A Nuffield Farming Scholarships Trust Report

Award sponsored by

The Company of Merchants of the Staple of England

Growing and marketing fine wool in native colours

Jennifer Hunter

November 2015

NUFFIELD UK

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A Nuffield (UK) Farming Scholarships Trust Report

Date of report: November 2015

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

Title	Growing and marketing fine wool in native colours
Scholar	Jennifer Hunter
Sponsor	The Company of Merchants of the Staple of England
Objectives of Study Tour	Evaluate current production and processing trends Research native colours and classification systems Define a use for all fleece components Discover innovation within the wool industry Investigate marketing strategies for a range of natural wool products Review holistic grassland management for dual purpose sheep
Countries Visited	Australia, Chile, Patagonia and Argentina Iceland, Norway, Copenhagen, France, Italy, Brussels
Messages	• Wool is an ancient fibre with a resilient future. • Multiple industries incorporate fleece components as a raw ingredient to create a diverse range of products. • Fine wool in native colours offers a safe alternative to chemically dyed fibres and is a valuable commodity within specific markets. • *Made in the UK* is a trusted brand image, offering sound ecological traceability and a transparent heritage. • The elite group of consumers buying wool want to find products easily and be rewarded for investing in the fibre of the future. • Ancient symbiotic relationships offer solutions to grassland regeneration projects and waste disposal issues.

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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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Published by The Nuffield Farming Scholarships Trust
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1.0. Introduction

I have often introduced myself as "*a pink rose" as* both sides of my family descend from livestock farms in Lancashire and Yorkshire. Entrepreneurial design and construction are family traits, along with self-sufficiency and health care. My own motivation has always been animal health and husbandry and after attending Myerscough College I drifted south to Harper Adams for my BSc (Hons) Agriculture with Animal Science degree.

Figure 1: The author, Jen Hunter, styling a wool snood

A placement with the Pig Improvement Company (PIC) genetic nucleus and a dairy exchange in New Zealand prompted my future interest in genetic improvements. MAFF/ADAS research on an established organic farm allied my science education with practical husbandry, and I have continued this holistic management approach ever since.

In the year 2000 when I was young, free and single, the lure of travel beckoned and believing in positive work experience, Voluntary Service Overseas (VSO) seemed the perfect challenging opportunity and adventure I was looking for. Based in Uganda, East Africa and working as a Livestock Technical Advisor and later as Events Manager of a popular visitor centre, these years were a life changing experience.

Returning to the UK, old friends and new prospects brought me to the Soil Association Producer Services Department in the centre of Bristol. Applied education was still a focus, and a city farm offered the perfect opportunity to express leadership and offer practical learning opportunities. Obtaining a teacher qualification, developing a vocational GCSE in animal husbandry and offering therapeutic animal care programmes together with Livestock Management – I found this role very rewarding if only on a miniature scale.

Always when least expected I was in need of a shearing machine; and that is how I met Andy Wear and came to realise that the various chapters in my life had prepared me for what was to become my future. A decade later Andy and I, now partners at Fernhill Farm, have combined livestock and people farming enterprises to create a bustling family business that is becoming the vision Andy had sensed when buying a redundant pile of rubble 18 years ago. Our Rural Interpretation Centre enables us to grow the nutrition we need from our own land, share open space with like-minded souls, welcome those far less fortunate than ourselves and create a hunger for additional learning. #Living the good life.

2.0. Background to my study

I am a recycling fanatic by nature and my two years in Africa cemented my incessant drive to harvest, re-use and leave nothing to go to waste. Wood, wool and water are naturally replenishing resources at Fernhill Farm and together with renewable energy installations, timber and wool insulation, water purification and human visitors, we are able to harness real power from nature's nutrients to grow holistic products.

British wool is generally considered as a by-product from the sheep meat industry, and in 2009 when Fernhill Shetland fleeces were valued at a mere £0.12/kg, I decided this needed attention. We began by seeking alternative buyers for our coloured fleeces which ultimately led to an increased appreciation and understanding of wool fibres.

Sheepskins, wool blankets, breathable clothing and the benefits of lanolin have been symbiotic with global societies since the dawn of domestication, but the West now relies heavily on chemical antibacterial production and synthetic materials. Andy has devoted the best part of his shepherding life to growing an array of commercial fine fleeces using true genetic variation, and with my personal background and ethos, we both decided we wanted to be price makers, not takers.

There was an increasing need for economic investment to rebuild our ancient farmstead in conjunction with establishing an Agri-Eco events business. This has resulted in us welcoming vast numbers of people to come and enjoy a 'Fernhill Farm Experience' with the majority genuinely interested in knowing what farms produce. Many find active involvement with life on the farm is therapeutic, and simple social evenings around an outside fire are our most successful ingredient. Hosting "Let Nature Feed Your Senses", "Send a Cow", "Food for Life", "Young Rangers" and "Young Carers", our wool workshops created interaction with all levels of society that highlighted the need to create awareness and reconnect consumers with the benefits of wool.

Investigating various options to process woollen products revealed my lack of understanding of what happens after wool leaves the farm and the required industrial transformation to manufacture yarns and cloth. One fine shearing day, Andy politely said to me: "Go and tell Nuffield Farming" and this started a journey which I am sharing with you now. To be a connoisseur of fine wool, and discovering wool innovation right across the world has to be the most rewarding task fate has ever brought my way - long may it last and long may it keep these skills alive.

Thank you Nuffield Farming.

3.0. My study tour: exploring wool in the 21st century

March 2014	CSC and own study Australia – NSW, Victoria & SA	4 weeks
May 2014 **November 2015**	The 8th Congress of Coloured Wool, Paris, Wool Scouring In Europe: Urgent & Ecological Solutions, France	2 days 4 days
September 2014	North Atlantic Native Sheep and Wool Conference, Iceland	2 weeks
October 2014	Norway Wool Week, Bergen	5 days
October 2014	Copenhagen, Holland	3 days
November 2014	Family holiday with research, Italy	2 days
November 2014	NTS Certificate in Sustainable Agriculture. UK	4 days
December 2014	International Wool Textile Organisation (IWTO) Multi-stakeholder meeting & wool round table. Brussels	3 days
March 2015	Chile, Patagonia, Argentina. South America	3 weeks
November 2015	Conference in France: "Wool scouring in Europe - urgent and ecological solutions"	3 days
2013 – 2015 UK -	BWMB South Moulton: BWMB HQ & Haworth Scouring plant, Natural Fibre Company: Halifax Spinning Mill: *Naturally Inspiring* Woolmark Event, London: Diamond Fibres: Fibre East, Alfred Brown: Bristol Weaving Mill: Bristol Textile Quarter	Ongoing

Understanding the UK wool industry became my priority and I visited businesses throughout the processing chain prior to attending the Contemporary Scholars' Conference in Australia. All this inspiration set me in the right frame of mind to start my investigations into genetic improvements, wool classing, fabric research and the Australian Wool Innovation.

Whilst visiting coloured Merino and Polwarth breeders in Australia I was invited to the **Coloured Wool Congress** in Paris, and secured contacts for **The Northern European Short-Tailed Sheep Conference** in Iceland - Icelandic sheep are famous for their woollen yarns and this was my reason for going north.

Norway's first **wool week** demonstrated the evolution of processing and the rebranding of wool as a modern fibre. Copenhagen had been awarded **Green Capital of Europe** status (Bristol is currently enjoying this status in 2015) and I planned a stopover to research what makes this city or its people so green.

A family holiday to Italy allowed our children to help investigate **Cashmere** goats with direct marketing. **Biella The Wool Company** is set in magnificent ancient settings and offers a complete processing service for European wool growers.

South America illustrated government assistance to maintain traditional weaving skills within indigenous populations. Patagonia highlighted the holistic management principles I had previously

been exposed to during my **Certificate in Sustainable Agriculture**, and Brussels consolidated my new knowledge at a **round table discussion** with industry leaders.

A meeting in the French mountains with 15 European countries discussing **ecological problems** created the opportunity to demonstrate my own personal research, and discover other industries researching the potential benefits of wool, waste and microbes.

Figure 2: Commercial Shetland sheep demonstrating true genetic colour differentiation

Figure 3: Icelandic double coated fibres spun at various lopi yarn weights

4.0. The production of wool fibres:

meat, wool and hair sheep

As a British sheep farmer with little exposure to the textile industry, I wanted to understand processing services to gain the required knowledge to implement my designs using our own Fernhill fibre.

I started my Nuffield Farming journey with these five main objectives:

1. To understand the wool classification system around the continents
2. Investigate microbial wool washing, natural dyes, heat- and chemical-free processing
3. Yarn development – traditional weaving and specialist knitting yarns
4. Blending plant and animal fibres
5. Using every part of the fleece

The UK and most northern hemisphere countries consider wool a by-product from the ***meat*** industry. Typically, wool fibres are highly variable in terms of length, diameter, crimp and colour as these relate to breed, cross-breed, age and environmental conditions. 90% of income is from the production of meat, and genetic selection is focused almost entirely on environmental adaptability and carcass conformation in the finished lamb.

The new world ***merino*** is the most predominant ***wool*** sheep across the world and very little value has been placed on the breed's production of meat, with vast, virtually identical flocks roaming across the southern hemisphere. Bred specifically for their wool and the benefits they bring to land fertility, the current trend among merino farmers is to try to increase market value opportunities with dual purpose types.

Hair sheep are considered genetically different as their primary follicles produce straight, short hairs that are considered coarse and exceptionally colourful when compared to those of meat or wool sheep. These sheep provide important sources of protein, nutrients, wealth and dowry in less developed countries.

Global sheep numbers and world production of greasy wool highlight the collective mass of sheep around the world and countries growing wool fibres. (*British Wool Learning. IWTO wool statistics 2012).*

Throughout ancient history, sheep were predominantly valued for their milk, manure, tallow, wool and eventually their meat production traits

5.0. Harvesting greasy fleece in the UK

Professional shearing is essential as second cuts (cutting the fibre twice) create mixed fibre lengths and fleece damage that lowers the potential use and value of fibres as spinning and weaving yarns.

Farmers pay shearers 90p to £1.10/sheep yet the sale of the fleece returns only £1 to £3 per sheep per year.

A **wool handler** gathers the fleece and keeps the shearing area clean from wool, dirt, droppings etc. On-farm **sorting** is not common practice here in the UK as wool is sold for the growers by the BWMB (British Wool Marketing Board), the marketing agent in the UK. The BWMB is responsible for the transport logistics of greasy fleece, providing wool sheets (poly-woven bags and strings) and instructions to farmers. The *Wool Clip Presentation* guidelines for **packing** include faults to avoid, ram fleece assessment services and packing and haulage information for farmers to help achieve maximum price for their wool.

> ***Pre-processing*** *- I have identified the term 'pre-processing' to distinguish each operation from shearing through to selling or using greasy fleece.*
>
> ***Early Processing*** *is deemed the scouring or washing and combing of wool fibres (IWTO, 2015)*

Collecting, grading, promoting and selling great British fleece wool since 1950.

We established a farmer-run organisation in 1950
BWMB operates a central marketing system for UK fleece wool using a fully computerised auction system, with the aim of achieving the best possible net return for producers (farmers).
We collect, grade, sell and promote fleece wool
We are the only organisation in the world that collects, grades, sells and promotes fleece wool. We are also the only remaining agricultural commodity board in the UK.
We are a non-profit making organisation
We receive no financial support. We operate commercially, but we are also a non-profit making organisation, returning to producers the market price for their wool.
Operations are carried out across the UK and Ireland
Day to day operations are run from our headquarters in Bradford. We also have smaller regional offices in Scotland, Wales and Northern Ireland.
http://www.britishwool.org.uk **2015**

Figure 4: British Wool Marketing Board

BWMB operates 10 regional depots that weigh, sort and press into 200+kg bales. British wool is **graded** into *types* rather than specific breeds and, with over 60 native breeds and as many crossbreds, it requires a 5-year apprenticeship to become a qualified British wool grader. Each farmer has a reference number and receives approximately 10% of the estimated value of their wool clip on delivery, with the remainder paid when the farmer's wool is sold into the global market.

> *To sell our wool privately we need to:*
>
> *- allocate grading, sorting and package requirements at shearing*
>
> *- consider transport logistics from our farm*
>
> *- pre-plan product design and processing volumes*

6.0. British wool buyers

BWMB-**registered buyers** are traders who attend electronic auctions to purchase British wool available in over 120 wool lines (types). Lots of 8 tonnes consisting of 21 bales apiece are sold to wool traders from all over the world. Only a registered person can enter this auction room in BWMB's Bradford headquarters from October through to March; after that the farmers receive their full payment. (A common misconception is that wool is ***never*** owned by the BWMB)

British wool is sold into global markets. *About half the exports go to the rest of Europe, a third to China, just over a tenth to the Far East and the rest to America, Australasia and Africa" British Farmer & Grower – August 2015*

In the 1970s Aiden Walsh set up **Texacloth** in Ireland to **buy** wool direct from farmers by weighing and paying on delivery, accumulate bales and then sell it in bulk quantities mostly to China, but also to India and Europe. There are now depots throughout the UK and we ourselves receive open offers to sell our wool in this way.

Hand spinners – the smallest percentage of buyers, but with the most appreciation for the product, is the hand spinner, who relishes the rich varieties of raw British fleeces. Hand spinners are prepared to pay higher prices for individual fleeces straight from the shearing boards at local shows, wool festivals and online.

Independent processors are small to medium sized businesses buying wool directly from the farm gates to add value from the early processing to finished yarn stages. **Agents** also source for companies incorporating wool for specific end products.

Comparison:

2015 BWMB fact sheet states they now permit a total of 3000kg to be sold privately by wool growers for artisan craft uses and 15000kg for insulation purposes provided wool exemption certificates have been obtained.

Both these situations require farmers to sell fleeces privately and Fernhill was advised to obtain a Wool Exemption Certificate from the BWMB. In 2009 we received a certificate to sell 50 fleeces for craft purposes annually.

Mini mills don't technically *buy* fleeces but have a range of equipment that does the same job as big industrial machines, enabling producers to have access to fibre cleansing and restructuring without losing the identity of individual animals or specific colours. Mini-mills process small quantities of wool (<6kg or 2-3 fleeces/batch) and offer complete *pre* and *early processing* techniques, spinning and associated balling, cones or hanks. Growers can then sell direct to consumers and continue to add value to their own wool fibres.

***At >£45 per fleece, mini** mills offer a viable option with speciality fleeces or specific orders*

Provenance is key here - when our fleeces leave the farm we need to ensure that it's our wool returning so we can sell it to customers as a Fernhill Farm product.

6.1. The Natural Fibre Company - case study 1

In 2009 the Natural Fibre Company started buying Fernhill's Shetland fleeces, and now includes commercial white fleeces in their range of British yarns. Based in Cornwall, this enterprise has dual business objectives:

1. *Offering specialist fibre growers automated scouring, carding and spinning services for their own natural fibres*
2. *Buying fibre to create their own range of yarns, knitting patterns, blankets etc.*

There are no **wool handling or classifications** courses available to farmers in the UK and we created a style that suited mechanical mill processing and our shearing systems. We *methodically remove unsuitable fleeces at shearing and send only the best fibres packed into smaller more manageable 20kg wool bags. This reduces transport costs and eliminates disposal fees for fibres not suitable for spinning as all second grade fibres stay on the farm.*

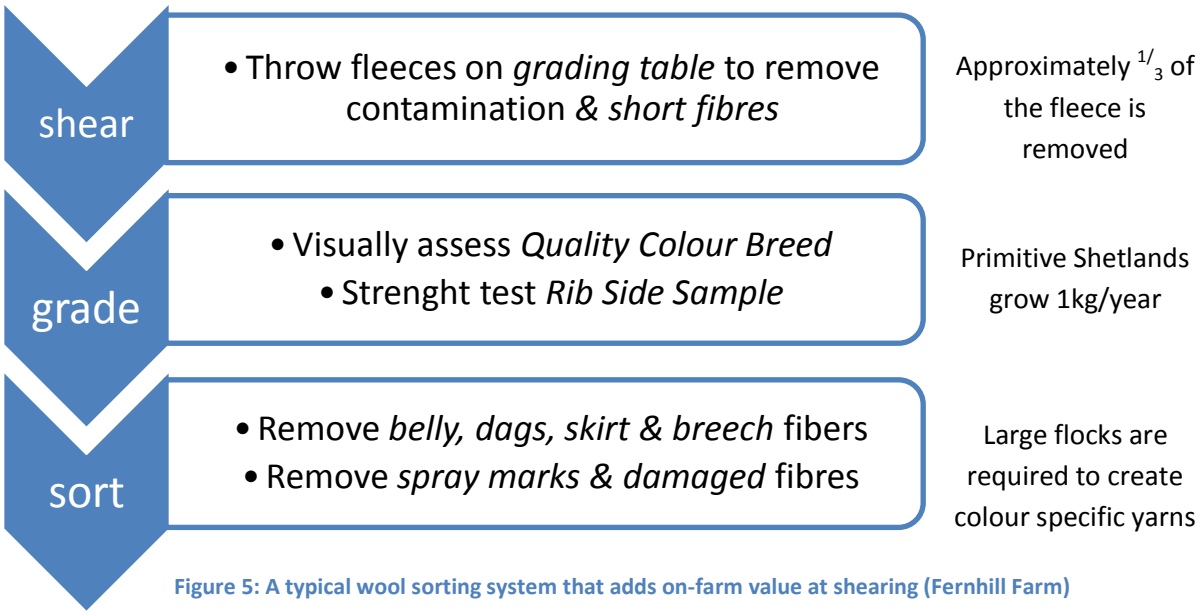


Figure 5: A typical wool sorting system that adds on-farm value at shearing (Fernhill Farm)

Figure 6: 50g balls of pure Shetland yarns selling at £5.50 from the Natural Fibre Company 2015

The ability to sell top grade fibres suitable for spinning has resulted in an issue with marketing second and third grade fibres - this is our biggest challenge and one of the key reasons I applied for a Nuffield Farming Scholarship was to assist my research in finding a use for these fibres.

6.2. Linking pre-processing and product development

What are we growing?

As **fine coloured** wool growers we are asked for micron measurements (1000th of 1 millimetre) when selling wool privately. Fibre length and strength are an important aspect of our wool sorting, removing short, coarse, tender and damaged fibres to ensure wool is fit for purpose.

Wool Testing Authorities (WTA) offer internationally recognised fibre tests and the BWMB uses this service (European WTA based in Wales) to provide accurate information from every bale in their UK depots. A similar service is also available to growers but, as it's not common practice to test fleece fibres in Europe, these prices are high due to lack of demand. (£8 - £25/sample)

A sequence of random bale punctures extracts small wool samples to provide consistent information for wool buyers. This accurately records contents of every bale, with information present at auctions consisting of micron, length, strength, colour and contamination levels.

Scouring is deemed the first element of early-processing and vast qualities of greasy wool (>8 <20 tonnes/batch) are washed in purpose-built scouring plants around the world. The fibres are submerged in hot alkali solutions, rinsed and then blown dry with warm air to produce lanolin free, sometimes bleached wool. Mechanical oils are often added to wool fibres at the carding and combing stages and with my limited knowledge I was curious about lanolin in the processing industry.

30-60% of fleece weight is lost during washing – can we harvest these potential nutrients and grease? How can we reduce chemical residues?

Alternatively, gentle washing with soaps occurs in smaller batch quantities and allows normal fleece structure to be maintained by reducing the heat, agitation and harsh stripping of all the lanolin from delicate fibres. Drying is a longer process using natural air flow or reduced heat and movement and thus this system is often requested in the production of hobby and craft textiles and is useful in the small scale spinning process.

Wool **production** and **pre-processing volumes** determine the options available for *early* processing and insufficient quantities are a common issue with speciality breeds. This is especially important when sorting coloured fleeces as this determines the final yarn colour, as buyers expect a range of natural Shetland shades.

Pre-processing is the only stage where farmers can instigate change and every handling operation has a cost that has to be monitored.

At Fernhill we have a purpose built shearing shed that enables Andy to give shearing courses – the quality of shearer is paramount to product development and blade shearing offers a fantastic clean wool clip with noticeably fewer second cut shorter fibres.

The challenge of *wool logistics* highlighted the need for small businesses to access **regional** volumes that can be handled safely. The decisions that are made at shearing are essential to both farm gate sales and product manufacturing.

Figure 7: Shetland fleeces showing eleven different shades. Shetland Breeders Society. (Thirteen colours are typical).

Figure 8: Wool grading tables are currently not available to buy in the UK

7.0. Wool users

adding retail value and industry distribution

Defining the types of actual wool *users* occurred after repeated exposure to those *getting their hands on wool* and thus I deemed this an important part of my findings. Processing is a complex operation and includes handlers at every level of pre-and early processing, with hands and machines that cleanse, colour, comb and restructure the fibres into commodities used to create fabrics. These textile *commodities* then become interesting to both artisan and industry designers, and individual and company manufacturers, who then add more restructuring stages and finishing techniques before it is offered to the consumer as a finished product

The table below defines those involved with wool industry logistics. (*Source: the author*)

	artisans	sheep farmer	Traders	R & D	consumers	fibre growers
who	Largest %age are women	Subsistence farmer	Largest %age are male agents	Scientist researchers	All	Commercial farmer
what	Luxury items	Everyday wool items	All stages of processing	Product specification	Clothing interiors craft insulation	Wool sales
where	Home business	Home and markets	Industrial	Laboratories and factories	Everywhere	Southern hemisphere
when	Variable times	Spare time	Full time	Project work	Specific purpose	Annually
why	Creative skills & time	Increase lifestyle funds	Add value	Technical data	Warmth comfort style	Business enterprise

What links these *user* groups with the fibre grower is the desire for wool to be graded according to colour, strength, length, contamination and micron level, as this affects the price, quality and type of finished product. Growers and traders are naturally interested in finding the best return but artisans and wool growers have a more vested interest as they will spend a greater amount of time, effort and dedication on these pre-processing techniques.

Growers* of any *commodity should understand those who want to buy and use their product, even when it's a by-product and especially when it is a speciality niche product.

It is also relevant to *link* traders with suppliers at this point - without direct contact it's difficult to know what traders are seeking to find, both for their own purposes and when acting as agents and this, along

with finding interested consumers, is often the missing connection for the majority of suppliers looking to add value to niche resources.

7.1. Concluding thoughts about wool in the 21st century

we are all consumers of wool in our daily lives

Even though considered a niche product in supply terms there is no doubt that wool turns up everywhere. How much is present in each one of our lives is determined by affluence, personal preference, understanding natural textiles, and media messages.

The list of industries where wool is used is endless and yet wool is still considered by many as a by-product rather than a **resource**:

- ✓ *floors, walls, lofts, roofs*
- ✓ *furniture and soft furnishings*
- ✓ *slumber scene – mattress, topper, duvet, pillows, blankets, throws*
- ✓ *Insulation & sound proof drapes*
- ✓ *curtains, blinds, draught excluders*
- ✓ *sheepskin rugs and accessories*
- ✓ *every clothing item from head-toe*
- ✓ *temperature regulating transport & packaging*
- ✓ *gardens & conservatories*
- ✓ *cars, planes and trains*
- ✓ *pets and animals*
- ✓ *tapestries, art and craft materials*

Questioning the relationship between harsh processing techniques and a gentle, comforting product, **time** becomes the determining feature that controls the quality of our modern lives.

Hand skills are an essential element when working with wool and I have continually witnessed the comfort that the resilience of wool offers to adults with support needs, children with challenging behaviours, people of every age and an eclectic mix of individuals trying their hands at shearing a sheep. *See photo on next page.*

By recognising *wool products,* we can identify how to make use of every part of the fleece, how much and what is required by the various industries - raw, washed, carded, spun, felted or woven textiles.

Insisting on a low toxicity processing application offers greater protection for our skin and provides evidence of our environmental commitment to our target audience.

> *"Didn't know sheep were useful, just thought they stood in a field all day eating grass".* Comment from a 15-year-old girl after a shearing demonstration whilst wool weaving.

Figure 9: Natural fibre discovery days at Fernhill Farm

Figure 10: Young Bristol wool art

8.0. Discovering wool from around the world

3 continents and 10 countries, including a conference, congress and multi-stake holder meeting, together with long drives around English countryside – this was my journey

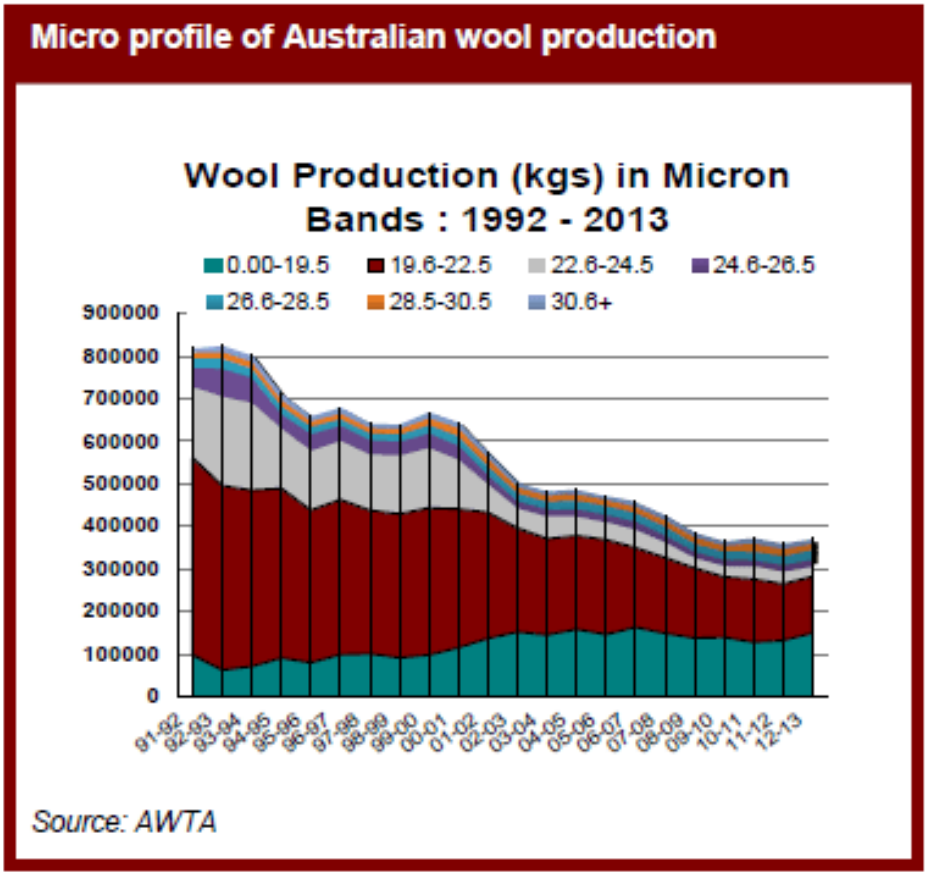
8.1. Australian innovation

My research in Australia began after an inspirational Nuffield Farming Contemporary Scholars' Conference. I visited farmers operating selective line breeding programs for increased fibre quantity that in its simplest terms reduced micron and increased fleece weight. The low emphasis on lambing percentages, mothering abilities and lamb survival rates was in total contrast to the British farmer producing meat.

Merino flocks by the thousands are producing a uniform wool product measurable by the micron, coefficient of variant in diameter, vegetable matter and fleece weight. Specialist fibre growers are maximising electronic recording equipment, obtaining pre-shearing fleece samples, annual wool tests and the most technological enhancements available to ensure they are within their predicted micron grade.

Superfine and ultrafine flocks are even more specialist in the fibre market, concentrating their genetics to achieve maximum income from lowest recorded microns. The micron profile of Australian wool production below illustrates the current trend in growers using genetics to reduce micron counts throughout their flocks.

Micro profile of Australian wool production



Source: AWTA

Superfine breeder, **John Ive** shared this message :

"You have to measure it to monitor it - whether it's the weather, wool or wethers for wool"

I discovered artificial insemination and embryo transfer that aims to increase the genetic gains by 50% beyond normal genetic levels in merino and crossbred flocks. Several specialist wool growers were using sheep coats on shearling wethers and shorn ewes that are removed a year later just before shearing. These dust-free clean fibres are valued by hand spinners and individual markets. Castrated male wethers are sometimes housed in large sheds at 10 months old and kept there for approximately 6 years, and shorn annually with or without these coats, before entering the live meat trade in Asia.

Shearing takes place throughout 11 months of the year around Victoria where I met up with Sarah Moran, who has won two Australian championships and represented her country at last year's World Championships in Ireland. A typical shearing gang consists of chef, gang of shearers, wool handlers, wool classer, and *rousie*. Every farmstead has a shed with shearing stands, port holes, wool grading table, wool sorting lines, wool press and dry storage areas.

Figure 11: Wool classification in Australia

Wool sorting is a quick repetitive process, with three sets of hands working their way around a fleece to remove the skirt, jowl, short leg and cheek fibres that are then divided into their requisite bags. The wool classer determines the micron of each fleece and the wool packer mechanically presses fleeces into bales labelled by **micron**.

Buyers are first hand receivers (traders) whereas a *broker* markets the wool (BWMB). The aim is to work with international buyers and assist in breaking down barriers, distribute new information and create a **free market** situation from weekly auctions allowing sales into overseas markets.

The scouring operation has virtually all gone to China and the Middle East with Michells in Adelaide SA being the only Australian company operating in this market. Carbonising plants clean the massively contaminated fibres by adding an acid bath, crushing and heat treatment to the alkaline scouring process to remove seeds, grass etc. from the wool.

Although no longer processing their wool, the Australians are fantastic at **innovation** and using the 2% levy that wool growers pay as an annual subscription, a dedicated team of professionals researches and promotes awareness. A current focus is creating new markets for their super and ultra-fine wools, *next to skin* concept and developing the **comfort and handle meter** measuring machines.

Further information is available at:
http://www.woolcomfortandhandle.com

***Mulesing** is a topical and controversial subject.* **It** involves the removal of strips of wool-bearing skin from around the breech (buttocks) of a sheep to prevent flystrike (myiasis).[1] The wool around the buttocks (if left on) can retain faeces and urine, so tissue that regrows in the place of the removed skin is less likely to attract flies.

Australian recap:

1. Gradual decline in merino numbers is consistent with collapsing wool prices and lower income returns after heavy genetic investments
2. The shift to super and ultra-fine fleece is over-supplying a relatively new market.
3. R&D data is becoming available about the 'next to skin' clothing suited to the mass of ultra and superfine fibre.
4. Increasing numbers of crossbred meat and wool producing flocks incorporate British genetics using rams such as the *white Suffolk, Dorset and Border Leicester*.

8.2. Case Study 2. Kangaroo Island Wool

www.kangarooislandwool.co.au

Kangaroo Island is an interesting case study as these messages are a sound reflection of the political voices echoing from around the globe: locally resourced, regionally recognised, environmental sustainability, cooperative power and family business.

All Kangaroo Island wool producers are shareholders of Australian Wool Innovation. Their wool clip accords with the Australian Wool Exchange (AWEX) code of practice for the preparation of Australian wool clips and they maintain their own codes of practice in sheep health and welfare, management excellence, social good, premium fibre and environmental care.

For further information see this link:

[PDF]Kangaroo Island Wool - Authentic Kangaroo Island
www.authentic**kangarooisland**.com.au/.../**kangaroo_island_wool**_standards....

8.3. The 8th Coloured Wool Congress, France

exposure to coloured wool enthusiasts

Meetings began in 1979 in Adelaide, South Australia, for those wanting to share knowledge about breeding naturally coloured sheep to supply increasing demand for their coloured fibres. Years later this congress is a large international family that meets up on a 5-year rotation across the continents.

In 2015 this was held in Paris and I was fortunate enough to be able to attend. The quantity, content and overwhelming enthusiasm from across the globe for coloured wool sheep and their inherent genetics was an exceptional second chapter of my journey. A common theme with guest speakers from over 20 countries celebrated the fact that wool has many natural abilities, developed centuries ago for preferred useful traits, which eventually created hundreds of recognised breeds.

Maintaining this genetic diversity was discussed in detail: moving away from mass flocks of identical sheep to secure a future for a diverse range of habitats using native sheep breeds.

See Appendices 1 and 2 at the end of this report for fuller details:

- **Content & Countries**
- **Genetic differences** in merino wool growth in comparison to double coated fibres.

Figure 12: Heidi Greb, the German felt maker, who gave a presentation at the Conference

Points brought up at the Conference included:

- "The lack of wool technicians is becoming a major issue." (*Sue Blacker of the Natural Fibre Company in the UK)*
- "Find a yarn that suits your fibre and a product that suits your yarn." (*Sue Blacker*)
- I was the only **commercial** sheep farmer attending as a participant alongside one guest speaker.
- The desperate state of fragmented wool industries is limiting growers, and frustrating those looking to source wool from regional breeds for their specific purposes.

8.4. Icelandic genetics

Farmers use inherent gene pools to select animals for combined meat, milk and wool quantity traits without looking at any other breeds. Every sheep is considered pedigree and individual records date back many generations and include *meat from milk* traits, fleece colour and markings to create a standard double coated fleece with over 40 recognised markings very similar to the Shetland breed.

Double Coated fleece characteristics:

thel (undercoat)	*tog* (hair-like layer)
6-10cm long	18-25cm
20-25u (micron)	40-80u (micron)

Most shearing is in autumn when flocks come back down from the mountains with a heavy, clean fleece and this equates to 70% of the total wool production. The remaining 30% is shorn in spring to create a clean unbroken staple ready for a summer in the mountains. After 5 months the lambs are fit and 90% are slaughtered within a 6 week period, stored in freezers, exported or gradually consumed. This ensures only breeding and replacement animals are fed through the winter months and the Icelandic cherish their young **tender** meat and soft warm wool.

Leader sheep are individuals that guide flocks out of dangerous situations in adverse weather conditions. This superior knowledge is spiritual within Icelandic communities and some even assume the meat sweeter, wool superior, hide and horns lucky - *but perhaps this is just good marketing?*

Facts and figures about Icelandic wool production:

- Sheep produce **25%** of agricultural income on this island
- Wool is predominantly **white** due to a higher price
- 15% naturally coloured is following the **worldwide** trend
- Native colours are increasing in popularity with **hand-knitters** and artists
- Iceland produces 800 tons of **greasy wool** per year (UK is 22000t/year)
- **Government** supports all sheep farmers – see premium in Table 2 below
- Farmers required to **classify** fleeces using grading system from Istex wool factory

Table 2 below shows:
2014 Istex price schedule (showing Icelandic kroner with British pound equivalent), highlighting the Icelandic government support

Flokkur	Istex wool factory price	Government subsidy	Total	
			Kr/kg	£/kg
H-Lamb	310 (£1.61)	**582 (3.02)**	Kr 892	£4.63
H-2 Lamb	280	**558**	Kr 838	£4.35
H-1 Flokkur *(white ewe)*	280	**558**	Kr 838	£4.35
H-2 Flokkur	175	**489**	Kr 664	£3.45
M-Svart *(black)*	220	**512**	Kr 732	£3.80
M-Gratt *(grey)*	220	**512**	Kr 732	£3.80
M-Morautt *(Moorit)*	220	**512**	Kr 732	£3.80
M-2 Flokkur *(damaged)*	90	**140**	Kr 230	*£1.19

*Damaged wool fibres receive more than best fleece prices do from some UK breeds

Figure 13: Poster for the North Atlantic Native Sheep and Wool Conference

Istex is the only processing company and buys the best grade fibres for making their unique collection of Lopi yarns. The tog and thel remain together and blending occurs after over-dyeing, often with a mix of 5 different complementary shades creating a yarn that has a fleck finish similar to tweed. Lopi means to half spin rather than the full tight twist and is possible due to the length of the tog and volume from the thel. Yarns can be light weight *pencil rovings (a long or narrow thread of fibre)* or layered together to create chunky weights. Air penetrates around all the fibres, heats up next to our bodies and as tog fibres are released, these rovings help shed water droplets.

After carding Icelandic wool undergoes a different spinning method and this is due to its double coated fibres

The Lopi is famous around the world and has undoubtedly helped raise the profile of Iceland with over a million annual visitors now coming to see the small island that caused so much air navigation trouble in 2010. The Icelanders are excellent at using their volcanic history to sell a good woollen product adorned with volcanic symbolism. The most impressive collection however, is pure new wool sweaters hand knitted in variations of Icelandic design. Hand-knitters Association of Iceland, www.handknit.is, has a shop full of genuine hand knitted wool garments with traditional patterns alongside seal, raccoon, wolf, fox and mink furs, sheepskins and the more usual tourist gifts.

Retail prices of £150 are average and knitters receive 40% - 60% of the sale price offering a steady income working from home anywhere in the country with little investment.

As the result of one newspaper advert 37 years ago a thriving business exists aiding the sale of Icelandic wool, maintaining heritage patterns, providing jobs and ensuring knitting stays a habit rather than just a hobby. Many knitters complete an adult sized jumper in a few days and it's normal to look to source a range of 16 sweaters a month per knitter from members of the above or the Alaflos hand-knitters associations.

8.4.i. The 4th North Atlantic Native Sheep and Wool Conference: Blondous, Iceland:

This event had previously been held in Shetland and Orkney and will take place in the Faroes in 2015 and, as its name suggests, refers to a group of sheep categorised as the 'short-tails' - **see Appendix 3 at end of this report for further details.**

Discussions arose around processing volumes and for a second time I was disappointed to be the only commercial British sheep farmer attending a wool conference. The vast majority of attendees were smallholders, artisans, or had an economic relationship with the textile industry.

The North Atlantic countries participating were the Faroes, Greenland, Iceland, Hebrides, Norway, Orkney & Shetland

After the conference I stayed at the Textilsetur Islands Textile Centre to learn how to invite students and artists to book into residency at our farm. I also discovered a room full of looms and enjoyed my first experience as a weaver.

TEXTÍLSETUR ÍSLANDS
Icelandic Textile Center

Figure 14: A room full of looms at the Textile Centre

8.5. Strong wools from Norway

The Campaign for Wool was briefly discussed in Iceland but it barely referred to northern countries and thus I decided to visit Norway during their first **Wool Week**.

With a long history of native sheep and a relatively new tradition of white commercial ewes, flocks average 200 ewes in the Bergen area. Farmers, who are often ladies, are instructed to remove dags and pack 5 fleeces per bags separated individually with paper to *enable wool graders at the depot to remove Individual fleece and further sort at the* Farmers' Co-operative ***Norilia*** */ Nortura.*

Fatland is a private company trading wool and together they purchase all Norwegian wools with the majority exported and sold outside Norway.

An important message - British genetics are behind the commercial white wools, and breeding ewes produce the highest premium at 31.4 average micron, with 90% processed as carpets.

The 10% of the wool production that stays in Norway is a popular **versatile** knitting yarn due to its strength, shine and **bounce,** and is trusted to be hard wearing and warm. Old Norse, Spaelsau, and Pelssau breeds are also reappearing and Hillesvag Woollen mill, near Bergen, became a thoroughly engaging place to base myself from during Norway's first Wool Week.

8.5.i. Wool Week in Bergen

This started in 2015 after a passionate artisan travelling to share valuable skills recognised the global potential for enhancing the Norwegian wool profile. This resulted in a collaboration of educational demonstrations, historic re-enactments, and modern workshops making traditional items and informing the younger generations about the value of woollen products.

Local artists are frustrated with cheap alternatives using the Nordic brand image to sell fake imported wool items to tourists

I gathered the messages below and the highlight was using native breeds and the marketing of wool products:

- ✓ Wool remains a highly respected commodity and many continue to knit and wear their ritual Nordic knitted jumper
- ✓ Fashionable trends for felting uses coloured carded fibres to make the traditional slipper, along with interiors, luxury garments and fashion accessories
- ✓ Yarns sold in conjunction with patterns are a popular addition in the wool shops as gifts ideas along with other innovative ways to rebrand knitting as a modern craft and art medium.
- ✓ It is generally considered that the campaign for wool is country-specific and is welcomed across European countries
- ✓ Separate machinery enables fibres to be 'spun in the grease' maintaining lanolin for socks

Figure 15: Four generations at the Hillesvag mill started by their grandfather's ambition to create a wool mill using hydropower.

8.5.ii. Case study 4. Clemente *Slippers*

Clemente is an unusual business and one that demonstrates how truly global our modern society has become. Using strong wools from Norway, scoured and carded at Hillesvag, an entrepreneur has created a business with a shoe making family in the Philippines to utilise their hand-made shoemaking skills, provide income, job security, a new school and community centre and it employs over 30 in the local Philippines village. In return the famous Nordic slippers are sold throughout Norway and Copenhagen with full traceability and a transparent agreement that helps provide a worthwhile product to those who want to know more about what they are buying. A perfect scenario it seems.

Figure 16: Fernhill Farm sample hangers destined for Copenhagen

8.6. Copenhagen fashion houses

The Danes have a saying: "*No-one can save everyone, but everyone can save someone*", and Copenhagen boasts 10 yarn shops, the Sustainable Fashion Academy, The Nordic Initiative Clean and Ethical (**NICE**) fashion source, and the origins for **the Environmental Profit and Loss** accounts. See chart (Fig 14) on next page.

> *"Quality is really important for Scandinavian people, so they are willing to pay more for something that will last, rather than spend money on cheaper items that won't stand the test of time". NICE*

The Danes are committed to protecting the environment with their purchasing powers, building stronger more resilient communities with fewer high street brands and more individual ***ethical*** *businesses that educate their consumers.*

This statement is evident when observing their shopping:

1. Rug and carpet shop with the name of the village where they are made and how the purchasing of these rugs helps a school in India
2. Prestigious alpaca and cashmere shop with photos of Peruvian Alpaca farmers and knowledge about their Scottish cashmere suppliers
3. Children's clothing shop with quality woollen and sheepskin products - only the best will do for their children
4. Faroes Islands wool is purchased as spun yarns, shipped over to Lithuania for garment manufacturing, then returned to Copenhagen for sale detailing the origin of the fibres.

The **Environmental Profit and Loss** is similar to the DEFRA **Sustainable Clothing Road Map** as both these *tools* help with creating a range of woollen products.

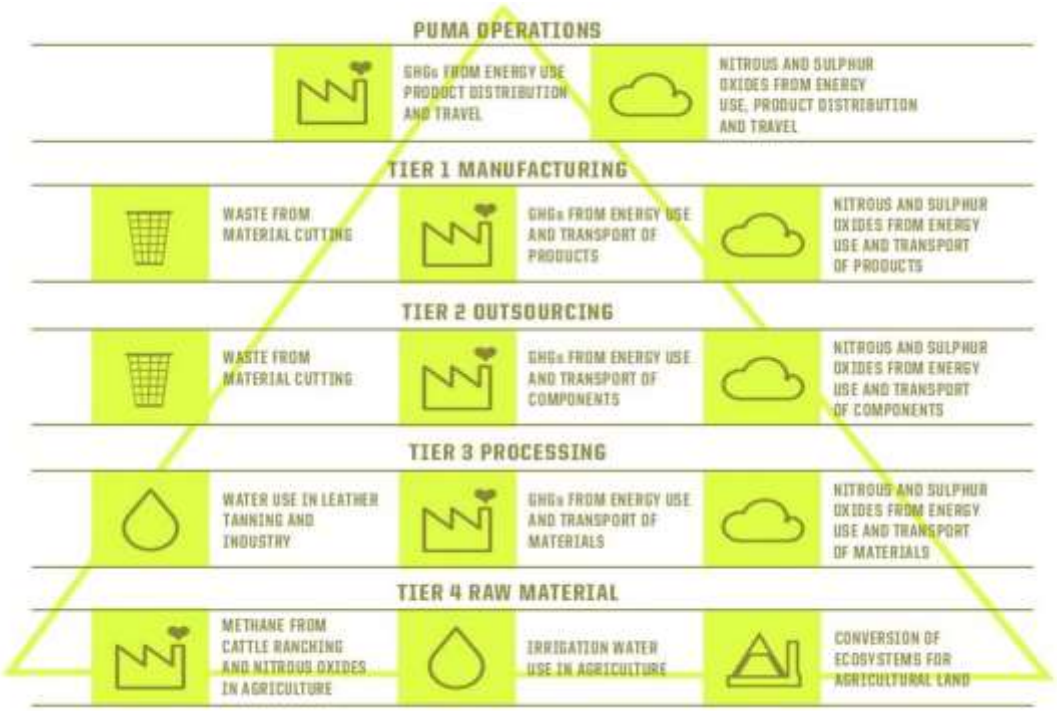


Figure 17: PUMA Environmental Profit & Loss Life Cycle assessment.
(PUMA Handbook on Environmental Management) **http://about.puma.com/en**

In addition to all this, meeting the Director of Fabric Source, Suzi Christopher, clearly illustrated the demand from fashion students and designers looking for locally grown wool. They are interested in a sound ethical story, request mulesing-free merino yarns and, importantly for Fernhill, there is a big demand for naturally coloured fibres to enable a movement away from chemical dyes.

Standards are set high with the Danish Fashion Institute (DAFI) and its members churning out messages like: ethical and practical, affordable to all, suitable for every occasion and encouraging an active lifestyle - wool is an obvious fibre of choice.

There were issues concerning minimum quantities from supplier to designer, and it was agreed Fernhill fleece wool samples would be welcomed within the Copenhagen fashion industry fibre sample display. They also showed an interest in their students visiting Fernhill at shearing time to truly understand the origin of our wool.

8.6. Italian connections

During a family holiday to Italy we stayed at Chianti Cashmere goat farm. Annual combing, separating fibres, processing and selling this product is a full time occupation, and with no meat for sale all income is derived from a maximum 1kg fibre per animal each year. Soap, yarns, postcards and books were also available along with delicately woven and knitted garments. I wear a lot of cashmere and fully understand the true cost of this delicate fibre.

Figure 18: Fernhill samples ready for Copenhagen fabric source

8.6.i. Biella the wool company – Italy

This newly formed wool processing company provides a complete processing service for many European countries that have limited options for spinning their fibres. This is an

attractive offer to producers looking to add value and create products but have little time and knowledge when making logistical decisions.

Biella has a long history with fibre processing and this networking business offers variable options to have greasy wool **commission spun** into yarn, felt, blankets or fabrics. Production volumes dictate the product options and the objective is to offer a one-stop processing service within a 30-mile radius around Biella.

Biella The Wool Company in Italy will host the next Coloured Wool Congress in 2019.

Figure 19: illustrates the connection with 12 other organisations who are collectively delivering the Wools of Europe travelling exhibition

8.7. International Wool Textile Organisation (IWTO) Brussels

The **Multi-stakeholder meeting** at the end of 2014, with nearly 90 delegates attending from 17 countries, seemed the perfect way to finish an incredible year of travel.

This captured all the **innovative** ideas I had seen and brought to my attention the latest developments:

- ✓ **next to skin** concept I had discovered in Australia
- ✓ Nordic consumer preferences in recycling, reusing and **non-blending** wool fibres
- ✓ Fire-fighting and Personal Protective Equipment (**PPE**)
- ✓ Using wool for interiors and fire safety due to its **flame resistance**

- ✓ **Biodegradable** properties
- ✓ Biosecurity and a new ISO standard
- ✓ **Life Cycle Assessments (LCA)*.** Understanding wool's environmental performance

LCA (see line above – Life Cycle Assessments) - is designed to monitor the environmental footprint of a wool textile product, considering every implication from raw material to finish product and, importantly, secondary use abilities.

The extract below recaps the IWTO messages:

USES OF WOOL

- Wool is a multifunctional fibre with a range of diameters that make it suitable for clothing, household fabrics and technical textiles.
- Its ability to absorb and release moisture makes woollen garments comfortable as well as warm. Two thirds of wool is used in the manufacture of garments, including sweaters, dresses, coats, suits and "active sportswear".
- Blended with other natural or synthetic fibres, wool adds drape and crease resistance.
- Slightly less than a third of wool goes into the manufacture of blankets, anti-static and noise-absorbing carpets, and durable upholstery (wool's inherent resistance to flame and heat makes it one of the safest of all household textiles).
- Industrial uses of wool include sheets of bonded coarse wool used for thermal and acoustic insulation in home construction, as well pads for soaking up oil spills **www.iwto.org 2015.**

At every international congress, conference and meeting I have been to during my research, overwhelming passion for wool fibres has been displayed and professional delegates from many industries have attended.

8.8. Indigenous Mapuche weavers of South America

A final expedition to *The Mapuche weavers of Chile* showed me traditional wool processing standards. **www.witralchile.com** (*Witral, meaning weaving in the Mapuche language,* encourages ***Fairtrade that "makes handcrafted friendships"*** by linking local wool growers, artisans, and independent processors with the formation of Fairtrade business objectives.

Through a shop in Santiago, affluent influential city dwellers purchase hand crafted woollens that carry old traditions forward through the creation of new-style interiors, rugs, cushions, wall decorations etc. Ancient symbols and natural dyes are encouraged, with central marketing outlets, training workshops, government funding purchasing new weaving equipment and, most importantly, *the link between consumers and suppliers.*

I am not convinced who has the better standard of living all things considered – Chileans or Brits - but do believe we have to take a few steps back to see where the future lies with wool processing.

An issue I recognised is the request for natural plant dyes and the problems associated with harvesting, consistent shades, and the additional costs in order to be able to offer non-toxic wool products.

Discovering lady farmers and hand weavers, a long way from the tourist track, made a huge impression and reinforced my vision that quality is key with our own product development at Fernhill:

> Buy once and buy the best, knowing where your woollen treasure originates from, and the story behind the item. Give the name of the skilled artisan earning their living making superior luxury items that give us internal warmth when we buy and are admired every time they are worn.

Figure 20: Suffolk X fibres: machine carded, hand dyed & spun. Modern/traditional techniques in Chile

Figure21: www.witralchile.com Design & Innovation, Cauquenes in Chile creates income generating projects at grass root levels

Mapuche tradition stated that women created protective and useful gifts from soft substances like clay and wool as they themselves offer soft life giving opportunities. Men created from hard substances like silver, wood and stone to reflect their strength, status and reproductive offerings.

The Poncho style coat is a popular item to copy, but the old methods always sell at the highest prices

I was impressed that wool in Chile was displayed with their prized fresh produce, dried healing herbs and was right at the heart of the fiesta.

Figure 22: Alejandra with 4.5kg Poncho. 80,000 Pesos or £75.

Commercial white wool is prized in Chile for knitting and weaving: to create trusted strong hard wearing garments that are appreciated for their warmth and durability.

Natural dyes and herbal drinks are still an important part of this culture and government initiatives are supporting new business opportunities and relocating Mapuche communities, subsidising facilities to dry, store, pack and sell medicinal herbs, alongside natural dye plants.

Mechanical carding machines are becoming available and the creation of networking opportunities to share wool craft skills and build working relationships with artisan and commercial retail outlets in cities like Santiago are all assisting the indigenous Mapuche farmers to gradually regain land and empowerment.

continued on next page

Figure 23: This photo is a miracle - because once every year this elderly couple load up their annual wool clip on their oxen cart to spend a day by the river washing their wool – and I was there to capture it! A moment later he was answering his mobile phone!

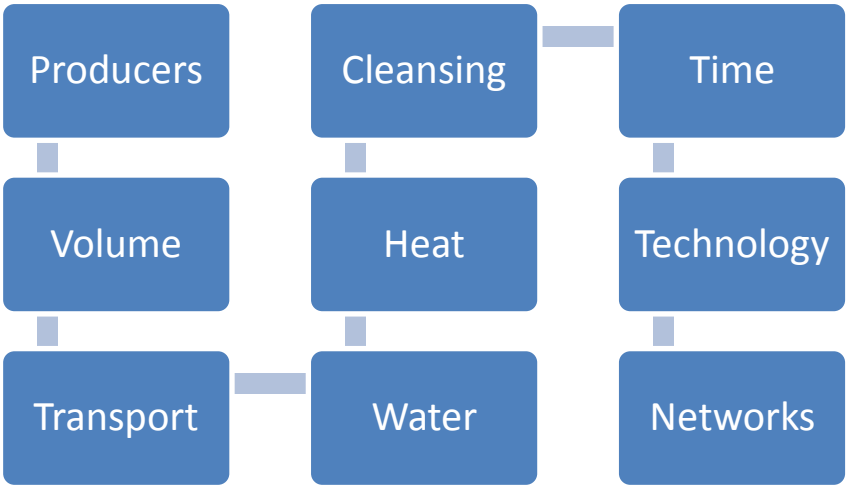


Figure 24: The essence of all my research

8.9. Patagonian sustainable wool

Fate has always arrived at opportune moments in my life and this time it brought me to stay on a farm in Patagonia recently acquired by two teachers from the *Savory Institute* (based in Colorado) who are jointly responsible for the set-up of **OVIS21** with other South American fibre producers.

- ✓ **Ovis 21** is **a B Corp** *www.Bcorporation.net* dedicated to the regeneration of grasslands and increasing the profitability of businesses
- ✓ It provides training, consulting and product certification services
- ✓ As a hub of the **Savory Institute** it specialises in **Holistic Management** and has great experience in sheep and wool
- ✓ It´s developed and manages a network of innovative land managers, technicians and related industries to **improve** the economic, ecologic, social and human sustainability of families, **businesses** and communities. www.ovis21.com

Discussing conservation grazing and grassland restoration principles using large mobs in **short rotations** allowing adequate **pasture resting periods**, along with alternative shearing dates (**pre-lamb** shearing) chimed with our own similar management approaches.

Soft Rolling Skin (SRS) in the Multi-Purpose-Merino (**MPM**) was however a very new concept - the practice behind this principle of growing meat and wool **(50:50)** from a Merino breed is selecting for skin attributes rather than its fleece growing ability. **SRS** is detectable with touch as the secondary follicles are the same size as the primary (hair) follicles, and are more prevalent in the merino breeds.

Meat and wool traits are known to have negative correlations - selecting for improvements in one trait reducing the production trait of the other and vice-versa, alongside other complexities such as prolificacy and natural mothering abilities.

MPM overall aim:

1. Reducing 1 micron/year - 18 microns as target
2. Wool classified at shearing
3. Prime meat production
4. 8 month shearing rotations = 3 clips in two years
5. Holistic grassland restoration

Surveying the skin – as opposed to fleece weight and fibre diameter - has been monitored for the last 12 years with positive correlations for meat

"Wool is free when you produce meat"

Three Organisations created the *Sustainable Wool Programme* and the **6 Million Hectare Campaign** which relates to wool grown from sheep holistically managed to restore and preserve the grassland in Patagonia, Argentina and Chile. The end result is a Patagonia Ltd woollen garment with fibre traceability and a transparent lifecycle assessment, an Environmental Profit and Loss to boast about, plus consumers paying a higher price that they themselves have demanded knowing that what they are buying is helping rather than hindering our struggling planet.

Figure 25: Organisations behind the sustainable wool programme

9.0. Topics for discussion from countries I visited

Wool is still considered the world's leading natural animal fibre (*IWTO 2015*), yet is a niche product in terms of volume produced. These figures however, do not indicate the entirety of wool present within total textile volumes and my research has shown that across all the available textiles, wool is a treasured lifelong fibre that stays with humans throughout their lives and in some cases to their grave. *This habit could be true for other textiles in regional societies but it has become strikingly obvious to me that wool has a positive relationship with our delicate human skin and this is why we cherish this luxury fibre.*

Evolution - The migration of sheep across the globe developed traits for survival with subtle differences in size, composition, and temperament and, throughout 10,000 years, man's ability to domesticate, consume, harvest and spin wool for clothing resulted in very few places where we could survive without a sheep by our side.

Symbiosis - Sheep and wool are an essential part of Icelandic culture and form part of their heritage breeds along with cattle, chickens, and horses. The Icelanders have maintained a thriving woollen industry by understanding their double coated fleeces and thus creating a bespoke yarn that complements both qualities of fibre. Warmth is essential and their half-spun lopi yarn is a worldwide export commodity and it appears everyone in the country has traditional jumpers, often made for them in unique pattern and colours.

12th century Mapuche weavers believed women created goods from soft material like clay and wool and men made gifts from solid substrates like metal and wood to signify the role of the organs. Woollen gifts were made for men and offered protection from harsh environments, and the poncho is a fine example of these ancient offerings and creates a strong South American image. This working garment is now a luxury tourist item appreciated for its decorative warmth.

From an external perspective Patagonia's relatively short farming history and network of tourism routes offers excellent business opportunities. However danger is lurking, and unless the Alan Savory message "*mimic nature with nomadic grazing animals*" is introduced effectively then there is a real risk that desertification could continue, and I wish OVIS21 every success in leading their directional grazing concepts. Land improvements and long term environmental gains are potentially possible if the 20% premium wool price filters down from the Patagonia Ltd Sustainable Wool project to the committed farmers.

In recent decades genetic improvements are linked to either wool or meat production but innovation in the southern hemisphere is showing a shift to dual production traits using the MPM breed. The soft, rolling skin concept is of major interest to avoid the negative correlation with improving wool traits, maintaining carcass confirmation without disrupting the natural ability of sheep to thrive in changeable environments. However, to grow meat, sheep need grass in front of them and as British sheep farmers we have to be thankful that we have ample supplies here in the UK.

Researching large scale commercial sheep farmers investing in genetic selection for wool traits is testimony that merino fibres produce a highly specialised commodity compared to our European meat sheep fibres. Australasian shearing and wool classification is an inspiration, with routine on-farm grading adding value to their wool clip for export into specialised markets. British sheep genetics offer unique opportunities for growing the world's leading natural fibre, requiring innovation and connective marketing.

Wool does not receive direct government support in the UK and has been considered an expensive by-product when selecting sheep breeds. In contrast the Australian Wool Innovation (AWI) operates a system where each fibre grower is required to submit a 2% levy and subsidies are available in several wool growing countries to maintain income from sheep enterprises. The UK needs to regain faith in this wool as a resource and invest in R&D.

Atelier and Biella the Wool Company highlighted the fragmentation of wool industries in Europe and many other countries I have yet to explore. Added interest in ecological processing, regional wool from specific breeds, and sheep farmers realising the potential from wool, offer an entrepreneur real opportunity with direct marketing. "Made in UK" products and services are required to satisfy the desires from our own increasing middle class as well as wealthy overseas nations.

I would like to finish this discussion by highlighting that authentic local **wool fibres** are for sale in Icelandic garages and supermarkets and the following airports - Iceland, Norway, Chili, Argentina and Australia: all successfully using provenance as their Unique Selling Point.

Figure 25 : This ancient loom in Chile is built into the side of a house. But modern homes are too small

10.0. Innovation in 2015

act or process of innovating new methods or change

This table includes concepts I have discovered on my Nuffield Farming travels where wool is behind the primary design principles:

Innovation	Country / Region	Product specifications	Industry
Genetics – GIVETS, MPM, SRS, Ultra & Super fine Merino	**Australia – NSW, SA Patagonia & Argentina**	*Dual purpose meat & wool sheep, improved genetic gains in breeding stock, <16 micron wool fibres*	Agriculture, Genetics, Breeding
Diversity – conservation of endangered sheep breeds	**Europe, USA, Norway**	*Maintaining old genetic pool for future reproductive and survival traits in changing environments*	Rare breed societies, Agriculture
Conservation Grazing	**UK, Norway, Patagonia**	*Using sheep to manage landscapes for biodiversity, habitat management & grassland restoration*	Agriculture, heath lands, biodiversity
Shearing & efficient wool harvesting	**UK, Iceland, Norway, (**New Zealand)	*Blade Shearing , shearing pre housing, post housing, pre lamb, autumn lamb and ewe shearing*	Agriculture, wool pre-processing
Next to skin wear / cool wool / wool bed wear / sports wear	**Australia**	*Lightweight garments promoted as protective, comforting and heat regulating all season garments*	Textile – apparel Marketing
Campaign for Wool	**International**	*Initiative to create awareness about wool fibre attributes and regain wool prices*	Campaigns, publications, Trade
Comfort & handle meter tests 2014	**Australia**	*Consistent testing for long life wool garments demonstrating anti-pile and wear-ability performances*	Textile research
NICE Fashions	**Norway / Nordic countries**	*Recycling, reusing, awareness blending fibres during processing*	Sustainable Textile fashion
Processing Natural Fibres - mini mills, felt loom, needle felt machine	**UK, Norway, Belgium USA**	*Specific mechanical equipment for small scale production of carded batts, rovings, yarns & felt (3-30kg batches) for all natural fibres*	Design and Manufacturing
Clemente Felt Slippers	**Philippines, Copenhagen & Norway**	*Danish Company designing handmade felted wool slippers & shoes using Norwegian wool*	Wool Processing, Export and manufacturing
Fibreshed	**California with SW UK affiliated contact Emma Hague**	*Regenerative textile culture, responsible clothing, online & farmers markets*	Providence, workshops, Membership
Working Wool 2012 * Bristol Textile Quarter 2014 Emma Hague	**Bristol & SW, England**	*CIC offering workshop space, equipment and locally sourced yarns and cloth for Bristol textile community*	Textile Merchant, workshops & networking
Halifax Spinning Mill 2009 * "Your Imagination is our Inspiration"	**Goole, East Yorkshire, UK**	*Specialist spinning mill focusing on customer satisfaction and experimenting with UK breeds to create batts, slivers and pencil rovings*	Wool Processing Industry, advice

BAA RAM EWE, Black Bat, A Yarn Story, Alterknit Universe	**Leeds, Redcar, Bath & Cleeve, SW near Bristol.**	*Specialist fibre shops selling mainly natural yarns from British breeds and blended yarns*	British yarn retail
Botanical inks *	**Bristol, UK**	*Plant pigments to colour wool using local resources – food waste, weeds, native plants*	Natural dyes, Workshops
The Knitting Gift Shop	**North of England**	*Products sourced from the North of England, 100% natural and undyed*	On-line retail
The Bristol Weaving Mill * (Dash & Miller)	**Bristol, UK**	*Weaving mill commissioning cloth production specialising in British fibre*	Cloth manufacturing
London Cloth Company – Daniel Harris	**London**	*Weaving mill commissioning cloth production specialising in British fibre*	Cloth manufacturing
Biella The Wool Company	**Italy**	*Wool processing chain developed exclusively for small European & international wool growers*	Wool Processing and Textile Manufacturing
The Icelandic Textile Centre	**Iceland, Blondous**	*Promote Icelandic & international textiles via educational seminars, art & design research within a workshop open residency space*	Education, Research, Art & Design, internships
ATELIER – Wools of Europe	**12 European Countries – founded in France 1989**	*Collaboration offering tuition, courses and incentives to add value to heritage sheep breeds through promotion of wool and cheeses. Travelling wool exhibition, ecological wool scouring conference*	Wool and craft industry, growers and processors. History and museums
Events – fibrefests, wool weeks, pop-up shops and shows	**International**	*Multitude of events, demonstrations, seminars selling wool to consumers*	Events, Education, Retail ,
Suzie Gutteridge – Passion, Protection & Preservation for the Environment	**Salisbury, UK**	*Textile artist sourcing local wool fibres for art installations, historic re-enactments*	Artisan tutor
Rebecca Macdonald	**Cornwall, UK**	*Textile artist commissioning wool felt creations using wool stuffing*	Artist
Vikingold	**Norway**	*Creation of 400AD smock using the old Spael sheep breed*	History, Museums, re-enactment,
Witral (Weaving)	**Chile, South America**	*Government supported initiative to share skills and equipment to empower rural women's groups in the production of wool textile*	Government, Education, History, SME
Innovation in the Wool Award 2016	**Worshipful Company of Woolmen, The Company of Merchants for the Staple of England**	*£5000 Award dedicated to commercial innovation using wool fibres*	Research and Manufacturing SME
Belacouche	**UK, Devon**	*Award winning wool coffin maker*	Artisan, & luxury craft

The Wool Packaging Company	**Shropshire, UK**	*Reusable heat regulating felt to transport medicines, food and farm meat boxes*	Health care, transport & logistics
Wool insulation, acoustic sound clouds, drapes	**UK - none specific**	*SME businesses incorporating wool fibres to create safe building and sound absorptive materials*	Building and Health & Safety
The Bean Bag Company	**Meare, SW UK**	*Local company making covers interested in wool stuffing*	Manufacturing Luxury items

** The Bristol Cloth project is an amalgamation of local businesses incorporating fibre shed principles to offer the citizens of Bristol a chance to design its own cloth as part of the Green Capital of Europe 2015*

Figure 26: Fernhill wool samples ready for European Wool Testing Authority based in Wales

11.0. Microbial wool washing

Microbial wool washing is the term used to describe the washing of wool without incorporating any detergents, soaps, heat, agitation or mechanisation. This concept is similar to **Suint Fermentation** and relies on a natural fermentation cleansing process that occurs when temperature, water, feed and time allow microbes to reproduce by feeding on nature's waste. My own experiment at Fernhill Farm involved submerging fleeces in rain water for a period of one to three weeks depending on temperature inside the poly tunnel.

The Atelier d'Laines Conference, "Wool scouring in Europe – urgent and ecological solutions", explored this concept amongst other processing issues with 15 European countries. Scouring removes 30% - 60% of the total fleece components that are considered as a waste product by the processing industry. I personally believe these to be beneficial nutrients that form part of our wool crop. When wool is washed on the farm, these nutrients are in the best location to be useful and microbes from chemical-free cleansing are active when applied to soils. Biogas, fertiliser, lanolin and fibre are all available resources from this method and wool is sold or processed by the kg, so can we maximise our returns from sheep and wool production?

The Process:

1. Rain water is collected in large non-corrosive containers with loose fitting lids -drinking/tap water is not recommended as it contains chorine and fluorides which alter natural microbial reproduction.
2. Greasy fibres are submerged in the rain water and left to ferment over a period of one to three weeks depending on external temperatures.
3. Fermentation occurs as microbes present in the atmosphere multiply by feeding on body grease and sweat (**suint**), traces of urine and faecal contamination within the fleece fibres.
4. After the *natural soap** [1] conditions occur, fibres are removed, rinsed with rain water and dried.
5. The rinse water creates the microbe rich water ready for the next fleece.

The result:

- Fleece fibres that smell fresh and clean, feel dry (not greasy) with traces of lanolin
- Fibres are open, straight with a structure virtually identical to greasy fleece
- **Nutrient rich water as a liquid plant feed resource?** *(See photo on next page)*

The conclusions I have gained so far:

1. This method of cleansing is suitable for open fleeces with limited surface contamination - bellies, skirts, and felted fleeces require longer cleansing times to allow the microbes to cleanse the surface of each individual fibre.

[1] ***Natural Soap occurs when fibres are surrounded by microbes and visually create a muculant texture***

2. Rinsing fleeces using rainwater is sufficient and this creates the next batch of water ready for microbial wool washing.
3. Water can be used three times and offers a faster cleansing period as sufficient microbes are already present and start multiplying immediately.
4. Lanolin is still present on fibres as a dry soft wax.
5. Fleece structure is maintained and despite the water being pungent during agitation and rinsing, dry fibres have no undesirable taint other than a satisfying natural sheep aroma.
6. Drying is achievable on racks with daily movement in the poly tunnel.
7. Warm water (+41^{o}C) rinsing is an option to remove lanolin if required.
8. Nutrient-rich water is available on three week rotations and is best applied directly to the soil between rows of plants.
9. Microbial water is recommended from secondary leaf, reproductive and other recognized growth stags to enable maximum nutrient uptake.
10. Diluted water is recommended for seeds, seedlings and direct plant applications.
11. Dirty (dag) fibres are useful for young plants to maintain moisture levels above the roots and create an absorptive pad to distribute liquid feed applications.
12. Water tests are required to detect chemical residues from sheep products and nutrient levels.

Radish on the left received microbial waste water at two week intervals.

Radish on the right received just grey water throughout this trail.

Evidently shows increased leaf growth, height and vigour in plants receiving active microbes present in the water after washing raw fleeces.

Fernhill Farm 2015.

Figure 27: Growth trials in my own poly tunnel

11.1. NTS Certificate in Sustainable Agriculture

behind every mineral is a microbe

The NTS Certificate in Sustainable Agriculture is awarded by Nutri-Tech Solutions and acknowledges *active participation in a 21st Century agricultural revolution where we have finally come to realise that plant, animal and human health are governed by soil health*.

I attended this four-day course in Hereford to assist my understanding of the microbial washing process and was also interested in modules covering mineral and microbe management, plant, and pest management practices whilst linking all these to subsequent human health. Never previously having studied soil at these levels, it continues to be a rewarding experience for me, understanding that "*behind every mineral is a microbe*" (*Graeme Sait 2014*).

12.0. Discussion

7 steps @FernhillFarm1 till the year 2020

My journey set out to investigate the processing of wool and has looked at: the role of grassland management, defining genetics, improving harvesting techniques, design and product specification, entrusting British manufacturing - and concludes with a genuine message about product safety to consumers.

1. UK Sheep Industry:

In the UK we currently see <10% of the total income coming from wool sales and subsequently little genetic selection occurs to enhance wool traits other than reducing yellowing stains, contamination and observing total annual weights. Recent price increases have inspired intuitive responses for improving the annual wool clip and BWMB have introduced the *Excellent Clip Presentation Certificate* to encourage growers to consider their attention to detail. This is a step in the right direction but we consider the BWMB as the last rather than the first option for selling our own fine coloured fleeces.

UK farmers are responding to changing land **management** techniques and altering genetic selection parameters to suit market trends. The current shift in farm size and business objectives here in the UK is opening up new opportunities for shepherding businesses, such as winter grazing on larger dairy farms, grazing solar parks and within conservation and habitat restoration schemes. Incorporating the holistic grassland management systems (large mobs in designated areas for short periods) allows extended regrowth periods within annual and short-term grazing agreements.

Diversification and innovation are linked to management systems and those with a long history often find it more difficult to make changes whilst those with a shorter history are prepared to try new concepts more quickly. Andy is an ambassador for blade shearing and gives young apprentices from every background equal shepherding opportunity to learn valuable husbandry, land management and business skills for the future. Understanding new scientific and technical **data** is essential and the UK's 60 breeds continue to offer dual purpose productive traits - this genetic diversity should be preserved.

2. Genetics:

Grass roots and wool follicle roots showcase the origin of **holistic** management principles. Primitive sheep represent 0.3% and long wools 0.1% of total breeding sheep numbers in the UK *(Kennard 2015)* and thus Fernhill fleeces are a rare commodity. Native colours are part of the genetic makeup of all sheep but white dominates the market due to its perceived finer fibres and pure white cleanliness; but it creates the misconception that sheep should be white. We are confident that our Romney x Shetland genetics can offer us a dual purpose colourfully diverse breed.

3. Harvesting techniques:

Blade shearing is a useful method of pre-lamb shearing that coincides with normal fibre breaks, maintains adequate skin cover and does not strip lanolin from the fibres left on the skin during shearing. Fluctuating energy intakes, nutrient absorption and redistribution imbalances can create

tender fibres and this procedure can aid mothering abilities when ewes seek shelter in adverse weather. Fleeces lose potential value from contamination, identification spray marks and physical damage.

Reports that machine shearing in the summer months creates extra-sensitivity to harmful UV Rays limits the ability to graze and reduces milk production in peak lactation, creates considerable lamb stress at gathering with subsequent loss of productive days.

It's also a recognised fact that cutting wool, hair or grass encourages regrowth **volumes** and autumn-shorn lambs grow well after shearing and create less management issues - short fleeces dry quickly in windy weather, whereas long fibres are easily entangled in mud and hedgerows.

4. Industrial process:

The creation of most synthetic fabrics mimics natural yarn behaviour but as yet, no man-made fibre can maintain the elasticity, texture or beneficial **resilience** of wool. Innovation occurs when we observe market trends, listen to consumer and media messages, share ideas and take positive actions to supply wool into specific industries. **Marketing** requires research and we can now begin to trail the concepts I have gathered on my travels.

5. Microbial wool washing:

Liquid plant food can be obtained from fermentation. Cleansing and growing experiments have demonstrated the concept that behind every mineral is a **microbe**. Sheep grow wool and lanolin together and early processing separates these two resources. Chemicals and heat change fibre structure and require the addition of synthetic substrates which effectively mimic the benefits of lanolin. The most **polluting** industry in the world is agriculture and the second is the production of textiles. Fernhill Farm incorporates renewable energy solutions to maximise our resources and the discovery of LCA, EP&L, and DEFRA's *sustainable clothing roadmap* provides the guidelines we need to consider when designing woollen products.

6. Collaboration:

The continued drive from the BWMB, aided by the support from the Campaign for Wool and consumer **awareness** about farm products is making a difference. I have often been the youngest attendee at wool events and am delighted to discover a diverse range of sheep farmers, natural dyers, weavers, textile students, product developers, on-line marketing and sales, event organisers, and fashion designers on my travels. We are all ladies of a similar age from very different backgrounds with a passionate belief that wool is definitely worth the investment. Trusting my genuine holistic approach along with DEFRA's *stages of environmental concern,* ethical decisions will be solicited right from the beginning. **Manufacturing in the UK** is steadily increasing and successful off-shore economies have created a new wave of consumers trusting our woollen heritage. Three new natural fibre outlets and a wool fair within 15miles of our farm gate are selling local British yarns and, with our own online shop we can become a stockist for a range of native unusual yarns.

continued on next page

7. Messages:

We have excellent **venue** facilities to host wool events showcasing *farm to yarn* activities, through to finished fabrics that expand knowledge and skill-based learning opportunities. After years of offering workshops in *pre* and *early* processing we are confidently moving towards combining education with resource awareness and availability - textile designers need to be aware of product safety and understand the impact of consumers' purchasing powers.

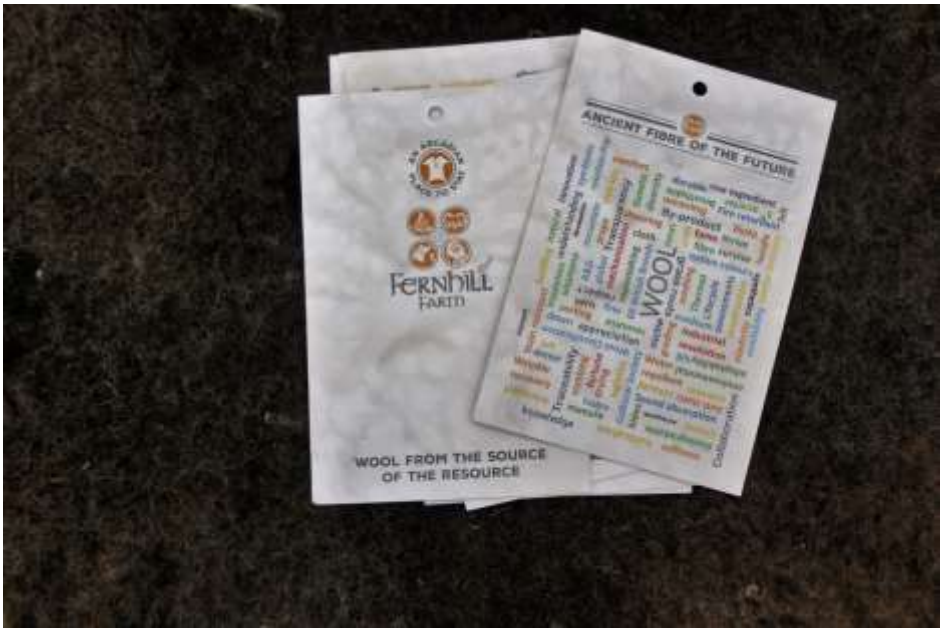
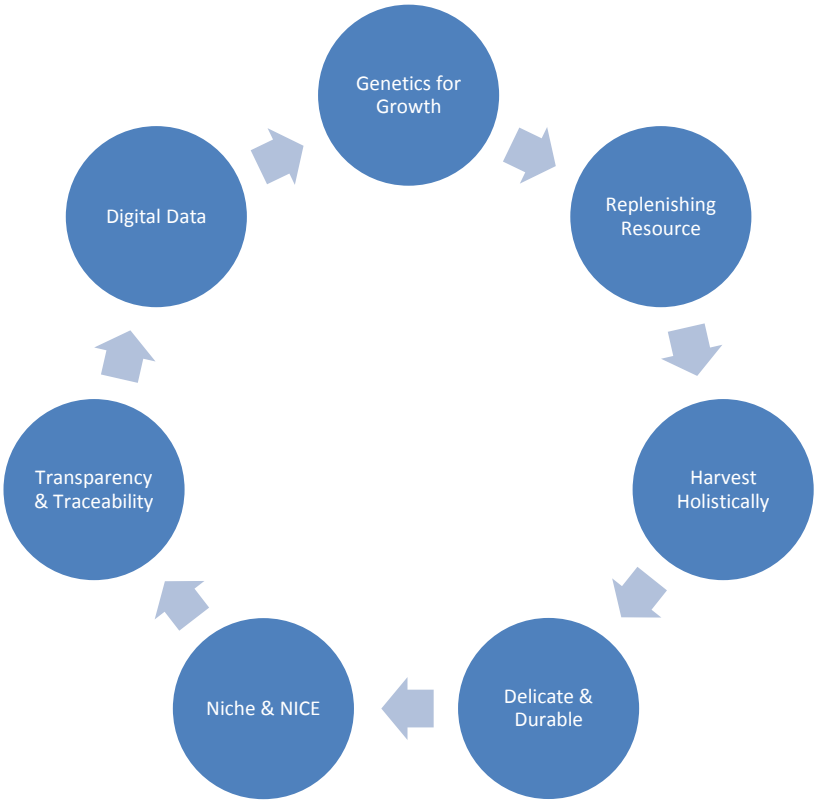


Figure 28: Wool word cloud creates an educational message for selling wool products from Fernhill Farm

13.0. Conclusions

colourfully diverse, abundant, protective, comforting and temperature-regulating whilst providing a durable long-life textile

1. Sheep are equipped with the **genetic** diversity to thrive on every continent with exceptional returns: human innovation must **harvest** these **holistically** at every level of production, processing and cultural society development.
2. Fernhill **grows** fine lustrous fleeces that are a unique **resource** within a **niche** market: produced from a **replenishing** source in native shades, the *quantity* and *quality* of our fibres are essential elements for defining speciality products.
3. Wool fibres are **delicate** animal proteins and present-day processing and blending of fibres is of paramount consideration for secondary uses of woollen products.
4. Incorporation of **NICE** parameters, fibre **traceability** and **transparency** with processing system offer *unique selling points* with the development of woollen products from Fernhill Fleece.
5. Excessive exposure to **digital data** suggests consumers require simple knowledge-based messages to understand the power of their purchases.



14.0. Recommendations

Trial – Test – Time

1. The soft rolling skin concept is a highly commended trait to adopt when genetically selecting sheep for finer wool qualities. The downside when improving wool traits is that carcass conformation can be adversely affected: but SRS can significantly reduce this, and the principle can be carried out by hand without the need for expensive recording equipment. (*See Chapter 8.9)*

2. Sorting and grading fibres at shearing demonstrates commitment to buyers and I recommend wool grading tables are used to enable fibre colours and qualities to be quickly and easily divided by trained wool handlers.

3. When looking to sell wool privately I recommend trialling the WTA service (*see Chapter 6.2)* to obtain specific genetic and marketing information about fibres from various breeds.

4. Monitor production and processing volumes to benefit from economies of scale.

5. From my own time and experience in dealing with individual customers I highly recommend creating purchasing options. Consumers will invest in top quality resources using on-line and direct marketing sales.

15.0. After my study tour

In November 2015 I attended the **Atelier Laines d' Europe** Conference: "*Wool Scouring in Europe – Urgent and Ecological Solutions"* to highlight microbial washing research to assist their request: "Can farmers and agricultural organisations take a more active part in the running and development of this process?" The outcome confirmed there was positive demand for wool to remain a focus for research and collaboration. We identified the need for a hub in each country to promote **European Wool** and Fernhill is offering a farm location for demonstration procedures, textile links and marketing a local product with provenance.

Current trends indicate continued demand for Fernhill's finest Shetland fleeces for knitting and cloth production. We are gathering volumes to create **four** native colours that are suitable for over-dyeing using non-toxic chemicals. Shetland cross fleeces are soft, colourful and are highly commended by spinners, weavers and wool users. WTA micron tests support this, with tender and secondary fibres allocated for processing into felt textile supplies.

In 2008 we identified 5 types of visitor to Fernhill Farm and set out to **supply** an appropriate service for each group using our resources and facilities.

In 2015 we are marketing sheep **products** listed in the table below and defining 2020 **wool targets**:

Fernhill Farm 5-year plan 2015-2020

Visitor 'name' and interests @ Fernhill Hill Farm 2008	Sheep Products in 2015*	Additional Wool Products by 2020
Taz (<40) *festivals, private gatherings, stag & hens*	yarns & sheepskins, meat dishes	Range of finished garments
Nigel (local families) *looking over the hedge*	Wool workshops meat boxes	Pop-up shop products educational demonstrations
Shirley (>45) *craft items from the source*	Greasy fleeces, rovings & slivers yarns & felts	on-line sales workshops
Mr. *Right* (Business) *Corporate meetings and Conferences*	All *as buying for others*	Range of bespoke garments
Jane (education) *school visits college study tours*	shearing & wool workshops meat dishes	Natural fibre workshops #Knit for Nature initiatives
Green Hope – *environmentally aware* (2014)	**newly identified group is major focus**	Finished garments microbial *best-seller*

**shearing is admired and respected by all types of visitors to this farm*

Encouraging every generation to **reconnect** with natural fibres is an attractive proposition with the stream of visitors coming to the farm. An internship involving textile residential

students incorporates use of facilities, venue and resources. Craft therapy workshops continue to excite a wide audience of visitors.

We have opened an on-line shop **Fernhill Fleece & Fibre**, hosted by Folksy* and our Wonderful Wednesdays create the research for future pop-up shops. An array of wool textile ***click-and-collect*** celebration gift items supplying life-time treasures would complement our existing weekend wedding and event packages.

*Modern British Craft. We love craft. On **Folksy** there are 173288 things for sale from 5161 British designers and makers

15.1. Items for sale in Fernhill Fleece & Fibre online retail shop

Figure 29: Weaving yarn

See more photos from our online retail shop overleaf

Figure 30: Shetland Lopi for sale from Fernhill

Figure 31: Carded Rovings for sale from Fernhill

16.0. Executive summary

Wool has always been an integral part of human existence and was England's largest export in mediaeval times, a driver behind the industrial revolution two centuries ago, and still today a major player in global trade. A natural animal protein protecting delicate human skin, wool aided man's health, hygiene and comfort; yet the post war 1940s triggered change as man-made synthetic fibres came into production. Demand for cheap fabrics has continued to escalate exponentially with a shift in the purchasing habits of a growing global population. Wool is currently a niche fibre and valued in the UK as a by-product from the production of meat.

As a grower with little previous exposure to the wool industry, I researched the harvesting and processing techniques required to create a range of non-toxic wool products to add value to every part of the fleece. Exploring economic and environmental benefits led me to the investigation of holistic grassland management and the need to incorporate dual purpose genetics to supply a natural fibre and high protein, healthier diet.

My study began in Australia with the leaders of wool innovation, commodity production and competitive selling agencies. The Coloured Wool Congress highlighted processing frustrations within a fragmented industry and the importance of maintaining genetic diversity in a changeable climate. Iceland is successfully marketing Lopi yarns from their double-coated breed. The Nordic Initiative Clean & Ethical (NICE) is challenging fashion perceptions with environmental profit and loss assessments, regional traceability and fibre life-cycles. Brussels is home to the International Wool Textile Organisation which continually drives new legislation and product awareness, and researches production parameters, lifecycle assessments and carbon sequestration. The Chilean Government is maintaining weaving traditions amongst the indigenous Mapuche, whilst Patagonia is monitoring the multi-purpose-merino, creating grassland management hubs: with demand for sustainable wool driving all these initiatives.

My journey led to the discovery of innovation and immense passion regaining momentum for this ancient and resilient natural fibre. Fibre growers should understand those who want to buy and use our raw ingredients, even when considered a by-product and especially when it's a versatile niche product

Sheep are efficient land management tools and are equipped with the genetic adaptability to supply a range of durable industry resources. Consumers worldwide consider wool is worth their investment and respect our Great British textile heritage. British wool producers need to make our niche products desirable and more accessible.

17.0. Acknowledgements and Thanks

Andy, Kyle, Seth, Folks and siblings and all who continue to support Fernhill Farm.

UK - Sue Blacker: Natural Fibre Company. **Tim Booth, Gareth jones, Mike Berry, Stephen Spencer**: BWMB, **Mary Gibbons, Lisa Reynolds:** Shetland Sheep Society, **Phil Stocker**: National Sheep Association, **William Hinton**: apprentice shepherd, **Lesley Pyre:** Bowmont breeder **Paul Crookes**: Halifax Spinning Mill, **Emma Hague**: Working Wool and Bristol Textile Quarter **Juliet and Franki**: Dash and Miller and The Bristol Weaving Mill, **Babs and Flora**: Botanical Inks, **David Gisbourne**: Haworth scouring company, **Mike Madden**: ECO global testing services ltd, **John Thorley:** president Campaign for Wool, **Liz Clay:** Felt Maker

Australia - Jay Stevens, *Sheep farmer*, Stawell, Victoria, **Denise Williams**, *Sheep farmer* Ballarat Victoria, **Paddy Mackenzie**, *Chauffeur*, Melbourne, **John & Robyn Ive**, *superfine breeder*, Canberra, **David Tester** *Sheep CRC* Albury, NSW. **Sarah Moran and Dad**, Wool Classers, **Tim Gubbins** *Nuffield Scholar 2014* & South Stud farm, Victoria, **Kanagoo Island wool** (KIW) - Grey Johnson, Greg, Caleb Pratt, **Rod Miller**, *Australian Wool network* (AWN), **Peter & Gillian McDonald**, **Martin Openheimer**, *sheep farmer and CSIRO,* **Hamish** at CRISO, **Paul Swan**, *Australian wool Innovation*

France – Dawie Du Toit and all at the Coloured Wool Conference in Paris. Marie-Therese Chaupin/Atelier – Laines d'Europe

Iceland - Olafur Drymmundson - National Farmers' Association, **Johanna & Palmi** – conference, **Johanna & textile centre** - residency girls, **Gummi, Addi and Inka** - sheep farmers, **Fiona Cribben** - fashion designer, **Hidle & family** - weighted loom, **Hulda** – Istex. All were at the conference

Norway - Ane and **Hillesvag** processing mill, **Ingrid** - driving and contacts, **Sheep shearer, Lilia** and **Ovue** – farmers, Felt Makers association, **Tone Tobiasson**

Copenhagen - Reynaldo, Martin & Anne from Clemente, **Suzi Christoffersen** Danish Design institute

Brussels - Elizabeth van Deldon, IWTO, **Joanna** IWTO, **Peter Ackroyd** CEO IWTO, **Paul Swan**, AWI, **Malcolm Corbett, Mark Bentley,** BWMB,

Chile - Vanessa Linforth, Alejandra, Lorena, Witral weaving groups, Cesar, Jeviar, Mapuche families, Patricio, Elizabeth & Jose Manuel

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IWTO - Green wool facts, Life Cycle Assessment, Biosecurity

Kate Humble – wild shepherdess films – Peru, Afghanistan, Australia

DVD – Radiance – Growing your own nutrition. Graeme Sait

19.0. Appendices

Appendix 1: Content & Countries featured in the 8th World Congress of Coloured Wool.

Adalsteinsson's Fingerprints on Colour Genetics, *D. Phillip Sponenberg*
A History of Previous World Congresses on Coloured Sheep, *BM Tinnock*
Managing the Role of Coloured Sheep in Rare Breeds, *D. Phillip Sponenberg*
The Colourful Sheep Of Iceland, *Olafur R. Dyrmundsson*
Old Norse Sheep, *Hilde Buer*
For the Love of Sheep, *Fiona Gardner*
Have Black Polwarths - Will Travel, *Wendy S. Dennis*
The *Landes De Bretagne* Sheep, *Bernard Denis and Regis Fresneau*
Diversity in Coloured Sheep Breeds in Britain, *Lawrence Alderson MBE*
Wool of the Coloured Shetland Sheep, *Mary Gibbings*
Soay Sheep, *June Hall*
The Portuguese Black Marino, *Andre Martinho de Almeida*
A Brief Introduction to *Serra da Estrela* Sheep, Maria Carlota Vaz Patto, Antonia Vaz Patto, *Andre Martinho de Almeida*
Romeldale/California Variegated Mutant (CVM) An American Breed,
Doug Madsen
Diversity - A Challenge, Conservation Measures for Endangered Sheep Breeds in Germany, *Antje Feldmann*
Two coloured Sheep breeds from Germany: East prussian Skudden and Rough-coated Pomeranian Landrace, *Dr Gunhild Kurt*
The Breeding History of the Coloured Mountain Sheep Breeds in Germany, *Dr Christian Mendel*
Historic Sheep Husbandry on Alpine Pastures, *Kerstin Tautenhahn*
Sheep and Landscapes in the Swiss Jungfrau Region, *Dawie du Toit*
Alpine Pasture and Breeding Project, Alpines Steinschaf, *Dr Christian Mendel* The Coburger Fuchs Sheep, *Verena Tauber*
A Collection of Diversity - Preserving Rare Indigenous Sheep Breeds in Germany, *Nathalie Ketterle*
Coat Architecture of Sheep, *Dawie du Toit*
Spinning Short Fine Fibers, *D. Phillip Sponenberg*
Developing a Market for European Wool, *Marie Therese Chaupin*
To Get Oneself a "Skin". The Art of Felt and Clothes, *Heidi Greb*
Understanding Primitive Fleece, *Diane Falck*
Local and Breed Specific Yarns: Preserving Local Woll Traditions through Yarn Marketing, *Dr Carol Huebscher Rhoades*
Spindles: Simple Enduring Spinning Tools, *Dr Carol Huebscher Rhoades*
Five Centuries of Weaving with Navajo-Churro Yarn, *Laurelen Jabbour* Landes de Bretagne and Belle Ile
Sheep Breeds - a wool project,*H B Osborne*
The Natural Fibre Company - Adding Value to Coloured Wool, *Sue Blacker*
Colour Genetics of Ouessant Sheep, *Diane Falck, Dominique Morzynski,* and *Herve Vaillant*
Hair Sheep Are Not Wool Sheep!, *D. Phillip Sponenberg*
Sheep Are Not Goats or Alpacas or Cows, *D. Phillip Sponenberg*
The Agouti Locus of the Sheep, 1. A Review to 1980 and a Little Beyond,
Roger S. Lundie
The Agouti Locus of the Sheep, 11. Research on Alleles From Within The New Zealand Flock, *Roger S. Lundie*
The Agouti Locus of the Sheep, V. Observations on Possible Alleles in the Corsican Bredd, *Roger S. Lundie*
Corsican Landscapes and Livestock, *Agnes Simonpietri and Dawie du Toit*

Appendix 2: Genetic differences in merino wool growth in comparison to double coated fibres:

Sheep that evolved in hotter arid climates are recognised for their increased capacity of follicles per square inch of skin. These fibres enable the sheep to remain at a constant body temperature by creating a dense protective layer to resist the sun's rays during the day whilst offering a warm insulating layer to protect against cool evenings. These fibres are consistently medium in length, fine and have a lot of crimp that creates a matt of dense fibres with little movement; and the whole body plus the 'extremities', face and legs, tends to be covered in wool.

Double-coated fleeces are found in sheep from temperate regions where sheeop grow a mix of super-soft down-like fibres alongside coarse hair-like fibres. The wool is short and close to the skin to keep the body warm. In addition to these they grow a lesser amount of long hair fibres that protrude in shaggy waves through these soft down fibres and allow moisture to gather and wick away from the body keeping the skin dry. Bare or clean legs and faces and a **short tail** is typical of this type of sheep and offers the ultimate combination in damp, wet windy climates such as those of northern Europe.

Appendix 3: North European short-tailed breeds of sheep: a review.

Author information - Dýrmundsson OR1, Niżnikowski R.

Abstract

The short-tailed sheep, native of an area stretching from Russia to Iceland, are generally considered a primitive type. These robust northern sheep seem to have been spread by Norse Vikings to several countries in this region from the late eighth century to the middle of the eleventh century AD. They have several common characteristics in addition to the fluke-shaped and tapered short tail: a wide range of colour patterns, dual-coated wool and the ability to thrive under harsh environmental conditions, often in isolated marginal areas.

While the 34 short-tailed breeds of North European origin can still be identified, it is clear that their population sizes have in most instances declined and several of them are now rare and endangered. Although these breeds have mainly been confined to certain localities, some of them have gained fairly widespread distribution due to their genetic merits, such as prolificacy. Of these, the Finn sheep and the Romanov are best known, being exported to several countries in the world where their genetic material has been utilised through crossbreeding with local sheep. This has resulted in the production of some new synthetic breeds. Meat is now generally the main product of the North European short-tailed breeds and their crossbreds, whereas wool, skins and milk are normally regarded as byproducts, yet of considerable economic importance in some cases. Such breeds have clearly a role to play in sustainable grassland-based production systems in the future.

PMID: 22444647 [PubMed

"http://www.ncbi.nlm.nih.gov/pubmedcommons/help/j