

CONSUMPTION RESEARCH NORWAY


# KRUS final report: Enhancing local value chains in Norway

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<b>Client</b> Norges Forskningsråd		
<p><b>Sammendrag</b></p> <p>Fra prosjektet startet i 2015 og frem til slutten i 2019 har KRUS hatt to mål: å forbedre markedet for og verdien av norsk ull og kartlegge mulighetene for lokal produksjon som et skritt mot bærekraft i klesindustrien. KRUS har sett på hvordan vi kan gjenopprette en forståelse av sammenhengen mellom råvaren og det ferdige produktet innen industrien og blant forbrukerne. Det er viktig å forstå denne sammenhengen, både for å sikre kvalitetsprodukter og for å nå markedspotensielt for norsk ull. Å gjenopprette forståelsen av "hvor klær kommer fra" er også kjernen i utfordringene innen tekstil.</p> <p>Forbruk og produksjon av klær vil møte store utfordringer og endringer de neste 10 årene. I dag er industrien preget av lite regulering, kontroll og kunnskap, men store volumer, miljøpåvirkning, og belastninger på dyr og mennesker. KRUS har bidratt i debatten om bærekraft og klær ved å fokusere på lokale verdikjeder og lokalt produserte klær, verdi, levetid, kvalitet og hjemmeproduksjon. Norsk ull og de spesifikke egenskapene til våre saueraser har spilt en vesentlig rolle for norsk tekstiltradisjon og kleskultur. Større bevissthet og stolthet over egne tradisjoner og mulighetene i våre råvarer har vært vesentlig for prosjektet.</p> <p>Norsk ull er ikke markedsført med opprinnelsesmerke. Private aktører har utviklet egne merker og markedsføringsstrategier for å få frem opprinnelsen. Da KRUS startet var det få produkter på markedet som inneholdt norsk ull utover strikkegarn og noen ferdige strikkegensere. Vi har opplevd et skifte, med mange nye produkter på markedet fra nye og små, og fra etablerte norske tekstilbedrifter. Ikke minst har utviklingen for de eldre sauerasene vært gledelig. Dette er den ulla der utfordringene har vært størst, og mest har godt til spille. Et marked med mer variasjon åpner muligheter for produkter som tar vare på ulike egenskaper ved råvarene slik som naturlig pigmentert ull. Det er fortsatt mye ugjørt både for norsk ull generelt og for de eldste rasene, men kunnskapen og interessen rundt mulighetene er raskt voksende. Ved avslutningen av KRUS er vi glade for å ha kunnet bidra til en positiv utvikling for norsk ull.</p>		
<p><b>Summary</b></p> <p>From its initiation in 2015 to the end in 2019, KRUS had two goals: to improve the market for and the value of Norwegian wool, and survey the opportunities for local production in a move towards a goal of sustainability in the fashion sector. On a larger scale, KRUS has looked at how we can re-establish an understanding of the connection</p>		

between the raw material and the finished product within the textile industry and among consumers. It is critical to understand this connection, both to ensure quality products and to reach the market potential for Norwegian wool. To restore the understanding of “where clothes come from” is also at the heart of challenges currently facing the textile industry.

The consumption and production of textiles faces major challenges and changes in the future. Today the industry is characterized by low control and little knowledge, while growth in quantity, environmental impact, as well as stress on animals and humans is high. KRUS has contributed to the debate on sustainable clothing by focusing on local value-chains and locally produced apparel. The focus on Norwegian wool and the specific qualities of the different breeds has played an essential role for Norwegian textile tradition and dress culture, and a better understanding of this has been essential to the project.

An important challenge for Norwegian wool is that it has not been marketed with any kind of label of origin. Private actors have thus entered the field and developed their own private labels for Norwegian wool. In addition, there are few products on the market containing Norwegian wool beyond hand-knitting yarn, which means that availability has been limited. Throughout the project, we have seen a shift, especially for older sheep breeds, which have posed a special challenge. Their wool is central in keeping Norwegian handicrafts alive, but the quality on some of the wool types has been declining. For others, the challenge is that much of the wool is not taken care of, and constitutes a waste problem. Through breeding-projects, work collaboration, looking closely at labelling systems and business models, KRUS has addressed these challenges.

**Stikkord**

Ull, norsk ull, verdikjede, ullkvalitet, opprinnelsesmerking, næringsutvikling, bærekraftige klær, lokale klær, strikkegarn,

**Keywords**

Wool, Norwegian wool, value chain, labels of origin, industrial development, sustainability and clothing, local clothes, knitting yarn

# Preface

KRUS, which means “crimp”, is the project-name, as Norwegian wool is known for its exceptional crimp (“bounce”), luster and durability. The project was funded by The Norwegian Research Council through the Bionær program with Ingun Grimstad Klepp (SIFO, Oslomet) as project leader. The sub-heading for the project is: Enhancing local value chains in Norway, or Green growth in white gold through locally based value chains.

Being a part of this project has been an educational process, and with this report we hope that our experiences and results in the project can be of use and inspiration to others. Our goal is to make the project results and publications more easily accessible to everyone. KRUS has a Facebook group as one of its faces outward. Now after completion of the project, the group still has 746 members. We feel a responsibility to continue the commitment that lies there, and will seek to continue the group even after the end of the project. We encourage all members to contribute to this by continuing to share wool news in the group.

We would like to thank NFR for granting the project, Norilia and Fatland for financial support, and to all participating actors including sheep farmers, actors in the wool industry, companies, organisations, researchers and students, who have shown great engagement in the project and supported with time and money, discussion and resistance, as they cheered and shared their knowledge with us.

Oslo, September 2019

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List of terms

### **Sheep and wool management**

Carded wool (No: Kardet ull)

Crossbreed (No: Krysningsrase)

Crossbred wool (No: Ull av crossbredtype)

Dual-coated wool (No: todelt ull)

Fleece (No: Fell)

Greasy wool (No: Uvasket råull):

Guard hairs (No: Dekkull): also called tog (Old Norse/Icelandic), is the coarse 'outercoat wool in the fleece from dual-coated sheep

Innercoat wool (No: bnull)

Kemp (No: Dødhår): hollow hairs

Medullation (No: Marghår): wool hairs without a mellow, e.g. hollow.

Outercoat wool (No: Dekkull)

Rooping (No: Napping): plucking the fleece by hand without shearing

Shearing (No: Klipping av ull): removing the fleece from a sheep by mechanical handpiece

Sheep gathering (No: sauesanking)

Scouring (No: vasking av råull): washing the wool to remove grease and dirt

TheI (No: Bnull): the Old Norse word for the soft 'undercoat' in the fleece from dual-coated sheep

Vegetable matter content (No: Vegetabiler)

Wool station (No: Ullmottak)

## Norwegian Sheep breeds mentioned in the report KRUS (in alphabetical order)

### *Grey Trønder Sheep*

Although the breed's origin is not quite clear, Grey Trønder (Grå Trøndersau<sup>1</sup>) was already recognised as a breed around 1930. Presumably, it originated from crossbreeding Old Norse sheep with the now extinct Tautra sheep.

Figure 1 Grey Trønder Sheep (photo credit: Anna Rehnberg, NIBIO)



### *Norwegian Old Spæl Sheep (No: Gammelnorsk spælsau<sup>2</sup>)*

Stems from the Old Norse sheep, on which today's spæl (short-tailed) breeds were based. Have the same dual-coated wool.

Figure 2 Norwegian Old Spæl Sheep. (photo credit: Anna Rehnberg, NIBIO)



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<sup>1</sup> [More about Grey Trønder](#)

<sup>2</sup> [More about Norwegian Old Spæl Sheep](#)



*Norwegian White Spæl Sheep (No: Norsk hvit spælsau)*

The modern-day spæl breeds have more or less the same breeding history as the Old spæl until around 1950. Since then, the so-called modern spæl sheep were bred for color uniformity and polledness (lack of horns), and with more emphasis on size and meatiness than on wool quality.

**Figure 3 Norwegian White Spæl Sheep (photo credit: Tone Tobiasson)**



*Norwegian White Sheep (No: Norsk kvit sau)*

The Norwegian crossbreed sheep is the most common sheep in Norway.

**Figure 4 Norwegian White Sheep. Photo credit: Tone Tobiasson**



*Old Norse Sheep (No: Norsk Villsau/Gammelnorsk sau<sup>3</sup>)*

Old Norse is a descendent of the short-tailed sheep that once was common throughout all of northern Europe. These sheep have a two-layer dual-coat consisting of an inner layer of short, fine wool fibres (undercoat), and an outer layer of long, coarse wool fibres (outercoat).

**Figure 5 Old Norse Sheep. Photo credit: Anna Rehnberg, NIBO**



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<sup>3</sup> [More about Old Norse Sheep](#)

## Introduction

This report concludes the research project KRUS - Enhancing local value chains in Norway, which was led by Ingun Grimstad Klepp, in collaboration with five work package leaders. This project was financed by the Bionær work programme – sustainable Innovation in Food and Bio-based Industries.

*KRUS consisted of five work packages. The following sections contain an overview of all participants that took part on the journey with KRUS, followed by an overview of funding and resources.*

WP1 'Marketing and transparency' was led by Gunnar Vittersø (SIFO) with SIFO, NICE and Kjersti Kviseth (IWTO) as R&D partners, and Marion Tviland (Norilia) as industry partner. Andrea Mørk Grundvig, master student in human geography from the University of Oslo (UiO), carried our fieldwork and interviews with key informants. Klepp and Laitala also contributed with work.

WP2a 'Wool quality of the Norwegian White Spæl Sheep' was led by Lise Grøva (NIBIO), in close collaboration with the Norwegian Association of Sheep and Goat Breeders (NSG), Animalia/Norwegian Wool Advising Office and Norilia as industry partners. Main collaborators from the industry were researcher Inger Anne Boman and Director of Breeding Thor Blichfeldt from NSG, Sissel Berntsen from Animalia/Norwegian Wool Advising Office and Stein Terje Moen from Norilia. SIFO and NICE were R&D partners, and there was mutual exchange of knowledge particularly within the WP2 participants.

WP2b 'Wool quality of pigmented Old Norse Sheep' was led by Torhild Kvingedal (Heathland centre) with SIFO and NICE as R&D partners, and Øyvind Myhr (Hillesvåg Spinning Mill) as industry partner. WP2b was part of a larger work in Nordhordland, involving several museums, companies and resource people. Among several events, Karin Flatøy Svarstad held several courses.

WP2c 'Wool quality of Pigmented Spæl sheep and Grey Trønder sheep' was led by Ingvild Svorkmo Espelien (Selbu spinning mill) with SIFO and NICE as R&D partners, and Marion Tviland (Norilia) as industry partner. Alana Lennon (NTNU) wrote a master thesis about Selbu spinning, highlighting the depth of networks around the spinning mill.

All work in WP2 has mainly focused on development rather than knowledge production. This has been done in close cooperation with players in the wool industry in Norway, from small contractors such as Værbitt, Varp and Veft and Lofoten Wool, to established companies with production in Norway, such as Krivi Weaving mill and Rauma. Many companies that have not previously used Norwegian wool have also gained, and given, knowledge about the possibilities for industrial products of Norwegian wool.

WP3 'Sustainable business development' was initially led by Anne Moxnes Jervell (NMBU), but was finished by Elin Kubberød (NMBU), with NMBU, SIFO, NICE and Esben Rahbek Gjerdrum Pedersen (CBS) as R&D partners. Contributing to WP3 was

also PhD student Victorija Viciunaite, and Siw Fosteløkken (NMBU) and Kirsti Reitan Andersen (Copenhagen Business School).

WP4 'Redefining sustainable fashion' was led by Klepp (SIFO) with Kate Fletcher (London College of Fashion), NICE and SIFO as R&D partners. Årolija Svedal Jørgensrud and Lizzie Harrison contributed with collecting data material.

WP5 'Dissemination nationally and internationally was led by Tone Skårdal Tobiasson (NICE) and Marit Jacobsen (the Norwegian Folk Art and Handicrafts organization) as organization partners.

In addition to the said people, a number of other contributors have been a part of KRUS and followed the work. These are employees and members of companies and organizations KRUS has formally or informally collaborated with and other 'wool friends'.

*Funding and resources from partners and other contributors:*

Table 1 and 2 give an overview of the budget in KRUS. The budget was 23 million, most of which was allocated from the Research Council.

**Table 1 Funding from NFR**

<b>Partner</b>	<b>Funding by The Research Council of Norway in NOK</b>
DRAGONFLY AS/Kjersti Kvisett	30 000
Museumssenteret i Hordaland	849 744
NIBIO-Norwegian Institute of Bioeconomy Research	1 800 000
NMBU	4 982 000
NORSK SAU OG GEIT	250 000
Selbu Spinneri AS	1 100 000
Tonique AS/Tone Tobiasson	2 064 392
University of The Arts London UAL	782 766
OsloMet ved SIFO	9 044 097
<b>Total</b>	<b>20 903 000</b>

Some funds, see table 2, came from partners in the value chain and some from consultants. These were funds that were in the project from the start or were later granted for special activities and projects with overlap to KRUS. Table 1 and 2 also show how the money was distributed between different institutions and organizations that have worked on the project. Most were allocated to SIFO (9 million), followed by NMBU (almost 5 mil) and then Tobiasson (2 million).



**Table 2 Funding other contributors**

<b>Contributors</b>	<b>Funding from other contributors in NOK</b>
The Research Council of Norway (conference financing)	93 000
Fatland Ull AS	70 000
Norilia AS/Nortura AS	210 000
Krivi-Vev AS	200 000
General consulate in London	15 000
General consulate in New York	20 000
Conference participants	12 400
Self-financing from partners	372 963
<b>Total</b>	<b>993 363</b>

Krivi Weaving mill got funding for a project they called Krivi Ull – Arven etter vikingene (Krivi Wool – the Viking heritage) in 2017, through SkatteFunn. SIFO and Tobiasson's efforts in Krivi Wool had overlapping features with KRUS and thus contributed to an increased focus on Norwegian wool products, especially in the form of woven products. We have therefore made these funds visible in the KRUS project. Krivi Wool focused on the further development of woven wool fabrics of Norwegian wool from Krivi, especially with a starting point in the VikingGull project. Årolilja Jørgensrud was project coordinator at Krivi.

The international cooperation was strengthened through collaboration with several people, institutions and embassies, from Sweden, Poland, Russia, Denmark, and Lithuania amongst others.

Several researchers, institutions, and companies who worked in KRUS have also used their own - and others' - resources and have thus contributed with more resources than the budget suggested. SIFO has worked in parallel with KRUS and other international projects funded by AWI (Australian Wool Innovation Limited). They have made it possible to have a greater international anchor for KRUS and get further into some of the issues we have been working on.

## Going back to the beginning of KRUS

The project has built on research from the NRC project Valuing Norwegian Wool (VNW) and the KreaNord Project VikingGold. It has specifically looked into some of the problems in the value chain that the VNW-project uncovered related to lack of cooperation, product-development, transparency and labelling, as well as working with the older sheep breeds, with links back to Viking times, which was VikingGold's aim. These challenges are addressed through combining research with development work on several levels within the value chain. The combination of new knowledge, dissemination, and product-development has ensured a dynamic project with a diverse set of out-comes and impacts.

For a detailed overview of the Norwegian value chain for wool, the VNW report gives an extensive overview<sup>4</sup>. The breeds mentioned in KURS is listed under List of terms

<sup>4</sup> [Valuing Norwegian Wool – full report](#)

before the Introduction, but other Norwegian breeds and more details of the Norwegian wool production is not explained in this report.

The following sections include parts from the project proposal that was written by Klepp and Tobiasson for the Bionær call, with important input and help from all WP leaders. We find these sections as a solid introduction to KRUS, as it describes some prevailing challenges within the wool and fashion industry. By looking back at what we knew then, we aim to emphasize the knowledge and background that founded the beginning of KRUS.

## **Project proposal**

*The project proposal described KRUS as follows:*

The goal of KRUS is to improve the market for and the value of Norwegian wool and survey the opportunities for local production in a move towards a goal of sustainability in the fashion and textile sector, through increased knowledge of business opportunities and quality improvements throughout the wool value chain. This knowledge is relevant for industry as well as policy makers, and actors both within and outside today's value chains. This project contributes to fulfilling some of the key strategic perspectives of Bionær. It combines biology, services and technology through merging biological and technical questions surrounding breeding and improved wool quality with the issues surrounding services in the areas of new business models (BM), marketing, and origin labels among others. Our aim is to increase production through more processing in Norway, better use of already existing raw materials, through increasing the value and demand over time, and also looking at the current on-shoring trend in the US and in the UK and EU. The goal is optimal utilization of already existing resources, as well as minimization of waste through focus on some specific qualities – both the largest class of Norwegian wool and wool that is not optimized in production today.

The Norwegian production of textiles is small in a global perspective. Our consumption of textiles is however one of the highest in the world (per capita) and still increasing. Just since 2001 the import of clothing to Norway has almost doubled and amounts to 16.6 kg per capita, while the current prices of clothing are the same as they were in 1980 (Statistics Norway, 2011). Textile production represents mounting global challenges linked to resource depletion, environmental impact, and ethical issues related to animals and humans (Laitala, Austgulen, & Klepp, 2014). Increase in population and wealth means that more of the world's water resources and soil will be needed in food production. It is urgent to find a way out of over-consumption of textile raw-materials. Our project thereby contributes to the discussion on global challenges in a Norwegian context.

Our theoretical contribution is on two levels:

- Research on innovative and sustainable business models (BM)
- Redefining what sustainable fashion is and can be

These two ambitions are closely linked, however their starting-points are at opposite ends of the value-chain. Thus, the challenge in this project will be to unite ideas and work-methods, activities and people who seldom interact (Engeström, 2001). We want Norwegian sheep on the red carpet and designers in the sheep-barns. Improving value-chains is also a question of respect and knowledge transfer, and a common belief in an economic and ecological sustainable development. In accordance with the desired project qualities listed in the call Bionær, this project is designed to increase cross-fertilization of ideas across disciplines and institutions, to secure information flow within the project as well as to the project stakeholders along the whole wool value chain, and to facilitate international co-operation.

### **Local as business models**

Research in rural development has for a long time focused on new income opportunities in agriculture and forestry, including rural tourism (Almås, 2002; Bessièrè, 1998; Marsden, 1998). Developing new product niches and alternative marketing, such as direct sales (farmers' markets, CSA local delivery systems, etc.) and marketing food in combination with tourism and leisure activities has been seen as alternative paths to sustainable development in rural areas (Rye, 2011; Vittersø, 2012). Besides economic support, establishment of labelling schemes for local and organic food has been an important support measure for these types of niche products on both national and EU levels (Morgan, Marsden, & Murdoch, 2008). The lack of similar discourse, knowledge and policies related to textiles has resulted in a lack of comparison of the value chains for food and fibres. However, in this project, we will draw on experiences gathered in the food sector and discuss how and if these can be utilized for wool as well, as the same animal contributes to both fibre and food.

While the value chains for food (from sheep and other livestock) are predominantly national, the value chains for wool and other fibres are mostly international. Local food is in 'vogue', but local fashion is hardly a phenomenon. Yet a number of sheep farmers alongside micro-sized and small businesses are currently developing sustainable business models based on local wool. These businesses vary in scale (size) and scope (breadth of products and services). Their products and services often involve cultural and experiential (Holbrook & Hirschman, 1982) values, story-telling, and use and demonstration of traditional techniques. The problem is finding a viable model and reaching a scale that delivers value to customers (and other stakeholders) and is economically sustainable. Recent research on innovative business models looks at the combination of increased value for consumers with viable ways of organizing business. In both the market for knitting yarn and fashion, the idea of customer co-creation of value (Prahalad & Ramaswamy, 2004) is highly relevant.

In this perspective, value can be increased by engaging the consumers more actively in the value-creation process. Co-creation can encompass a specific creation process of a joint product or service as well as focus on creating a relationship with the customer to maximize the experiential aspects of the consumption itself ("value in use") (Payne, Storbacka, & Frow, 2008). Incorporating the consumers actively as part of the business model and value proposition is a growing trend in modern societies, relevant for both agriculture and sustainable development within textiles. The co-creation

perspective, often called 'prosumption' (Ritzer & Jurgenson, 2010), is highly relevant for a commodity such as handicraft yarns as it points towards a market for home-production. In the field of sustainable fashion, the interest for consumer's competence and coproduction are growing, pointing towards a systemic shift, and not just minor and neglectful changes in the value-chain (Fletcher, 2012).

## **Norwegian wool**

Norway has cultural and competence advantages through artisan traditions which have neither been documented nor been included in international research. This represents a potential both for Norwegian yarn-mills and textile companies, but also for consumers. Changing consumer awareness and new platforms for involving customers, create opportunities for new ventures and innovative business models that combine increased value for consumers with viable ways of organizing business. At the same time, this type of change in the understanding of textiles is pivotal in changing production and consumption in a more sustainable direction. Raw wool is mainly sold through auctions (Champion & Fearn, 2001) and is transformed into consumer goods through different low-level integrated value chains. Norwegian spinners, however, buy the Norwegian wool directly from one of the two national wool handlers (Norilia and Fatland), and represent both small niche enterprises and large industrial firms with close to 100 employees. The products derived vary from pelts and processed wool for felting, to yarns for handicrafts, interior, knitwear, underwear, folk costumes and fashion. Norwegian wool captures little value in the large-scale value chains for wool; most of the Norwegian wool clip is used in floor carpets, while a smaller portion is spun into hand-knitting yarn and industrial yarn for knit and woven products (Hebrok et al., 2012). Artisan production, however, based on traditional design and renewed through innovative ideas, organizations and marketing strategies has a significant chance of success (see e.g. Dinis, 2006).

Increasing the value created from Norwegian wool in general is partly a question of increasing the attractiveness of the raw material for established businesses, but also a question of increased transparency and control through the value chain. The project Valuing Norwegian Wool (VNW) documented that most businesses in the Norwegian textile, knit and fashion industries source their wool internationally. Yet the Norwegian wool used, for example in knitting yarns, is not labelled as such (Hebrok et al., 2012; Klepp et al., 2014). Development of labelling schemes that may enhance consumers' awareness and knowledge about Norwegian wool products is one central measure to strengthen the transparency in the value chain.

A main hurdle for Norwegian wool has been the focus that softness is equivalent to quality, however, recent studies within sensory research have emphasized the cultural significance of the senses (Bull & Society, 2006; Classen & Howes, 2005; Howes, 2005, 2010). Such insight opens up the prospect of studying wool's physical and esthetical properties in relation to cultural values such as history and origin, and thereby circumventing the problem. The aim is to circumvent the key challenges, as well as actually delivering to the market place new and exciting wool products. Timing of this project is crucial, as we are experiencing a handicraft revival, increased focus on local crafts and raw materials, tradition, co-creation, on-shoring and prosumption



(Ritzer & Jurgenson, 2010). Also, the Norwegian Folk Art and Handicrafts organization decided to focus on wool, from 2015 till 2019, with their four-year Ullialt project. The potential for export of such products and the role of these as part of the destination experience for tourists has yet to be captured. The results of the project will also have relevance for local value creation based on other combinations of bioproducts, landscape and experience (*end of proposal excerpt*).

## How to read and use the report

KRUS is a very extensive project, and as the previous sections refer to, the goals and tasks were both diverse and manifold. We will, in this report, describe how we reached the project-goals, give a reflection of these goals, and describe potential for further R&D and impact from the project.

A great number of talented people have been involved and worked on the project during the past four years, showing how research that invites different actors to join forces can really make an impact. Therefore, the content of this report has a particular outline. It is designed to inform about activities, milestones and happenings and the many talented partners in the project, to inspire producers, policy makers and consumers, and to give our reflections and show a bit of proudness of the many impacts KRUS has had. The chapters in this report give an overview of the many pieces connected to KRUS. To make it possible to read only some parts of the report, and not the whole, there is some overlap between different chapters.

We began this report by looking back at the beginning and background, and we will continue by using chapter 1 to reflect on the project's goals and tasks, and also to provide a conclusion. Our reflection is a summary of results in KRUS, as we see them now, and to what we find important for further research. We have written the reflection as a way to see the connection between current research and the research that we find important to yet be done. Chapter 2 will be a summary of the work packages and milestones during the past four years, with examples from working methods and different developments and results. In chapter 3, we focus on the impact from KRUS and emphasize the contributions made on societal means. At the end of the report, we give an overview of all the publications, divided by theme, from both popular and scientific disseminations. We also show an overview of the project's total production.

# 1. Reflections – crimp enough yet?

In this chapter we reflect on and give a conclusion of the status of our knowledge and the research topics we have pursued during the project. By looking back, and a bit forward, we contemplate on our achievements, and issues and discussions we deem important for developing the knowledge further.

## 1.1 Wool production

Norwegian wool is mainly perceived and referred to as a by-product of the meat production. This entails that the amount of wool produced is a result of the profitability in the meat industry, and not a direct result of neither the market nor the price. Therefore, the augmentation of wool production follows an increase in value, increase in better refining and increased marketing and retail-opportunities for wool as Norwegian, and not an increase in the number of animals.

### *More awareness*

We believe a lot has happened regarding wool and production. Wool is increasingly valued as a product within farming and agriculture, and the one-sided focus on food has decreased. Here, we believe KRUS has made an important contribution and achieved several goals initially set in the project application.

### *Value/price*

The subsidy incentive, based on the Norwegian Wool Classifying System, sets the farmers' price for wool. During 2016, this changed, which led to the lower grades of pigmented wool losing their (small) subsidies. This was a big setback. At the same time, there was an increase in the price for the best classes, based on an argument that it would make the wool more profitable. However, for farmers with older, pigmented breeds, handling wool in general is not profitable. Due to factors such as animal welfare, shearing the wool is absolutely necessary, but this costs more than profit gained from selling the wool. While this subsidy disappeared, collaborations within KRUS managed to develop several products from Old Norse Sheep wool and Old Norwegian Spæl wool. During the negotiations for subsidies, it was noted that the subsidies could indeed change "back" if the wool in question was the basis for high quality products. For KRUS, it has been essential to see this change happen, but the problems of the low subsidies for some of the pigmented wool have not been solved. KRUS has shown that wool can be used for high quality products, and it is important that this work is followed up so that it is worthwhile to supply wool also from pigmented breeds. The farmers (and others) with the older breeds have been encouraged by KRUS and others to implement good wool handling and supply of wool – and until the systems follow through, they cannot be let down. Especially if these products are to continue to be available.

## **Breeding for wool quality**

An overall goal in the KRUS project was to ensure better wool quality through breeding. When the KRUS project was initiated, farmers and the wool industry expressed worry that the wool quality was declining, particularly for the dual-coated wool from the Norwegian White Spæl Sheep. Through the KRUS project, we were able to access knowledge showing the status of the wool quality from this Spæl breed. The quality showed levels of medullation and kemp out of line with the Norwegian wool standard, which the industry aims for. A common understanding of the status on wool quality traits and challenges, and common understanding that there was a need for improvement, lead to development of breeding tools being implemented on a national level. In addition, the common understanding of the status of the wool quality amongst national stakeholders, made possible the high priority put into this work by national experts.

NIBIO has collaborated closely with the Norwegian Association of Sheep and Goat Breeders (NSG), Animalia and Norilia, gaining knowledge on the status of the wool quality from Spæl sheep and in developing tutorials and tools for both farmers and sheep show inspectors. NSG have estimated breeding values (EBVs) for wool quality and quantity (e.g. wool class and wool weight). The effect of implementing wool EBVs in the breeding total merit index (TMI),, tutorials and tools for evaluation of wool quality on farm and national level is expected to show an improvement of the 1st class (F1) versus 2nd class (F2) ratio over time (see Wp2a). The focus on wool quality has, during the KRUS project, lead to an increase in the proportion of rams not being accepted for breeding due to not meeting the wool classifying standards. This is likely due to better equipment and increased knowledge of how to assess wool quality.

In the long-term perspective, it is important that sheep breeders pay attention to the wool quality when selecting breeding stock. For the industry to do so, it is important that the wool generates income and has value for society. An understanding among all stakeholders for the potential of wool being a local fibre providing sustainable textiles for future generations is crucial for sheep breeders to continue to put effort into ensuring a high-quality raw material. The KRUS project has done so through extensive communication to all actors. The industry has ensured the same through a decision made by the national breeding board (Avlsrådet for sau, March 8-9 2016) to carefully improve wool quality from Norwegian Spæl sheep in a long-term perspective.

## **Processing Old Norse wool**

KRUS have contributed to better training of producers and development of a system for collecting the Old Norse wool, with several new products being made. These products are still being tested, but most essentially, this has proven that the wool is well suited for knitted products from both hand and machine knitting, and may be used to make high quality products. This work needs to be continued in order to utilize the wool.

## **Increasing presence on the Norwegian market**

As we later refer to in chapter 3, there has been an extensive development for marketing of Norwegian wool. Many actors are interested in using Norwegian wool, with several new products in development and many already on the market. In addition,



development has happened much faster than we first imagined, although there still are several bottlenecks in the value chain.

### *Scouring*

Those who aspire to see the whole value chain, with its many stages, in Norway, meet several challenges. The most complicated issue relates to a lack of capacity for scouring, although some mills offer this on a small scale. However, on a larger scale this constitutes a problem. Sandes Garn can scour on a large industrial scale, but they do not offer this to other actors. Hillesvåg Spinning Mill does some scouring (especially Old Norse wool), while Rauma has no capacity for scouring. Therefore, most of Norwegian wool is scoured in the UK – as Norilia holds a majority shareholding in a large scouring company (Haworth Scouring). Several actors have expressed a wish for a scouring plant in Norway, and this may now appeal more with the recently established scouring plant on Gotland, Sweden. However, nobody has yet taken the first step to establish a scouring plant in Norway.

### *Sewing*

Woven textiles need sewing to become finished products, and in Norway, there is limited capacity for sewing. Sewing entails a lot of manual labour, and since the cost of labour is high in Norway, sewing is very expensive. There is also a lack of people with these kinds of skills and knowledge. This has become an issue for actors who manufacture fabrics, and especially clothing and interiors that need to be sewn. The solutions to these issues have been to either concentrate on a small and exclusive production or outsource the sewing to other countries. In order to increase the quantity of products made in Norway, there is a need to investigate the capacity for sewing in Norway, and how and if the capacity can be expanded. The Norwegian Fashion Hub are currently running a project exploring robot sewing, which might present a possible solution.

## **Small scale business development**

A large part of the value creation in Norway is delivered through the smaller businesses. It is a paradox that most of the research within business development and marketing is performed on larger SMEs. Consequently, there are few lessons to be learned for the small business owner managers (of businesses with between 1-10 employees) to develop their businesses. By providing a research context from KRUS, the small-scale actors within sustainable Norwegian wool and their practices extend current theories and frameworks in entrepreneurial learning and business development.

KRUS has contributed directly to offering arenas and networking opportunities to strengthen the cooperation and relational learning in the value chain. This has contributed to a community of small business practitioners to start initiating more frequent and long-term cooperation. This is of crucial importance if the actors are going to succeed and expand the market for their products. Though being in an early development phase, the project has been inspirational in the evolution of creating a pioneering industry with actors that work together and share knowledge in a common domain to challenge existing large-scale practices. This is interesting and highly similar

to the development of the local food sector in Norway, which has also been largely ignored in research (however heavily invested in by Innovation Norway through the programme “Kompetansenettverk Lokalmat”). These research insights therefore inform further research in the local food sector, which is recently initiated in a new PhD project led by NMBU and Nofima. Hopefully, the research on the small-scale wool actors in Norway will inform and motivate future policy makers as well, to contribute to continued growth of this industry through facilitation and financial support through appropriate Innovation Norway instruments. One idea would be to initiate a facilitated knowledge network among small-scale businesses in the wool industry.

## 1.2 Consumption: awareness and knowledge

We have witnessed a greater awareness surrounding animal welfare, wool and its origin and quality, but the knowledge is still low on textiles in general. Combined, this presents an opportunity that is not fully utilized. To increase knowledge about clothing’s environmental impact, especially wool and Norwegian wool’s role in this conundrum, is a complicated task where KRUS has contributed considerably. Despite this, there are still big challenges ahead. The knowledge needs to spread if we are to meet the challenges facing the fashion industry, such as overproduction, social conditions, micro plastics, climate change, environmental pollutants, insect death rates, biodiversity, etc. The awareness of the environmental impacts from consuming and producing clothes is increasing – and more often, we see local production with natural resources as part of the solution to these challenges. However, the media, consumers and governments have limited knowledge, which prevents the increased attention to move further into political action or development.

### **Labelling and marketing**

Companies using Norwegian wool have become more visible in showing the wool’s origin, especially by developing their own labels along with information available on their websites. The Ullialt project, led by the Norwegian Folk Art and Craft Association, has a website that lists yarn made with Norwegian wool, which was an important contribution. The level of awareness among employees in stores and other resource persons has increased. However, there still exists misleading marketing and labels for wool pretending to be Norwegian, as a third-party certification has not been developed.

On a global level the interest for transparency and origin is growing and ensuring wool standards and schemes incorporating animal welfare and the best possible environmental practices are gaining momentum. Some of this relates to the increased awareness surrounding sustainability, but also, within wool production in general. Several animal protection organisations have raised concern relating to the practice of mulesing in Australia. This is a practice that has arisen as merino sheep in Australia have been bred with skin folds to have a larger skin-area for wool production, and in the folds under the tail, around their rectum, flystrike lay their eggs. When the larvae hatch, they eat their way into the sheep, which is extremely painful. The solution has been to remove the skin folds surgically when they are lambs, mainly without pain relief. This has naturally created strong reactions and created an awareness leading to down-stream producers and manufacturers using merino wool taking a stand opposing

the practice. Many sheep farmers in Australia have started administering pain relief right after the procedure (which will soon become mandatory), others have started with an alternative technique that “freezes” the area and numbs the nerve-endings, and others “jet” the sheep every year – which means they high-pressure water-jet the behinds. No matter, the animals must be treated in some form, as the alternative – that the larvae eat the lambs alive – is animal abuse. The solution to permanently end mulesing is that the sheep need to be bred back without the skinfolds, however, this takes time.

Responsible Wool Standard has spent the last years establishing a third-party certification scheme which guarantees the wool is non-mulesed. Some think RWS does not go far enough, and have their own systems. Ortovox has their *Ortovox Wool Promise* which promises ‘fair wool’. Among other measures, they follow the sheep all the way to the slaughter-house, something RWS has decided is outside their scope. Norwegian brand Devold has their own ‘Sheep to shop’ program which they launched in 2017, with full traceability for the value-chain. They have visited all farms (also some Norwegian) where they source their wool, documenting much of their journey on their web-site. A Nordic Swan label ensures that the wool has not been mulesed, however other animal welfare issues are not at issue, as chemical applications are of more concern. While newcomer SustainaWOOL™ for the time being has two levels for its integrity scheme. A green level which means non-mulesed or ceased-mulesed, and a blue level which is mulesed with pain relief. There has been growing concern that the many different schemes would contribute to fragmentation and that no one would «win». It is a goal for some actors in the wool business that the schemes in the future must adhere to common and harmonized requirements set up as an IWTO<sup>5</sup> standard.

Other solutions than labelling include isotope testing, DNA markers, and block chain technology. As we have witnessed the debate and the technological developments available, we have still not seen commercial solutions that can be easily applicable to Norwegian wool. There are several indications that specific questions relating to origin, ethics, content, health, etc. for products, lead to a complex and incomprehensible abundance of labels. Thus, there is a need for more honesty and transparency, so that consumers can access reliable knowledge about products. KRUS does not have a final answer to these issues, however, we believe the right place to start is by removing misleading marketing. Trustworthy marketing can be used to inform, and perhaps even educate, consumers. Furthermore, cleaning up the mess in marketing could be done by using the current laws, if only the legislation was followed up. This goes for the marketing law, consumers’ rights, the rights for repair and replacements of faulty items. Conducting this important work goes beyond just wool and Norwegian wool, however it would be an important continuation of KRUS, embracing the whole scope of textile products.

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<sup>5</sup> International Wool Textile Organisation, the recognised global authority for standards in the wool textile industry

### 1.3 Discussing clothing and sustainability

One of KRUS's two main goals was to change the discussion about sustainable fashion. We wanted to emphasize that the use phase of clothing was included in the discussion and that the knowledge of local clothing production as an environmental strategy was increased. To achieve these goals, we needed to develop concepts, methods, knowledge, and arguments.

The interest in clothing and sustainability has increased immensely in only the past year. This is due to an increased awareness surrounding micro plastics, and thus micro fibres, and attention from UNCTAD (United Nations conference on Trade and Development) on the massive environmental impact from the global apparel and footwear industry, which appeared in the spring of 2019. We can observe a more distinct and polarized debate where the industry, and unfortunately also governments and research funding institutions, dream about “new technology” and recycling as the answer to the conundrum, while research institutions address overconsumption, poor utilization of resources and the use phase of clothing. At the centre of the critics is the Union of Concerned Researchers in Fashion (UCRF). Kate Fletcher (researcher in WP4) established this union in the spring of 2019 as a reaction to the lacking ability of the industry to discuss solutions that involve something more than minimal improvements. Local production and consumption are viewed as the only alternatives that to some extent may be realistic<sup>6</sup>. The fashion industry has a different perspective, summarized in the PULSE report (Lehmann et al., 2018) and in their own “circular” manifesto launched ahead of the Copenhagen Fashion Summit in 2019. This report is not research, but it is perceived as research by several companies and consumers. It is therefore problematic that the perspective given by the PULSE reports is quite different from the actual research presented by KRUS and its associated researchers.

KRUS had a goal to change the discussion on clothing and sustainability, but the way this has happened, is very different from what we could foresee. Our vision was to reinforce perspectives to achieve greater potentials in a unified debate, where industry, research and media work together. However, today there seems to be a discord between the different positions, where each gives their own alternative solution. One of the most efficient sustainable solutions, that we know of, for the fashion industry, is fewer products used for a longer time; however, the industry seems to be more occupied with keeping their profits and shows no intention of slowing down production. The ‘sustainable ideas’ discussed by the fashion industry today, are the same ideas that were discussed during the 1980s and 90s. In other words, little changed despite decades of sustainable talk within the industry<sup>7</sup>.

We could never have imaged that we would contribute on an international level, or find ourselves in conflict with the international fashion industry. For example, SIFO has worked with the IWTO and Australian Wool Innovation Ltd (AWI) to change how the Sustainable Apparel Coalition estimates environmental impacts in the HIGG Index, who as a consequence of this work, opted for including the use phase of clothing.

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<sup>6</sup> [Website for UCRF](#)

<sup>7</sup> [Newspaper article from Mandagmorgen, discussing greenwashing and Copenhagen Fashion Summit](#)

Furthermore, Fletcher, has initiated a 'research rebellion' on how knowledge is utilized by the industry in the discussion on clothing and sustainability. Thus, as KRUS comes to an end, we stand nationally, and even more so internationally, in the centre of a debate discussing how to define sustainable fashion, and who has the most relevant knowledge to solve the conundrums created by the industry.

### **From “best fibre” to “best utilization of resources”**

Seen from a KRUS perspective, the increased attention on micro plastics has brought natural materials into the spotlight (increasing the interest in wool rather than synthetic materials) and also revealed the importance of including the use phase when measuring the total environmental impact. This debate, and most research on clothing and sustainability, has focused on fibre comparisons. Questions such as 'what fibre is worst' or 'what is the most sustainable fibre?' have been repeated in media and in social media over and over. However, this discussion is based on the wrong terms, as there is no 'best' fibre. Materials have different qualities and applications, and the sustainable part relates to how materials are optimized. Therefore, it has been essential to change the discussion to consider the best possible way to utilize materials. Dissemination of these two parallel messages has proven complicated. KRUS' aim to develop both the value and understanding of Norwegian wool, has surprisingly fitted well with AWI's aim to improve how wool is rated internationally in an environmental perspective. Thus, by dealing with both issues, we have implicitly contributed to define a discussion that was taking place on the wrong premises. This has been necessary and important, and successful, but now we need to play a part in how to focus on resource-optimization, in order to diminish the naive thoughts about recycling and the absurd comparisons of fibre against fibre.

During the whole value chain of apparel production, the fibre production itself has little impact (ca 15 % of total environmental impact if we calculate according to climate gas emissions (Quantis, 2018)) and the issue of fibre, recycled or not, has little significance for the total impact of production. However, when we look at the use phase, fibre does play a huge part, especially in terms of how often the garment is washed and how long the first user uses the item. The most relevant factor, for environmental benefits, is to use a garment as long as possible – and it will be used longer if it is appreciated and functional. Consequently, we come back to, on the one hand, the most optimal choice for a product's functionality, aesthetical and technical resilience, and on the other hand, measures that can reduce over-production (in all parts of the value-chain). There is much to be done, and it will be hard to break through in the debate, especially coming from a project based on promoting one particular fibre.

Quantity was discussed spring 2018 at the KRUS conference “Warm Threads” with Kate Fletcher, Rebecca Burgess from Fibershed, and Klepp among others. We discussed the ideas for a 'fibre diet' related to changes made within the food sector. How many people are we in the world and how many clothes do we need? Discussing this in terms of clothing is far more complicated than for food, as it would also include lifespan for clothing. However, it may be beneficial to imagine a future scenario in order to bring forward the necessary knowledge about a sustainable future. This discussion would also need to include what is desirable clothing and textiles, and set goals for how long garments should last. Thus, the aspect of fibre becomes important. How much

wool, cotton and synthetic fibre are we going to produce on a yearly basis in 2040? How much of this production should be based on recycled materials and which ones? The discussion needs to change from what is 'best' to how much do we need of the different ingredients, and how much can be produced locally in order to create a good wardrobe for everyone, without over-stepping the planetary boundaries. As far as we know, no one has started from this perspective and we hope to initiate such research.

### **Labelling more than fibre**

Solutions for improving the fashion industry have been overshadowed by the discussions on recycling and 'sustainable fibres'. The processing of materials, such as dyeing and finishing, is the most polluting phase in the production chain. To discuss these impacts, there is a great need for knowledge about the processing. An efficient tool to offer information would be detailed labels on the garments, which emphasize the whole value chain and can enable consumers to make informed choices and participate in the debate. A detailed labelling would make it easier for people with allergies to avoid certain chemicals, and more difficult for producers to defend their use of extremely harmful chemicals. Thus, detailed labelling about the whole value chain has the potential to change the debate, and more so than e.g. labels of origin. It is important to note that fibre constitute a small outcome of the total environmental impact from the fashion industry. However, the debate on clothing and sustainability has too much focus on fibres, because today fibre is the only way for consumers to know anything about the content of the garment. Consumers are not informed about other materials and chemicals that are part of the garment. Therefore, future research should concentrate on how to arrange for such detailed labelling for textiles and what they should look like. It is still much to learn from other products such as food and cosmetics that for a long time have been assigned such labels. However, equally important is challenges facing the overproduction in the fashion industry, with clothing durability as one of the key issues. Developing labelling schemes should therefore be based on the abilities of clothing.

### **Labels of origin**

In Norway, we have witnessed a wish to identify products made of Norwegian wool both among producers, consumers and in actors engaged in work within the value chain. The efforts opting for more transparency in the value chain for textiles is very strong and originates from several actors. Many actors have much to gain from more transparency, and others have a lot to lose. The question relates to interests within climate change, sustainability, animal welfare and ethics among other issues. It appears as if labelling schemes have halted in their development, and as the flow of information keeps growing out of control there might not be a need for such labels anymore. Especially as certifications, which are securing correct information from the whole value chain, is a very complicated task. Perhaps this will affect the labelling of Norwegian wool and that we face a fundamental change in how we handle and share information. It appears that special interests, either local ones or those related to particular challenges (such as mulesing), will be handled differently in the future. Information, regulations, trust and transparency need perhaps to be researched as a total – and not, as KRUS has done, locally. It is possible that labels of origin become less relevant if other information is made mandatory, such as detailed content. We

need knowledge on what is happening, and especially in order to secure consumer interest in the changes, and to stop knowledge from being misused to benefit special interests.

### **Local as a solution**

During KRUS, we have aimed to highlight the potential in local production and local fashion, and we included the whole value chain. For the production part, we have made great progress, but it is still difficult to disseminate the local perspective in relation to consumption of clothing. A lot of work is still unfinished and we could have utilized our data from the KRUS fieldwork even more. Perhaps this perspective will be clearer if we separate the clothing use phase into smaller, more tangible parts. The local part is the use of clothing in relation to reuse and recycling, just as much as the production of new clothing. "Local" is not limited to a discussion about the commercial, but also home production, caring, repairing, reuse and recycling in the home. For example, at home we can recycle our garments and make cleaning rags of them when they are no longer functional. Above all, local clothing is local fashion, how clothing makes an impact on everyday life and occasions, both day and night. It is how nature, culture, landscape and our clothing are connected. We have highlighted some of these processes, but many have remained in the dark. This is due to limited time, and not a lack of material. We have not published enough data that connects local production and local use. We have applied for, but not received funding, to take this into further research.

### **More knowledge on lifespans**

The quantity of garments bought and produced is the most pressing issue related to environmental impacts, and thus the lifespan of clothing is essential. Internationally, SIFO's knowledge in this field is extensive. This has not been central to KRUS, but very much so for the AWI projects. However, the lacking attention on lifespan has been important for the ambition in KRUS to change the debate on environmental sustainability. In the continuation of these projects, we find it essential to keep researching product lifespan. Therefore, we have applied for funding on new projects about lifespan. The lifespan of clothing depends on both the products and the consumers – and their interaction. We need more knowledge on what creates policies that contributes to longer lifespans and how consumers can contribute to increasing lifespans. In addition, we need knowledge that can challenge the naive faith in recycling, e.g. in the debate on circular economy, to concentrate more on keeping the resources in use.

### **Land, animals and climate**

Before KRUS, we already had connections with actors working with regenerative agriculture and using livestock to restore the land, and during the project, we collaborated with Fibershed (for the Warm Threads conference). This relates to how the soil is used to store CO<sub>2</sub>. To make the emissions add up with a carbon-positive result, clothing needs to be produced locally, as the transport will off-set the positive effect of storing CO<sub>2</sub> in the soil, according to calculations from Fibershed. Thus, during the project, as we were occupied with these perspectives and the possibilities for Norwegian sheep farmers, the discussion took a sudden turn to livestock and climate issues in the Norwegian media. As usual, food received a lot of attention, but another



perspective taken into the debate, was by vegans, who would not only change the diet but avoid use of any animal products. This would have wide-spread consequences for our clothing habits, traditions of handicraft, the cultural landscape and all kinds of livestock and pets.

For a long time, the wool industry has been in conflict with international animal welfare organisations, arguing in favour of 'vegan wool' (e.g. acrylic). Synthetics has been recommended by some environmental organisations as a better alternative. The relation between this and the suffering of animals ingesting plastics and micro plastics should be investigated. In addition, we have the relation between small scale and local production, global productions system with soy and oil as the most important raw materials. KRUS has attempted to continue the work by applying for projects that supports sustainable agriculture, keeping in mind questions that address the whole value chain, and Norwegian production. For climate-positive and regenerative agriculture, the potential of these production systems for clothing and conditions regarding small and large-scale production, overconsumption and environmental pressures, are issues that should be studied further. It is important that the discussions about sustainability include a larger set of values.

## 1.4 Disseminating a new discourse

In KRUS, a number of experiences have been gained in closely linking dissemination and research in the project. However, we have not formulated anything specifically about this. The project would have been suitable for discussing how such close work could be organized. The question that arises is how much is dependent on the people, the subjects, themes, plan - and the willingness to communicate - and how much of the experiences are transferable to other projects and themes. Another theme of this type of research dissemination is when the project ends. KRUS is no longer a project, but the demand for dissemination within the Norwegian value chain for wool will not cease. In many ways, we as researchers (and communicators) find that the work related to the project can surface a long time after the project ends, as we become part of the discourse we have contributed to creating. This can of course be fine, but will also come into conflict with the demands on us as researchers and the time available to engage in new projects.

### **When something ends, something new begins**

Accumulating knowledge about a field is always about learning something that you did not know before. Now, at the end of KRUS, we know so much more than when we first started. Within this, there lies an obligation to continue working with the many unresolved parts of the value chain, to move the debate on clothing and sustainability onto the right path, and to complete the exploration of local clothing as a positive utilization of resources, based on Norwegian wool and other fibres. Norwegian consumers have shown to be more knowledgeable about the use of wool, and for example wash it more seldom, thus contributing to less environmental impacts.

We started KRUS with two research questions: How to develop the Norwegian industry through increasing the value of Norwegian wool and how to change the debate on

environmental sustainability. These questions closely relate to international ones. During our work, we found that the two perspectives, the national and international, have joined forces. The 'local' has become more important as a possible solution in the global debate, and local production has increased. Thus, working to change an industry, where it is not about growth, but how the material (wool) is processed and used, is very much about improving the utilization of natural resources. Researching how to use raw materials in areas where their properties are most suitable should be prioritised. The earth has limited resources and the question of how they can be utilized sustainably is something we all need to take a lot more seriously.

## 2. Work packages and milestones

KRUS has been a multi- and interdisciplinary project, where approaches and methods were chosen to facilitate communication among the involved researchers as well as with involved businesses. The latter has increased during the project. This has implied the use of natural and social science methods that include descriptions of both natural (breeding and raw material quality), cultural, economic and material factors, and their inter-relationships. Case studies of value chains and emerging businesses are often easier to communicate across disciplines, potentially also creating new and deeper understanding within disciplines and theoretical concepts. We have drawn from the co-creation perspective (Ritzer & Jurgenson, 2010), theories about materiality, praxis (Warde, 2005) and system change within sustainable fashion (Fletcher, 2012).

Our most important hypothesis is that it is possible to increase the value and use of Norwegian wool through better cooperation, active use of cultural history, new BMs, product development and better marketing. The project's main objective was divided into four sub-goals with separate work packages.

The same methods were used in several WPs. Some of the methods are well-known (such as stakeholder interviews, desktop studies, case studies and historical sources), others were developed under VNW and similar multi-disciplinary projects and represent method-development. This concerns material/tactile tests (Klepp & Bjerck, 2014), wardrobe studies (Klepp, Hebrok, & Laitala, 2013), and object-based qualitative interviews. These were further developed through cooperation with Kate Fletcher, who has previously participated in the same methodology development through the Wardrobe Network (lead by Copenhagen Business School), and in the project 'craft of use'. Together, we have further developed methods that facilitate the understanding of apparel as something anchored in local praxis and materiality. This work was done parallel in the UK and Norway, and has generated new knowledge in each location, adding to understanding about place, product and people.

### 2.1 Launch of KRUS

*A two-day conference, Needlework & Technology, saw the launch of KRUS, March 16th and 17th, 2015.*

Speakers from the UK, Scotland, the US and Denmark added a global dimension to the focus on local, as partners in the project kick-started the knowledge-building in front of an interested audience of designers, students, media, NGOs, spinners, wool traders and others in the business of processing wool into wonderful products. Next door to the conference, the National Arts and Design school and Scandinavian Business Seating (later Flokk) had cooperated to showcase a woven wool cloth with a Norwegian value chain for office chairs - and as fashionable clothing. This exhibit caught the eye of Yahoo Japan and was featured online.

The inspirational talk by Manufacture New York's founder Bob Bland and Professor Kate Fletcher's exploration of how an indigenous Indian culture in Chile tells and acts

out everything they do through textiles and their relationship with their local surroundings - brought forward how KRUS could be instrumental in the paradigm shift the textile industry clearly needs. The launch on day 1 ended with a debate looking at these issues, where Gisle Mardal (Norwegian Fashion Institute), Johan Kryger (Danish Fashion Institute) and Gunni Hilmarsson (Icelandic Fashion Council) participated. Research professor and project leader Klepp presented KRUS and emphasized how the project's initiation not only was a personal victory but a victory for the whole fashion industry in Norway. We found it well worth celebrating that textile fibres could compete with food in the NFR calls. By this, we aimed to have an extensive support base, with sheep farmers and designers, fashion brands and clothing enthusiasts, and start on our journey to investigate the whole value chain of clothing. To some of the partners in KRUS, this meeting was their first time experiencing a world of fashion and design in the capital of Norway.

For the structure of chapter 2, all WPs will first be introduced as described in the project proposal, followed by a summary of findings and results.

## 2.2 WP1 Marketing and transparency

*The project proposal described WP1 as follows:*

Research questions:

- In what ways will clearer communication of origin change the work with quality, transparency and confidence within the value chain?
- How is wool taken care of in other countries, and how are the schemes aimed at labelling of origin organized?
- In what ways are the experiences with local food and Nordic cuisine transferable to the value chain for wool?
- What regulatory measures are required to change the current marketing practices on wool?
- What effects do Nordic Ecolabel/Cradle to Cradle have for the approval of Norwegian wool?
- How does the international development of textile labelling effect Norwegian/Nordic labels?
- How can the attention towards Norwegian wool yarn among knitters and designers be increased?
- How do consumers perceive textiles with local or national origin?

Yarns are interesting from the prosumer perspective as handicrafts are "in vogue". Home production and personal involvement are important strategies to counter fast fashion. Norway's lead in this development opens up for possibilities not yet exploited. However, the increased interest has not significantly resulted in increased sales of yarn based on Norwegian wool, whereas the import of alpaca has soared. Could new niche products counter this trend? We will make use of knowledge on change within the food area to contextualize the potential of marketing yarn and textiles locally. Another important question tied to labels is the understanding of quality, and the relationship between environmental issues, quality and trust. We will follow wool products in

Norway and abroad and study marketing and market response for a better understanding. This will also include opportunities for encouraging consumers to actively take part in the value chain through factory-visits, handicrafts, adopt-a-sheep, rental-spinning through mini-mill set-ups (commission spinning) etc.

The study will draw on experiences with labelling of origin presently under development for wool and new techniques for identify natural or intrinsic traceable markers associated with fibre and bio-based products (ISOTOPE labelling / New Zealand). In addition, we will carry out a comparative study of the value chains for wool in Scotland and Iceland. Together with Norway they represent three different contexts for valorisation of wool. In Iceland the system for collection and marketing of wool is well developed, while in Scotland there has been little valorisation of local wool in spite of the country's well-known wool industry. This study will be carried out through field work together with specialists within the value chain in the three participating countries. The two last questions in WP1 are related to the Norwegian market and pertain to handicraft yarn and high-end fashion. Norwegian spinners are experiencing a growth in demand for handicraft yarns both locally and internationally. We will use both quantitative and qualitative methods. A representative survey of consumers and niche producers' customers will be conducted. Methods developed in VNW on tactile and sensory perceptions will be utilized in cooperation with members of the reference group. The work in WP1 will be in close cooperation with WP3, alongside making use of material collected in WP2 (*end of proposal excerpt*).

### **The OL report on labelling and origin**

The main outcome from WP1 is the report "Opprinnelsesmerking av norsk ull" (Origin-labelling of Norwegian Wool) which was published spring of 2017 (Vittersø, Klepp, Tobiasson, & Kviseth, 2017). The purpose of the OL report was to examine the possibilities of a labelling scheme for origin of Norwegian wool, and the report shows that there can be several arguments for this. The following sections are quotes from the summary of the OL report:

A label can help to raise awareness about Norwegian wool among both producers and consumers, thus strengthening production and sales of local wool. Norwegian wool has several properties that seen from a quality and environmental perspective are favorable. Norilia, who alongside Fatland, collect and resell wool from Norwegian farmers, have already attained the Nordic Swan ecolabel. The license applies to Norwegian wool tops (and otherwise scoured wool). A label of origin can possibly contribute to further promoting the quality of Norwegian wool. A labelling scheme could also contribute to a more trustworthy marketing of Norwegian wool. Currently many products are marketed using the Norwegian flag and national symbols, without necessarily the wool or yarn having any Norwegian origin.

The OL report serves as a knowledge base for the potential establishment of a labelling scheme. It investigates various alternative arrangements without taking a stand on how a labeling system actually should be organized. The report builds on diverse sets of data. Firstly, we interviewed stakeholders in the value chain: primary producers, representatives from the wool industry, brand organizations, government and consumers. The aim has been to examine which aspects of labeling of Norwegian wool are important to the

stakeholders and what consequences this may have for the organizing, financing, verification and format of a possible labeling scheme.

There is no mandatory origin labeling of textiles in Norway. The only compulsory labeling schemes that exist, meaning fiber and washing instructions, does not appear to be followed up by the authorities and are often misunderstood by consumers. Marketing of fabrics often contains reference to geographical places with words, symbols, pictures and/or flags. There is often no correlation between how the products are presented and where they are manufactured, or the origin of the raw materials. Meanwhile, interest in origin labeling is increasing in the textile industry. So far, this has resulted in several private logos that companies themselves have developed.

In the food sector, there have been several labeling schemes for some time. The government supports these labels and use them to promote Norwegian products and culinary traditions. Other food products outside agriculture also have labels, such as seafood and salt, but there has so far been no opening for other agricultural products outside food. Ecolabels such as The Nordic Swan and the EU Flower are also state-sponsored schemes, and the strength of these is that control and certification are performed by an independent third party. There are, however, few eco-labeled textiles on the market. The Swan labeling of Norwegian scoured wool has not yet changed this further down-stream because wool tops are not a commodity to the consumer market, but further processed by companies that are currently not Swan certified.

There are several different international labels for origin of wool. The labels are not harmonized as to how they are defined and organized. The US, Holland, Switzerland, Iceland, South Africa, United Kingdom (including Shetland) and New Zealand have chosen different approaches and models of ownership. Different types of collective cooperative or private ownership are the most common. The labels are not really certifications. One exception is Wools of New Zealand which has a third-party certification for a label that focuses on the eco-credentials. The vast majority of the labels are relatively new, which indicates a growing interest in origin. Authorities are not involved in or control these types of labeling schemes. One exception is that the EU has approved a label of origin for organic Shetland wool under the system of protected designations (Protected Designation of Origin/PDO), but there are as far as we know, no products on the market with this label.

Animal welfare is the main basis for increased interest for labeling and standards. A new labeling scheme (Responsible Wool Standard) is trying to gain support from major brands who want to guarantee that the wool they use can be traced. Since wool is a globally traded commodity, traceability has been difficult and deemed undesirable by traders.

Food, fiber and textile production meet many common challenges, and these apply specifically to meat and wool which originate from the same primary source. Common challenges are related to animal welfare, health and environmental aspects while making sure these commodities represent a significant opportunity for value creation based on sustainable resource utilization. Paradoxically, it is only for food that the government has formulated a policy to increase the knowledge and awareness of local origin among producers and consumers. This has led to wide differences in interest and knowledge of local production for meat and for wool. In our consumer

research, we find significant differences between food products and other products from sheep (wool cloth, wool yarns, sheepskins) in consumers' knowledge and awareness of products' provenance and raw materials' origins.

Among the various stakeholders in the value chain, we find varied arguments and expectations for a labeling scheme and what it can contribute to. Awareness surrounding Norwegian wool is rapidly increasing, and a labeling system is seen as a way to strengthen this. The labeling scheme has a potential to get rid of questionable marketing on the one hand, and on the other hand increase the number of private brands using Norwegian wool. It will give consumers the opportunity to choose Norwegian products if they so wish, and provide raw material manufacturers an opportunity to recognize the results of their own work in the form of finished products on the market. This will not only strengthen their pride, but also contribute to increased interest in quality work and thus to more and better wool in the long term. Both producers and consumers are keen on recognizing Norwegian wool in products. Manufacturers see this both as a safe way of not being drawn into problematic issues, f. ex relating to animal welfare, and as a source for more sales. Norwegian wool has many different and specific qualities and a labelling scheme is thus seen as an opportunity to strengthen awareness surrounding these. Last but not least, both consumers and industry representatives see labeling as an opportunity for value-creation in Norway and thereby create jobs and economic growth.

The stakeholders in the industry have shown the greatest interest in a labeling scheme. Some have also begun to create their own labels, however they see the need for a common labeling system. Internationally, such schemes are mostly organized by the industry itself, with or mostly without certification by a third party.

How a labeling scheme should be organized is a matter both of what is ideal and what is possible. If we look at who the stakeholders are, namely the industry itself, the processes in Norway are very much in line with what is happening abroad. A common Norwegian private label will be a major step forward compared to diverse companies' labels. There are significant costs associated with organizing and administrating a labeling scheme with control by a third party, and there will be major challenges related to financing, as both the numbers of producer and the market is limited in Norway. Many pointed out that it would be better to have a government-backed scheme in line with the one for food. Regarding origin labeling, various forms of governmental support may be in conflict with international agreements such as the EEA and the WTO, and this is a point that should be examined further.

As the report shows, the textile industry itself established a number of labels and schemes to inform and promote their production and products as meeting certain standards for quality and the environment. This can be interpreted as a trend toward taking a greater ethical, environmental and social responsibility in the textile industry, but which probably is primarily a result of firms experiencing external pressure against making changes in these areas. The private labeling schemes are a form of private self-regulation which are seldom controlled by third parties, and consequently it is difficult to say to what extent these labels contribute to improvements in more sustainable directions. Experience with *Nyt Norge* (Enjoy Norway),



the Swan, Debio and other official labeling schemes, indicates that the certification should preferably be carried out by a third party, and that it should also be communicated clearly who is behind the scheme. If consumers perceive that the information is misleading and the label as obscure, it can quickly lose credibility and it will take time and resources to build up new confidence. Regardless of whether an arrangement is privately operated or publicly supported, experience with these other labeling schemes shows that third-party inspection and certification helps to strengthen confidence and credibility of the scheme. Through interviews with stakeholders in the Norwegian value-chain, we also found adherence to the principle that a scheme should include requirements and criteria that are verifiable and controllable by a third party.

In the report, we focus on the agricultural industry. Wool is an agricultural product that currently receives substantial state subsidies from the Department of Agriculture and Food, who consequently is a possible addressee for establishing a labeling scheme. Policy wise it should be of interest to look at means of developing this production. Good experience from the food sector alongside the financial side of a labeling scheme, points in the same direction. Meanwhile, Norwegian wool is already eco-labeled and a collaboration with the Swan therefore seems natural. Representatives from labeling organizations and the Department of Agriculture and Food urged in the interviews taking advantage of and collaborating with the various labeling organizations that already exist for food and environmental issues. This will leverage existing resources and expertise. To start work on a labeling scheme from scratch will be resource-intensive.

On the basis of this summary, we highlight the following:

- For consumers, it is not necessarily the provenance of the raw material or production that is important, so other characteristics of Norwegian wool should probably also be emphasized in connection with a labeling system
- A labeling scheme should preferably be based on independent certification and be controlled by a third party to ensure the greatest possible trust and credibility
- One should seek collaboration with existing brand organizations such as Matmerk, The Nordic Swan or Debio to benefit from their expertise and experience the opportunity to link to existing schemes, especially in the food sector, should be examined further
- Government support can be a strength both because official schemes have great confidence among Norwegian consumers and because it is costly to establish a new labeling scheme
- It must be clarified whether there are limitations in international agreements such as the EEA and WTO for governmental support for a wool labeling scheme (Vittersø et al., 2017).

### **Label prosperity?**

After the OL report was published, on November 30 2018, the following news arrived via email from the Savory Institute:

As part of the continued rollout of Savory Institute’s Land to Market™ program, the Savory Hub in South Africa has delivered its first bales of regenerative wool to the international wool market in Port Elizabeth. These bales carry Savory’s Ecological Outcome Verification™ (EOV™) seal, which is the first to indicate that the land from which the wool is sourced has been verified to be regenerating. Brands and businesses sourcing EOV wool at the Port Elizabeth market will be early supporters of a system of Holistic Management verified to achieve positive outcomes in soil fertility, biodiversity, and water retention.

Savory Institute’s Land to Market program is a farmer-focused, collaborative sourcing program that prioritizes regenerative agriculture as a solution to critical environmental issues such as climate change, and water and food security. Ecological Outcome Verification (EOV) - or the “science inside” the Land to Market program - is a soil and landscape assessment methodology that tracks outcomes in soil health, biodiversity, and ecosystem function on participating farms and ranches. More than three years in the making, the EOV protocol was developed in collaboration with land managers, scientists, agronomists, and ecologists, including OVIS 21 in Argentina, and Michigan State University.

(...) Savory’s Land to Market program is in its early development but has ambitious - and global - goals. As the program progresses, consumers will be able to choose wool, leather, dairy and meat products carrying the EOV seal and know they are investing in a regenerative claim that can be trusted to support farmers who are improving the environment. Verified farms and ranches will be listed in a global regenerative supplier roster from which participating brands, retailers, and consumers can access livestock-derived supply and products<sup>8</sup>.

The reason for mentioning this new labelling scheme is work with new applications, looking at grazing practices as a basis for positive stories surrounding both meat and wool from rangeland grazing.

In relation to Fibershed, it is interesting that this fairly new company aims to reflect some of what the EOV seal (Ecological Outcome Verification see above) includes, although only for fibres grown or sourced within a given geographical area. Fibershed in California has been cooperating with the sports label, The North Face, and have developed a project focusing on climate beneficial wool.

In the OL report, one can study the many labelling schemes we have found, from Woolmark, which is the international quality label for wool administered by Australian Wool Innovation, to the labels that are either origin (country) specific, related to animal welfare issues<sup>9</sup>, or other labelling schemes that were deemed relevant for wool, and Norwegian wool. The report also includes Viking Wool of Norway, which was developed by Curtis Wool Direct for Norwegian wool. This label was on several occasions planned to be introduced on the Norwegian market, however this was never done. Parallel with this, Hillesvåg Spinning Mill has started using GOTS approved

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<sup>8</sup> [More information about Savory and land to market on their website](#)

<sup>9</sup> Responsible Wool Standard administered by the Textile Exchange and Patagonia’s Wool Restart being perhaps the most visible

dyes, to follow up on Norwegian scoured wool and wool tops being Nordic Swan approved (Information gained October 15<sup>th</sup>, 2018).

An important question related to labels is the understanding of quality, and the relationship between environmental issues, quality and trust. Fifty seven percent of the sheep farmers surveyed as part of the Valuing Norwegian Wool project, in cooperation with Landbrukets utredningskontor (the Norwegian Agricultural Investigation Office), thought that a label would help increase pride and priority of wool production. About one-third (31%) answered neither/nor, while only a small percentage (12%) said that it would have little or no significance (Fjellhammer & Hillestad, 2011). According to an informant in one of the labelling organizations, experience from other label schemes shows that work with certification also contributes to increased interest in quality work (Vittersø et al., 2017, p. 66).

The labelling thus brings quality work in a new direction with further development and innovation, and new quality dimensions are highlighted. A brand can increase pride among manufacturers because it allows them to see the commodities again in finished products. Branding can also be perceived as a quality stamp. Overall, this can help increase efforts to improve quality both in breeding work, in the treatment of the wool, and thus contribute to what is commonly referred to as value creation (Vittersø et al., 2017).

Protecting your own industry is not just something that exists in political rhetoric. Local provenance are widely regarded as the future of marketing goods of Norwegian origin and are actively used when selling Norwegian tourism. The use of Norwegian wool can thus, in the same way as for food, contribute to increased pride in agriculture in general by the creation of value through the use of Norwegian resources. The sheep farmers believe that increased utilization of Norwegian wool can also contribute to increased pride in agriculture in general. According to the aforementioned survey of sheep farmers, to the tune of 89% who are positive to the following question: Do you think that it would lead to a better reputation for Norwegian agriculture and Norwegian wool if the Norwegian wool to a greater extent was used in Norwegian design and fashion products (Fjellhammer & Hillestad, 2011).

A labelling scheme can also help raise awareness about qualities of Norwegian wool, but it is not given that the label itself is the place to convey wool's different qualities. This can be done in different ways, either through the label itself, or it could be done in the same way as merino, through other marketing platforms. A labelling scheme could facilitate this work by guaranteeing that the wool is Norwegian, and then it would be up to the individual companies to find out what this entails (Vittersø et al., 2017).

In summary, there are many different arguments for a label for Norwegian wool, and the expectations of what this can contribute to, are many. The awareness surrounding Norwegian wool is growing rapidly, and a label is clearly seen as a way to strengthen this. A label could help to get rid of questionable marketing on the one hand, and an increasing number of private labels for Norwegian wool on the other hand (four the last time we counted). It will enable consumers to choose Norwegian products if they so wish and to provide raw material producers with the opportunity to recognize results of their own work in the form of finished products on the market. This will not only

strengthen pride, but could also contribute to increased interest in quality work and thus to more and better wool in the long term. Both producers and consumers are concerned about the ability to recognize Norwegian wool. Manufacturers see this as both a safeguard against being drawn into problems outside of their reach, for example linked to animal welfare, as well as a source of better sales. Many want to support Norwegian companies, Norwegian agriculture and good resource utilization through local products and production. Norwegian wool has many different special qualities, and a Norwegian wool label is seen as an opportunity to strengthen their attention, including a more diverse approach that not only focuses on Norwegian, but also local origin. Finally, yet importantly, both consumers and industry representatives see the branding scheme as an opportunity to increase value creation in Norway, thereby creating jobs and growth (Vittersø et al., 2017).

Based on the experience of different brand schemes, the OL report finds three alternative ways for a label for Norwegian wool:

1. Create a new private label
2. Create a new publicly supported scheme
3. Partner with an existing scheme

A common label that many manufacturers and organizations stand behind will provide a clearer and probably more credible marketing of Norwegian wool (Vittersø et al., 2017).

### **Questionnaires distributed at KRUS events**

We conducted a number of surveys on events and courses in WP1. In this way, we gained insight into people who were engaged in Norwegian wool and their attitudes and knowledge. This material has not been previously published and has been used primarily to provide us with valuable feedback along the way. Material was collected during 2016 and comprises a total of 74 forms on paper. The answers were read and then compiled digitally. The participants were sheep farmers and wool experts, but also knitters and other actors involved in the Norwegian Folk Art and Craft Association. The highlights are reproduced here.

Not surprisingly, the participants showed a great interest in wool, and most of them were women.

Many participants noted that they were interested in plant dyeing and would like to learn the practice more. Colour was also noted as very important when the participants bought yarn, in addition to sheep breed.

In terms of knowing the origin of a product, food was noted as more important than woollen garments. However, this was still important to many, but not as important as for food. This was the same for yarn, while for sheep skin, it was just as important to know that the origin was Norwegian.

Several participants stressed the importance of keeping the wool production chain in Norway.

Participants expressed a lack of labelling on the products and thought more labels would make it easier to find wool from Norway. In addition, several had confusions about what the labels are supposed to signify and trust in these labels was low.

Almost all of the participants had skills in handicrafts such as knitting, sewing and crochet.

Many participants mentioned the bunad as the most treasured and oldest garment in their wardrobe. The bunad was often associated with Norwegian wool, although not everyone knew the origin of the yarn in his or her bunad. This outcome corresponds to results from a previous SIFO survey (representative for the Norwegian population), finding that, for women, the bunad is the oldest garment in their wardrobe (Klepp & Laitala, 2016). If we combine both genders, the woollen sweater was the oldest garment. Also, in the questionnaire, the oldest garments owned by the participants was a woollen one. Several wrote that they had inherited a woollen garment through more than one generation, and that this garment was still in use and in good condition. Wool is a durable and strong fibre, which is likely to be one of the reasons why it is the oldest garment in Norwegian wardrobes.

The participants showed big consensus about the good quality and use of Norwegian wool, and that buying Norwegian produced yarn could support animal welfare, local farmers, and have environmental benefits.

## 2.3 WP2 Wool quality

Goal: To reveal variation in wool quality of sheep breeds and investigate approaches to ensure a desirable wool quality.

WP2 looked at practical solutions in relation to specific challenges in terms of evaluating, collecting, classifying and pricing of wool, as well as implementing tools to ensure wool quality in breeding. It was divided into three sub-packages, a, b and c, with different research questions, geographical locations, issues and breeds in focus. WP2 has been important as a basis for WP4 and comparison of cases of BMs in WP3.

*The project proposal described WP2 as follows:*

As mentioned, the project Valuing Norwegian Wool (VNW) unearthed several gaps in the wool value chain: Lack of cooperation, transparency, product-development, quality development, and relevant origin labels. Wool fibre quality is classified based on a number of characteristics and in Norway defined by the Norwegian Wool Standard (Animalia, 2007), and we have a great variation in wool qualities from various breeds. Norwegian sheep provide both crossbred wool (e.g. merino type wool) and dual-coated wool (e.g. fine undercoat fibres and lustrous strong outercoat fibres).

The development of local brands and local value chains has enabled farmers and food producers to create increased value and capture a larger share of food retail prices. Similar opportunities exist for wool. Thus, drawing on literature on innovative and sustainable business models, user-driven innovation, as well as previous research from

the food sector (such as Bessi re, 1998; Jervell & Borgen, 2004; Marsden & Smith, 2005), these factors has been a starting point for WP2, alongside investigating if and how strategies can be imitated or adapted to enable economic development based on scarcely exploited resources that have little value today. WP2 has been divided into three sub-projects. The first entailed specifically the breeding of Sp el sheep, the other two concern the 'Old Norse Sheep' and 'Grey Tr nder' (*end of excerpt from proposal*).

### **WP2a Norwegian White Sp el**

*The project proposal described WP2a as follows:*

Research questions:

- Will the new database on individual wool quality class and weight enable estimation of a breeding value (EBV) for wool?
- What are the phenotypic and genotypic variations in wool quality traits of the white Sp el wool?
- Can phenotypic wool quality traits of Sp el wool be improved without negatively affecting other production traits?

The aim of this study is to reveal phenotypic and genotypic variation in wool quality of the Sp el sheep, and investigate approaches to ensure a desirable wool quality. The research questions will be answered using two different approaches: A) Analysis of data from the new data-recording on individual wool quality class and weight and B) On farm registration of wool quality traits and selection for desirable wool quality.

Wool quality will be recorded at the wool stations at Nortura slaughterhouses, providing individual wool quality class and weigh data from approximately 50 000 individuals likely sired by rams in different flocks. A quality check of data, estimation of heritabilities of wool quality class and weight and relevant genetic correlations, and prediction breeding values will be carried out by NSG. A mapping of Sp el wool quality traits from sheep in Sp el breeding circles will be conducted. Stamped envelopes will be provided to selected Sp el breeding circles for sampling of individual wool staples. Animalia will classify the wool. This will allow estimation of phenotypic variation of wool quality parameters for Sp el wool. Sampling wool from individuals in breeding circles will provide data on lambs sired by common rams within and between flocks. This may allow us to disentangle flock effects from environmental factors and allow estimation of both phenotypic and genotypic variation in 7 wool quality traits. The data will be analysed by appropriate statistical models in collaboration with NSG. 5 – 10 farms with Sp el sheep breed will be included in a study where selected breeding for wool quality will be conducted on   of the flock. The other half will be a control-group. The wool quality of all sheep and lambs in each flock will be evaluated and rams for breeding will be suggested, likely based on knowledge obtained in WP2a/1. The first season of selective breeding will be conducted December 2015, and continued in 2016 and 2017. The wool, once spun, will be tested by Krivi Weaving mill in new fabrics for designers (*end of proposal excerpt*).

## Outcomes

WPL Lise Grøva, at NIBIO (Norsk institutt for bioøkonomi/Norwegian Institute of Bioeconomy Research), has held several meetings, mainly phone-meetings, with the stakeholders in order to find the best ways to reach the ambitious goals in this WP. The very first meeting was held face-to-face, in Ås, with NIBIO, the Norwegian Association of Sheep and Goat Breeders (NSG) and Animalia/The Norwegian Wool Advising Office in the project group. The research questions from the proposal were discussed and adjusted to increase relevance for the national Spæl Sheep population. Norilia/Gol wool station was invited and included in the workgroup of WP2a from the second project meeting and onwards with their expertise on the dual-coated wool from Spæl Sheep.

Spæl Sheep is the second largest sheep breed in Norway and is characterized by their short tail and dual-coated wool with lustrous outercoat and fine undercoat. In the National Sheep Recording System (NSRS) some 30 000 breeding ewes are registered, and overall approximately 10% of the sheep population in Norway is of this breed. The wool industry asks for first class (F1) dual-coated wool, and there is a perception that the wool quality of this wool struggles to meet first class (F1) wool standard requirements. In case there are unwanted genetic correlations between other traits in the breeding goal, wool quality traits need continuous attention in the breeding system in order to ensure desirable quality. Obtaining a unified understanding of the current wool quality, desirable wool quality, relevant tools, and how to implement this in the sheep farming system, has been the overall scope of this WP2a. To address this, we identified three main activities:

1. **Index calculations:** Estimating Breeding Value (EBV) for greasy fleece weight and quality class and including them in the Total Merit Index (TMI) in the National Sheep Breeding Scheme.
2. **Tutorials:** Developing wool quality assessment tutorials for farmers, breeders and sheep show judges for evaluation of wool quality in the dualcoated wool from Spæl Sheep.
3. **Wool quality and OFDA analysis:** Use the Optical-based Fibre Diameter Analyser (OFDA) for wool quality assessment of wool from breeding rams in the Spæl Sheep population for three consecutive years (2015, 2016 and 2017).

Activity '2. Tutorials' was not originally part of this WP, but became important in order to increase the knowledge among wool growers. This also made possible better cooperation on wool quality work between NSG, Animalia, Norilia and also Fatland. It was decided early in the project to produce an instruction video for judging wool and to develop a kit for farmers to evaluate their wool. These two early outcomes brought this WP a big step forward and is now the common platform on how wool quality is evaluated in the industry. The collaboration with Krivi Weave is reported from other WP's.

### *Background on wool quality and breeding in Spæl Sheep*

The dual-coated wool from Spæl Sheep represents less than 10% of the total wool volume from Norwegian sheep, but has unique characteristics and is important for Norwegian handicraft tradition. Maintaining desirable quality for this type of wool is important. The overall share of 1st class (F1) versus 2nd class (F2) wool from white Spæl Sheep is low, and has varied between 0.71 and 0.59 in the last six years. In 2018, 70 tons of wool from Spæl Sheep was classified as F1 and 105 tons as F2 giving us a F1:F2 ratio of 0.6<sup>10</sup> (Landbruksdirektoratet, 2019). This shows that there is substantial potential for improving wool quality for this dual-coated wool from Spæl Sheep.

Wool has been accounted for when selecting animals for breeding for as long as there has been a national breeding scheme. All Spæl Sheep breeding-rams must have 1st class wool or good 2<sup>nd</sup> class wool in order to be selected for breeding. Dual-coated wool seems to be challenging to classify. Also quality within each fleece varies; commonly best quality of wool on the animal is found on the shoulder. The dual-coated wool seems to suffer from both challenges with uniform wool classification, as well as wool facing low economic value. There is potential to increase the proportion of high-quality wool from the Spæl Sheep population, and thus a need for implementing relevant tools to do so.

The work conducted on wool quality in the KRUS-project is presented in detail in the forthcoming NIBIO report *Ullkvalitet hos kvit spælsau* (Grøva & Boman, 2019). An outline of the most important work and findings is presented below.

#### *Activity 1. Index calculations*

Selecting the right animals for breeding is an important task in the sheep industry, and is conducted through a series of well-established tasks from farm to national level. This allows systematic selection and breeding based on Estimated Breeding Values (EBVs) for performance traits of ewes and rams. Up to 2014, only traits related to meat production from sheep were recorded and possible to include in the Total Merit Index (TMI). Traits such as number of lambs born, weight gain and slaughter characteristics have been recorded in NSRS for many years and has allowed NSG to calculate EBVs. Wool quality traits have previously not been recorded in a similar system until 2014.

Implementing shearing sheep after killing at the slaughterhouse has allowed individual recording of greasy fleece weight and wool fleece quality class from slaughtered lambs and transferring this information to NSRS. In 2014, the first wool data was transferred and now include data for 'greasy fleece weight' and 'wool fleece quality class' from individual lambs slaughtered at slaughterhouses in Norway. This made it possible to calculate heritabilities and correlations for these two wool traits, and to include the information as EBVs in the national breeding scheme. In 2015, NSG decided to include wool trait EBVs in the national breeding plan for Spæl Sheep. The TMI included a 2 (3) % weight on greasy wool weight and 6(5) % weight on wool class in 2018 (2016) respectively. The fraction of wool classified as first class was a reason for increasing

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<sup>10</sup> Landbruksdirektoratet, Ullstatistikk for 2014-2018, meddelt på epost 29.05.2019



the weight from 5% to 6% for wool class in the TMI. Heritability estimates for *greasy wool weight* was 0.22 and for *wool class* 0.14 in 2018, and the genetic correlation between them was 0.27.

The relative weighing of traits in the TMI is a continuous process and is every year decided by the breeding board (Avlsrådet). Also, the wool from white Spæl Sheep is mainly graded as either F1 (best class) or F2 (second best). An increase in the % F1 of F1+F2 is therefore a relevant measure of improved wool quality from the Spæl Sheep population.

Non-genetic factors affect the quality of the wool fleece, and the quality gradually declines in the autumn. To reduce this problem, only data for fleeces from lambs culled August 16<sup>th</sup> to October 31<sup>st</sup> are included in the calculations of EBVs. NSG calculates EBVs for two datasets; one comprises all Spæl Sheep in the NSRS and a pruned dataset is used for ram evaluation. As can be seen from the number of fleeces in table 3, there were some problems in 2014 and partly in 2015 when the abattoirs started to collect data. The fleece weight is approximately 1 kg and roughly twice as often the fleeces are scored in the best quality (F1) compared to the second best (F2) in the pruned dataset.

**Table 3 Number of fleeces in the calculations of EBVs and the proportion of F1 to the sum of F1 and F2 in the dataset for ram evaluation.**

Year	Total no.	No. in ram evaluation	Mean fleece weight (kg)	% F1 of (F1+F2)
2014	11902	5925	1.1	61.9
2015	16235	8257	1.1	67.0
2016	19431	9820	1.0	68.0
2017	19707	9413	1.0	67.3
2018	20897	10012	1.0	68.4

Impact of activity 1:

From table 3 we are tempted to say that we observe a slight increase in the % of F1 wool already. This observation is however not statistically valid based on this novel dataset. Breeding is a long-term task, as the genes are the same for as long as the sheep lives. A four-year period (2015-2018) is too short when it comes to observing effects of implementation of wool traits in an overall index, and selection for particular traits in animals. We do hope to see a steady increase in the years to come. In 2018 the traits '*greasy fleece weight*' and '*wool fleece quality class*' were included in the overall breeding index of Spæl Sheep with 2% and 6% respectively. In Report 1/2016<sup>11</sup> from The Sheep Breeding Board (8<sup>th</sup>-9<sup>th</sup> March, 2016), the following was agreed: '*The breeding board plans for a careful and long-term improvement of the Spæl Sheep wool quality.*' This is implemented in the '*Regulations for selection of rams for breeding from the Norwegian White Spæl Sheep 2018*'<sup>12</sup>.

<sup>11</sup> [Report from the Sheep Breeding Board 2016](#)

<sup>12</sup> [Regulations for selection of rams for breeding 2018](#)

## Activity 2. Tutorials

Evaluation of wool quality from sheep is conducted at different levels; at farms and at local ram shows. Roughly, rams for breeding are first selected by the farmer before 'ram shows', where they are evaluated and selected for breeding by authorised persons/judges. A common understanding of desirable wool quality, as well as common tools to evaluate wool quality is important, and it became clear that there was a need for improving tools for wool quality evaluation for both farmers and authorised persons/judges. Therefore, the project developed tutorials including a 'wool evaluation kit' with a pocket microscope (figure 6), an instruction video (figure 7) and educational material on a PowerPoint presentation<sup>13</sup>. It is important to note that 50% of the lamb's genes comes from the ewe, thus, farm selection for wool quality in ewes has great impact on the potential for genetic improvement.

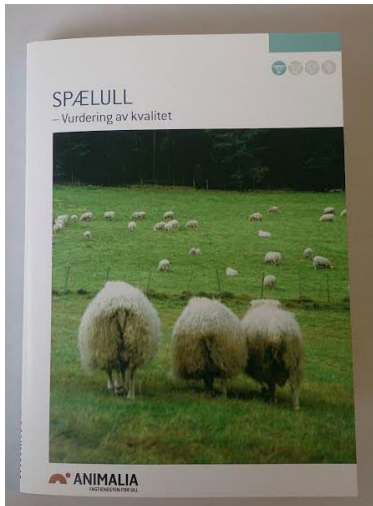
**Figure 6 Wool evaluation kit with a pocket microscope (NSG) (photo: NSG)**



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<sup>13</sup> [Tutorials on wool evaluation](#)

**Figure 7 Instruction video (Animalia) (photo: Inger Anne Boman)**



**Figure 8 Norwegian white Spæl Sheep with good wool type (photo: NSG)**

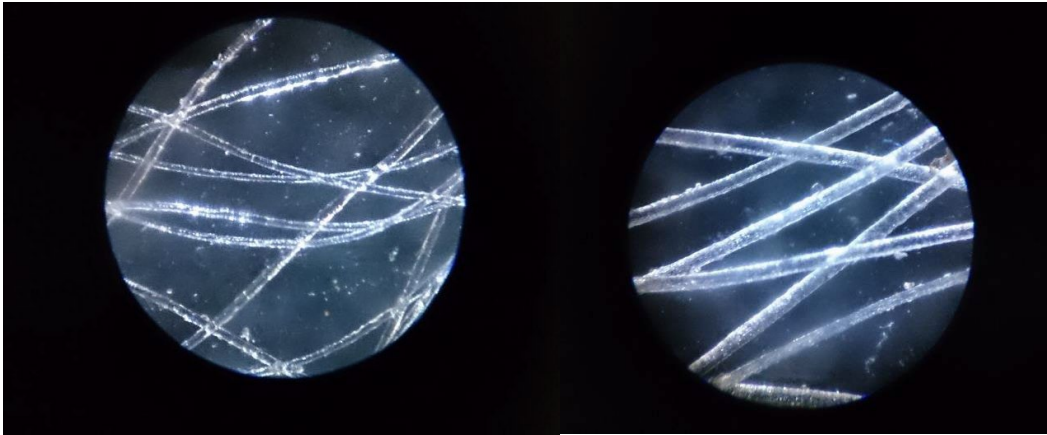


Below are selected images from the wool evaluation tutorials and checklist developed to describe desirable and undesirable wool.

**Figure 9 Dualcoated wool from white Spæl Sheep with fine undercoat and long lustrous outercoat (photo: Turid Sundt)**



**Figure 10 Good quality undercoat (left) and outercoat (right) of white Spæl Sheep wool (photo: NSG)**



**Figure 11 Undercoat with undesirable kemp (left) and without kemp (right) (photo: NSG)**



**Figure 12 Medullated fibres appear as milky white filled fibres (indicated by red arrow) and are undesirable. Microscope photo (photo: Anne DeBoer/NIBIO)**





**Figure 13 Undesirable medullated fibre (top left arrow) and unwanted coarse fibre (bottom right arrow) in undercoat from wool from white Spæl Sheep. (photo: NSG)**



Impact of activity 2

The development of these tools has already provided a uniform understanding of wool quality traits in the industry. All national ram-judges have completed the new tutorials on wool quality during the project. Also, there has been sold more than 500 samples of wool-evaluation kits, to farmers, judges, and to other actors in the industry such as Rauma and designer students. A uniform understanding of wool quality evaluation is expected to increase the understanding between professions.

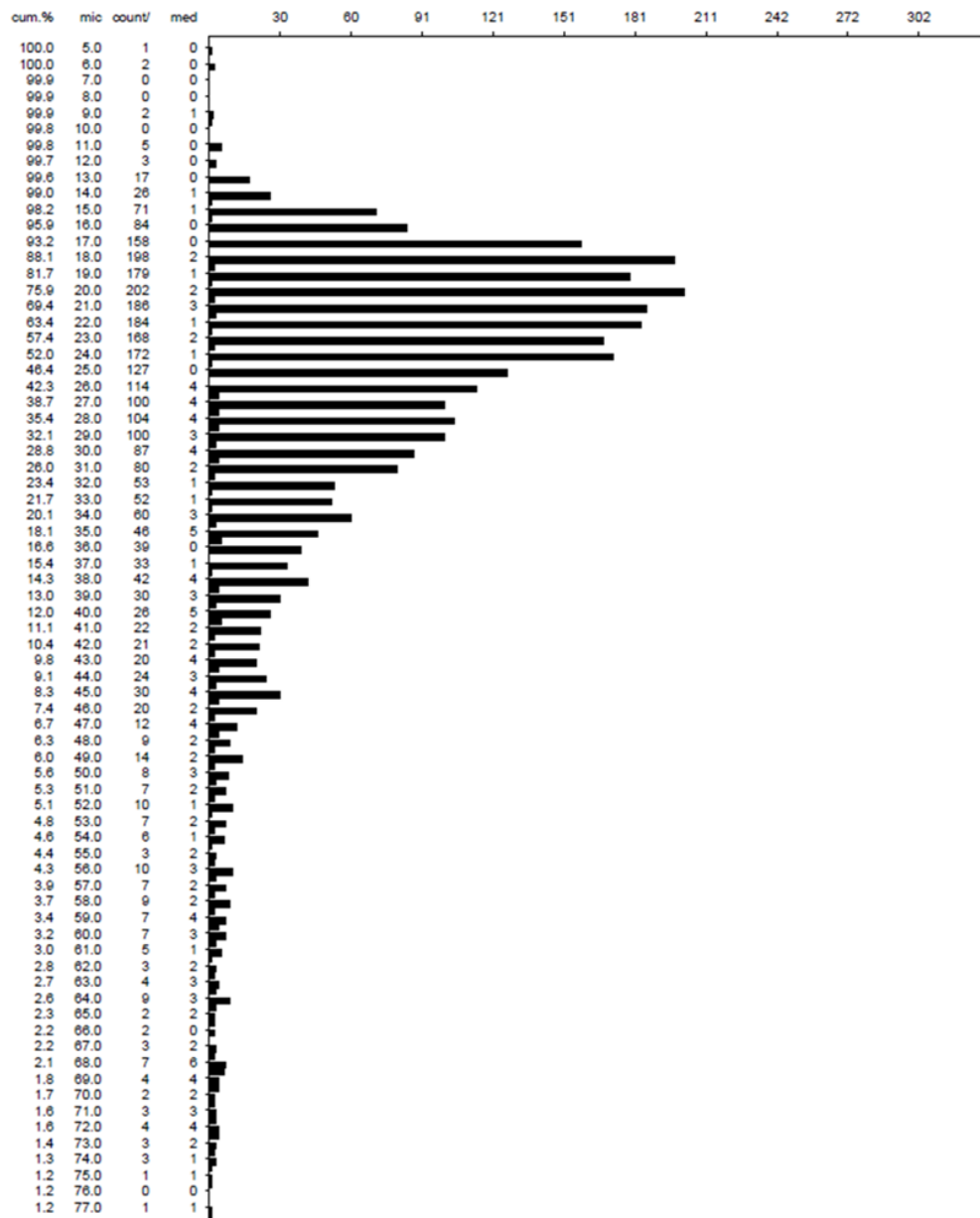
#### *Activity 3. Wool quality and OFDA*

In order to obtain a uniform understanding of wool quality, the project group decided to explore the potential of OFDA to obtain detailed knowledge on the status of wool quality as well as obtaining detailed knowledge on wool trait challenges. The OFDA method is developed for merino wool (a crossbred uniform type of wool), thus we questioned its suitability for dual-coated wool as a starting point. The group has addressed this activity by doing the following:

- a) Pilot testing of OFDA method on wool classified by a wool classifier as poor/average/high quality wool.
- b) Tested coherence of OFDA2000 analysis from Wales and OFDA100 analysis from Sweden for 10 wool fleeces with a variation in quality as determined by a wool classifier and including undercoat and outercoat fibres.
- c) OFDA analysis of under- and outercoat fibres from wool samples from rams representing the national breeding population of white Spæl Sheep for three consecutive years: 2015, '16 and '17. This also allowed looking into the effect of age on wool quality as some rams would have repeated samples of wool over year for analysis. The question being does wool quality deteriorate with age?

Using OFDA, each fibre in a sample, usually comprising a few thousand fibres, is measured. In figure 14 you see a histogram that the OFDA100 software can produce, where we get the count of fibres per micron and how many fibres that are medullated. We get the large picture by looking at the shape of the histogram. Also, the shorter bars in between represent the medullated fibres.

Figure 14 OFDA histogram of one wool sample (undercoat) showing count of fibres per micron and count of medullated fibres (shorter bars in between)



The pilot testing of OFDA method (activity 3a) showed satisfactory, but not great coherence between wool classified by wool classifier and OFDA results in general. Based on this we decided to pursue the OFDA-method by testing OFDA2000 analysis from Wales and OFDA100 from Sweden for 10 wool fleeces (activity 3b). OFDA2000 in Wales is how the Norwegian wool in wool bales are tested, but OFDA100 in Sweden was decided to be better for our purpose, as it reports kemp in addition to medullated fibres and the costs per sample was lower. The testing of coherence of OFDA2000 analysis from Wales and OFDA100 analysis from Sweden also gave us information on the correlation of medullated fibres between outer-, under- and whole-coat. There was a satisfactory correlation between the OFDA2000 (Wales) and OFDA100 (Sweden); correlation of 0.9 for wool diameter and 0.6 for medullation. It was therefore decided to analyse further wool samples for description of wool quality of the white Spæl Sheep population by OFDA100 in Sweden. Both samples of outer-, under- and whole-coat of

wool were analysed to explore which wool fraction that was best suited to analyse for our purpose. The fraction of medullated fibres was much higher in the outercoat than in the undercoat. This implies that if we select for less medullated fibres in whole coat samples, we may unintentionally select for a coat with relatively fewer outercoat fibres. It was therefor decided to analyse outer- and undercoat separately.

The OFDA100 results from breeding rams (Activity 3c) provide a unique dataset to understand wool quality traits of the dual-coated wool from white Spæl Sheep. Wool samples were collected from the Spæl Sheep breeding rams in the autumns of 2015, 2016 and 2017 for wool characterisation by OFDA100. We collected in total 897 wool samples from 713 rams with an age span of 0.5 – 3.5 years of age, 536 rams were sampled once, 170 rams were sampled twice and 7 rams were sampled three times. All sampled rams were judged as 0.5 year old and as acceptable for breeding by sheep show judges, e.g. holding F1 or a good F2 wool quality.

The wool quality of a fleece is known to vary within fleece. As a rule of thumb, you find better quality wool at the shoulder of an animal than further back and down the thighs (which is why the Norwegian fleece does not include wool from the belly and the lower part of the hind legs). Wool samples for analysis are traditionally cut from the loin, to increase the likelihood to detect animals with wool quality challenges. The OFDA results showed that the wool samples did not meet the F1 criteria (see table 4). Particularly the high % of medullated fibres needs to be addressed. Breeding to improve traits is a long-term task and the identification of the problem together with improved tools for farmers and sheep show judges should pay off in the coming years to improve and ensure wool quality.

Age effect on quality: From table 4 we also observe possible poorer wool quality measures from older rams compared to young test rams.

**Table 4 Selected wool quality traits from white Spæl Sheep based on OFDA100 from breeding rams used by ram circles in 2016-2018. The numbers are the average of the group.**

	Under coat	Outer coat	Ratio	Under coat				Outer coat			Ratio
	Cm	Cm	B/D	My	Med ulla %	Kemp%	5 % rough	My	Med ulla %	Kemp%	My B/D
<b>2016</b>											
Young test rams (<0,5 years)	11	23	50 %	27,9	5,9	0,2	53,3	57,7	29,9	0,1	0,49
Older rams	12	25	48 %	33,1	10,1	0,3	63,0	60,3	40,4	0,1	0,54
<b>2017</b>											
Young test rams (<0,5 years)	12	23	52 %	28,2	7,1	0,3	56,3	55,5	31,6	0,2	0,51
Older rams	12	21	56 %	33,6	10,2	0,4	63,3	62,4	44,8	0,5	0,54
<b>2018</b>											
Young test rams (<0,5 years)	8	20	38 %	27,3	22,4	0,7	54,3	50,1	40,5	0,7	0,55
Older rams	9	22	40 %	34,5	27,1	1,0	65,1	55,6	51,3	1,6	0,63



*Description of parameters in table 4:*

The ratio **B/D** is the % of length of innercoat to outercoat. The criteria used by judges is 50%, and was earlier 33%. **My (Micron)** is fibre diameter and the criteria for F1 is max 25 micron for undercoat and 60 micron for outercoat. **Medulla%** is the percentage of medullated fibres. The aim is no medullated fibres and the criteria for F1 is < 3 %. In general, there are less medullated fibres in the undercoat. **Kemp%** is percentage of kemp (No: dødhår). Fibres with more than 60% of the diameter having medulla are called kemp here. The aim is no kemp and the criteria for F1 is up to 0,3%. Kemp is mainly observed in the undercoat. Pigmented fibres will be observed as kemp in the OFDA100. **5 % coarse** is the cut off (in micron) between the fine fibres and the 5% coarsest fibres in the undercoat. The higher the number, the greater the proportion of coarse fibres. These are unwanted in the undercoat. The ratio **micron B/D** is to help assess whether outer- and undercoat are properly separated. Undercoat should commonly be approximately half as coarse as outercoat, and thus approximately 0,5.

These OFDA data give a thorough understanding of wool quality traits in the Spæl sheep breeding population in Norway. Implementing use of OFDA in the regular yearly breeding scheme is not feasible due to costs and the time perspective, as analysis are not ready before rams are selected for breeding. Further statistical analysis of the wool quality traits with correlations and effect on age is to be published in a scientific publication with the tentative title: *Wool quality traits measured by OFDA of dual-coated wool from the Norwegian White Spæl Sheep from breeding rams* (Grøva and Boman, in writing.)

## **WP2b Old Norse sheep, Hordaland**

*The project proposal described WP2b as follows:*

Research questions:

- Survey of Old Norse sheep in selected locations: What is good wool quality, criteria and standards for classifying?
- What can be done to ensure better collection and use of Old Norse sheep wool?
- How to prevent wool as waste?
- What products ensure the wool's rustic character but also defend a high price?

There is growing interest in older sheep varieties because of meat taste, less labour required and expert landscaping qualities. Due to extremely low prices and lack of industrial up-take, wool from older sheep varieties is burned, thrown in the sea, dug down in the earth or in other manners disposed of. This is waste of resources and affects animal welfare. Wastage of wool represents an actual problem especially in marginal landscapes with recreational and touristic values (Bryn, Flø, Daugstad, Dybedal, & Vinge, 2013). An additional problem is that the quality varies significantly between farmers. Yet there are stellar examples where this type of wool is a part of new and innovative businesses, and some of this wool is expertly sorted and spun by mini-mills and the smallest industrial spinner directly for the farmers or artisans (Klepp & Tobiasson, 2013). This is yarn with unique qualities, with a potential for high end artisan and tourist products, and more couture products.

WP2b will identify barriers in the value chain to find local solutions. This will include interviews with sheep farmers, testing new procedures for collecting wool in

collaboration with Hillesvåg Spinning Mill (HSM) and the Heathland Center, the development and design using Old Norse sheep wool, training and inspiration of farmers and display of results and products of the Heathland Centre and Hillesvåg Spinning Mill. By linking a high-profile designer to the project (Leila Hafzi) we want to show the untapped potential of the raw material. The products will be included in the object-based interviews (*end of proposal excerpt*).

### *Outcomes*

WP2b set out to explore the wool's unique qualities, its potential for high end artisan and tourist products, and for "couture" and "gourmet" products. The first step was to identify barriers in the value chain, through interviews with sheep farmers, testing new procedures for collecting wool in collaboration with Hillesvåg Spinning Mill and the Heathland Center. Training farmers to take proper care of the wool and shearing at the optimal time (as the wool fleece naturally "lets go" at a specific time) has been vital, in order to get a good yield from the sheep. A display of results and products has found a permanent home at the Heathland Centre and HMS has spun 5000 kilos of hand knitting yarn, some of which was launched before Christmas 2018 in three dyed varieties alongside the natural grey.

The work in WP2 and, especially in WP2b, has been characterised by development more than research. The result is better wool, improved collection, new products and attention to the potential of the wool. The delivery has been courses and exhibitions, guided tours and lectures, and new products - but not much published writing. We have therefore chosen to describe this WP in more detail, and include the results of a survey among Old Norse Sheep farmers who have not previously been published.

### *Old Norse Sheep*

The Old Norse Sheep is central to WP2, and it is also the starting point for the Wild Sheep Centre (WSC) who has led the work. It was created to work on the conservation of Old Norse Sheep and to contribute to research and dissemination of the distinctive forms of operation that once dominated the Norwegian coast-line, such as the coasts along the North Atlantic in many other countries. When the stock was at its lowest, there were only approx. 1000 individuals distributed on islands along the Norwegian coast. The Norwegian Wild Sheep Association (Norsk Villsaulag) has rights to the name 'Villsau', as a brand name for the breed Old Norse Sheep (Gammelnorsk sau) as a year-round pasture in coastal heathland. Today, Villsau (Old Norse Sheep) has become the general name of the breed, although it is a protected brand name. Several professionals from Austevoll, University of Bergen, and others joined forces to salvage the sheep from extinction. The focus was on the positive qualities of the sheep as a unique gene resource for the future, specially adapted for grazing the coastal heathlands, preventing overgrowth along the coast and a tasty lean meat with hints of wild game flavour. This has been a success and today ONS is grazing again in many coastal municipalities in the country. Today we expect it to be approx. 60,000 winter grazing ONS spread in the coastal areas from Halden to Finnmark.

Thus, the preservation of Old Norse Sheep has been a great success. But in this work, the focus has been on meat and grazing in overgrown coastal heaths, and not on wool.

Wool from ONS has a high content of lanolin which acts as a natural impregnation, and is known to provide good heat. In recent times, wool from the ONS has not been utilised, with a few exceptions for smaller handicraft projects. This has led to a waste problem rather than a resource. In ancient times, wool from ONS was very important for the coastal population to make good clothes for fishermen and farmers. In recent times, it is only in the last 5 - 10 years that several actors have focused on the good qualities of the wool.

#### *Improved wool quality and standards for classifying*

Farmers have not focused on wool quality when they have selected animals for breeding and have little knowledge of this. It is therefore very variable wool quality in the different flocks. Also, no specific criteria have been prepared for this wool and it is not specified in the wool standard from Animalia. The sheep are outdoors all year and the wool is therefore year-round wool, which is usually sheared or rooed once a year in May/June until early July.

Increased focus on local resources, today there are about 60,000 Old Norse Sheep that produce about 1 kg of wool per sheep: that is about 600 tonnes of year-round wool per year. Some of this wool is collected through the official wool collection for Norilia and Fatland, but there are no figures for the amount of collected wool from Old Norse Sheep. Smaller quantities of wool are spun at Selbu spinning mill or Hillesvåg Spinning Mill, and possibly other smaller spinning mills, but most of the whole year's wool has become a waste problem for the farmers. Wool from the lambs slaughtered, on the other hand, has been sold in the form of sheep skins, which have increased in price and demand in recent years.

Old Norse Sheep have been little engaged in the official work of the Norwegian Association of Sheep and Goat Breeders (NSG), when it comes to breeding or wool standards, and the starting point for mapping the quality is limited. There is also little experience of using the wool on a larger scale (industrial), from sheep to finished product. Some artisans have for many years used the wool for felting, and on a smaller scale, wool has been used for spinning yarns into knitwear and fabrics. Hillesvåg Spinning Mill has for several years received ONS wool from some farmers, for commission spinning, and have experienced that the wool quality varies widely from flock to flock.

The wool is very poorly paid. Norilia has previously payed NOK 1 per kg, but now, according to Marion Tviland at Norilia, they have not been able to continue this due to low earnings. Thus, the work of delivering to collection is less than they receive back. Little was known about what happened to the wool. This is why KRUS conducted a survey of Old Norse Sheep farmers (see below). It shows that many throw it out, burn or dig down the wool. This is especially so for farmers with larger herds. At the same time, the farmers think it is terrible that such a good resource is not used. The work from this WP has therefore been well received, although it has not yet provided any financial results for the farmers.

The work was usually conducted in the form of courses. The courses focused on a) How to increase the quality of the wool? b) Which products are suitable for Old Norse Sheep? An overview of courses can be found in table 5.

**Table 5 Wool sorting courses for Old Norse Sheep farmers 2015-2018**

<i>Date</i>	<i>Place</i>	<i>Nr. of participants</i>	<i>Organisers</i>
<i>June 15</i>	Nordhordland og Gulen	24	KRUS
<i>Feb. 16</i>	Sortland, Lofoten	30	KRUS, NWSA <sup>14</sup> , county and municipality
<i>Feb. 16</i>	Hitra, Trøndelag	9	KRUS, NWSA, county and municipality
<i>Feb. 16</i>	Sande, Møre og Romsdal	25	KRUS, NWSA, county and municipality
<i>March 16</i>	Fosen , Trøndelag	18	KRUS, NWSA, Hilde Buer and Mons Kvamme
<i>Nov. 16</i>	Stette i Skjold, Møre og Romsdal	18	KRUS, NWSA, county and municipality
<i>Oct. 17</i>	Ull i Vesterålen	20	Sommerakademiet, KRUS
<i>Feb. 18</i>	Austrheim	13	KRUS / Austrheim landbrukskvinnelag
<i>March 19</i>	Nordhordland	9	KRUS and project 'Villsau' Nordhordland
<b>9 courses in total</b>		<b>166 participants</b>	

The courses were developed based on existing knowledge and contributed to both the collection of wool and knowledge about wool quality and the development of farmers' understanding of the wool (see results below). In the courses the following resource/expert persons were gathered:

1. Experienced people from Hillesvåg Spinning Mill who know the quality needed for the wool to be used for spinning and yarn of different quality and applications.
2. Craftsmen and artisans who have a great deal of experience with the use of wool for felting, spinning, knitting and weaving and who know the quality needed for this purpose.
3. The farmers bring their own wool, which they are allowed to classify the wool and receive direct feedback from the course leaders on the quality.

The courses have been based on the practical approach and sharing of knowledge based on experience and professional knowledge over many years. No technical characteristics were measured in the wool. The courses emphasised the intangible cultural heritage and tacit knowledge. It is important in all development work that this is taken care of, that is, local knowledge based on traditions and experiences over many years. However, there is much we do not know about this wool, and its exploitation in earlier times.

The courses have followed this set-up:

- Theoretical and historic introduction, wool in general and wool properties.
- A review of various wool grades and various applications.

<sup>14</sup> Norwegian Wild Sheep Association

- Review of different products using different craft techniques.
- Potential product development.
- Cooperation models for further work.
- Participants have brought their own wool of different qualities and colours for evaluation, feedback and advice.

#### Lygra and Nordhordland

In 2014 and 2015, the wool classifying courses (ullsorteringskurs) began at Lygra together with Hillesvåg Spinning Mill. For 5 years, the focus has been on selection of rams, shearing time and wool classifying, which has resulted in a better wool quality.

The courses were held at Hillesvåg, Lygra and Knarvik regional centre. Invited farmers with Old Norse Sheep have participated in 3 courses during the period together with experienced people from Hillesvåg and Lygra Wild Seep Association (Villsaulag) and local traders. The farmers had 1-2 bags of their own wool that have been classified during the course and they received direct feedback on quality and measures to improve the quality of the wool. After the courses, the farmers had the opportunity to supply smaller bales to Hillesvåg Spinning Mill for spinning. If the quality was not good enough, they received direct feedback on this.

As previously mentioned, the Old Norse Sheep is outdoors all year. Once a year the sheep are gathered and at Lygra this is an open event with many happy volunteers. At the sheep gathering (sauesanking) in early June, the adult sheep are sheared. Local tradition bearers are used to sort and classify the wool as soon as it is sheared. We invite farmers and other interested parties to participate in this work. This is a good place for learning, and especially for gaining knowledge and networks. At the same time, it is also part of the Wild Sheep Centre's annual event with many visitors. In this way, they also contribute to the dissemination of knowledge and interest to the general public.

The wool is delivered to Hillesvåg Spinning Mill for spinning, and then it is more carefully sorted. The Heathland Centre invites farmers and others interested to join. This is an important work because HSM does not have the capacity to fine-sort or classify the wool before spinning. Many have received training in sorting through this measure.

The Wild Sheep Centre and HSM sorted much of the fleeces and picked out 1) good 2) medium good and 3) useless fleeces. The fleeces were carefully analysed by professionals, focusing on medullation, kemp, felting in the fleece, dirt and vegetable matter content. The guard hairs were examined for softness and strength, length and thickness. The professionals gave feedback and advice on what to look for in order to classify it as a good fleece.

The result was learning a lot very quickly and all the knowledge we got that day meant that those who selected rams for mating knew what to look for. The knowledge of how the wool should be sorted led us to see an improvement in the quality of the wool that was delivered the following year. Two years after the course, we could see traces of what conscious selection of rams led to for the quality. This produced rapid results in

the herds at Lygra. In the fall of 2019, Lygra Wild Sheep Association has purchased rams with good wool quality in addition to other beneficial breed-specific traits. We look forward to seeing the result of this in a couple of years.

Result: In the herds at Lygra the progress of quality has been good. As the knowledge and awareness of this has increased, the wool quality in the herds is more similar. In total, about 170 animals are sheared in early June. There are some differences in the quality of some of the colours in the herd, but the reason for this is unknown.

So far, the experience from Lygra is that there has been less kemp and medullation and, improving the yarns produced to become softer. The feedback is that the yarn provides "godt hold/fasthet" (strength) in the knitted products. The feedback from Hillesvåg Spinning Mill over the past year is more specific on traits such as the white wool, which has contained more medullation in recent years. The brown wool has not been beneficial for machine knitting and breaks off easily. It looks like the brown wool is more easily felted on the sheep and that the length is shorter, but there is no difference in the strength of the yarn. HMS has been most satisfied with the sorted shades in grey. In their opinion, this is the wool that gives the best yarn. The Wild Sheep Centre has retrieved most of the yarn that HSM has spun, to put up for sale at the centre (more on product development later).

#### Nordhordland and Gulen

Experiences from the courses here is the same as Lygra, namely that the quality of wool varies widely within the herd, even between the herds. Knowledge is important and with a focus on wool quality in the herds this can be quickly improved. Hillesvåg Spinning Mill has several customers for commission spinning that have been delivering for many years and manage to maintain a solid and good quality over time. Those who do not want their wool returned, deliver wool of lesser quality. Several of those who have attended the courses and Møteplass Ull (Wool forum) have continued to invest in wool and wool products for sale. At the first courses, HWS saw that several herds had been bred with Old Spæl Sheep. This wool has longer guard hairs than Old Norse Sheep and may be more difficult to spin. Together with the "Project Wild Sheep in the Nordhordland region", there was a desire to get a joint collection and sorting of wool throughout the region, in order to supply larger quantities to HWS. HWF does not have the capacity to receive many small quantities of wool. This requires too much work and provides poor finances both for them and for the farmers.

Wool Forum (Møteplass Ull) which is a collaboration between Nordhordland development - Nordhordland biosphere area, Summer Academy, Hillesvåg Spinning Mill, Local chapters of Norwegian Folk Art and Craft Association, the Museum Center in Hordaland represented by Osterøy museum, Havrå and the Heathland Centre. The focus has been on sheep farming, wool quality and handicraft traditions, design and the product. This, together with the Wool Week festival, has inspired many to invest in wool from Old Norse Sheep in the region. These measures are an important arena for knowledge, networking and inspiration.

KRUS and other measures implemented have greatly boosted the use of Old Norse Sheep wool in the region. Several have started small-scale production of yarn and wool

products, courses, etc. But more people with larger herds do not have the opportunity to take care of the wool themselves. They prefer to send to the wool stations and get paid a fixed price for the wool. All the Old Norse Sheep farmers, in contact with the project, think it is terrible if the wool becomes a waste problem rather than a resource.

Møre, Trøndelag and Vesterålen

In 2016, four courses were arranged in collaboration with KRUS and the Norwegian Wild Sheep Association/local teams. In addition, "mini courses" have been held in sorting and classification in Fosen, Trøndelag, as part of a larger course in Old Norse Sheep farming.

Karin Flatøy Svarstad at the Summer Academy has been engaged to hold these courses. She has over 20 years of experience using Old Norse Sheep wool of various qualities for felting, yarns, etc.

The courses have been over 2 days and covered the history, wool in general and wool properties. In addition, the courses covered a review of wool grades, application areas for products in various techniques, and potential product developments as well as collaborative models for further work. The participants brought their own wool of different qualities and colours. A practical review of wool brought by the participants and visits to sheep farms were arranged.

Course results: There was greater variation in quality. This is not surprising because in many places there has been no focus on the wool. Work must be continued on those herds who already have good wool and those who want to attain better quality. But some areas stand out positively, like some herds in Møre and in Vesterålen. In Vesterålen, several sheep farmers have gathered forces on joint collection and sorting of wool, and they will collaborate with Hillesvåg Spinning Mill and Kåfjord spinning mill for carding and spinning. Also, in Sunnmøre, several farmers delivered together last year, through Norilia, to the wool station in Førde for classifying. The plan was for HWS to spin this batch in different yarn grades to test out different product options.

The work has shown it is possible to quickly improve the quality of Old Norse Sheep wool. Furthermore, we see that local initiatives, and especially spinning mills, are important in this work. Improvements in the wool must be aimed at specific products and thus go hand in hand with product development.

There are still barriers to overcome. The most successful use of wool from Old Norse Sheep is various types of commission spinning, collection and processing beyond the systems of Norilia and Fatland. To scale up, good logistics are needed in collaboration with Norilia/Fatland. The lambswool yarn described later is an attempt at such upscaling, but much remains to be done. The results from KRUS has been primarily to show that quality work is possible.

#### *Survey among Old Norse Sheep Farmers*

A questionnaire was distributed during the courses on wool quality from 2015 to 2019. The objective was to gain insight into experiences, practices and challenges from the



farmers. This material is not previously published, but has been important for the work of KRUS.

A total of 100 farmers participated in the courses and 49 responded to the survey. Some who participated in the courses had Norwegian White Sheep, or Norwegian Old Spæl Sheep, or they did not have sheep themselves, but made different products of the wool. A total of 38 farmers with their own sheep herd of the Old Norse breed are included in the material. The answers from those who did not have sheep or had other Norwegian sheep are summarised separately.

There was great interest in the courses and an agreement that it was very unfortunate that wool as a valuable resource was not taken proper care of. At the same time, there was little knowledge about good wool quality. Participants find pricing of wool hard, and thus finances, lack of knowledge, and practicalities around collection by the wool stations are seen as the most important challenges.

### **Shearing/rooing**

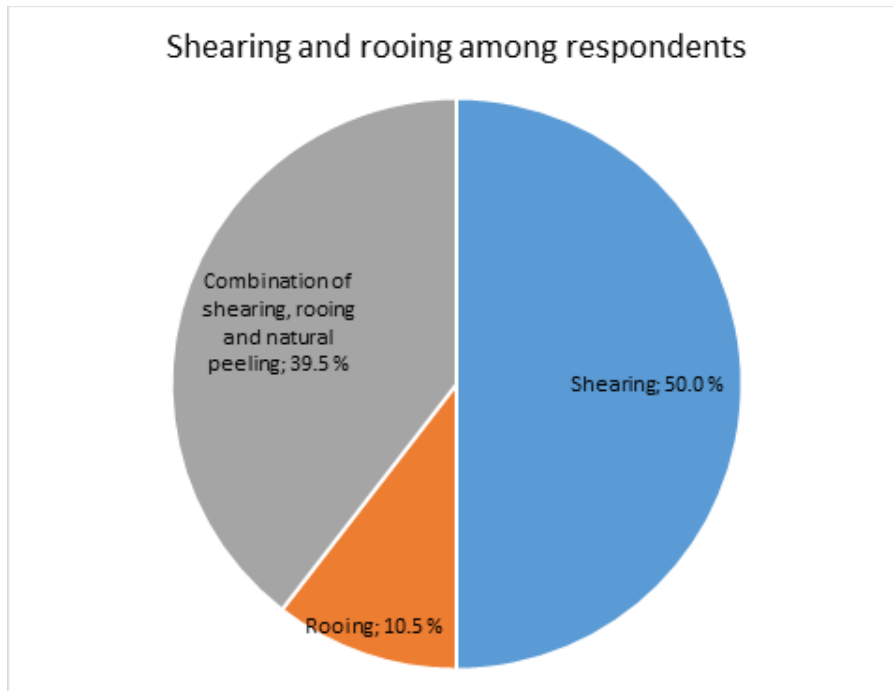
Shearing or rooing, or both, and timing, is important for the quality of the wool. On Old Norse Sheep, the fleece peels away as whole or in part. In the spring some of the sheep will lose their wool. The time of shearing is best right after the wool has started to peel. Within the herd there will be great variations if and when this happens. If you wait too long before the wool is sheared, the wool will easily begin to felt (tove), and new wool can grow into and tangle with the old wool if the sheep does not lose the whole fleece.

The shearing time is important for what the wool can be used for afterwards. If it is spun into yarn, it must not be felted, and ideal shearing time is at the end of May/June in accordance with Hillesvåg Spinning Mill with reference to the herd of sheep at Lygra. By then, the wool of some individuals has already started to loosen, but the wool has not begun to felt. Exact times will vary slightly from herd to herd and among regions in the country.



## Shearing or rooing

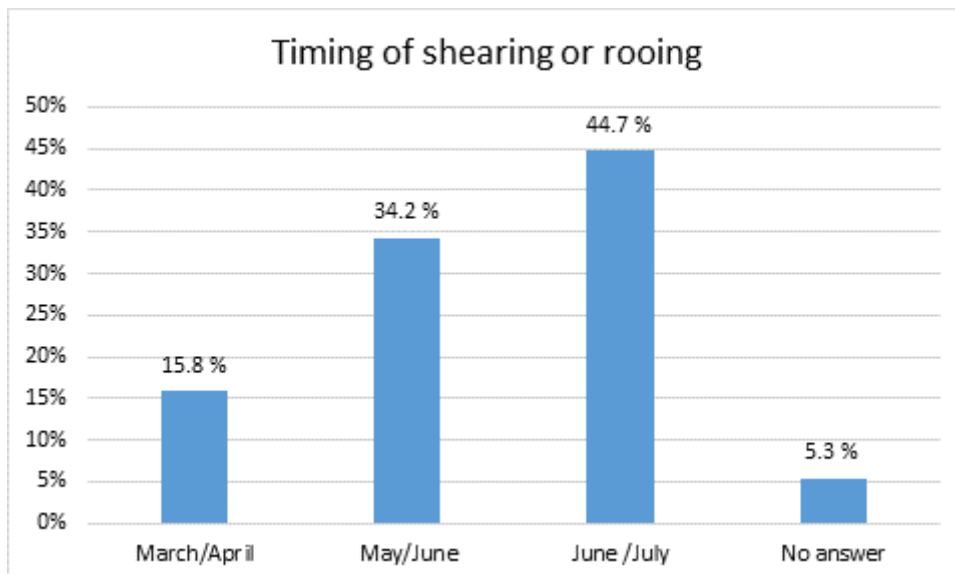
**Figure 15 Shearing 50 %, rooing 10.5 %, combination 39.5 % N = 38**



As Figure 15 shows, 50 % replied that they shear, and 40% that they combine a method of shearing, rooing, and letting the fleece peel off naturally. Ten percent replied that they rooed. Some claim that rooing is best, as the wool has started to loosen and the fibre is closed at the end (lukket i enden), and this is used by many as an argument for rooing and not shearing. As far as we know, no comparative tests of the properties of shearing versus rooing the wool have been done; however, there are many opinions on this.

## Timing

**Figure 16 Timing of shearing or rooing: March/April 15.8 %, May/June 34.2 %, June/July 44.7 %, no answer 5.3 % N = 38**



The time for shearing and rooing varied between the farmers. Figure 16 shows that 45 % of the farmers shear/roo at the end of June/July, while 34% shear in May/June. The farmers who responded have from 2 to over 200 sheep. The remaining respondents shear early spring and some also in the fall. The latter applies primarily to herds kept inside during winter.

We find that the time for shearing is a barrier for the quality. The majority of the farmers shear late in the year, and one can assume that much of this wool has already begun to felt and must be sorted out to get a good enough quality for carding and spinning. In order to make a profit, most of the wool must be of good quality, with time spent on sorting. According to tradition, shearing is done in late June/July, and the fleece peels off naturally from the sheep (the breed standard from the Norwegian Wild Sheep Association).

### Keeping or throwing away wool

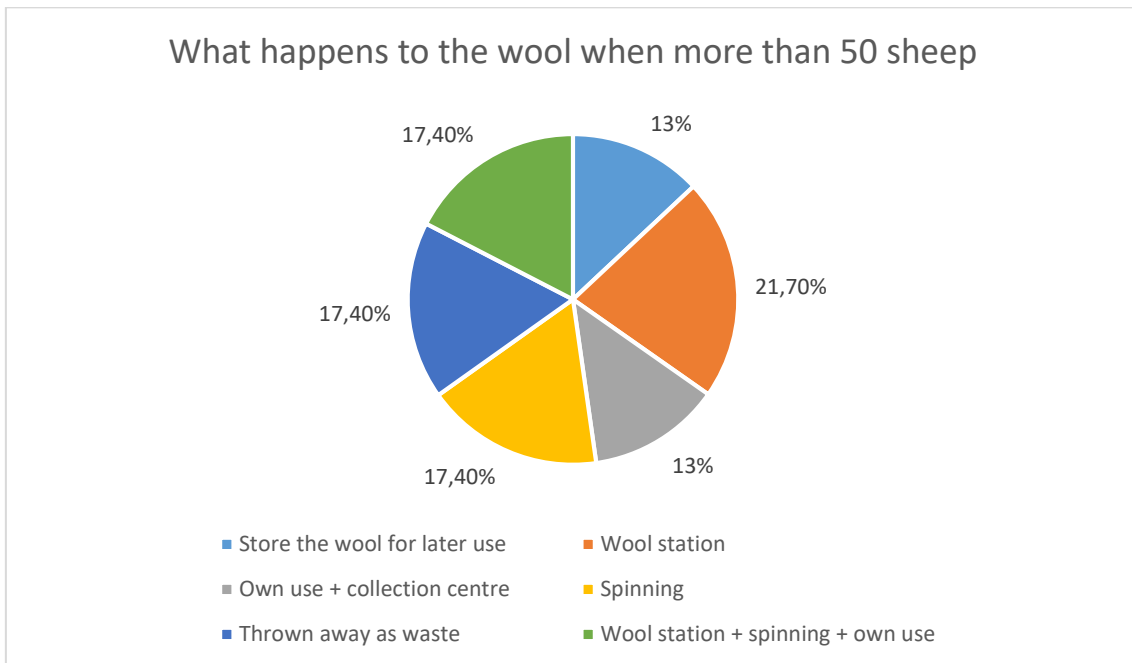
The goal of working with Old Norse Sheep wool in KRUS has been to take more care of the wool. We had as a working hypothesis that much of the wool went to waste. At the same time, there were no statistics on wool waste. Therefore, it was important for us to ask the farmers about this. We found from the replies that farmers with large and small flocks have somewhat different practices, and we therefore choose to present the results separately.

**Figure 17 Less than 50 sheep: store for later use 13 %, own use+collection centre 13 %, collection centre 22 %, collection centre+spinning+own use 17 %, spinning 17 %, thrown away as waste 18 % N = 23**



There were 23 farmers who had less than 50 sheep, and as shown by figure 17, 18 % replied they throw away the wool as waste, and 70 % that they deliver to a wool station, to spinning or use the wool themselves. 13 percent replied they take care of the wool for later use. We do not know what happens to stored wool, but it can also be a way to delay throwing it away, which is not something that farmers like to do.

**Figure 18 More than 50 sheep: store for later use 13 %, own use+collection centre 13 %, thrown away as waste 17.4 %, collection centre 21.7 %, spinning 17.4 %, collection centre+spinning+own use 17.4 % N = 16**



In the larger herds with between 50 and 190 sheep, figure 18 shows that the proportion that is discarded is greater. Of these 16 farmers, 50 % replied that they throw away the wool, 38% delivered to a wool station, for spinning or used it themselves. 11 % replied that they store the wool for later use.

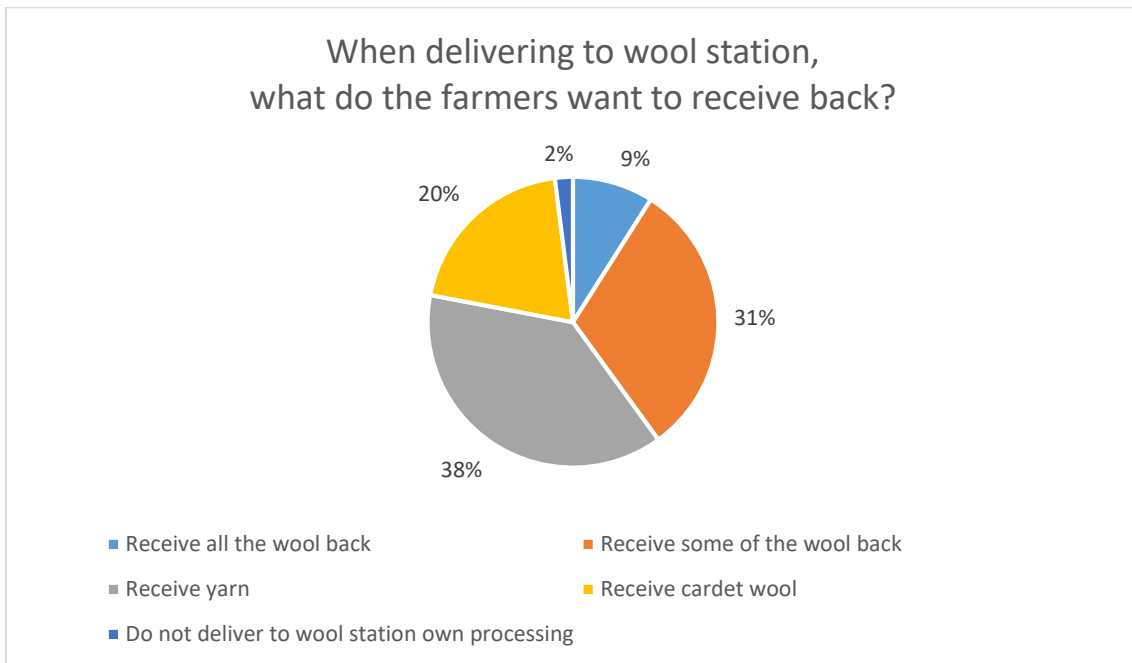
There is a clear distinction between large and small herds in how the wool is handled. If we look at volume, it is clear that large producers to a greater extent throw wool away, than the small ones. If large volumes of Old Norse Sheep wool are to be collected in the long term, more active efforts must be made towards this segment, especially for quality, shearing time, and delivery/finances.

All the farmers expressed that it was a negative thing to throw away the wool, and they want to make good use of this resource. This is a good starting point for change, but also an indication that the reality is probably worse than our numbers indicate.

**How is the wool utilised?**

There are several ways to take care of the wool. As shown by figure 19, among the farmers who keep their wool, 2 % do the processing themselves. The other respondents deliver to wool stations, and many of those who deliver to these, receive their wool or yarn back.

**Figure 19** Receive all the wool back 9 %, receive yarn 38 %, do not deliver to wool station 2 %, receive some of the wool back 31 %, receive carded wool 20 % N = 46



The numbers from figure 19 are based on 29 respondents and 46 answers, as they could choose several answers. Almost 40 % were interested in received yarn back from their wool, which they could then use for sale or make products for own use. This survey does not say anything about the amount of wool the farmers want back, but shows that many are interested in receiving wool back. We have therefore looked into what the farmers use the wool for.

**Figure 20** Use of wool: felting 33 %, carding 19 %, isolation 10 %, weaving 5 %, spinning 24 %, lanolin 5 %, trenches 5 % N = 19

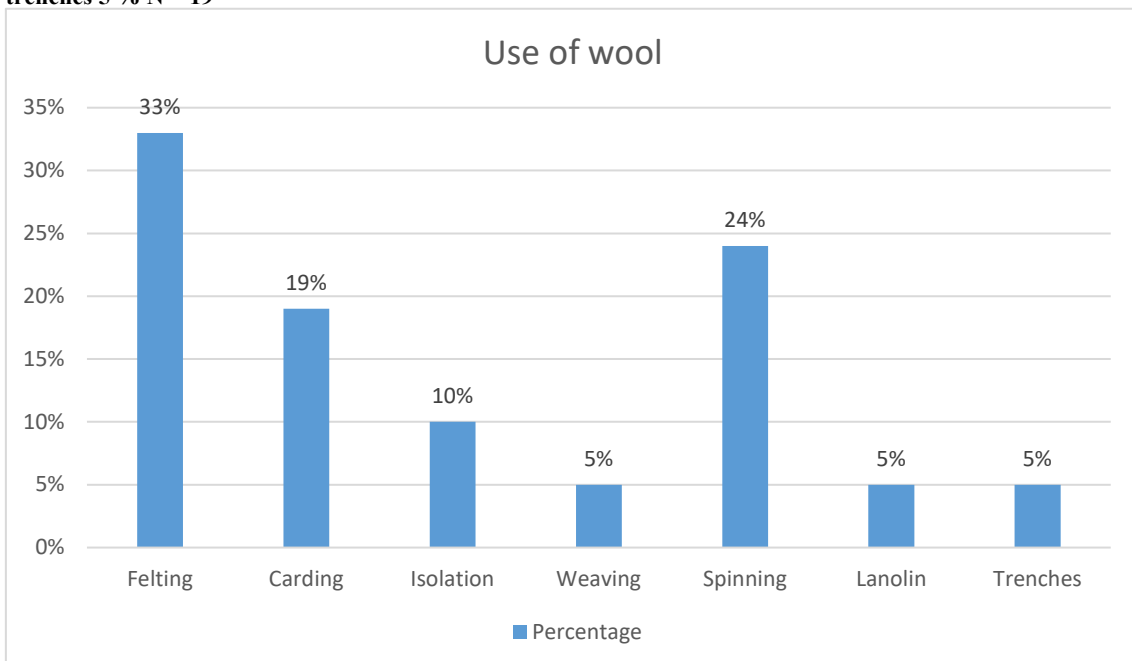


Figure 20 is based on 19 respondents, where some would use the wool for several purposes.

**Figure 21 Products made from the wool: Knitwear 6, felting 6, socks and mittens 3, cardigans 1, seating pad 4, lanolin 1, yarn 6, trench draining 1 N = 18**

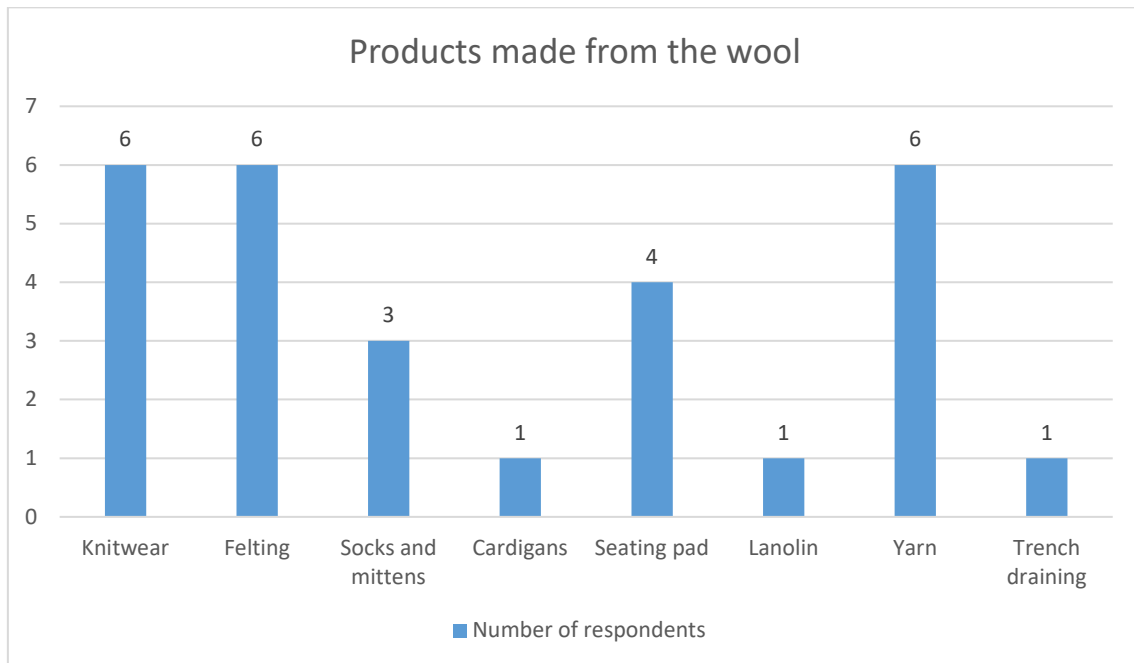
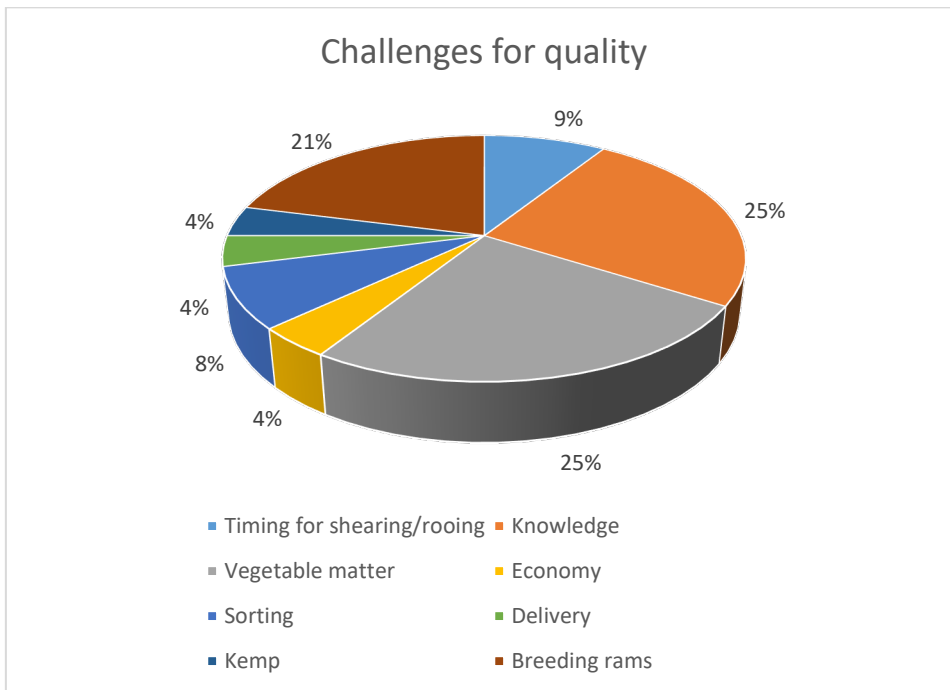


Figure 21 is based on number of respondents, and shows that products such as felting, seating pads and knitwear were popular to make, and some also use the wool for isolation and trench draining. The number of farmers in the survey gives few answers when we ask so specifically. The answers nevertheless give the impression that felted products and yarn are made from their wool, and that it is also used for very simple products such as insulation and trenches. This indicates that it is also possible to increase the utilisation among the wool being taken care of.

#### How to ensure sufficient wool quality in the future

The farmers were also asked what can ensure wool quality in the future. The answers here may be influenced by the themes and discussions during the courses, but still they can give a clue as to what farmers think are the most important challenges.

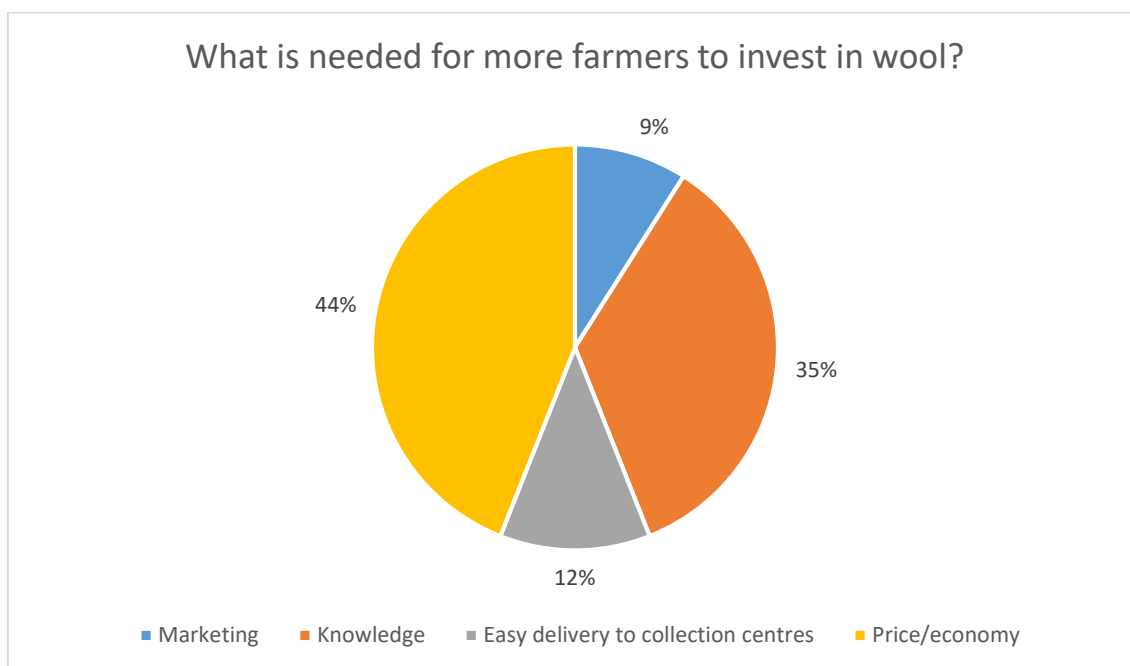
**Figure 22 Challenges for quality: timing for shearing/rooing 9 %, economy 4 %, kemp 4 %, knowledge 25 %, sorting 8 %, breeding rams 21 %, vegetable matter 25 %, delivery 4 % N = 38**



The answers from figure 22 are complex and point to both the specific challenges such as the amount of vegetable matter and kemp, and problems related to systems such as knowledge, access to good breeding rams, sorting, delivery and finances. Surprisingly, few respondents point to economics (4 %) as the biggest obstacle, but it is actually knowledge and vegetable matter (both 25 %). This may be due to the way the question is posed, where it is quality, and not what can contribute to the improvement in quality, which is focused on.

The survey also asked what is needed for more farmers to invest in wool. Here, figure 23 shows that economics is the most important (44 %), while knowledge comes in second place with 35 % of the answers.

Figure 23 Marketing 9 %, knowledge 35 %, easy delivery to collection centres 12 %, price/economy 44 % N = 38



The survey is important to document that throwing away wool from Old Norse Sheep is a problem that must be solved. All wool in Norway can be delivered to collection centres. However, when this is not done, there may be several reasons for it, but low price is probably the most important. It is interesting that farmers with small herds are usually those who keep the wool. This is because they deliver, but also take back their own wool as carded wool, or yarn. In other words, the delivery is part of their own production and possibly also sale of their own products. In the effort to get farmers involved in the supply of wool, it is important that this solution, with a lot of in-house work and on a very small scale, is not the only solution, but that there are other solutions that are better suited to farms with larger herds.

Replies from the survey show a desire for more knowledge. It turns out that the farmers deem it important to have time to attend courses, and they replied that knowledge is an important barrier to improve the quality of wool. In addition to knowledge, the economy and the practicalities surrounding delivery are important.

We will now leave the study of the Old Norse Sheep farmers and look at WP2b's next RQ, which is in many ways closely related to what has so far been presented.

#### *Increased wool quality on Old Norse Sheep through breeding*

On this research questions we have worked with the Norwegian Wild Sheep Association. The question itself is problematic because one does not want to breed the Old Norse sheep to safeguard one specific trait. Old Norse sheep have a primary purpose for their wool, namely providing protection throughout the year for the sheep that are outdoors in a harsh climate. Therefore, one must look at all the characteristics of the sheep. KRUS and work package WP2b, and the focus on the use of Norwegian wool, has led the Norwegian Wild Sheep Association to increase their focus on wool. They decided at the annual meeting in 2016 to develop a breeding standard for Old

Norse sheep<sup>15</sup>. They have also posted on their website to educate their members through the "Breeding school for Old Norse sheep" - 3 lessons have been published - so far not for wool, though. One had originally thought that kemp would be the biggest problem, however, it has turned out to be medullation. Wool from Old Norse sheep *should* actually contain kemp, beard, guard hairs and underwool (Møtepluss Ull 23.3.2017). This means that because of the focus, and through the many courses that were held on medullation, there is hope that a vast improvement should be seen within a timespan of perhaps five years.

Old Norse Sheep herds are to a small extent included in the sheep control, where kinship of the individuals is recorded. The reason is that the animals walk free-range throughout the year, and thus there has been no controlled mating or lambing, and it is difficult to detect exact paternity and in some cases maternity. The sheep cannot be selected (rated) for breeding if they are not registered in the sheep control. At the same time, this type of breeding is less organised and problematic. Some farmers use the Old Norse sheep as mother sheep and cross with more meat-rich breeds, such as Blackface, Shetland, Dala sheep etc. This is partly done according to older recommendations from NSG. Such a crossbreeding will give more weight, and possibly better economy. However, at the same time there is a decrease of the "pure" Old Norse Sheep and no one knows for sure the origin of the rams used in herds that want an uncontaminated breed with Old Norse Sheep.

Breeding in the natural sense, meaning random, is neither desirable nor easily possible with Old Norse Sheep. However, it is possible to do something to control the development and, above all, to prevent a mix with more modern breeds. Such work has been by the Male Animal Center in Nordhordland (Hanndyrsentralen). One of the goals has been to secure access to good rams with sufficient wool, but also to enable a system that ensures ram breeds according to the criteria of the breed standard that Norwegian Wild Sheep Association created in 2016.

The Wild Sheep Center in collaboration with Lygra Wild Sheep Association and the Norwegian Wild Sheep Association have arranged Ram reviews for Old Norse Sheep farmers in Nordhordland (Lindås, Meland, Radøy, Austrheim, Fedje and Masfjorden). The project was also supported by the County Governor of Hordaland, Department of Agriculture. A total of 13 exhibitors and 48 rams were included. Judges from Norwegian Wild Sheep Association judged the herds. The focus was on specific characteristics and the totality, and both meat fullness and wool quality were included in the assessment. An experience from this work is that knowledge and advice on wool quality has been inadequate.

#### *Development of new products*

Rather than developing products with couture designer Leila Hafzi, Hillesvåg Spinning Mill cooperated with a sports brand and spun industrial yarn for the Ulvang brand, which knits 500 sweaters using Old Norse Sheep lambswool in the "Ulvang Feral sweater", which was launched the fall of 2018. HWS has been working hard to develop yarns from lambswool from Old Norse Sheep. It has given promising results and they

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<sup>15</sup> [Document with breeding standard for Old Norse Sheep](#)



have also cooperated with Krivi Weaving mill on developing new materials (a continuation of VikingGold). At the Heathland Center, we have tried out a curtain fabric from Krivi in lambswool in meeting rooms, which provides good shielding from daylight for projector use.

**Figure 24 Exhibition of products during a KRUS seminar**



Yarn for knitting by hand

Hillesvåg Spinning Mill has increasingly spun more yarn from Old Norse Sheep wool every year. The spinning takes place both as commission spinning and through the development and sale of their own yarn, and by spinning yarn (see the Ulvang sweater). There is a lot of positive feedback and a great interest in the yarn from professionals. Many farmers reach out to supply wool and HWF has now opened for more capacity. Because much is commission spinning, a limited amount of yarn from Old Norse Sheep is available through the spinning mill's regular sales channels. It is desirable to have more farmers who can deliver wool for collection for further sale. The challenge is to get all the pieces in the value chain in the right order. One of the most important barriers is low price, which reduces the delivery of wool. At the same time, it is also important to increase demand, which in the long run can both secure demand and better prices.

#### **Knitting products of yarn from Old Norse Sheep, sold by the Wild Sheep Centre.**

The Wild Sheep Center is one of many who does commission spinning at Hillesvåg Spinning Mill. They started by using the wool themselves as work attire at the centre and felt it was important to try out the products to experience the usage over time.

Figure 25 Sweaters knitted in Old Norse Sheep wool



The experiences of sweaters are positive; they are light and warm. The sweaters, seen in figure 25, seem a little hard and prickly at first, but as they are used, the kemp/medullation escapes from the garment and it gets softer. When the garment is worn for a while providing warmth, they become softer and do not itch. The products also become softer through laundering.

In addition to sweaters, “sea mittens” (used by fishermen in earlier times) have also been made and used. They are comfortable and warm. The lanolin makes the mittens feel soft and it gives a good grip of the oars. There is little blistering in the hands when rowing with sea mittens of Old Norse Sheep wool. Before rowing, the mittens should be immersed in water, which makes them firmer and warmer. They are felted during rowing, so they must be knit loose and large. After use, when the mittens have dried, they “expand” slightly again.

Models and patterns, some examples

Berit Løkken at Hillesvåg Spinning Mill has designed a hat recipe for the Heathland center, launched during the Wool Week (in 2017), and knitting kits are now available. HWF also produces patterns for mittens, socks, sweaters and a jacket in Old Norse Sheep wool, also available as knit kits.

Figure 26 Hat models in Old Norse Sheep wool



The jacket is included in *Knit with Norwegian wool (Strikk med norsk ull)*, which was launched during Wool Week 2017, in Hillesvåg, but can be purchased along with the yarn. Right before Christmas 2018, yarn from Old Norse Sheep was launched in three dyed colours (red, green and blue) alongside the natural grey yarn.

Figure 27 Yarn from Old Norse Sheep, also a skein of dyed yarn, launched right before Christmas in 2018, [posted on Instagram](#)



Svarstad has together with two local craftsmen, Anne Grete Breisnes (weaver) from Austrheim, and Leto Design by Elin Gaulen from Lindås, designed, woven and sewed a collection in Old Norse Sheep wool. This was show-cased at the opening of the Wool Week in September 2018.

Lambswool from Old Norse Sheep wool (Hillesvåg)

The spinning mill will invest and develop this product further. Several knitters have used this yarn, spun in Nm 7/2, Nm 7/1 and Nm 5.2/2 quality, with the name Norsk Villsau Lamullgarn (Norwegian Old Norse Sheep lambswool yarn) but not yet sorted by



colour. The yarn has been used in Krivi weaving mill, and as a knitting yarn for machines by Ulvang in the production of an edition of the 'Ravgenser' (Rav sweater) called "Feral sweater w/zip". This is one of Ulvang's most unique sweaters, and is according to Ulvang's description, weatherproof and warm, made from 100 % Old Norse Sheep wool.

#### *Unresolved issues and further work*

The courses for Old Norse Sheep farmers have given results. A focus on local resources and the use of Norwegian wool has led to increased interest from the farmers to take care of the wool. This has resulted in a great rush for commission spinning at Hillesvåg Spinning Mill. They give each sheep farmer feedback on sorting and testing of quality for spinning. This gives results, but it is labour intensive and when KRUS ends, systems are needed so that more of Old Norse Sheep wool is collected through Norilia and Fatland. It is very resource-consuming to receive many small batches and work with increasing quality directly with each farmer.

Increasing demand for Old Norse Sheep wool is the best way to increase finances. The goal is to increase the quantity of both large-scale products and niche products from wool, focusing on all the good qualities of wool. With 60.0000 winter grazing sheep there is a potential.

Getting the subsidy back for the Old Norse Sheep wool, as soon as possible, seems to be crucial to moving forward. Good cooperation with Norilia and Fatland is also crucial. An important measure is to disseminate knowledge to extensive parts of the industry, for example in a film similar to the one for Spæl sheep wool handling

#### **WP2c Norwegian Spæl sheep and Grey Trønder sheep, Trøndelag**

*The project proposal described WP2c as follows:*

Research questions:

- How can the (older) Norwegian textile history contribute to product development?
- Is it possible to transfer knowledge from archaeological/historical research to the current value chain and from the work of reconstruction/historical textiles to the current product?
- How can the knowledge- and craft-based production of textiles become profitable?
- How can the collection and wool quality be improved?

WP2c has helped to develop more appropriate collection and grading of wool in cooperation with Norilia, mainly for WP 2a and 2b. Another main contribution has been to study concrete properties of wool-types: colourfastness of pigmented wool, strength, crimp, flammability, etc. At the very outset of the project, Ingvild Svorkmo Espelien, founder and director at Selbu Spinning mill (and WP leader), met with Ingun Grimstad Klepp, and agreed on the following tasks to be addressed:

- Description of what has been done in local wool processing in the region until now
- Description of current working methods
- Changes focusing on sustainability (economic, social and environmental), planning and implementation
- Coordination with the rest of WP2 and with the entire project
- Exploring collaboration methods and product development that can strengthen both the company and its partners
- Make information, knowledge and experience accessible to the general public

WP2c will focus on the interdependence of conservation work in genetic resources and cultural history. With pigmented Spæl (short tailed) sheep we mean Old Norwegian Spæl and modern, pigmented Spæl. Without the old breeds we cannot reconstruct old fabrics, while older cultural history has remained untapped as resource for new designs. Under the auspices of the University of Oslo, Selbu spinning mill is currently partaking in the reconstruction of the oldest surviving garments in wool found in Norway. The VikingGold project aims to deliver modern design inspired by Viking textiles and produced by Norwegian wool in. A prerequisite for this is that older indigenous breeds are preserved and that we have the knowledge and production facilities. Selbu represents a unique textile treasure throve in a Norwegian context, and Selbu spinning mill is a partner in restoring and developing these textile treasures. This is a good example of the close relationship between local crafts where local sheep breeds have played a significant role. This work contributes to bring new quality products forward, produced in Norway.

Selbu spinning mill works with characteristics of wool from Norwegian sheep breeds (fibre diameter and fibre quality, light fastness, etc.), related to issues in WP1, 2 and 4. Older breeds often have a strong local connection, such as Grey Trønder in Trøndelag and Steigar in Nordland, and the relationship between the landscape and sheep thereby gives a new dimension to local textiles. Selbu spinning mill collaborates with designers who contribute to innovation and exploring new opportunities in products. The results will be different types of yarn and felted fabrics from Spæl and Grey Trønder. The products will be displayed at various sales fairs and lectures/theme nights, as they have been a very active lecture-resource. WP2c will develop more appropriate collection and grading of wool from Grey Trønder and pigmented Spæl in cooperation with Norilia, and work done in WP2a and b (*end of proposal excerpt*).

### *VikingGold*

To understand the background for WP2cs research questions, we start with a description of the VikingGold project, which overlapped with KRUS, and which describes both some of the regional wool processing and current working methods. This project started out the exploration of collaboration methods and product development for strengthening both the company and business partners, alongside making information and knowledge available to the general public.

VikingGold was a project led by Norwegian Fashion Institute (later Abelia and now Norwegian Fashion Hub), that SIFO also was active in, and some of the experiences from this project were incorporated into KRUS. Financing for this project came from

KreaNord, which was funding for creative industries, financed by The Nordic Council of Ministers. VikingGold was the first project within textiles to receive such funding. VikingGold began in the autumn of 2013 and lasted until the autumn of 2015. It sprung from an idea Ingun Grimstad Klepp and Tone Skårdal Tobiasson had as a reaction to the use of Vikings in the marketing of wool (Viking Wool from Norway and Viking Yarns) and in souvenirs, instead of using quality and tradition - products of low quality and bad taste dominated. The project was led by Gisle Mardal, and was a Nordic collaboration. Also included in the project group was Marianne Vedeler from the Museum of Cultural History, University of Oslo.

The objective of the project was to present a few but good examples of how it is possible today to use knowledge of Viking's textiles for beautiful design products. Another important element was to achieve knowledge exchange in the value chain in the Nordic region and to develop products through cooperation between different companies. The idea was to show how an older textile history could be used positively and that the modern textile industry has unused possibilities within local traditions and through providence. The Vikings' textiles were technically superior, beautiful and functional. They decorated residences, ships and people, and kept warm and dry. The tightly woven sails in wool brought them across the seas and enabled cultural exchange and trade; also, of textiles. In graves like Oseberg, textiles held a central place and are found in a plethora of techniques and functions. In spite of this, there is little research on the Vikings' textiles and hardly any available literature, exhibits or other dissemination platforms. The dominant rendition of Vikings as trolls, with horn-decorated helmets dominate the tourist market, and is probably as far from the original as the local renditions of the textiles as felted, bulky and non-aesthetic sack-like clothing.

Important for the project was to create meeting points for historical expertise, raw material suppliers and the finished goods industry and designers. These represented people and groups who had not earlier cooperated. Representatives from the industry and designers got access to historical archives and got to see preserved textiles from the Viking Age, alongside knowledge on the Vikings' clothing and textile production. It was necessary early on to make some choices. Because Marianne Vedeler, the archaeologist in the project, simultaneously was working on a reconstruction of the tunic from Lendebreen, Norway's oldest garment from around year 300 AD, we chose this as a starting-point. The tunic is about 500 years older than the Viking Age, but diamond twill, which is a weaving-pattern, was widely used in the Viking age. The selected tunic was thoroughly examined and well documented, and this made it possible for us to be able to show both a reconstruction and our industrially produced fabric at the same time. Our collaborators, from sheep farmers to designers, were involved in the decision-making process and the discussions themselves, and were important for enhancing competence and understanding of what compromises must be made when a historical material is to be produced in a modern way.

As we used wool from both the Old Spæl breed and the modern Spæl sheep; we had a natural grey and a natural off-white yarn which gave a very nice pattern. However, the textile pilled, so when Krivi Weaving mill continued with a new material in the same pattern, they chose cross-bred wool. The pilling could have been caused by the shorter

under-wool 'escaping' the yarn, as different lengths in wool is known to cause similar problems. During a meeting with Marianne Mørck, a Trondheim-based designer, who had used the new material to sew up some samples in her design, she informed us that also the new material in cross-bred wool pilled, and that Krivi Weaving mill is trying out a new alternative. Krivi Weaving mill received funding (SkatteFunn) for a project they called Krivi ull – arven etter vikingene (Krivi Wool – the Viking heritage) in 2017. The project looked into using more Norwegian wool in their textiles, also their national costume textiles, where the content now is 65 % Norwegian wool (Facebook post Nov 27<sup>th</sup>, 2018), alongside other fabrics with even higher percentage, such as Varp & Veft's materials in Grey Trønder wool (see below).

## **The wool**

The wool in the reconstructed tunic was not sheared, but rooed from the animal in one fleece, when the wool lifted itself naturally and shed in spring. In Norway today, the older breeds do not shed their wool in the same way. For the reconstruction, Old Norse Sheep breeds were used, while the VikingGold project used Old Norwegian Spæl and Norwegian White Spæl to get two different shades. Ingvild Espelien took responsibility for the collection of the 200 kilos of wool from two local herds and it was also she who sorted the wool into two shades and cleaned it, and separated some of the coarser guard hairs out of the fleeces.

## **Spinning**

Half of the wool was sent to Hillesvåg Spinning Mill, to spin the weft yarn. Selbu Spinning Mill spun the warp yarn, and both were spun with a z twist, though the warp was a little looser spun. The thickness of the yarn corresponded to 6 nm, as 7 nm was on the border of what the machines could spin. This may appear as a minor detail, however the trade-off between being closest to the original yarn in the tunic, and getting a good raw-material with the wool and the technology we have today, was important. All those involved generously shared their knowledge, alongside learning a lot, not just about the Lendebre discovery and the Viking Age, but also about wool, spinning and weaving today.

## **Weaving**

Espelien sent the warp yarn first to Krivi Weaving, and in order for the yarn in the weft to be as compatible as possible, it was weighed before Hillesvåg Spinning Mill started their spinning. No one at Krivi Weaving mill had seen the original fabric, and worked from drawings and pictures in order to set up the pattern and density. A characteristic of older textiles is the lack of symmetry in the patterns. Today, the irregularities appear as faults and not conscious choices. Krivi Weaving mill chose to clean up the pattern a little, and also chose to distribute darker and lighter portions evenly in the weave to counteract clear stripe patterns. The yarn initially seemed more difficult to weave than it actually was. The actual weaving of the 200 meters therefore went quickly and easily<sup>16</sup>.

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<sup>16</sup> [Video from Facebook of the weaving process at Krivi Weave](#)

## Finishing

Krivi Weaving mill has no finishing at Tingvoll, and usually sends their fabrics to Sweden for these types of processes. However, Sjølingstad Woollen Mill museum (which is part of the Vest-Agder museum) assumed responsibility for the last finishing, and although the fabric was a bit too wide, this went well. We chose a very simple and easy finishing, although some of the designers had wanted a felted fabric. For anyone who had seen the fabric before and after treatment, it was striking how much softer and smoother the finished fabric was<sup>17</sup>.

## Design

Parallel to the actual fabric production, a design competition was announced for a select group of Norwegian and Icelandic designers – and the invited sketches were then exhibited as part of *Ta det personlig* (Take it personally) exhibition at the Historical Museum in Oslo, where both the Lendebre tunics, the reconstruction and VikingGold were presented. Five Norwegian and two Icelandic designers participated, and among these we picked out three who got several meters of fabric and sewed up the outfits that were shown on the Wool Day in 2015 (Sissel Strand, Connie Riiser Berger and Elisabeth Stray Pedersen). These were also shown at an exhibition at the Coastal Museum in Florø (Tradition and trend: Norwegian wool in all times). In addition, several designers have tried the fabric afterwards: Marianne Mørck (who has used a new textile that Krivi Weaving mill has woven afterwards with ordinary crossbred wool), also Malin Håvarstein and Rebeca Herlung. In addition, Kim Holte has received the material, and both Ingun Klepp and Ingvild Espelien have sewn dresses with the fabric.

The project ended, although parts of it lives on in KRUS, as an example of the use of tradition to produce good, new, Norwegian produced textiles in wool. The exhibition at Museum of History was opened by (current Minister of Culture) Trine Skei Grande, who got an introduction to the project by Ingun Grimstad Klepp.

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<sup>17</sup> [Video of steaming of fabrics at Sjølingstad](#)



Figure 28 Klepp and Trine Skei Grande



A modern version of the tunica material from the Lende glacier:

- Wool: 70% Old Norwegian (short-tailed) Spæl sheep, Class F1S, from Nordfjordeid and Snåsa.
- 30% Modern white (short-tailed) Spæl sheep, CF1, from Trøndelag, Malvik wool station
- Classified by Norilia
- Colour-sorted and removal of some of the coarse cover-wool at Selbu Spinning Mill
- Warp: Scoured and spun at Selbu Spinning Mill
- Weft: Scoured and spun at Hillesvåg Spinning Mill
- Cloth woven in a diamond twill pattern at Krivi Weaving mill, based on the pattern from the tunic from the Lendrebre, however slightly modified for the modern machinery
- Post-production work: Sjølingstad Woolen Museum mill

To achieve the resulting textile and the modern designs, we relinked different stakeholders, and this is still on going. The project had several cooperating partners from collection and classification of wool, spinners and weavers, and finally Nordic design companies. However, as the textile itself currently does not uphold the quality for such high price points, this specific project is at a standstill. Mørck wishes to continue with the material if the quality is good enough, but she is struggling with the price-point. This is a recurring problem for the designers, as the cost for producing a skirt or jacket (even when sewn in the Baltics) has proven to be too high for the market (private conversations with designers). The current business model with the stores charging three times the wholesale price, is inhibitive for high cost fabric. Some designers have also complained that the material was hard to work with, with the 'extreme' bounce in the wool. It may thus find other uses than in apparel. Lillunn Design/ESP Oslo, who was part of the original project, has launched a jacket based on the coat Elisabeth Stray Pedersen designed for VikingGold. However, the fabric is woven in the Baltics – with Norwegian wool and a slightly different pattern.

The success of «local» and «slow» signals a change in attitude towards developing products that build on local traditions and history – both for local customers and tourists. The Nordic region is already known for good wool products – and for Vikings. Linking these together with local production and designers, gave us a new take on cultural heritage – even though this specific textile has some wrinkles that need ironing out. However, as a useful point of departure for further developments – it offered many lessons in just how complicated the value chain from sheep to shop is (VikingGold report).

### **Selbu's role in VikingGold**

A YouTube film<sup>18</sup> gives a good summary of the reproduction process, and shows Selbu spinning mill's role, as they collected the wool and spun half of the yarn for the weaving of the material for the designers at Krivi Weaving mill. A very interesting estimate of time-use and pricing for the very simple tunic is that using current handicraft hourly wages, would have cost 380.000 NOK in current monetary value, and taken 760 hours to produce. The exhibit at the National Historic Museum was an important milestone for both VikingGold, and KRUS, as this happened during the project's operational period (from June 11<sup>th</sup>, 2015 until October 1<sup>st</sup>, 2016) and was a showcase for both research question 1 and 2. The museum store also sold yarns spun by Selbu. This was important in making information and knowledge available to the general public (From report 1<sup>st</sup> half of 2015 and later reports mentioning VikingGold and the museum exhibit).

### [Expanded cooperation with Varp & Veft](#)

One of Selbu's many partners is the company Varp & Veft, based in Sandes. The company sells fabric from Norwegian wool woven at Krivi Weaving mill. Their first collection was based on Grey Trønder, the wool that is the starting point for Selbu Spinning Mill.

*This fall, woollen textiles from Grey Trønder sheep are showcased in London, in the design stronghold. This is specially selected high-quality wool from an endangered sheep breed that will be presented to an international audience. Carina Sandsmark Øvestad, who runs the textile company VARP & VEFT, has had the opportunity to showcase textiles from her new initiative Norway Cloth at '100% Norway' during the London Design Festival September 19<sup>th</sup> – 27<sup>th</sup> this year. Textile designer Jon Pettersen has been assigned the task of developing light and draping qualities suitable for both interior and apparel. Selbu Spinning mill has sorted the wool from Grey Trønder, while Hillesvåg Spinning Mill has spun it into thin weaving yarn, which are then woven to textiles at Krivi Weaving mill." (Press release Varp & Veft fall 2015<sup>19</sup>).*

After a successful exhibit in London, Carina Sandsmark Øvestad received orders in London for her materials, and in the autumn of 2015 Selbu therefore sorted a new batch of wool and sent to Hillesvåg Spinning Mill for spinning. The wool was pressed at

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<sup>18</sup> [YouTube video showing reconstruction of the Lendbreen tunic](#)

<sup>19</sup> [Press release from Varp & Veft's Facebook page](#)

Norvik (Malvik) to save volume during transport. The wool's volume is one of the challenges when transporting, and the pressed wool is significant more environmentally friendly, because it takes up less space during transport. Norilia's wool press was therefore important. The wool is spun at Hillesvåg Spinning Mill. However, for Varp & Veft, it proved to be hard to create a sustainable business based only on woven materials. Øvestad developed ready-made products to sell (pillow cases, bow ties, hairbands and baby caps). After a long struggle, she was also invited in to be part of a push for handicraft products in the Norwegian Folk Art and Handicrafts organisation's co-exhibit space at Oslo Design Fair. This has resulted in several Norsk Flid and related sales points. Øvestad has also opened her own flagship store in Sandnes.

#### *The Selbu mitten project with Anne Bårdsgård*

While VikingGold highlighted the use of older breeds primarily, and Varp & Veft explored the Grey Trønder wool, another project emerged during the second half of 2015: A collaboration with Anne Bårdsgård and her exploration of the Selbu mitten. Historic mittens were reconstructed using yarn spun from Norwegian wool at both Rauma and Hillesvåg Spinning Mill. Selbu spinning mill collaborated with Anne Bårdsgård on the reconstruction and development of yarns, which were spun in a way similar to yarn used in the oldest mittens. During the project, Anne Bårdsgård collected over 400 historical mitten patterns that had not previously been known. She has developed knitting patterns based on these and ensured that they were knitted. For these patterns, mainly yarn from Selbu spinning mill was used. Some of the yarn was dyed red at Hillesvåg Spinning Mill. Experienced knitters knit the mittens from Selbu and surrounding areas.

The first exhibition of these was opened in Klæbu (neighbouring municipality of Selbu) during the cultural week. The exhibit has since been travelling around the country, and will do so for the next four years. A book with all the recipes, describing the cultural history behind the mittens going back to the 1850's, was also published by Museumsforlaget in 2016. The book quickly became a best-seller, and for the launch at Selbu spinning mill, they had a record-high number of visitors. In conjunction with the launch of the book, Selbu spinning mill, in cooperation with Bårdsgård, also developed several knitting kits with yarns and recipes for mittens that were not in the book. These have so far sold quite well (for the patterns in the book, some are with Selbu spinning mills yarns, others with yarns from Hillesvåg Spinning Mill and Rauma, which are dyed).

The wool used in the yarn that was developed by Selbu was spun from local sheep, and the choices were made according to yarns and mittens in the local Selbu knit museum collection. The white yarn is spun from cross bred (NKS/cross bred/rygja or dala) and not bleached. The natural black yarn is spun from wool from "bleset" sheep, while the grey yarn is spun with wool from Grey Trønder. The wool is specifically sorted for durability, washability and high contrast in two-colour knitting patterns (Reports from Selbu 2015 and 2016).

### *The 'big knit'/carpet yarn with Stellaria*

As part of the WP, Selbu also wanted to look at minimising waste and thus becoming more sustainable. Therefore, Selbu started a cooperation with Stellaria, a small-scale weaving company based in Tromsø, who describes her handloom business as follows: "My name is Charlotte Engstad and I am a Norwegian weaver and designer-maker working from in my studio in Tromsø, Northern Norway. I specialise in high-end textiles, be it bespoke yardage, collaboration projects or limited series of own design". She also writes this about her range: "Folk costume aprons in red and green, stripy dress fabric, waistcoat fabric patterned with small trees, simple wool or linen twills for lining, warm blankets, light and soft shawls, sturdy pillow fabrics" (atelierstellaria.no 2018). Added to this mix, Selbu and Stellaria have been experimenting with a 'waste yarn' for carpet runners and rugs, which can also be used as 'big knit' yarn.

According to Espelien, up to 50 – 60 % of wool from the delivered fleeces ends up as waste in the process of becoming yarn (report 2015/16). Some of the wool is felted, and some fleeces contain very coarse hairs that are not fit for knitting yarns. Therefore, they applied for a project under the name: Development project 'rye' yarn: Textile properties and resource utilization, which they received through *Skattefunn* (report 2016).

### *The characterisation of Norwegian wool*

A separate project was initiated on characterisation of properties of wool, yarns and knitted/woven fabrics carried out for the Norwegian sheep breeds, which provides recommendations for using the wool based on the characteristics described by the project. The information is useful for those who want to learn more about Norwegian wool and to work with textiles and products from Norwegian wool. The focus is on the sheep breeds and the various characteristics of wool from these. The Norwegian Gene Resources Center allocated funds for the project. Selbu Spinning mill contributed man-hours. Animalia, part of the Professional services for wool, have performed the analysis on the samples. Norilia has contributed with the analysis of the white sheep breeds and the breeds that are not considered to be on the verge of extinction. In order to complete the project, Selbu Spinning mill contacted the breed organisations and owners of the breed flocks, so that they could collect samples and wool for spinning from all the breeds. Without their efforts, it would be impossible to complete the project. With this extensive collaboration, we now have an overview of all the Norwegian sheep breeds.

#### *1. Wool classification and wool quality*

The wool was classified according to fibre fineness/coarseness, length and fibre types in the wool. This classification was carried out by the Professional service for wool, Animalia headed by Sissel Berntsen. They also carried out a characterisation of the fibres of each breed, with characteristics such as fibre diameter and various types of fibre-hairs in the wool examined.

#### *2. Textile properties in wool products*

Abrasion resistance and other use-properties in spun thread and finished fabrics. Properties of the wool are important for choice of applications. In particular, it is important to know the properties when the wool is to be used in knitted and woven

garments. There are characteristics like colour-fastness, durability and felting ability. SVEREA/IVF in Sweden conducted the tests according to ISO standardised methods. All material samples collected now constitute an exhibition, making it possible to study textiles and wool samples. The feeling of a material, the "grip", is important for understanding the quality and applications. The exhibition will be permanent housed at Selbu spinning mill, but it will be possible to borrow for use all over Norway.

The characterisation contains the following elements:

- Description of fibre: Gloss, tension of the wool fibre (resistance to stretching/change of crimp), amount of guard hairs, medullation, kemp, and bottom wool/undercoat.
- Classification of wool from a variety of individuals from each breed, such as adult ewes and rams as well as lambs.
- Fibre diameter.
- An overview of the colours of the breeds.
- Brightness of the main colours.
- Durability of a standardised yarn spun from wool from the breed that maintains spin quality, in some cases sorted in lambswool and adult wool.
- Washing characteristics of standardised knitting samples knitted from the standardised yarn of each sheep breed.
- Felting qualities in wool from adult sheep, primarily wool sheared in spring
- A description of wool properties and suggested uses, sheep breed by sheep breed.

This characterisation is an important addition to the breed standards. Based on the results of the characterisation, it is possible to set new breeding goals for the sheep breeds in order to change the wool quality relative to the breed-type properties of the wool, or one can preserve the qualities as they are today. If the results of the characterisation do not match the current 'picture' of wool held by the breeding teams, the results in the report may be the basis for mapping the wool further for more representative results.

Wool shows great variety. This applies both to differences between breeds, between individuals in the same breed, and depending on where on the sheep wool sample is taken. Development of wool and the sheep's age also makes a difference, and health of the sheep affects wool quality. This makes it difficult to get representative results with regard to fibre research when a very limited number of samples are taken.

#### *New yarn in cooperation with Hillesvåg Spinning Mill*

Already during the first meeting held in WP2, the workshop in Selbu May 2015, a collaboration was discussed between Hillesvåg Spinning Mill and Selbu for specialty wool qualities. A challenge for both HMS and Selbu is that the capacity is limited and fluctuating. HMS can take on some commission spinning as well as spinning yarns for selling on the open market, while Selbu has the challenge of spinning yarns for sale, as so much capacity has been tied up in the commission spinning. In the fall of 2015, Selbu sorted wool for several specialty purposes, including a planned commission

spinning at HMS for 2016. The wool for this commission spinning was scoured at Selbu spinning mill in order to save time and capacity at HMS. Much of the wool was donated by Norilia for product development, and some wool came from local farmers with exceptionally good wool, and was mainly from Grey Trønder, 'bleset' and white crossbred. The wool was spun to resemble the 'Ask' yarns from HMS, both for hand knitting and as industrial yarns. This was an important cooperation in order to meet the demand in the wake of the knitting book for Selbu mittens (Report 2nd half of 2015 and 2016). Later, the yarn from KRUS has contributed to greater flexibility, for example in relation to the relocation and expansion of Selbu Spinning Mill.

### *Expanding own business operation*

For Selbu spinning mill, developing an economical stable and sustainable business model has been a challenge, and much of the project period has been spent on finding the right business location, size of operation, partners and finally investors. This is important knowledge for others who want to start up similar businesses. In the first half of 2015, they did a time-use analysis for the various craft-processes and the prices for the most important products were calculated. This resulted in some price-increases to reflect the actual costs. In conjunction with the move to Klæbu, first to one larger location and later on to another, even more functional location – Selbu gained more space both for machines and for a factory outlet store. In Alana Lennon's Master thesis, parts of these processes have been documented, also the consequences for Selbu spinning mill and the local community (see below).

Much of 2018 was spent on expansion of the spinning mill. In January, the mill started a Facebook action where we used a Facebook page to inform that the mill expanded the share capital and that those who would like to know more about this could contact us and get information about the opportunity to buy shares. This ended with the sale of shares for NOK 2 million. The whole process was non-commercial. The stock buyers are sheep farmers and people interested in crafts, as well as designers, artists, craftsmen and a few owners of yarn shops. The investors are both big and small, and we also attracted an 'angel' who contributed a considerable amount and who is interested in collaborating and advising on the spinning operations. This is probably the first time social media has been used in this way in terms of a spinning operation in Norway (Report end 2018). By the end of 2018, the turn-over for Selbu Spinning mill had doubled several times. During a visit to the new mill before Christmas 2018, for a premature inauguration of the mill and store, the premises over-flowed with customers and visitors.

During the project period, not only has Selbu spinning mill grown, it has also contributed to disseminating knowledge and to the establishment of several other spinning mills. Espelien has informed that five or six new mini-mills are about to be established in Norway, which will ease the pressure on commission spinning and free up more time to produce yarn for the store and internet sales. Espelien is also cooperating with Krivi Weaving mill in developing yarns from Old Norse Sheep for new textiles.



### *Dissemination activities*

WP2c has had a very high level of dissemination, with lectures, courses, workshops and tours. A main focus has been on better sorting of the non-mainstream wool breeds. Here is an example of the content of one of the wool sorting courses from an invitation sent out in 2015:

The aim of the course is that you will be able to: - Sort wool in different grades suitable for spinning, felting and other uses for the wool - Sort wool by color for specific uses and reproducibility from year to year - Understanding wool processing in smaller spinning mills - Maintain a wide variety of qualities of wool for different uses - Ideas and inspiration with regard to processing and business opportunities for local wool products and processing.

The course is suitable as an introduction for those who want to work with wool from their own farm or with wool in general. It will be possible to work with your own wool during the course for those who bring it in, otherwise we will use wool from the spinning mill's stock, and it will be possible to purchase wool from the spinning mill's shop. We will display wool from many of the Norwegian conservation breeds during the course, and talk about the qualities of the wool of the different breeds.

In 2015, Norwegian Folk Art and Craft Association was active as they had wool as a theme from 2015, and were granted funds via the Savings bank foundation to develop knowledge and educate instructors for children and youth (the project Ullialt – Wool in everything).

Some courses were organised by Selbu spinning mill as part of their regular courses. These courses were developed under a KIL (competence development tools in agriculture) funded project in collaboration with Skjetlein Green Competence Center. The courses have since been developed and adapted as needs have changed. During KRUS, experiences and academic updates from the project have been incorporated into both courses and lectures. Courses and lectures have been held both nationally and internationally.

### *Synergies*

As clearly stated in the WP description, Selbu spinning mill has cooperated with other stakeholders and the other WPs in a stellar manner. In addition to effectively communicating with the actors, developing new ideas and new knowledge, they have sought new sources of revenue in order to expand the leeway for activities. As VikingGold was nearly finished when KRUS started, there were clear synergy effects from this project. This project has also morphed into off-shoots as designers have gained interest in the actual woven material, and Selbu has been pivotal along with Hillesvåg Spinning Mill in actually sorting, processing and spinning wool from old, indigenous breeds.

The cooperation Selbu spinning mill already had with Anne Bårdsgård with developing yarns for the Selbu mitten book, also resulted in other platforms for cooperation. With funding from ERASMUS, Ingvild Espelien and Anne Bårdsgård traveled to the



University of Tartu, department of Viljandi (culture and society), in Estonia. They have started a learning-mill for spinners. The idea was developed after a visit to Selbu in 2015. The visit was therefore a return visit with the purpose of exchanging experiences with the wool processing. At the same time, they had the chance to explore the very rich knitting tradition in Estonia and especially on the island of Kihnu. The island has an endangered sheep species, and the tour included encounters with sheep, farmers, knitters and hand spinners.

Ingvild Espelien also joined Ingun Klepp and Tone Tobiasson on a trip to Bielsko-Biala, Poland in November 2017, funded by a Norwegian-Polish fund for business development. Three professors from the local Textile Engineering University had already visited Norway earlier in the year, where KRUS organised a tour to Hillesvåg Spinning Mill, Lygra Heathland Center, Gol wool station and Oslo Design Fair. The trip to Bielsko-Biala included tours of the local textile museum, a hat factory and a weaving mill. There was no use of local wool, but when we visited the bordering mountain region, with sheep farming as an important part of the pastoral landscape. Traditionally local wool had been an important part of their local textile industry, which in the past rivalled Italy's Biella region. We are currently working on an application for a Polish-Norwegian collaboration, with SIFO and Selbu spinning mill and the University of Bielsko-Biala, focusing on utilisation local polish wool in new products.

Selbu spinning mill also applied for 'Skattefunn' funds: The co-operation with Charlotte Engstad (Stellaria) is a good example of synergy, and has expanded with her becoming a shareholder in the spinning mill. Together they sought 'Skattefunn' funding to finance a screening test for flammability in the carpets and some other wool products. Together with RISE Fire Research, they want to focus on flammability, looking at Norwegian wool's specific properties where they get free samples from us while we can access the results. This could be important for both Norwegian and Swedish authorities in avoiding chemical flame-retardants. The signals RISE have received, is that naturally flame-retardant fibres are to be investigated both in interior and in building elements as an alternative to the use of chemical flame-retardants (Report half of 2018).

#### *Alana Lennon's Master thesis*

Lennon wrote her master thesis "*Natural Regional Resilience Determining the Sustainable Value of a Local Wool Industry through Actor-Network Theory*" at the Norwegian University of Science and Technology (NTNU) under the Department of Geography. The following are key conclusions from Lennon's thesis:

Actor-Network Theory is used as a theoretical framework and methodology, offering a holistic approach to researching the complex relational activity between animate and inanimate elements of the wool industry. Assembling the actor-network of the local wool industry, which the researcher is also a part of, made it possible to see all the connections between the actors and understand the collaboration and relationships stretching across space and time. Although the different elements and relationships showed that aspects of ecological, social and economic sustainability are interwoven, this study argues that the local wool industry in Trøndelag has a deeper focus on ecological sustainability. This suggests that it operates outside a capitalistic system,

which is driven primarily by economic interests. The study further suggests that the industry is perhaps not so much working towards sustainable regional ‘development’ as sustainable regional ‘resilience’. Collaboration is central to the industry’s sustainability through helping to build up environmental, social and technological resources for providing local clothing and food. From an ecological perspective and in the light of an uncertain or unpredictable future connected to today’s environmental crises, this perhaps offers greater regional and local value (Lennon, 2017).

One aspect that Lennon writes about is that the interest in *commission spinning* is increasing:

Commission spinners are obviously essential for the actor-network of Trøndelag’s local wool industry as they constitute the majority of the work being undertaken at the spinning mill: ‘They [farmers] are the most important group of customers that we have. We are very happy with that kind of customer because they buy our service and they are like big customers compared to the knitters who are small customers [...] I would say maybe 80% of the wool is farmer’s wool that goes back to the farmers’ (Ingvild Espelien - interview 1) (*ibid.*).

Consequently, several farmers complain about the low price brought by the current system with wool classification for pigmented wool, explained as:

Norilia’s director of the wool department explains the reasons for the low payment of pigmented wool. ‘I set [the prices] because I know what the State subsidy is for the different classes and in addition to the subsidy I calculate on my earnings and my costs and make a consideration on the basis of how much profit I have and how I will distribute the money to the various [wool] qualities. Some I really want to give a good price for because I want to get it in because there is a high demand and we can obtain good prices when selling the wool, while others, for example the poorer qualities, I am unable to obtain a good price for in the market, so I can’t spend a lot of money paying for this wool. Norilia prioritises wool that is most sought after and therefore in total brings the most value back to the wool providers’ (Marion Tviland) (*ibid.*).

As Selbu Spinning Mill pays more than market price, in addition to subsidies for this wool, we see a tempting side-market developing:

In this way market forces are an actor in the network that help to recruit some farmers into the actor-network to find alternative ways to value the natural resources produced through farming pigmented breeds of sheep. This also suggests that farmers who are utilising their natural resources in new ways are working with elements of green entrepreneurship (Allen & Malin 2008) (*ibid.*).

The claim is that this wool would otherwise become waste, making it a problematic resource. Lennon’s thesis goes into the discussion of provenance, and first describes why wool going through the classification system, at one point, is no longer traceable to a specific farm or region.

The wool station can only keep track of the wool for part of the processing: ‘When the wool enters the wool station, we know which farmer has

delivered it and it is recorded on the individual producer so they can receive payment. But then the wool is placed into different containers and the wool from one producer can end up in more than one container. So, we have no traceability of which producers have wool in which containers other than who we have sorted that day [...] It then becomes Norwegian wool (Marion Tviland) (ibid.).

According to Malvik wool station, it would be possible to narrow down the traceability to a smaller region or municipality in relation to where the wool is collected before being delivered:

When we get a container [of wool] in, it comes from a region. We begin with one region and then when it is finished, we'll start a new one. We don't really have a storage area so when the container comes in it acts as our storage. So, it'd be really quite easy to organise if someone wanted to have the wool from a particular breed from one region, yes (Olaf Berset) (ibid.).

This is important for actors such as Lofoten Wool and many of Selbu Spinning Mill's customers. One reason being:

Micro-cluster theory is often connected to the development of community-based tourism. This concept of tourism describes the synergy-effect of a variety of small, localised firms within niche areas interacting to provide complementary products and attract visitors (Michael, 2007). Further collaboration within the actor-network of Trøndelag's local wool industry (...) could work towards creating an attractive tourist network (ibid.).

Lennon mentions that comments from many farmers confirm that some form of closer network would be beneficial, through for example the establishment of a communication platform or a meeting place that could improve networking, where several farmers could work together in relation to sales or further production. Such networks for food have been successful in relation to Farmers' Markets, etc. However, they are still in development for wool.

Norilia has registered an increased interest for Norwegian wool in Norway. Norwegian companies have increased their use of Norwegian wool from 15% to around 20% although this has mainly been for white wool. When asked what the future possibly held for Norwegian wool, communication was also a key element for its development: 'I am very optimistic; I think there are lots of opportunities both in Norway among Norwegian businesses and customers and internationally for telling the story of Norwegian wool. The method of using non-arable land for grazing and good animal welfare; those things can appeal internationally. Also, there is a potential in getting different Norwegian actors to collaborate more to create new opportunities. So, I think there is potential for continued growth and I'm optimistic about the increased use of Norwegian wool in Norway (Marion Tviland) (ibid.).

The master thesis provides a good insight into the network that surrounds Selbu Spinning Mill and how a small company can contribute to growth and development in a larger surrounding area.

WP2c has contributed to development, knowledge and dissemination. As we have tried to show, the work has been done with support from various projects, but with KRUS as

an important support both financially and professionally. Selbu spinning mill is doing well, with larger machines, new capital and talented people who are now in training and will have their craft certificate in spinning. The business is developing constructively and Selbu is an important actor to disseminate knowledge to others who aim to be engaged in spinning and related practices. The mill is collaborating well with wool producers on the one hand, and other spinning mills and companies on the other hand. Espelien has continuously emphasised the impact from KRUS in developing the business, and the products and networks. Combining cultural history with textile industry, and especially the older breeds, has revealed how much this competence was needed, and KRUS has only uncovered parts of this work.

## **Concluding WP2**

The partners in WP2 have proven that collaboration is possible, and necessary, even though they are located in different areas around the country. This collaboration has been essential for the development of the companies involved, and for the products and knowledge. It seems that the companies being different in size and fields have been a strength for KRUS, but also for the opportunities to support new initiatives, designers, founders and others in the field.

The work in WP2 is rich and complex, and has only started with the magical challenges and opportunities that exist. Good new products and better price for wool from the older breeds are common challenges. Cultural history and animals steeped in traditions, and the forms of operation that surround them, are resources that bear much more potential to be utilised. At the same time, there have been major changes.

We know a lot more today about the wool quality of White Spæl and the possibilities to improve it. The new knowledge gained on quality assessment of white dual-coated wool from Spæl sheep has led to development and implementation of tutorials and tools for assessing also coloured wool and crossbred wool, plus Estimated Breeding Values included in the Total Merit Index. It has thus had an impact on quality work of wool at a national level on all types of Norwegian wool.

The attention on wool from Old Norse Sheep has grown rapidly several places in Norway and especially in Nordhordland. The Wild Sheep Center has really put the spotlight on wool, both in terms of dissemination and development work. We have received good new products from the older breeds, both as materials for handicrafts and art craft, and as ordinary finished products.

WP2 has been implemented by and in collaboration with several companies and has helped to develop these. As such, this work also has a clear connection with the work in the next WP.

## **2.4 WP3 Sustainable business development**

*The project proposal described WP3 as follows:*

Research questions:

- How can new BMs and innovations increase the value creation of wool?
- How do BMs related to wool differ from other local, Nordic textile value chains?
- What characterises the Nordic value-chains for wool compared to local value-chains and BMs in the North Atlantic region?

There is little general knowledge about how actors can create value through a business model perspective. WP3 set out to create applicable knowledge for the industry and contribute theoretically and empirically to the emerging research fields of sustainable venturing, and business model innovation through user-innovation and entrepreneurial learning. Based on case studies anchored in existing research, WP3 aimed to produce knowledge that inspires exploration of new business model design practices relevant for established business, entrepreneurs and users.

New BMs and strategies for products are in constant change, also for products based on Norwegian wool. There is little systematic knowledge about the business models and strategies and the products and services based on these. WP3 aims to create an overview of the actors, a typology of their business models and an understanding of the entrepreneurial and innovation processes involved in the further development of the value chains. We examine questions such as: What are the roles of established businesses in the wool, apparel and fashion industries? Are new ventures initiated independently of these? How do small and micro businesses influence larger businesses?

By combining established strategy literature on value creation with the recent research on sustainable venturing (Dean & McMullen 2007, Dean 2014) and responsible business models (Jørgensen & Pedersen 2013), we examine how the environmental and ethical challenges of today's textile and fashion industry may create entrepreneurial opportunities. Our approach is supported by the growing interest among consumers in ethical consumption (Bray et al 2011). An empirical study of the strategic responses of the existing Nordic fashion industry (Pedersen & Gwozdz 2013) to institutional pressures confirms opportunity-seeking behaviour also among existing firms. This may again create opportunities for locally sourced wool.

WP3 will create applicable knowledge for the industry and contribute theoretically and empirically to the emerging research fields of sustainable venturing, entrepreneurial opportunities and business model innovation. Based on case studies anchored in existing research, WP3 produces descriptions of different business models and strategies of the existing actors as well as emerging new ventures, and will analyse their value creation potential. The Norwegian Folk Art and Handicrafts organisation organise courses for small handicraft and artisan businesses suitable as arenas for collection of material and dissemination. M.Sc. students will take part in data collection and analyses. The relative importance of wool as a product compared to meat and services (landscape, environment, tourism etc.) will be explored.

Interest in local fibres and new BMs, where local resources and control of the value chain is integrated, is rapidly increasing in several places in Scandinavia. It is therefore important that collaboration and comparisons are established. We aim to do this by comparing the Nordic cases in a local textile value chain. What are the similarities and

differences between the effort to establish (or re-establish) local value chains in wool, viscose, flax, in the Nordic region? What separates a Norwegian wool-based BM from other pilots and discussions in the other Nordic countries related to sustainability and local industry? (*end of proposal excerpt*).

## **Outcomes**

WP3 went through several changes from the original proposal. The project manager from NMBU, Anne Moxnes Jervell quit her position at the NMBU school of Economics and business and therefore did not lead the WP as planned. The project management was taken over by Elin Kubberød, and Siw Marita Fosstenløyken joined the research team. Thus, the WPs goals and research questions went through some changes, in combination with the hiring of Viktorija Viciunaite for the PhD position, and the WP become more focused on entrepreneurship. These are the new research questions and background that guided most of the work in the WP:

- How do actors in the wool value chain create value through innovation and entrepreneurship?
- How can the environmental and ethical challenges associated with large-scale textile and fashion industry be transformed to create entrepreneurial opportunities and benefits for small actors in the value chain of wool in Norway?

The local wool businesses and entrepreneurs in Norway take their offerings to the marketplace through a specific business model and a unique combination of available local resources and know-how. This implies that the actors in the wool industry not only need to modify their products, but also to modify *how* they deliver these products and market them in a way that can sustain business and strengthen their uniqueness as actors and entrepreneurs in the market place, challenging the large-scale wool industry. There is a promising avenue for exploring how business model designs and entrepreneurial activities can enhance the smallest businesses' and entrepreneurs' unique benefits in the marketplace. There has been very little focus on the smallest businesses in the scholarly literature, as most of the research has focused on larger SMEs' business development. The theories and frameworks derived from general business research is not applicable for the smallest entrepreneurial businesses, and consequently there is little established lessons to be learned that can enhance these actors' empowerment as value providers in the marketplace. This notion has been the core drive and inspiration in all activities in this WP, research-wise as well as on the practical level.

WP3 has contributed theoretically and empirically to the emerging research fields of sustainable entrepreneurship and small business development and provided applicable knowledge for the entrepreneurs and small businesses in the wool industry. The main deliverables in this WP are connected mainly to the research and the associated PhD project within this WP. Below we first present the main contributions from the research, before we present the practical implications for industry actors, particularly for the small- scale businesses and entrepreneurs.

## Viktorija Viciunaite's PhD

PhD project title: Moving towards sustainability: Business models and entrepreneurship in the Norwegian wool industry. Overall research aim of the project: *To explore how sustainability oriented firms can create value through their business models as well as entrepreneurial activities.*

Status: The PhD candidate plan to submit during spring 2019. The thesis is contextualised in the Norwegian wool industry and contains four papers that span the wool value chain, including the focal firm, its suppliers, business customers and consumers. The thesis sheds light on the wool value chain in Norway, starting with a better understanding of sustainability-oriented consumer demand and how to satisfy it through innovative uses of the business model, and moving onto concrete applicable measures small business owners can take to address the typical challenges they face when trying to introduce new sustainable offerings into the market.

### *Paper 1:*

*Informing sustainable business models with a consumer preference perspective (V. Viciunaite & F. Alfnes).*

Sustainability-oriented firms can incorporate information about the sustainability of their business model (BM) elements such as resources, activities, and partners, into their value proposition. Norwegian yarn labels engage in this activity to a varying degree. For some consumer segments, such information will add value to the products and services offered by the firm. However, which sustainable BM elements are most attractive to different customer segments is unclear. In this article, we studied consumer preferences for these types of sustainable BM elements. We used a sample of 394 active Norwegian knitters to elicit ranked importance of sustainable attributes when choosing yarn labels and stores. Our findings indicate heterogeneous consumer preferences with regard to interest in sustainable attributes. The least sustainability-oriented customer segment ranked all sustainable attributes as less important than price. The most sustainability-oriented consumer segment ranked sustainable attributes related to the BM elements key partners, key resources, key activities, and channels higher than price. The sustainability of several of these BM elements is often not promoted toward consumers. Firms can harvest the revealed consumer interest through integrating the valued BM elements into the value proposition. Through making pro-social and pro-environmental attributes visible to consumers, firms would simultaneously make the yarn value chain more transparent. Our findings also point to the BM trio of customer segments, value proposition, and channels as the focus point for sustainability-oriented firms aiming to capture the value of their sustainability efforts. Status: Published in the *Journal of Cleaner Production*

### *Paper 2:*

#### *Translating sustainable business models to consumers (V. Viciunaite).*

In sustainable business model (SBM) research the SBM-consumer interface has received little scholarly attention. We need more knowledge about this interface for several reasons. On the most basic level, it is about understanding the demand for a given offering, which is essential for firm survival. The customer is present in most business model (BM) conceptualizations for practitioners (see e.g. the BM canvas by Osterwalder and Pigneur (2010)) yet is largely absent from BM research (Ojasalo & Ojasalo, 2018). The consumer-BM interface is especially important in the context of SBMs because of the numerous hindrances to sustainable consumption (Connell, 2010; Jacobs, Petersen, Hörisch, & Battenfeld, 2018) and because firms have a role to play in encouraging more sustainable consumption practices (N. Bocken, 2017; Tunn et al., 2019). This study aims to create more knowledge on the SBM-consumer interface by exploring how firms translate their BM sustainability efforts to consumers in the context of the Norwegian yarn industry. Thematic analysis of data from firm's webpages, newsletters and social media profiles revealed that firms did not use business model terminology but translated their sustainability efforts as product attributes or consequences to consumers, communities or the environment. Translating sustainability efforts as consequences rather than just attributes might be considered more efficient, since it creates shared understanding and meaning of what a firm's sustainability efforts mean in the consumer's domain. Data analysis also led to the identification of three types of translation – post scriptum sustainability, the value of localism and the value of sustainability.

Status: Finalization stage

### *Paper 3:*

#### *Entrepreneurial learning and local embeddedness: A study from the creative industries (E. Kubberød, V. Viciunaite & S. M. Fosstenløkken)*

This paper expands the theory of entrepreneurial learning (EL) by drawing attention to its local embeddedness, a hitherto under-investigated area in entrepreneurship research. Through a qualitative, abductive case study in the creative industries, we investigate how local embeddedness operates through learning in networks in the Norwegian wool industry of micro entrepreneurs and we explore how micro-entrepreneurs employ locally embedded knowledge to create new opportunities. The analysis uncovered four main themes that constitute the main pillars of localised embedded entrepreneurial learning: (i) Accessing embedded localized knowledge, (ii) Localized co-creation in learning to recognize opportunities (iii) Embedding opportunities in local networks, and (iv) Moving the knowledge front of localized practice through bridging. This new framework of localised embedded entrepreneurial learning carries important implications for contextualised studies in entrepreneurship theory and practice.

Status: Under review in *International Small Business Journal, Researching Entrepreneurship*



#### Paper 4:

*“Marketing under uncertainty – The role of effectual networking in Entrepreneurial marketing”* (E. Kubberød, V. Viciunaite & S. M. Fosstenløyken)

Small business owner-managers face many challenges, of which marketing is one of the most important activities for survival, renewal and growth. The prevailing view depicted in the marketing textbooks is that one should start with an identified market need, conduct market research and orchestrate the resources to reach a measurable marketing goal through the marketing mix (Product, Price, Promotion and Place). However, this is not necessarily the case for small business owner-managers entering into new market territories, where they do not possess prior market-relevant experience nor have the right configuration of resources. Because they are often acting under limited knowledge about market needs and conditions, small business owner-managers can instead effectually create the market themselves by employing the set of means already available to them at a given point in time. Marketing of small businesses often involves the leveraging of a scarce resource-base through partnering with other stakeholders. Unlike larger firms, the success of a small businesses rests highly on the marketing skills and management practices of the owner-manager who usually employs unconventional marketing practices with great success. Knowledge on how the small-scale marketing practices operationalise in the small business context is rather weak in the literature, which this paper seeks to address. Drawing on the entrepreneurial marketing mix (Person, Purpose, Practice and Process), we aim at conceptualising how marketing practices play out in the small business context. An in-depth case-study from the Norwegian wool industry is conducted of an owner-manager who networks with many different stakeholders to create new markets for wool. Our study demonstrates that market uncertainty can be reduced through effectual networking producing highly beneficial outcomes for the small business. Our findings give rise to a new model of the Entrepreneurial Marketing Mix under uncertainty, emphasizing the role of the owner-manager (Person) and the Purpose as the outset and driving force of the marketing process. The study contradicts the wider literature suggesting that relying on the SME's owner-manager is not sufficient. We argue, that in early and uncertain phases, relying on the *Person* with a clear *Purpose* might be a good starting point in exploring new markets. This represents a hitherto under-investigated area of research in small business marketing.

Status: Accepted for publication in *Journal of Small Business and Enterprise Development*

#### **Other scientific contributions**

In addition, two M.Sc. students have been taking part in the project and collected data in this research project, and one of these students, Linn Meidell Dybdahl has also published her master thesis in a recent book chapter with the title: *Business Model Innovation for Sustainability Through Localism* (Dybdahl, 2019). Abstract (from the book)

*This article explores localism as a strategy for business model innovation for sustainability through a case study of four small Norwegian fashion companies that try to establish a local value chain in Norway. The study shows that their localism pursuit leads to step-by-step changes in how the*

*companies create, deliver, and capture value which over time leads to considerable business model redesign. As a strategy, localism can generate shared value of various forms. The geographic proximity seems to enable reconnections between resources, people, place, community, and environment that correlate with sustainability. However, this entails that the company has a sensitivity to place and a broad range of stakeholders.*

Dybdahl's work contributes with important knowledge about a topic that was highly emphasised in the original project proposal. Much remains to be done to find ways out of mass production, growth and global trade, in order to make the textile industry profitable.

### **Activities and practical recommendations**

Practical activities in the WP for the small-scale industry actors:

In October 2017, a business development seminar and workshop was held at NMBU hosted by the researchers in this WP, entitled “*Forretningsutvikling i nettverk - Erfaringsdeling og læring*”. This workshop invited small-scale businesses and entrepreneurs to a café-dialogue and knowledge-input to business development. The theme for the seminar was how small-scale actors can gain legitimacy as entrepreneurs in the market through using their network more strategically. The seminar was also instrumental to inspire and develop a new cooperation platform for small-scale actors in the wool industry on common issues related to the business aspects of their operations, such as; business model, branding and marketing, use of social media, how to benefit from networking, and newer financing models like crowd-funding. The technology entrepreneur Christine Spiten (listed as one of the most successful technology entrepreneurs under the age of 30 on the Forbes list) was invited to share her learning-journey as entrepreneur, and she interacted in the workshop in advising the invited stakeholders. Several direct beneficial outcomes came out of the seminar, such as new business relations, a common understanding on marketing issues, like “what are our common denominators as entrepreneurs in the wool industry and how can we promote it to the market”, and one actor also successfully implemented a crowd-funding campaign to secure the future viability of the business.

Overall implications of the research and activities in the WP for practice:

The entrepreneurs and small businesses in the wool industry of Norway that took part in our research challenge, established industry practices and work relationally as pioneers to transform the industry with a more sustainable-oriented focus. This includes activities such as sustainable animal breeding, the use of local natural and renewable raw materials and more sustainable production practices. In order to accomplish their ambitions, learning in networks is essential. Overall, learning in network strengthens the viability of the entrepreneurs' businesses and contributes to unexpected benefits that can be harvested to create value. In light of the insights gained from the research, we suggest the following practical recommendations for entrepreneurs and small businesses who want to succeed with their effort in creating value from Norwegian wool and local resources:

- **Team up with more competent experts in your value chain:** This will enhance your skills in overcoming your resource-constraints efficiently. Be open to help others in the same way, this is an intelligent altruistic strategy that is better than a competitive strategy when you are operating a small business.
- **Engage your network to test your new business ideas:** This is a low-cost strategy in an early market-entry phase and might provide directions for future product development that reduces initial uncertainty.
- **Pool your resources with others in your network if you lack resources yourself:** This might lead to new business relationships, unexpected benefits and new joint concepts further down the road.
- **Use what you already know and whom you know to develop your Purpose:** Act upon your initial inspiration, passions, and know how to invite your network relations to ideate and envision a future market of what might be, instead of setting up a market goal. This facilitate development of a cleared Purpose that sets the ambition for your marketing efforts and this can also be employed strategically in promotion to efficiently build your image in an early phase.
- **Engage in altruistic market research practice:** Practice an open-door policy and invite potential customers to your site as it can provide you with valuable ideas for new products, new knowledge about important market trends, deep customer insights and expand your mind-set to be employed in future product development. It can be a low-cost strategy to generate pilot customer relations in an early phase and under resource constraints.
- **Share your industry know-how and engage with your suppliers:** Assist your suppliers by sharing what you know and aid in their problem solving. This altruistic practice will commit them to your purpose and align them in your effort in creating a market for your future product.
- **Use your pilot customer relations to prototype yourself into the market:** Prototyping in general is an efficient way to kick-start the product development process. Prototyping with a pilot customer is a much more controllable strategy that serves to reduce uncertainty and secure future demand because the focal customer already has a stake in the process.
- **Use openness to contingency as a market orientation:** Be open to unexpected input from your network and engage with unusual user-groups as this might lead to unexpected market discoveries in terms of new product ideas or new market segments.
- **Understand your customer:** Different customers can be interested in different aspects of the value proposition. Understanding customer needs and how to help satisfy them is an important step for sustainability-oriented firms.
- **Share information and be visible:** Sustainability-interested consumers need to know about the sustainability benefits you are offering as well as where to acquire the offering in order to purchase it.
- **Investigate which information to share:** Consumers might be interested in aspects of your business that are not traditionally visible to the customer nor used in marketing and promotion. Transparency about previously inaccessible aspects of the business model can become an additional source of value creation.

The research in WP3 fills an important gap through providing an expanded and detailed view on small business marketing and business development practices, generally, and through the value chain of Norwegian wool. Being in an under-investigated area, there is a need for more future research on the business operational practices of the small scale actors in this particular industry, particularly long term studies of their business development to evaluate more appropriately the effects of their strategies for success.

Most people who have been active in KRUS have for a long time worked with wool, and many have also previously worked in VNW and VikingGold. This does not apply to the partners in WP3. For them, the wool and textile industry was a new field of work. They have done a great job in bringing wool and textiles into their research and thus contributed to making this industry visible in a new field and discipline. This is important for an industry that has long been faced with knowledge obstruction and closure of educational institutions. In addition to developing its own research, WP3 has also shared its knowledge with small businesses in the industry. It has been a very valued knowledge.

## 2.5 WP4 Redefining sustainable fashion

*The project proposal described WP4 as follows:*

WP leader: Ingun Grimstad Klepp

R&D partners: Kate Fletcher (London College of Fashion), Tone Skårdal Tobiasson (NICE) and Kirsi Laitala (SIFO)

Deliverables: 1 book, 3 papers, 2 popular articles, a conference in Norway (Bergen-area)

Methods: Case studies, fieldwork, statistics analysis, wardrobe studies and method development

Research questions:

- How can local value-chains and the consumer-perspective on apparel redefine the ecological focus for textiles?
- How can wool contribute to change the debate on environmental issues and textiles?
- What distinguishes Norwegian and UK/Scottish wool-use, and an understanding of local clothing?
- How can Norwegian handy-craft traditions contribute positively towards a more sustainable apparel sector?
- How could knowledge pertaining to Norwegian prosumer trends push forward the discourse on sustainable fashion internationally?

Some of the wool apparel we use is tied to older consumption-patterns with longevity and less laundry frequency as rule of thumb. Good examples are folk costumes and knitted sweaters. A change in focus concerning apparel is a new hard look at consumption, rate of replacement and quantity. Clothing we keep long enough to learn to love points us in a new direction beyond the buy-and-bin logic of fast fashion. We

need stories where people and their clothing are anchored locally and in the production process to create a contrast to the idea of apparel as (only) a global production- and value-system (fashion). The WP will continue SIFO's, Kate Fletcher's and NFI/NICE's work and be aligned with the goals set forward in the Roadmap being developed for the Nordic Council of Ministers. We will coordinate efforts with Fletcher's project; Fashion Ecologies, at the same time ensuring that Norwegian conditions are contrasted to the UK and to other case studies in the project. We will survey the apparel-use in some local communities and look at how clothing with a local connection function in their wardrobes. By choosing some local communities in both Norway and the UK/internationally; we will compare use and production, along with focus on both formal and informal clothing related interactions (exchange/gifting/inheritance) and relationships. Important questions will be the relationship between the global and the local, between production, market, and use. This is further related to the question of formal/informal, value and price. Both SIFO and Fletcher have developed methods for studying apparel consumption. WP4 will include an international conference with focus on local apparel's opportunities in redefining sustainability. The conference will be held in one of the areas where WP2 is concentrated, and function as an exhibition window for high quality products based on Norwegian wool (*end of proposal excerpt*).

The result of this work package is overwhelming, in terms of the amount of published material. A method book, a special issue of a journal and a number of scientific papers and book chapters. The number of popular texts is difficult to estimate because of the overlap with the dissemination WP.

We will now summarise the work and the results by answering the RQs on which we based the WP; however, shuffling the order and organising them in three:

### **Understanding of local clothing in Norway and UK**

RQ 3 was slightly changed because the KRUS partners in Scotland pulled out, due to Zero Waste Scotland pulling out of textiles. We therefore concentrated on the UK and Norway, specifically Macclesfield, Nordhordland and the Tingvoll/Molde area. In the UK, Lizzie Harrison (a researcher and entrepreneur working on local fashion and design activism) was engaged to contribute to the collection of the material, while Årolilja Jørgensrud contributed in Tingvoll and Molde. The field work in Nordhordland was organised in collaboration with WP1 and the SIFO researchers Klepp, Laitala and Vittersø.

We spent a lot of time developing our own understanding of what localism and local clothing were - and were not. In Norway, the terms were easily understood, and reduced to "local clothing", i.e. bunad/folk costumes and knitwear with local links. However, this did not fit with a British understanding, where a class perspective became a stumbling block. Both the use of land for pasture, and the use of wool in outdoor wear are part of an upper-class culture that does not include the local population. We therefore needed to discuss both the concepts and methods we were to use, before starting.

### *Special Issue on Fashion Localism*

Exploring the concepts included looking at what others had done before us. We did this, among other things, as Fletcher and Klepp took on the role of being guest editors for the Journal of Fashion Practice with a Special Issue on Fashion Localism that explored the frameworks, dynamics and practice of localism as a route to radical sustainability change.

The issue set out to explore localism as a process that subordinates economic decisions to communities, a region's natural factors and by what ensures long-term prosperity. Being small scale, shaped by traditions, necessity, climate and other factors, as opposed to the forces of globalisation and the highly-decentralised textile and clothing systems, localism offers community empowerment, heterogeneous products, local stories, myriad dress practices and fewer goods. A transformation of the sector's underlying organising structures can catalyse new knowledge about products and their production for the people who buy them, as consumers' proximity to sites of manufacture changes understanding and respect for goods. At smaller scales of activity, raw materials may be adapted to the finished product or the other way around: the finished products may enhance the qualities of the raw materials. Geographical closeness may increase cooperation, and may even lead to less waste.

In the introduction, this was further outlined:

It is into the space that this Special Issue steps. It is at least somewhat true that 'local' is part of the contemporary textiles and clothing vernacular; consider for example heritage fibres, traditional cloth construction techniques, the highly skilled techniques of hand-finishing only possible at small scales. Further, clothing manufacturing activity is increasingly moving 'home', that is relocating production near high value markets to reduce lead times and cut costs. Indeed all of these features can be seen to have been adopted within fashion brands in various configurations and at different scales as part of conventional business practices. Yet as a coherent conceptual framework and explicit set of practices for sustainability change, localism is little explored in the fashion context. To address this gap and catalyse action in this area, we set about editing this volume. It is said that capacity for change and social action is based in language (Klepp et al., 2017). And so our idea was that in order to facilitate activism in this area, we needed to write about it, and encourage others to do the same. It is a fact that the economic world order sees fashion dictated from and worn in the Global North while it is produced in the Global South. Economic surplus ends up in the former, while the manufacturing nations are left with environmental problems and, increasingly, with waste. A common point of discussion within these flows of resource and activity are the working conditions in producer countries and the loss of manufacturing jobs in consumer ones. However, just as much of a problem from the perspective of the Global North, is loss of knowledge. Knowledge of fibre, cloth and garment is sustained by historical memory, but moves with production and is today increasingly held in the Global South (Fletcher & Klepp, 2018).

The journal received a good number of expressions of interest and submissions; however, Klepp and Fletcher were not completely satisfied. Many were concentrated on marketing a place, country or region through the fibre and garments made there.

This was not the wanted focus. Not because this perspective is uninteresting, but because it does not fulfil the aim of KRUS to explore localism as a process of transformation towards sustainability. It was the case that several of the contributions, which we liked very much and which fully shared KRUS' ambition, did not have the form of a research paper.

The introduction of the chapters that were chosen for publication was presented in this manner:

While frameworks and practices of localism are somewhat undeveloped in the fashion context, the same cannot be said for the food sector. Research in food development has for a long time focused on developing new product niches and alternative distribution systems, such as direct sales (farmers' markets, community supported agriculture local delivery systems, among others) and marketing food in combination with tourism and leisure activities has long been part of sustainable development strategies in rural areas (Vittersø, 2012). Besides economic support, the establishing of labelling schemes for local and organic food, has been one important support measures for these types of niche products both on national and EU levels (Morgan et al., 2006). The lack of similar discourse, knowledge and policies related to textiles and clothing has resulted in few opportunities to compare the value chains for food and fibre – and we feel this is an omission. As a first foray into this territory, Kate Fletcher and Gunnar Vittersø combine their fashion and food expertise to contribute an opinion piece to start a discussion about how knowledge about local food can be utilized in a fashion context. But such work is just a beginning – so please readers and writers, weavers and cooks, dressers and eaters – continue! And if the 'food people' view the developments in local fibre rather dismissively, just ask them to try a week without both. And then see which they miss the most.

When wardrobes are surveyed in different countries, many differences are revealed (Hebrok et al., 2013 & 2016). In this Special Issue, Ingun's paper discusses the distinctive clothing habits in Norway, which includes a lot of use of national costumes and home-knitted sweaters, and moreover what this has meant for the maintenance of a local Norwegian industry. For years, Norway's textile and clothing industry was seen as old fashioned and on route to being closed down or out-sourced. Today, on the other hand, the interest in the textile industry is increasing, partly due to a revitalisation of artisan- and craft-based activity, based on local raw materials and clothing culture. Her paper suggests that clothing can support improved ecological practices for land use and rich and unique cultural expression; framing fashion localism as a restorative force for environment and people (Fletcher & Klepp, 2018).

Klepp and Fletcher were particularly pleased that we had contributions from other regions than the global North. One of the contributions centred on Uruguay, where Berea Susan Antaki and Katalin Medvedev explored some of the tensions and opportunities between global markets and local products, including between tradition, resource depletion, the production of goods not considered authentic by producer communities and the development opportunities afforded by global markets to artisans involved with craft production. With work on localism, as with many areas, it is perhaps easy to fall into dichotomies: 'Small-scale' versus 'large-scale'; 'global' contra 'local';

'before' and 'now'. However, textiles have long been a global commodity dating back to the Vikings and the Silk Road. Emily Taylor's contribution to the discussion of localism was through a historical analysis of garments from eighteenth-century Scotland, concluding that the dresses' value consists both of the materials, and the personal investment, from both maker and wearer. With today's new interest in the relationship between value, production, use and reuse, such studies of the past are important and contribute to a more total view of fashion localism as relating to the system as a whole.

In contemporary discourse, the loss of biodiversity, receives warranted significant attention. Yet few people have so far begun to look at the eradication of cultural diversity with the same systematic seriousness. This could also be the loss of variety of ways of dressing, of material types and production processes. In Daphne Mohajer va Pesaran's paper on local paper-making (sic) tradition and an unusual material for clothing construction, she explains how almost by chance, this practice was saved for the future. Further, she suggested the need for a textiles and clothing equivalent of a seed bank, to preserve and showcase genetic diversity as the basis for new, creative solutions to how and with what we dress in (Mohajer va Pesaran, 2018). In the exploration of localism, it seems again that we turn to the field of ecology for words and methods with which to affect change. The etymology of the word ecology is from the Greek *oikos* meaning 'house'.

Therefore, we summarised in the following manner:

"Ecology is the study of relations in and to home. The places we live in and our actions there – including our fashion actions – define our lives. Localism is a movement that cuts fashion in the cloth of nature and community. It is a radical force for sustainability change" (Fletcher & Klepp, 2018).

One of the many aspirations in the proposal was to use experiences from the food area in relation to better understanding of local clothing. This was done both in WP1, which was led by an experienced researcher in the local food area, and in WP4. Fletcher and Vittersø tried to develop a longer paper on this for the Special Issue, but did not manage to do so. A shorter paper comparing food and clothing ended up as the solution. As KRUS comes to an end, as with many other projects, there are several unpublished and semi-finished papers in the "drawer". And within WP4 there are many. We nevertheless came to a clear conclusion in this comparison. Food is eaten only once, and is heavily controlled by public regulation. This can also be said the opposite way around; one of the most important prerequisites for sustainable development for clothing is longevity - how long and how much a garment is used, and therefore the lack of both local and global regulation is a problem. These are perspectives that will be dealt with elsewhere in the report.

#### *Field work and Opening up the Wardrobe*

Both Klepp and Laitala at SIFO, and Fletcher, have for a long time worked with developing methods that facilitate the understanding of apparel as something anchored in local praxis and materiality. This has been both in cooperation through the Wardrobe Network (led by Copenhagen Business School) and separately. For Fletcher this has been through the project *Craft of use*, and for SIFO through a series of projects and



studies, among others in *Textile Waste* and VNW. In KRUS this method developing work was continued.

The development of the methods was done simultaneously in the UK and Norway, through a parallel field work where several different methods evolved. In connection with the field work, Klepp and Fletcher together with field workers, Lizzie Harris and Årolilja Jørgensrud, travelled to the chosen locations. Following one of these trips, Fletcher wrote this summary (Blog post March 2016):

Spring has arrived! And so too have our project collaborators from Norway. The Fashion Ecologies is a work package for the KRUS project at SIFO and today Ingun Klepp and Årolilja Jørgensrud came to visit Macclesfield. We commenced the field trip with a walking tour of Macclesfield. Starting up in the surrounding peak district we went to see the hills and local resident sheep that make up the landscape of the town. From here we descended into the town centre. An early part of the research project was to map a 1km transect of the town centre noting the types of retail spaces on the busiest stretch of the town. Today we retraced the route together spending time in the shops to understand the fashion offering in the town. This included scoping out the second hand clothing in the numerous charity shops that can be found on Mill Street and searching for wool products in the high street retailers that are within the Grosvenor Shopping Centre. Mapping the town in this way is a core part of the project giving us insights into what the fashion offering is and will cover local clothing manufacture and suppliers, retail, care and repair and recycling. This is the first stage of building an interconnected picture of the fashion ecosystem in this place. Working with our Norwegian partners made us reflect on these (eco) systems and consider what is common between the UK and Norway and what is unique to these countries.

Day 2 of our Macclesfield field trip with Ingun and Årolilja and today we visited an absolute institution for crafters and makers in the North of England, the delightfully named materials supplier Shufflebothams. In a deceptively large warehouse on the edge of town Shufflebothams supply high quality silks, wool and upholstery fabric to customers from Macclesfield and beyond. The space is an Aladdin's cave of exquisite fabric much of which was sourced from local factories as they closed in the 80s and 90s. The collection acts as an archive of what was woven and printed in the area and included a good range of woollen cloths. We all felt that a having a supplier like this in the town was a real asset for Macclesfield.

Our visit today got us thinking about how we view the count the clothing in the home as part of our Wardrobe Audit. We are looking to uncover all of the clothing provision within the home and so far had been working on a traditional list of clothing categories we will count during the visit. Visiting Shufflebottoms has made us rethink our audit from being about clothes to wider categories of household resources including clothes, materials, tool and equipment allowing us to capture all of the resources a household has for clothing provision.

The field work generated new knowledge in each location, adding to understanding. Elements of the field work are presented in the method book we shortly will return to, and has been utilised in various papers. Nevertheless, much of this material could have been better exploited. It provides the opportunity for further scientific analysis and for a

more comprehensive popular presentation of the subject *clothing culture*, by itself or in other contexts. Examples of the latter are found both in Klepp's lecture "Warm threads" during the final conference by the same name in May 2018, and in several other lectures and papers.

The editing by Klepp and Fletcher of the method book *Opening up the Wardrobe* is thus the most comprehensive result of the work within this type of method development so far. The book presents 50 methods for exploring actions, relationships and the material content of wardrobes. Organised as a practical guide to gathering information about people and their clothing beyond the point of purchase, it included visual, tactile and verbal methods and others which involved co-creating, loitering and a session in the gym. With contributions from four continents from both inside and outside academic circles, it was the real lives of wearers of clothes that has been the book's focus. The book's goal was to create a powerful new narrative of a more diverse, resourceful, emancipatory and holistic fashion and clothing system.

Development of methods for field work in KRUS, was included in the book as 'method 3' and 'method 9':

Auditing total fashion assets: Counting clothing and the tools and resources of clothing care. (Fletcher, Harrison, Klepp and Jørgensrud: 'Whole fashion audit')

Mapping retail spaces and counting shopping bags along a transect (Fletcher and Harrison: 'Mapping, counting, loitering')

Another important contributions is the Conclusion: *The family tree of wardrobe methods*, where Klepp and Fletcher name the different types of methods and show their relationship with each other and other relevant methods.

### *Fashion Ecology*

Fletcher engaged her work with KRUS to be a part of Fashion Ecology, and one of the results was A Pocket Guide, with the following introduction:

"Everything happens somewhere. Fashion ecology deals with the interactions and relationships between garments, people and their environment. This small booklet of definitions charts a first topological map for fashion and place".

*Laws of Ecology (including for clothes and their wearers)*

*All things are interconnected*

*Everything goes somewhere*

*There is no such thing as a free lunch*

*Nature knows best*

**Figure 29 Scan of the definition of 'fragmentation'**



### **Consumer-, and prosumer local value-chains and handy-craft traditions**

The local is usually understood as local commercial production. We want to emphasise that, regardless of whether ALL products are imported, an important part of the value chain for clothing will take place locally; namely use - with all the various aspects such as procurement and home production, care, washing and maintenance, repair, reuse and recycling in the home and between friends and family.

Just as the industry and the authorities see clothing primarily as items that are bought and sold, the research has been concentrated on all stages or transactions where not only clothes, but also money, change hands. Thus, commercial reuse, repair and recycling, and not the much more common and important private and non-commercial transactions and transitions, have been the subject of attention. The only stage where research is done, is around laundering. The fieldwork tried to capture this locally-based use. We wanted to find out how clothes are part of our lives and part of a number of different types of actions and social activities.

SIFO has produced a number of scientific texts on this topic in the KRUS project, with Laitala and Klepp at the forefront. Many of the publications are based on sources other than the fieldwork in KRUS, although this was important in developing an understanding of the field. This includes the material from previous SIFO projects, and the yearly SIFO survey - quantitative material about Norwegian consumers.

An important topic has been how clothes are shared, owned and circulated between people. This includes both inheritance and sharing, but also lending/borrowing, "stealing" and a number of other forms of using or owning clothing jointly. Laitala and Klepp have also published papers on why people share - or do not share clothes, and on the range of different forms of sharing. While for KRUS, the focus has been on the local, and on what actually takes place. The press (and authorities), on the other hand, have sought knowledge about commercial solutions, which is also often global trade in

"reuse" and "recycling". Thus, the attention surrounding the knowledge has been there, but with a different focus than what KRUS wanted to contribute with.

Good maintenance and repair are very important for clothing to last. SIFO has published several papers on the scope and techniques that are in use. Repair and home production are closely linked, and SIFO has also published on this topic. Nevertheless, this is one of the areas where we have much undone. The most common form of home production is knitting, and knitting yarn is the most important product being produced with Norwegian wool. Thus, KRUS has concentrated on this, which we will immediately return to. Maintenance and care have come a little in the shadow of the domination of knitting. To better understand local clothing, it would be good to have deeper knowledge of what is being repaired. Do woollen clothes and homemade clothes form another pattern here, and how different are the mending-techniques performed? In addition, this represents an exciting weave of our own work, exchange of services in and outside white, grey and black markets, which could be the subject of further investigation. SIFO would also like to have continued earlier work with a more historical approach to repair, prevention of wear-and-tear, and wardrobe planning. These are topics that are increasing in importance.

To reduce the environmental impacts from clothing consumption, knowledge and skills are needed about washing and care, repair, use, reuse and recycling, including a variety of techniques and practices. We have not limited ourselves to write about these topics scientifically, but have worked a great deal on increasing knowledge among consumers. This is discussed in the next WP. In this field, much is undone. In August 2019, Klepp and Tobiasson published a practical book on laundry that contributes to raising knowledge among the general public. The plan is that the book will be followed up by two new books that deal with use and wardrobe-planning, and repair - precisely the kind of knowledge we see is lacking. In KRUS we have contributed with dissemination of knowledge through lectures and shorter, popular texts. Some of the most important ones were aimed at arts and crafts teachers who are important actors if we are to bring about changes in this field.

An even closer collaboration between dissemination and research has been within the field of knitting. Here, the central actors have been Klepp and Tobiasson. The research has mainly sought to explain and convey the position and importance of knitting in Norway. This has been written in other languages and geared towards a foreign audience (English/German/Russian). For the Norwegian public, however, we have worked both to increase the status of knitting, knitters' self-awareness and awareness of Norwegian history and Norwegian wool. This is done through two books, and a series of lectures, popular articles and op-eds.

*Strikk med norsk ull (Knit with Norwegian wool)* was published in 2017. This is a book about Norwegian sheep breeds, their wool and the different types of yarn produced with sheep-wool in Norway. It shows the diversity of Norwegian-produced wool yarns and Norwegian breeds. Knitting books are a major and important genre for Norwegian publishers. We took advantage of this fact and created a type of book that people are used to, to some extent. At the same time, the knitting patterns are designed to show the yarn - and wool - and not vice versa. In other words, Klepp and Tobiasson made a

book about wool camouflaged as a knitting book. *Knit with Norwegian wool* has been very important as a way to increase the competence among knitters, and perhaps even more in the Norwegian value chain. It clearly shows the connection between raw material production and finished, home-produced clothing.

The following year, in 2018, Klepp and Tobiasson published the book about Norwegian knitting history. This was an extensive project that aimed to show the whole story of this technique. Here, we emphasised the interaction between the industry and home production, and the story is thus also the history of the value chain that KRUS sought to bind together. Norwegian knitting history is a contribution to the field that WP2c in particular has had a responsibility for; namely, utilising the cultural history in today's product development. More research is needed on these issues, and also more solid dissemination, for example in the form of books and exhibitions.

Clothes are usually understood as "fashion", which changes every season or even more frequently. However, much of what is highly successful remains there for decades. Norwegian knit sweaters are definitely on this list, along with loden jackets, Harris Tweed, tartan patterns and a variety of other clothes and patterns. In Norway, the bunad/folk costumes are a good example how change does not necessarily generate value. In WP4, we have written both scientifically and popularly about this form of clothing, but again, there is still much to be done.

#### *Warm Threads*

Warm Threads conference: Landscape and clothing conference in Hordaland 15th and 16<sup>th</sup> of May 2018, 85 participants Day 1, 42 Day 2. This was a cooperation between WP4 and WP2b<sup>20</sup>. The following section is a travel note reporting from the conference and a report written by Tobiasson for EcoTextile News:

FREKHAUG - How could laundrettes, dietary requirements and local wool change consumer behavior and mitigate climate change? Close to 80 activists, researchers, academics, designers, small-scale entrepreneurs and sheep farmers explored language and landscape at the two-day conference **Warm threads**. Wearing climate-positive proteins, like The North Face's beanie, could be the future, as reported by Tone Tobiasson from Bergen, Norway.

In stunning nature-surroundings and gorgeous weather on the west coast of Norway, delegates met to discuss if scaling down and reverting to localism is possible and the solution for a fashion-sector gone haywire. As Rebecca Burgess from Fibershed described the 'climate-positive' beanie from The North Face, there seemed to be actual hope, and a 'fiber-diet' in the making.

"Place matters," said Professor Kate Fletcher from the Centre for Sustainable Fashion, University of the Arts London in her opening lecture at the conference *Warm threads – clothing and landscape*. The theme was 'exploring local actions for changing the fashion story', which entailed a

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<sup>20</sup> [Video recording of the warm Threads conference on YouTube](#)

varied approach that could be said to be academic, related to biosphere or ‘fibershed’ initiatives – as well as commercial solutions. Once the two-day event came to a close, a select group of the academics gathered to discuss how to move forward, and came up with the radical idea of ‘fiber diet recommendations’ in the ‘food diet recommendations’ vein of thinking.

Research Professor Ingun Grimstad Klepp from Consumer Institute Norway (SIFO) at OsloMet University said:

It’s a bottom-up-approach, rather than the industry ‘deciding’ the volumes to be manufactured based on sales projections. How many clothes do we actually need to feel warm and beautiful, and how much ‘must’ be produced to clothe us for our daily tasks and comfort? In our wardrobe studies we have learned a lot about people’s relationship with their wardrobes and clothing, and it is not at all a mirror of what the fashion industry is trying to tell us. We need to take this seriously, as it goes to people’s self-esteem, well-being and level of satisfaction.

A theme that often surfaces at conferences is “how can I access sustainable apparel?”, and the inevitable “what is sustainable?”. Rather than espousing recycled as the ultimate goal, some new, some old and some novel approaches surfaced; as the discussion also went to what type of language and words about sustainability in textiles should be used. Kate Fletcher introduced ‘Fashion Ecology: A Pocket Guide’, a deliverable in the KRUS project. Here she gives new meanings to words we use and misuse, in a fashion ecology setting. “We can actually improve the human condition,” said Fletcher and added how less is possible; and if change is what we are about we cannot be in a ‘more’ mode. “Localism is both radical, uncomfortable and surprising.”

One thing that became very clear through the many talks, and when around half the delegates toured the Heathland Center at Lygra among the old Norse sheep the second day; how important local adaption of knowledge and better stewardship of local resources are - two things that have disappeared with globalism. “The more we have, the less we seem to know about them,” as Fletcher claimed. Which is why she has developed a Haberdasher-emergency-kit, a basic sewing kit that she restocks in the local launderette. “People actually leave notes about what they do.”

“What is the strategic geography that clothes us? Could I grow and produce my clothing, including dyes, within a 150 miles radius? Could we at the same time enhance the amount of carbon we are capturing?” asked Rebecca Burgess, founder of California-based Fibershed. Her story of how she convinced The North Face and investors from Silicon Valley to believe in her carbon-sink wool and other natural fiber production is quite a story. Not only did she convince tech investors who “never invest in this type of industry, ever,” to finance a spinning and a weaving mill (“they are freaked out about climate change”). When she brought local wool that was not being used at all for textiles or yarns to The North Face’s Alameda headquarters – they saw the possibility of a double-whammy. “They admitted they mainly produce plastic and had realized we are now eating it, so when I explained how the nearby ranch, through simple changes in farming practices could – when we did all the math on greenhouse emissions – sequester 6-9 pounds CO<sub>2</sub> per pound of wool, the result was the ‘Warm your dome, not the globe’ campaign.”

To make a long story short, since California started European-farming practices (which mainly means tilling the soil), the soil has lost 50 % of the carbon-content. One result was the dust bowl in the 1930s, when the intensive farming showed off its worst side. Another is the current firestorms that are plaguing California. “The more carbon in the soil, the more diverse and healthy the soil. We tend to demonize greenhouse gases; however, they are fuel for the soil-fauna. Carbon captured by the soil becomes grass and releases oxygen. Wool is a protein derived from the same grass. It is a renewable resource. However, you need to use it – otherwise you lose it.” Showing off the soil-to-soil circle (after innumerable wear-years, wool is biodegradable if not treated with any toxic chemicals or problematic applications), Burgess added that our second largest carbon pool is the soil.

“However, the value chain needs to be regional, if you send the wool to China for processing, it busts your LCA,” she said, explaining how COMET offers all the data-source she needs to plug in numbers for soil-enhancing practices as the US has mapped every single area for its soil. “The ranch which is now the biggest supplier of wool to The North Face is offsetting 800 cars a year through very simple measures.”

Thus asking #whogrewyourclothes, as Fibershed delves into flax, hemp and naturally, colored cotton – which are the carbohydrates of the future fiberdiet – seems to make very much sense. Other speakers described local and innovative uses of wool, plans for wool weeks and wool tours; and learning from food – where making things from local raw materials and from the ‘ground up’ has been quite the fad and a reaction to processed foods. “The discussion is over-ripe for the clothing sector,” was a conclusion made by Klepp. (EcoTextile News)

Co-organizers of the conference were Nordhordland Biosphere project, which is led by the University in Bergen, however it is the local council that coordinates the practical aspects. A Biosphere area is defined by UNESCO and covers all living creatures both under water, on land and in the air in a given geographic entity. There are around 670 such biosphere areas spread in 120 countries, this is the first in Norway. During the conference, a joint application with a Scottish and Italian biosphere was explored based on wool, but it stranded because of time-limitations and the Shetland trip (see below). As sheep are such an important aspect of this area, and create value through their grazing also for tourism and biodiversity, the value of including also wool has become more and more evident. Thus, they have become more involved in the local Wool Week, which has established itself as a weeklong autumn activity based in Knarvik and at Hillesvåg Spinning Mill. “Møteplass Ull” is a platform/cooperation between Hillesvåg, the region of Nordhordland, the Heathland Center, Sommerakademiet, Husflidskonsulentene in Hordaland constitute the Ullklynga (Wool cluster) Nordhordland (Travel note 2017).

Both before and after the conference, the invited researchers and staff in WP4 had time for discussions and exchanges. Efforts were made to take ideas further into possible joint applications, some of which were sent, but so far no one granted.



## **Redefine the ecological focus for textiles and clothing**

This goal relates to one of the two main goals for KRUS and a significant RQ in WP4. We have worked on this goal in many ways, through method and knowledge development, through professional and general debate and through the establishment of new concepts where these have been missing. It is also a continuation of SIFO's, Kate Fletcher's and NICE's prior work.

This includes SIFO's and Tobiasson's work with a Roadmap developed for the Nordic Council of Ministers (NCM), which resulted in a report with policy recommendations for the sector. NCM chose to put aside the report, and instead publish a plan in line with the fashion industry's interests and without the potential for any lasting change. Kate Fletcher has had a similar experience with the (mis)use of her research. She has written a number of books on sustainable fashion and is the most quoted researcher in this area. She established early (Fletcher & Grose: Fashion & Sustainability – Design for change 2012) the expression "system change". Fletcher's books and the phrase is cited diligently, while at the same time it is usually stripped of its true meaning. The NICE project – which was a platform for exchanging the latest research on themes surrounding sustainability and textiles – lost its funding and backing once it became critical to mainstream and industry-friendly 'solutions'. All researchers in WP4 have extensive experience working with sustainable fashion, textile and clothing. We shared the same experience that knowledge is overruled by the industry's demand for growth. Therefore, it is also a paradox that in this area we received help from an industrial partner.

In the application, the International Wool Textile Organisation (IWTO) was one of the partners. The largest member of this member organisation is Australian Wool Innovation (AWI). This is the world's largest producer of merino, and it is important both for research and marketing, the latter through their brand Woolmark. SIFO has carried out research for them both before and after KRUS ended, and has also contributed to the industry's strategic work on environmental issues. In KRUS, the collaboration has not been formalised, but as both KRUS and AWI have the same goals with their research, this has been fruitful. The global textile industry's environmental work, organised through the Sustainable Apparel Coalition (SAC), has for many years worked towards a comparison tool and a labelling scheme aimed at consumers. This may immediately seem like a good plan, but the knowledge base which this is based on, through LCAs (Life Cycle Analysis) and similar calculations, has unilaterally focused on production, and not use. Wool has been the loser, while synthetic fibres and especially "recycled polyester" have emerged as the green "choice". Wool's status as "environmental dunce" has been the starting point for several projects that SIFO has had for AWI, which in short, is about generating knowledge about the use phase of clothing so that it can be included in the environmental calculations. This will both bring forth negative aspects of synthetic fibres, such as micro plastics, and positive aspects of wool - such as less environmental impact in laundering, and a long life-span.

In other words, KRUS and AWI/IWTO have two common issues; to criticise the way the environmental debate on clothing is conducted, and bring forward use as an essential element in environmental calculations. Inspired by SIFO's work with wardrobe studies, AWI/IWTO have developed a global quantitative survey for examining wardrobes and

calculating their impact. SIFO has produced reports and scientific papers based on global wardrobe studies and the overall knowledge of clothing use, from studies in languages mastered by the research team. This research has been important in AWI/IWTO's work to change how the environmental debate is conducted and has thus contributed to KRUS' goal of achieving the same. The result has been that the Sustainable Apparel Coalition has changed their estimates of environmental impacts in the HIGG Index, and opted for including the use phase of clothing. This work has significantly strengthened KRUS through a larger suite of methods, more knowledge (through partners) and through the use of recent studies in policy work.

The work with the RQ on sustainable fashion became more global than we imagined. At the same time, it is still through the local we see the greatest potential for change. We have a lot undone in lifting this up and out into the world, and Klepp, Tobiasson, Laitala, and Fletcher will continue to work on these issues both through new applications and through activist research (UCRF). In this work, it is essential to bring knowledge to people, about how they can be proud of their clothing and clothing practices, and how they can contribute to sustainable development. Dissemination is at the heart of this change, and also the theme of KRUS in WP5. Shortly before this report was published, UCRF, represented by Kate Fletcher and Mathilda Tham at Milan Fashion Week, received the inaugural North Star Award at EcoAge's Green Carpet Fashion Awards<sup>21</sup>.

## 2.6 WP5 Dissemination

The project proposal described WP5 as follows:

Goal: improve wool quality by influencing producers and increasing the demand for wool by augmenting demand from consumers.

WP leader: Tone Skårdal Tobiasson

Organisation partners: Marit Jacobsen (the Norwegian Folk Art and Handicrafts organisation)

Industry partner: Fiber source (DAFI)

WP5 aims to improve wool quality by influencing producers and increasing the demand for wool by augmenting demand from consumers. Among the stakeholders in the value chain the raw-material producers will be our main target. Knowledge from WP1-4 will be the base for education, competence building and inspiration. All the other work packages also have specific dissemination plans, but these will be coordinated in WP5, also including public dissemination.

Targeting consumers will focus on three areas

1. The relationship between our textile heritage, yarn quality and good design
2. Knitting yarns in Norwegian wool

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<sup>21</sup> [Article from EcoTextile News about the award to UCRF](#)

### 3. Dissemination towards children and youth through the Norwegian Folk Art and Handicrafts organisation

Dissemination will be in close cooperation with the Norwegian folk art and craft association, who have just been granted 3 million NOK from the Savings Bank Foundation DNB Nor for "Wool - children and youth give life to cultural heritage." PL and WPL5 will both take part in this work. This will ensure that updates on ongoing research and development will quickly be spread, as social media is one of our main channels. On the other hand, our focus on children also secures a wide dissemination of research that would not be possible within the framework of most research projects. NH also works with Red Listing of crafts, which will be relevant to the project especially with a focus on protecting material techniques. As their main focus for the next 4 years will be wool, they will update the public through their website, the membership magazine Husfliden and 35 stores across the country, as well as numerous local chapters and their member meetings, knitting cafes, a wool parade, design competition, a travelling exhibit, etc. The association's broad interface with consumers in relation to knitting yarns, is vital, and building competence here is at the core of the project.

Reaching stakeholders in the value chain will focus on best practices and new opportunities from the work in the different WP. This will ensure pride and knowledge and build on the work in WP2. Working directly with the Fiber Source Textile and Yarn Library in Copenhagen will enable us to show-case the yarns and woven materials for designers in the Nordic region. This is part of NICE's on-going work for more local value-chains.

The local focus will be of interest for other disciplines, on the one hand for bio-based value chains but also for the academic community working towards sustainable solutions on consumption. Engaging the fashion community gives the project a clear edge and an explosive opportunity in visualising the local in high end design. Interest is already generated as far ashore as Hong Kong and China. Dissemination will also serve as networking opportunities within the project's teams, between PL, WPL, R&D teams and wool friends (WF) (*end of proposal excerpt*).

KRUS was planned from the start with dissemination as an integral part of research - and integrated into the development work. Opinion editorials, articles, lectures, media contributions (TV, radio, podcasts, etc.) were planned from the beginning as a way to change discourse, spread knowledge, and to engage in a dialogue with the value chain. This has been extremely successful; we have gained plenty of attention and have been able to make a mark both nationally and internationally. During the KRUS project, project lead Klepp received the NFR's dissemination prize, partly on the basis of this work. Beyond that, there has not been much interest in *how* we have organising the research dissemination.

#### **National**

We see that the overall goals for deliveries have remained the same, however we have pro-actively used the opportunities that have emerged along the way. This has partly changed some of the original plans, and has partly come in addition to these plans. It is

thus possible that in many cases an "ambitious" dissemination plan is actually not having a plan, but resources and willingness to seize the opportunities that are offered. It would, however, be a somewhat different way of organising this work than what the NFR applications now propose.

Originally the plan was for displaying yarns and woven materials at the Fiber Source Textile and Yarn Library in Copenhagen. However, the uptake of new yarns in the Norwegian market and in new products turned out to be a sufficient push for expanding the market for Norwegian wool. The two books, *Strikk med norsk ull* (2017) and *Norsk strikkehistorie* (2018), generated so many lectures all around the country, where we show-cased both yarns and woven materials from Norwegian wool. The small retailer Værbitt, located in Grünerløkka in Oslo, and several other yarn stores have started stocking 'gourmet' Norwegian yarns like Lofoten Wool and specialty dyed yarns from Telespinn, Selbu Spinning Mill, Hillesvåg Spinning Mill and Rauma. These actors also travel to knitting festivals and yarn selling events around Norway, and thus make these new wool products available to the general public at a level it was impossible to predict when KRUS started up. Many of these events are combined with lectures, and Klepp and Tobiasson have been invited to give talks about KRUS and their books.

This following summary is about one of many hundreds of lectures, but shows a clear point. The lectures have contributed to new contacts and discussions - and thus to being a part of KRUS, but also to open the eyes to the fact that wool is, or can be, a part of discussions about business, agriculture, district development - and so much more.

On one of the trips, where Klepp and Tobiasson were invited to speak in Lærdal, at a local conference about "Sheep and rangeland grazing". The focus, as usual, was very much on food; however, once we brought in the perspective on wool we immediately had several 'new' friends who wanted to talk with us, among the politicians particularly. This, if there is a new round of applications on rangeland grazing, could perhaps be activated. Tor Grøthe, Progress Party's representative from Hemsedal and Bjørn Harald Haugsvær, Assistant Agriculture Director at the Agricultural Department at the County Governor's Office in Sogn and Fjordane (from Christian Democratic Party) both sought us out to discuss this further. The health benefit of the mutton was a theme, since the sheep have grazed for 120 days in the mountains. One has to cultivate 830,000 acres to get as much feed as this represents. It equals 525 million NOK and corresponds to all cultivated land in Hordaland and Sogn & Fjordane all together. Ninety-six percent of Norway is rangeland that cannot be cultivated. A theme was if the sheep that are not to be slaughtered, were kept on the rangelands for an extra month, this would be a valuable economic gain. When the lambs (that are to be slaughtered) are taken from their mothers, the sheep flock together, so it would be easy to take them down later.

### **KRUS goes international**

Aside from generating interest for learning from the KRUS project internationally in Poland, Sweden, Russia, Uzbekistan, Bosnia-Herzegovina and Lithuania as mentioned f. ex. in WP2c; we started out presenting the project at The Scottish Smallholder & Grower Festival in the small town of Lanark, Scotland. During Klepp and Tobiasson's

visit to Scotland in 2015, the festival received a new partner, Zero Waste Scotland, and celebrating this event led to an official welcome by the Scottish Minister for the Environment and Climate Change, Dr Aileen McCloud.

The international attention was very much intensified as a result of SIFO's work with AWI and IWTO, as the reports on the use-phase of clothing and on micro plastics were widely cited – both in EcoTextile News on several occasions (and elsewhere). Here is an example of how the studies or research papers were cited:

“Comparing dissimilar garments – a practice frequently performed in apparel reports and studies, but never on labelling as of yet – “will not help consumers to make choices that will reduce the environmental burden of clothing,” according to the 2018 research paper *Does Use Matter? Comparison of Environmental Impacts of Clothing Based on Fiber Type*.”<sup>22</sup>

When Kate Fletcher co-founded the Union of Concerned Researchers in Fashion, a lengthy interview with Fletcher on EcoAge's website also referenced this research. This is quite a milestone for research from such a small institution internationally, and especially in light of the resources spent on generating this research. (See Outcomes KRUS under Impact). International attention was also generated by the *Warm Threads* conference, held in May 2018, outside Bergen with several international speakers on the podium (with additional funding from the Norwegian Foreign Ministry). Important discussions started here, and were continued when key researchers travelled on to Lofoten to visit Lofoten Wool.

The conference also started a discussion with several of the participants which has led to one application for a new project, which was submitted in April 2019; related to carbon-sequestration in the soil tied to rangeland grazing. Another application submitted simultaneously relating to life-span of apparel, was also rooted in discussions at this conference, and opinion editorials generated as a result of these talks. The network generated through this conference, also led to a completely new conference in Copenhagen, hosted by Copenhagen Business School and the Design School Kolding, which aims to become a yearly conference (Sustainable Fashion Research Agenda Conference). This again generated a lot of press in Denmark surrounding the issues brought forward by KRUS, with localism, local value chains and slowing consumption as central themes in the debate.

## Exhibitions

Here, we shall begin with a retrospective glance. Valuing Norwegian Wool chose an exhibit to end the project (Det Kvite Gullet), which was shown at Kunstindustri Museet/The Museum of Decorative Arts and Design, curated by Karen Gjelsvik who was commissioned by Norwegian Fashion Institute. Originally the idea was to present products in Norwegian wool, but these were too few, so the concept was expanded to a focus on the positive uses of wool, looking at today's fashion retrospectively and to the new talents and creators of today. This included Dale of Norway, Røros Tweed, the

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<sup>22</sup> [Article from EcoTextile News about comparing food and fashion](#)

spinning mills, Oleana, Janus, Vera & William and Camilla Bruerberg; to mention some of those exhibited.

A year later, with the launch of the book *Ren ull* (Aschehoug), the Design Collective in Oslo opened a pop-up “wool” store in Glasmagasinet in the fall of 2013. Some more products were available, and were sold as well. The following year, NFI arranged a pop-up wool shop, this time at Paleet, again mainly with merino-wool products. A few, however, offered Norwegian wool. The pop-up store was written up in Aftenposten on September 2nd, 2014. The fall of 2014 (October) also saw the opening of the exhibit *Lev vel* (“Live well”) at DogA (the Design and Architect Center), curated by Kjersti Kviseth, which focused on sustainable choices, including for food, textiles and interiors. We contributed to this exhibit, with information and material pertaining to the VikingGold project, as this project now was well under-ways. The process of weaving and processing the VikingGold material, as well as design sketches from Icelandic and Norwegian designers, became part of the *Ta det personlig* exhibit at Oslo’s History Museum, which opened June 13th, 2015.

By now KRUS was under-ways and at the Wool Day the same fall, designers who had been in the VikingGold competition showed off the designs in the woven material as part of the exhibit at Abelia’s headquarters. These also traveled to Florø for an exhibit at Florø Coastal museum, see figure 30, which opened March 3<sup>rd</sup> 2016 (*Tradisjon og Trend - norsk ull til alle tider*). Klepp and Tobiasson contributed to develop the exhibition and during its opening. This was an exhibit that captured how sheep have developed over time, the wool value chain, older and new designs, uses and traditions in an educational and visual manner.

**Figure 30 Exhibition at Florø Coastal museum**



At the Warm threads conference, the Heathland centre and others in the network around Wool Forum contributed with an exhibition of new and old clothes and textiles in Norwegian wool, both at Frekhaug and at the centre itself. The Heathland Centre has also changed its store and distribution during KRUS with much more focus on wool and wool products.

As the KRUS project is coming to an end, we are not planning a large-scale exhibition, but if we had, we would have filled a whole museum. We have an abundance of goods both from established fashion and sports companies, from designers and from artists, artisans and student projects. The development has been overwhelming.

### **Media – popular and trade**

The trade magazine for the knitting industry in GesamtMasche ran a cover story on Norwegian knits and wool, in their issue 4/2017. *Wool-Klassiker aus Norwegen* was the headline on the cover, with a picture of four world champion women skiers wearing Cortina-sweaters from Dale of Norway. The story – three pages – was called *Der Norweger*. When Tobiasson was contacted to write the story, she and Klepp were far from finished with *Norsk strikkehistorie*, but as *Strikk med norsk ull* was out, we were able to include information about Norwegian wool.

EcoTextile News also published another article related to KRUS, “Marching to a different drum beat” (February/March 2018), and «Could we end up eating our textiles?” was a cover-story (August/September 2015), the first in a series warning of the dangers of microfibers – both written by Tobiasson. Following up the ISPO sports fair in Munich in January 2019, Tobiasson reported the following in EcoTextile News:

*“Slow fashion and local production and sourcing also popped out at some stands at the Munich event. Greater Than A, the brand from the soon-to-be-former downhill skiing champion Aksel Lund Svindal from Norway, showed off a “Life-Time Duffle” coat that they were considering offering a life-long guarantee on. Made from 100 per cent Norwegian wool, the material woven at Krivi Weaving Mill situated on the north-western corner of Norway and with the bone-buttons fastened with rope from the next-door Møre Bånd factory, the localism was rather obvious.*

*Lavalan, the company selling wool insulation, on the other hand wanted to give the Swedes some credit, as Fjällräven had decided to go for Swedish wool lining scoured at Ullkontoret – a new and local scouring mill on Gotland. “That is just an amazing story, how the owners of Ullkontoret found an old scouring mill in Spain and transported it through Europe getting several traffic fines under-ways and just started up,” said Lavalan’s Matthias Boehme as he pointed to another Norwegian outdoor-brand who was looking at the wool lining for their winter-jackets.”<sup>23</sup>*

We see thus how local wool is gaining media attention in relation to sustainable issues. So far two companies in Norway (Greater Than A and Amundsen Sport) have chosen Norwegian wool lining for jackets, and a third company was interested at ISPO. Following the Wool Day in Oslo in 2016, Financial Times, see figure 31, ran an online story on Oslo Innovation week, and wrote: “Still, there were signs of progress (...). One was gathering farmers, fabric companies and designers dedicated to reviving the wool industry” (Gapper, 2016).

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<sup>23</sup>[Article from EcoTextile News about wool and sportswear brands](#)



**Figure 31 Extract from Financial Times**

ULLDAGEN blir spesielt fremhevet i Financial Times sin omtale fra Oslo Innovation Week #OIW2016.

"Still, there were signs of progress at Innovation Week. One was a gathering of farmers, fabric companies and designers dedicated to reviving the wool industry", -med gode innspill fra [Elisabeth Stray Pedersen](#)

"There I met Elisabeth Stray Pedersen, a 29-year-old fashion designer who last year bought a factory opened in 1953 by the designer Unn Soiland Dale. She wants to revive its Lillunn brand and sell more of its Norwegian wool blankets and coats abroad. "People have lost jobs in the energy industry and it sends a signal to young people that we need to do something different," she says.

Ms Stray Pedersen has her own fashion brand, which she calls Lillunn's "rebellious younger daughter". Norway needs more of those."



*International podcast:*

In the original dissemination plan, we had no concrete pod-casts listed. We have, however seen how this area has grown exponentially the last year, and we were contacted by several international pod-casters specialising on knitting, wool and yarns. KRUS was seen as something news-worthy and worth lengthy, in-depth conversations; which pod-casts offer as a unique forum. One of the first was *Nordic Knitting*, who Klepp and Tobiasson met on a visit to Stockholm, invited by Handverkets Vänner to give a talk. Later they ran into them again at the Bergen Knittingfestival at Norsk trikotasjemuseum, and did an impromptu interview about *Norsk strikkehistorie*. The first interview had been related more directly to KRUS<sup>24</sup>.

*The Wool Academy* is another blog, started by Elisabeth van Delden, former Secretary General to the IWTO; and is followed by the international wool industry and others with a passion for wool. She came to Norway to one of our wool days in Oslo to give a talk about the international organisation, and was instrumental in the IWTO becoming partner in KRUS. She first interviewed Tobiasson (in her third podcast, and later on Marion Tviland in Norilia (#67) and Klepp (#75). This ensured a wide, international audience<sup>25</sup>.

*Paper Tiger* is an American podcast for knitters, where the theme often is yarns, and in this case the theme was Norwegian wool, about the spinning mills and yarn types. The

<sup>24</sup> [Blogs post about the knitting books](#)

<sup>25</sup> Podcast interviews with [Tobiasson](#), [Tviland](#) and [Klepp](#).

podcast based most of its information on *Strikk med norsk ull* and other KRUS publications<sup>26</sup>.

This is just some of several examples on contributions to podcasts, a new and important way of conducting dissemination.

#### *Norwegian major popular press-stories*

Late fall 2016, NRK's *Forbrukerinspektørene* delved into how much of the yarn sold by the major yarn actors in Norway was actually Norwegian wool; which was a major milestone for the focus on Norwegian handicraft yarns and the misrepresentation done by some of the actors, like Viking Yarns (who use Norwegian flags shamelessly on their yarns produced in China from generic wool) and Dale Yarns, who had rather woolly claims of their provenance on their web-pages. Sandnes, Rauma and Hillesvåg Spinning Mill's share of Norwegian wool in their total production was quite well illustrated, see figure 32, with yarn balls with of varied sizes with Norwegian flags super-imposed on the yarns to show the actual shares<sup>27</sup>.

**Figure 32 Share of Norwegian wool in production: Sandnes 21 %, Rauma 75 %, Hillesvåg SM 80 %**



This was followed up, and eventually became Ullialt's and HF's guide to Norwegian yarns containing Norwegian wool, the work we had begun with *Ren ull*, and a new webpage dedicated to this theme (Norsk garn)<sup>28</sup>.

Tobiasson also caught the attention of Visit Norway's main communication channel for tourists coming to Norway, as we had discussed with Innovation Norway the lack of 'teaching tourists how to dress for Norwegian active outdoor life'. This eventually resulted in a story titled: *Norwegian Wool is like wearing nature*, which brought forward

<sup>26</sup> [YouTube video from Paper Tiger](#)

<sup>27</sup> [Newspaper article from NRK about the amount of Norwegian produced wool](#)

<sup>28</sup> [Website 'Norwegian Yarn'](#)

several of the products in Norwegian wool that tourists could look for as souvenirs as well as purchase to be better prepared for the Norwegian unpredictable weather<sup>29</sup>.

This “push” towards tourists, which we have sought and requested as something Norway could galvanise into action much more, has finally been implemented by VisitBergen this spring with ‘*the Wool Route*’ (Ullruta) which takes tourists to and through the many exhibits, nature habitats, production facilities, companies, etc. in the Bergen region related to wool. This is a direct result of “Møteplass ull” and the discussion at the Warm Threads conference. As this is currently a brochure (and therefore a type of media), and not a product, we have included it in this section<sup>30</sup>.

In conjunction with the Norwegian knitting history book, Klepp and Tobiasson wrote a 10-page article for *Aftenposten Innsikt* (in the print version) late 2018. This was quite an undertaking; however, we saw that getting media to write about more complicated and in-depth issues ended up easier to deal with and deliver ourselves. The current state of media, with cut-backs and minimal staff means that we ourselves need to deliver much more content than previously. This again taxes any research project, as such projects then really need to have journalistic competence to deliver the dissemination they outline. This development is a new challenge for researchers and research institutions. Some smaller, more agile publications did interviews to follow up both book publications, and NRK TV news even filmed the launch of *Opening up the Wardrobe*, however the latter story was axed at the last minute because of some other fast-breaking news story<sup>31</sup>.

To really capture how the media has embraced the focus on Norwegian wool as a positive, in the wake of KRUS is in one way reflected through not only the many inquiries we receive, but also the many articles that appear that cite or offer references that we see clearly are KRUS-related. Tobiasson participation in networks like FLOKE, where Helly Hansen was a major player and discussions were informal and attempting to find good uses for e.g. Norwegian wool, have generated many projects that may or may not be fruitful. However, they add to the ongoing discourse, keeping wool and specifically Norwegian wool a “hot” topic<sup>32</sup>.

It did of course help that Norwegian companies (within sports and fashion) caught the attention of media both internationally and nationally. Elisabeth Stray Pedersen’s bold move to take over the Lillunn operation, was a success story that resonated in the media. She also returned to using Norwegian wool in some of her products, even inviting Norilia and Norwegian weaving- and spinning mills as sponsors for her catwalk show with a sample-box of yarns and woven fabrics in the ‘goodie-bag’ as a first ever (Tobiasson’s many years as an editor in the fashion press can vouch for this). She was awarded the prestigious Jacob prize in 2018, and the story was spread internationally by the IWTO. “I feel as if a change is taking place,” she says in an interview after being granted the 2018 Jacob Award.

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<sup>29</sup> [VisitNorway on Norwegian Wool](#)

<sup>30</sup> [Brochure on the Wool Heritage Routine 2019](#)

<sup>31</sup> [Article published in Aftenposten Innsikt on Norwegian knitting history](#)

<sup>32</sup> [Statement about the collaborations between Helly Hansen, SINTEF and NORILIA](#)

There is a shift in trend towards everything from food to clothes, in that we are becoming more and more concerned about how everything around us is produced. Whereas the previous generation was, if I may be so bold, preoccupied with consumption and cheap goods, it seems as if more and more people are interested in ‘the real deal’ nowadays. They want to know the origins of their belongings and that they’re not contributing to negative impacts if they have a choice. E S P is all about giving people that choice by focusing on high-quality materials and more sustainable production methods.

She cites Kate Fletcher as a concrete inspiration (from the launch of KRUS) and also mentions Norwegian wool as important. She has also been very clear in her product-information when she uses Norwegian wool, in spite of a lack of an official label<sup>33</sup>.

Also, the launch of Anna Blix’ book *En hyllest til sauene* (A homage to sheep) who cited Klepp and Tobiasson’s books and other KRUS publications, played a role in augmenting attention. However, the decision by *Landbrukssamvirket* (the national farming cooperative) to actually source Norwegian wool for their new office furniture and interior textiles, was a true milestone when they refurbished their offices. This was a first in “walking the talk” for this type of organisation, where food had been a main focus and their surroundings seemed to be off the map. Perhaps, at a future date, when the discussion intensifies around micro-fibres, their office clothing and the farmer’s ‘uniforms’ will become equally important in the conversation and purchase practices.

The spread of media-coverage, from farmer-related to fashion-focus arenas, and in-between mainstream media and social media, has been an interesting travel, as mentioned because the change in the landscape in the last ten years has been so profound and everyone is still looking for the answer of what will become the ‘go-to’ for both the general public and academia. YouTube is effective in many ways, blogs as mentioned as well; and of course the constant social media postings. The whole media sector is volatile, and will continue to be so for years to come, however, we seem to have navigated this arena in a stellar manner.

### *Social media*

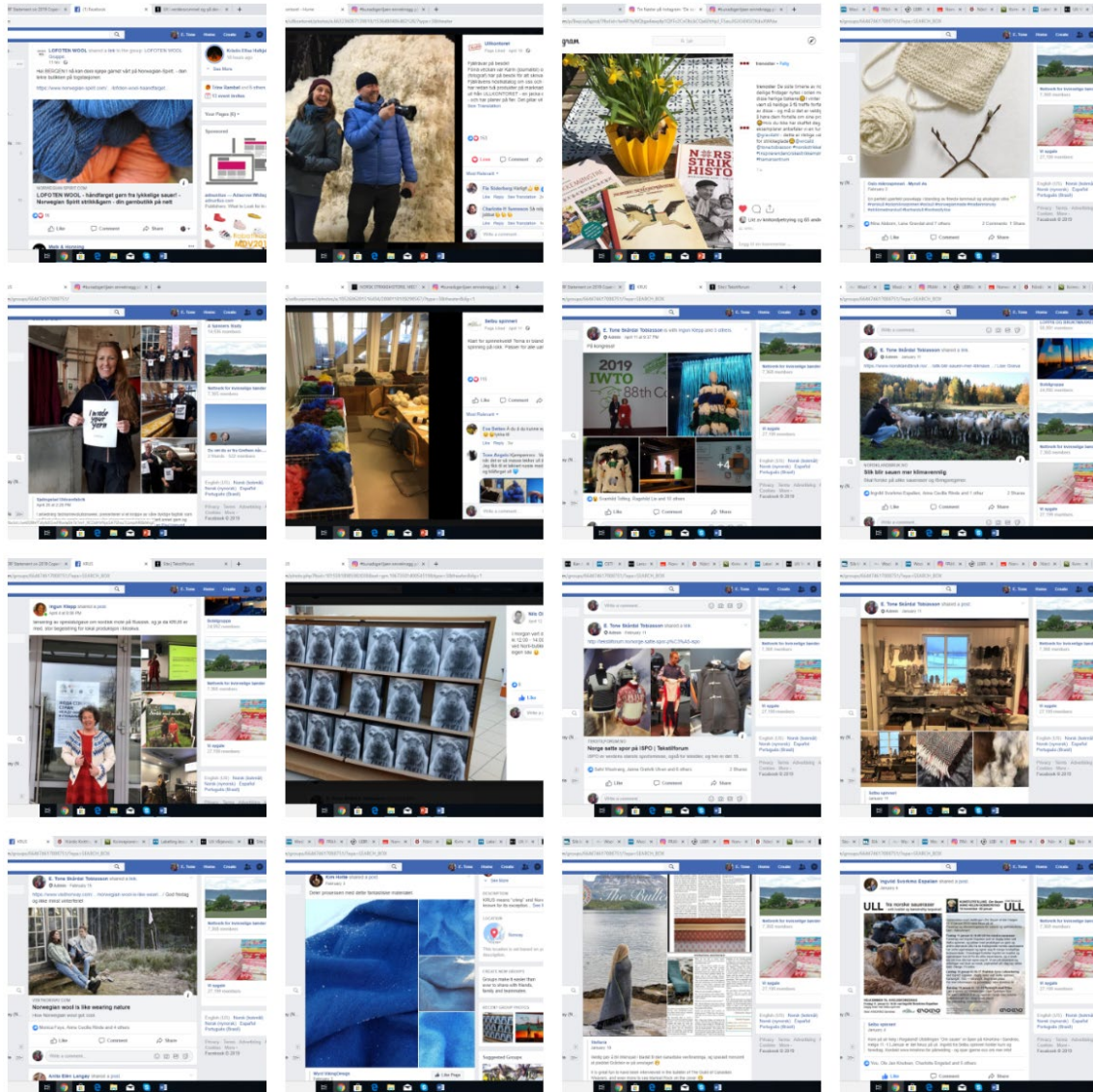
Tobiasson early on established a group on Facebook for KRUS, which today has 742 members (September 10<sup>th</sup> 2019) and is constantly expanding. As it is a group, and not a page, members need to ask for admission, not just click ‘like’; and the level of engagement is therefore higher. The number of posts has been too numerous to count, and so numerous that Facebook, see figure 33, does not scroll ‘down’ far enough to show all. Some of the posts have also been shared in the VikingGold group, as well on the Wool week in Oslo, Norge page. We also established a page for *Strikk med norsk ull* (576 have liked this page September 10<sup>th</sup> 2019) and for *Norsk strikkehistorie* (152 likes). It is quite time-consuming to keep the pages and groups active with posts, however they represent an effective arena to spread events, reports, news-stories, pictures and videos.

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<sup>33</sup> [Article from IWTO about Elisabeth Stray Pedersen](#)



Figure 33 A collage of some of the many Facebook posts published in the KRUS-group.



The project has thus ‘over-delivered’ in the sense of more than meeting the deliverables set up in the project proposal on dissemination. We also believe we truly have created a new discourse on climate for local wool, localism and slowing the flow, and thus made what the Norwegian Research Council now increasingly emphasises; showing more clearly the potential impact of a research project.

## 3. Impact

KRUS was from the start a project with large ambitions, both for generating new knowledge and for initiating debate. The goal was, among other things, broad general knowledge dissemination within the project's two main issues, valuation of Norwegian wool, and clothing and the environment. Parallel to the project, there was also a change where the research communities in Norway were increasingly encouraged and concerned with the *impact* of the research. We can see this, for example, in the changes made in the Research Council's applications. KRUS was at the forefront of this development.

Impact is difficult to measure. There are several reasons for this. We will look at how we have measured - and organised impact - in the project.

In research, we are traditionally measured by deliveries, e.g. what we produce both quantitatively and qualitatively. This can be shown through activities where impact is the goal. In KRUS, this means the number of opinion editorials (40), the number of books (3) and chapters in books (22), the number of scientific articles (25), the number of popular articles (20), and the number of lectures to actors in the industry and the general public (139). In addition to instructional films and recordings of equipment to measure wool quality on the farm. However, these numbers do not show the impact of these measures - just their magnitude. A detailed overview of the publications can be found in table 6.

If we are to look at the actual impact, however, we must see what has been achieved, what has changed, on the basis of the goals KRUS had and the situation when the project started. Overall, we can say that the goals have been achieved, and more than so. Demand for and valuation of Norwegian wool has grown. The debate surrounding the environment has changed and local production of clothing and textiles has been established as an alternative to the global fashion system. KRUS has thus over fulfilled the initially ambitious goals, although there are still unresolved issues and new challenges. The question we then have to ask ourselves is whether this would have happened without KRUS? To what extent are the changes we can observe due to the project's efforts? This question is also made a little more complicated because KRUS is one of several projects with similar goals - and most of them are interrelated.

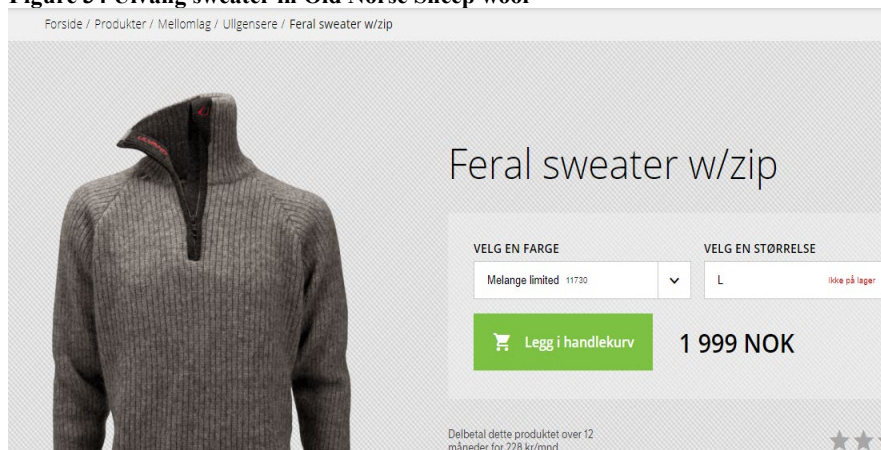
### 3.1 KRUS products on display

As described in the chapter on dissemination, when we made an exhibit at the end of Valuing Norwegian Wool, there were very few products on the market made from Norwegian wool. The exception was knitting yarns, a few heavy machine-knitted sweaters in Dale of Norway's and Devold's collections, alongside Rauma Collection's limited sweaters and jackets and Røros Tweed throws. Some designers had tried or made trial collections with some items in Norwegian wool, but none of these reached the market.

Here is a list of some of the actual products, from companies in close collaboration with KRUS. We have listed the products from Old Norse sheep first as this has been the 'most difficult' wool to develop commercial products from.

Hand-knitting and industrial yarns from 'Old Norse Sheep' wool commercialized – resulting in a series of hand-knitting yarns (dyed in three colours) and an industrially produced Ulvang-sweater, see figure 34, sold mainly in Germany and Norway.

**Figure 34 Ulvang sweater in Old Norse Sheep wool**



Lofoten Wool knitted and woven products and yarn from Old Norse Sheep and other Lofoten sheep breeds. Pillowcases from figure 35 and sweaters from figure 36 are some examples.

**Figure 35 Pillowcase in Norwegian wool**





Figure 36 Knitted garments in Norwegian wool



Krivi Weaving Mill is cooperation with Flokk, see figure 37, on materials in Old Norse Sheep wool for furniture being developed.

Figure 37 Post Instagram Flokk and Krivi Weaving Mill working on fabrics for furniture in wild sheep wool December 14th 2018, posted on [Instagram](#)



Vêr (Softvêr) headbands, figure 38, and sweaters, figure 39, in Norwegian wool. The garments are knitted locally and the company also do sound absorbing materials for interior/architecture features (Hardvêr)<sup>34</sup>.

**Figure 38 Frost headband from Vâr**



**Figure 39 Sno Sweater from Vâr**



Værbitt as a store, see figure 40, and their dyeing (and value-increase) of gourmet (Norwegian wool) yarns.

**Figure 40 The Værbitt store (photo: VisitOSLO/Didrick Stenersen)**



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<sup>34</sup> [Vâr webpage](#)

Lofoten Wool has developed 'tweed' materials (figure 41) in Norwegian wool.

**Figure 41 Tweed material from Lofoten Wool**



Marianne Mørck has worked with designs in the VikingGold fabric, see figure 42, which was shown several times at Oslo Design Fair. Håvarstein Couture is also testing the VikingGold fabric, alongside other designers.

**Figure 42 Garments designed by Marianne Mørck in VikingGold fabric (photo: Lasse Berre)**





Oleana's coat in Norwegian wool, see figure 43, woven at Røros Tweed, for their fall/winter collection 2019/20

Figure 43 Winter coat in Norwegian wool from [Oleana](#)



ESP Oslo's coats and jackets, see figure 44, woven in Norwegian wool, were shown during Oslo Runway and the Fashion festival, and is being worn by international influencers. Cooperation with designer Thomas Frodahl in FRAM men's wear, who made [a film about using Norwegian wool](#).

Figure 44 Coat from ESP Oslo at Oslo Runway (photo: Oslo Runway)



Greater Than A, the downhill skiing gold medal winner Axel Lund Svindal's brand, launched a life-time duffel, figure 45, at ISPO 2019, in Norwegian wool, woven at Krivi Weaving mill (the duffel is not in production as of fall 2019). Earlier they have used insulation, in Norwegian wool, developed by Lavalan, who also have delivered this lining to Amundsen Sport.

**Figure 45** The life-time duffel from Greater Than A showed by Jens-Petter Ring (photo: Tone Tobiasson)



Fogg Gildeskål introduced a handknitted collection of beanies, see figure 46, with Norwegian wool, handknitted by the two founders' mom.

**Figure 46** Knitted beanies in Norwegian wool



Røros Tweed, see figure 47, is now investing heavily in design collaborations; with Tom Wood and IBO, using Norwegian wool<sup>35</sup>.

**Figure 47 Woollen blankets from Røros Tweed in Norwegian wool**



Lygra Villsaulag introduced a handbag, see figure 48, made from 100 % Old Norse Sheep wool. The bag is knitted, felted and designed by Knarvik Industri og Miljø.

**Figure 48 Hand bag made from Old Norse Sheep wool**



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<sup>35</sup> [News article from The Explorer about wool](#)



Perhaps the greatest 'win' has been the knitting yarn from the Old Norse Sheep lambswool (see WP2b) and the Ulvang sweater knitted in the same yarn, which was launched in the fall of 2018, 500 sweaters all in all (Klepp & Tobiasson, 2018). Ulvang has decided to continue producing the sweater, a sign that it has been a success. In January 2019, the Feral sweater was nominated to the Scandinavian Outdoor Award at ISPO, based on "functionality, quality, innovation, design and sustainability". The Feral and Vegard sweaters, see figure 49, all in Norwegian wool were the main exhibits on the Ulvang stand at the same ISPO fair<sup>36</sup>

**Figure 49 Ulvang sweaters in Norwegian wool**



In addition to products, the podcast Tråd (Thread) by Louisa Bond and Tone Sjøstad was launched in the fall of 2019, with the aim to promote wool, textiles and quality work, emphasising the process from farm to yarn and fibre to product<sup>37</sup>.

### **Outcomes without expressed links to KRUS**

Several concrete changes and products developed in recent years have happened as a result of individuals, companies and organisations who have eyed the importance of local fibre, and Norwegian wool specifically. It is of course difficult to know why the interest has increased and how much KRUS (and the other adjacent projects) have had to say for what has happened. Certainly, the companies and organisations have been able to build on the work that was already done, and perhaps even more importantly, the attention that was already created. In mentioning these changes, project manager Klepp has often said that the entire value chain has needed to take a step forward in tandem. There is no use waiting for the others. This collective step is exactly what we have experienced. It includes small and large changes and some of them are small and diffuse, others large and measurable.

This 'collective' step means that many small and large players are now doing something different and changing their framework conditions. This may well happen without knowing - or willingness to admit - that the decisions have been influenced by

<sup>36</sup> [Video from Facebook about Ulvang Sweaters](#)

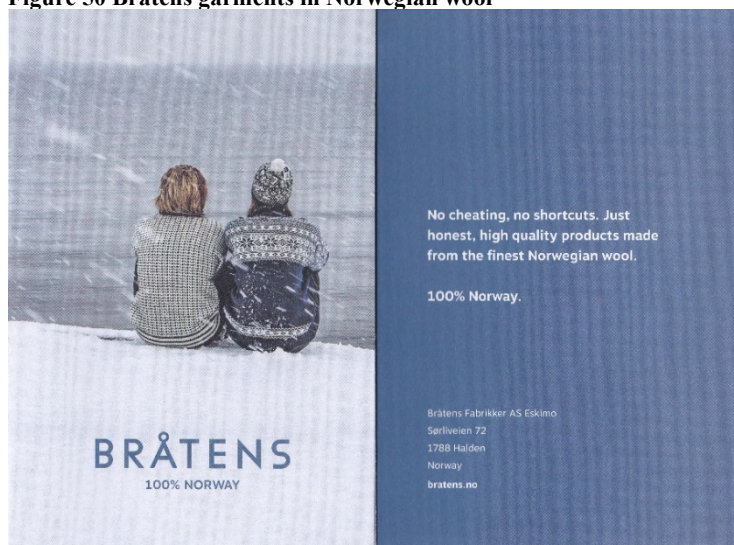
<sup>37</sup> [Website to the podcast Tråd](#)



KRUS or others outside their own business. Of course, they may well have happened without KRUS having anything to do with the matter. At the same time, the massive impact is not only articles, op-eds, lectures, workshops, media reports, etc. on their own, rather they are an important influence for the many who may have heard, read or seen and will later on contribute in some way. As a project, it is difficult to set a boundary between what we have directly and indirectly contributed to, and what has been pulled in by the undertow. We will therefore mention some concrete examples, and expound on one of them.

Bråtens have new sweaters, see figure 50, beanies and sock producer focusing on 100 % Norwegian wool in their marketing strategy.

Figure 50 Bråtens garments in Norwegian wool



Norlender knitting producer of Norwegian knit sweaters, see figure 51, hats and other related products, switched to more Norwegian wool in their products, by purchasing yarns from Sandnes Yarns.

Figure 51 The Island sweater from [Norlender](#)



Rauma Collection has increased the rather small 'tourist' sweater collection, see figure 52, with several new designs, also beanies, all in Norwegian wool. This is a result of having invested in state of the art Shima Seiki whole garment knitting machines at their spinning mill, and savvy marketing at Oslo Design Fair where 100 % Norwegian has been prominent.

Figure 52 Sweater from the Rauma Collection



*Dingsøyrr & Hatletveit* have launched hand-knitted sweaters made in Norway and with (some) Norwegian wool, see figure 53. We cooperated with Dingsøyrr for *Strikk med norsk ull*, where she designed chunky products in Norwegian wool<sup>38</sup>.

Figure 53 The Arja Sweater from [Kupon](#) knitwear in Norwegian wool



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<sup>38</sup> [News article from DN about Dingsøyrr & Hatletveit sweaters](#)

Gudbrandsdalens Uldvarefabrik had not used Norwegian wool in their fabrics since the 1960's, and when Klepp and Tobiasson visited them during research for *Ren ull*, they spent a lot of time explaining us why they never would. Later on, at the sheep festival in Gol, they repeated "we will never ...". However, the Norwegian Folk Art and Handicrafts organisation later invited them to a meeting with Norilia, and then SSB/FLOKK contacted them and specifically commissioned a fabric in Norwegian wool, which won the DogA design award in 2017. The chairs and apparel using the same material were also exhibited during the Framtanker conference at DogA in the fall of 2015. In 2018, Gudbrandsdalens Uldvarefabrik launched a 'bunad' fabric in three shades, see figure 54, and in 2019 the Oslo bunad advertised that they now use Norwegian wool fabrics from GU.

**Figure 54 The Oslo Bunad in 100 % Norwegian wool**



Increased attention to the origin of materials within such a "sensitive" area as the bunad could probably not be ignored. As long as nobody knew or thought that bunads could not be in Norwegian wool – they were not - this was no problem. But as the attention on origin of the raw material increased, the incentive was probably even greater to switch.

In terms of activities and happenings, Dale of Norway – during a private tour of the factory – told that customers are increasingly asking where the wool comes from, and they have therefore decided to increase the use of Norwegian wool. The yarn is currently spun by Schoeller in Austria. There have also been some Swedish



developments – Klepp and Tobiasson have travelled to Sweden on several occasions sharing knowledge, and this has generated a lot of press in Sweden, and product-development, where [Fjällräven](#) and [A New Sweden](#) are two stellar examples.

The work on dissemination has brought Klepp and Tobiasson, but also many others in KRUS, travelling far and wide. Coming back, we always have new wool friends and possible partners in new projects. Some of the most important are:

- Lille Lam/Baylon is developing a product in Norwegian wool.
- Crowd-funding (as new BM) for increasing the size and capacity of Selbu spinning mill shows the potential for other small enterprises. 5 or 6 new mini-mills will be starting up in 2019, spread around the country, as a result of increased demand for commission-spun wool yarns.
- A new Research Council application is submitted on carbon-positive products from rangeland grazing: *Amazing grazing* (NIBIO has taken the lead on this application, submitted spring 2019). Directly addresses issues uncovered in KRUS.
- SIFO submitted in the spring 2019 an application to the Research Council for the project *Lasting*. If granted, the project will continue the work pertaining to the discourse surrounding sustainability in fashion and apparel.
- We have identified partners in the countries Poland, Uzbekistan, Russia, Italy, Scotland, Lithuania, Germany, US, Canada, India and South Africa, for further research and projects, if the right project or call comes along.
- Union of Concerned Researchers in Fashion with hundreds of signatories will be an important resource and partner in the future.

KRUS has broad contact with the international on-going development on wool. We cooperate with researchers who want to learn from the Norwegian experience of improving the utilisation of wool locally. We are also working to improve wool's environment and health status through collaboration with IWTO and AWI, as well as making available knowledge of appropriate wool care. This work has had a major international breakthrough, where our research has greatly influenced focus on the use-phase, and not just production, in the environmental calculations of the international textile industry. This has major consequences for wool's international environmental status, and thus both what is produced and by what is defined as sustainable.

## Concluding remarks

Figure 55 Knitted hat with wool from Norwegian Old Spæl



«Spun, knitted, crocheted and tassled. Will be a prize at the local community bazaar. Thanks for inspiration!” May-Brith Ohman Nielsen, History Professor at the University in Agder, wrote in a text to Klepp the summer of 2019, referring to the woolen hat in figure 55. Her summer-home is on an island in the archipelago in Southern Norway. One of her neighbors had gotten a nice gang of Norwegian Old Spæl sheep to preserve the agricultural landscape. May-Birth has followed the KRUS project from a distance, through a common project on environmental poison. Sheep have wool, as we know, but what was the neighbor to do with it? May-Brith could knit, but that was all; however, she was not afraid of learning something new. The wool was scoured and carded, spun and knitted. The latter with a recipe from *Knit with Norwegian wool*, designed by a farmer on the West coast with Old Norse sheep.

In this chapter, we have written mainly about impact from commercial actors. However, our goal in KRUS has been that every now and then, people can experience where their clothes actually come from, how they have been made and that everyone who have contributed have received good care and proper pay for their struggles. We have therefore chosen to end this report with this story as we wish to high-light that developments in the value-chain do not only mean changes for the commercial actors. The fact that May-Brith – and others – see that the sheep have wool, that this wool has value, that taking care of it and creating something that warms and is shared, is exactly what we have worked towards. Local value-chains for wool are both the Norwegian systems for collection and processing, buying, selling and using – and small pockets like this – where the wool does not even leave the summer island but is produced, processed and used there. The hat was a start. In some years’ time, people and cabins will be decorated, and more people will experience the warmth from local clothing.

## Publications and deliverables

This chapter is an overview of publications in thematic sections. All publications can also be found in alphabetical order with the other references.

Table 6 Number of deliverables in KRUS shown in relation to the proposal

<b>Deliverables</b>	<b>Promised in the proposal</b>	<b>Delivered results (as reported to the Research Council summer 2019)</b>
<i>Scientific articles</i>	14	25
<i>Reports</i>	5	4
<i>Books</i>	3	3
<i>Popular publications</i>	12	60
<i>Scientific lectures and lectures to other target groups</i>	N/A	139
<i>Media content</i>	N/A	239

Table 6 shows in numbers that we have delivered far beyond what we promised in both scientific and popular dissemination. Some of these numbers are higher and will increase as there are still material and data to be published based on the project.

## Valuing Norwegian Wool

KRUS is based on results from a previous project: Valuing Norwegian Wool. The following three publications presents the most significant results from the project.

Colburn, M. (2012). Reading into Norwegian Wool - an Annotated Bibliography for Textile Innovators and Entrepreneurs, [Full report](#).

Hebrok, M., Klepp, I. G., Tobiasson, T. S., Laitala, K., Vestvik, M., & Buck, M. (2012). Valuing Norwegian Wool. *National Institute for Consumer Research (SIFO). Professional report*, (5-2012).

Klepp, I. G., & Tobiasson, T. S. (2013). *Ren ull [clean wool]*. Oslo: Aschehoug.

## Wool, quality and value chain

Developing the quality of wool can be done through breeding and caring for the sheep and their wool. The value chain consists of different stages in production, retail and consumption that together enables scouring, collecting, sorting and the classification of

wool. In order to develop and take care of the wool, it is necessary to have collaborations within the value chain. In KRUS, WP2 was responsible for the usage and care of wool, while the whole project worked with collaboration within the value chain.

### **Scientific publications**

Grøva, L. & Boman, I.A. (2018) Wool quality of the dual-coated Norwegian White Spæl Sheep breed. Poster. NJF conference. Kaunas, Litauen. 26.6 – 29.6. 2018.

Grøva, L. & Boman I.A. (2019) Ullkvalitet hos kvit spælsau. NIBIO RAPPORT 5(112)

Hebrok, M., Klepp, I. G., & Turney, J. (2016). Wool you wear it?—Woollen garments in Norway and the United Kingdom. *Clothing Cultures*, 3(1), 67-84.

### **Popular publications**

Boman, I.A. (2018) Norsk ull blir enda bedre. [Landbruk.no](http://Landbruk.no). 12.10.2018.

Grøva, L. & Boman, I.A. (2016) Hvordan bedre spællullkvaliteten? Sau og geit nr 1/2016

Klepp, I. G. & Tobiasson, T. S (2014) Med sau i bagasjen. Bergens Tidende

Klepp, I. G. & Tobiasson, T. S (2017) Svenskene vil lære å lage klær av ull  
Adresseavisen

Klepp, I. G. & Tobiasson, T. S (2016) Sorte får i åpent landskap. Sau og geit

Tobiasson, T. S (2016) Ekte kjærlighet: En nasjon av ulldotter. Feelgood Klepp, I. G. &

Tobiasson, T. S (2018) Verdi i kjede. Form tidsskrift for kunst og design

## **Economy, BM and entrepreneurship**

Changes in companies' collaborations and profits are an important part of the alteration to more sustainable BMs. NMDU and CBS have worked specifically on this issue, but it has also been important to all the involved partners of KRUS.

### **Scientific publications**

Dybdahl, L. (2016). Building business models for sustainable fashion: a case study of Norwegian fashion companies focusing on local value chains and locally sourced wool (Master's thesis, Norwegian University of Life Sciences, Ås).

Dybdahl, L. M. (2019). Business Model Innovation for Sustainability Through Localism. In *Innovation for Sustainability* (pp. 193-211): Springer.

Lennon, A. (2017). Natural regional resilience: determining the sustainable value of a local wool industry through actor-network theory (Master's thesis, NTNU).



Klepp, I. G., Tobiasson, T. S., & Laitala, K. (2016). Wool as an Heirloom: How Natural Fibres Can Reinvent Value in Terms of Money, Life-Span and Love. In *Natural Fibres: Advances in Science and Technology Towards Industrial Applications* (pp. 391-405). Springer, Dordrecht. (Also given as lecture at the *International Natural Fiber Conference in the Azores*.)

Viciunaite, V., & Alfnes, F. (2019). Informing sustainable business models with a consumer preference perspective. *Journal of Cleaner Production*, 118417.

### **Popular publications**

Gossner, T. 2015. "Vil bane vei for «det hvite gullet» gjennom forskning på bærekraftig forretningsutvikling og innovasjon", [Paving the way for the «white gold» through research on sustainable business development and innovation], Publisher: NMBU Handelshøyskolen, Yearly report from 2015.

Kubberød, Viciunaite & Fosstenløyen (2018). Forretningsutvikling hos småskalaaktører i ullbransjen [Business development among small-scale entrepreneurs in the wool industry], Publisher: Learning center NMBU. Two articles in video formats have been made to promote the business development part of the KRUS project from the entrepreneurial perspective: [Forretningsutvikling hos småskalaaktører i ullbransjen](#) and a [short version](#).

Lothe, R. 2017. "Norsk ull som merkevare", [Norwegian wool as a brand], Publisher: NMBU

## **Tradition and history in value creation**

Today, old breeds, old textile history, techniques, and local patterns are the sources to creating value. Such perspectives have been essential for KRUS in its continuation of VikingGold and the work of Selbu spinning mill.

### **Popular publications**

Klepp, I. G (2015) Pelles Nya kleder, och våra. Nordiska museets förlag

Klepp, I. G (2016) Moten er død, leve kleda [Fashion is dead, longe live the clothes]. Syn og Segn

Klepp, I. G. & Tobiasson, T. S. (2015) Hva byr vi våre gjester? [What do we offer our guests?]. Nordlys

Klepp, I. G. & Tobiasson, T. S. (2016) Bunadens revansj [Revenge of the Bunad]. Dagbladet

## Knitting

Yarn for hand knitting has for a long time and are continuously being produced in Norway from Norwegian wool. Knitting for home production and as a hobby have contributed to maintain Norwegian spinning mills and maintain a market for Norwegian wool yarn. KRUS have contributed to an awakening of what kind of yarn is actually used for knitting, and in the development of more breeds, better yarn and diversity in types of yarn and companies involved with yarn sale.

### Scientific publications

Klepp, I. G. (2019). A Louse in court: Norwegian knitted sweaters with "lus" in big-time criminals. Turney, Joanne (Red.). *Fashion Crimes. Dressing for Deviance*. 12. Bloomsbury Academic.

Klepp, I. G., & Laitala, K. (2016). Ullne fakta om strikking og klær. Hjemmeproduksjon og gamle klær i velstands-norge. *Forbrukstrender*, 11-16

Klepp, I. G., & Laitala, K. (2019). «Ты это сам/а связал/а?», или Почему норвежцы вяжут одежду сами. Aliabieva, Liudmila; Grigorieva, Tatyana; Petrov, Sergey (Red.). *Теория моды: одежда, тело, культура. Норвегия*. s. 161-179. New Literary Observer publishing house.

### Popular publications

Klepp, I. G., Laitala, K. & Tobiasson, T. S. (2016) 43 prosent av alle norske kvinner stirkker [49 percent of all Norwegian women knit]. *Forskning.no*

Klepp, I. G. & Tobiasson, T. S. (2017) *Strikk med norsk ull [Knit with Norwegian wool]*. Vormedal publishing

Klepp, I. G., Tobiasson, T. S (2018) *Norsk strikkehistorie [Norwegian Knitting History]*. Vormedal publishing  
Klepp, I. G., Tobiasson, T. S (2018) *Hvorfor oppfordrer Bymisjonen i Trondheim til å bruke Dale garn? Adresseavisen*

Tobiasson, T. S. (2018) *Woll-Klassiker aus Norwegen. Die Masche. Vol. 4*

## Local, Origin and Labelling

While the term 'local' is well known within the food sector, it is less clear in terms of fashion and clothing. How do we know the origin of the wool and yarn? The value chain is extensive and complex, with limited regulations and no official labelling, which makes this field highly complicated. The increasing attention towards animal welfare, the environment and origin have contributed to a greater international focus on such conditions.

## Scientific publications

Fletcher, K. (2018). The Fashion Land Ethic: Localism, Clothing Activity, and Macclesfield. *Fashion Practice*, 10(2), 139-159.

Fletcher, K., & Vittersø, G. (2018). Local food initiatives and fashion change: Comparing food and clothes to better understand fashion localism. *Fashion Practice*, 10(2), 160-170.

Klepp, I. G., & Laitala, K. (2018). Nisseluelandet—The impact of local clothes for the survival of a textile industry in Norway. *Fashion Practice*, 10(2), 171-195.

Klepp, I. G., Laitala, K. & Vittersø, G. (2015). Lokale klær og lokal mat? Forbrukerholdninger. Forbrukstrender 2015

Vittersø, G., Klepp, I. G., Tobiasson, T. S., & Kviseth, K. (2017). Opprinnelsesmerking av norsk ull [Origin-labelling of Norwegian Wool]. *SIFO Forbruksforskningsinstituttet*.

## Popular publications

Klepp, I. G., Tobiasson, T. S (2017) Merking av norsk ull [Labels for Norwegian wool]. Norsk Husflid

Klepp, I. G., Tobiasson, T. S., & Espelien I. S. (2017) Korttenkt om kortreist [short-sighted around short travelled]. Dagens næringsliv

Klepp, I. G. & Vittersø, G. (2016) All makt til forbrukeren? [Does the consumer have all the power?] Klassekampen

## Sustainable fashion

Sustainability have become a critical term in the fashion and textile industry. However, there are disagreements between the connotations of this term. Taking on the global chain stores approach to define recycled plastic as 'green', KRUS have worked as an opponent to promote quality, lifespans, local production and solid products.

## Scientific publications

Fletcher, K. (2018) Fashion Ecology. A pocket guide.

Klepp, I. G., & Laitala, K. (2018). Shared use and owning of clothes: borrow, steal or inherit. In *Contemporary Collaborative Consumption* (pp. 153-177). Springer VS, Wiesbaden.

Laitala, K., & Klepp, I. G. (2017, 2nd October 2017). "Nobody Mends Clothes Anymore"? *Environmental Implications of Norwegian Consumers' Home Sewing Practices*. Paper presented at the 18th European Roundtable on Sustainable Consumption and Production, Skiathos.

Laitala, K., & Klepp, I. G. (2017). Clothing reuse: The potential in informal exchange. *Clothing Cultures*, 4(1), 61-77.

Laitala, K., & Klepp, I. G. (2018). Care and Production of Clothing in Norwegian Homes: Environmental Implications of Mending and Making Practices. *Sustainability*, 10(8), 2899.

Laitala, K., & Klepp, I. G. (2018). Motivations for and against second-hand clothing acquisition. *Clothing Cultures*, 5(2), 247-262.

Laitala, K., Klepp, I., & Henry, B. (2018). Does use matter? Comparison of environmental impacts of clothing based on fiber Type. *Sustainability*, 10(7), 2524.

Tobiasson, T.S. (2019): *Slowing the Flow Norwegian Style*. Fashion Theory: The Journal of Dress Body & Culture *Nordic Issue* (Russian).

### **Popular publications**

Klepp, I. G. (2017) En bedre verden for dyr, og mennesker. [Forskning.no](http://forskning.no)

Klepp, I. G. (2018) Bruker vi bærekraft for å rettfærdiggjøre økt forbruk? [Melk&Honning](http://Melk&Honning)

Klepp, I. G., Ohman, M. B. & Tobiasson, T. S. (2017). Environmental Literacy in the Wardrobe: Capacities for social action are based on language. [Tvergastein](http://Tvergastein). (12). s 64 - 71.

Klepp, I. G., Tobiasson, T. S., & Laitala, K. (2018) Alle som elsker miljøet bør heie litt ekstra på Aksel Lund Svindal. [Forskning.no](http://forskning.no)

Klepp, I. G., Tobiasson, T. S., & Laitala, K. (2015) Norden som sinker. [Aftenposten](http://Aftenposten)

Klepp, I. G. & Tobiasson, T. S (2015) A Dizzying Spin on Green Growth. [Tvergastein](http://Tvergastein) (6) s 34-39

Klepp, I. G. & Tobiasson, T. S (2016) Forkjempere for gode klær trengs. [Forskning.no](http://forskning.no)

Klepp, I. G. & Tobiasson, T. S (2015) Det klør, det klør, tiddelibom. [Dagbladet](http://Dagbladet)

Klepp, I. G. & Tobiasson, T. S (2017) Fiberfusk og grønn sminke. [Klassekampen](http://Klassekampen)

Klepp, I. G. & Tobiasson, T. S (2017) Brenner tonnevis med usolgte klær. [Forskning.no](http://forskning.no)

Klepp, I. G. & Tobiasson, T. S (2017) Er resirkulert plast løsningen på miljøproblemene? [VG: Verdens Gang](http://VG:VerdensGang)

Klepp, I. G. & Tobiasson, T. S (2017) Misvisende om klesproduksjon. [Forskning.no](http://forskning.no)

Klepp, I. G. & Tobiasson, T. S (2017) Plastpakket landbruk. [Nationen](http://Nationen)

Klepp, I. G. & Vittersø, G. (2016) Har det blitt mindre sølv? Klassekampen

Tobiasson, T. S. (2019) Discussion about Nordic innovative approach in creating sustainable fashion, [Video](#)

## Use of clothing and wool

Knowledge about the use phase of wool is important in order to utilize the beneficial qualities in wool, for both consumers and the environmental impact. For this part of the project, the collaboration with the Australian Wool Industry (AWI) have been essential, and they have partially funded several of the publications. This collaboration has promoted the beneficial qualities of wool to the global fashion industry and contributed to changing the discussion on sustainability within the industry.

### Scientific publications

Henry, B., Laitala, K., & Klepp, I. G. (2018). Microplastic pollution from textiles: A literature review. In *Project Report no. 1–2018*(Vol. 2018, p. 49). Consumption Research Norway-SIFO Oslo.

Klepp, I. G., Buck, M., Laitala, K., & Kjeldsberg, M. (2016). What's the problem? Odor-control and the smell of sweat in sportswear. *Fashion Practice*, 8(2), 296-317.

Laitala, K., & Klepp, I. G. (2016). Wool wash: Technical performance and consumer habits. *Tenside Surfactants Detergents*, 53(5), 458-469.

Laitala, K., Klepp, I. G., & Henry, B. (2017). Global laundering practices—Alternatives to machine washing.

Laitala, K., Klepp, I. G., & Henry, B. (2017). Use phase of apparel: A literature review for Life Cycle Assessment with focus on wool. *Oslo and Akershus University College of Applied Sciences, Oslo, Norway*.

Laitala, K., Klepp, I. G., & Henry, B. (2017). Use phase of wool apparel: A literature review for improving LCA. PLATE

### Popular publications

Klepp, I. G. (2016) Barns forbruk er voksnes ansvar. Budstikka

Klepp, I. G., & Laitala, K. (2018) Halver ditt utspill av mikroplast fra klær. Aftenposten Vitenskap

Klepp, I. G. & Tobiasson, T. S (2017) Klærne våre dreper liv i havet. Forskning.no

Klepp, I. G. & Tobiasson, T. S (2018) Plast og plastdiskusjoner på avveie. Tekstilforum

Klepp, I. G., Tobiasson, T. S., & Laitala, K. (2018) Sjøppel i forkledning. NRK ytring

## Research method

Developing new methods have been essential in order to see clothing beyond the ways of the fashion industry. KRUS have aimed to see clothing as part of local culture and soil, with roots going deep and its positive impacts.

### Scientific publications

Fletcher, K., & Klepp, I. G. (Eds.). (2017). *Opening up the wardrobe: A methods book*. Novus Press

Klepp, I. G. & Bjerck, M. (2012). A methodological approach to the materiality of clothing: Wardrobe studies. *International journal of social research methodology*

Book launch: Opening up the Wardrobe (2017). The launch was video recorded and posted on [Facebook](#)

## Other deliverables

### Conferences

*The work from WP1 has been presented at the following conferences*

Vittersø, G., Klepp, I. G. & Laitala, K. (2015). Local as the new green: Exploring new possibilities for sustainable fashion. Global Cleaner Production & Sustainable Consumption Conference. Barcelona

Vittersø, G. (2015). *Comparing local food and wool – labelling, regulation and value creation*. Workshop: Food transformations in a Nordic perspective. Copenhagen University, Dept. of Food and Resource Economics

Gunnar Vittersø participated with a paper, written with Ingun and Kirsi, at the European Rural Sociology Conference in Aberdeen 18<sup>th</sup> – 21<sup>st</sup> of August, 2015, entitled "Sustainable value chains for wool-alternative development paths in bioeconomy". Here we problematized the lack of investment in wool as a resource and source of value creation in the agricultural and textile sector. The paper specifically discusses the potential of marketing wool with local/Norwegian origin and tries to draw some parallels to the political and commercial focus on local food.

Vittersø, G., Klepp, I. G. & Laitala, K. (2015). *Sustainable value chains for wool - alternative development paths in the bioeconomy*. XXVI European Society for Rural Sociology Congress, Aberdeen

Vittersø was at the VEC conference on September 13, 2016, Mid Sweden University, Östersund at the conference, entitled "Valuing and Evaluating Creativity for Sustainable Regional Development", which was organized in connection with an annual meeting of UNESCO's Creative Cities Network in which Östersund participates. Mid Sweden University in Östersund was an organizer and this was the first time a research conference was linked to this meeting in the UNESCO network. Gunnar,



Ingun and Kirsi wrote the paper: "Localizing fashion: Slow sweaters as a strategy for sustainable development".

Vittersø, G., Klepp, I. G. & Laitala, K. (2016). *Localizing fashion: Slow sweaters as a strategy for sustainable development*. VEC-conference, Østersund.

*The research from WP3 has been presented at the following conferences and events:*

Fosstenløykken, S.M., Viciunaite, V. & Kubberød, E. 2018. Developing a relational view of entrepreneurial learning: a case study of sustainable entrepreneurship from joint learning in the wool industry. Paper presented at RENT XXXII Conference, November, 15-16, Toledo, Spain.

Kubberød, E., Fosstenløykken, S.M., & Viciunaite, V. 2017. *Business development in networks*. October 17, Business Development seminar, NMBU, Ås, Norway

Viciunaite, V. 2018. Yarn and sustainability in Norway. Design By Me, September 21-22, Lillestrøm, Norway.

Viciunaite, V. & Alfnes, F. 2018. Consumer preferences for sustainable business model elements in yarn production and sales. Paper presented at RENT XXXII Conference, November, 15-16, Toledo, Spain.

Viciunaite, V. & Dybdahl, L.M. 2016. *Local value chains, environmental and financial sustainability: is there a double dividend? Case studies of business models of local wool manufacturers in Norway*. Nordic Ruralities: Crisis and Resilience 4th Nordic Conference for Rural Research; 2016-05-22 - 2016-05-24.

Viciunaite, V. & Kubberød, E. 2016. *The business model as an arena for entrepreneurial learning – An effectual perspective*. The 4th effectuation conference; 2016-06-05 - 2016-06-07.

### **Activities online**

Examples on dissemination activities in WP5

[The Lendbreen Tunic](#)

[Norwegian wool and local resources](#)

[News article from Norsk Landbruk](#)

[Video from the conference 'Ullialt'](#)

[News article from Dagsavisen about Oslo Runway 2017](#)

[Article from Landbruk about Norwegian wool and sustainability](#)

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- Dybdahl, L. (2016). Building business models for sustainable fashion: a case study of Norwegian fashion companies focusing on local value chains and locally sourced wool (Master's thesis, Norwegian University of Life Sciences, Ås).
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Consumption Research Norway (SIFO) is a non-profit, transdisciplinary research institute at OsloMet – Oslo Metropolitan University. SIFOs research aims to understand the role of consumption and consumers in society and to provide the knowledge basis for public consumer policy in Norway.

SIFOs core research areas are:

- Sustainable consumption
- Digitalization of everyday life
- Market based welfare
- Clothing and food