A Nuffield Farming Scholarships Trust Report

Award sponsored by

AHDB Beef and Lamb

Sustainable grazing strategies that meet ecological demands

Geraint Powell

July 2018

NUFFIELD UK

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A Nuffield (UK) Farming Scholarships Trust Report

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

Date of report: July 2018

Title	Sustainable grazing strategies that meet ecological demands
Scholar	Geraint Powell
Sponsor	AHDB Beef and Lamb
Objectives of Study Tour	To discover where a healthy balance can be struck between the natural environment and agricultural productivity To study the role of grazing animals in maintaining and enhancing the ecosystem function
Countries Visited	USA, Netherlands, France, Germany UK, Ireland
Messages	A better understanding of the laws that govern nature and embracing the benefits of soil health and diversity will result in greater resilience Policy driven prescription of the "what" is completely ineffective if the "why" is not understood Resources need to be evaluated and allocated effectively to ensure growth is regenerative The most profitable place to keep a cow is where nature thrives

EXECUTIVE SUMMARY

I liken the modern livestock farm to a camel being ridden across a desert. It's tough in that desert but, when the camel drops, the farmer knows there is a fix he can just about afford, to get the camel up and moving again. At the end of the season the camel and the farmer are in pretty bad shape, the residents of the desert are not happy with the farmer's treatment of the camel or the impact it's had on the desert. The farmer is paid just enough to keep him interested in doing it all over again.

Farmers are governed by the volatility of commodity prices, costs are escalating, productivity is stalling, and we are spending more on vaccines and treatments as diseases become more prevalent. All the while we are chasing numbers harder to, at best, break even, with most livestock businesses only making profit if support payments are factored in. We are farming by "satnav", getting to a destination by following instructions without having understood the route, or questioned if it is the best route.

This became the aim of my study. We need to recalculate, find a better route, the challenge being:-

"How do we strike a healthy balance between economy and ecology?"

I travelled and met pioneers of regenerative farming practices who had become observers and students of the ecosystem processes. They mimicked nature to produce an optimum, without outperforming or compromising the ecosystem services that underpin our wellbeing and the production of most of our living needs.

These farmers are profit-orientated, allocating resources on regenerative principles and recognising the importance of the complex relationship between the sun, the soil, the plant and the animal. Over time they have become masters in harvesting sunlight to enhance animal health, performance and profitability.

This route takes more thought and planning and a different approach to how things are done. The balance between ecology and economy has to be reached. Farmers cannot keep giving our money away and watch our natural resources degrade. Knowledge gained through on-farm ecological monitoring and better awareness of ecosystem function will improve productivity and can also be the vehicle for positive communication between producer and consumer.

Change is not chosen voluntarily; it usually happens through disruption or is forced upon us. Disruption is coming our way in the form of Brexit. Trade relations and support payment mechanisms are likely to change. We need to build resilience into our current systems to ensure future viability of our livestock sector. Resilience is built by advancing the natural resources of soil health and diversity, and allocating all other resources in a regenerative way.

The UK, with its forgiving climate for growing green plants, stable politics, and a huge population to feed, has great potential to become world leader in regenerative agriculture.

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DISCLAIMER

The opinions expressed in this report are my own and not necessarily those of the Nuffield Farming Scholarships Trust, or of my sponsor, or of any other sponsoring body.

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1. Personal Introduction

I was brought up on a beef and sheep farm near Brecon in Mid Wales where my parents still farm today. I have been involved in livestock farming all my life and at the time of writing this I am 45 years old.

After finishing my studies in Aberystwyth I travelled to New Zealand and on my return moved to the Tamar Valley to take up the shepherd's role on a mixed estate.

Figure 1: The author, Geraint Powell

I arrived in the Cotswolds in December 1999, at first working as livestock foreman on a large mixed estate. In 2004, after being approached by Toby Baxter, a local contractor and sheep farmer, to have a chat about opportunities he had coming his way, I became a self-employed shepherd and fencing contractor. Fourteen years later this has grown to lambing 4000 ewes and calving 50 cows alongside 1700ha of arable land. I describe us as permanent squatters on other people's land: nothing owned, all rented.

At the core of the overall business there is strong focus of soil health, animal integration and diverse rotations

I live in the small market town of Northleach with my much-better-other-half Sam and daughter Chloe.

I am extremely grateful to my sponsors AHDB Beef and Lamb for giving me the opportunity to step back from my current duties to travel and study, with the aim of giving back to the industry that has given so much to me.

"It is wiser to find out than to suppose". Mark Twain

2. Background to my study

Go no further if you are hoping to read a scientific study based on "scientifically proven data" (whatever that means), citations or endless lists of references. I make no apologies for writing anecdotally and subjectively. I chose to go out in the world to find farmers who were successful in an environment where others around them were not. True innovation is conceived in the fringes by individuals who are forced by disruptions outside their control to find another way - a better way. These are the people I believe we can learn the most from …. the self-confessed lunatics in their area.

I am no scientist, academic, ecologist nor economist: I am a farmer. This report is a personal reflection on what I found out in trying to answer some of the questions I have been asking myself and the industry. I hope it makes you, the reader, question and I hope you gain something positive from reading it.

True innovation is conceived in the fringes by individuals who are forced by disruptions outside their control to find another way - a better way.

I studied and researched pastoral systems that are addressing sustainability in different parts of the world, and even though the climatic, social and political situations might be hugely contrasting from ours, the endeavours of all farmers are the same - produce high quality food and fibre that is affordable for the consumer, profitable for the producer and ecologically resilient.

Can it be done? How can it be done? What is being done? Where is it being done?

I am strong believer in that, if the fundamentals of a system can be replicated, then the detail can be made to fit the constraints of the new framework. Farmers are very good at working out the "how".

Sustainability can mean many things but, foremost, sustainability has to mean profitability for the producer. I enjoy working and living in the countryside but can only do this if it is financially viable.

At the time of choosing the study title topic it seemed the word "sustainable" would suffice as a target for production techniques. A sustainable system has to be resilient, mindful of its consumer, adaptable, sympathetic to its environment and not exploit its resources.

A sustainable system has to be resilient, mindful of its consumer, adaptable, sympathetic to its environment and not exploit its resources.

I quickly realised that "sustainable" is not enough. To make real step changes for future resilience in UK agriculture we need to ***correct*** and ***improve*** our land resource with regenerative principles.

It got me thinking about myself and my reason for applying for a Nuffield Farming Scholarship. I felt like I needed a new challenge and, with various aches and pains developing, realised the body wasn't

going to last forever so it was a good time to find a new direction and try to answer the questions that I had been asking of myself, policy writers, and the wider industry, and see where that led.

I needed to regenerate myself, to get out of the mine and see what was going on at the surface.

After careful thought I realised that to give the Nuffield Farming Scholarship the time it deserved, I would have to take a step back; providing just a supporting role at work, let the younger generation experience the highs and lows, and give myself the time to concentrate on the next challenge.

*I quickly realised that "sustainable" is not enough. To make real step changes for future resilience in UK agriculture we need to **correct** and **improve** our land resource with regenerative principles.*

Back to the title: is it "Sustainable" strategies or "Regenerative" strategies that are needed to meet ecological demands?

At this point I realised the magnitude of the task I had set myself and contemplated changing my title to "Solving the conflict between science and religion"!

3. My Nuffield Farming travels

Where/When	Reason
USA September 2017 - 4 weeks	**Meet and learn from some of the world's leading practitioners of regenerative farming techniques** Attend North Dakota State University Extension Service. *Integrating Crops and Livestock Training (3 Days)* Attend South Dakota Grassland Coalition *Range Management Grazing School (3 days)* Attend *Grassfed Exchange Conference (3 days)*
Netherlands November 2017 – 1 week	**The small country that thinks big. High levels of productivity on limited land resources. What are the pitfalls?**
East Germany March 2018 – 1 week	**Jena Biodiversity Experiment.** Longest running grassland diversity experiment in Europe.
Ireland April 2018 – 1 week	**Similar climate to ours. The land of grass and a rapidly increasing dairy herd.** Attend Smart Farming seminar (1 day)
France May 2018 – 1 week	**Experience the culture of the produce and the tradition of the farming systems**
UK January 2018 February 2018 June 2018 June 2018	Attend Stewarding your soils workshop (1 day) Attend Niels Corfield: Regenerative design for small farms workshop (2 days) Attend Holistic Management Course run by 3LM. (Intensive 9 day training) Attend Groundswell No Till Show and Conference (2 days)

4. The Issue

I work in a business that claims no support payments and pays a rent for the land. Profit is won or lost through output - with no income from subsidy - and as a result is hugely susceptible to volatility in commodity prices and input costs. It's marginal, very marginal, even at scale with strict cost control, and with great people involved who are always prepared to go that little bit further to make things work.

What is the main cause of this precarious position? Is it the inevitable race-to-the-bottom globally of commodity values and food prices; or are we trying to outperform the ecosystem processes that govern our natural environment, both of which are leading to escalating costs and increasing stresses on the humans and animals involved? It is a fair comment to assume both reasons are highly connected. I wanted to dig a little deeper.

Where can we strike that healthy balance between the business model and the natural environment?

It's what is being asked of us more and more by a vociferous yet extremely hypocritical society which demands one thing, then purchases something completely different. We are stuck in a position where we are governed by price yet we are being vilified and demonised by social narratives of discontent in regard to the management of our livestock, crops and landscape.

The answers to this might be too far reaching for my little brain and one single Nuffield Farming study, but another direction is definitely needed. This became the aim of my study. The slope we are on is getting far too slippery. Regenerative agriculture is making the right noises, I needed to investigate further.

Figure 2: The Author lecturing students at Chadron State College, Chadron, Nebraska.

5. Regenerative Agriculture

Regeneration International (*www.regenerationinternational.org)* defines regenerative agriculture as "farming and grazing practices that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity; resulting in both carbon draw-down from the atmosphere and improving the water cycle".

I spent a month travelling the Mid West of the United States with the aim of meeting and learning from some of the best regenerative ranchers and farmers on the planet. I wanted to know why they had taken this leap of faith, what they are doing, and what are the results. I had watched countless YouTube videos into the small hours produced by these "high priests" of the Regenerative movement. I wanted to know how their successes could be relevant to me and our industry at home. The first one I met is probably the most famous: Gabe Brown, the high priest of Regenerative Agriculture.

5a. Case Study 1: Gabe Brown, Nourished by Nature, Brown's Ranch, North Dakota

Case Study 1: Gabe Brown, Nourished by Nature, Brown's Ranch, North Dakota
While in North Dakota I was lucky to be invited by the North Dakota State University extension service to Brown's Ranch. Gabe Brown is one of the world's pioneering Regenerative farmers and speakers.

Gabe's path to his current day practices was not through choice or a desire to save the planet. It was down to lack of money and the real threat of losing his farm. He was a conventional crop and cattle farmer and several consecutive years of extreme climatic events (drought and hail) had left him with no crops to harvest, no crop insurance and no money in the bank to pay for inputs. He was forced to make radical changes or go bankrupt.

Inputs cost money and he had no money, so he experimented with ways to mimic nature to grow his crops and raise his cattle. In the 25 years since this disruption to his business he has become the master of recruiting biological processes and harvesting sunlight to fuel them.

Nature's way of farming:

- No mechanical disturbance of the soil
- No bare soil
- Cycles water effectively
- Living plant-root networks
- Nutrient cycling via biology
- Nature benefits from thousands of years of research and development

(continued on next page)

Gabe explained that the soil is the most important resource on the farm. The amount of carbon built in the soil is the direct indicator of its health and continued fertility. Gabe believes there is a strong correlation between carbon content of the soil and farm profitability. He now uses no artificial fertilisers, pesticides or fungicides, and very little herbicide. Yields might not quite be the highest in the county but he definitely has the most profitable crops and cattle.

> ***"There is no point in sustaining a degraded resource. You have to regenerate it," said Gabe***

Gabe spoke about the declining nutrient density in the modern diet of the US population over the last 50 years, and how they now spend more on health care than food. But they still have some of the highest incidences of chronic illnesses in the world. With regenerative principles crops and animals can be grown naturally on healthy soils with higher nutrient density - can food become medicine?

He referred to his farming methods as an art not a science. Observing and monitoring were the key to future success and not recommendations of synthetic inputs. If he was an artist and his farm was his canvas he was painting quite a masterpiece!

Figure 2: Gabe Brown demonstrating different soil qualities

(continued overleaf)

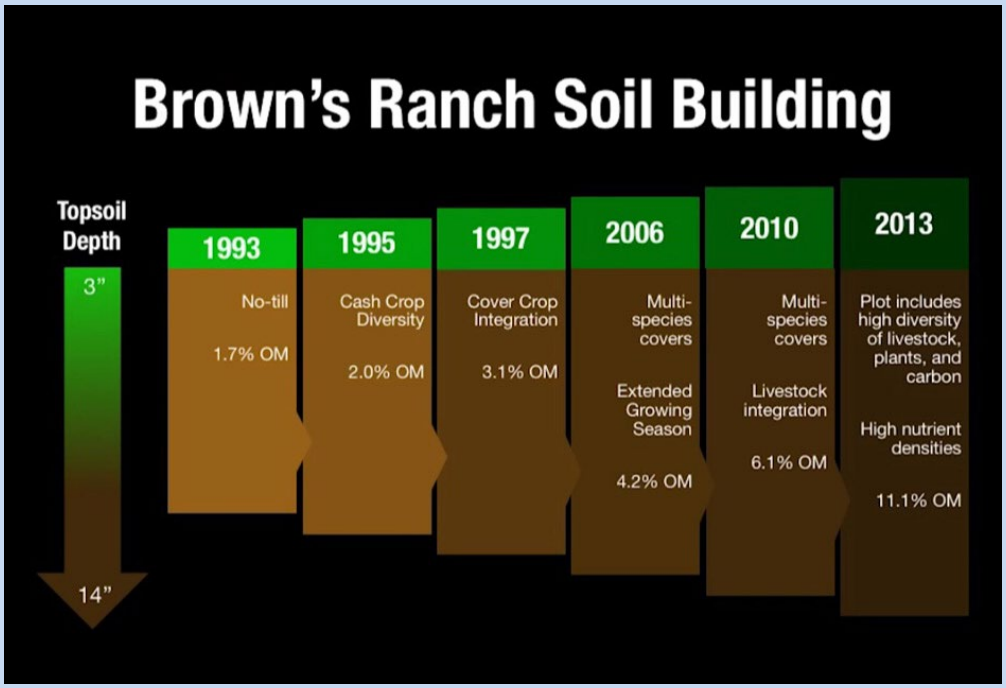

Figure 3: The journey to soil health, Browns Ranch (source: Gabe Brown)

5b. Section Conclusions

- **Success is measured in profit not yield**
- **Diversity is key to ecosystem resilience**
- **Learn *from* nature not *about* nature**
- **Farmers have a great opportunity to contribute to the public health challenge**
- **YouTube is a great tool for education. Many pioneering farmers have made videos to share their successes for other farmers to aspire to. They also show their failures, so we won't make the same mistakes**
- **Gabe has added to his own financial gain by direct selling but his methods of production are still very profitable at commodity prices**

6. Paradigm shift

A paradigm shift is a situation where the usual and accepted way of thinking of how something is done changes completely. Sounds pretty scary to most of us, as we all cope with change in different ways. The successful farmers I met around the world had a powerful capacity to deal with disruption and stress in both their farms and themselves. This is partly due to the resilience they have built into their natural farming systems by advancing their resources, but also how they deal with disruption as individuals.

What Gabe had done was very inspiring and made a huge amount of sense to me personally and for the relevance of my study. Gabe had experienced a pivotal moment which made him question science, tradition and the certainty of modern advice.

As I reflected on what I had learnt from Gabe I realised my study had to take a change in direction. I needed to look more deeply than just growing the grass and the livestock grazing it.

I realised my study had to take a change in direction. I needed to look more deeply than just growing the grass and the livestock grazing it.

He had stressed unequivocally that the resilience he had built into his natural system of farming was only possible by studying and educating himself on the complex relationships between the sun, the soil, the plant and the animal.

6a. The new order of thinking:-

HARVEST SUNLIGHT ➡ ***FEED SOIL MICROBES*** ➡ ***GROW GRASS*** ➡ ***GRAZE LIVESTOCK***

I thought I had my Nuffield Farming study tour planned out: go forth and find the "what"; then work out the "how"; put it into practice. Job done. Wrong. I was missing the "why": the understanding and the reasoning , which ultimately yields the empowerment and the reward.

I realised that, to have a positive impact on myself and the industry, my Nuffield Farming Scholarship wasn't going to be about crossing the finishing line.

Instead, it would be about finding the start.

My farming predecessors rode horses or walked the land they farmed, constantly observing and learning the subtle changes at the soil/plant interface and adjusting their management techniques accordingly. I have spent my farming career being propelled by hydrocarbons across the field and through a gate to get the next job done. I needed to learn the art of reading the language of the land and the processes that govern it.

My Nuffield Farming Scholarship wasn't going to be about crossing the finishing line. Instead, it would be about finding the start.

7. Ecosystem processes

Grazing animals are an essential component of grassland ecosystems; influencing plant health, productivity, biodiversity, water cycling and mineral cycling. Grazing ruminants convert sunlight into protein and fibre by eating plants that are inedible to humans. In many cases they graze areas where land constraints dictate that human-grade crops cannot be easily grown. This is what I enthusiastically proclaim as the ruminants' super power.

Not all super heroes wear capes. Some just wear ear tags.

I was at a point in my study where I realised there was no mileage in analysing different grazing systems if I had no understanding of the impact these could have on the ecosystem processes - beyond the interaction of the animal and the plant.

Not all super heroes wear capes. Some just wear ear tags.

The finish line is choosing the grazing system to align with your goals.

The start line is understanding why you have chosen a particular system.

How can we make best use of nature's goods and services without having a negative impact on the resources that are provided - but still maintain levels of productivity and profitability?

When you find yourself surrounded by 20 ranchers - who have between them hundreds of years of collective experience over tens of thousands of acres looking after tens of thousands of animals - you can't help but learn quite a lot. I found myself in this fortunate position in Chamberlain, South Dakota. Being a farmer from another land, I was the target of questioning. The conversation and interaction that night further expanded my thinking about the limitations that we are facing: stalling productivity and declining financial performance.

These ranchers have been around the track a few times and seen many economic cycles and tried every conceivable way of producing protein to fit whatever demands the market forced on them. The consensus among them was clear: ***you cannot create the environment for the animal, the animal is just another part of the overall ecosystem it resides in. If the ecosystem doesn't function correctly then neither can the farmed animal within it.***

I was reminded by one rancher about the definition of madness, but he encouraged me to look at things differently and start by studying the 4 ecosystem processes:

- Water cycle
- Mineral cycle
- Energy flow
- Community dynamics

(*continued on next page*)

7a. Water cycle

Water is a finite resource and needs to be cycled effectively. Every drop of rain that falls on the land must go into the land and not run off (taking soil and nutrients with it) or be evaporated. Water should enter the atmosphere via plant growth or move through the soil into natural underground storage.

7a.i. Indicators of effective water cycle:-

- Soil surface must be permeable and lower layers well aerated
- High organic content of soil
- Transpiration of plants is high, faster growth rates achieved
- Large leaf area
- Droughts and floods are less severe

7b. Mineral cycle

The movement of mineral nutrients from soil to plants to animals, and back to the soil.

Plants take up nutrients from the soil, and animals re-cycle nutrients back to the soil either by eating or trampling the plants.

7b.i. Indicators of effective mineral cycle:-

- Soil is covered by living plants or plant litter
- Large number of surface insects (animal dung breaks down quickly)
- Rapid turnover of plant material
- Good plant root structures, penetrating many layers

7c. Energy flow

The flow of energy from the sun to green growing plants, which convert the energy through photosynthesis - the food that fuels all life

7c.i. Indicators of effective energy flow

- High plant density
- Keep a green leaf growing throughout the year
- High plant diversity (large solar panel)

7d. Community dynamics

The more complex and diverse soil communities become, the more stable populations tend to be (biodiversity).

The four fundamental ecosystem processes (water cycle, mineral cycle, energy flow and community dynamics) are intricately linked and interrelated. One cannot make a decision that modifies one without ultimately affecting another. Think of them as looking through four windows into the same room.

7e. Case Study 2*:* Prescriptive Environmental Stewardship Grazing, UK

Case Study 2: Prescriptive Environmental Stewardship Grazing, UK

Every acre of land I graze has a prescription attached to it. I manage the compliance by grazing within the prescription in order for the landowner to successfully claim their environmental payment; all boxes are ticked, no one gets fined and everyone is happy.

But what about the results? Evaluations of agri-environmental schemes have recently questioned the effectiveness of using management prescriptions to achieve outcomes.

What effect is prescriptive policy having on the ecological value of UK grasslands?

If we think about Stewardship Schemes in the context of the 4 ecosystem processes then it is inevitable that, by managing and prescribing for an isolated outcome rather than taking all the processes into account, there will be unintended consequences.

Take the prescription for cutting hay as an example; carrying out the same action, in the same place, at the same time, every year. This is a stress event which certain plants are adapted to. These plants are the pioneers: they are natures healers, the first responders to the disturbance.

But this action will affect the community dynamics, with diversity diminishing as pioneer plants dominate after every continued stress event. To change the succession you have to change the management; nature functions best with chaos. Nutrient removal (in the form of hay) with nothing put back is not conservation, it is mining. You can only mine for so long.

What if you could have the intended ecological outcomes and high levels of productivity in the same place? It's more than possible but will take a different approach to managing and monitoring.

By planning the grazing by the rules of the 4 ecosystem processes rather than dates and prescription we can have the intended ecosystem services provision plus the production of healthy, nutritious food. This is something I intend working on in the future.

I don't have all the answers to this one just yet, but watch this space.

Figure 4: High Level Stewardship Grassland, Cotswolds

Figure 5: Photo taken on side of the road outside same field as in Figure 5

Maybe we should be looking to the hedgerows for our ecological inspiration?

7f. Section Conclusions

- **Nature thrives on and causes chaos, it cannot be bound by rules**
- **You cannot manage for isolated outcomes, all 4 ecosystem processes must be considered**
- **The environment cannot be treated as a box ticking exercise**
- **Our animals must be part *of* the environment not the reason *for* the environment**
- **Prescribing the "what" is pointless if the "why" is not educated or simply ineffective**
- **Is it possible to have enhanced ecosystem service provision and productivity in the same place? Yes, but it will take a change in management**

8. Building resilience

Resilience is the capacity of a system to absorb shocks and stresses while retaining the same function and structure.

At the time of writing this report (July 2018) farmers in the UK are experiencing some very extreme weather conditions. The last 6 months have gone from being the wettest spring in many places, to the driest start to summer since records began in 1961. Crops are thirsty, grass is burning off and winter feed stocks are being fed shortly after being harvested. Conversations are already speculating about fodder shortages and the financial impact this will have.

Resilience is a not a concept of sustaining; it is a discipline that requires continued regeneration and creativity.

8a. The 3 capacities of building resilience

- **Respond:**
  How you react to disruption
- **Adapt:**
  How you assess and plan recovery
- **Change:**
  How you transform to improve resilience

Subsidies in any form will discourage farmers from using more resilient techniques because they still make a profit when their farming systems fail: direct payments can be defined as delaying the inevitable. The weather and the market will always be volatile and can never be controlled or accurately predicted. We need to concentrate efforts on what we can influence and improve.

8b. Soil health

The world has changed dramatically since the days of our great-grandparents but one major constant remains the same: that all life is 100% reliant on the thin layer of weathered material on the surface of the earth – ***SOIL***.

> ***"An important function of a healthy soil is to store and supply nutrients to the growing plants. The ability to perform this function is what we know as soil fertility. Soil health is the continued capacity of a soil to function as a vital living ecosystem that sustains plants, animals and humans". Jay Fuhrer, NRCS Soil Health Specialist, Menoken Farm, ND***

Figure 6: Jay Fuhrer

We know more about space than we do about the complex relationships between the microscopic organisms in the soil, and it is a distinct possibility that the combination of science and the human brain will never unlock all the secrets of this mysterious world beneath our feet. Luckily the principles of rebuilding soil health are easier to navigate and well within the capability of all of us to put into practice.

8b.i. Soil health principles:

- Minimise soil disturbance (no till)
- Maximise solar energy interception – big plants
- No bare soil - keep soil covered with crop residue
- Maximise diversity of plants in the rotation
- Maintain a large living root mass in the soil
- Integrate animals (into cropping systems)
- Reduce synthetic inputs

These are the core principles that can be used to increase carbon content which is the key driver for a healthy functioning soil and maintaining effective ecosystem processing.

"The health of soil, plant, animal and man is one and indivisible" Albert Howard

8c. The Soil Food Web

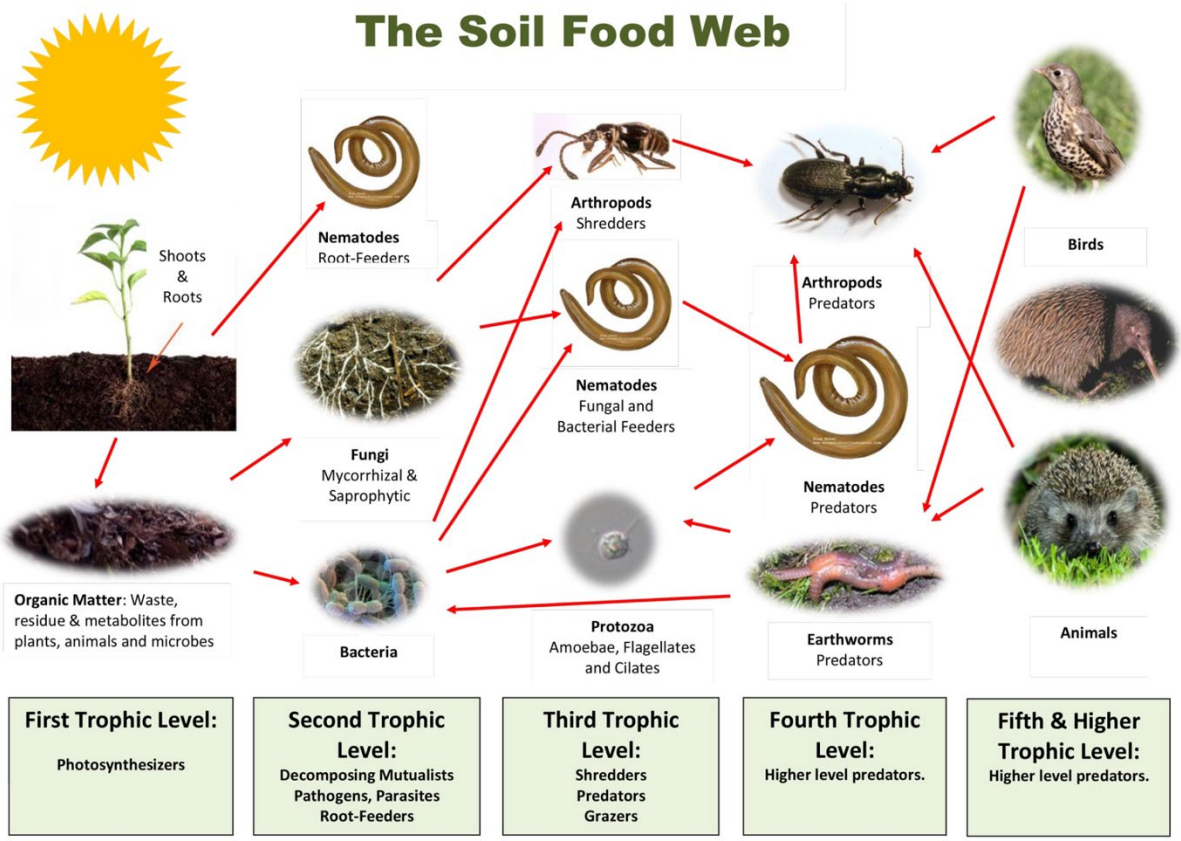

Figure 7: The Soil Food Web" (*source: Soilfoodweb NZ*)

In January 2018 I attended a soil food web course run by Regen Ag and taught by Dave Beecher. Soil science is both complex and complicated. I needed to increase my understanding about what was happening under my feet and be informed of what processes can compromise or restore soil health.

The main message I took away from this course was that the health of the "livestock" *below* the ground (the soil food web) will be an accurate reflection of the health, profitability of the livestock and cropping systems *above* the ground. Life creates conditions conducive to life. If your soil food web is functioning properly it will sustain more life above ground.

How does the soil food web work? During the day the plant absorbs CO^2 through its open stomata, then releases O^2 back into the atmosphere - like taking a deep breath.

Photosynthesis is the process by which green plants harvest sunlight and convert atmospheric carbon dioxide and water into sugar compounds. The plant releases sugar compounds and carbon into the soil which feeds organisms such as bacteria, fungus and micro/macro invertebrates which, in return, mineralise nutrients to feed the plants. This happens in the root area (rhizosphere) and the bigger the root mass the better the exchange functions. Big leafy plants create a large root mass.

Everything eats everything in the food web. The plant and animal residues at different stages of decomposition are known as the organic matter fraction of the soil. This continuing decomposition of

dead material and organic matter results in the formation of humus, a more complex form of the previous organic matter present. Humus is extremely important for the function of a healthy soil as it increases soil aggregation and aggregation stability, increases the ability for a soil to attract and retain nutrients, and improves water holding capacity and infiltration rates. A visual indicator for humus present in a soil sample is the darkening colour of a soil.

Think of the soil food web as a party of biological activity that needs to be noisy and well fed with water, air and plant residue. You need to manage your soils to keep that party pumping, holding carbon in the ground and not releasing it into the atmosphere. When the soil biology is present, diverse and functioning, all the other systems and natural processes are balanced without much interference or input.

Figure 8: Soil Erosion (something you expect to see in the Mid West of USA). But this is an example of soil erosion in the Cotswolds, wind blown onto snow drifts after cultivation (March 2018)

8d. Observation and monitoring

When it came to formulating agricultural and environmental policy to limit the effects of soil erosion, everywhere I travelled in the world had placed soil health at the top of the agenda: declining soil fertility and the resulting biodiversity loss.

It worries me that the current UK political rhetoric surrounding the subject of soil health seems to be a conversation regarding complicated tests for the purpose of rewarding for positive indicators and penalising for negative indicators. Is this a prime example of putting the cart before the horse? Can these tests be interpreted accurately over time?

Personally, I am a long way from deciphering complicated soil test analyses and do not have the knowledge to write a cheque with confidence for what corrective procedures are recommended.

… the current UK political rhetoric surrounding the subject of soil health seems to be a conversation regarding complicated tests for the purpose of rewarding for positive indicators and penalising for negative indicators.

But we start by observing and learning and there is some clever and simple technology out there to help us.

8e. Case Study 3: Sectormentor For Soils App

Case Study 3: Sectormentor For Soils App

Abby Rose from Vidacycle developed the Sectormentor for Soils App in collaboration with the PFLA (Pasture Fed Livestock Association) and soils advisor Niels Corfield. The app was developed to enable farmers to monitor their own soils effectively and cheaply. You cannot really know your soils from a few numbers: you have to go out and look for yourself, which is why observation is at the core of the app.

Using the app and associated tests farmers will learn to be the soil health experts on their ***own*** farm. It equips farmers with the tools they need to learn about their own soils in a systematic and quantitative way.

The guidelines for each test are online and are designed to be easy to do with little instruction in the field. Farmers take their spade and other low cost equipment into a field once or twice a year, entering their observations in the app as they go.

Observations have no bounds, here are examples of what is being measured:

- % of bare soil
- Species count
- VESS (1-5)
- Smell
- Earthworm count
- Slake test
- Infiltration test
- Brix % and fuzziness
- % undesirables

The app is then synchronised when back at home and all the photos, notes and health scores can be seen on one's own computer. There are graphs to compare between fields as well as showing trends over time. Through graphs, photos and data visualisations farmers can see trends in their observations in each field, as well as comparing different fields and see how their soil measurements are changing over time.

> ***"Observing soils in a systematic and quantitive way enables comparisons of findings year on year, which allows farmers to try different management techniques and learn whether they are positively affecting the soil or not, and what works best for them" Abby Rose***

Figure 9: Soil monitoring with Niels Corfield

Soil monitoring and testing has traditionally been confined to the realms of scientists in a lab, with recommendations coming back about what nutrients to apply to soils, based on complicated tests. Due to the complexities and huge variation this can leave the farmer feeling disconnected from understanding their key resource and how they can conserve and improve it over time.

Only if the numbers are accurate and can be fully understood and quantified can the farmer then deal with the metrics and use the corrective procedures confidently and effectively.

Visual Evaluation of Soil Structure

Soil structure affects root penetration, water availability to plants and soil aeration. This simple, quick test assesses soil structure based on the appearance and feel of a block of soil dug out with a spade.
The scale of the test ranges from Sq1, good structure, to Sq5, poor structure.

AARHUS UNIVERSITET UEM SRUC

Equipment:
Garden spade approx. 20 cm wide, 22-25 cm long.
Optional: light-coloured plastic sheet, sack or tray ~50 x 80 cm, small knife, digital camera.

When to sample:
Any time of year, but preferably when the soil is moist. If the soil is too dry or too wet it is difficult to obtain a representative sample.
Roots are best seen in an established crop or for some months after harvest.

Where to sample:
Select an area of uniform crop or soil colour or an area where you suspect there may be a problem. Within this area, plan a grid to look
at the soil at 10, preferably more, spots. On small experimental plots, it may be necessary to restrict the number to 3 or 5 per plot.

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Lars Munkholm, University of Aarhus, Denmark (Lars.Munkholm@agrsci.dk)

Method of assessment:

Step	Option	Procedure
Block extraction and examination		
1. Extract soil block	Loose soil	Remove a block of soil ~15 cm thick directly to the full depth of the spade and place spade plus soil onto the sheet, tray or the ground
	Firm soil	Dig out a hole slightly wider and deeper than the spade leaving one side of the hole undisturbed. On the undisturbed side, cut down each side of the block with the spade and remove the block as above.
2. Examine soil block	Uniform structure	Remove any compacted soil or debris from around the block
	Two or more horizontal layers of differing structure	Estimate the depth of each layer and prepare to assign scores to each separately.
Block break-up		
3. Break up block (take a photograph - optional)		Measure block length and look for layers. Gently manipulate the block using both hands to reveal any cohesive layers or clumps of aggregates. If possible separate the soil into natural aggregates and man-made clods. Clods are large, hard, cohesive and rounded aggregates.
4. Break up of major aggregates to confirm score		Break larger pieces apart and fragment it until a piece of aggregate of 1.5 - 2.0 cm. Look to their shape, porosity, roots and easily of break up. Clods can be broken into non-porous aggregates with angular corners and are indicative of poor structure and higher score.
Soil scoring		
5. Assign score		Match the soil to the pictures category by category to determine which fits best.
6. Confirm score from:		Factors increasing score:
	Block extraction	Difficulty in extracting the soil block
	Aggregate shape and size	Larger, more angular, less porous, presence of large worm holes
	Roots	Clustering, thickening and deflections
	Anaerobism	Pockets or layers of grey soil, smelling of sulphur and presence of ferrous ions
	Aggregate fragmentaion	Break up larger aggregates ~ 1.5 – 2.0 cm of diameter fragments to reveal their type
7.Calculate block scores for two or more layers of differing structure		Multiply the score of each layer by its thickness and divide the product by the overall depth, e.g. for a 25 cm block with 10 cm depth of loose soil (Sq1) over a more compact (Sq3) layer at 10-25 cm depth, the block score is (1 x 10)/25 + (3 x 15)/25 = Sq 2.2.

Scoring: Scores may fit between Sq categories if they have the properties of both.
Scores of 1-3 are usually acceptable whereas scores of 4 or 5 require a change of management.

16 Oct 2012

Figure 10: Visual Evaluation of Soil Structure (VESS) (courtesy of SRUC (Scotland's Rural College))

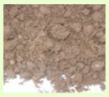
Structure quality	Size and appearance of aggregates	Visible porosity and Roots	Appearance after break-up: various soils	Appearance after break-up: same soil different tillage	Distinguishing feature	Appearance and description of natural or reduced fragment of ~ 1.5 cm diameter
Sq1 Friable Aggregates readily crumble with fingers	Mostly < 6 mm after crumbling	Highly porous Roots throughout the soil			 Fine aggregates	 The action of breaking the block is enough to reveal them. Large aggregates are composed of smaller ones, held by roots.
Sq2 Intact Aggregates easy to break with one hand	A mixture of porous, rounded aggregates from 2mm - 7 cm. No clods present	Most aggregates are porous Roots throughout the soil			 High aggregate porosity	 Aggregates when obtained are rounded, very fragile, crumble very easily and are highly porous.
Sq3 Firm Most aggregates break with one hand	A mixture of porous aggregates from 2mm -10 cm; less than 30% are <1 cm. Some angular, non-porous aggregates (clods) may be present	Macropores and cracks present. Porosity and roots both within aggregates.			 Low aggregate porosity	 Aggregate fragments are fairly easy to obtain. They have few visible pores and are rounded. Roots usually grow through the aggregates.
Sq4 Compact Requires considerable effort to break aggregates with one hand	Mostly large > 10 cm and sub-angular non-porous; horizontal/platy also possible; less than 30% are <7 cm	Few macropores and cracks All roots are clustered in macropores and around aggregates			 Distinct macropores	 Aggregate fragments are easy to obtain when soil is wet, in cube shapes which are very sharp-edged and show cracks internally.
Sq5 Very compact Difficult to break up	Mostly large > 10 cm, very few < 7 cm, angular and non-porous	Very low porosity. Macropores may be present. May contain anaerobic zones. Few roots, if any,				 Aggregate fragments are easy to obtain when soil is wet, although considerable force may be needed. No pores or cracks are visible usually.

Figure 12: Visual Evaluation of Soil Structure (VESS) (courtesy of SRUC)

8f. Section Conclusions

- **Plant size, leaf area, root mass, residuals, removal and replacement of nutrients are examples of factors that need considering when formulating a grazing plan that meets the requirements of the soil's ability to function effectively**
- **In grazing systems we need to treat the soil as a living organism and not the medium to carry out chemistry experiments**
- **Learn to encourage and nurture the below-ground livestock. They don't have to be bought. They are free employees and will work hard but they need looking after**
- **We need to be confident in making soil assessments ourselves. Observing and monitoring is incredibly simple and effective, but for too long we have been told we need someone "more qualified" to tell us what is right**
- **Using simple and effective tools such as the Sectormentor for Soils App will improve confidence and knowledge, creating an understanding of the patterns and trends of soil health improvement over time**
- **This empowerment of knowledge in soil health will help distinguish between the current sensationalist political jargon and the real issues that need addressing, leading to practical farmer-led solutions**
- **Complicated soil tests should only be carried out if the results can be completely understood and quantified, and not on the advice of the salesman who recommends the fix**

8g. Biological diversity

Biological diversity (biodiversity) has become a buzz word used by politicians, ecologists, environmentalists and general society. What does it mean and how can it influence production agriculture? Biodiversity can be loosely defined as ***the frequency of different organisms within a given area***. Organisms are life forms which interact and create symbiotic relationships with other life forms.

The diminishing effect global agriculture has had on biodiversity over the last 50 years is profound and well documented. A major cause of this can be attributed to the specialisation of modern industrial agriculture, resulting in a simplification of the landscape it impacts. This diversity loss is mirrored by the modern-day situation where less than a dozen species of animals provide nearly all the animal protein consumed globally and only 4 crops (wheat, rice, maize, soybeans) are needed to fulfil the demand of just over half of the plant-based calories.

8g.i. Ecosystem services

Biodiversity drives ecosystem health and function where every life form has an important role to play. Ecosystem services are the natural processes we receive for free. All of these natural processes rely heavily on biodiversity, and the biodiversity is influenced by the decisions the agricultural sector make within their managed environment. Ecosystem services underpin our well-being, including the production of most of our living needs and therefore are crucial to our existence:

PROVISIONING SERVICES	*Food security, clean water, medicinal resources, raw materials*
REGULATING SERVICES	*Air quality, carbon sequestration and storage, mitigating climate, waste water treatment, erosion prevention and maintenance of soil fertility, pollination, biological control.*
HABITAT SERVICES	*Habitat creation to ensure species diversity*
CULTURAL SERVICES	*Recreation, tourism, aesthetic appreciation*

8g.ii. Subjectivity

Versions of biodiversity can vary greatly from one individual to another depending on their personal bias about what they want their version of biodiversity to look like and deliver.

I am a livestock farmer: therefore I have a bias in that my version of diversity is a managed grassland habitat relying heavily on herbivores as keystone species in maintaining and regenerating the species' richness and ecosystem health. Others may challenge this thinking and will argue that the managed herbivores within this framework are not needed (or even damaging) in maintaining or improving species' richness.

The important issue to stress here is that there is no right or wrong answer, just differing opinions and agendas formed by differing lifestyle choices. Energy and time should not be wasted on the argument but directed towards an understanding of how your managed animals influence and affect the frequency of different living organisms within your own environment; and the positive ecosystem functions that occur as a result of this.

8h. Section Conclusions

- **Ecology is a complex subject, but a good place to start for any farmer is to ask the question whether they want to suppress or nurture? What are the consequences of choosing to suppress and what are the associated benefits of deciding to nurture?**
- **The more variation of life you have, the healthier the ecosystem function processes will be. The community will become more stable as complexity and diversity increases, and lower frequencies of unwanted species will colonise and dominate. E.g. disease, pests and weeds. At this point it is important to think of your farmed area as an ecosystem and your aim is to manage this ecosystem to function with resilience over time**

8i. Plant diversity

"A plot of land growing distantly related grasses will be more productive than a plot with a single species of grass" Charles Darwin, Origin of Species, 1859.

When considering the benefits of diversity, why in recent times have we become obsessed with "bowling green" grass, monoculture and artificial inputs. In truth, it is a system that doesn't take much thinking about, is just within the realms of what we can afford and we believe it is productive based

on the metrics of performance that accompany the sales brochure. Is this system sustainable and what are the options? To find out more I travelled to East Germany.

8*i.i.* *Case Study 4….*Jena Biodiversity Experiment, Jena, Germany

Case Study 4: Jena Biodiversity Experiment, Jena, Germany

Figure 11: The Jena Experimental Site

The Jena experiment is the longest running biodiversity experiment in Europe, funded by the German Research Foundation. The research site is situated in the Saarle river valley just outside the town of Jena in the state of Thuringia, East Germany. I was very lucky to meet Dr Anne Ebeling, one of the leading researchers at the site. What I wasn't so lucky about was the weather! The diversity was hidden under a foot of snow that fell as I drove to Jena.

Project details:- Established 2002
100 scientists employed
10ha site
650 plots
Ranging from 1–60 species planted and recorded
Over 85,000 different measures taken to date

The aim of the project was to investigate the above and below ground interactions and processes and to evaluate the mechanisms influencing biodiversity effect in ecosystem

functions. In the summer of 2013 after the River Saarle broke its banks the whole site flooded and remained under water for 3 weeks. Dr Ebeling described it as disastrous at first then, as the water subsided they observed the recovery and the more diverse plots recovered more quickly than the monoculture plots indicating greater resilience to extreme weather events.

Figure 14: The Author and Dr Anne Ebeling at the snow-covered Jena Experiment Site

Results

- **Biodiversity is a significant driver of ecosystem functioning**
- **Diversity increases yield, even outperforming intensive monocultures where synthetic fertilisers are used**
- **The "soil livestock" took several years to respond to the increase in plant species indicating biodiversity can be a long term investment, but a very good one**
- **Carbon Storage increases with plant species richness**
- **Diversity encourages and maintains resilience**

Dr Ebeling made the comment that most research projects have to make a very good case for continued government funding. In the case of the Jena experiment there was no battle and the funding was increased at each review, as the funding body appreciated the value of the work done. Not many farmers have passed through their gates; a lot more should.

See Case Study on next page

*8j.i. Case Study 5….*2018 Natural Prairie Contest, Regional Natural Park, Haut Languedoc, France

Case Study 5*:* 2018 Natural Prairie Contest, Regional Natural Park, Haut Languedoc, France

Figure 15: The judging of the National Prairie Contest, Southern France

Biodiversity is valued and considered vital to the health and productivity of the French upland meadows. Monocultures would not be considered by the French farmers. Every year a farmer can enter a meadow into the "Concours General Agricole", the Oscars of farming in France, organised by the *Parc Naturel Regional*. The judging panel is made up of botanists, entomologists, wildlife experts and farm advisors. It is a prestigious national award which is hard fought and held in high regard. Since 2007, 500 farmers have participated from 55 territories of France.

I was impressed and humbled by the farmers' knowledge of their meadows including plants, insects, birds and trees, and the complex interactions between them. The importance of diversity was ingrained in the culture of the farmers of upland French meadows; not just for tradition and aesthetics but also for the benefits of animal health, animal performance and grass productivity. I didn't need to ask for data to prove their claims, the health of the pastures and the animals was clear to see.

8k. Section Conclusions

- **The more plant species present, the more root exudates you have to feed different soil biology**
- **We need to re-consider what is the best environment for animal health and productivity**
- **Plant diversity encourages and maintains resilience**
- **Amount and quality of forage is more consistent over the growing season as diversity increases**

9. Resource evaluation

Since the inception of the common agricultural policy (CAP), policies have painted broad brush strokes across the farming landscape of the UK with the aim to control and regulate, in order to implement support payment mechanisms. This UK landscape is extremely diverse in terms of culture, topography and land use potential. As a result of these policies, the question is: are current business models fit for purpose?

"The main driver of a successful business can be measured by its best allocation and use of resources". Sean Kelly, Range Field Specialist, South Dakota State University

What is influencing these fundamental business decisions? Is it a planned approach to a profitable and sustainable use of resources by the farmer, or are their decisions driven by EU Directives, regulation, support payments, culture and/or simply habit? A realistic vision statement for a business requires an accurate assessment of the current situation. How does a business realise its competitive and/or comparative advantage without knowing exactly what resources it has and the best way to use them? On my Nuffield Farming journey I found a potential solution.

9a. "Ranch Inventory"

"Ranch Inventory" was the first session of the grazing school I attended in South Dakota (SD), a 3-day school facilitated and run by ranchers involved in the SD Grassland Coalition. The school is held every September and offers hands-on instruction in ranch management delivered by experienced producers and range science professionals. As the session progressed I realised how important resource evaluation is to achieving effectiveness and success for a business as diverse as farming. The word "efficient" was hardly used.

The sessions were about explaining how to compile a resource inventory. A resource inventory is a personal exercise of identifying resources available and the first steps towards the planning process of what you want to achieve as the business manager. If you want to compare your business or your plan to others you need to make sure all the variables are ironed out before attempting to decipher and quantify.

The tutors were educating farmers and promoting a culture of observing, measuring, documenting and analysing, which was referred to as "Intentional Management". Attendees were asked if they were currently managing by habit, convenience or letting circumstances and external influences manage them.

9b. Resource inventory – why do one?

There are a number of reasons why you might do a resource inventory to:

1. Overview of business, strengths and weaknesses
2. Provide summary of capital for borrowing
3. Complete balance sheet (*continued overleaf*)

4. Identify stakeholders (*parasitic or mutualistic relationship*?)
5. Evaluate options for growth and diversification
6. Problem solve

The farmer needs to think first about why they are carrying out a resource inventory, as this will affect how they do it and what they do with the results.

> ***"A thorough resource inventory should allow someone with little or no knowledge of your operation to gain a better understanding of all the resources available". Dan Rasmussen, 33 Ranch, Belvedere, SD.***

The 4 Pillars of a Resource Evaluation are:-

- Human
- Natural
- Physical
- Financial

What are the steps involved in carrying out a resource inventory?

Well, first of all there is no template. The inventory has to be easy to write and easily read. The inventory has to be accurate but also realistic.

The goals of compiling a resource inventory are different for each farmer and include to:

- Work towards a goal that is financially, ecologically and socially sound
- Be wealth-creating not wealth-consuming
- Regenerate, not degrade
- Provide quality of life

The outcomes of a resource inventory are to:

- Evaluate areas of the business that may contain either excessive or limiting resources
- Help with future decisions as finances are used for expansion or reduction planning
- Provide an insurance policy of information (a business cannot be in one person's head)
- Meet market demands/flexibility
- Deliver risk evaluation (climate events, market trends, policy change, society demands)

What has a resource inventory got to do with grazing? Cornerstone Grazing show how to put this into practice.

See Case Study on next page

9c. Case Study 6: Derek and Lisa Schwanebeck, Cornerstone Grazing, Ellsworth, Nebraska

Case Study 6: Derek and Lisa Schwanebeck,
Cornerstone Grazing, Ellsworth, Nebraska

Derek and Lisa ranch in the Sandhills of Nebraska running various classes of stock (cow/calve pairs, yearlings) and custom-grazing other ranchers' cattle in an extremely fragile ecosystem where forage management is critical. The business "Cornerstone Grazing" has been built over 25 years, focussing on regenerating and enhancing their rangeland while maintaining a profitable bottom line. Utilising free solar energy and harvesting plants by intensively managed grazing is the backbone of what they do. This approach has increased plant diversity and the carrying capacity of the land. The vision at Cornerstone Grazing is *"to best utilise and enhance every asset to create profit that will support their family, employees, environment and community"*.

Figure 16: Derek Schwanebeck

While touring the ranch in a beaten-up Suzuki jeep, Derek explained that observing, recording and adding layers of actual information to his ranch inventory was critical to his decision making and future planning. Matching forage with demand was an art, that by his own admission was as much down to his instinct as the data he had collected over time, but it took both elements to make it work properly. The inside of the windscreen was covered in black marker notes and diagrams. "*I don't forget things when they are right in front of me*" he explained. During our ride he wrote a lot of notes on his windscreen, I am glad we weren't on a busy road!

Derek took his inventory further in that he constantly ran a balance sheet, valuing cattle and quantifying forage stocks, always planning and always adapting. This information was always accurate and decisions could be made quickly with conviction. The two most important resources were cash and grass. The stock numbers were constantly fluid, increasing and decreasing to match grass growth patterns and market fluctuations. This information and flexibility allowed him to avoid "wrecks". He referred to his rangeland as the "real" bank which, if treated badly, would remind him for years into the future with ecosystem failure and production losses. He cared little for comparison or benchmarking. His bank account and individual rangeland situation were his responsibility but if a neighbour had a good idea he was always keen to listen.

Very little of his time was spent worrying about what he couldn't control nor influence e.g. climate, market fluctuations, policy disruptions (USDA Farm Bill) and societal demands. Instead he put his efforts into building resilience and transparency into his business, ignoring the noise going on around him. It was his knowledge and information that led ultimately to his decision-making processes that afforded him the luxury to do this, not any form of external financial advantage. Cornerstone Grazing knew exactly what their resources were and the best way to allocate them.

Victor Eldred, a pioneer rancher of the Sandhills, wrote: *"The Sandhills are inhospitable to most species. Drastic changes in temperature, sandy soils and powerful winds mean that anything living here must be strong-willed yet flexible".*

That statement summed up very well both the Schwanebeck family and the cows they had bred.

9d. Case Study 7: Smart Farming Project, Ireland

Case Study 7: Smart Farming Project, Ireland

Smart Farming is a voluntary resource efficiency programme led by the Irish Farmers Association in conjunction with the Environmental Protection Agency. I attended a Smart Farming seminar while in Ireland, where the results of the 2017 programme were discussed between participants, the facilitating body and other stakeholder organisations.

The aim of the project is to collate existing knowledge and expertise from Ireland's leading academic and advisory bodies by communicating this in a targeted way to improve farm returns and enhance the rural environment through better resource management. Each participating farm receives a resource efficiency assessment completed by a qualified agronomist using information the farmer (importantly) collects and submits himself.

The collaboration and partnership of organisations within the Smart Farming project is having a real impact on policy debate regarding climate change, water and air quality, and resource efficiency. More can be achieved by working collectively towards realistic and relevant outcomes.

The results of Smart Farming Project 2017 speak for themselves:

- **40 farms participated**
- **€8700 average cost saving**
- **10% average GHG emission reduction**
- **47% cost savings due to addressing soil fertility**
- **21% saving due to improved grassland management**
- **Cost savings to project expenditure ratio of 3:1 was delivered**
- **Far exceeded all expected results**

At the end of the day I heard a presentation from Andrew McHugh, a dairy farmer from County Longford, who made a saving of €9025 participating in the project. It was inspiring to listen to Andrew's experience. The financial savings were not laboured upon: instead he spoke about his increased understanding of his business and awareness of his environment and how both are intricately linked. He spoke with great pride, and the confidence that the project had given his family was evident, and the savings made were a huge financial reward for taking the time to better understand and evaluate his own resources.

9e. Section Conclusions

- **Creates a higher level of understanding creates solutions as problems arise**
- **Question and quantify inputs and spending**
- **Taking ownership empowers the farmer**
- **Relevant information can be included for assurance/regulation**
- **Identify Stakeholders (recognise mutualistic or parasitic relationships)**
- **Gives direction in a post-Brexit environment, best outcomes for UK farmers and UK consumers**
- **More can be achieved by working collectively towards relevant and realistic goals**
- **Resource evaluation is critical in answering the most important question of any farming business, which is *"who am I going to feed and how am I going to feed them?"***

I am not a huge fan of paperwork (I don't think many farmers are) but this method of documenting and analysing is both financially and personally rewarding, realising positive outcomes from making informed decisions based on personal information leading to accurate measures of on-farm resilience and profitability.

Maybe we are all doing the "wrong" paperwork?

10. An holistic approach to evaluating resources

10a. What is holistic management?

Holistic Management was developed by Allan Savory, a Zimbabwean ecologist, farmer and environmentalist, and co-founder of the Savory Institute.

> ***"Holistic Management is a process of decision making and planning that provides the insights and management tools needed to understand nature, resulting in better, more informed decisions that balance key social, environmental and financial considerations."***
> **Savory Institute**

I was struggling to piece together everything I had learnt over the travel period, so on the advice of some of the best farmers I had met, I hesitantly booked myself on a 9-day intensive Holistic Management course facilitated by Christopher Cooke of 3LM (Savory Hub UK).

My head initially resisted the idea of a self-inflicted paradigm shift. The idea of change can be more daunting than accepting the norm (even if the norm is not comfortable). I needn't have worried. The 9-day course answered a lot of questions and provided several missing pieces to my Nuffield Farming jigsaw and I really enjoyed it!

Holistic Management is a decision-making framework based on a personal context, which takes into account quality of life (statement of purpose) and consideration of future resource base.

10b. The 4 key insights of holistic management

The following 4 key insights are the foundation of holistic management. Once the 4 key insights are understood it is easier to understand how different actions affect the health and productivity of the landscape.

10b.i. Nature Functions in wholes and patterns

To effectively manage your own land resources by improving biodiversity, increasing production and generating more profit, it is important to consider that everything is intricately linked. You cannot manage for one thing without affecting something else.

10b.ii. Brittleness scale.

Based on how well humidity is distributed throughout the year and how quickly dead vegetation breaks down.

10b.iii. Predator/prey connection.

This mimics the natural movement of large mobs of herbivores, kept tightly bunched and always moving by the presence of predators.

10b.iv. Time rather than numbers governs overgrazing and trampling

Not influenced by the number of animals but more to do with the amount of time the plants and soils were exposed to the animals.

10c. Holistic context checking

Before making decisions there are 7 basic checks that consider the social, economic and environmental impact, avoiding actions that may cause undesirable outcomes at a later date. This is a discipline of avoiding unintended consequences:

1. *Cause and effect*. Does this action address the root cause of the problem? Managing and understanding causes is much cheaper and less damaging than constantly treating the effects of symptoms.
2. *Weak Link*. Includes Social (e.g. how it affects neighbours?), Biological (e.g. does it affect earthworm population?) and Financial (e.g. can it be paid for?).
3. *Marginal Reaction.* Does it provide a greater return, in terms of time and money spent, than other possible actions?
4. *Gross profit analysis.* Which enterprise (if choosing among enterprises) contributes most to covering the overheads of the business?
5. *Energy/Money source and use.* Is the energy and money to be used in this decision derived from the most appropriate source based on holistic statement of purpose?
6. *Sustainability.* If we take this action how will it affect our future resource base?
7. *Gut Feel.* What are our instincts telling us.

10d. Case Study 8: Rob Havard, Phepson Angus, UK

Case Study: Rob Havard, Phepson Angus, UK

Rob Havard is an organic farmer in Worcestershire, England. He farms grass-fed pedigree Angus cattle and sells breeding stock into the growing pasture-based dairy and beef sector.

Rob grew up on a 180-acre mixed farm in Worcestershire, England. A combination of family ill health and of market moves related to BSE and Foot and Mouth led to him coming home from University to a 44-acre pasture farm. He spent 10 years practising all the ways conventional agriculture loses money and then he came across Holistic Management at one of the first Pasture Fed Livestock Association AGMs. From there on he started growing and now farms 420 acres.

"I have a profitable business, the big change that Holistic Management has made is that the outlook is positive. There is a future here."

Figure 17: Rob Havard and his Angus stud bulls

Using Holistic Management Rob keeps very tight costs control, wintering all his cattle out on heavy clay that most people think can't stand winter grazing.

> ***"Using ecosystem processes to make our land more resilient has a massive impact on our costs. No bedding, only stockpiled forage and hay. If the cattle can't perform on that then they don't stay here long – they become cash flow."***

Rob has imported NZ and North American genetics and used older lines of more moderate growth that thrive on low cost systems. He aims for optimum - not maximum production.

> ***"If you're not making money when prices are high now – how are you going manage when they inevitably go down again? - Low cost systems are the future for family farms – we don't want to be in a race to the bottom in a commodity market. HM has made us focus not just on cost but maximising income at the other end from premium breeding stock. We are not price takers so, to be in business, we have to provide value to our customers. We won't be here long if we sell cattle that cost people money."***

Even with that focus on finance Rob says its isn't enough. Holistic Management ensures that a focus on the social/people side of the business as well as the environment ensures businesses can be resilient and move forward.

> ***"What is the point of what we are doing if it doesn't work for my family and the other businesses on the farmstead? If my family falls apart the business means nothing.***
>
> ***Also, by looking after our environmental resource we are actually looking after our balance sheet. If our soils are resilient, productive, and save us money then we better make sure we look after them and not sacrifice that for short-term production gains that will cost us in inputs in the long run."***

10e. Section Conclusions

- **It is assumed that Holistic Management is "mob grazing" when in fact it is a decision-making process**
- **Holistic thinking is not natural in Western culture. The checking questions and framework are essential to make it happen**
- **Holistic Planned Grazing takes mob grazing further by considering multiple aims, planning carefully and monitoring results which aim for the animals to interact with the grass in a way which enhances soil and plant health, resulting in improved animal health and productivity**
- **Holistic Management encourages people to look at the WHOLE operation and through testing questions ensures that single focus production/growth goals do not put the wider resource base at risk but actually build it for future generations**

After completing the training my personal definition of Holistic Management would be :

> ***"Harvesting sunlight as effectively as possible to create profit in an ecologically regenerative way, using socially-sound management techniques"***

11. Animals and arable

Livestock and cropping systems have become separated over the past 50 years, despite the recognised sustainability benefits of mixed farming. Arable farming has become the dominant land use in the east of the UK, with livestock farming more concentrated in the west.

This evolution towards continuous monoculture production aims to maximise yield through improved mechanisation, fossil fuel availability, chemical advances, policy, and the globalisation of markets; resulting in linear, specialised cropping systems. The unintended consequence of this has led to an over reliance on expensive synthetic inputs, compromised soil health - and nature is winning the war against chemical weed control.

Animal grazing/integration is needed to rectify situations where there is an incidence of herbicide resistance or soil health issues or, more, commonly a combination of the two.

Figure 18: Livestock are the vehicle to building high potential soils"

11a. Why aren't there more livestock grazing in crop rotations?

11a.i. Culture/skills/confidence

Specialisation in a sector ultimately ends in specialisation of skills and knowledge in all levels of the workforce.

11a.ii. Fixed Costs

Arable farming is a low margin (over oil price) business with fixed costs (particularly labour and machinery) spread as effectively as possible over the farmed area. Taking a percentage out of cropping will have negative effects on cost structure.

11a.iii. Infrastructure

Crops don't need fences, water troughs or handling facilities. Level of investment on these has been negligible on arable acres in past decades.

11a.iv. Location

The critical mass of livestock and processors is found in the opposite side of the country to the critical mass of the arable crops. Haulage is expensive and there are biosecurity issues to take into account when moving animals between locations.

11b. Case Study 9: North Dakota State University Extension Service, Animal Integration Training, Bismarck, North Dakota.

Case Study 9: North Dakota State University Extension Service, Animal Integration Training, Bismarck, North Dakota.

Figure 19: Ranchers and Extension Service Agents discussing the benefits of grazing animals within arable rotations

I had the pleasure of spending 3 days with the NDSU Extension service for their 'animal integration into cropping systems' training. Over the course of the 3 days we visited and listened to ranchers about their experiences of bringing animals back onto their crop land. They are dealing with a very different climate to ours: theirs is an arid climate, winter cold, summer dry. Rainfall of around 18 inches but 5 inches of that could happen in one afternoon in May. Increasing soil organic matter to hold more water was critical among other soil health issues.

These farmers had a problem and they knew it needed to be fixed. The way to fix it was moving back to a mixed operation of livestock and crops. I liked their approach, there was no fiddling around the edges; they were tackling the fundamental issues and making it happen. Capital was being re-allocated, staff were being re-trained and investment was being implemented with long term goals.

Key Messages:

- **Their businesses *had* to change if the issues were to be properly addressed**
- **Success depended on the planning and communication between the parties involved**
- **Infrastructure is a crucial investment**
- **The plan is flexible but its integrity doesn't change with volatility of commodity prices (livestock or crops)**
- **Long term planning is needed to rectify the effects of managing for the short term. Animal performance was checked until soil health started to improve**

11c. Case Study 10: Doug Sieck, Selby, South Dakota

Case Study 10: Doug Sieck, Selby, South Dakota

Doug has been implementing novel grazing practices over the past 20 years into his cropping and grassland area, incorporating full season cover crop and catch crop grazing on his cropland acres. He grows diverse warm and cool season mixes to feed cattle, leaves residue as an armour on the soil, to improve soil function and water holding capacity by improving infiltration.

Doug is an extremely enthusiastic rancher and has recently been appointed the chair of the South Dakota Soil Health Coalition. It was great fun to spend a morning with him. He knew his system had to change from growing low value, high risk commodity crops

Figure 20: Doug Sieck and his cows

In his own words he told me he was sick of giving his money away while watching his soils deteriorate. He still grows cash crops but he now keeps more cows and grows his weaners on to 18 months old, adding value by harvesting sunlight to convert plants into kilos of beef and invests in infrastructure to improve his grazing effectiveness.

"The drugs are bad, get off the drugs!" Doug's advice.

Farm facts:

- 1000 acres cropland
- 1250 acres native rangeland
- 250 cows plus progeny carried to 18 months old
- Doug plus one seasonal member of staff

Management changes:-

- 14 miles of fencing erected
- 3 miles of water pipeline installed
- Increased cattle numbers
- Cropping area decreased
- Increase diversity
- Doesn't buy crop insurance
- 25% of cropland in full season cover crops
- Feed "below ground livestock" as well as the "above ground livestock"

Results of changes:-

- **Improving soil health**
- **Asset value protection**
- **Production responses and more profitable cattle**
- **Cattle graze 12 months, no expensive confinement**
- **Profit orientated cash cropping - more resilient to climatic events**
- **Taken stress off cattle, reduced vaccinations, eliminated pour-on insecticides**

11d. Infrastructure

Fencing, water, laneways/tracks and handling facilities are a considerable investment, but necessary if animals are to be kept where you want them to be and have the outcomes that are hoped for. It needs a long-term thinking approach to the investment. The reasons why animals are needed back in arable rotations are not a quick fix. Temporary is fine but it's called temporary for a good reason: the labour requirements are considerable when moving fences, and maintenance is very time consuming.

There are currently options within Stewardship schemes that offer financial reward for returning arable land to grass. These payments to the landowner should be allocated as the means of financing infrastructure. Margins are tight in all sectors but a livestock farmer will have no enthusiasm to invest in someone else's land to solve someone else's problem.

11e. Section Conclusions

- **There are various ways of successfully integrating livestock in an arable rotation. How this is planned needs to ensure there is a trusting relationship between all the parties involved which will ultimately determine the level of success of the outcomes desired. Many different arrangements and contracts are possible**
- **Integrating livestock (above and below ground) into a cropping system can bring multiple benefits including improving soil function and managing weed control**
- **Packed with biological organisms, animal saliva, urine and manure can act as an antidote to soils exposed to years of high input continuous cropping**

Figure 21: Sums it up??" (*Courtesy A. Bacall)*

12. Discussion: including overall Conclusions

The chapters in my report are varied and cover quite a bit of ground so I have chosen to summarise conclusions at the end of each section. I have attempted to consolidate the key findings of my study below:

1. Livestock farming is becoming a very emotive subject with growing opposition to the production of red meat for many different reasons. As producers we should step away from the emotionalist, sensationalist and (most of the time) inaccurate facts that accompany the anti-livestock farming rhetoric and concentrate on communicating the positive effects animals have on providing ecosystem services as well as healthy, sustainable protein and fibre.

2. Good monitoring depends on a broad awareness of the state of the land, but this means training your eye to look for a broad range of specific things. Productivity and how ecosystem services are delivered are the direct result of how the ecosystem processes are functioning within our managed environments. Regular monitoring enables us to spot early warning signs so controlling actions can be taken.

Figure 22: Ecological monitoring, part of Holistic Management Training

3. If grassland environmental policy is designed with the 4 ecosystem processes at their core, then productivity and ecosystem service provision can be delivered in the same place. Current policy

is counterproductive, holding back innovation. Efforts must be concentrated on developing frameworks can be a catalyst for positive outcomes instead of being an impediment to change.

4. I found no silver bullet because there is no silver bullet. The success stories I met were not addicted to the activity of farming, they were instead driven by an understanding that the ecological, social and economic responsibilities of agriculture are intricately linked and cannot be separated nor treated in isolation.

"Sustainability can be the short term fashion around which resilience has to be the perpetual trend". *The author*

13. Recommendations

For Policy makers:

1. Learn from previous shortcomings on design and implementation
2. Resist the temptation of being over-elaborate and over-ambitious
3. Manage special sites for isolated outcomes but keep that level of micro management to those sites. Do not roll out a similar prescription for the greater "farmscape" around it
4. Potential means nothing unless it is realised…**it's the results that count**
5. Production and ecosystem service provision can happen in the same place
6. A budget for support payments should be allocated to communicating the benefits of improving soil health and diversity; with the provision for capital grants to improve much-neglected infrastructure to increase productivity without compromising the natural environment

For Producers:

7. Grazing animals will only enhance ecosystem function if managed correctly. An understanding of ecosystem processes is crucial if ecosystem services and improved profitability are to be delivered in the same place
8. Livestock health and performance is a direct reflection of soil health, and diversity is key to building resilience
9. Do not out-perform your environment; if you know you are doing something detrimental find other ways before it is too late
10. The future of ruminant production should be less about horse power, fertiliser and monocultures, and more about harvesting free solar energy to feed soil microbes
11. Learn to read the language of the land, communicate positivity, and concentrate efforts on educating fellow producers.
12. Listen to the consumer but remember the consumer is flakey and cannot be trusted to buy what they demand. I know this because I am one and so are you!

For Politicians and the Public:

It is estimated that by 2050 agriculture will have to increase production by 70% to feed a growing population of 9bn people, with nearly all of this expected growth happening in developing countries. Production increases are expected to happen in land-limited, developed countries which have the benefits of stable politics (no corruption), access to credit, and good transport and processing infrastructure. Developing countries where the population is expected to increase the most have access to land, (e.g. Sub-Saharan Africa) but also have serious issues with corruption, no credit and poor infrastructure, which limits their potential to produce and feed themselves. The fundamental issues of food waste, poverty, distribution and the controversial use of food grade crops for Biofuel production need addressing by governments and society before further pressures are put on the natural resources of land-limited countries to meet these unsustainable demands. The market is only concerned with price: it cares nothing for the people nor the environment we live in.

14. After my study tour

It has been a great opportunity to take a back seat from the day job and travel around the world and meet inspirational people. The reason for applying for a Scholarship was to work out what was going to be the next challenge and try and solve some of the issues we are facing. I wasn't surprised that I discovered more questions than answers but I did find a direction. Change of direction is needed because, like a lot of livestock farmers, I was starting to feel like a living definition of madness.

To take a lighter touch and work with the laws of nature will be my focus in the future, taking a more holistic approach to decision making and management of resources, while still focussing primarily on the bit that pays the bills – production.

Geraint Powell

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