



**A Nuffield Farming Scholarships Trust  
Report**

*Award sponsored by*

**Three Counties Agricultural Society**



**How are farmers re-engaged with their  
soils? Through fear, finances,  
regulation or education?**

**Kate Speke-Adams**

**July 2016**

**NUFFIELD  
UK**

## **NUFFIELD FARMING SCHOLARSHIPS TRUST (UK)**

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# A Nuffield (UK) Farming Scholarships Trust Report



Date of report: July 2016

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

Title **How are farmers re-engaged with their soils? Through fear, finances, education or regulation?**

Scholar Kate Speke-Adams

Sponsor Three Counties Agricultural Society

Objectives of Study Tour

- What mechanisms are most effective for achieving change within agriculture
- How fear affects our ability to change
- The role regulation plays
- Whether financial incentives are a help or a hindrance
- Identify the most effective knowledge transfer techniques
- Understand the barriers to change and how to overcome them

Countries Visited USA, Canada, Australia, New Zealand, France

Messages

- No single mechanism if implemented alone will reinvigorate interest in soil health. A combination of regulation, knowledge transfer and financial rewards is more likely to engage the broad range of farm types and farmer personalities.
- Regulations must be enforced so that they can be relied upon to address poor practice. It can encourage the adoption of innovative solutions which result in more resilient businesses.
- Financial support schemes should reward or be happy consequences of good practice, not an incentive.
- The role of facilitation is essential for effective knowledge transfer and farmer empowerment.
- It is most effective to focus resource and effort on assisting those most likely to change practice rather than chasing the hard-to-reach.
- Only those who have changed can explain how they overcame the barriers.

## CONTENTS

1. About me .....	1
2. Background to my study subject .....	2
3. My study tour.....	4
4. Fear .....	5
4.1. Land degradation .....	5
4.2. Human health scares:.....	6
4.3. Discussion .....	8
5. Regulation .....	9
5.1. Chesapeake Bay .....	10
5.2. Lake Brunner .....	15
5.3. Discussion .....	17
6. Finance.....	19
6.1. New York State.....	19
6.2. Chesapeake Bay .....	22
6.3. Discussion .....	23
7. Education and Knowledge Transfer .....	25
7.1. Penn State University .....	25
7.2. Manitoba Grazing Clubs .....	25
7.3. Canadian Beef - distilling and disseminating research .....	28
7.4. Soils for Life initiative, Australia .....	28
7.5. Conservation agriculture, France .....	31
7.6. Facilitation, South Africa .....	32
7.7. Discussion on Chapter 7 .....	32
8. Barriers to change .....	34
8.1. Discussion on Chapter 8.....	38
9. Conclusions .....	41
10a. Recommendations for re-engaging farmers with their soil.....	42
10b. Recommendations for farmers wishing to re-engage with their soil .....	43
11. After my study tour .....	44
12. Executive Summary .....	46
13. Acknowledgements and Thanks.....	47

## Table of Figures

Figure 1: The author, Kate Speke Adams .....	1
Figure 2: No-till air-seeder drills are now standard practice in Saskatchewan.....	5
Figure 3: Summary of changes in the mineral content of Vegetables, Fruit and Meat between 1940 and 1991; <i>D Thomas, 2003</i> .....	7
<b>Figure 4: the impact significance of the original soil protection review. Source: Clare Greener, 2015</b> .....	9
Figure 5: Understanding of the new soil standards launched in 2015. Source: Clare Greener, 2015 .	10
Figure 6: Satellite image of the Chesapeake during an algal bloom in 2013. Source: Livablefutureblog .....	11
Figure 7: The Chesapeake Bay, Annapolis, Maryland.....	11
Figure 8: small dairy unit in Maryland.....	12
Figure 9: a larger dairy unit in Maryland, which had acted to reduce nutrient losses proportionate to its size .....	13
Figure 10: Phosphate stripping unit at Jones Family Farms, Maryland .....	14
Figure 11: A phosphate stripping unit for dairy slurry which produces a granular struvite .....	14
Figure 12: A fenced tributary draining dairy pastures in the Lake Brunner catchment .....	15
Figure 13: Dairy cows returning to the parlour at Inchbonnie Farms .....	17
Figure 14: typical small family dairy farm in Upstate New York.....	20
Figure 15: internal view of small family dairy unit shown in photo above.....	20
Figure 16: watercourse buffer with tree planting scheme to prevent livestock poaching on a tributary of the Delaware river .....	21
Figure 17: Livestock collection yard in New York State to prevent poaching and manure runoff.....	22
Figure 18: Chesapeake Bay themed number plates. Source: <i>Chesapeake Bay Foundation</i> .....	23
Figure 19: Manitoba Grazing Club field visit during Johan Zietsman regenerative grazing course .....	26
Figure 20: Manitoba Grazing Club members learning from each other to assess biological activity of the soil .....	26
Figure 21: Angus cattle at pasture on Neil Dennis's farm .....	27
Figure 22: Neil Dennis' ultra-high stocking grazing technique building soil by the inch compared to his neighbours' soil which is still set-stocked.....	28
Figure 23: Maintaining forage supply in such an extreme climate is challenging at Gus Whyte's farm Wyndham Station .....	30
Figure 24: Wyndham Station had far more forage during a drought period than set-stocking neighbours.....	30
Figure 25: Popularity of measures mentioned by farmers surveyed in the Demonstration Test Catchment .....	34
Figure 26: Fertiliser at the Saskatchewan's south west Inland Terminal .....	36
Figure 27: Diagram categorising the different audiences by likeliness to change, <i>Charlie Massy 2013</i> .....	37
Figure 28: Diagram categorising the different audiences by likeliness to change, <i>Charlie Massy 2013</i> .....	38
Figure 29: Diagram of engagement mechanism by segmented audience type .....	39

## **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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*Published by The Nuffield Farming Scholarships Trust  
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## 1. About me

I grew up on a dairy farm in Herefordshire. Our situation is quite unique locally with the business being run by my mother after a tragic accident took away two generations of the family. She had not grown up in farming but took the burden of the business, combined with two young children, in her stride. Her strength and ability to enthuse those who work alongside her is inspiring, and what has kept the farm flourishing for now almost thirty years. She is a strong role model, gliding like a swan above the surface no matter how manic the paddling below.

After three years in London studying geography at Kings College University I jumped at the opportunity of employment back in my home county. I was employed by the Environment Agency carrying out cross compliance inspections and enforcing water quality regulations. The role of regulation provided a valuable steer to those who took risks without the necessary mitigation measures in place to protect the environment. For others it left the farm in a worse situation than before with less finance available to resolve the original problem.



Figure 1: The author, Kate Speke Adams

After several years it had become wearing to be the face farmers dreaded seeing coming up the drive. In 2012 I was given the opportunity to shift roles and work as a Catchment Sensitive Farming adviser for Natural England. This role was exactly what I needed, providing advice and guidance rather than stern words. Unfortunately, as with many government bodies, staff can only be hired on fixed term contracts so my time with CSF was short but sweet.

Thankfully, just as my time contract was nearing the end I was invited to join The Wye & Usk Foundation as Head of Land Use. WUF, the local Rivers Trust, were well known in Herefordshire for their tenacity and reputation for delivery rather than paperwork, a refreshing and invigorating change after 6 years working in statutory bodies! I co-ordinate a team of advisers delivering projects across the Wye catchment. Our aim is to work with farmers to find pragmatic and cost-effective solutions which are a benefit to the business whilst improving water quality in our rivers and streams.

Recommendations to improve infrastructure tend to have a much higher uptake than recommendations which require changes to management practices. Investments in infrastructure are quantifiable; adapting how crops are grown or stock are grazed is not always as easily measured. If how we manage our soils needs to change what are the different mechanisms which could be implemented to facilitate that change?



## 2. Background to my study subject

There are countless examples throughout human history of entire civilisations which have crumbled as a result of the inadequacies of their soil management: Mesopotamia, Ancient Greece, the Roman Empire, European Colonies, Central America, and more recently the collapse of the American prairies. Yet we appear doomed to repeat these mistakes century after century. In an industry as old as agriculture new techniques are hard to come by. This poses challenges for our psyche which prefers new solutions to old problems. We therefore end up badging old techniques as new in order to pique interest. Take controlled traffic farming, a technique designed to reduce the compaction damage we have caused by movements of vehicles which get heavier and heavier with each purchase. This issue and its solution sound painfully similar to a technique that was launched by John Fowler in 1858 whereby traction engines were tailored to mechanise ploughing. John Fowler employed a portable engine and an anchor carriage on opposite headlands whilst drawing the plough across the field thus avoiding the weight of the heavy engines on the field.

For at least a generation traditional soil husbandry has been far from fashionable. The rise of fertilisers and sprays has made it possible to prop up yields despite declining soil health. Further to this the ever increasing power and weight of machinery has meant that only being able to work soil when conditions are right has become an inconvenience of the past. Machinery available now is bigger and stronger than ever allowing us to do what we like, when we like. I heard John Lewis-Stemple, a notable writer and an advocate for all things sustainable and organic, observe that one of the reasons farmers have become less connected to their surroundings, is due to enclosed cab tractors. Now we don't get wet when it rains or hear the birds chirp in the hedgerows; of course it does have practicalities like air conditioning during hot weather and protection from drift during spraying, but perhaps he has a point. Likewise if our only interaction with soil is from the comfy seat of a tractor rather than with our hands and a spade, it is no wonder we don't realise when damage is being done or how our soil is changing over time. The dependency on inputs and technology is unfortunately combined with increased administrative burdens, which often results in more time farming from the office than the field.

Pressure from contracts more often than not worsens the habit of disregard for soil. If the contract says the crop must be harvested by X date and that day happens to be wet there is not a lot that many growers can do but pull on their wellies and make a mess. Further to this, where salad crops and vegetables are concerned, contracts often stipulate that organic manures cannot be used to maintain fertility of the soil. This is due to consumers not liking the inconvenience of washing their food before use; consequently not only compromising the health of the soil but also the quality of the produce. To further complicate matters, in recent years we have seen a rise in the amount of land rented under short term tenancy. Who then has the soil's best interest at heart? The landowner who is receiving rent no matter the state of the soil, or the tenant who will not reap any of the long term benefits of taking care of it today?





So why seek soil enlightenment now? Professor Wilfred Otten<sup>1</sup> concluded that *“there is only a thin layer standing between humanity and extinction, and our salvation lies in the soil.... We are thinning this critical layer at a rate slow enough to prevent immediate anxiety in society but fast enough to threaten long term survival.”* In Herefordshire in April 2010, during a 7-day spate on the River Lugg, 200,000 tonnes of suspended sediment left the catchment: the equivalent of 64 acres of top soil being lowered by a foot. This was not recognised by the farming community as a particularly awful incident. It passed most by without too much concern: just another rain storm with *“a bit of brown water...”*. Even fairly significant soil loss does not cause anxiety when it is diffuse by nature.

*... during a 7-day spate on the River Lugg, 200,000 tonnes of suspended sediment left the catchment: the equivalent of 64 acres of top soil being lowered by a foot.*

For other sectors this anxiety is already more acute. Each time the rivers run red after rain there are negative impacts on tourism, fisheries, local housing growth and potable water supplies. But the impacts of our rivers not meeting the requirements of the Water Framework and Habitats Directives are not limited to off-farm. These failures hint at declining organic matter levels, increasing costs for cultivations and artificial inputs, inefficient grazing and an overarching decline in traditional soil husbandry at the expense of profitability and sustainability. But this transition has been gradual. Most people haven't even realised it's happened. Besides, technology is far sexier than soil. Worms and organic matter don't make your neighbours crane their necks when they drive by.

The Government are not ignorant of the issue either. Another reform of the Common Agricultural Policy saw the introduction of more ambitious soil management requirements into cross compliance. The shelving of the Soil Protection Review was received with mixed response; for those working proactively to improve their soil the arrival of more stringent regulations was of little consequence. For those pushing their soils hard with little understanding of its “health”, witnessing structure issues and runoff on a regular basis, the new soil Good Agricultural and Environmental Conditions posed a significant threat to their basic payment. The latter group were exactly the audience the soil GAECs are aimed at, but without appropriate enforcement it seems these requirements will also fail to engage farmers with their soil.

The year I was awarded my Nuffield Farming Scholarship was the FAO's International Year of Soils, raising the profile of soils as not only a growing medium for the food we eat but as a crucial tool in mitigating climate change. Meanwhile the media is plagued with negative press exposing the industry's perceived shortcomings of *“2 million tonnes of top soil degraded in the UK each year”* and *“only 100 harvests left”*. But at a grass roots level - pardon the pun - there felt like a gathering of momentum in the level of interest in soil health. What approaches for reinvigorating a farmer's interest had proven to be successful elsewhere in the world?

That's what I sought to discover during my Nuffield Farming Scholarship.

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<sup>1</sup> <http://www.dundee.com/news/thin-layer-stands-between-humanity-and-extinction.html>

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### 3. My study tour

<b>USA:</b> New York state, Pennsylvania & Maryland	The US extension service is renowned worldwide for its success in knowledge transfer. Extensive regulation and innovative financial support schemes protecting environmental assets to preserve water supply, fisheries and tourism have also proven to be very effective in recent years.
<b>Canada:</b> Manitoba & Saskatchewan	Land management changed dramatically to cause, and then counteract, the effects of the Dustbowl. Is Canadian soil management further ahead now as a result or have memories faded?
<b>Australia:</b> Victoria & New South Wales	Farming in such a brittle environment means soil management has long been on the agenda in Australia. Proactive campaigns and mentoring programmes now aim to facilitate knowledge transfer between farmers but what are the challenges and practicalities in such a vast country?
<b>New Zealand:</b> South Island	Widely recognised for its progressive but more recently adopted intensive farming and beautiful scenery, I had heard the observation that New Zealand was only just now starting to see the downstream impacts and declines in water quality. How were new regulations being implemented to address these issues?
<b>France:</b> Paris	French farmers are famously strong-willed, their policies are equally so. Their pivotal role in launching the “4 in 1000” Initiative (a new programme for carbon sequestration in agriculture) is yet more evidence that they are at the forefront of sustainable agriculture.
<b>UK</b>	It was important for me to explore the networks utilised by some of the most forward thinking UK farmers. How do they compare to those seen abroad and how can existing opportunities be promoted or adapted to reach those not currently engaged?

In subsequent chapters I shall be discussing the mechanisms that engage farmers and facilitate change – beginning with Fear.



## 4. Fear

The role of fear as a mechanism for change will be considered under two primary drivers: fear as a result of total land degradation and fear as a result of human health scares.

### 4.1. Land degradation

The prairies on the Canadian side of the border were just as ravaged as those to the south during what is better known as the American Dustbowl. The Canadian immigration boom from 1867 to 1914 saw native prairie converted to cropland with intensive agriculture pushing the soil to, and far beyond, its limits. The repercussions of this misuse were felt across the Great Plains and Canadian prairies during the 1930s. It is clear that the scars of the Dustbowl are still felt on the soil and the way in which it is managed today.

The Prairie Farm Rehabilitation Association (PFRA) was formed in 1935 to support the worst affected Canadian states to help co-ordinate mitigation against soil erosion. PFRA programs included extensive shelter belt planting to protect against wind erosion as well as strip tillage and reversion of abandoned land. Provincial level Soil Conservation Associations were formed in the decades that followed. These varied province to province but generally encouraged interaction with research bodies, on-farm trials and adoption of soil preservation techniques. As a result Saskatchewan is 80% minimum or no-till today, a much higher uptake of that technique than that in the UK where we are perhaps only just seeing the effects that decades of intensive agriculture can have on our soil.



Figure 2: No-till air-seeder drills are now standard practice in Saskatchewan



Examples of reversing land degradation can be found on most continents and are often spoken of with reverence; Alan Savory's work to halt and then reverse desertification in Africa is the most documented. Those lucky enough to work alongside him have taken those principles and applied them in other degraded landscapes around the world. One such example is Johan Zietsman whom I met during a grazing management seminar in Saskatchewan where he was promoting adoption of sustainable grazing techniques and choosing appropriate stock breeds for individual climates. Johan worked in partnership with Jim Elizondo, a Mexican rancher, and together they had presented to farming audiences across the globe. The subsequent cascade of enthusiasm was clear within many of these groups. However, an issue which often stifles wider uptake is that, for the majority of people it is hard to learn from others' mistakes, and they are destined to continue on their chosen pathway until *force majeure* mandates change.

#### 4.2. Human health scores:

Many of the world's most renowned soil health experts are from Australia, America or Africa. It can be no coincidence that these were countries once colonised by European settlers. Techniques which suited temperate conditions were transplanted into more brittle climes, more often than not resulting in widespread degradation. Dr Christine Jones, an Australian Soil Health expert, links the declining health of our soils to declining human health. Christine equates this to the lack of active soil biology which plays a vital role in making minerals and trace elements available for uptake. Christine likens the use of artificial fertilisers as akin to giving children enough sweets to make them full and then expecting them to seek out vegetables. The energy provided by said sweets is enough to keep the child alive but does not provide enough nutrition to be able to resist disease and illness in the long-term.

During her work Christine refers to a study carried out in the UK by David Thomas<sup>2</sup> which compared mineral levels in foods between 1940 and 1991. The report concluded that, of the 27 different varieties of vegetable, 17 varieties of fruit, 10 different types of meat and several dairy products, all showed "*that there has been a significant loss of minerals and trace elements in these foods over that period of time*". See Figure 3 overleaf. The study was based on data collected by the UK Medical Research Council. Research conducted by an impartial body on such a topic is probably now hard to come by, normally being dominated by those wishing to sell mineral supplements or pharmaceuticals.

The health issues associated with mineral deficiencies include a wide range of degenerative diseases such as osteoporosis as well as cardiovascular diseases, infertility, hypertension and heart attacks to name but a few. Effectively western society is predominantly composed of individuals who are both overfed and undernourished of key trace-elements and micro-nutrients.

The health implications of our agricultural practices are not particularly well publicised. The Soil Association regularly runs campaigns which relate to the benefit of consuming organic food. The "Not in our Bread" campaign highlighted that as much as 30% of breads contained glyphosate

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<sup>2</sup> D Thomas, 2003. A study on the mineral depletion of the foods available to us as a nation over the period 1940 to 1991. *Nutrition & Health*; 17(2):85-115.



residues, classified by the World Health Organisation's International Agency for Research on Cancer as a '*probable carcinogen*'. Since this campaign no dramatic drop in bread sales has been witnessed. As with Jamie Oliver's free range poultry campaign in 2008, any changes in consumer habits tend to be short lived. Most people are quite content to buy their food with little explanation of the standards to which it was grown, as long as the price is right. This cycle is then only broken when health problems arise and individuals change their eating habits as a preventative method.

Year of Analysis	Mineral	Vegetables (27 Varieties)	Fruit (17 Varieties)	Meat (10 Cuts)
1940	Sodium			
1991	(Na)	Less 49%	Less 29%	Less 30%
1940	Potassium			
1991	(K)	Less 16%	Less 19%	Less 16%
1940	Phosphorous			
1991	(P)	Plus 9%	Plus 2%	Less 28%
1940	Magnesium			
1991	(Mg)	Less 24%	Less 16%	Less 10%
1940	Calcium			
1991	(Ca)	Less 46%	Less 16%	Less 41%
1940	Iron			
1991	(Fe)	Less 27%	Less 24%	Less 54%
1940	Copper			
1991	(Cu)	Less 76%	Less 20%	Less 24%

Figure 3: Summary of changes in the mineral content of Vegetables, Fruit and Meat between 1940 and 1991; D Thomas, 2003

Graeme Sait, another notable Australian Soil Health Expert, observed that many of the farmers and ranchers who had engaged with his approach had done so after significant trauma or upheaval, for example due to a personal health issue or due to a wild fire destroying their homestead. Dr Charlie Massy, a visiting fellow at Australian National University in Canberra, in his PhD which studied the barriers to change in agriculture, also refers to similar trends. Dr Massy concluded that 60% of farmers that have achieved transformational change had done so due to a major emotional event;:

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financial loss, natural disaster, own or family health issues. Both scenarios resulted in the individual reassessing their approach to farming and making radical change as a result of fear that it may reoccur. Graeme's courses are well respected; Woolworths South Africa ask their growers to undertake his 'Nutrition Farming' training to ensure that the food they sell is produced sustainably and is nutritionally dense.

However, as well as being a catalyst, fear can also act as a barrier to change. Peer pressure was also identified by Dr Charlie Massy as a key influence on the likelihood of changing practice, especially where it related to fear of judgement from family and neighbours, and ultimately fear of failure. Identifying techniques to overcome these cognitive barriers will be imperative in facilitating change and will be discussed in later chapters.

### 4.3. Discussion

The saying "you don't know what you've got until it's gone" holds true for agriculture historically. In most historical cases of land degradation it is not until the soil is beyond or almost at the point of no return that we see the error of our ways. For those of us from more forgiving climates where soil health is only now finally starting to show signs of decline, establishing key alliances with those who have addressed similar issues in the past should help us to address the issues before they progress too far.

Fear, whilst a proven driver for change, is not something which can be relied upon for uptake of more regenerative soil management practices. Fear-mongering is often the selected tool of the media and environmental NGOs for engaging the wider public, especially in relation to health issues or environmental damage. It proves ineffective in the long term as memories fade and people generally revert to ingrained habits. Consumers instead should be persuaded or convinced by standards to which food is produced, whether this be animal welfare, nutritional value or environmental protection. Supermarkets could play a key role in achieving this, as seen by the example set by Woolworths South Africa. Rather than being a powerhouse which producers loath due to restrictive contract requirements, yet fear risking loss of essential contracts, supermarkets could and should be their suppliers' greatest publicist, promoting the nutritionally dense, environmentally sensitive, sustainably grown produce which is selected to ensure the longevity of their customers and the environment in which they live.

It can be assumed that, as we progress, there will be a small percentage of the farming population who change on account of fear. There are likely to also be those for whom fear is a barrier to change. This will be discussed in subsequent chapters. In the meantime our effort and resources should be focused on avoiding reaching the point of soil collapse.

\*\*\*\*\*

The next mechanism that engages farmers and facilitates change is Regulation. This will be discussed in the next chapter.





## 5. Regulation

In recognition of its contribution to soil fertility, Cleopatra declared the earthworm sacred. Ancient Egyptian farmers did not dare to touch earthworms for fear of offending Cleopatra or the God of Fertility. The crime of removing earthworms from Egypt was punishable by death. This is probably the first and most extreme regulation which relates to protecting soil health. No regulations since have even come close to being as simple to comply with or so resolute in their consequence for non-compliance. Clare Greener, 2010 Nuffield Farming Scholar, undertook a study of farmer attitudes in 2015 for her Master's thesis<sup>3</sup>, which found that 50% of farmers surveyed appreciated regulation for setting boundaries and clearly defining right and wrong. This cohort was probably not thinking of Cleopatra's rule book when answering, but it does suggest that regulation can provide reassurance to those who are trying to do things "by the book". In contrast, the other 50% considered regulation to be insignificant. It is clear that in the UK, regulations relating to soil management have thus far had limited effectiveness, see Figure 4 below:

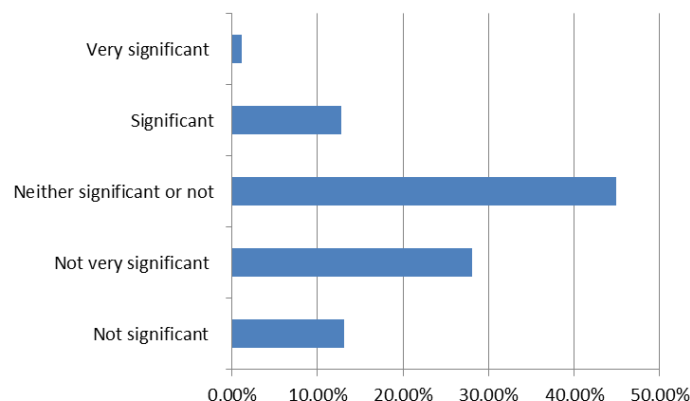


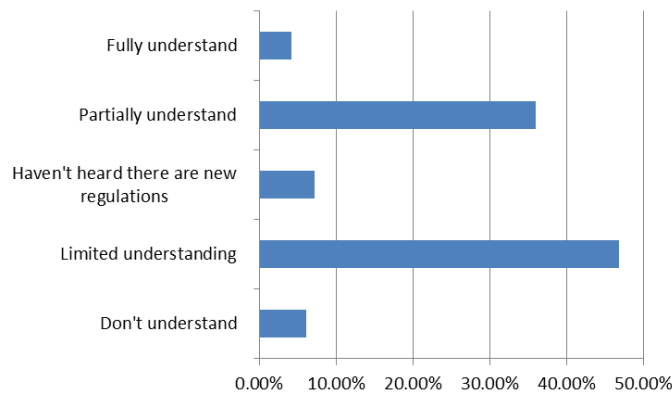
Figure 4: the impact significance of the original soil protection review. Source: Clare Greener, 2015

Compliance with much of the Basic Payment Scheme's cross compliance requirements can be achieved through record keeping and paperwork. It's therefore unsurprising that the majority of farmers surveyed considered the Soil Protection Review, which effectively made soil management a desktop exercise, to be of little significance. The introduction of the new Good Agricultural Environmental Conditions for Soil (GAEC 4, 5 & 6) should have resolved this issue. However, the results of Clare's survey suggests that their importance has also been lost in the melee of cross compliance bureaucracy, see Figure 5 on next page:

<sup>3</sup> Which is mightier: the carrot or the stick? Should resource protection be more about business advantage and education and less about regulation? A Herefordshire case study. Clare Greener, 2015

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**Figure 5: Understanding of the new soil standards launched in 2015.**  
Source: Clare Greener, 2015

Regulation in the UK is between a rock and a hard place: constantly under review as part of the “red-tape cutting” regime, and constantly under scrutiny by those who demand a cleaner environment. This battle is more often than not played out in the British countryside: farm yards seen as key fortifications to be breached, erosion gullies as the trenches from which a battle for healthy rivers can be won or lost. This chapter will consider the effectiveness of regulatory approaches taken to protect important habitats and environmental features.

### 5.1. Chesapeake Bay

The Chesapeake Bay is national treasure with extensive legislation designed to protect its condition. It is a complex feature to manage as its watershed spans six states: New York, Pennsylvania, Maryland, Virginia, Delaware, and West Virginia. The Chesapeake ecosystem is severely impacted by eutrophication; where excessive nutrients cause algal blooms known as Dead Zones, see Figure 6. Nutrients like nitrogen and phosphate, once lost to water, behave similarly to if they were applied to crops: they stimulate growth. Algal blooms block sunlight from aquatic plants which restricts their growth, and this reduces habitat for invertebrates, fish and waterfowl. When the algae die they strip oxygen from the water which suffocates the oysters, blue crab and striped bass which famously call the Bay their home.

*See satellite image of Chesapeake on next page.*

Agriculture is considered to be the single greatest contributor of sediment and nutrients to the Bay system. In 2012 it was estimated that 58% of the phosphorous, 42% of the nitrogen and 58% of the sediment currently entering the bay was from agricultural sources<sup>4</sup>. After decades of failed agreements the Chesapeake Clean Water Blueprint was passed in 2010. This agreed a Total Maximum Daily Load allowable for each bordering State with incremental improvement targets set and consequences for failure.

The American Farm Bureau Federation (AFBF) launched an appeal immediately, gathering as many allies as possible, including the National Homeowners Association, National Chicken Council, National Corn Growers Association, National Pork Producers Council, The Fertiliser Institute and the

<sup>4</sup> <http://www.cbf.org/about-the-bay/issues/dead-zones/nitrogen-phosphorus>

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US Poultry and Egg Association. Their objections included questions relating to the Environmental Protection Agency's authority to specify TMDLs, inaccurate monitoring data, and lack of time for the public to comment. These criticisms were overruled and the Clean Water Blueprint was upheld at Federal District Court by Judge Sylvia Rambo in October 2011. AFBF proceeded to appeal at the Federal level and eventually even petitioned the US Supreme Court, but this was petition was also denied in February 2016.

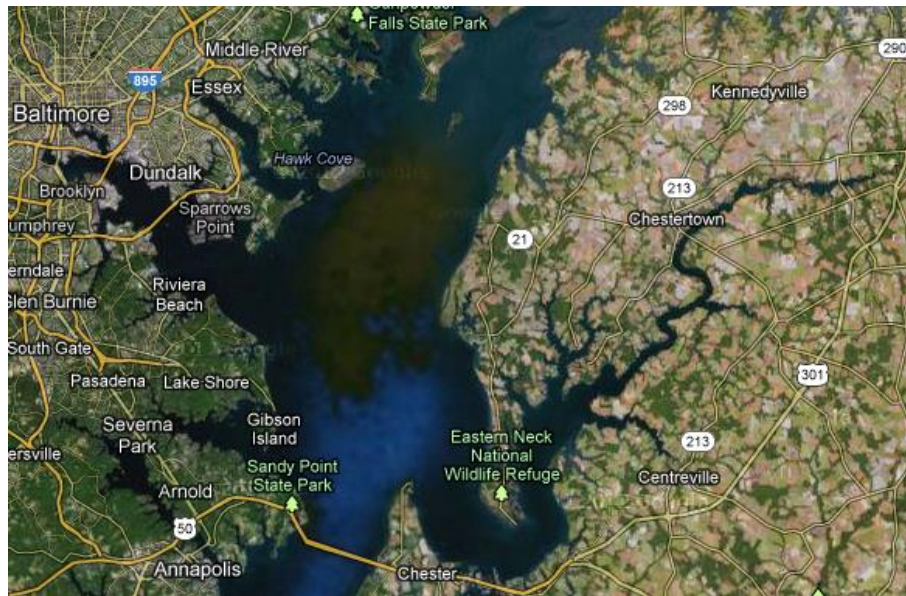


Figure 6: Satellite image of the Chesapeake during an algal bloom in 2013. Source: Livablefutureblog



Figure 7: The Chesapeake Bay, Annapolis, Maryland

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My visit to the Chesapeake Bay, hosted by the Chesapeake Bay Foundation in May 2016, was therefore well timed. CBF, along with several other nature and wildlife conservation groups, had supported the EPA's position to better protect the Bay. CBF now play a key role in co-ordinating delivery of the required improvements to water quality, including reductions in the quantity of nitrogen and phosphate lost from agricultural diffuse sources. Establishing relationships with landowners who felt the regulatory requirements were unfair may therefore pose somewhat of a challenge for CBF. However those who engage have access to funding for yard improvements, conservation schemes and the grazier mentoring network - to name just a few of the support programs available to farmers in the watershed. Engagement levels with these schemes to date are excellent but this highlights the difficulties that can arise for NGOs when trying to be both a lobbying organisation and front line deliverer.

Whilst in Maryland I visited a number of farms, from a small husband and wife dairy unit milking 40 cows, to a 1200 cow unit, see Figures 8 and 9 below. The former had made small-scale improvements including fencing and tree planting to buffer the streams they had on their farm. The latter had more of a challenge to overcome due to their size and therefore potential to cause damage.

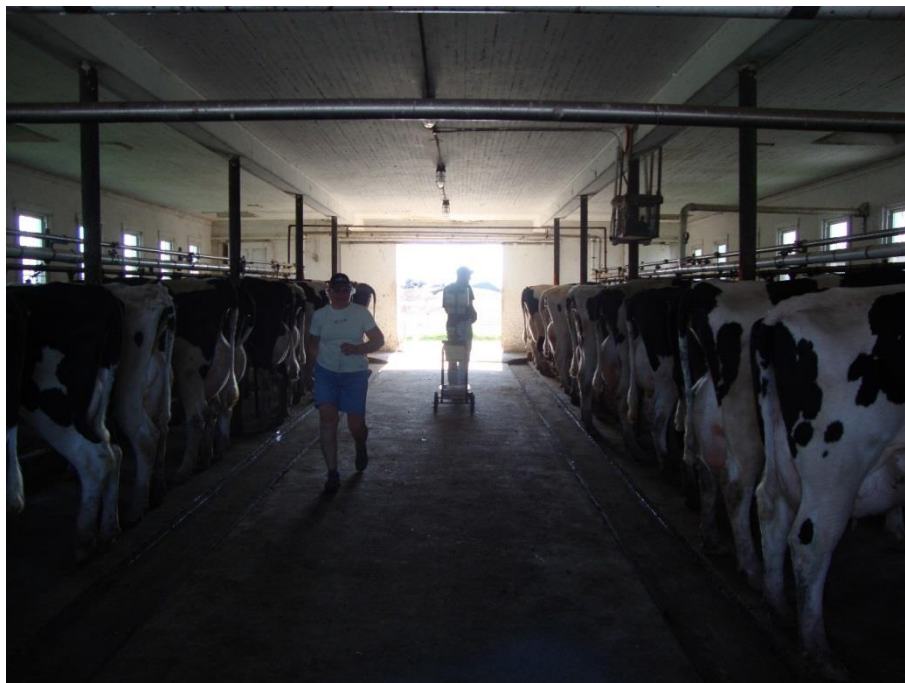


Figure 8: small dairy unit in Maryland



Figure 9: a larger dairy unit in Maryland, which had acted to reduce nutrient losses proportionate to its size

Maryland will need to reduce their phosphate losses by 48% if they are to achieve the TMDL target by 2025 as required. A key challenge they face is the Delmarva Peninsula. This is an area previously made up of wetland and forest which was drained for agricultural production and where more recently the poultry sector has boomed to take advantage of its close proximity to the millions of consumers in Washington, Baltimore, Philadelphia and New York City. There is an abundance of manure in the Delmarva Peninsula arising from the high numbers of poultry and dairy farms. As a result phosphate indices have built up in the soil over time. If soil is lost to a watercourse, so is phosphate, which is normally bound to the soil particles; however phosphate can leach into water the same as nitrogen when it reaches high indices. Enter the Phosphate Management Tool (PMT). The PMT allows the EPA to collate soil testing data to monitor levels of P and classify whether farm land has low, medium, optimum or excessive phosphate levels, combined with soil type, slope and proximity to watercourses. Where these factors indicate a high risk of phosphate pollution, future applications of manure are restricted and the farmer would need to export the manure, possibly out of State, to ultimately remove some of the excess phosphate from their system.

The objectives of the PMT were no secret. It has been the subject of a decade's worth of research by the University of Maryland. Many farmers, including the Joneses' family farm in Massy whose large modern parlour is shown in Figure 9 above, saw the threat the PMT posed to their business on the horizon and responded accordingly. One third of the 1500 acres farmed by the Jones family is already at or above "Optimum" for phosphate. They therefore implemented an innovative technique to strip phosphate from a third of the slurry they produce. A magnesium solution is added to an agitated dilute slurry, the pH is then reduced to 4.3. Aqua ammonia solution is added to the reactor to bring the pH back up and causes struvites to form and settle to the bottom. This allows the Joneses to apply the P-stripped slurry to those fields which are already in excess so that they still

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receive the benefit of its nitrogen content. On the remaining two thirds of the farm slurry is applied as usual. Soil tests monitor the phosphate levels to ensure they do not tip from Optimum into the Excessive band, stripping more or less slurry as required to suit the crop needs. The struvites are in the form of a sandy grit which they are currently identifying alternative markets for, including possibly fertiliser for gardeners, and is much easier to transport due to its more concentrated form, see Figure 10.



Figure 10: Phosphate stripping unit at Jones Family Farms, Maryland



Figure 11: A phosphate stripping unit for dairy slurry which produces a granular struvite



This system had also been added to an anaerobic digester serving a poultry unit locally. Both sites made the observation that their approach wasn't popular with the neighbours: *"we've just proven it can be done..."*

The extensiveness of the regulations and tools implemented reiterates that, should environmental targets not be met, there is always more regulation just around the corner. For many farmers the desire to not *"be the generation of farmers responsible for killing the Chesapeake"* is reason enough to embrace change and take any steps necessary to ensure their businesses are viable in the long term despite tightening environmental standards. For others, regulation is something to resist or even try to shortcut.

## 5.2. Lake Brunner

In the Lake Brunner catchment on the west coast of New Zealand's South Island, one-size-fits-all regulations were something the local farmers were simply not willing to accept. In 2004 Lake Brunner was experiencing algal blooms due to elevated nutrient levels. The predominant source was identified as the local dairy industry which made up the majority of the surrounding land use. These deteriorations were impacting on the Lake Brunner fishery and associated tourism, upon which the local community were reliant, thus regulations were to be introduced to reduce the losses. Initially a voluntary approach was used with Landcare producing farm plans for 25 out of the 30 farms in the catchment, with most farms subsequently self-funding recommended infrastructure improvements ranging from fencing to slurry storage. However, water quality and nutrient sinks have complex interactions and despite these infrastructure investments nutrient levels were not decreasing significantly enough.



Figure 12: A fenced tributary draining dairy pastures in the Lake Brunner catchment



By 2009 the West Coast Regional Council decided that new rules were required to ensure reductions within a reasonable timeframe. At the time there were very few such rules in New Zealand, so this put both the regulator and the regulated in uncharted waters. Through the voluntary approach the farmers were fairly well engaged with the issue, and a dialogue began between the farmers and the Council. Initially it had been proposed that all dairy farms would have to install a standard effluent collection system. This typical one-size-fits-all approach was strongly resisted by the local farmers. Several farms engaged with research bodies to demonstrate the differences in efficiencies and practicalities between slurry systems to ensure that they had the freedom to choose the one that suited their business. Once this approach had been agreed it then came to negotiating reasonable timescales for installation. Three years was considered by most farmers as reasonable for making the required investments. Those who chose not to comply at the end of this period were picked up via the regulatory system.

Improvements to water quality are now being seen in the lake and those who have engaged with the process are also benefitting from their investments via livestock handling efficiencies and improved utilisation of nutrients. Renee and Greg Rooney who have a 500-cow dairy unit at Inchbonnie Farms are amongst them. Renee has been an advocate for the Lake Brunner farming community throughout the latter stages of this process, promoting the achievements, sharing the challenges and lessons learnt for the benefit of those who may go through similar processes. Sat at her kitchen table one hot summer afternoon she reflected on their experiences; compromise in her opinion was essential, as was each party gaining an understanding and mutual respect of each other. Whilst it is often assumed that change is preferable when it is quick and negotiations or disputes over detail do not drag on, the Lake Brunner example found that by allowing a dialogue to naturally play out, it gave those adverse to change time to get used to the idea. By the time said regulations came into force a level of acceptance had already been reached. Keeping the local farmers involved in the formation of the regulations and ensuring the dialogue and exchange of views remained a two-way process was essential for this to be effective. This is a scenario not yet experienced in the formation of regulations for UK agriculture.

There can be wider implications to regulation. Renee explained that unfortunately because Lake Brunner was the first catchment to be subject to such regulation there had been a knock-on effect on the desirability of farming there, and therefore the value of land. The restrictions and regulations were considered so limiting by those who farm elsewhere and operate in relative freedom that a stigma attached itself to the area. Hard to believe in such a beautiful location well suited for growing grass! This stigma may be quashed somewhat given that regulations requiring the exclusion of livestock from all watercourses were introduced across New Zealand in early 2016.

Fellow Lake Brunner dairy farmer and 2015's Dairy Woman of the Year, Katie Milne's approach to regulations was somewhat more challenging than Renee's. In a rotational grazing system such as hers each paddock is only grazed 9 times a year. This makes the economics for fencing vast kilometres of ditches and streams alongside fields which each will only have cattle in them for 2.5% of the year more difficult to accept. However, this is the nature of diffuse pollution especially when it accumulates in a common sink downstream. The persuasion for Katie came in linking the damage done to pasture in wet conditions with possible negative effects in water quality. For her, improving grazing technique provided economic benefits of reducing reseeding and improved grass yields whilst also reducing the risk of runoff. The average rainfall in the Lake Brunner catchment is

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4.7m/year; therefore the risk of runoff of manures and soil is high. Katie concluded that in order to be successful in the long term she had to farm within her climatic means. If the climate is changing, you can't just always do what you've always done. If this attitude could be adopted by all farmers we would be far more resilient in the more extreme weather conditions we are experiencing, and halt if not reverse the wide-scale declines in water quality which have resulted as a consequence of current practice.



Figure 13: Dairy cows returning to the parlour at Inchbonnie Farms

### 5.3. Discussion

Regulation may be the only mechanism which can be relied upon to wholly achieve high environmental standards or protect important habitats, as other mechanisms like knowledge transfer programmes rarely engage everyone successfully. This approach is costly as it requires extensive inspection and enforcement to ensure compliance. There are several examples, the UK included, where extensive regulations are in place but lack enforcement due to limited resources or political pressure. It also leads to an association of environmental protection with “red-tape” and bureaucracy as they tend to be overly-prescriptive. This in itself also poses a problem as it can result in a propping up of the bottom half and holding back of the top half. In the case of the Chesapeake Bay high environmental standards had pushed the proactive farmers to find innovative solutions. This allowed them to farm within the constraints of their environment whilst protecting their business long-term.

Regulatory mechanisms often lack buy-in as they are produced with little consultation with their target audience. Little effort is made to communicate the drivers or standards which are trying to be met. How then are those most affected by new rules going to take ownership of the problem and feel pride when it is corrected by their actions? Praise and credit are not often provided or well

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publicised when improvements are achieved. In the case of the Lake Brunner farmers the formation of regulations was an interactive process. The farmers were able to take ownership of the issue which had caused the regulations to be introduced, and credit for the subsequent improvements in water quality has been passed to them.

In the UK, the greatest similarity I can see to the above examples is the implementation of Nitrate Vulnerable Zones and the requirement for additional slurry storage. Consultation of such regulations is often carried out from a distance; complicated and time consuming online surveys are only likely to be tolerated by lobby groups and NGOs. When NVZs were introduced many within the dairy sector took the bull by the horns, and invested in improved clean and dirty water separation and new slurry stores where needed. Others still hide their heads in the sand praying they don't one day hear the rattle of an inspector's clip board when the storage calculations don't add up. This is where some ill-feeling can develop within the farming community. Most of the requirements of the NVZ regulations are good in principle; and have adequate storage to ensure that nutrients can be spread when growing crops require them not just when the lagoon is full. It is frustrating for those who have made significant investment in infrastructure to see others at a financial advantage for not, even if this is only in the short term. Those not complying could face deductions to their basic payment, court cases from the Environment Agency if the lack of storage results in a pollution incident, as well as still needing to invest in new storage eventually. A far worse fate for sure, but one rarely suffered due to the regulatory bodies being painfully under-resourced and often reluctant to enforce.

In Pennsylvania, Sjoerd Duiker, an agronomist and Associate Professor of Soil Management at Penn State University, undertook a three year project called "Without carrot or stick". His aim was to assess farmer uptake of methods which were environmentally beneficial but not currently supported by subsidy or enforced by regulation. He observed that regulations tended to hold back the top half and prop up the bottom half: *"Most regulations are overly complicated as they need to fit diverse farm types... so they manage to create something that both goes over the heads of the people lagging behind but also holds back those at the front of the pack..."*. He was concerned that this restrictiveness would stifle innovation, yet the farmers who were complying with the Phosphate Management Tool in Maryland had avoided this situation and also made their businesses more resilient for the future.

Seeing the different examples of regulation during my travels has made me question why they are only introduced to mitigate bad practice. The negative connotations may be avoided if they were introduced to support good practice before the problem or deterioration occurs.

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The third mechanism that engages farmers and facilitates change is Finance. This is discussed in the following chapter.





## 6. Finance

A mechanism popular with farmers is the use of financial incentives to support particular practices on farm. Financial schemes often have environmental benefits as the key driver: for example environmental stewardship schemes in the UK. But do financial incentives win over hearts as well as wallets? Both New York and Maryland have identified innovative funding sources to fund land management and infrastructure improvements in order to achieve compliance with water quality targets. The ways in which each state has delivered these financial incentives are outlined below:

### 6.1. New York State

The drinking water of New York City is supplied from surface water abstraction. How the land above it is managed impacts on its quality so is therefore the concern of nine million people downstream. New York City and the Environmental Protection Agency signed an agreement in 1997 to reverse the declines in water quality. This landmark agreement mitigated the requirement to install a water filtration system costing \$6 billion with \$300 million a year operating costs. A far cheaper alternative, \$250million/year instead, was to invest upstream to reduce the levels of contamination arising in the catchment. For twenty years this approach has been delivered in the Delaware and Catskills receiving worldwide accolade for its success.

Work in the watershed to protect water quality takes several approaches:

The Land Acquisition Program (LAP) acquires land from willing sellers at full market value and has bought up significant swathes of the catchment for woodland reversion. There is no “cleaner” and more secure way to achieve good water quality than if the land is owned and controlled by the water company who then revert it to woodland. Alternatively, rather than sell the land in its entirety, owners can sell their “easements” or planning permission rights, at approximately 8000USD/acre. This restricts any further building or expansion of the business so that no additional nutrients and pollutants are produced on the holding. Whilst sellers can exclude the farmstead or nearby fields this reduces the easement payment significantly so is less attractive financially. These are appealing offers for the ageing farming population in New York State, but something which certainly poses challenges for the following generations of farmers when their ability to expand and diversify has been sold to the highest bidder. As well as restricting future development, LAP also diminishes the value of the property as future investors are restricted with what they can do with it.

*See photos on next page of typical small family farms in Upstate New York.*

Conservation easements, similar to Environmental Stewardship, are available to provide payment to landowners for managing land for the environment in the form of buffers and tree planting schemes rather than agricultural production, see Figure 16, two pages further on.



Figure 14: typical small family dairy farm in Upstate New York

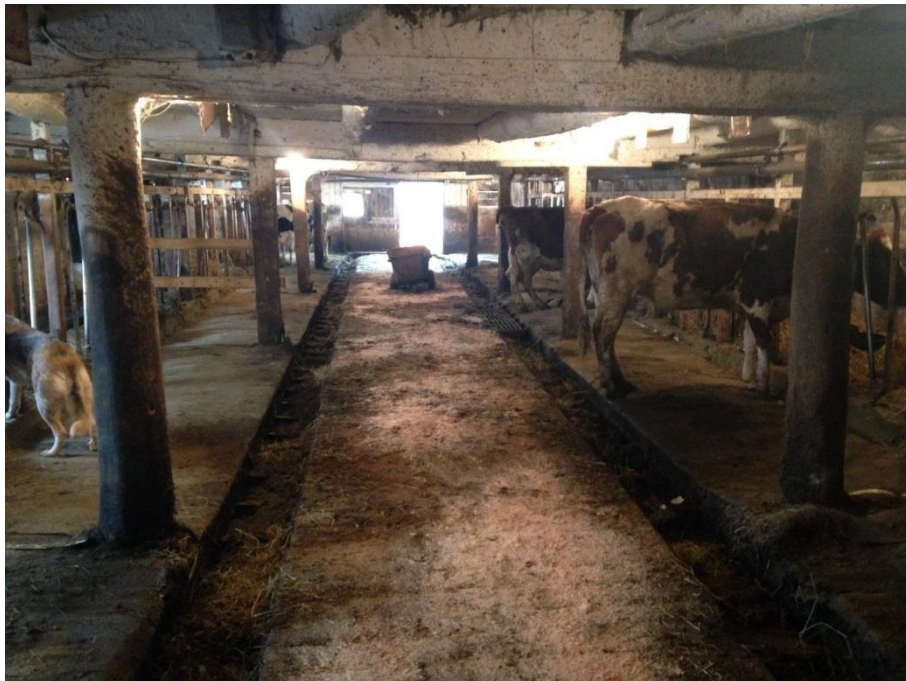


Figure 15: internal view of small family dairy unit shown in photo above



Figure 16: watercourse buffer with tree planting scheme to prevent livestock poaching on a tributary of the Delaware river

In addition to the options above, funding is available to improve infrastructure which may otherwise contribute nutrients and faecal indicator organisms to watercourses. The Watershed Agricultural Council (WAC) is a non-profit farmer-led group which was formed to input into the decision making for regulations and investment within the Delaware and Catskills catchments. WAC now administers grants to improve water quality by investing in yards, excluding livestock from streams and mitigating erosion, also known as “Best Management Practices”. It is WAC’s ambition to engage with 85% of the farmers in the catchment and get high levels of uptake of BMPs on these holdings. In addition to funding for capital work, engaged farmers can access a broad range of advice from researchers and extension officers on topics such as nutrient management planning, yard infrastructure etc.

During my time in New York State I was hosted by WAC who organised several farm visits to see first-hand how the money siphoned off rate-payers’ water bills is reinvested upstream in the catchment. Stock fencing had been erected, outdoor stock yards had been concreted and new stock housing had been built to reduce the need to outwinter. The WAC advisers were passionate about the improvements seen in the local rivers and the level of participation from landowners was high. The 100% funding rate meant that some landowners lacked ownership of the work completed, with the advisers occasionally receiving phone calls to say *“your fence has fallen down and my cattle are back in the brook...”*

In order to improve this further, more emphasis could be placed on the financial benefits that the improvements would have on the business: for example contaminated rainwater draining from concreted livestock yards could be collected to utilise their nutrient value instead of draining to a soakaway area.





Figure 17: Livestock collection yard in New York State to prevent poaching and manure runoff

The WAC advisers work hard to ensure that agreements made in Whole Farm Plans are not lost when land changes hands. This is essential to attain continuity in the long term and ensure that where investments have already been made to infrastructure the management of it continues to be appropriate. Similarly where farms have signed up to conservation easements like the USDA funded Conservation Reserve Enhancement Program (CREP), the agreement must be transferred from the previous landowner to the new, or all payments already received must be repaid in full.

The concept of eco-system services, whereby those benefitting pay for its delivery, is clearly demonstrated here and as long as New Yorkers continue to turn on their taps the funding will continue; 93% of the budget required to fund the above mechanisms arises from the rate payers of New York City.

## 6.2. Chesapeake Bay

As described during the chapter on Regulation, the Chesapeake Bay Foundation works with farmers to implement good practice to ensure improvements to the state of the Bay. Funding is received from various sources in order to support the investments required within both the sewage treatment works and on-farm:

- Maryland State has a flush fee added to urban and rural rate payers which is reinvested on improving the standard of treatment at sewage works as well as investments within the agricultural sector.
- Washington gas customers are given the option to off-set their carbon. If chosen the company then invests these funds in local habitat improvements.
- State income tax can also be allocated to the CBF.



- Residents of Maryland and Virginia can choose the Bay-themed License Plate for their vehicles at a cost of 20-25 USD, which have “Treasure the Chesapeake” or “Friend of the Chesapeake” logos:



Figure 18: Chesapeake Bay themed number plates. Source: Chesapeake Bay Foundation

Where elements of this funding is directed to farming it is normally invested in Best Management Practice schemes similar to those seen in New York State. Cover cropping, fencing and habitat improvement through planting schemes and arable reversion normally receive funding at 100% contribution rate, but will have a fifteen year agreement length to ensure maintenance by the landowner.

Where infrastructure improvements have been required in Maryland, for instance to comply with closed spreading periods, these have received funding from the State. However, there is also support via the Maryland Graziers Network for farmers who currently house stock during the winter to transition from forage to a pasture-based system. This reduces the time the stock are housed and therefore the quantity of slurry produced and requiring storage.

Maryland has been imaginative in identifying different opportunities to raise money which also results in engagement of the wider public. It has also viewed the money spent as a long-term investment which requires buy-in from the farmer or land-owner through long term management agreements.

### 6.3. Discussion

Providing financial incentives is ultimately paying landowners to manage their land in a specific way to reduce negative impacts downstream for the benefit of the wider society. However, if someone is always paid to do something then they do not realise why it is good for them to do so in a private capacity. When discussing the UKS basic payment scheme, Australian Nuffield Farming Scholar Mick Craig observed that *“British farmers are like children being told to eat their vegetables, they don’t realise why it is good for them so they’re just doing as they’re told...”* If farmers are always paid for good practice, whether these are environmental stewardship or soil management practices, when the payments stop so may the good practice.



It would be far better if as a result of adopting or maintaining sustainable farming practices, which are financially beneficial in their own right, poor soil management and water quality issues were resolved or avoided. Any payments should be a cherry on top rather than the driver, so payments are a reward rather than an incentive. Sequestering carbon in soils could be a good example of this: farmers actively building the organic matter levels and the health of their soils will be sequestering carbon too. Currently agriculture is excluded from the European Carbon Trading Scheme; however the “4 in 1000” initiative which was launched at the COP21 Climate Change talks in Paris during 2015 highlighted this flaw and seeks to change it. If a Carbon Trading System is established it should reward further those who are actively trying to replenish depleted organic matter levels and are already experiencing the benefits of:

- Potential yield increases through improved nutrient cycling and cation exchange capacity
- Improved water retention during drought
- Increased resilience during extreme rainfall events
- Less susceptibility to structure damage as soil particles and aggregates are stabilised.

The drawback of course is that in the short-term such payments would certainly reward those who have depleted their soils the most and therefore have the biggest capacity for improvement.

One of the key flaws of financial incentives is that they often come with restrictive requirements as to how the objectives should be achieved. Where specific environmental targets need to be met, farmers and landowners need to be aware how that relates to their holding and the actions or practices they could adopt to avoid damage. Where prescriptive requirements are specified those implementing them will have less ownership of any achievements and it is far less likely to result in a change of mindset. This reiterates the observation made by Sjoerd Duiker in Pennsylvania that regulations can hold back the top half; so, it seems, could financial incentives for good practice.

Another limiting factor influencing how we manage our soils is the limited ability to put £ signs where our mouths are when it comes to the benefit of good soil husbandry. Increased water holding capacity to mitigate flooding is certainly of benefit to downstream properties, but how is this benefit quantified, how could upstream management realistically be funded by downstream benefactors? The cost-benefits would be far more robust if supported by quantitative data. Measuring “soil health” certainly appeared to be a popular theme of the research projects which sought funding from the levy-boards and European funding streams in 2016. These projects may provide some of the answers so desperately sought by farmers and advisers.

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Lastly the fourth possible stimulant for farmers to re-engage with their soils is discussed overleaf.



## 7. Education and Knowledge Transfer

As a race we are suckers for a “silver bullet” that will cure our woes and make life easier in one quick motion; a paracetamol for a headache, a cross-slot drill for a soil which is suffering from decades of cultivation. Unfortunately, much to the neighbours’ satisfaction, when min-till or no-till drills are out on demo they are often being used on farms which have up to that point cultivated their soil “conventionally”. It is therefore often doomed from the outset: soil can’t be expected to go cold turkey overnight and yield the same as last year. Unfortunately many research studies into innovative and novel techniques, including those undertaken by DEFRA, often follow the same approach; and therefore conclude said techniques don’t work in Britain. This stifles how agriculture progresses. But the hundreds of farmers round the country who have been practising no-till for years disagree, as proven by the UK’s first No-Till Conference held in 2016 with over five hundred delegates in attendance.

During my Farming Scholarship I met with several organisations experienced in knowledge transfer, utilising different techniques to ensure the adoption of best practice, and the merits of each will be discussed:

### 7.1. Penn State University

As with many American universities, Penn State has an effective outreach programme with extension officers working within the local farming community as well as establishing demonstration farms. Host farmers are encouraged to get involved in trials as well as holding field days for neighbours. No subsidies were offered to local farmers to support the practices which were being promoted, for example cover crops, rather the trials sought to demonstrate their worth by the benefits they provided. PSU’s extension service is strongly of the opinion that education and engagement is always much cheaper than subsidising good practice, especially where it needs to suit all the different types of farm and business. This approach should change mind-sets not just persuade wallets as the benefits are not masked by subsidy.

### 7.2. Manitoba Grazing Clubs

Manitoba Grazing Clubs were established for groups of graziers to work together and share information on different approaches and techniques. They are proactive and innovative, engaging with leading researchers and world renowned speakers. During my time in Manitoba I was lucky enough to attend one of the Grazing Club events which was hosting Johann Zietsman, a rancher from Zimbabwe, and Jim Elizondo, a rancher from Colombia, both of whom follow biological principles with ultra-high stock density grazing. These high calibre speakers were presenting over two days with field visits for practical demonstrations too, a far cry from the hour long evening talks more commonly witnessed at UK Grassland Societies.

*See photo on next page*





Figure 19: Manitoba Grazing Club field visit during Johan Zietsman regenerative grazing course



Figure 20: Manitoba Grazing Club members learning from each other to assess biological activity of the soil

Amongst the attendees was Neil Dennis, a grazier from neighbouring Saskatchewan, who started mob grazing in 1998 and has since become a leading light for the practice. When considering the practice initially he had attended a Holistic Management course but was disbelieving of the promises

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made; his main driver for changing the practices was to prove the speaker wrong! For the next six years he tried mob grazing and found the grass species became more diverse and infiltration rates improved significantly. He had consulted local government advisers who were also sceptical of the principles to say the least. They advised him to stick with “conventional” set stocking rather than adopt mob or rotational grazing practices. The latter see high densities of cattle grazing for short periods, moved regularly to allow for recovery and regrowth before regrazing. This approach requires a significant change in mindset and the advice given to Neil was this type of grazing simply wouldn’t work. Despite this advice Neil persisted. He sought out like-minded farmers like Gene Govan in North Dakota to learn from their experiences instead. As a result of changing his grazing he is growing soil by the inch, the mob grazing technique feeds the soil with good doses of manure and treads a significant percentage of grass back in too, see Figure 21 below. This is not at the expense of the cattle; the amount of grass this approach has created has allowed Neil to increase his stocking density three fold.



Figure 21: Angus cattle at pasture on Neil Dennis’s farm

These forward-thinking grazing clubs foster change and provide a place for peer-to-peer learning. The Manitoba Grazing Clubs utilised a facilitator or co-ordinator with external funding from a local conservation organisation - Ducks Unlimited - and took advantage of funding opportunities from companies like Tucson Gas & Oil who operated locally and were keen to off-set any environmental damage their oil wells may cause. Identifying key alliances and funding opportunities has allowed the group to progress much further than it would have without facilitation.

*See another photo of Neil Dennis’s farm overleaf*

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Figure 22: Neil Dennis' ultra-high stocking grazing technique building soil by the inch compared to his neighbours' soil which is still set-stocked

### 7.3. Canadian Beef - distilling and disseminating research

Linking to researchers appears to be a useful mechanism for knowledge transfer as it ensures access to the most up-to-date knowledge and scientifically proven techniques. However, due to the technical nature of their work, researchers are not always good at communicating in simple language that can be understood by multiple levels of people. Researchers often have limited practical experience; yet it is to practical experience that farmers often relate best. Often, too, research has a vested interest due to reliance on funding and sponsorship from corporate companies. Canadian Beef, the equivalent of the UK Levy Boards, runs a programme to ensure relevant research is communicated to farmers in clear and succinct language. Studies are distilled down into two-page summaries with visual learning tools as opposed to just text. These are then disseminated to growers.

### 7.4. Soils for Life initiative, Australia

The Australian Soils for Life (SfL) initiative takes a multi-faceted approach to raising awareness of the importance of soil health. SfL benefits from a charismatic, passionate and nationally respected chairman; Major General The Honourable Michael Jeffrey, appointed by Australia's Prime Minister in 2013 as the Advocate for Soil Health. This role complements the bottom-up approach of SfL, as it campaigns from the top-down in relation to the role of soils within governmental policy, landscape implications, food security, education and impacts on wider society. General Jeffrey and SfL work tirelessly to raise awareness of the importance of soil with research bodies and educational

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institutions. These in general still focus on “conventional” practices rather than teaching progressive concepts like regenerative agriculture. The role of soil is threaded across a broader range of government departments than commonly seen elsewhere in the world; how does soil management influence the health of the nation, ravaging wildfires, flooding of residential properties, as well as the profitability and sustainability of agriculture in the face of climate change? SfL’s vision is *“enhancing the natural environment through the provision of information and education on innovative leading performance in regenerative landscape management.”* To achieve this a three phase approach has been used:

- i) **Document and demonstrate:** Farmers using “Leading” practice were identified across the country with 19 case studies produced to communicate what the approach taken was, demonstrate how it has been implemented and promote the benefits felt as a result. The case-studies were found to be more engaging when written as narratives; *‘This is what I did...’, ‘This was the result...’*.
- ii) **Inform:** Identify the barriers to uptake and wider adoption of regenerative practices, addressing where possible via improved access to support and advice. Field days were held at each of the host farms to provide opportunity to see methods in practice and facilitate peer-to-peer knowledge exchange. This provided valuable opportunities to promote good work already taking place; something which the agricultural industry is normally rather passive at. Though field days received good attendance, feedback after such events was often similar: *“Great event, but what do I do next? Where do I start?”* It was also observed that attendees tended to be from further away and very infrequently were direct neighbours. This hints at an innate competitiveness and fear of inadequacy between neighbours; people generally don’t like to feel someone else is doing a better job than they are and are unlikely to seek guidance from people they already know. Therefore phase three was developed...
- iii) **Foster and facilitate change:** Support and enable the uptake of “Leading” practices across the country. This phase was initially funded through the Sydney Rotary Club which had previously raised funds to send hay and forage to farmers hit by drought. This was a classic example of treating the symptoms rather than the cause: in line with the proverb *‘give a man a fish and you feed him for a day; teach a man to fish and you feed him for a lifetime’*. Directing funding to SfL provided the opportunity to address the land degradation which caused the lack of feed in the first place. A key element of the ‘facilitate change’ objective is delivered via a Mentoring programme currently being piloted in Western NSW. The mentoring scheme has set criteria for both mentors and participants. Pairing complementary personalities can be challenging, as can the distance between sites, especially in a country as vast as Australia. Both parties need to be committed to the process. An agreement is signed, stipulating the number of formal meetings, telephone conversations etc which should take place during the initial twelve months.

Gus Whyte from Wyndham Station in western New South Wales is one of the SfL mentors. He started to rotationally graze in 2002, in an attempt to restore grassland health after witnessing his





land deteriorate, and coming to the realisation that “you can’t keep doing the same thing and expect a different outcome”.



Figure 23: Maintaining forage supply in such an extreme climate is challenging at Gus Whyte’s farm Wyndham Station



Figure 24: Wyndham Station had far more forage during a drought period than set-stocking neighbours



For a long time after changing his approach Gus felt like he was one of very few to have made such a change. Now, via S4L and social media platforms like Twitter, the feeling of isolation has reduced dramatically; it has made it possible to find and connect with like-minded people across such a vast country as well as around the world. Surrounding himself, even if only virtually, with like-minded people provides essential reassurance and support when needed. As a SfL mentor Gus is now able to share his knowledge and experiences, speeding up the rate of change for others. He is currently assisting a “local” - which in Australian terms is normally someone within 100 miles - farmer to transition from set stocking to rotational grazing. Those participating in the mentoring process benefit from the guidance of those who have already been through the process, helping them to avoid repeating the mistakes the mentors may have made when they went through the same process alone.

The Soils for Life initiative is a world leading example of how soil can be promoted as an essential resource which benefits not only farmers but also the wider public due to the eco-system services good management can provide. Before I left SfL I again raised the question of engaging nay-sayers, and again I received a similar response: focus on those who are engaged or likely to engage and the rest will follow in time.

### 7.5. Conservation agriculture, France

APAD, France’s no-till farmer association, also works on two levels: the upper tier influences wider society and government policy where possible. At the lower tier APAD utilises advocates; farmers who are good operators and can demonstrate their approach to others in the industry. Gerard Rass, the General Secretary for APAD, acknowledges that facilitators are often needed to bring farmers together but not to tell them what to do. Farmers do not often need experts as they are already experts of their own farm and only their knowledge will make a difference to how it is managed. The facilitator role is essential during farm events and meetings as these cannot be hosted by the person who has the most to say about the subject. Chairing and facilitation must be carried out by someone who can listen, steer and draw out quieter participants.

*“Only farmers can explain the barriers to change and only those who have changed can explain how they overcame these barriers.”*

Gerard observed similar issues in France with neighbours not wishing to work together as documented by SfL in Australia, reiterating that some of the most successful farmer-to-farmer knowledge transfer has occurred when there is distance between participants to reduce feelings of direct competition. APAD has also found that farmer groups are most effective when made up of a small number of members initially as this avoids the need for management, organisation and the inevitable costs which those attract.

Near midnight in a Paris restaurant Gerard also answered my question about reaching the hard-to – engage. He too concluded that much more can be achieved with those who are interested than those who are not. But his final comment on the matter was as follows: *“Only farmers can explain the barriers to change and only those who have changed can explain how they overcame these barriers.”*

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## 7.6. Facilitation, South Africa

During the final months of my Scholarship I met with several farmers and groups in the UK to seek their opinion on my studies. During a trip to Kent to take part in the BASE UK spring farm walk I had the opportunity to discuss my studies with Hendrik Smith, a South African conservation agriculture facilitator. Hendrik's role with Grain South Africa and The Maize Trust is to work with established farmer groups and encourage them to incorporate or progress sustainable production practices within their existing systems. The key driver for this approach is the rate of soil loss, estimated at 2 tonnes of soil for every tonne of maize produced.

In South Africa the Research > Extension > Farmer flow of knowledge has not proved effective. Instead an interactive approach has been adopted with farmers as the driving force of where research should be going. Hendrik once again confirmed what several now had said before him: it was not a worthwhile use of time and resource to seek to engage the hard-to-reach, it was better to help those going in the right direction. He remarked that: *"Farming systems can only be improved where they are, and by whom they are farmed, therefore farmer empowerment is key."*

Hendrik's visit to the BASE UK group, which is already one of the leading groups in the UK for biological farming, was as a result of fellow 2015 Nuffield Scholar Andy Howard's suggestion. He had seen the merits of Hendrik's work first hand and wanted to share this with the BASE UK group; a clear example of the cascade effect, especially when combined with an effective dissemination network between those who share the same passion and enthusiasm for a topic.

## 7.7. Discussion on Chapter 7

We must consider the sources from which we learn good soil management at the various stages throughout our lives and ensure it is possible to access knowledge of "leading" practices throughout. If studying agriculture at college or university we adhere to the taught curriculum. However, in the UK there is no driving force such as the Australian Soils for Life initiative which is actively promoting for the most innovative and regenerative topics to be included in the curriculum. Parents who farm progressively are then faced with the dilemma of sending their children to university and them returning "conventionalised". Degrees now come with a significant price tag. The last thing those who have adopted new and innovative techniques themselves want is to invest in an education of old fashioned methods which focus only on artificial inputs and success measured only in tonnes.

*However, in the UK there is no driving force .... which is actively promoting for the most innovative and regenerative topics to be included in the curriculum.*

Research can put the meat on the bones for new techniques or approaches, helping to quantify cost-benefits. The interaction between researchers and farmers must be a two-way process, so that findings can be implemented and "farmer-proofed" rather than research taking place for research's sake and never being put to use. The relationship between universities and research bodies with corporate companies can be a limiting factor here. Both the US Extension system and the Canadian

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Beef distillation of research ensure that the millions invested in research reach farmers in a user-friendly format. We currently lack anything similar in the UK.

Most farmers are involved in a discussion group or agricultural society of some sort. Discussion groups, with the correct leadership and direction, can be excellent forums for bench-marking and peer-to-peer knowledge transfer as witnessed at the Manitoba Grazing Club. However discussion groups tend to be sectorial or have defined interests, so opportunities to learn from other sectors or specialisms are often stifled. Likewise it is easy for groups or societies to get lazy or indeed sentimental about celebrating traditions. It would be wonderful to see min-till competitions running alongside traditional ploughing matches, with judges choosing the winner based on how little the ground was disturbed by the chosen cultivation equipment.

Ensuring those who have already implemented “leading” practice are accessible to a wider audience improves likelihood of uptake by others. SfL have used field days and case studies led by farmers for farmers so that the language used is relatable and practical. They identified a barrier to uptake of “leading” practice and responded accordingly with the mentoring program, facilitating knowledge transfer in a peer-to-peer format. This reiterates the comments made by Gerard Rass of APAD and Hendrik Smith of Grain SA, that the role of facilitation is key in knowledge transfer but the facilitator must understand that their main objective is empowerment: empowerment of host or “leading” farmers so that they can enthuse others, and empowerment of attendees so that they have the confidence to change their practices.

SfL took the time to review their approaches and success levels to ascertain what the barriers to success or uptake were. This process is essential for all organisations and initiatives to achieve their goals in the long-term; analysing what has worked, and what hasn't worked. Then acting upon those findings, changing the approach where necessary or filling knowledge or skills gaps so that the barriers are overcome in future work.





## 8. Barriers to change

The previous chapters have given an overview of the different mechanisms which have been used to influence and achieve change in farming practices. It is my impression that no single mechanism, if implemented alone, will achieve long-term positive change. A combination of all is more likely to engage the broad range of individuals and personalities. Whilst it is obvious that farms and farmers vary greatly across the industry, I had not previously considered how this influenced their ability to change. Arable farmers often manage their businesses with spreadsheets tracking inputs vs outputs. This mechanical and technological mindset may not lend itself as easily to understanding the concept of soil health.

Traditional livestock farmers have animal husbandry skills so improving understanding of natural principles should be easier within this sector. However, no matter the farm type, one innate trait in common is the fear of failure when trying new practices. How we respond to this fear is dependent on many factors, like fight or flight. Within each of the mechanisms studied, fear, finances, education and regulation, there are likely to be barriers to uptake or limitations to success. This chapter seeks to discuss these.

The UK Demonstration Test Catchments reviewed<sup>5</sup> the differing attitudes of farmers towards adoption of measures which would reduce diffuse pollution. They concluded that farmers were more likely to make improvements to farm infrastructure than change land management practices, see Figure 25 below. This is mainly due to the fact that it was possible to quantify these improvements financially. Land management changes were more likely to be made when these also related to easily quantifiable cost-saving measures like – for example - fertiliser savings.

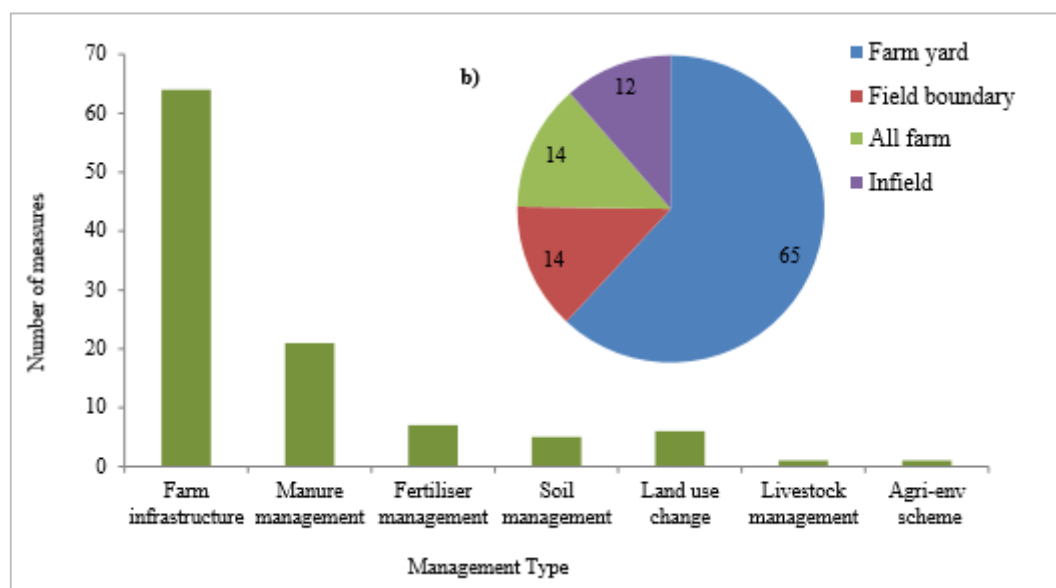


Figure 25: Popularity of measures mentioned by farmers surveyed in the Demonstration Test Catchment

<sup>5</sup> Farmer attitudes towards diffuse pollution mitigation measures in England; A Demonstration Test Catchments Report. Vrain, Lovett, Noble, Grant, Blundell, Cleasby, University of East Anglia, Farm Systems and Environment, ADAS, Eden Rivers Trust. December 2014.

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This reiterates the reliance on regulation for enabling change or, alternatively, the need for financial incentives. The case study concluded that *“the most palatable measures are those that are relatively easy to implement, attract grant, or provide economic or practical benefits to farms’ operations.”* If these latter elements are currently missing from our knowledge base when it comes to the merits of soil management, it is essential that we quantify them and communicate them clearly to persuade people rather than allow this to remain a barrier to uptake.

Dr Charlie Massy from the Australian National University studied barriers to change<sup>6</sup>; he concluded that farmers are adept at technological change but not at transformational change. He identified several key impediments to people changing practice, some of which are discussed below:

- **Tradition:** Current agricultural practices are, in the main, less than 70 years old, so what we consider and often revere as ‘traditional practices’ in fact only span a couple of generations. In contrast, organic approaches to farming are thousands of years old so should these principles in fact be the ones considered as ‘traditional’?
- **Family/neighbour/social pressure:** As observed by Soils for Life and several other initiatives which utilise on-farm events or demonstration sites, there tends to be a competitive or secretive nature between neighbours which deters sharing of knowledge or experience between neighbouring properties. Family can reassure and provide a valuable support system during challenging times.
- **The farmer’s own personality** and adherence to comfort zone: Character and personalities can range from outspoken entrepreneurs who are happiest leading the way, to more reserved, risk-averse individuals who prefer to follow. The role of facilitator often is simply identifying these key traits and then ensuring the learning mechanism most suited to them is accessible.
- **Level of formal education:** Rather than “level” it may be more appropriate to consider this as “quality” of education, given the lack of ambition of many university syllabuses currently. Dr Massy does however link this to many individuals being hooked on technology but lacking in basic agricultural knowledge and skills.
- **Loss of objective and publicly-funded extension services:** A huge majority of the research relating to farming never reaches farmers due to a lack of extension services. Further to this, the involvement of corporate companies in funding research tends to reduce its objectivity.
- **‘Knowledge is power’ nexus:** This concept suggests that each is mutually supportive of the other; therefore without knowledge one cannot have power. Dependence on the agricultural support industry for advice rather than expanding upon your own knowledge is self-limiting, especially when said advice often comes with vested interests. We are regularly exposed to opinion in the agricultural press and of course take advice from our agronomist/adviser. But if inputs like fertiliser and sprays have become agriculture’s biggest

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<sup>6</sup> Transforming The Earth: A study in the change of agricultural mindscapes. Charles Massy, 2013.  
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dependency, we must ensure that those advising us are independent of influence and sales commission.



Figure 26: Fertiliser at the Saskatchewan's south west Inland Terminal

These barriers will not be applicable to every individual or scenario. However, once overcome, Massy found that approximately 40% who made a significant change had developed a need for more knowledge and wished to progress further. If networks can be established and utilised these leading individuals can develop a community of change with their own attitudes and language. This reiterates Gerrard Rass's observation that only those who have changed can explain how they overcame their barriers. If shared, this will provide valuable learning for those who are following suit.



As mentioned above, personality types influence our openness to change. Massy concluded that there were four key groups in the transformational process. These are explained in Figure 27 below.

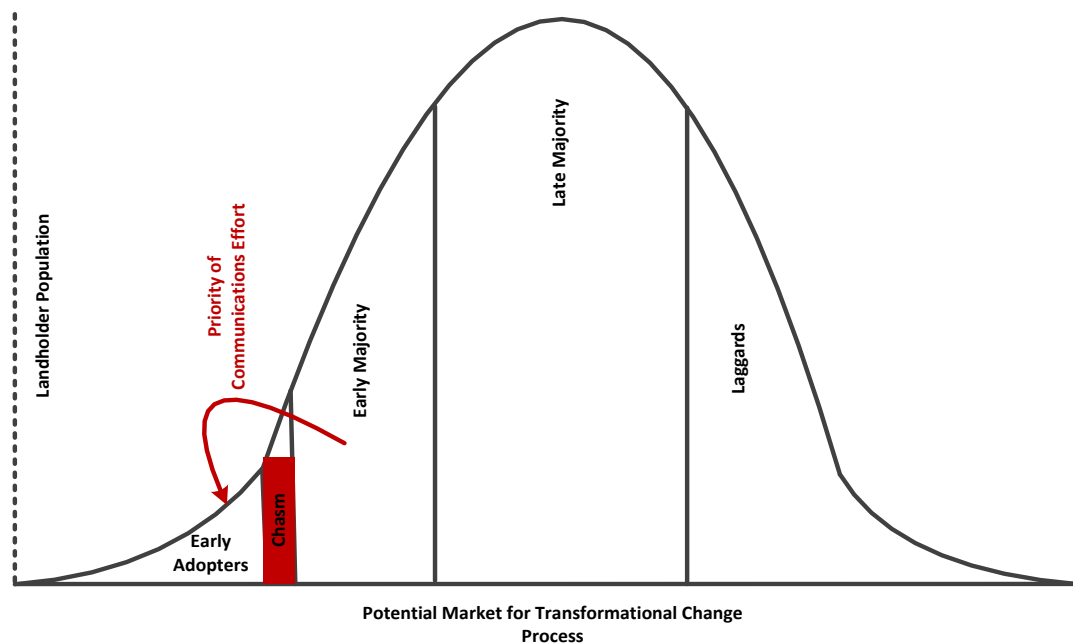


Figure 27: Diagram categorising the different audiences by likeliness to change, Charlie Massy 2013

This diagram was also used to inform where resources should be focussed when the majority of individuals fall into the category of Late Majority or Laggards. Throughout my travels I have asked the question: “How do we engage the hard-to-reach?” The resounding consensus was that focus should be placed on those who are willing to change. In knowledge transfer and educational approaches much resource can be wasted chasing the 20% who don’t willingly engage when much more can be achieved with the 80% who do. If those classed as early-adopters are those who have already successfully changed, Dr Massy identifies a chasm between them and those who have not. Ensuring the early majority are aware of the early-adopters and have access to their experience will be important to bridge said chasm.

*In knowledge transfer and educational approaches much resource can be wasted chasing the 20% who don’t willingly engage, when much more can be achieved with the 80% who do.*

For those wishing to proactively seek change themselves it is a useful process to consider your own personality type, strengths, and weaknesses; and then identify the preferred avenues for learning new techniques. Prochaska & DiClemente created the Transtheoretical Cycle of Change in 1983, see Figure 28 on next page, which explains that all people move through a series of stages when attempting to change behaviour. Some may take more time to pass from stage to stage but the overall upward cycle does not alter despite relapses occurring.

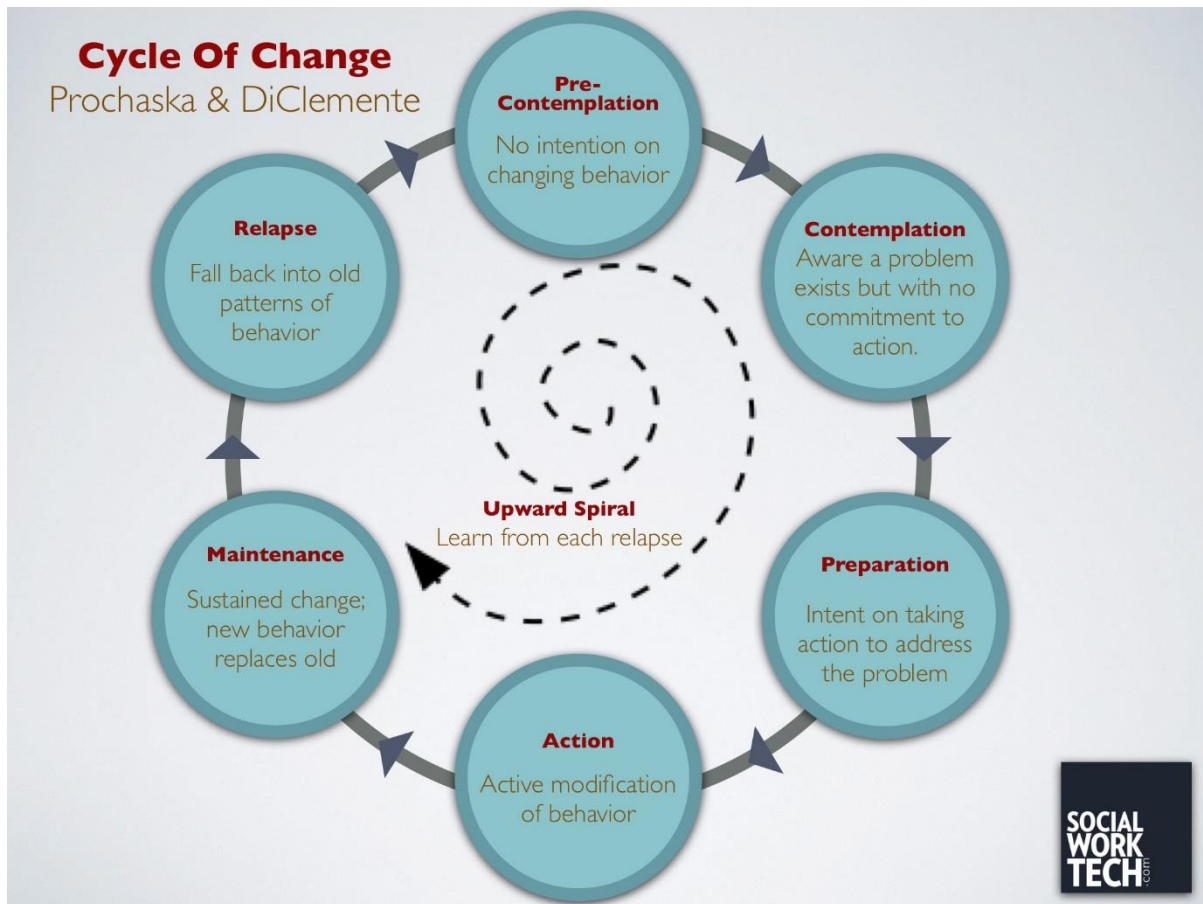


Figure 28: Diagram categorising the different audiences by likeliness to change, Charlie Massy 2013

### 8.1. Discussion on Chapter 8

In relation to the mechanisms studied in this report which can be implemented to instigate change I would incorporate Dr Massy's suggestion for segmenting the audience into a tiered system of engagement, see Figure 29 on next page. This approach assumes that the regulation focuses its resources primarily on the laggards and late majority who are less easily persuaded to change. Knowledge transfer and educational techniques would be targeted at the early majority primarily plus any of the late majority who are progressing as a result of regulatory influence.

Financial rewards will be felt by those who have achieved change of practice, especially where related to improved soil health. Beyond this, schemes with financial rewards for certain management practices, for example carbon sequestration, could be used to help the early majority bridge the financial gap between changing practice to improve soil health and feeling the financial benefits of healthy soils.

See figure 29 on next page

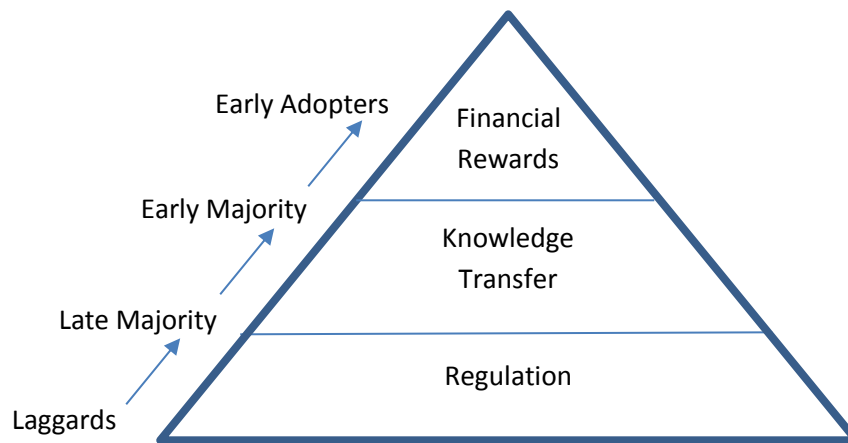


Figure 29: Diagram of engagement mechanism by segmented audience type

When considering the Prochaska & DiClemente 'Cycle of Change' and Dr Massy's study alongside each other it would suggest that mechanisms will be required to:

- Progress "Laggards" from the Pre-Contemplation stage
- Support the "late" and "early majority" from a stage of Contemplation to Preparation and Action.
- Support and facilitate Maintenance of the early-adopters

Each of these steps would benefit from facilitation and support especially where Relapse occurs; and also to ascertain the point at which each individual is entering the cycle and ensuring there are opportunities for them to progress to the next stage.

Dr Massy also suggests that rather than relying only on facilitation, change can also be serendipitous. If an opportunity arises to attend events or meet peers who may assist you in your journey it is important to have the courage to take advantage of it. We have to be prepared to accept that soil health is not an exact science due to the complex interactions between biology and the number of variables which influences them. There is no magic bullet, practice or piece of equipment which will solve the problem. Mind-set is important; visualising where you want to be at the end of the process will help to measure progress and success. The language we use also affects how we look at things; words like trash and litter are used to describe straw and plant material when in fact they are protecting the soil surface from the impact of rainfall and providing valuable feed for soil biology. Tasks which are essential in maintaining soil health certainly should not have such negative connotations.

*We have to be prepared to accept that soil health is not an exact science due to the complex interactions between biology and the number of variables which influences them.*

During a public talk at the Hay Festival in 2016 I heard Charles Tudge state that: "*change cannot be achieved by incremental steps, it needs a revolution or a renaissance*". This thought process is at odds with the experiences of the Lake Brunner farmers where for many a gradual acceptance of

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change occurred over time as new regulations were consulted upon and then introduced. The two chosen methods described by Tudge vary greatly; a revolution has negative connotations with change forced by dispute, whereas a renaissance is a more positive change of great revival. In my opinion groups such as BASE UK and events such as the Groundswell No-Till Show are certainly demonstrating the latter. These forums provide valuable opportunities for like-minded individuals to meet and often provide a sense of solidarity. Establishing such support systems are key to ensure individuals contemplating or attempting to adopt different practices do not feel isolated, as experienced by Gus Whyte at Wyndham Station. Alliance with innovative groups can provide reassurance as well as opportunities to progress further, and motivation when otherwise relapse may occur.





## 9. Conclusions

1. No single mechanism if implemented alone will reinvigorate interest in soil health. A combination of regulation, knowledge transfer and financial rewards is more likely to engage the broad range of farm type and farmer personalities.
2. Regulation must be enforced so that it can be relied upon to address poor practice which impacts negatively on the environment. Its presence can encourage the adoption of innovative solutions which result in more resilient businesses.
3. Financial incentives may engage an audience but it can also create a mind-set of only following good practice if you are paid for it. Instead financial benefits should reward, or be a happy consequence of, good practice.
4. The role of facilitation is essential for effective knowledge transfer and farmer empowerment. Promotion of “leading” practice through discussion groups, peer-to-peer, on farm events, and short videos will enhance the cascade of enthusiasm from early adopters.
5. Only those who have changed can explain how they overcame the barriers. Much resource can be wasted chasing the 20% who don’t willingly engage when much more can be achieved with the 80% who do. Resources and effort should be prioritised accordingly.



## 10a. Recommendations for re-engaging farmers with their soil

1. Research should focus on quantifying the benefits of healthy soils in order to equip those who engage with farmers with the tools to win over hearts, minds and wallets. This will also inform the wider landscape and societal benefits that agriculture provides and may identify innovative funding streams, for example ecosystem services. Researchers must utilise existing networks to disseminate relevant findings.
2. Legislators must proactively engage and consult the agricultural community over new regulations, especially the drivers and consequences in relation to their own business. The agricultural community must not shy away from taking ownership of the issues the regulations seek to address and ensure credit is given for improvements made.
3. The UK needs an independent Soil Health initiative and National Advocate for Soil Health to:
  - a. Promote the benefits of a range of approaches rather than segment itself under one, e.g. holistic or organic, to ensure it can engage a broad audience.
  - b. Thread soil health principles across multiple streams of governmental policy rather than just agriculture.
  - c. Distil and disseminate relevant research in a user-friendly accessible format.
  - d. Engage the wider public over the importance of soil and its associated health benefits to ensure long term behaviour change of consumer habits and improve understanding of our farming systems.
4. Those in charge of initiatives proactively engaging with farmers should develop their role as a Facilitator rather than considering themselves to be an Educator. Empowerment of leading/host farmers will allow for the cascade of enthusiasm to occur with ideas and practices shared peer to peer.

*See overleaf for Recommendations for farmers wishing to re-engage with their soil*



## 10b. Recommendations for farmers wishing to re-engage with their soil

1. *“As to methods there may be a million, but principles are few. The man who grasps the principles can successfully select his methods...”* This quote from Ralph Waldo Emerson must be considered when addressing soil health issues. There is no ‘magic bullet’ product or practice that will cure degraded soils. Once the cause and effect of said degradation is understood methods can be chosen to correct it.
2. Be mindful of what your personal barriers to change are so that if they are restricting progress you will be able to identify this and rectify it.
3. Change does not occur over the short term and support during the process is essential. Involving family and/or friends in the process establishes a valuable support network.
4. Sir Isaac Newton used the phrase *“Standing on the shoulders of giants...”* and this is recommended for those adopting new techniques. Learn from those who have already implemented them successfully; involvement with innovative groups and taking advantage of key alliance opportunities can ensure the transition is less challenging.
5. Think of soils as a bank account; whatever we take out with cultivations and cropping we need to replenish with grazing, manures, chopping straw, cover crops. Understand the cost-benefits of good soil health so that funding opportunities are a consequence not a driver of change.



## 11. After my study tour

The lessons learnt during my study are already being put to good use in Herefordshire. We currently face challenges due to the levels of phosphate impacting on the health of our rivers, which are European-designated sites for the rare aquatic animals and plants which inhabit them. These designations bring with them standards to ensure the habitats are protected, including phosphate limits.

The River Lugg, the main tributary of the Wye, is currently in breach of said phosphate limit. The Wye pushes dangerously close to the limit, but is not yet in breach. While not to the same severity as the Chesapeake Bay, the River Wye nevertheless suffers from algal blooms most summers due to eutrophication. Breaching the P limit has county-wide ramifications as it puts Herefordshire's Core Strategy at risk; the county needs more housing to support a growing population and economy, but more housing means more sewage and more sewage means more phosphate. To address the issue a Nutrient Management Plan was composed by the Environment Agency and Natural England for the Wye catchment. This included apportionment modelling to identify which sectors were contributing phosphate, and proposed several actions to assist in reducing the levels whilst accommodating future growth.

The apportionment studies attributed the main contribution of phosphate to sewage treatment works and agriculture in almost equal proportions. Each sector is expected to reduce their contributions proportionately. Welsh Water will be investing in additional treatment to strip phosphate from their final effluents which are discharged under a permit to local watercourses. These improvements will be costly to the company. Agricultural sources of phosphate are far more diffuse: drainage from dirty yards, livestock in watercourses and, of course, soil loss. Reducing these losses should equate to savings for the business as soils will be healthier and nutrients better utilised resulting in improved profitability and sustainability for each farm.

"Agriculture" in Herefordshire relates to approximately 2200 farmers, who initially have the opportunity to reduce losses through voluntary measures. A meeting was convened of the various organisations and initiatives already working with farmers and land-owners: ourselves at the Wye & Usk Foundation, Herefordshire Rural Hub, the Campaign for the Farmed Environment, Catchment Sensitive Farming, the CLA and NFU - to name but a few. It was agreed that we would need consistent messages and to work together to try and raise awareness of the issue throughout the county.

The first task was to host a supper; invited were local farmers and agronomists already engaging with good soil management. We canvassed this group for opinion on whether farmers were aware of the phosphate issue in the local rivers and streams; the consequences of not meeting the required standards; whether the farming community needed to know about the issue; and how best to communicate it with them if they did. Their steer was clear; the farming community needed to be aware of the issue, how it related to their farm and their county. The messages needed to be clear and implementable, that could be disseminated via existing networks and discussions groups - of which there is a plethora in the county.

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It was decided to name the initiative “Farm Herefordshire” under which all the partners shared the objective of promoting good practice to reduce phosphate losses. And into the breach we went! We engaged with and held joint events with 32 discussion groups, ploughing societies, agronomists, levy boards and seed companies. I have also produced several short videos promoting the approaches of several local farmers who are already proactively working to improve their soil health and reduce their impact on the environment ([www.wyecatchment.org/farm-herefordshire](http://www.wyecatchment.org/farm-herefordshire)). Ensuring the messages we promote are clear, concise, practical and accessible to all was the approach Soils for Life took, and one which I have tried to replicate with these videos. It also follows the guidance provided by Hendrik Smith and Gerard Rass that actually farmers are more likely to learn from, and be persuaded by, other farmers. The key role in this is facilitation to ensure that situations arise when this can take place.

My study has provided invaluable guidance on the range of mechanisms which could be implemented to address the phosphate issue locally and how soil health should be integrated within UK agriculture. Regulation, knowledge transfer and financial rewards are equally important to establish in the county if we are to transform the way in which we manage our soils. The biggest learning point has been considering the psychological barriers to change. Improving my understanding of this has then influenced the way in which I communicate and how to adapt my approach to suit the needs of the individual.

A year on in June 2016 we held a second supper with the same group. We gave feedback on our progress and once again asked for a steer from the group; the resounding response received was that the awareness-raising and advisory approach was being well received but it needed to be backed up with regulatory pressure when bad practice or incidents occurred. This to date had been lacking in their eyes. These comments reiterated the conclusions I made in relation to the importance of regulation for engaging the “laggards” and in this instance being appreciated by certain members of the agricultural community as providing clear boundaries of right and wrong between which to operate without negatively impacting on the environment. As we progress, if improvements are not seen with voluntary measures, then further regulatory pressure could be applied in the form of a Water Protection Zone, the highest form of regulation currently available in the UK.

In the short term the Brexit referendum may make addressing the quantities of phosphate and soil lost to the rivers more challenging as new agricultural and environmental policies are composed. Funding streams and uptake of Environmental Stewardship are likely to reduce. European Directives which protect designated sites are introduced into UK law in order to be enforced, so departing from the European Union does not necessarily mean that we no longer need to protect these habitats, just that we no longer face EU fines if we don’t. Rightly or wrongly Brexit provides us with an opportunity to form our own agricultural and environmental legislation and it will be interesting to see how this unfolds in Westminster.





## 12. Executive Summary

Throughout human history there are examples of entire civilisations which have crumbled as a result of their soil management; yet we appear doomed to repeat these mistakes century after century. If our only interaction with soil is from the comfy seat of a tractor rather than with our hands and a spade it is no wonder we don't notice how it is changing over time and when damage is being done. The year I was awarded my Nuffield Farming Scholarship was the FAO's International Year of Soils: raising the profile of soils as not only a growing medium for the food we eat but as a crucial tool in mitigating climate change. Meanwhile the media was plagued with negative press exposing the industry's perceived shortcomings of *"2 million tonnes of top soil degraded in the UK each year"* and *"only 100 harvests left"*.

The aim of my study was to understand which mechanisms are most effective for achieving change within agriculture. I visited organisations and initiatives in the United States, Canada, Australia, New Zealand and France which have utilised a range of regulatory mechanisms, knowledge transfer techniques and financial incentives. I also engaged with farmers who had been involved with these initiatives to understand the strengths and weaknesses of each approach. Understanding what the barriers to change were and how these initiatives had overcome these barriers was a key learning point. Would it be possible to utilise any of these mechanisms to reinvigorate interest in soil health in the UK?

I concluded that no single mechanism, if implemented alone, would achieve long-term positive change. A combination of regulation, knowledge transfer and financial rewards is more likely to engage the broad range of farm type and farmer personalities. Where regulation is to be introduced an interactive consultation process with the target audience can improve understanding and ownership of the issue that the regulation seeks to address. Regulation can encourage the adoption of innovative solutions which result in more resilient businesses. Financial support schemes should reward or be a happy consequence of good practice. When incentives are used it often results in a mindset of only carrying out good practice when one is being paid to do so, winning over wallets but not hearts and minds.

Personnel working for initiatives proactively engaging with farmers should develop their role as a Facilitator rather than considering themselves to be an Educator. Empowerment of leading/host farmers will allow for the cascade of enthusiasm to occur with ideas and practices shared peer-to-peer. Resources and effort should be focused on assisting those most likely to change practice rather than chasing the hard-to-reach. Only those who have changed can explain how they overcame the barriers.



## 13. Acknowledgements and Thanks

First and foremost I would like to thank the Three Counties Agricultural Society and the Nuffield Farming Scholarships Trust without whom this life-changing opportunity would not have been possible.

I would like to thank my husband John for enduring the hours of stories from my travels, and my family for listening when John wasn't available to!

Thanks go to my colleagues at the Wye & Usk Foundation, your support and enthusiasm have been invaluable along the way and I look forward to putting more of my learning in to practice with you.

The generosity of the people who met with me and gave up hours and even days of their time during my travels has been truly humbling.

Name	Company	Country:
Heather Magnan	Watershed Agricultural Council	USA
Larry Hulle	Watershed Agricultural Council	
Brian Latourette	Watershed Agricultural Council	
Joe Eisele	Andes, New York	
Joe & Jackie Evans	Andes, New York	
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Sonia Rama	Lucky Dog Organics Hub	
Dave & Merry Rama	The Cattle Exchange	
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Jim Shortle	Penn State University	
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Gary Zimmer	Mid-Western Bio Ag	
Dan Johannes	Chesapeake Bay Foundation	
Doug Myers	Chesapeake Bay Foundation	
Michael Heller	Claggett Farm	
Veronica & Dana		
Sean Jones	Jones Family Farm	
Jason Lambertson	Millenium Farms	
Neil Dennis	Sunnybrae	Canada
Johann Zietsman	Sustainable Grazing Course	
Blain Hjertaas	Holistic Educator	
Jim Elizondo	Sustainable Grazing Course	
Michael Thiele	Manitoba Grazing Club	
Dr Christine Jones	Australian Soil Expert	
Ron & Linda Catt	Back to Your Roots, Soil Solutions	
Kelvin & Shelley Meadows	MaxCor Ventures Inc	
Brett & Rana Mienertt	Saskatchewan Soil Conservation Association	
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