices surrounding technologies within the context of a family farm are often creative, imaginative and unpredictable. Moreover, technologies that allow this creative engagement (through their simple construction or ease of use) tend to be the most popular and successful, and will be in a 'neo-productivist' future. Second, knowledge-cultures provide an important context for discussing, introducing and resisting technological practices. It is likely that this significance will increase as family farmers are encouraged to consider new or different technologies such as GM under 'neo-productivism'. Third, while literature concerned with Government recommendations or agricultural geography suggests that 'neo-productivist' change is anticipated, it could be suggested that some current on-farm practices show movement in a 'neo-productivist' direction. For example, the measured and managed use of grass within a successful block-calving system at Farm B, fulfils the 'neo-productivist' principle of efficiently and sustainably using resources to maintain sufficient levels of production. It will be interesting to observe how these current farm practices may change as 'neo-productivism' becomes more of an influence. So, for Farm B, for example, the availability of "'green fertilizer[s]'" such as controlled-release or biomass-based formulas may add another dimension to grass management within the block-calving system (Ambler-Edwards et al., 2009, p. 28).

The research on which this article is based makes a key contribution to four central areas of debate and research engagement in agricultural geography. First, it is one of the initial attempts to interrogate 'neo-productivism' and how it might become embedded in the day-to-day activities of farm families within the UK agricultural sector. As a result, and second, it re-visits and builds on literature in agricultural geography concerned with understanding the shape, dynamic and features of family farming. Third, this research questions and broadens theoretical interpretations centred on the understanding of technologies as constructed through practices which are underpinned by

cultures of knowledge. Fourth, the utilisation of an ethnographic approach fulfils potential to move in and explore this methodological direction in rural and agricultural geography (Holloway, 1999; Hughes et al., 2000). Finally, the contribution that this research makes to these four areas of potential is certainly not conclusive or complete, and there is definite scope for additional and alternative perspectives on the dimensions of changing 'neo-productivist' agriculture.

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