



Professional report no. 5-2012

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## Valuing Norwegian Wool

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Professional Report No. 5 -2012

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<b>Tittel</b>	<b>Antall sider</b>	<b>Dato</b>
Valuing Norwegian Wool	161	26.09.2012
<b>Title</b>	<b>ISBN</b>	<b>ISSN</b>
	978-82-7063-440-8	1502-6760
<b>Forfatter(e)</b>	<b>Prosjektnummer</b>	<b>Faglig ansvarlig sign.</b>
Marie Hebrok, Ingun Grimstad Klepp, Tone S. Tobiasson, Kirsi Laitala, Marit Vestvik og Madeline Buck	11201011	
<b>Oppdragsgiver</b>		
<b>Sammendrag</b>		
<p>Ull har blitt kalt det hvite gullet, og har varmet og gledet den norske befolkningen gjennom hele vår historie. Det er også en tekstilfiber med mange utnyttede egenskaper. Utgangspunktet for prosjektet Valuing Norwegian Wool er et ønske om å bidra til at norsk landbruk, ullbasert industri og design utnytter det potensialet som ligger i norsk ull som råvare, og i norsk tekstiltradisjon. Norge har en livskraftig tekstilindustri og en rekke sterke bedrifter som produserer produkter i ull. Samtidig som en stadig mindre andel av produktene blir laget av norsk ull, har forbrukere ikke uten grunn tatt det for gitt at norske produsenter bruker norsk ull. Markedsføringen av tekstilene gir mangelfull informasjon om råvarens opphav og er i noen tilfeller direkte misvisende. Prosjektet er finansiert av Norges forskingsråd og ledet av SIFO. Prosjektpartnerne består av representanter fra hele verdikjeden - fra landbruksorganisasjoner via industri og handel til design og forbruk. Rapporten er en av mange publikasjoner i prosjektet og viser utfordringene som finnes i verdikjeden, men også det store potensialet som ligger der.</p>		
<b>Summary</b>		
<p>Wool has been called the white gold and has warmed and brought joy to the Norwegian population throughout history. It is also a textile fibre with many unused features. The starting point of the project <i>Valuing Norwegian Wool</i> is a desire to help Norwegian agriculture, wool based industry, and design to exploit the potential inherent in Norwegian wool as raw material, and in the Norwegian textile tradition. Norway has a thriving textile industry and several strong companies that produce products made of wool. The marketing of the origin of the raw material these products are produced from is however rather inadequate and sometimes misleading. While fewer and fewer of the products are made of Norwegian wool, consumers - not without reason - take it for granted that Norwegian producers use Norwegian wool. The project is funded by the Norwegian Research Council and led by SIFO. The project partners include representatives from the entire value chain - from agricultural organizations, industry and commerce, and design and consumption. This report is one of many publications in the project and makes visible the challenges that exist in the value chain, but also the great potential that is there.</p>		
<b>Stikkord</b>		
<p>Ull, ullklassifisering, råvareproduksjon, sau, næringsutvikling, ullindustri, tekstilindustri, tekstilforbruk, ullvask, merking, opprinnelsesmerking, ullgarn, ullgensere, ullundertøy, tekstilmerking, mote og design, garderobestudie.</p>		

**Keywords**

Wool, classification of wool, commodity production, sheep, industrial development, wool industry, textile industry, textile consumption, wool wash, labelling, origin labelling, wool yarn, wool sweaters, wool underwear, textile labelling, fashion and design, wardrobe study.

# Valuing Norwegian Wool



by

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2012

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## Preface

The project with the same name as this report; *Valuing Norwegian Wool*, was funded by the Norwegian Research Council through the program *Natur og Næring* (Nature and Industry). The primary aim of the program is to trigger research and innovation for value creation in Norwegian bio based industries.

The project as the program has had a clear goal: to generate knowledge that can contribute to value creation in Norway. From the beginning of the project it has been characterized by dedication and a lot of attention from the outside world both nationally and internationally. We have placed great emphasis on dissemination and discussion along the way. At times, this emphasis has required so much attention that professional ambitions have had to be set aside, but in relation to the aim of both the program and the project this has been a correct prioritization.

The project connects all the vital parts of the value chain of Norwegian wool into a network. SIFO has been managing the project, however, a substantial effort has been made by the project partners either as independent deliveries or through committed and informed contribution by email, telephone and mail. The learning curve has been steep and the temperature has been high throughout the project. We would like to thank all partners, staff at SIFO outside the project and all our “wool-friends” at home and abroad that have contributed in different ways. Last but not least, we would like to attribute a special thanks to everyone who has favourably agreed to be interviewed and showcased their wardrobes and businesses for their trust and efforts.

A report is usually published at the end of a project. This report is however not as the project will continue into the first quarters of 2013. We have decided to publish it now so that it may be available simultaneously with the exhibition "*Det Kvite Gullet*" (The White Gold) at Kunstindustrimuseet in Oslo October 8<sup>th</sup>-14<sup>th</sup>. We hope that the exhibition and the report will contribute to

the debate and spur further development in order to revive Norwegian wool as *The White Gold*.

Oslo, October 2012

NATIONAL INSTITUTE FOR CONSUMER RESEARCH



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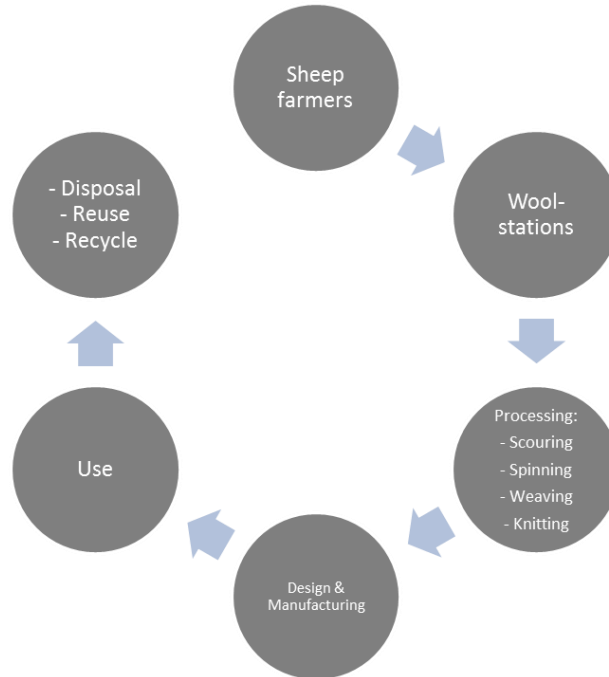
## Summary

Norwegian sweaters and patterns are known worldwide, and no other people are as eager to dress in woollen underwear and folk costumes as the Norwegians. Amundsen would not have reached the North Pole, the Vikings would not have had sails, and the fishermen of Lofoten would have frozen to death if it wasn't for wool. Today the Norwegian sheep population is declining. Norway has a thriving textile industry and several strong companies that produce products made of wool. The marketing of the origin of the raw material these products are produced from is however rather inadequate and sometimes misleading. While fewer and fewer of the products are made of Norwegian wool, consumers - not without reason - take it for granted that Norwegian producers use Norwegian wool.

The starting point for the project with the same name as the report; *Valuing Norwegian Wool*, was a desire to help the Norwegian agriculture, wool based manufacturing and design to fully exploit the potential that is inherent in the raw material and in the Norwegian textile tradition, in order to create profits, good jobs, pride, and durable beautiful products.

The project was funded by the Norwegian Research Council through the program *Natur og Næring* (Nature and Industry). The primary aim of the program is to trigger research and innovation for value creation in Norwegian bio based industries. A key objective of the project and the report is to see the Norwegian wool based value chain in context. In other words, we do not wish to provide a comprehensive picture of each link in the value chain, but to produce knowledge that is relevant to see the relationships between the links and how they can be strengthened and developed further.

The value chain:



Because today's wool products are mainly made of new wool and not by shoddy there is no arrow between disposal and production. There is some shoddy in production today and earlier it was an important part of the industry. However, the report does not focus on this form of recycling, and is therefore referring to wool as what is described as "pure new wool". The chapters of the report follow the value chain as it is represented here, where the concluding chapter contributes to a discussion of labelling where all the links in the value chain are included.

It has long been an outspoken political goal that the grass-based animal husbandry in Norway should be maintained and increased. This is important for upholding the activity on Norwegian grassland and also in terms of the associated employment and economic value creation, as well as to ensure self-sufficiency. The utilization of uncultivated grazing areas helps to maintain the cultural landscapes. It also serves the environment by reducing the utilization of industrial grain and by not occupying land fit for food production (Ministry of Agriculture and Food, 2011-2012).

Nevertheless, the number of sheep farmers in Norway has steadily decreased from 22 214 in 1998 to 14 559 in 2011, which is a significant decrease of

34.5%. There is also a downward trend in the number of winter-fed sheep in Norway, though this number has only decreased about 5% from 1 102 855 in 1998 to 1 044 036 in 2011 (Statistics Norway, 2011b). The chapter gives an overview of important aspects of the production of wool in Norway in order to identify challenges and opportunities within the industry, and is based on available written sources as well as stakeholder interviews.

Producers of Norwegian wool shear and deliver the wool to wool stations where the wool is classified and sold. The class is of great importance to the state subsidies the farmer is receiving. A wool standard is a specification of different qualities of wool that sets the rules for how the different qualities shall be classified and sorted. This enables a differentiation in wool qualities with different properties that can be sold at different prices. During classification the wool is judged by several different criteria; length of fibre, fineness, resilience, crimping, dead hair, marrow content, yield after scouring, vegetable matter, whiteness, pigment, and felting. These criteria are based on the New Norwegian Wool Standard of 2007. The challenges regarding the classification of wool and low quality yields are not a new phenomenon, they have followed the industry for decades. There is currently an on-going discussion regarding classes and attempts to change them to get wool of higher quality. One problem with this is that when you take out the finest wool, the rest will become of lower average quality. Classifying a high number of classes is both time consuming and costly.

There are two key challenges in relation to the production of wool; animal breeding and processing. Given that most of the income of farmers comes from meat, wool is not being prioritized high enough. Wool is still a criterion considered in breeding, but it could put more effort into the development of wool quality. Another problem is the profitability of the industry as a whole - which leads to part-time farmers and little development. In particular are issues related to the profitability of smaller and older breeds. The conditions around wild sheep are especially problematic. This wool is discarded due to the lack of systems required in order to exploit it. Additionally one is wasting valuable resources, and causing a waste problem. Wool degrades very slowly and is therefore not suitable for composting.

The next link in the value chain is the production of finished goods, yarn, fabrics and garments. This chapter builds on stakeholder interviews and visits to businesses around the country. Before the many different textile techniques can be initiated, such as carding, spinning, weaving, knitting, etc., the wool must be scoured. This is "the missing link" in the chain from a Norwegian perspective. A very small part of the Norwegian wool is scoured in Norway

regardless of how it is applied later. The scouring is done in England in by a company which is partly owned by Norwegians. Only a few of the textile companies have the opportunity to scour themselves, but no company is scouring for other stakeholders in Norway on a large scale.

There are various Norwegian manufacturing companies of various sizes, producing various kinds of products such as; yarn, knitted garments, woven fabrics and wool for further processing. A few companies use only Norwegian wool, some use only imported wool, while others use a combination of Norwegian wool, imported wool, and fibres from different animals such as alpaca and mohair.

An important question is why those who use Norwegian wool have chosen to do so. The answer here is first and foremost that it is a natural choice. The histories and locations of these companies are built around making use of Norwegian wool. But taking into consideration the fact that few exploit this in their marketing, the question remains why they have continued to use Norwegian wool? Some answers are given to this question through discussions with our informants, and they are mainly connected with different sheep breeds, products and qualities. There is a lot of commitment and personal interest regarding the small breeds such as villsau (wild sheep), merino, and grå trønder, and a strong wish to utilize the resource that wool is. The Norwegian heritage within textiles and crafts is also an important motivation. Spel sheep in particular has a unique place in handwork and the art worlds. For Norwegian Crossbred, it is the technical qualities of the wool that are important. Norwegian wool is resilient and durable. Norwegian sheep farming commonly uses very little pesticides and has very few problems in terms of animal welfare.

Companies report that they cannot use Norwegian due to certain of its qualities. The main reasons given for not using Norwegian wool are vegetable matter, lack of whiteness, fineness, and elements of dead hair.

Good treatment of sheep and wool can reduce some of the occurrence of vegetable matter, but essentially this is the "price" we have to pay because we use uncultivated land for grazing. In relation to the political goals of open landscapes, it is difficult to envisage any major changes in this. However, what may be a solution is greater tolerance for the irregularities in the finished product created by this kind of grazing. Whiteness, fineness and absence of dead hair are questions related to breeding, sorting and classification.



Seen from the viewpoint of fashion designers Norwegian wool is a highly coveted product they would like to use more of. The use of local raw materials is growing with a focus on environmental and sustainable products. The status of Norwegian textile traditions, both at home and abroad suggests that this represents a huge potential that could contribute to greater awareness and profitability for the entire Norwegian wool based textile industry.

The chapter on consumption is based on fieldwork with wardrobe studies, material tests and interviews in addition to lab tests. The reason for this breadth of methods is that in order to understand the use of textiles and the user properties of textiles knowledge is needed about the textiles themselves as well as about the practices and interpretations related to them. While lab testing provides information about the physical and mechanical properties of textiles, the material test and wardrobe studies combined with interviews provided us with information about the relationship between this materiality and use, attitudes and knowledge. As we have shown, the knowledge about textiles is inconclusive. This has consequences both for the opportunity to answer the questions we asked and the analysis of the material. The question of *How is wool incorporated in today's consumption?* is only partially answered. The comparison with the use of wool in selected English families shows that there may be large regional or national variations in these consumption patterns. This implies that multiple comparisons are required to map these differences. The relationship between the wardrobes and the development of markets and marketing is also interesting. We need, in other words a better analysis of the material we have, more material on the use of wool today, and a historical analysis in order to answer this question in a satisfactory manner.

The next question we raised was: *What are the possibilities and barriers related to increased use of wool?*, and is closely related to the first question. Wool's thermal properties is perceived as a problem in England and as a benefit in Norway. Is this just a matter of climatic differences? In relation to the issue of itchiness there are unresolved questions as well. Half of all samples in the materials test were not recognized as wool, which means that wool is not so easily identified as "itchy". How the relationships are constituted between expectations, attitudes and perceived characteristics should be studied further. This has implications for Norwegian wool because the focus on the softness is one of the changes that have led to favouritism towards other wool fibres than Norwegian crossbred. How can a shift of focus be made from the properties lacking in Norwegian wool (e.g. softness) to properties such as shine, colour and resilience?

Although the chapter on consumers (Use and usability) raises more questions than it answers, it contributes to the knowledge of the value chain. Norwegian consumers have different ways of perceiving *Norwegianess* in relation to wool. Based on how informants spoke about Norwegianess, we suggest that garments in themselves can be seen as traditionally Norwegian, in relation to origin or traditional patterns, but Norwegianess applied also to the use of the garments. Thus, the Norwegianess is ascertained by both imagined and realized fabric, fibre and garment uses. What is revealed is the close connection between the properties of woollen garments and traditional Norwegian activities, as well as Norwegian perceptions and sartorial codes and clothing consciousness regarding how to dress smartly during the cold months, promoted through national bodies and the passing on of familial knowledge. Indeed, how to dress in woollen layers was emphasized repeatedly both concerning everyday activities, such as travelling to work, and for outdoor activities. Thus we see clear parallels between the way consumers perceive Norwegianess and the way this is communicated in the marketing of Norwegian products regardless of where the raw material comes from.

The various technical tests are conducted to contribute with knowledge that makes it easy for the consumer to use and handle woollen garments. We have answered questions regarding whether wool can be washed together with other fibres, how to dry it in the best possible manner and what contributes to shrinkage. Documentation of these tests - and of wool characteristics in terms of cleanness is also important in discussions about the environmental impact of various fibres. This discussion is however not included in this report as the issue is addressed in other publications within the project.

In the chapter on labelling, we give an overview of some key labelling systems for textiles, as well as origin labelling of food in Norway. This is intended as background to lead a discussion on how the use of Norwegian wool should be communicated in a more consistent and unambiguous manner. In many of the other wool producing countries labels are being developed. The chapter also describes various viewpoints taken by stakeholders. How an improved labelling of Norwegian wool can be developed is an open question which includes who will develop, own and control the brand, and whether it is appropriate to cooperate with labelling for other agricultural products. Since wool is not the only resource we extract from sheep, there is also meat, it is possible to envisage a common labelling system for multiple kinds of products. However, no matter how a label is defined and organized, it is essential that it gives the finished product added value. This will depend on both appearance and credibility.

Finally, we point out the main challenges in the value chain. It is said that a chain is no stronger than its weakest link. There are major challenges in all links of the value chain of Norwegian wool, and several problems must be solved. The issues of scouring and labelling are examples of such problems that are important to address. One strategy would be to start where efforts can produce results quickly. Connecting Norwegian designers with producers and retailers of fabrics and yarns made of Norwegian wool seems to be such a strategy. Norwegian wool is a beautiful and resilient material, both in terms of its technical characteristics and the historical associations connected to it. It will have a bright future if we allow it to.



# 1 Introduction

This report is part of the project *Valuing Norwegian Wool* which was initiated by the National Institute for Consumer Research in Norway in 2010. The project has been funded by the Norwegian Research council through the program *Natur og næring*, and by the partners Norsk Industri, Virke, Norilia and Fatland Ull AS. Other partners in the project are: Nordic Initiative Clean and Ethical, Norwegian Fashion Institute, The National Academy of Arts, Oslo and Akershus University College of Applied Sciences, Norwegian University of Science and Technology, 2025design, Oikos, Norsk sau og geit, and Animalia AS. The projects main focus is to contribute to increase a sustainable value creation from value chains based on natural resources, suggesting a fresh look at wool. It aims to map the value chain of Norwegian wool through its entire life cycle, and will focus especially on examining and describing the important links in the value chain and their relationships, to make visible the challenges and possibilities within the industry.

## 1.1 Valuing Norwegian Wool

Today, wool is a bi-product (a + product) of Norwegian sheep farming, and there are serious challenges to the production. As a generic product, a major part of the production is exported, but the world market prices have plunged over the last years. The share of income stemming from wool production among farmers has been shrinking from 23 % to 18 % (Animalia, 2009). Norwegian textile and garment industries currently use less than 30 % of their wool input from Norwegian producers, and there is concern that both the consumers and the industry will increasingly favour qualities that Norwegian producers currently are unable to meet. The project's main hypothesis has been that Norwegian wool has technical, environmental and symbolic values that have not been fully exploited in the value creation process.

The main objective of the project has been to provide knowledge on how Norwegian wool can contribute to a more environmental sustainable textile production and consumption and increase value creation in agriculture, textile industry, retailing and design.

*Sub goals:*

- estimate the economic significance and potential
- document Norwegian wool traditions to facilitate revitalization
- establish international cooperation and exchange knowledge on sustainable innovation
- identify comparable environmental benefits of Norwegian wool
- identify barriers and possibilities for increased use of Norwegian wool among consumers
- create ideas for new products based on Norwegian wool
- identify concepts for marketing and communication
- disseminate innovative ideas and knowledge on Norwegian wool (technical, environmental, cultural aspects)

Contrary to other rural industries such as food production and tourism, there has been no systematic research and development on the area of wool. As the focus on environment in the textile sector is rapidly increasing, and textiles with technical qualities are in demand, we have found this to be an opportune moment to explore the value creation potentials of Norwegian wool where both knowledge and strategic action is fragmented. In order to do that, we have mobilized the whole value chain – from farmers to consumers. The organization of the research project is unique and links all vital elements in the value chain into a network. The consortium comprises of first-hand sellers, manufacturing industry and retailers collaborating to increase the value potentials of Norwegian wool, a fibre with a broad area of applications. Our ambitions have required a holistic and cross-disciplinary approach, that not only includes disciplines such as humanities, marketing and social sciences, but also textile engineering, fashion and design. This is reflected among the project partners, consisting of environmental organizations, textile boards, design schools and fashions institutes. Finally, our research and development ambitions have also required a cluster of activities and methods, ranging from conventional research methods and laboratory testing to design and exhibitions.

## 1.2 Frontiers of knowledge and technology

The project builds on several fields of knowledge that are embedded in each other. To simplify we present the frontiers of knowledge along five complementary dimensions.

### **Economic**

The economic significance of Norwegian wool is understudied. There is substantial information on production volumes related to product standards (SLF 2007), and some information available at each link in the value chain. Compiling data on the total economic frame of support schemes at the farm level from first-hand traders (such as Norilia and Fatland Ull AS) is possible, but a more comprehensive approach is needed to estimate the significance of wool in economic terms. As a commodity industry, the wool product industry is facing similar challenges as those found in the descriptions from the wood industry (see Sande 2001, Freng Svendsen and Haugland 2006): Most local markets with limited exposure to international competition are today increasingly global, export and import have increased more than production and consumption, and prices seem to have converged across regions and countries. The world market prices are therefore prescriptive for the prices paid by the Norwegian textile industry for Norwegian wool. Companies have grown international by means of mergers, acquisitions and strategic alliances; both global and multinational companies operating in markets with a wider product range, and specialized niche companies operating in a few selected markets with a more limited product range. Norwegian wool will by any standard be a niche product, what needs to be investigated is what niche strategies are available in terms of creating added value.

Soon after starting the project in 2010 we found that the attention towards wool was growing several places in Europe, including Norway. This caused us to gain many “wool friends” along the way, which can be read about in appendix 1. Simultaneously as the Valuing Norwegian Wool project was initiated in 2010 the Norwegian Central Research Office for Agricultural Associations (CROAA) initiated a project that was going to look into the economy of sheep farming in Norway. When we realised this we engaged in collaboration with CROAA. Instead we commissioned several questions to be included in the planned CROAA survey that was going out to sheep farmers across Norway. The questions concerned the importance of subsidies to uphold production of wool, breeding for wool quality, the significance of Norwegian wool in Norwegian design, branding of Norwegian wool, and finer classification and sorting of wool.

## **Technology**

The quality of wool depends on the length of fibres, coarseness, shine, curliness, strength and colour, and is affected by various factors such as breed, nutrition and climate, when, where and how it is cut and sorted etc. Norwegian wool is divided into three major quality grades, crossbred wool (Norwegian standard C1) being the most important by far (SLF 2007). The quality of Norwegian wool is considered coarse, excluding Norwegian wool from markets demanding softer wool types. However, it remains to be documented how these limitations should be met. During recent years, a wide array of new wool products have been developed, but few innovations are adapted to Norwegian wool qualities. Little research has been conducted on exploring the potentials of prevailing standards, and how these could be better adapted to existing and new demands both from industry and consumers. These are issues that are addressed several places in this report. The chapter on wool production describes some of the background for today's wool standard and the work that has been conducted to improve it. The chapter about the consumer research performed by SIFO show findings regarding consumer attitudes towards wool, whilst the chapter about the wool manufacture industry makes visible the demands and wishes the industry has regarding the future development of Norwegian wool.

## **Environment**

Ecological design may be defined as: “any form of design that minimizes environmental destructive impacts by integrating itself with living processes” (Van der Ryn and Cowan, 1996:18). The project proposes to do “research by eco design” to gain added value related to Norwegian wool. The environmental benefits of using wool instead of cotton and synthetic materials are relatively well documented, both in terms of production (Allen Woodburn Associates, 1995) and use (Fletcher, 2008) – however, contrastingly, relatively unknown to most consumers. A change from cotton to wool would by itself add to a more sustainable consumption pattern due to a lower washing frequency needed and the durability of wool as material (Klepp et al 2003, Klepp 2009). Durability and reuse are important environmental strategies (Strandbakken, 1995). Norwegian wool may have comparative environmental benefits compared to foreign competitors. The production is cleaner, both the meat and the wool are exploited, and neither mulesing nor sheep dips are used. Part of the Norwegian wool production would probably qualify for organic labelling schemes without extensive investments; however, what is the best communication strategy is subject to discussion (Patterson 2009). To gain added



value these environmental benefits need to be documented and communicated.

Caring for the environment has become important in international competition, and there has been developed several methods for comparing the environmental impact of fibres. Surprisingly, wool has scored rather badly in the outcome of different environmental analysis methods. The work to document the environmental benefits of wool has thus been aimed at understanding why wool achieves such low scores within prevailing ranking methods. One important reason for this is the exclusion of the use phase of woollen clothes. To document the environmental impact of the use phase has thus been a priority in this project and the results are summarized in chapter four.

### **Market**

Companies trading Norwegian wool have been product oriented with focus on raw material and physical processes, trading very standardized wool qualities. The increased internationalisation and drop in wool prices induce traders to evaluate their market strategy. Contrary to the wool commodity market, the market for wool garments is much more specialized. Aspers (2008) makes a distinction between a “standard” and a “status” market. Value in the production market is measured against a rating - such as standard and price - while value in the status market is measured against position in the market in terms of high or low fashion, making symbolic value and brands crucial. Aspers concludes that the ties between the standard and status market should be further investigated in order to analyse value creation impacts. In a similar way, we suggest here a more holistic approach to the value chain of Norwegian wool.

A discussion about the need for common rules regarding branding and marketing of wool will be initiated through seminars and an exhibition after this report has been completed. We have emphasized the potential in collaboration within the value chain in order to increase the value of Norwegian wool and achieve common benefits.

### **Cultural heritage & fashion**

The significance and meaning of Norwegian wool as an important element of Norwegian cultural heritage is visible – however, there has been surprisingly little research conducted on the topic. Maintained by a vital handicraft and knitting tradition, Norwegian knitwear is regarded as an important representation of national identity – knitwear being the Norwegian souvenir per se ex-

posing traditional patterns. There are a few examples of innovative use of this tradition in contemporary design, and there have been attempts to utilise Norwegian wool in high-end design despite the obstacles related to quality and production costs – however, mostly imported wool is utilised in this segment. The value of the local aspect related to consumer goods has been investigated related to other farm products (Jervell et al 2007, Vittersøe and Amilien 2009), and consumer trends point to an emphasis on quality and local products (Goodman 2004, Tregear 2003). The globalisation phenomenon does not eradicate but rather arouses the rebirth or reconstruction of local and regional productions (Holt and Amilien 2007). As an already established consumer trend is now moving into the textile sector, the cultural history of Norwegian wool needs to be documented to exploit the potential of added value.

There have been several publications on this topic within the project that are not referred to in this report. A popular book is also in the pipeline and will be published after the project has ended.

### 1.3 The history of wool

Before we describe and discuss the value chain we would like to introduce this report by placing the Norwegian wool industry in a historical context.

The first clothes made from sheep were made of sheepskin, this was before the sheep were even tamed. One could imagine that the first sheep farmers found large felted fleeces from sheep that shed their wool, and just used them over their shoulders as they were. Historians claim that man learned the art of felting long before spinning, knitting and weaving. Felt was used for clothes, tents and blankets. First findings are probably from the Iron Age (Buer, 2011).

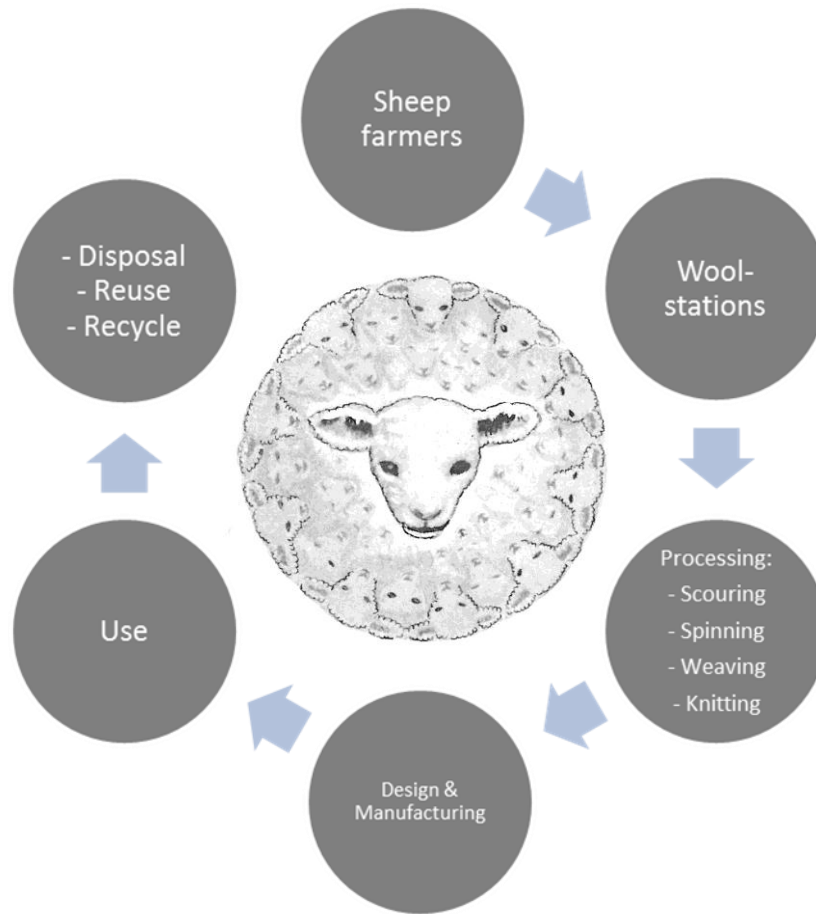
In Norway sheep have been highly valued through all times. The first farmers during the Stone Age used them for warm leather clothing, food, and for clearing land. The Vikings used large amounts of wool for their sails and clothing. Fishermen were able to survive long hours out at sea thanks to warm woollen clothing and woollen mittens. Buer (2011) claims that, opposed to today, wool has been more valuable than meat through large parts of history. Sheep with wool appear in writing about Babylon that built its wealth on wool. Flocks of thousands of animals provided wool for the Babylonians and for export. The wool was about ten times as valuable as the meat from the sheep, even the milk was more worth than the meat. Wool was also traded in the Mesopotamia of Antiquity, and within the Greek civilization, where it was sorted into different qualities as we do today (Buer, 2011).

Findings suggest that sheep came to Norway approximately 6000 years ago. The long tailed white sheep arrived during the sixteenth century, and almost displaced the original short tailed coloured sheep (gammel norsk sau). In the middle of the seventeenth century there were more sheep than people in Norway. The wool industry emerges around 1850-1860, and soon wool stations were established to receive wool and educate and guide sheep farmers on wool and how to handle it. The process of separating the bottom wool from the cover wool was considered too time consuming to be profitable, and the coloured wool from the Norwegian sheep breed was of such low quality and equally poorly priced that it was just used for household crafts. From 1875 to 1900 the sheep population in Norway is declining. This may be explained by increased sheep size and productivity, and that the imported sheep breeds need more feed (Buer, 2011). The cross-bred sheep increasingly took over, and it took some hard work by enthusiastic stakeholders to avoid the extinction of the Norwegian wild sheep. Today there are 1 million sheep in Norway (2,5 million in summer). The most common breed is crossbred.

The industrial revolution which to a great extent originated in the emergence of the textile industry in the UK set the country apart from the economies on the continent. In the mid nineteenth century British technology was transferred to Norway, and extensive knowledge diffusion made it possible for Norway to build its own textile industry. Not only machinery was imported, but the skills and knowledge needed to set up and work the industry was transferred from British engineers who were part of the 'industrial packages' that came from the UK (Bruland, 1989).

Norway, only with a later industrialization of the textile production. Norway was importing wool manufactures by great quantities during the mid-nineteenth century, and the growing demand gave Norwegian entrepreneurs a commercial opportunity. Imports rose from 93 tons in 1830 to 229 tons in 1845 (Bruland, 1989). The significance and meaning of Norwegian wool as an important element of Norwegian cultural heritage and identity is unquestionable. Norwegian knitwear is still regarded as an important representation of national identity – knitwear being the Norwegian souvenir per se exposing traditional patterns. Late industrialization and a large degree of home produced textiles, together with conscious revitalization, preserved knitting and knit patterns as a living tradition.

## 1.4 The value chain



**Figure 1-1: The value chain**

The value chain of the production of wool and woollen products is diverse, from the sheep farmers to the clothes that we wear. The sheep farmers breed different kinds of sheep yielding different kinds of wool qualities. On this stage in the production is the ground work laid for the quality of the fibres. Breeding, animal husbandry, shearing and sorting of wool are important aspects that influence wool quality. The certified sorting is conducted at wool stations according to *Norsk ullstandard*, the Norwegian standard for wool. Wool stations are situated all across the country (Norilia, 2012). The new Norwegian Wool Standard was introduced in 2005 and is based on interna-

tional requirements for wool quality. Approximately 4500 tons of Norwegian wool is produced each year.

## 1.5 The global status of wool production

We have gathered experiences from initiatives in the wool industry internationally in terms of environment, technical innovation and branding through participation at seminars, networking, information exchange as well as collecting documentation, and have sought to answer these questions:

- What are the international trends relevant for the Norwegian situation?
- Are there new areas of utilizing wool of the same quality as the Norwegian wool or new innovative processes that could increase the value of Norwegian wool?

At the beginning of the project we had little knowledge of how the international arena of wool functioned, and also knew very little about the fact that Norwegian wool was scoured abroad – but in hind-sight the project has produced communication-platforms and new networks that were hard to imagine when the application was formulated. Ingun G. Klepp (SIFO) and Tone S. Tobiasson (NICE) have travelled extensively around the world learning about and connecting with important actors within the wool business. An account of the wool market of 2008-2010 has been given by Tobiasson, Bandlien and Klepp in the paper “A Fresh Look at Wool” and will be summarized in the next section.

Sheep-farming has the lowest profitability of all livestock and farming practices (Klepp and Lutnæs, 2007). Furthermore, the European sheep population has declined by 20 % in the last 20 years (Popescu, 2010). Globally the same tendency can be seen, with a decline in clean weight production of 2.5% world-wide in 2008 with the largest drops in some of the largest wool-exporting countries: Australia was down by 8%, New Zealand down by 6% and Argentina down by 16%. Fine wool production (24.5 microns and finer) was estimated to have fallen by 5%. Sheep numbers are continually falling, as growers shift from wool towards meat, together with continuing drought in Australia and in South America (IWTO, 2009).

Apparel wool prices fell sharply in October 2008 as the result of the downturn from the Global Financial Crisis, and prices reached a low point in February 2009 before recovering slightly by the end of the 2008/09 season. Trends in the prices for wool used for interior textiles were more mixed in 2008/09

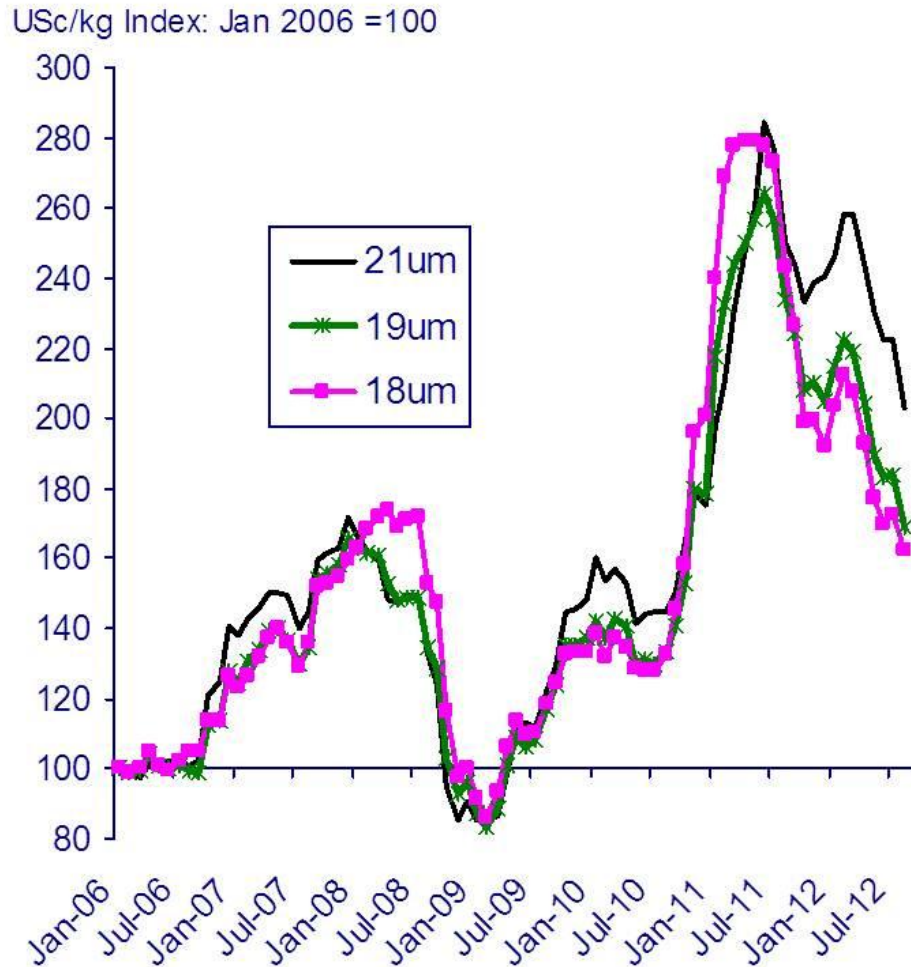
since the decline was not as significant, in part because prices for woollen interior textiles had not increased as much as apparel wool prices in 2007/08. Further support for wool prices has since been the very low levels of wool production and supply, particularly of apparel wool. In fact the decline in wool prices in absolute terms as a result of the two financial crises was about the same, but the price level at the low point in 2009 was well above the low point in 1998. This illustrates the impact of the low supply level, particularly when one considers that the global financial crisis was more widespread and deeper than the Asian financial crisis (IWTO, 2010). Apparel wool prices fell sharply in October 2008 as the result of the downturn from the Global Financial Crisis, and prices reached a low point in February 2009 before recovering slightly by the end of the 2008/09 season.

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Through email correspondence with IWTO (2012) we have received reports that the 2011/12 season has been a disappointment, and that the wool prices keep declining in 2012/13. The world wool production has gone down again in 2011/12, and raw wool stocks are very low. There is a fall in production of medium merino wool, and Australian wool production is static in spite of increased sheep numbers. Commodity prices in general have fallen due to the recession in Europe and the wool prices are no exception. Wool prices are down 20% in South Africa, 15% in Uruguay, 20% in Argentina, 17% in New Zealand, and 24% in the United Kingdom. The decline is caused by a lower demand for fine and super fine wool. However, compared to other fibres, wool is relatively expensive. Cotton prices have fallen 43%, acrylic has fallen by 26%, and polyester by 18% from 2011-2012. Still, wool is six times as expensive as cotton, and five times as expensive as synthetics. The global wool production fell by 3% in 2011/12. This has helped support the prices. It was however the lowest production in 70 years. This fall was partly caused by the fact that many growers began to focus on breeds that could produce both meat and wool. Competing fibre prices will keep wool prices under pressure for some time. However, the IWTO is predicting 2013 to show brighter prospects as key economies will probably recover.

The shift towards meat is a consequence of higher meat-prices (Nicholson, 2010). One sees the “pull” between food production and fibres increasing in other sectors too, as problems surrounding drought, flooding (recently in Pakistan) and population growth shifts focus of agriculture towards food rather than clothing. According to several news sources, the Chinese government has decided that former cotton-fields will be designated for rice instead. Yet, scarcer resources can mean better prices for suppliers.



**Figure 1-2: Trends in wool prices.** Source: AWEX, Cotton Outlook, PCI Fibres and Raw Materials, Poimena Analysis.

Conversations with stakeholders in the global wool industry have given us information about the steep rise of wool prices in 2011. According to our contacts this happened partly due to commodity shortages and hoarding. The latter has caused the prices to fall again as demand went down. However, these fluctuations in price have not affected the Norwegian wool prices as Norwegian wool is not sold on the spot market, but prices are negotiated with fixed customers for years at a time.



The international experiences and networking in the world of wool has been documented and included in the report as an appendix (see appendix 1). Due to the nature of this work the appendix will consist of travel reports and summarized notes written along the way by the authors. As this has been a “travel” more than anything else, it will reflect the process in a more informal tone and in a form that will remind more of a “travel-log” than a research report. The sheer magnitude of the international travels by far exceeds the means that were allocated for the project, but we have been lucky and other parties have contributed to make these travels possible, including the Nordic Council of Ministers, Woolmark, IWTO, the Peruvian government, The Ministry for Children and Equality, etc. Since Tone Tobiasson works as a journalist, conferences have waived her fee since she has covered the conferences for either Tekstilforum or Eco Textile News or both. These kinds of expenses could easily have hampered our work and would have made it impossible to disseminate and build the international alliances.

The mapping in this report relies on available written sources, laboratory testing and qualitative scientific research methods, as well as information from stakeholder interviews.

In the following sections we will provide you with an overview and an analysis of the different links in the value chain of Norwegian wool. Starting with the production of the raw material wool itself, followed by the processing of the wool and design and manufacturing of woollen products such as clothes and yarn. Then we compile the research conducted within the sphere of the consumer, where laboratory tests and qualitative research methods have been applied to gain knowledge of the use phase of woollen garments. Further on, an account of the status of wool internationally is made based on extensive travelling, networking and desktop studies. In the concluding chapter we attempt to address the challenges and possibilities identified through the research project and make visible the implications of our research.

## 1.6 Methodology

The report relies on six methods: 1) Desk-top investigation, 2) Stakeholder interviews, 3) Laboratory methods, 4) Wardrobe studies, 5) materials test and 6) survey. Even though the different chapters in the report mainly report on results derived from one method, the knowledge that has been generated through all the methods is interconnected and the results from several methods are thus referred to in many of the chapters.

### 1.6.1 Desk-top investigation

This method has been most important for chapter 2. Wool production. An important prerequisite for the work was the Project note Reading into Norwegian Wool by Mae Colburn (2012) which gives an overview of the literature on Norwegian wool. This emphasizes new literature, focuses on clothing textiles, and includes sources written both in Norwegian and English. An overview of the libraries and interviews that were used can be found in the report. In addition, the contact with many of our partners has been important both in finding the literature and for clarifying elaborate questions. In this way, the desktop investigation and stakeholder interviews have overlapped.

The limitations in this work were first and foremost the time we had at our disposal. We sought to limit the shape of the work by concentrating on literature on wool in Norway from around 1940 up until now. We have not made use of the literature on our neighbouring countries, even though this could have provided a more rich picture.

### 1.6.2 Stakeholder interviews

Chapter 3. Yarn, fabric and clothing is built mainly on stakeholder interviews. A better use of the literature sources as well as the company histories and internet presentations could have given a wider picture of the businesses we reviewed or even allowed us to include more businesses. When we haven't done this is it is because our main question was to present the attitudes towards the use of Norwegian wool and the proportion of Norwegian wool in production. These questions are discussed less in the written materials. Another problem with the written material in relation to our questions is reliability. We see that the expression of "Norwegian wool" and "Norwegian production" and "complete production process" is not necessarily used in the way we would have defined it. The majority of the interviews were conducted by

Ingun Grimstad Klepp and Tone Skårdal Tobiassen, while some were done by Tobiasson alone. They used both audio recording equipment and saved notes, references and prints as separate documents. When deciding on the companies to interview we emphasized reaching all the large, and some of the small, companies that use Norwegian wool in their production. We also interviewed some of the companies which do not use Norwegian wool, but where this could be a possibility. We have also sought to include mills, weaving factories and manufacturers of knitted clothing. The number of companies visited amounted to 15, with one additional interview conducted on the phone. Several informal conversations with designers and other stakeholders can be added to this work. The project partners also contributed valuable information, for the most part, in the form of presentations at project meetings and seminars, and through email correspondence.

It is complicated to get a complete view of the wool industry, from sheep to catwalk. The many trips, seminars, and other meeting places with increasingly new wool friends from Norway and abroad have contributed in providing us information. In the process of this work, we have come across a number of conflicting claims and ambiguities. It has been a challenge to produce in the report where the different claims are taken from, because they often build upon a number of different sources and discussions. The appendix 1 also gives an overview over those that we have met and discussed with abroad and some of the main ideas these discussions have revolved around.

### 1.6.3 Laboratory methods

The methods that are used at an accredited laboratory such as SIFO's are subject to strict rules. The description of the methods are embodied in the standards and lab instructions. In this report, we summarize the main findings from the tests/experiments that were conducted. This is both standardized methods and methods applied and developed especially for this project. A close description of which methods are used and the uncertainty in these methods as well as the conditions the methods were performed under can be found in the test report.

### 1.6.4 Wardrobe studies

The material is not just 'a carrier' of different types of symbols, but an active element in the practices (Latour 1996). Bringing this to the fore requires new methods. The method of wardrobe study aims to contribute to increasing the materiality of clothes studies. It is a method that puts materiality at the core of understanding practice. It draws on central works of great social researchers

such as Bourdieu (1984), de Certeau (1984) Giddens (1984) and Foucault (1979).

Well-known methods such as qualitative research interviews, field work, inventories and laboratory testing, are combined within wardrobe studies. However, not all methods are equally important in all studies. In this study we have conducted interviews, inventories, and sample tests.

Tools such as audio recordings, interview guides, transcriptions, descriptions of the interview context, and other different qualitative and quantitative analytical tools are part of the wardrobe study and are drawn from the qualitative methodological tradition. The inventory is conducted by cataloguing the garments inherent in the wardrobe, and by a recorded interview that aims to reveal what the owner is able to say about his/her material and social perceptions of the garments. The sample test investigates how and if the informants recognize 32 different textile samples consisting of wool, cotton and synthetics and how they think about them. Fieldwork is used as a method within the wardrobe study, however, instead of observing practices directly, which is difficult to facilitate, the situation is constructed. The informants are asked to present their clothes and talk about them, preferably in the place where they are normally stored. Thus, practices are not directly followed, but their material frames are being made available; the clothes, the wardrobes, laundry baskets etc. By crossing a line of intimacy it is possible to gain knowledge about how the practice of categorisation is conducted both spatially and mentally within the wardrobe. Questions that can be answered are for instance how, how long, and why are particular woollen garments stored, how, when and why are they washed, why, how often and in what context are they worn etc.

What is important in the wardrobe study is that questions should be directly connected to the specific garments and be repeated for each garment. This method reveals perceptions that are more tied to the concrete and practice related aspects of the garments instead of more general and ideological ones. The physical presences of the garments spur memories and thoughts about specific events, attitudes, considerations, experiences, and emotions etc. that concern the different garments inherent in the wardrobe.

The method of wardrobe study is a method that is being developed through different case studies conducted by a group of fashion researchers participating in an on-going research initiative and network devoted to the study of consumer dress practices (financed by NOS-HS 2008-2010). The initiative is led by Copenhagen Business School.

During this project we have conducted nine full scale wardrobe studies with inventories and photographs of specific clothing. Three with Norwegian families (middle class), three with Indian immigrant families in Norway, and three with English families (middle class). Interviews regarding attitudes and practices related to wool but without inventories have additionally been conducted with four other consumer groups. The different groups participating in the wardrobe studies were:

1. Working class: between 40-65 years old, low income
2. Middle class: between 30-40 years old, middle income, academics (Norway and England)
3. Economic capital: between 40-50 years old, high income
4. Senior Citizens: around 80 years old
5. Immigrant background: from India
6. Youth: 17 year old boys

We have however due to time restraints only been able to fully analyse the material derived from one group; Middle class families in Norway and England.

#### 1.6.5 Material test

In connection with the wardrobe study, a materials test was conducted in which the six consumer groups were asked to sort 34 textile samples into three categories: wool, cotton, and synthetic. They were told that the three piles would not necessarily be equally large, but they did not know that approximately 70% of the samples were wool. The informants were asked to feel the samples, describe how they looked and felt, explain what they thought of them, and guess which material they were made of. This test not only allowed us to study which samples were identified correctly or incorrectly, but the interviews also gave us insight into how the informants made their guesses and what kinds of attitudes, expectations, and associations they have for each of the textiles.

#### 1.6.6 Survey

The Norwegian Central Research Office for Agricultural Associations (CROAA) has conducted a survey as a part of a larger survey of the economy in Norwegian sheep industry. The questions on wool were developed in coordination with CROAA and Valuing Norwegian Wool. The survey questionnaire was sent out by email to a random selection of 2, 500 farmers who had applied for production of sheep. Their email addresses come from Producers-

registeret AS. Of the 2,500 emails sent out, 1063 of them responded to the survey. This is a 42.5% response rate. CROAA received more than 1,000 responses which is a representative number of respondents. CROAA has further stated that there is correlation between the responses and the Statistics Norway number regarding age, gender, and region with underrepresentation for people between the ages of 60 and 69. This underrepresentation is likely connected to the fact that this age group does not use their email as much as other age groups. Also, the Østland region is slightly overrepresented at the cost of Northern Norway. These differences do not affect the conclusions that emerge from the survey. CROAA believes that the survey is representative of sheep farmers in Norway.

## 2 Wool production

As stated by the governmental white paper number 9 (2011-2012), it has long been an outspoken political goal that the grass-based animal husbandry in Norway should be maintained and increased. This is important for upholding the activity on Norwegian grassland and also in terms of the associated employment and economic value creation, as well as to ensure self-sufficiency. The utilization of uncultivated grazing areas helps to maintain the cultural landscapes. It also serves the environment by reducing the utilization of industrial grain and by not occupying land fit for food production (Landbruksdepartementet, 2011-2012).

Nevertheless, the number of sheep farmers in Norway has steadily decreased from 22 214 in 1998 to 14 559 in 2011, which is a significant decrease of 34.5%. There is also a downward trend in the number of winter-fed sheep in Norway, though this number has only decreased about 5% from 1 102 855 in 1998 to 1 044 036 in 2011 (Statistics Norway, 2011b). On average Norway has about 1 million sheep during the winter. As a result of lambing in spring there are 2,5 million sheep in the summer months (Berntsen, 1999).

This chapter will provide an overview of important aspects of the production of wool in Norway in order to identify challenges and opportunities within the industry, and is based on available written sources as well as stakeholder interviews.

### 2.1 The economy of wool production in Norway

According to the Norwegian Central Research Office for Agricultural Associations (Landbrukets utredningskontor, CROAA) in their recent report on the economy of sheep husbandry (Fjellhammer & Hillestad, 2011a) the main reason for the decrease in Norwegian sheep farming is the economic development within the industry. Although sheep farming is substantially subsi-

dized (about 60% of total income) through grazing grants, production grants, cultural landscape grants, and land grants, it seems not to be a business farmers wish to conduct exclusively. Approximately 5% of Norwegian sheep farmers have sheep as their only source of income. Most of these sheep farmers get their main income from other kinds of productions or occupations. Unfortunately, this does not make up a strong community amongst sheep farmers that could work collectively towards improving the profitability of sheep husbandry (Fjellhammer & Hillestad, 2011a).

However, there is optimism. A CROAA survey conducted amongst 1055 sheep farmers in 2011 showed that 30% of the sheep farmers who participated stated that they plan to increase production during the course of the next five years. Amongst those who stated that they plan to close down their sheep farm during the next five years, most explained this by the fact that the business is not profitable. The complete results from this survey are published in a CROAA-report about the status of the Norwegian sheep farmers (Fjellhammer & Hillestad, 2011a). SIFO commissioned five questions concerning wool in the survey that we will return to later in this chapter.

The CROAA-report further shows that there are substantial differences in the economic profitability amongst sheep farmers. Whilst some farmers earn half of the average income per sheep, others earn double the average income. Recent investigations (2006) conducted by the Norwegian Agricultural Economics Research Institute (Norsk institutt for landbruksøkonomisk forskning) into the debt of sheep farmers reveal that younger farmers stand for most of the debt. This might imply that the older generation does not invest in necessary maintenance, machinery and facilities that are required for an efficient and profitable business. Naturally, more of the younger sheep farmers plan to increase their production during the next five years.

According to Fjellhammer and Hillestad (2011a) there are three main motivations for being in the business of sheep farming: a special interest in sheep husbandry, the opportunity to fully exploit a farm's resources, to uphold activity on the whole farm area. Furthermore, they suggest that economic profit is not a primary motivation for sheep farming in Norway, thus more attention will be paid to keeping costs down than creating a profit. However, the number of sheep on the farm does influence how farmers reply to the question of motivation. Farmers possessing more than 150 sheep state more often economic profit as motivation for sheep husbandry. This is not surprising due to the known economic benefits of large scale production versus small scale production. Additionally, the appropriation of as many as 150 sheep or more indicates an intention of value creation and not just the utilization of available

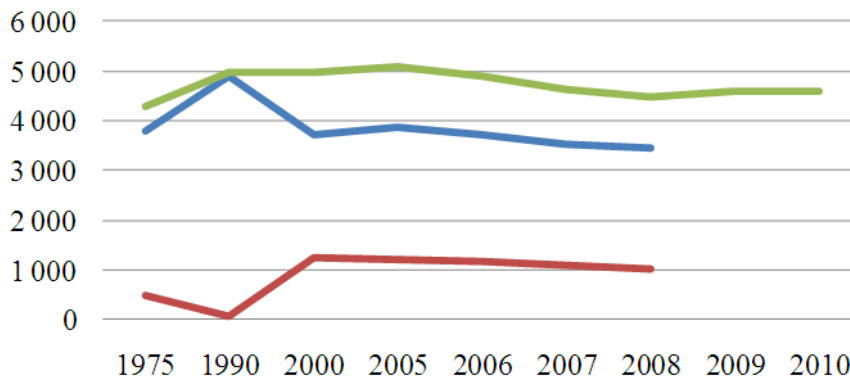


facilities. However, the production grant per sheep is only given for the first 300 sheep, thus sheep livestock above 300 animals is rare. Only 7% of all sheep farmers owned more than 150 sheep in 2009, according to Norway Statistics.

In sum, Fjellhammer and Hillestad conclude that scale and efficiency are important factors influencing the profitability of sheep farming in Norway. Scale and efficiency can be determined by available land, whether the land is owned or must be rented, availability of self-produced feed, capacity of existing facilities, willingness to invest in new facilities, and machinery and labour. In order to increase production, farmers ask for increased meat prices, increased subsidies, and increased investment in production facilities (Fjellhammer & Hillestad, 2011a).

There are two main wool collectors in Norway; Norilia BA and Fatland Ull AS. Norilia collects  $\frac{3}{4}$  of all the wool that is produced each year. Norilia is a wholly owned subsidiary of Nortura AS that is organized as a cooperative owned by 18 700 Norwegian farmers. Fatland Ull is a private, family-owned company that takes care of about  $\frac{1}{4}$  of the wool in Norway.

The table below shows tons of wool delivered to Norwegian wool stations from 1975-2010. The red line shows wool delivered to corporations (aksjeselskap), the blue line shows the wool delivered to the cooperative (samvirke), and the green line shows the total of wool delivered.



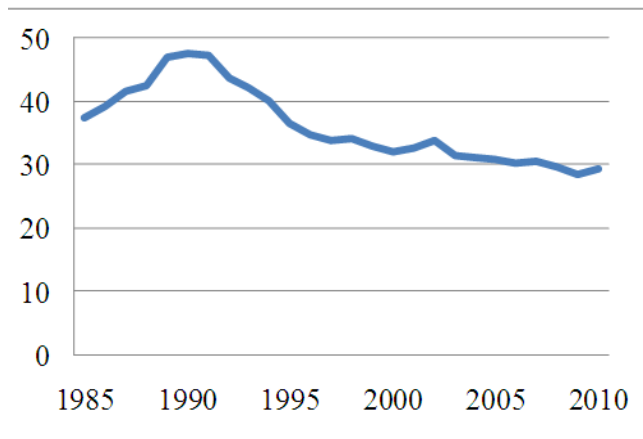
**Figure 2-1: Tons of wool delivered to Norwegian wool stations from 1975-2010. Source: SLF, Animalia and the Wool Advisory Service.**

In 2010 4551 tons of wool were produced in Norway (Statistics Norway, 2011). The farmers' income from wool production is provided by the governmental grant for wool, which is set annually according to the agricultural settlement (jordbruksoppgjøret). Prices and conditions for wool usually change annually, at the start of the "wool year" (September 1). The prices are determined on the basis of prices of outstanding contracts, expectations of price movements, as well as provisions for the costs of operation and administration. If the conditions for determining the price have changed significantly from September to February, the price is adjusted (Norilia, 2011). The size of the grant can be influenced by the international wool prices, that again are influenced by general market conditions that affect currency and demand. Since the governmental grant is supposed to reflect international wool prices, grants can be increased for some classes of wool if they prove to generate more income from the world market.

A reference farm with 142 sheep delivered on average 663 kg wool at an average price of NOK 29 per kilo in 2010. Estimates made by Animalia shows that there is a discrepancy of over NOK 20 per kg in between the best and worst quality wool within one wool class (for instance between C1 and C2). A greater focus on wool quality and the financial gains involved will lead to more supply of wool with 29 micron instead of 35 micron (Fjellhammer & Hillestad, 2011a).

The grants are diversified according to wool quality and are channelled through the wool stations. From here the wool is sold on the world market. The world market price for wool quality of 23 microns was 38.50 NOK per kilo in 2010, according to [indexmundi.com](http://indexmundi.com), a website with a list of prices for wool in the world market. Norwegian wool does not have this fine quality and is therefore sold at a considerably lower price. According to Norilia the average price gained for Norwegian wool is around 10NOK per kilo. This price is highly fluctuating – as late as two years ago it was only an average of 6NOK per kilo. In 2012 the price for the best quality wool (A1, B1, C1, F1) is on average 15NOK as raw wool and 25NOK as scoured wool.

Below is a figure that shows the development of the nominal price (NOK) per kilo Norwegian wool from 1985-2010:



**Figure 2-2: Development of the nominal price (NOK) per kilo Norwegian wool from 1985-2010.** Source: Agricultural Economics Research Institute, total cost estimate for agriculture)

Grants make up about half of the current price for Norwegian wool. There are separate price and quality grants for wool and meat (Fjellhammer & Hillestad, 2011a). Quality grants for meat are calculated based on quality grades defined in the European grading system EUROP. The price grant for wool is divided in a basic grant and a regional grant. According to the Norwegian Agricultural Authority (Statens Landbruksforvaltning, undatedB) the price grant for wool should contribute to reaching the goals for the development of value creation and production within sheep farming as a supplement to market price and other grants. The grant should also contribute to increase the quality of Norwegian wool, and ensure its provision in the market for Norwegian wool of good quality. The average wool price grant has decreased from 32 to 31 NOK from 2000 to 2011, which is actually a major decrease of the grant.

If the wool grant lapses, the price the sheep farmers receive for their wool would become so low that it would not even cover the costs of shearing of the sheep. Similarly, if the cost of shearing increases in line with general inflation, shearing will become an expense rather than a source of income and some farmers might decide to dispose of the wool as it no longer brings profit. Since wool is not an easily degradable material it will become a waste problem. The decomposing process of wool is so slow that it cannot be called compostable according to EU definition. This means that it will be burned in most cases. The CROAA survey shows that 50% of the participating sheep

farmers would continue to shear and deliver the wool as they do today even if it would result in costs and not profit, however 18% state that they would shear the sheep and discard the wool. A closer examination of the last group of farmers makes it evident that the size of livestock matters. 36% of the sheep farmers with a livestock below 10 sheep state that they would discard the wool, whilst only 18% of the farmers with a livestock between 50 and 100 sheep state that they would do the same. Some farmers even state that they would leave the wool on the sheep. In these cases the wool would become a waste problem or an animal welfare problem (Fjellhammer & Hillestad, 2011a).

## 2.2 Import and export of wool

Wool tops: From 1999-2010 the number of imported wool tops ranged from around 300,500 kg (300.5 tons) to around 800,500 kg (800.5 tons.) The peak was in 2006 when the level of imports reached 836,495 kg (836.5 tons.). The imports proceeded to drop drastically, reaching their lowest point in 2009 before rising slightly in 2010 to 461,312 kg (461 tons) of wool tops imported.

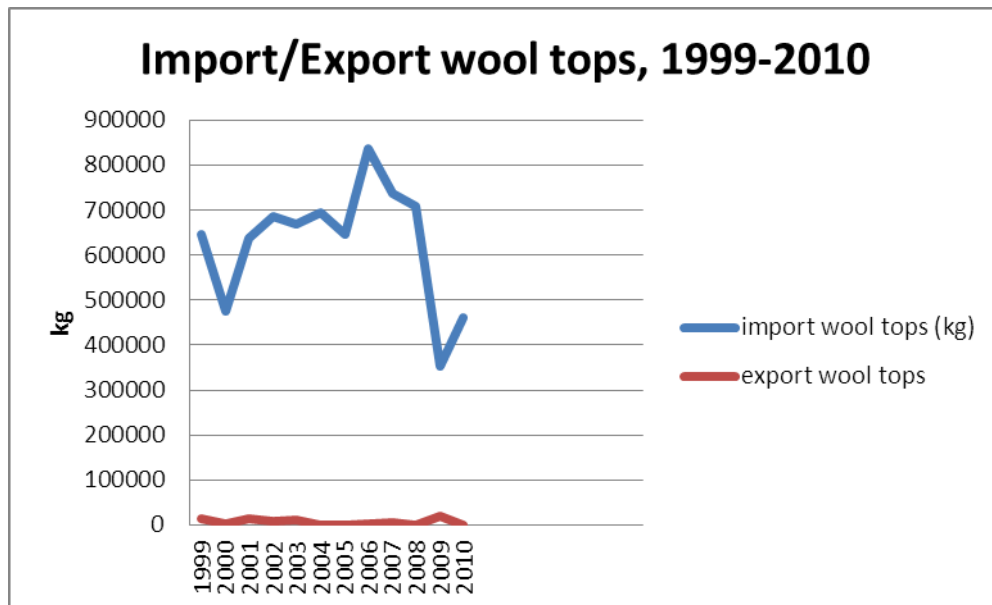


Figure 2-3: Import and export of wool tops 1999-2010. Source: Statistics Norway 2011, SSB.no

Carded wool: Imports of carded wool during this time varied greatly, the market appears quite volatile. The peak was in 2003 with 86,000 kg (86 tons) while in 2005 the imports decreased significantly, down to 2,710 kg (2.7 tons) of carded wool imported to Norway.

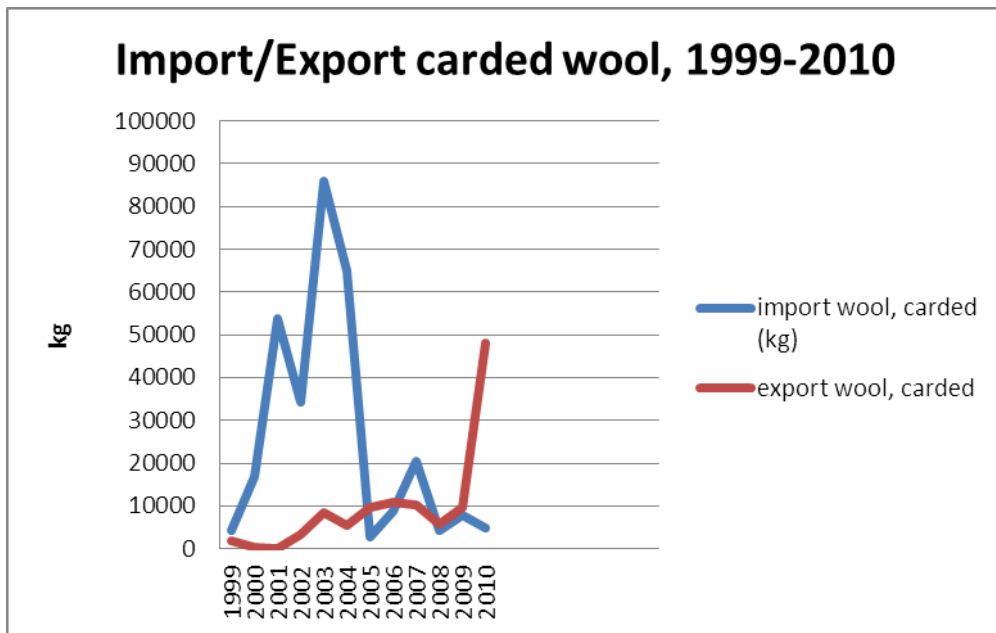


Figure 2-4: Import and export of carded wool 1999 2010. Source: Statistics Norway 2011, SSB.no

Raw wool: Imports of wool that is neither carded nor combed have been fairly low in the period from 1999 to 2010. The numbers range from 732,766 kg (732.8 tons) in 2003 to 50,985 kg (50.9 tons) in 2010. The exports of raw wool that is neither carded or combed greatly outnumber the imports in Norway.

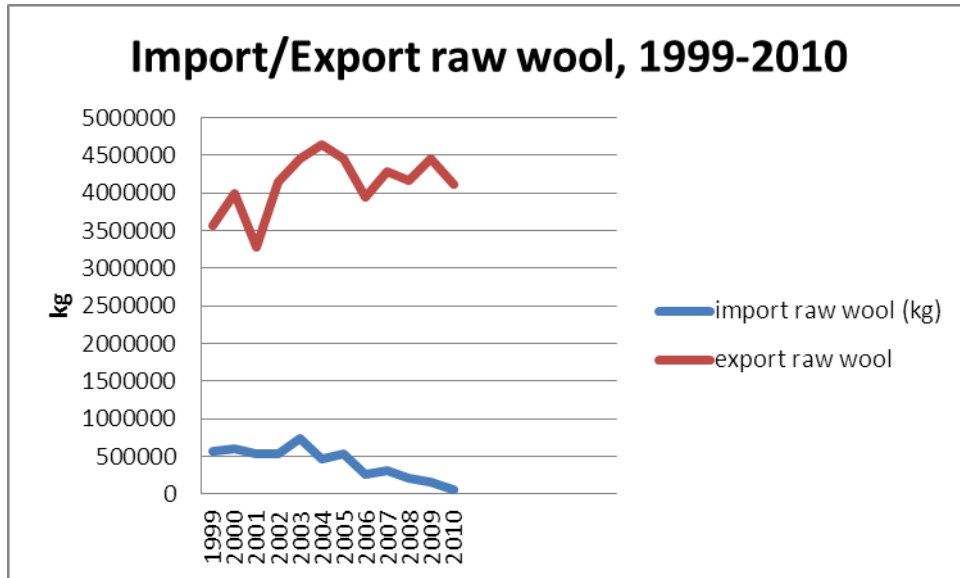


Figure 2-5: Import and export of raw wool 1999, 2010. Source: Statistics Norway 2011, SSB.no

### 2.3 Wool quality, sorting and handling at the farm

The price the farmer can get for the wool delivered to the wool stations is also determined by the quality of the handling of the wool at the farm through shearing and sorting. There are several aspects that influence profitability at this stage, whereas four are especially stressed in information brochures distributed by Animalia through the Wool Advisory Service, the research and knowledge centre of the Norwegian meat industry. Those four are timing, shearing, sorting and packaging (Animalia, 2009).

First, timing regarding shearing; the wool should be shorn in spring and/or in the fall, whereupon it will be classified as “spring wool”, “fall wool”, or “full year wool”. Spring wool comes from sheep that mostly have been living indoors half a year through the winter, while fall wool is from sheep that have been grazing outdoors for half a year. The full year wool has been growing on the sheep for a whole year and is shorn in spring. The advantage in shearing

once a year is of course that the farmer only has to pay for the shearing once. The challenge of shearing only once a year is that there is a substantial risk of felting and contamination by vegetable matter and dirt. Some breeds of wool felt more easily, such as the spel sheep. Full year wool is sheared in the spring as it is important to avoid felting of the wool during the summer.

Secondly, it is imperative for the shearing to be high quality to avoid spoiling the quality of the wool. The shearing location must be tidy and clean, so that no foreign matter gets mixed with the freshly shorn wool. White and black animals must not be shorn simultaneously so that the different coloured fibres are not mixed. Shearers must possess the right competence in shearing technique. Important shearing skills include shearing close to the skin (to avoid double shearing which creates short fibres), keeping the animal calm, and keeping wool from different parts of the animal separate from one another. This brings us to the third essential part of the handling the wool at the farm, the sorting.

Sorting the wool at the farm during the shearing process is crucial in order to get the best profit when delivering it to the wool stations. The best wool comes from the back and sides of the animal. It must be kept separate from the wool from the legs, belly and behind, and the wool contaminated by excrement, dirt, or marking paint. Thus there should be three piles of wool from each sheep after shearing.

Wool that is not sorted at the farms will be classified in the lowest quality grades and generate less income as the governmental subsidies are calculated by quality. The difference in price between high and low quality grades can be as significant as from 50NOK per kilo to 5NOK per kilo, so it can really pay off to work for high quality.

The fourth aspect that affects profitability is the packaging and storing that is done after the wool has been sorted. The wool must be packed into large paper bags and the three different piles described above must be kept apart by paper sheets. The wool must be dry and must not be stored too long to avoid mould and discolouring (Animalia, 2009).

To influence the active handling of these considerations, Animalia is working to generate and disseminate knowledge about the important aspects of wool handling at the farms and contribute to raising skills amongst farmers by offering an array of practical courses and lectures. Additionally, state subsidies are aimed at creating incentives for the farmers to deliver high quality wool and thus ensure the quality of the Norwegian wool production.

## 2.4 A Norwegian Wool Standard

A wool standard is a specification of different qualities of wool that sets the rules for how the different qualities shall be classified and sorted. This enables a differentiation in wool qualities with different properties that can be sold at different prices. During classification the wool is judged by several different criteria; length of fibre, fineness, resilience, crimping, dead hair, marrow content, yield after scouring, vegetable matter, whiteness, pigment, and felting. These criteria are based on the New Norwegian Wool Standard of 2007. The challenges regarding the classification of wool and low quality yields are not a new phenomenon, they have followed the industry for decades. In the next section an account will be given on how the Norwegian Wool Standard was developed and how it is constituted today.

Historically, most of the production from the Norwegian wool industry was used to cover the stakeholders' own needs. 40-50% of the production went in return for contract work (leiearbeid) turning the wool into usable products (the return on wool that was processed by contract workers was greater than the wool sold directly to factories), and the rest was sold at market price. Wool has also been used to trade different kinds of goods. If a merchant needed wool, for instance, he and the farmer would trade the wool for household goods needed by the farmer. However, there was not much attention paid to the handling and classification of wool to enhance quality. The low prices and scarcity during the war are just some aspects that caused a lack of incentive for caring about wool quality. Nevertheless, stakeholders had acknowledged the problem since 1910 when The Norwegian Farmers Union (Norges Bondelag) first addressed the question of rationalizing the Norwegian wool industry. This question was addressed regularly through the next years, but with few results (Landbruksdepartementet, 1947).

Starting in 1929, local wool unions formed to accumulate larger quantities of wool that were for sale and had been sorted according to quality. Some farmers greatly profited from the new system due to higher income gained from higher quality wool, but others who still sold the poorer qualities of wool did not, and the transition was not welcomed by all stakeholders. By 1947 there were only two unions left (Landbruksdepartementet, 1947).

A system of standardization rules was suggested in 1934 and implemented in 1940 to gain control over the Norwegian turnover and use of wool. It was then decided that all Norwegian wool could only be sold through the Norwegian Meat and Pork Central (Norges Kjøtt og Fleskesentral, NKF), or directly from the farm to textile manufacturers. All wool was to be classified, and no wool



could be held back from the market except 2.5 kilograms per person in the household for private use. The rule was that all wool had to be delivered to the NKF within two months. There were then 65 factories and mills that were permitted to buy wool and the NKF had established about 50 wool stations collecting the wool from the farmers. The wool was not sorted at the wool stations, but at the factories and mills, and the settlement was paid directly to the farmer. As an exception to this rule, some factories were allowed to send their wool classifiers directly to the farms to purchase wool. This had a negative effect on the actual classification of quality due to scarce wool production during the Second World War. Sloppy classification was being conducted and prices were above the allowed limits. Those factories who conscientiously classified the wool were left with little wool to work with, while the sloppy ones got the larger quantities. Classification was thus influenced by the availability of wool. If the factories got small quantities they paid well, if they got more than they were allowed to, they paid poorly. Because the market situation was dictating the way the wool was classified, the actual classification for quality was of little real value. This improved somewhat after the war, but the problem with the lack of control when factories bought and classified their wool at the farms remained (Landbruksdepartementet, 1947).

In 1947 the Norwegian Ministry of Agriculture commissioned a wool committee with members from government and business to suggest an improved system for the turnover of Norwegian wool to deal with the problems of poor sorting and classification of wool. Since the Norwegian wool industry consisted of many small entities with just a few sheep on each farm, the wool tended to be delivered unsorted with wool from different sheep mixed together. Because the farmers got paid by weight, many deliveries also contained wet and dirty wool. This way of handling the wool was causing a decrease in the potential value creation in the wool industry. The committee thus discussed two important issues. The first was how to get the industry to improve the sorting, classification and, in the end, the marketing of the wool to enhance quality. The second issue they addressed was the consideration of new regulations of the import of wool that would benefit the Norwegian wool industry. The Norwegian industry provided only 25 per cent of the total consumption of wool at that time. The committee realized that one could only gain control over the quality of the wool turnover if all wool was delivered to the factories through the same control organ. In their report to the Norwegian Ministry of Agriculture they addressed the paradox that although Norway provided great natural conditions for sheep farming, the prosperity of the industry was limited. They argued that there were two main reasons for this; the first being that production had not been profitable due to low prices on meat and wool causing insecurity regarding the return for increased production.

The second was that the system for turnover of Norwegian wool had not promoted better wool qualities and higher returns. Following these arguments they concluded that new forms of turnover must be found to ensure a stable and profitable price for wool, and that the returns on wool must be reflective of the quality, thus increasing interest in wool quality. To achieve this aim, the committee proposed a new law for wool turnover (Landbruksdepartementet, 1947).

Fearing the competition from foreign wool growers that were about to return after the war, they suggested that Norwegian factories and mills must be tied to a purchase obligation of Norwegian wool. If the turnover of Norwegian wool became too low, the Ministry of Agriculture would need to enforce the obligation that a certain percentage of the total wool input to factories and mills be domestically grown wool (Landbruksdepartementet, 1947).

The committee advocated a substantial increase in wool production, rejecting current opinion that Norwegian wool was unsuitable for production of domestic woollen products. They pointed to the increased interest for tweed fabrics, the development of domestic crafts (Husfliden), and the potential for channeling more Norwegian wool into production of Norwegian uniforms within the military, the police, the postal services, and the railroad. The restrictions of the war had shown them the need for being self-sufficient when it came to textiles (Landbruksdepartementet, 1947).

For the regulation of the wool turnover they looked to existing systems regulating the turnover of domestically produced food in Norway through cooperatives. Although this system is based on voluntary participation; this had not seemed to work regarding the wool industry, leading the committee to suggest regulating this industry by law (Landbruksdepartementet, 1947).

Due to massive resistance from the factories and mills, the committee departed from its initial principle that all wool must be purchased through a collaborative administrated by the NKF, and would still allow purchases from outside the collaborative. It was, however, emphasized that this would be observed through a trial period. To deal with the problems of the sloppy classification of traveling buyers outside the factories, the committee proposed to forbid this practice. Furthermore, they suggested extensive dissemination of best practices regarding the handling of wool, through presentations, films, demonstrations, research, and exhibits, as well as increased focus on the factors concerning breeding, such as feed, grazing, and heritable properties. These were suggested in hopes that they may increase wool quality and quantity. However, until the prevailing conception that wool was not paid for in terms of quality

(where low quality wool yielded the same return as high quality wool) had been rejected, these efforts would be in vain (Landbruksdepartementet, 1947).

The practice of contract work and return in the form of wool products was advocated by the factories claiming that the profitability of sheep farming would suffer if this practice were to be forbidden by law. Nevertheless, the committee stayed firm in the matter, and viewed the practice as detrimental to the quality of wool. They claimed that since wool growers knew that the products they got in return for their wool were not made from that same wool, they did not care for the quality of their input, and that this was the main reason that Norwegian wool has always been coarse and heterogeneous. Because it is said that some factories were strongly dependent on the contract work system, and many wool growers appreciated the opportunity to receive wool products in return for their wool, the committee did not propose to ban the practice, but rather to regulate it and thus increase control. This meant that they suggested to impose a system of classification reporting to ensure quality and more detailed invoices to make the pricing and returns to the farmer more transparent (Landbruksdepartementet, 1947).

Concluding the report the committee provided a draft of the proposed law as well as a suggested detailing of a new wool classification standard. One member of the committee opposed the draft and suggested his own version, claiming that the law would have unjust consequences for wholesale actors and some producers of wool products. This objection concerned in particular the imposition of the purchase obligation to buy a certain amount of Norwegian wool as well as the prohibition against buying and selling wool outside the collaborative and the approved factories. This objection and the relating draft is noted and included in the committees report (Landbruksdepartementet, 1947).

The approved Norwegian Wool Standard of 1950 described 9 main classes of classification; A, B, C, E, F, G, H, K, and T, with 40 sub classification categories (Norsk Standard, NS 496 B, Landbruksvarer). Later the standard was revised a number of times.

In 1979 the Wool Advisory Service suggested to merge the finest classes into one in order to provide fine wool to all the factories that were requesting it. This was done with a promise that the average fineness of the wool would still be satisfactory. Most stakeholders approved of this merge, but the member organization for sheep and goat breeders (Norsk sau- og geitalslag) objected, arguing that the farmers would get paid less for the finest wool. However, a new standard for Norwegian wool qualities 28 (Standard for norske

ullkvalitetar, 1979) was adopted that described 10 main classes of classification A, B, C, D, E, F, G, H, K, S, and V, and 28 sub classes which represent different criteria regarding sheep breed and wool qualities. Thus, only one main class had been added, but the sub classes were reduced from 40 to. In 2000 the classes were reduced down to 20.

## 2.5 The New Norwegian Wool Standard 2005-2007

Due to feedback from the market that Norwegian wool was unstable in quality, the council for wool turnover (Rådet for ullomsetning) initiated a process of renewal within the Norwegian system of wool classification in 1999. The Norwegian Agricultural Authority (NAA) suspected that increased competition between wool stations had caused changes in the interpretation of the subjective criteria in the Norwegian Wool Standard, thus causing differences in the quality of the wool being sold to the market. To regain control over the sorting and classification of Norwegian wool, NAA initiated the projects “Quality Control of Norwegian Wool”, and later “New Norwegian Wool Standard and an Objective Quality Control” which were completed in 2003 and 2005. The last project was aimed at simplifying and streamlining the control of Norwegian wool, and from the first of September, 2005, the New Norwegian Wool Standard was implemented with its new and simplified criteria based on international wool standards (Landbruksdepartementet, 1947).

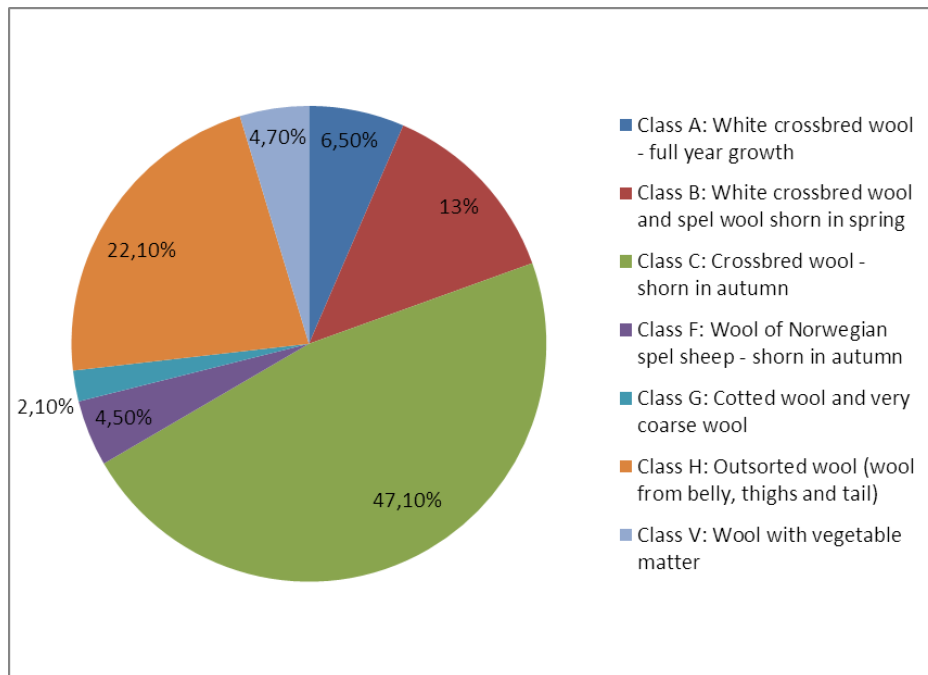
The New Norwegian Wool Standard of 2005 specifies 7 main classes and reduces the subclasses from 20 to 16, thus merging some of the original classes. This was done to make the handling of the wool more efficient and to align with international standards.

Suggestions made by the working group on which classes should be merged together were distributed amongst the most important stakeholders within the Norwegian wool industry, and the final classes reflect their feedback. Only the stakeholder suggestions that represented the majority were taken into account. One stakeholder wished for the pigmented wool to be sorted according to colour; grey, brown, and black. This was not taken into account. The working group which set out to create the New Norwegian Wool Standard had different views regarding the definition of classification classes, and thus distributed three different drafts amongst the most important stakeholders within the Norwegian wool industry. A few international stakeholders with important positions in the value chain were also included. Based on the feedback from the stakeholders, the group completed their work on the new standard. In two of the three drafts made by the working group, it was suggested to establish

the classes CX and FX to meet the needs of the textile industry for finer fibres. A major uncertainty regarding whether Norwegian wool growers were even able to deliver the qualities that the industry was asking for, caused the working group not to meet this goal. There have been tests made of lambswool that suggest that this wool contains finer fibres. However, the contamination by vegetable matter is somewhat higher than what the textile industry allows. Calculations made by wool station management have shown that the cost of sorting these finer fibres will exceed the price the textile industry is willing to pay for this wool. Thus, due to the high uncertainty and unresolved economy of finer fibre classification, this suggestion was not taken into account.

In 2007 a project group was formed to evaluate the new standard and suggest revisions. The report produced by this group suggested changes in the system for objective quality control by decentralizing the equipment needed for undertaking control samples from chosen wool batches so that each wool station could perform its own controls twice a year and report the results. This would free time at the Wool Advisory Service that could be used to advise the classification of wool when it comes in to the wool stations. Furthermore, they suggested that the system for sanctions due to false classification should be revised (Statens Landbruksforvaltning, 2007). The Norwegian Wool Standard that now applies was established in 2007.

Below is a figure that shows the distribution of wool classes delivered to Norwegian wool stations from 2010-2011:



**Figure 2-6: Distribution of wool classes delivered to Norwegian wool stations 2010-2011.**  
Source: The Wool Advisory Service.

The class C, which consists of 4 subclasses (C1, C2, C1S, and C2S), is the class representing the highest amount of wool produced in Norway (In 2010/11: 47.1%). C1 is white crossbred fleece wool grown outdoors for approximately half a year. This wool is normally shorn in autumn. The Norwegian Wool Standard describes the finest C class like this: “Class C1 is soft, crimped wool with high bulk. The fibres should be longer than 70mm and finer than 38 $\mu$ . (...) The fineness and the length of fibres ought to be even within the fleece. Only insignificant amounts of vegetable matter and felting (cotting) are accepted, and the yield should be high. Good whiteness after scouring is demanded.” (Statens Landbruksforvaltning and Animalia, 2007).

In 2010/11 22.1% of the production was outsorted wool. This is because around a fourth of the wool on the sheep comes from the belly, thighs and tail. The wool growing there is of low quality and gets exposed to dirt and other contaminants. The outsorted wool is classified in class H which consists of H1, H2 and H3. The Norwegian Wool Standard describes the H1 class like

this: “H1 is white outsourced wool from half year autumn clip or full year growth and/or fleece wool mixed with wool from belly, thighs and tail. The average length should be at least 70 mm, and the fibre fineness less than 90 $\mu$ . Medulla and kemp are accepted. A little content of vegetable matter is accepted, as well as slight felting. Only an insignificant amount of wool discoloured by urine is accepted”. (Statens Landbruksforvaltning and Animalia, 2007).

At the two wool stations in Norway (Fatland Ull AS and Norilia) approximately 7 tons out of 4500 tons of wool is discarded every year (0,16 %). This volume does not only consist of wool, but is contaminated by dirt, water and vegetable matter. Fatland Ull AS reports frequency of rainfalls as potentially influencing how much wool is discarded due to excessive dirtiness and moisture. The wool is transported to the landfill for disposal, where the wool stations have to pay to discard the wool. At the scouring company Haworth Scouring in England where most of the Norwegian wool is sent, they report no wool being discarded. However, yield varies according to the different grades. Some wool can be very low yielding, 55-60%, while some is higher. Combing yields are lower still with an additional loss of over 10%. On average there is an overall yield of 68-70%. The yield loss is in grease, dirt, dag, and vegetable matter. The Wool Advisory Service assumes that some wool is being discarded by sheep farmers due to lack of profitability in delivering it to the wool station, but there has been no investigation into the amount of discarded wool at the farms, thus this knowledge is only based on informal information.

The third largest class is class B. This amounted to 13% of the Norwegian wool production in 2010/11. Class B consists of the subclasses B1 and B2 and is described similarly as C1 in the Norwegian Wool Standard. However, B1 is grown partly or fully in an indoor environment for half a year or less, and is normally shorn in spring. The fibres are shorter than within C1 and should be no longer than 40 mm (Statens Landbruksforvaltning and Animalia, 2007).

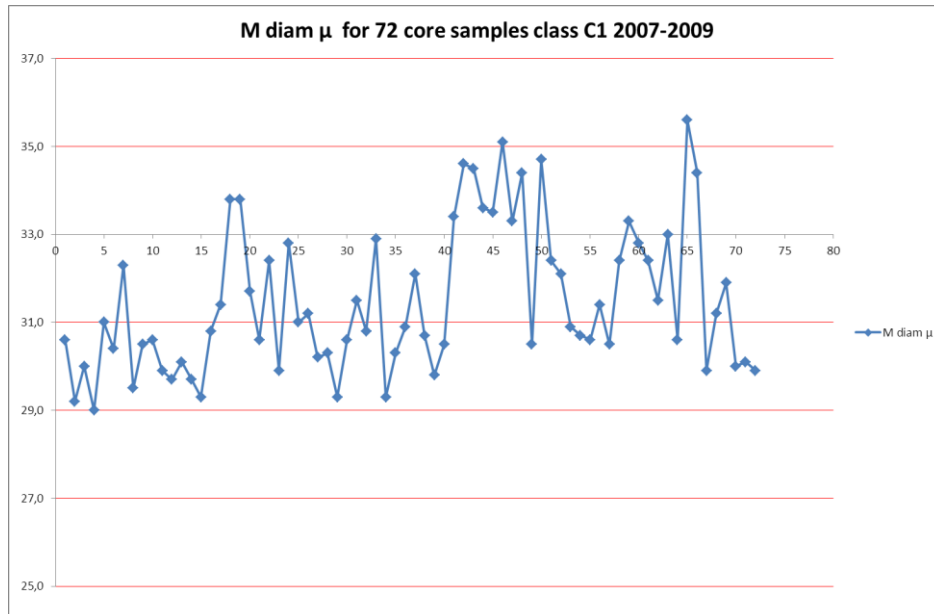
## 2.6 Fineness is measured in micron

Fineness for wool is measured in  $\mu$ (my) or microns and indicates the softness of the wool. Tolerance for coarse wool varies from person to person, yet in general, a lower amount of microns indicates wool that is most comfortable close to the skin. The most comfortable wool is between 17 and 24  $\mu$ . The itchiness of wool that some people experience is mostly related to fibre diameter. Finer fibres, naturally, give greater comfort. The comfort limit for garments worn next to the skin is on the average 28  $\mu$ . Many people experi-

ence discomfort if more than 3 to 4 % of the fibres are over 28  $\mu$  (Klepp, Bandlien, & Tobiasson, 2010). According to the Wool Advisory Service, around 30 per cent of Norwegian wool is class C1, which means an average of around 32  $\mu$ . Measuring fineness in microns is a way to align with the international system, but also a way to ensure objective quality controls based on measurable qualities. This was a new and important aspect of the new wool standard, as the wool had until this point been sorted according to subjective visual properties. Fjellhammer and Hillestad (2011a) claim that it is possible to undertake a finer classification of wool than is done today. However, they find that the disadvantage of carrying out a classification system for the finest wool is that it will influence the average of the other wool that is delivered, the potential consequences of which remain unclear at this point. For it to be worthwhile economically to undertake this finer classification of wool, the wool would need to be sheared in the fall. This is due to the fact that it costs less to sort the wool from the larger parties than to pick out small quantities over the course of an entire year (Fjellhammer & Hillestad, 2011a).



The graph below shows the micron fineness of wool samples of C1 classified wool from crossbred sheep taken from the wool stations between 2007-2009. In 2009, the wool stations received 4468 tonnes of wool, of which about 30 per cent was of an average quality of 32 $\mu$ , according the Wool Advisory Service. There are some parties that are down to 29 $\mu$  and a few parties up to 36 $\mu$ , but most is about average. Core samples taken of C1 class wool in 2011 showed that 57% of the wool that was tested was on average 29.1  $\mu$ , whereas 43% was on average 31.6  $\mu$ . The finest fibres were not sorted out in a separate class. 28 parties of wool were tested at different wool stations in Norway.



**Figure 2-7: Average micron for 72 core samples class C1 2007-2009.** Source: Wool Advisory Service

Since fine fibres such as merino wool are in such great demand on the market, the issue of fineness is also a much debated subject in the Norwegian wool industry. Is there a way to extract finer fibres from the Norwegian wool production?

At one time there were finer classifications of wool than C1 in Norway. Finer wool once had a higher price than is the case for today's wool. When asked if

a finer classification of wool in Norway should be reintroduced, 85 per cent of the surveyed sheep farmers say yes (Fjellhammer & Hillestad, 2011b).

According to the Wool Advisory Service, the wool from the Norwegian breed Spelsau can be as fine as 11-12 microns, due to its dual set of fibres with soft bottom wool and coarse cover wool. However, the separation of these fibres is currently a manual operation, and thus very costly and non-commercial. Core samples of crossbred wool from the fall season 2012 show that the fibre fineness is on average  $3\mu$  finer than in 2011, and is below  $30\mu$ . This fineness is, however, difficult to guarantee because of irregularities in the wool quality. Core samples are only conducted of 4% of the total Norwegian wool production, so to be able to guarantee a certain fineness, classifiers must learn how to sort the finest fibres. Yet, this seems feasible as core samples continually show average values below  $30\mu$  in the 2 ton test batches. The Wool Advisory Service believes that it would be possible to reduce the average micron to 28, possibly as low as 25-26 $\mu$ , but then it would be difficult to assess the annual quantity. To assess the possible quantity of fine Norwegian wool one would have to conduct a special classification throughout one year.

## 2.7 Breeding for quality

Sheep farmers could choose to focus their production on meat or on wool and sheepskin, but most farmers focus mainly on producing meat, as this is a more profitable business. As a result, wool becomes a secondary product. However, Fjellhammer and Hillestad (2011a) argue that paying more attention to wool quality could increase total income per sheep.

There are approximately 1 million sheep in Norway during the winter that birth about 1,5 lambs each in spring. The majority of sheep in Norway are classified as *crossbred*. The crossbred classification includes several different breeds such as *dalasau*, *rygja*, *steigar*, *sjeviot* and *teksel*. A large part of the population is in fact cross breeds of the different crossbred races mixed with other breeds. The most common breed in Norway is dalasauen (about 45%). This breed produces both good meat and a great deal of wool. When crossing two breeds with different wool qualities this will yield poor wool quality.

A smaller part of the Norwegian sheep population belongs to the *spel breed* which descends from the old Norwegian breed that once was wild. The spel breed includes *spelsau* (Old Norwegian Short Tail Landrace), *norsk pelssau* and *villsau* (gammelnorsk sau). These breeds produce wool consisting of two kinds of hair; cover wool and bottom wool (Berntsen, 1999). They live outside year round, and the wool is not shorn, but combed off the sheep. Only in

a few cases is the wool quality improved (ullboka). As described in the section above, spelsau wool is a very soft quality which might be able to compete with merino wool. In 1912 there were only a few remaining of the old original Norwegian sheep breed spelsau. To preserve the breed, the government funded two breeding centres. In 1950, there were hardly any sheep remaining of the old Norwegian breed villsau (wild sheep), just a couple of hundred animals. Villsau is a descendant of the old Norwegian short tailed breed that once was wild (ullboka). The villsau live close to the coastal line and have adjusted to this kind of terrain, whilst the spel breeds can walk the mountains. Different breeds are adapted to different kinds of habitat. A member organization for villsau owners was established in 1956, and in 1960 a partition to preserve the breed was issued to the government. The government, however, declined the partition. The stakeholders did not give up and in 1995 the Norwegian villsau association (Norsk villsaulag) was established. The association made villsau into a trademark that guaranteed a certain quality and heritage of the breed. This was a great success. The population has risen from 2000 in 1980 to 40 000 in 2010.

Some of the sheep breeds yield naturally coloured wool, for instance *gammalnorsk spelsau* (old Norwegian spel sheep), *norsk pelssau*, *villsau* and *bleset*. This naturally pigmented wool is classified in low quality grades according to the Norwegian wool standard as there are low quantities and low demand for this wool. The National Institute for Consumer Research (SIFO) is attempting to raise funds to document the properties of Norwegian pigmented wool to increase its commercial potential, but has not yet succeeded in this. There is a need to document light fastness and durability so that buyers feel confident in their purchase. There is also a need to find new modern ways to use the pigmented wool. Wild sheep wool could for instance have some potential in rain-coats, since the cover-wool is water-repellent. The mill Selbu Spinneri is the only company that refines this wool into yarn in Norway today.

There are also other breeds than those sorting under *crossbred* and *spelsau*, such as *fuglestadbroket sau* (origin unknown) and *merino* (originated in Spain) but these are only a very small percentage of the whole sheep population. Many of these have originally been imported from Britain, such as for instance *bleset*, *Suffolk*, *svartefjes-sau*, and *oxford down* (Buer, 2011).

**Table 2-1: Sheep breeds in Norway**

<b>Spel breeds:</b>	<b>Crossbred:</b>	<b>Other breeds:</b>
Spelsau	Dalasa (Originates from Hordaland)	Bleset (Originates from Rogaland)
Gammalnorsk spelsau	Rygja (Originates from Rogaland)	Fuglestadboket (Originates from Rogaland)
Norsk pelssau (Originates from Swedish «got-landsfår»)	Steigar (Originates from Nordland)	Merino (Originates from Spain)
Villsau (gammelnorsk sau)	Sjeviot (Originates from Eng-land/Skottland)	Svartfjes (Originates from Scotland)
	Teksel (Originates from Holland)	Suffolk (Originates from England)
	Grå trøndersau (A mix between crossbred and land breed)	Oxford Down (Originates from England)
	Norsk hvit sau	Finnish land race (Northern European short tail, barely exists)
		Østfrisisk mjølkesau (Bare-ly exists)

In 1808 eight Merino rams were imported and distributed across the country to raise the quality of the Norwegian wool. This was repeated through several epochs but without leading to any significant spread of merino sheep. There are more than 100 merino sheep in Norway today. Globally, merino is the most widespread and numerous breed. In 1820-30 several English breeds were imported to Norway, amongst them the Southdown breed. Breeds from the Faroe Islands and Iceland were crossed with the Norwegian breed which produced larger animals. In 1960 the breeds Sjeviot, Leichester and Oxford Down were imported (Buer, 2011).

There are many ways to enhance wool quality. Fjellhammer and Hillestad (2011a) pose two suggestions. The first is for Staur farm, which has an artificial breeding centre for sheep, should invest more care into the quality of the wool from Rams that are drained of semen. They would also need to save wool samples from the rams that were slaughtered, if there still exists semen from this animal, for the farmers to be able to value the quality of the wool when they are buying semen. The second suggestion is that the advisors for

wool be included in taking out semen rams such that it is not only the meat quality and number of sheep for which they are bred.

There has been a widespread belief that farmers should not breed for meat and wool quality at the same time as this will yield a lower quality on both entities. However, Norilia has refuted this through a breeding project in 2010, where it was proven that breeding for both wool and meat is possible with promising results. The farm that participated in the project experienced an increase in class 1 quality wool from 62,7% in 2006 to 85,5% in 2009, whilst the yield and quality of meat per sheep went up as well. The dissemination of knowledge of how to combine breeding efforts for wool and meat is important in order to increase the production of Norwegian class 1 wool. For instance, in the Stavanger-area there is a breed of sheep with exceptionally soft wool, but it is being bred now to “up” the meat-quality and the wool-softness is being prioritized “down”. This could be avoided if farmers were given assistance in how to preserve quality in both commodities.

Many of the sheep farmers surveyed by CROAA responded that they are already conscious of the wool in the context of breeding, yet the majority believe that the price of wool must increase if more work/attention is to be put into the quality of wool. Breeding today is done with special consideration/focus on meat quality and the number of lambs per winter-fed sheep. It is not a given that these positive properties will be preserved if breeding is also done in regard to high wool quality. Furthermore, breeding requires work and time. As it is now, governmental subsidies barely cover the costs of hiring shearers. For those that have sheep farming as a side production, the income is such a small share of their total income that is not worth trying to breed for wool quality (Fjellhammer & Hillestad, 2011a).

Fjellhammer and Hillestad (2011a) claim that if sheep farmers are to use more time and resources on the quality of wool, the profits from wool will increase. Past experience from quality subsidies on lamb meat show that sheep farmers put more effort into quality when it was to bring in more pay. The survey undertaken by CROAA shows that sheep farmers are willing to work with wool quality if it becomes more economically viable to focus on quality rather than not doing so. Fjellhammer and Hillestad address the problem that there is not enough of a distinction in subsidies between good and poor wool quality. The majority of sheep farmers in the survey respond that farmers must be able to see that it is worth their while financially to take care of the wool, before they focus on getting a finer quality of wool. Some of those surveyed also believe that a larger part of the subsidies must go to the finest wool with the best resilience (Fjellhammer & Hillestad, 2011b).

## 2.8 Concluding remarks

To achieve better wool quality, the actors that are sorting the wool both at the farms and classifying it at the wool stations must be further educated in order to capitalize on the finest wool qualities. Breeding for better wool quality, not just for meat, is also imperative to achieve a Norwegian wool production that can compete with international standards.

To address the economic problems as well as the potential environmental and animal welfare problems, the authors of the CROAA-report suggest that the sheep farmers should be rewarded financially to breed for better wool quality. They should also provide more extensive training of sheep farmers and shearers regarding how to evaluate the different qualities of wool and how to sort them. Moreover, the wool grant must be increased to maintain wool as a valuable resource and avoid it becoming a waste problem. However, in the long run it would be preferable if wool prices would increase in order to reduce the need for subsidies.

Norwegian wool sells at a low price on the global market because it is not classified in the best international quality grades. Meeting the criteria of softness is the problem as Norwegian wool holds very good quality when it comes to resilience and sheen. According to Animalia, there is a potential to increase the quality of Norwegian wool without compromising meat quality. Statistics show that the majority of the wool delivered to the wool stations is of the best quality (A1 and C1). However, Fjellhammer and Hillestad claim that the problem is that there are large quality variations within these grades. If the farmer would sort the wool more thoroughly before delivering it, he/she would gain a higher profit for the best wool.

### 3 Manufacturers; yarn, fabric, clothing

The textile industry was among one of the first industries to be established in Norway, as was also the case in many other countries. From the middle of the 19th century the manufacturing of wool grew exponentially, as it began being manufactured on a large scale to a wide market both in Norway and abroad. The industry has been characterized by having transitioned from many small, local companies to larger entities. Wool undergoes many different processes from when it is sheared from the sheep all the way until it becomes finished yarn, or fabric. This includes time-consuming tasks which once were done as handicrafts. The transition from craft to industry was occurring in such a way that the simplest of the processes could be taken over by industry, while the others remained crafts. The companies which exist today generally have their roots in this period and are located in an area of the country where sheep and other livestock was strong. The other deciding factor was electricity in the form of waterfalls and rivers – making scouring and other processes easy in the factories.

In this chapter, we will look at different textile companies in Norway today and how and what they produce. But before we do this, however, we must quickly go through the different labour and wool manufacturing processes to get an overview over what the different companies do, and which of the processes are done or can be done in Norway. We will then present a selection of Norwegian companies. The chapter is built mainly on interviews and can therefore be difficult to double check all the information. We kindly ask for understanding for any inaccuracies which may exist, and hope this overview provides insight into today's Norwegian wool industry and the challenges meeting the use of Norwegian wool.

### 3.1 The Process: From raw wool to yarn and fabric

The manufacturing process varies between businesses, depending on the abilities of each individual company. To begin, we will look fairly generally at which processes are done in the manufacturing of wool. The manufacturing process follows two different paths depending on whether it is worsted or woollen yarn which is being produced. Even though the different operations are described separately it is often the case that in between the different processes they both undergo scouring and quality controls which are parallel with other operations. As we will see when we come to the descriptions of the individual companies, the process varies by company as well as how many parts of the process the different companies perform themselves.

#### 3.1.1 Sorting and Classification

Sorting and classification is done mainly at the wool stations, with exception of a few small entities that do this job themselves. Those few that do this themselves have the chance to do a thorough quality selection at the same time. More information on sorting and classification can be found in chapter 2.

#### 3.1.2 Scouring

The process of scouring is often the bottleneck for many companies. In Norway, of the larger companies, only Sandnes Mill scours wool. Though a few smaller companies do the scouring themselves, such as Selbu and Hoelfeldt Lund, the majority of Norwegian wool is shipped to England. At the scouring location the wool is also treated. It can then be sold as scoured wool, as wool tops, or as rovings. Haworth Scouring is where the majority of Norwegian clip is scoured and treated by Curtis Wool Direct. The wool from Fatland Ull was also scoured here until recently, though they now scour elsewhere. Even though Norwegian sheep are not dipped, Norwegian wool can only be marketed as “virtually chemical-free”. Though they could test and guarantee this at their facilities, the cost would likely be prohibitive. Despite this fact, the naturally soft water in the area ensures ideal scouring conditions for wool. Curtis Wool Direct has invested in 16 new combing machines which are to be installed at the firm’s Cashmere Works, which will feature innovative processing techniques. Curtis Wool Direct is 50% owned by Nortura. They process 30 million kilos a year, only half the amount sold just a few years ago. Curtis also sells to China, but only processed wool, no greasy wool. They can comb, as well as card. As we will come back to later, there is a great deal of



criticism of Curtis Wool Direct among our informants. The reason behind Norway's limited ability for scouring is a very unlucky story which includes new investments, bankruptcies, and embezzlement. To our knowledge, it is not well documented.

### 3.1.3 Carding and combing

Carding and combing are processes for preparing yarn, where the fibres are detached from one another and vegetable matter is removed. The carding process loosens, cleans, and neatens the fibre so that it is ready for spinning. As carding can be a very demanding and strenuous process, it was taken over by industry well before spinning and other less demanding processes. Carding can take place at a scouring plant or at a mill. Carded wool is called woollen, and yarns are called woollen yarns. Woollen yarn is warm, light, stretchy, and full of air. It is thus a good insulator, and makes a good knitting yarn.

The goal of combed yarn production is to make the fibres as parallel as possible, while this is only partly done in the manufacturing of carded yarn. Parallelization is carried out by stretching the fibre ribbons obtained by the carding process, this process increases with the tensile grade. Combed yarn is stretched many times. For combed wool yarn, often called worsted yarn, this is done many thousand times as the short wool fibres are combed away. Under this process the fibres are brought together to form a new thread which becomes smoother. Finally the yarn is stretched and twisted on the fine spinning machine and is wound onto a spool. Worsted wool fabric is typically used in the making of tailored garments such as suits, as opposed to woollen wool which is used for knitted items such as sweaters.

### 3.1.4 Spinning

Spinning is the process where the fibres are rotated together to become thread or yarn. Before this, the isolated fibres are arranged to bond without twisting. In the past this process was done using a tool called a spindle, which is essentially a stick with an extra weight attached to one end. When the spindle is set in rotation the yarn is made to twist at every turn. Later, the technology developed into the spinning wheel and the spinning jenny to today's advanced and speedy spinning machines. When the yarn has been sufficiently spun, it is wound up on the spindle. The spinning system is divided into two categories: 1) spinning of combed yarn with a smooth surface and 2) spinning of woollen yarn with a rougher, hairy surface. The yarn is spun together with two or more

threads and is adapted to the different techniques to create fabric, weaving, hand knitting, machine knitting, etc.

### 3.1.5 Weaving

Weaving is the preparation of textiles on a loom. Weaving is done by crossing two sets of thread systems over one another, perpendicularly, which binds them together. The threads that are held lengthwise in the loom are called the warp. These are fastened to a frame in the loom. The number of threads can be in the thousands, depending on width and tightness of the weaving. Each individual warp thread is passed through what is called a heddle, often made of wire. The thread is threaded through the “eye” of the heddle. The heddles are attached in groups to harnesses, or heddle frames, which can be lowered or raised to weave the threads together. After going through the heddle, the warp threads are pushed into place by the reed, a kind of comb with steel teeth which ensures the threads are in position and untangled. The warp then goes over the breast beam and finally the newly woven fabric winds around the cloth roll. The other thread system is called the weft. It is inserted into the space created by the raised and lowered warp threads, which is called the shed. In conventional weaving, the weft is threaded through the shed in a shuttle, or pirn, which holds the thread on a small spool. After the weft is threaded through the shed, the shed is closed and the weft is pushed in against the front of the fabric with the reed. The warp threads are then reversed (either lowered or raised) to create a new shed. This process binds the weft into the weaving.

Weaving is the part of the process that most are familiar with. Today looms are automated, which allows for many different variations for the shuttle to go through the shed. The weave is described by the number of harnesses or heddle frames. In other words, the number of different sheds it creates. The plain-weave is the simplest weave. This can create patterns using different techniques. More complicated weaves may use looms called Jacquard looms, which are mechanical. These are able to create complex patterns. Jacquard looms could be considered the computer’s predecessors due the punch card system that was developed for this kind of loom. In modern wool manufacturing, these modern, automated looms make a great difference. For example, with modern looms, it is possible to scan a fabric and then recreate a pattern. It is also very simple to switch between different patterns when they are saved in the system. Yet, even though the looms are modern with many functions and settings, they do not function the same with all kinds of yarn which makes manual settings still very necessary.

### 3.1.6 Knitting

Knitting is a method by which thread or yarn is turned into cloth or other fine crafts. Knitted fabric consists of loops; called stitches. The active stitches are held on a needle until another loop can be passed through them. The knitted fabric is often used for garments. There are numerous types of knitting machines, ranging from simple spool or board templates with no moving parts to highly complex mechanisms controlled by electronics. All, however, produce various types of knitted fabrics, usually either flat or tubular, and of varying degrees of complexity. Pattern stitches can be selected by hand manipulation of the needles, or with push-buttons and dials, mechanical punch cards, or electronic pattern reading devices and computers. Complete garment knitting making a 3-dimensional full garment. Unlike other fully fashioned knitting, where the shaped pieces must still be sewn together, finished complete knitted garments do not have seams. The knitting machines' computerized instructions direct movement of hundreds of needles to construct and connect several tubular knitted forms to create a complete garment in a single production step.

### 3.1.7 Dyeing

When a material is dyed, it is treated in a solution composed of dye and water (a dye bath). Depending on the fibres that are being dyed; the type of colouring agents used; and also by the available machines, the colouring process is controlled by the maintenance of a specified time/temperature cycle; the intensity of contact between the dye and the fibre material; and with the addition of appropriate chemicals to the dye. It is possible to dye wool both before it is carded and before it is spun. Dyeing can be done at various stages; on wool tops, yarn, finished fabrics, or garments. However, this will give different results. Individual companies, such as Gudbrandsdalen Uldvarefabrikk, are able to do all three types of dyeing. In the majority of companies, however, the dyeing of wool products is done at the mills. Some do it themselves, where they have their own laboratories to develop dyes, while others send the finished yarn to other manufacturers for dyeing. At Hoelfeldt Lund, until the middle of the 1960s, all dyeing was done at the factory using only natural and vegetable dyes. After a while most of the dyeing was put aside and done primarily at Sandnes Garn, though there is still some yarn dyed at the factory. Hoelfeldt Lund still dyes using natural dyes, but the majority of the dyeing done today is with chemical dyes. Mandal Veveri does some of the dyeing of its woven textiles, however due to financial reasons, the majority of their textiles are sent to Lithuania for dyeing. Dyeing can also be a laborious process since different batches of yarn absorb the dye in different ways and to differ-

ent degrees. This means that the process can be expensive, which may be a reason some choose to outsource the dyeing to other countries.

### 3.1.8 Finishing Treatments

After the textiles are dyed, they go through a process known as the finishing treatment. Fulling (or waulking), raising the nap, decatizing, and the removal of vegetable matter are examples of typical finishing treatments. These treatments are to be applied when the wool is wet, generally when soaked in a soap solution. Fulling (or waulking) is when the wool hairs are filtered together. The textile then shrinks both in length and width, and in that way increases the density of the fabric, making it water-resistant. An example of fulled wool is «vadmél», the home-spun cloth used for bunads. Fulling/waulking is therefore a treatment for wool which uses water, warmth and mechanical labour to release tension, improve the grip, increase the fabric's elasticity, density and strength, and provide filter effects that form a fibre cover on the surface. Raising the nap is a process in which rotating wire brushes or hand cards draw out ends of fibres on the surface of the fabric to give the textile a fuzzy effect. On rougher fabrics, the raising is often done on the opposite side which gives the surface a softer feel. Decatizing is a treatment involving steam and pressure which is done to reduce sheen after pressing. Carbonisation is a treatment for the removal of vegetable matter. This treatment simultaneously weakens the fibre.

## 3.2 Manufacturers

Now we will move on to look at the individual companies which produce woollen goods. An important question for us is how the companies see their relationship with the use of Norwegian wool as a raw material. We will also look at what the companies experience as barriers and obstacles for the production of woollen goods, and what they consider to be opportunities and potential for its production. The companies we highlight do not consist of a complete overview of the wool-based textile industry in Norway, but they are important examples of different companies and production methods. Both because we wish to highlight the different aspects of wool production in Norway and because companies have different characteristics connected to their operations, there will be different perspectives and stories between companies that are concerned in the manufacturing of wool. This also allows us to see the breadth and variations that make up wool manufacturing in Norway.

### 3.2.1 Rauma Ullvarefabrikk

Rauma Ullvarefabrikk AS is a Norwegian wool mill and wool manufacturer which mainly uses Norwegian wool and produces 65 different yarn qualities. The raw material they use is scoured wool which they buy pre-scoured from Curtis Wool Direct, but the raw material is Norwegian and comes from the Norwegian crossbred sheep and spelsau. They make many different types of yarn including knitting and tapestry yarn, art weaving yarn, and hand weaving yarn. They also have a small knitting factory connected to their company. Røros Tweed is a subsidiary of Rauma. Røros Tweed produces mainly wool blankets out of Norwegian Rauma yarn. Røros Tweed also makes woven fabric and “vadmél” used in bunads. The majority is made from Norwegian wool. Blanket production consists of around 90 percent of production, where only Norwegian wool is used. This has at least been the case up until now. They are experimenting with a lighter quality for export to Europe and have been looking at different mixes, including alpaca but also Norwegian lamb-wool. The Røros blanket - the traditional blankets - are the mainstay of the factory.

Rauma also owns the wholesaler Per Tryving (PT Design) which has marketed itself especially with Blåfjell products and Arne & Carlos Christmas ornaments, in addition to designing patterns for both clothes and home decor. Rauma has 34 employees, Røros Blankets/Tweed has 20, and Per Tryving has 4. They produce industry yarn only for their own production of blankets and yarn. One of their largest blanket customers is the interior design store, Tannum, and one of their largest yarn customers is the Norwegian Husflid. Rauma is therefore an example of a Norwegian company which takes advantage of Norwegian wool, produces in Norway, and sells to a Norwegian market. Rauma also delivers and has delivered Norwegian wool yarns to designers, currently LillUnn Design; earlier Cecilie Melli and ChillNorway.

### 3.2.2 Sandnes Garn

Sandnes Garn is the largest producer of yarn in Norway. They buy tops and un-scoured wool as raw materials, and scour the latter themselves. They use wool from Norwegian Crossbred and from Icelandic spel sheep. They once produced primarily industry yarn and carpet yarn, but today they produce mainly hand-knitting yarn. This represents 95% of their production, while the remaining portion consists of carpet yarn which goes on to Loen and Woolin. They once produced a great deal of carpet yarn for a factory in Denmark, which amounted to 350 tonnes a year. Later, the profit margin became so slim that they cut out this delivery. Then came the hand-knitting boom and a new

market opened up. Now they produce 600 tonnes of this yarn a year, in addition to 70 tonnes of industry yarn. There were once many small industry yarn factories from which they could buy yarn, but today most of this market has disappeared. Therefore, they produce relatively little industry yarn. If hand-knitting had not become fashionable again, they would likely not have survived, they themselves have claimed.

The demand for hand-knitting yarn has increased significantly in the last few years. Sandnes Garn also sells patterns with yarn packs, and has the copyright on the Marius pattern through Vigdis Yran Dale. Sandnes Garn has its own scouring site where it scours around 250 tonnes of wool per year for its own use. Sandnes Garn makes use of Norwegian wool in its own production, but the majority of the products they produce are made of imported wool. They import ‘tops’ from Australia (23  $\mu$ ), and a lot of wool from Uruguay. Alpaca has stepped up in demand and they get about 40 tonnes a year, from Bolivia and Peru. They also import 50 tonnes of cotton from India. Sandnes is a mill which does all of the manufacturing itself. They have invested a great deal into modern facilities and new machines to streamline their business. They have, among other things, replaced four old industrial lines with one new one.

Sandnes Garn has 100 employees. They sell directly in Norway, Sweden, and Denmark and via distributors in USA, Canada, Iceland, and Finland. 25% is exported. The plan is to focus more on the Norwegian market. They own three individual stores, but they sell also through others. They have seen a 50% increase in sales over the last three years. Sandnes has been successful in internet sales which they find allows them to reach out to more and more this way. They sell woollen yarn from Norwegian wool to Janus which use it in wool socks and some of their coarser sweaters. They sell quite a bit of wool yarn, which is made of Norwegian wool, but they have not had a particular focus on marketing this yarn as Norwegian. It is not always labelled on the product that it is Norwegian wool. 100% Norwegian wool is found on one yarn-brand, Fritidsgarn. Through a discussion of this with the owner, Harald Mjølne, it became clear that this could be dealt with if there was a ‘Norwegian wool’ trademark. They also were interested in more life-style branding, since they clearly saw a link from the focus on knits in fashion to young people’s increased interest in knitting. They have the current rights to all new designs from Arne & Carlos, and the popular ‘Dorte Skappel-sweater’. Neither of these pattern-packages use Norwegian wool, the latter includes alpaca yarn.

Some of the wool they spin is from Icelandic spel sheep. Otherwise, some of their raw materials are from Norwegian crossbred. They sell Norwegian yarn, South American alpaca, and merino wool from New Zealand and wool from Uruguay. They say that they could not have survived if they were to only sell Norwegian wool. They are dependent on selling both, in combination because their customers are looking for softer qualities of yarn for hand-knitting.

Four designers work full-time at Sandnes Garn, but they also buy designs from free-lance designers. They make many booklets with patterns, and also develop new qualities of yarn. They present themselves as being good at delivery and delivery precision. Some yarn qualities which are the mainstays that they sell the most of which allows them to juggle and try new things on the side. Peer Gynt yarn was their former mainstay, however it is no longer so popular as many consumers feel that the yarn itches, so now they only sell a small amount of this yarn.. Also, the fact that consumers want to wash their clothes much more frequently now than before, means that these types of yarn weights become less popular. They say also that there are trends that come and go, such as the Marius Sweater which is knitted with Peer Gynt yarn and boosts the sale of this yarn, or a polyester yarn called Funny which they sold a lot of (83 tonnes) until it suddenly went out of style.

Sandnes Garn sells neither organic nor Nordic Swan labelled wool, nor the Woolmark label. They do not see the purpose. Rauma and Dale, on the other hand use Woolmark. They don't put much weight on environmental awareness in the form of communication to the customer. They could have taken it upon themselves to scour wool for others and have been contacted about this, but they have not given this priority because they lack a wool press, which costs close to 1 million NOK in investment and up-keep.

### 3.2.3 Hillesvåg Ullvarefabrikk

Hillesvåg Ullvarefabrikk is significantly smaller than the two aforementioned manufacturers, and once was the largest producer of tricot wool yarn. Hillesvåg uses 30 tonnes of Norwegian wool which makes up about half of total production. A large portion of the foreign wool is worsted wool spun abroad and Merino wool for felting. In the 70's and 80's they went from tricot wool yarn to hand-knitting yarn and wool for felting. In the period when hand-knitting "went out of style", felting, however, came back. Now it is about 50-50 each. Hillesvåg has been producing wool for felting since the 30's.

Hillesvåg has 18 employees. They sell a lot on the internet where they have free knitting patterns which can be downloaded. Hillesvåg also sells yarn to

other, lesser entities. Pickles is an example of this. They also deliver wool for felting to a Danish slipper brand which has sent its production to the Philippines. They use mainly C1 for knitting/woollen yarns, for weaving yarns they use spel sheep because it has more sheen, though it is worth noting that this yarn would itch more in a sweater than when it is woven. They also import merino wool, especially for the finer felt products. Most of the machinery in the factory is very old, late 1800s, early 1900s; which makes them easy to repair since they are mechanical. They dye about 70 tonnes a year, in several different machines depending on the thickness of the yarn. After dyeing the yarns are spin-dried twice. The worsted yarn they dye and sell is bought from Spain. They use so-called “pellsull” (pelt wool) for effect in carded wool and dye it.

Hillesvåg have their own “master felt-maker” who experiments with new designs and qualities. All in all 18 people are employed here. They sell their wool products on the internet, along with other products, [www.ull.no](http://www.ull.no). Hillesvåg uses C1 for the felt for special slippers made in the Philippines that are probably the world’s most expensive slippers – but the quality is superb. They also have an American customer who orders special costume-dyed wool that only be done on their machine. We were walked through the process from “pre-yarn” which is very frail – through the spinning – and then the spun threads being made into yarns that can be 1-ply or more. They also sell some pre-yarn – in Iceland they stretch pre-yarn to make it stronger – and it stays softer than if spun. Felting grew a lot in popularity in the 1990’s and Hillesvåg was initially one of the few delivering to this market; now the competition is tougher also from abroad. Knitting was less popular in the 1980’s and 1990’s, but has seen a recent increase. Hand-spinning has also increased in popularity.

For the wool they dye themselves, they air-dry in the attic – which they claim is less harsh than micro-wave drying. Hillesvåg buys worsted yarns they dye for Lone Tepper, a Norwegian brand, among others. They can dye very small batches, down to four kilos, and compose special colours on demand. They dye for the Bergen-company Blæst who produce sweaters to match their colourful rain-coats. When naming their yarns, they use matching names: Ask and Embla, Fjord and Fjell, etc. They have also recently produced yarns from Wild Sheep wool for Karin Flatøy Svarstad where this is clearly written on the label.



### 3.2.4 Sjølingstad Uldvarefabrik

Sjølingstad Uldvarefabrik is a museum with some manufacturing, where the mission is to be an educational and knowledge-based institution that safeguards and communicates the labour process to the public. Sjølingstad was a mill and weaving factory which manufactured wool goods (they use mainly Norwegian wool), but it is now a “live” museum. Their main function is to communicate the manufacturing process and tell the local history of the value-chain from sheep to shop. The museum is the factory, with its machinery, factory operations, and processes. They do very little production, but then again, they are not profit-driven. Tours through the factory show the production processes to visitors from raw material to finished products.

Many of the machines at Sjølingstad were bought used, and may have been rebuilt so it is difficult to determine how old they are. They have ten employees, some that work in production and others that work only with the tours and the dissemination of information and the processes connected to wool manufacturing. Their wool comes pre-classified so they do not do any sorting or selecting on site. However, they do have their own dyeing factory. In the dyeing factory they dye yarn in many large dyeing vats. Today they only use chemical dyes, which are imported especially from Germany. They also make recycled wool products. They have done this by blending so-called “shoddy”-they get pre-shredded shoddy from Fretex which they blend into the wool products they make. They also make different felt materials.

At the weaving site they weave vadmél, drapes, and blankets; their most popular product. The production is also not something they can make much of a profit from, according to the mandate of their production unit. Yet, they don't look at the production as something profitable, their goal is to take care of the tradition and the machines. At one time they even kept the prices low so that people could afford the products, and since becoming a museum they have continued to keep prices down in line with their role as caretaker of tradition.

At Sjølingstad, they wish to maintain the tradition of lanolin wool but it inhibits production to have too much lanoline in the machines and it is very expensive to wash out of the machines. Therefore, they often apply the lanolin afterwards. In terms of customers, they have a steady delivery to Husfliden, but they also have limited resources and time for product-development. They have become more and more focused on income. The best-selling product is the blankets, and they could have sold many more. They also sell fabric for the local bunad which requires a very special pleating technique, and takes a

year to produce. Of the two materials that go into two different “skirts” – one could very well be Norwegian wool – and they are at a crucial point of deciding whether this is important. They have done some projects where students or others come in and develop special products, but this is time-consuming and they must either rely on the project paying well or that whoever is doing the project is independent enough to manage on their own.

### 3.2.5 Salhus Tricotagefabrik

Salhus Tricotagefabrik: Today, the factory which first opened in 1859 is a museum. It was the Germans who saw the potential in the waterfalls and bought the rights to the water-power cheaply from the local farmers. In the beginning the factories used cotton, but the American Civil War resulted in a ban on cotton export, so Salhus became a woollen mill. This was the home of the “Krone-Maco” underwear, and they exported what are generally called Norwegian sweaters in the US to the Japanese and US market (what we in Norway call “islender”). While the factory in the beginning relied on buying yarn, they soon became self-sufficient and scoured, carded, spun and twisted their own yarn for jersey-production. Much of the process was manual, in spite of the mechanical machines. After a bankruptcy in 1888 the company was restarted and continued as a jersey-factory, while a weaving factory was established alongside the original factory – now as a modern state-of-the-art factory. In 1910 the work-day was reduced to ten hours with three days of vacation. After World War 2 the factory experienced bonanza years, where just filling orders was the main challenge. In the 60s they produced a million socks a year. The factory closed down in 1989, and opened as a museum and educational centre in 2001. After a major flooding some years ago some of the machines are no longer functional. A distinct Salhus-pattern is still in production, and in the gift shop they sell several products with this pattern.

### 3.2.6 Dale of Norway and Dale Garn

Dale of Norway and Dale Garn. The yarn mill was started in 1879 by Peter Jebsen, who bought the waterfall rights in 1873. In 1905 the factory went bankrupt since half the market disappeared with the dissolving of the Swedish-Norwegian union. This was the first worsted mill in Norway, and in 1967 they started the knitting factory. There was also a cotton mill and weaving mill, which became Dale Tech – they produce flame-retardant work-wear, but the production was closed in 1995 and is now moved to Pakistan. When the knit-factory started up, the British market was the aim, but it eventually became the markets in classic ski-resorts and tourist-trade that dominated sales.

Ski-sweaters turned out to be big business, and Iselin Hafseid and Kirsti Bræin were among the designers who were hired to design some of the iconic sweaters.

Dale uses a lot of Norwegian wool. They have a collection which is made of Norwegian wool and which is mainly produced in Norway. Until 2001, they used only Norwegian wool but have in recent years supplemented with Australian merino wool. Today Dale of Norway use Norwegian wool in 70-80% of their production (measured in weight). Dale Garn spins most of the yarn they use, but recently Sandnes has supplied them with some yarns. Today they use about 70-90 tonnes Norwegian wool for the heavier knit sweaters (and some outer-shell jackets), the remainder is 20-30 tonnes of merino-wool bought through Schoeller, an Austrian agent that sells merino mainly from New Zealand. The thicker knit sweaters are experiencing a renaissance, in the same way that when the Olympics were held in Lillehammer in 1994, it was a bonanza for Dale. Around 2000 Dale was struggling and the need to update products became a clear focus. This was a period of changing ownership and structural changes, but since Hilde Midthjell bought majority-shares in the knit-factory (Dale Yarn and Dale of Norway became two separate companies in 2009), product-development has escalated, and in 2010 the knit-company again showed a profit after 8 years in the red. The World Championship sweater in 2011 has been very popular, and they have developed a water-proof yarn used in a knit-shell with a wind-stopper membrane, based on a 70 year old pattern. The Norwegian yarn is laminated in Italy. The membrane is merino.

In the yarn mill, we were shown the tops that Dale had bought from Curtis Wool Direct, which is part A1 and part C1 wool. The A1 wool is so-called “whole-year-wool”, the fibres are about 9,5 cm long and very smooth. C1 is sheared in the fall, and is 8 cm on average, with more crimp. When combed, the shorter fibres are pulled out. The combination gives an optimal result, which does not pill.

As the machines become more advanced, so do the patterns and the use of colours. They had a whole-garment machine, but it was taken out of production. There has been a lot of waste from the flat-knit machines – about 20% when they cut from square knit-forms. The waste was used to clean the machines, but they now have much less waste. However there still is a certain amount and this is not reused. Because of the nylon-threads they are sewn with, it becomes impossible to recycle them. Some of the finished items that have to be pulled because of minor flaws are donated to the Red Cross.

Mark Bruce, who works on the technical parts of the designs, used to work for Shima Seiki, but the machines they use are from Stoll. These are flat-knit rather than whole-garment. The whole process when designer and technician have to come to a compromise was described. In the 1980's the knit-industry adopted "intarsia" from weaving techniques – which means patterns do not have to go all the way back and forth in machine-knit, but can be in blocks. If the "distance" is too far between stitches – this affects the weight of the garment – and one has to use a "ladder-back". The technician explained that when he started working there, there were four choices in stitch-thickness (gauge) – now almost each stitch is programmed. This reduces the waste. The knitted elements for the sweaters come out as a "package" for each item. They are pressed, and then sent to the sewing-division (the main sewing is outsourced to Poland). After sewing, the sweaters are pressed again. Some sweaters use very coarse 8-ply yarns.

40 % of turn-over is in Norway, 90 % purchased by tourists, 30 % of sales in the US (main office in Burlington, VT) and 30 % sales in Europe, some in Korea and Japan.

Most of the dyeing is done on the machine-knitting cones, rather than before – this is more economical. Their yarn-quality Daletta – which is very light – is from "colonial wool" – which is purchased via the UK, but is from South America. The quality dates back to the 1980's and is 28 m $\mu$ . Heilo is the yarn made from Norwegian wool. The yarn division had looked at samples of the new tops from Curtis Wool Direct ("Viking Wool") but found these to be inferior to the C1/A1 tops they already buy.

Dale of Norway divides their products into three segments; Nature – which is for outdoor use, Cabin – which is for indoor use, and Extreme – which is the three-layer and knit-shell technology. Dale of Norway's products are launched so that they are in-store in April, in order to target the tourists, who come to Norway in the summer and wish to purchase a typical Norwegian knit sweater. This makes it hard for the designers, who need to "guess" colour trends half a year ahead of other winter-launches. One last detail: Dale Yarn used to fumigate the wool with chemicals because of moths. This is no longer done.

### 3.2.7 Mandal Veveri

Mandal Veveri AS has 18 employees and produces mainly different qualities of cloth. Mandel Veveri has both a dyeing factory/dyeing laboratory and has a factory outlet. They market their efforts to preserve the patterns of old costumes when they cooperate with other players in order to reconstruct and

transfer old patterns to fit with modern production. They import wool from New Zealand and Australia, and they get some yarns from Sandnes. They have ten looms and invested in new machines in 2006.

### 3.2.8 Norsk Kunstvevgarn

Norsk Kunstvevgarn AS, producer of Hoelfeldt-Lund yarn, is a mill which uses Norwegian wool from spel sheep, but also some from other breeds, Norwegian merino is one example. Hoelfeldt-Lund is most famous for his "kunstvevgarn", wool yarn from Norwegian spel sheep. The mill purchases unscoured wool which they scour themselves. At the mill, they take care of the entire process from sorting of the wool, to dyeing and scouring, to finished yarn. Norsk Kunstvevgarn AS/ Hoelfeldt Lund spin the bottom and cover wool together, which makes the yarn especially shiny, and strong. Spinning spel in this way is very difficult, and few others are able to do so. Hoelfeldt-Lund is one of few industrial mills which sorts the incoming fleeces. If the quality of the wool is too low, it is returned, but the wool that is up to standard is sorted. In the sorting process, the different wool qualities are separated from one another. They separate the wool that will be used for weaving from that which will be used for knitting yarn, which is a different way of sorting and classifying than is done at the wool stations. The most coarse wool may, for example, either go to felting or for use in carpets. Sorting is done by hand. Hoelfeldt-Lund uses 100% locally sourced Norwegian wool. The owner is a pensioner and the future is uncertain.

### 3.2.9 Selbu spinneri

Selbu spinneri AS is one of the "minimills" in Norway. The other is Telespinn AS. A minimill has the equipment for the whole process from scouring, carding, to spinning, but on a much smaller scale. At Selbu spinneri, they use the wool from Norwegian sheep breeds. The main breeds are grå trønderfår, local merino and other naturally pigmented breeds. They spin wool in natural shades which are suited for weaving, knitting, and felting, and make different products (mainly yarn) for sale in their store or online. The wool is processed in such a way that the process is essentially craftsmanship. Telespinn spins all types of animal fibres, and has also specialized itself in mohair and dog hair. Mohair is particularly thin and shiny compared to sheep wool. The economic feasibility of such a small-scale production is, however, questionable.

### 3.2.10 Gudbrandsdalens Uldvarefabrik

Gudbrandsdalens Uldvarefabrik AS is a wool manufacturing factory and mill. They produce high quality upholstery as well as cloth for bunads. For this they use only imported wool in the production. The wool comes pre-scoured from New Zealand. It has been this way since the 1950's, but they have noted that they would be interested in using some Norwegian wool if the Norwegian wool were of better quality. 70% of their production goes to exports. Their market in Norway, first and foremost is public procurement, but they also sell to large entities such as NSB, Hurtigruta and the furniture and home decor industry, as well as architects.

GU have organised the production into five main departments with corresponding sub departments. These are: The Mill (plushing, carding, and spinning), «Spolieriet» (winding, twisting, warp and yarn making), Weaving factory (weaving, knotting and departmentalizing), Finishing and Dyeing factory (dyeing solutions, yarn dyeing, pieces dyeing, dye stock, lab, broad wash, wash / fulling, carbonisation, drying / water-proofing, product control). The factory's organisation can provide a picture of the manufacturing processes that are part of such a factory business, and most Norwegian spinning mills and weaving mills have the same processes that these departments are referring to, even though not all have the entire value chain. The only thing GU does not do itself is scour the wool. GU labels all of their products with an EU flower and has thorough environmental program.

The main reasons given for not using Norwegian wool in the bunad materials and interior fabrics is zero-tolerance for vegetable matter, lack of whiteness, mean- $\mu$  over 28 and volume. However, in tweeds some of these factors are not so important. The biggest problem is Norwegian wool for bunads because this market requires extremely high quality goods. The fact that the fabrics are mostly darkly coloured makes the vegetable matter appear particularly well. If GU were to use Norwegian wool it would be best to focus on tweed for apparel use. They believe that there is more attention on local materials and origins when it comes to clothes than there is for interiors. The possible story-telling surrounding a special run of a tweed, based on Norwegian wool in cooperation with a fashion designer, is thus more realistic than cloth for bunad or interiors.

### 3.2.11 Leine Merino

Leine Merino is a farm with Norwegian merino sheep. They sell knitting yarn, wool for felting, sheep skins, and knitting patterns; at their farm store and other retailers, as well as online. The yarn they make is sent to Hoelfeldt Lund for scouring and spinning. They only sell undyed yarn with a large content of lanolin. The profitability of the production is low, but the commitment is high. Leine Merino is working to increase and improve their flock as they find the interest in merino wool to be growing in Norway. Regulations regarding the import of semen have previously caused problems for the development of the flock. Merino sheep thrive better in dryer climates than we have in Norway, but this merino farm is situated in an area in Gudbrandsdalen that is quite dry for Norwegian conditions.

### 3.2.12 Janus

Janus, Janusfabrikken AS: This factory dates back to 1895. They used local wool, and underwear was the basis for the production – mixed with cotton. Janus as a trademark was registered in 1909, in the 1930's they led the market on ladies tights, until nylon stockings took over. Then came sweaters – which they have discontinued. They have discontinued the use of Norwegian wool – based on VM – but in their coarse “rag” socks, they still use indigenous, carded (woollen) yarn from Sandnes. They use different knitting techniques on the machines with transferring “stitches”. Some techniques are used to produce a three-thread fleece (evidently a similar knit-system as Lacoste uses), Interlock – giving the material more stability and “crinkle” (tubular) where the material “bellows” since it is knitted with more yarn and stitches on one side than the other – fastened at different points and creating air-holes in the material. This last technique is used in infant clothing and has a very soft feel. There are many production steps in the factory. The flat-knitted fabric is cut after it is dried and pressed, steamed, centrifuged, micro-waved, and folded before it arrives on the automated cutting table. The fabric needs to “rest” before it arrives here, where suction ensures that one is able to cut through 25 layers of cloth. The knives that cut the fabric are continuously sharpened, and everything is pre-programmed. Janus is the biggest manufacturer of wool underwear in Europe, with export to Russia, Finland, Sweden, Iceland, France and Germany. All cut-offs are sold to a shoddy-factory in the UK, and KLIF receives reports on all water-discharges. They also produce some private labels like Polarn o Pyret. Not all production takes place in Norway, they also have a factory in the Baltics.

### 3.2.13 Oleana

Oleana A/S has since its start been located in the same building as Janus, but this last summer they have moved. They manufacture in Norway but use only imported wool. Design-wise, they started using local patterns they found in museums as inspiration. In their new location, Oleana's new facility is a destination production centre with a café, outlet, and tours of the facilities to show that they are "truly made in Norway". Today they have 65 employees, Sandnes and Janus are two companies who have more – but this is unusual in the textile industry – but more unusual is that 50% of the costs of a clothing item are labour costs. They can do this with low overhead and a small administration. Since things are going extraordinary well, they have three shifts running. Their philosophy is to have a good working environment – so once a year they close down the factory and everyone goes on a study-trip. Their main markets are Austria, Germany, France and Japan. UK they have not been able to "crack the code" on. Solveig Hisdal is their sole designer and she has a very free reign. She photographs the collections, does their set-ups for trade-fairs – while her daughter is graphic designer and model. They keep many of their same looks over time, invest in details and are not afraid to explore new techniques (the programmer for the knit-machines is not always happy with this). At one point they decided to discontinue the use of Norwegian wool, as they opted for even finer qualities – their staple combination is merino and silk, but also alpaca. If the trend tells them that coarser qualities are on the way back, they may reconsider. But as the situation is today, they are not able to meet the demand for their products. They have branched out, so they now design blankets that are produced at Røros Tweed from merino – the yarn is spun at Rauma. They also produce pillows and throws from alpaca.

### 3.2.14 Gjestal

The companies named thus far have production in Norway. There are, however, also many Norwegian brands that do their production abroad. One example is Gjestal AS. Gjestal fabrikkutsalg was once a part of Gjestal spinneri, a smaller mill which also had its own weaving factory. It is however no longer operational. The "factory outlet" is therefore just a store for the products they now import: knitted sweaters and socks with a prominent Norwegian flag on them, and yarn. They claim to use both Norwegian wool (from leftovers from the former factory production) and imported wool yarn, and market themselves as selling Norwegian quality by using Norwegian designs and knitting patterns under the Norwool trademark. In addition they market some of their wool with names like Trysil and have bought a painting of a Norwegian sheep from a local artist to brand another of their yarns.



### 3.2.15 Ulvang

We mentioned in the introduction that the Norwegian textile industry is composed of many older companies with old traditions. Ulvang is an example of the opposite. This brand changed the way wool was marketed in Norway. Until the Ulvang sock was launched, wool underwear was an anonymous product. However this brand, which was closely connected to the skier Vegard Ulvang, was the first wool-product that was marketed as such, in the 1990s. This highlighted wool in a new way. The Ulvang story is a success story representing a breakthrough in thermal underwear which also paved the way for the recovery of other manufacturers and new companies in the new millennium. Even though wool underwear is their main product range, Ulvang and the other brands have items in their product range that could be made with coarser wool such as Norwegian cross bred wool, especially the lambswool quality. An example of this is a thick, gray wool sweater in an airy knit, called the Ulvang Raw Sweater.

## 3.3 Fashion and design

Knitted wool has been a very important product for Norwegian textile companies, including wool underwear which has been on the rise in the last few years. Within this type of production there are strong brands. Either the production takes place in Norway, like in the case of Dale and Oleana, or abroad, like in the case of Ulvang and Kari Traa. The latter don't use any Norwegian wool in their production, but then neither does Oleana. The focus in wool underwear production, and also for a number of other wool apparel, has been on softness. Here they use wool with finer fibres, something the Norwegian wool is not able to deliver. The most popular fibre is therefore merino. We will come back to this and look more closely to their reasoning for this later in the chapter. But even though brands do not use Norwegian wool, they are nonetheless eager to connect to Norwegian traditions and values and market themselves as Norwegian. This could be by marketing the fact that the products are produced in Norway, or that the products are inspired by Norwegian clothing traditions or patterns. Oleana is an example of a brand that uses patterns inspired by Norwegian tradition. Oleana used Norwegian wool at one time, but no longer do as they wanted a finer and thinner quality of wool for their products.

### 3.3.1 Norwegian wool in fashion and design

Few designers use Norwegian wool, but some have tried to delve into the value chain – and several more have expressed a wish to use Norwegian wool in order to enhance their story-telling and position in the market. Among the designers who showed collections during Oslo Fashion Week 2011 and 2012, Lillunn Design is the only one who uses Norwegian wool in more or less all her products. The materials are partly woven in Norway too, at Røros Tweed, and her finishing factory is outside Drammen. She has inherited the company from her mother Unn Sjøiland Dale. The company is doing well in the tourist market, sells through Husfliden, and is slowly cracking the fashion market with some of her new products (ponchos and leggings).

Two design companies, Cecilie Melli and ChillNorway, did a cooperation through a private person who tried to tie in Norwegian wool with a production facility powered by wind-mills in Northern-Norway around 2010. Several designers were contacted for the project and Innovation Norway in Finnmark received a substantial application for funding. The application did however not go through, but Cecilie Melli and ChillNorway both partook in the project and developed prototypes for cardigans, sweaters (CM) and a coat (CN). The yarn was from Rauma, and the cardigans and sweater had a “stiff” feel to them, though in the coat this was less noticeable. Cecilie Melli experienced resistance among buyers as they complained of the itchiness. But she sold them in her own flagship store and as she is good at story-telling, the whole background of how they had been produced added a value proposition the costumers found alluring. However, the factory (Noravind) went bankrupt and production halted.

Oikos also tried to initiate a project with Norwegian organic wool in cooperation with Telespinn and wool from Rogaland. Innovation Norway Rogaland gave some funds to this (a pre-project), but for the actual application Oikos needed partners who would contribute economically. Several were contacted (iiS of Norway, Fabel, Fam Irvoll, etc) but everyone came to the same conclusion: the raw material was too expensive. This reflects the cost-level for mini-mill production for small businesses, which is prohibitive, and goes to the size and production-capacity of mini-mills (10-15 kilos max capacity per day).

Viking Wool was developed as a brand name for wool tops dyed in melange hues (see next chapter), which Curtis Wool Direct claimed were treated in such a way that the tops were softer than normal. As tops (or pre-yarn), the wool is softer before the actual spinning tightens and stresses it; this was hard to evaluate.

Fabel is a Norwegian company with a long tradition working with wool, the head designer and owner had worked with Sjølingstad. The daughter of the owner, Helle Frogner, has become increasingly involved and she was invited to participate in a design exhibit in the Baltics as one of two Norwegian designers with the theme: Nature and the sea. Helle Frogner therefore wanted to work with Norwegian wool, inspired by the sheep she saw grazing on Stad, where she lives and works. She was given machine-knit yarn from the Viking Wool tops and made a sweater inspired by local design-traditions for the exhibit, which travelled widely in the Baltics. The sweater has not been put into mass-production.

The Viking Wool tops (though without the name and label) did make the rounds to several designers during 2011. Voice (their new designer Frank Remme), Kari Traa, Camilla Bruerberg, Haaning & Htoon, L&J of Norway, Peter Løchstøer, Fam Irvoll and With & Wessel all were interested in looking more closely at Norwegian wool for capsule collections. But because of lack of platforms or arenas to develop yarns and prototypes, time-constraints and other hindrances – this work has halted. Yet there are a few exceptions:

L&J of Norway entered in to a cooperation with Røros Tweed designing blanket-ponchos for the new hotel-project “The Thief in Oslo”. Norilia ensured that Rauma received the softest grades (lowest  $\mu$ ) of the C1 class – which is lamb-wool and is marked C1xx from the wool station. This ensures that the end-product is lighter weight and less prickly.

Sølv is involved in an application for naturally pigmented wool with Selbu Spinneri, to use in their outer-wear products. They use materials from Harris Tweed that are woven in the Hebrides in cottage-production and prefer to source locally.

Two other design-companies, Nina Skarra and With & Wessel, are still very interested in doing specific projects with Norwegian wool. Gudbrandsdalen Uldvarefabrikk is a possible solution, because vegetable matter and whiteness would not be so important.. For W&W’s part it is a question of developing yarns for their use from spel-sheep, for capsule products. Technical issues and capacity have so far held up this possibility. Their operation is based in the US, but they have had feedback from their costumers that products based on Norwegian wool would be welcome and a good selling-point.

A recurring problem is the lack of product-development opportunities for designers. Even if the will to use Norwegian wool is very much present, and Sandnes Yarn is willing to work with yarn-development – time has to be set

aside and machines freed from ordinary production. Some work is being done at KHiO (thanks to Dagfinn Skoglund's passion for wool and knit, and Franz Schmidt's passion for woven fabrics), but transforming prototypes into full-fledged production lines locally is a big obstacle. Dale Yarn and Dale of Norway are more or less an ideal site for those working with knits, and there is a certain willingness to work with designers, but recently they chose to work with the Danish designer Henrik Vibskov rather than Norwegian designers.

The current students and recent graduates from KHiO are potential Norwegian wool users, and have been experimenting with the machine knit yarn from the Viking Wool tops.

Norilia also recently sold its first batch of Norwegian wool to Devold, who have only sourced Australian wool for many years; also in their coarser sweaters. The Thief has also opened up for more design products made from wool – with focus on Norwegian raw materials – some of the products are not typically made from wool. But many of these interior items (tong-slippers, newspaper and magazine holders, key-holder, trays, etc) cannot be produced from Norwegian wool, only merino (because of hairiness in felting) and others have stranded for other reasons (wool-filled duvet and pillow, and carpets). The use of wool in interiors is potentially a big and new area for Norwegian designers to look into.

### 3.4 Obstacles and challenges

Our main impression after visiting the many Norwegian textile companies is overwhelmingly positive; beautiful and varied products, knowledgeable and committed people, tradition-filled companies with the ability and willingness for new investments. Norwegian textile products, to a high degree, are among the products foreigners associate with Norway - and brands such as Dale and Gudbrandsdalens Ullvarefabrikk are more successful in the export market than here in Norway.

This does not mean that there are not also challenges. The challenges can be summarized as follows:

- 1) Recruitment of qualified personnel to factories, simple labour jobs and textile engineers. These jobs are not attractive to young people today, who would rather be designers than work in production.
- 2) Cost-level for hands-on operations in Norway.

- 3) State-of the art machinery, up-grading costs, investments and up-keep: Several of the factories are in the process of investing – and are therefore dependent on increasing their market-shares.
- 4) Risk of uneven raw material input if using Norwegian wool; vegetable matter, contaminants, mean  $\mu$ , modulation and volume are challenges mentioned.
- 5) Lack of agreement on what constitutes 100% Norwegian yarn/raw material for down-stream production.
- 6) Lack of regional/over-all vertical integration of all steps in the production, starting with scouring – for smaller scale designers and companies they have to follow up on too many suppliers.
- 7) Lack of time, money and settings for R&D. A need for “innovation workshops” with input from yarn-developers, weaving- and knit-experts. More need for knowledge-sharing and technology transfer.
- 8) Lack of understanding at the consumer level for what constitutes a Norwegian wool product.
- 9) Pricing of products need to reflect more the actual value of the product. There has been a tendency to under-price design-products.

In the overview of the different companies we have focused on determining to what degree they use Norwegian Wool. The table below shows our sketch of what raw materials and breeds of sheep they use and what they make with it.

**Table 3-1: The table shows the production of manufactured goods based on Norwegian wool at the various companies.**

	Raw material	Breed	Products	Ratio of Norwegian wool in production
Sandnes Garn	Wool tops and un-scoured wool	<ul style="list-style-type: none"> <li>• Norwegian crossbred</li> <li>• Icelandic spelsau</li> <li>• Other unknown</li> </ul>	Yarn (hand-knitting and some machine-knitting)	40%
Rauma	Scoured wool	<ul style="list-style-type: none"> <li>• Norwegian crossbred</li> <li>• Spelsau</li> <li>• Lambswool (NZ)</li> <li>• Merino</li> <li>• Alpaca</li> </ul>	Yarn (hand-knitting and some machine-knitting) and some finished, knitted products.	Dominant
Røros	Rauma yarn	<ul style="list-style-type: none"> <li>• Norwegian crossbred</li> <li>• Lambswool(NZ)</li> <li>• Merino</li> <li>• Alpaca</li> </ul>	Blankets, pillows, seating pads	Dominant
Hillesvåg	Scoured wool and wool tops	<ul style="list-style-type: none"> <li>• Norwegian crossbred</li> <li>• Spelsau</li> <li>• Villsau,</li> <li>• Merino</li> </ul>	Yarn and wool for felting	50%
Dale of Norway	Dale Yarn Sandnes Yarn	<ul style="list-style-type: none"> <li>• Norwegian crossbred</li> <li>• Merino (NZ)</li> </ul>	Knit products	80%
Hoelfeldt Lund	Un-scoured wool	<ul style="list-style-type: none"> <li>• Spelsau</li> <li>• Other breeds</li> </ul>	Yarn	100%
Selbu	Their own and others' un-scoured wool	<ul style="list-style-type: none"> <li>• Grå trønder</li> <li>• Other breeds</li> <li>• Dog hair, etc.</li> </ul>	Yarn	100%

Leine Merino	Their own manufactured wool which is scoured and spun at HL	Norwegian merino	Yarn	100 %
Sjølingstad	Un-scoured wool, shoddy	Norwegian crossbred	Yarn, bunad fabric, blankets, isolation felt	A large amount
Mandal veveri	Sandnes Garn	<ul style="list-style-type: none"> <li>• Merino (NZ/AU)</li> <li>• Mohair</li> <li>• Norwegian crossbred</li> </ul>	Fabric and the majority of Norwegian bunad fabric	?
Gudbrandsdalen Uldvarefabrikk	Scoured wool	Crossbred (NZ)	Upholstery fabric and bunad material (home-spun cloth)	0%
Oleana	Yarn from Rauma to blankets which are made by Røros Tweed Imported yarn	<ul style="list-style-type: none"> <li>• Merino</li> <li>• Alpaca</li> </ul>	Clothes and blankets	0%
Gjestal	Not certain	Not certain	Yarn	0%

### 3.5 Concluding remarks

An important question is why those who use Norwegian wool have chosen to do so. The answer here is first and foremost that it is a natural choice. The histories and locations of these companies are built around making use of Norwegian wool. But taking into consideration the fact that few exploit this in their marketing, the question remains why they have continued to use Norwegian wool? Some answers are given to this question through discussions with our informants, and they are mainly connected with different sheep breeds, products and qualities. There is a lot of commitment and personal interest regarding the small breeds such as villsau (wild sheep), merino, and grå trønder, and a strong wish to utilise the resource that wool is. The Norwegian

heritage within textiles and crafts is also an important motivation. Spel sheep in particular has a unique place in handwork and the art worlds. For Norwegian Crossbred, it is the technical qualities of the wool that are important. Norwegian wool is resilient and durable. Norwegian sheep farming commonly uses very little pesticides and has very few problems in terms of animal welfare.

Then why don't more companies use Norwegian wool? The answer here is again partly connected to the quality of the wool. The main reasons the industry gives for not using Norwegian wool include the vegetable matter, lack of whiteness, fineness, and remnants of dead hair or modulation. Good treatment of sheep and wool can slightly reduce the vegetable matter, but this is mainly the "price" we have to pay because we use rangeland grazing instead of containing the sheep on fenced in pasture land. In relation to the political goals for the grazing areas it is hard to imagine any significant changes to this. However, one solution may be greater tolerance for the irregularities in the finished product that are created by rangeland grazing. Whiteness, fineness, and absence of dead hair are questions related to breeding, sorting, and classification, as we have already discussed.

From the fashion design perspective, Norwegian wool is a highly coveted material designers would be eager to use more of, if possible. The emphasis on "the local" has grown lately along with a focus on the environment and lasting products. The status of Norwegian textile traditions both in Norway and abroad suggests that this constitutes a great potential which could contribute to increase attention and profitability for the whole Norwegian, wool-based textile industry.



## 4 Use and usability

Consumption is an important phase in a product's lifecycle and in the value chain. Yet, consumption is often not taken into account as part of the discussion. In this project we sought to answer a number of questions, the most important of which being:

- How is wool incorporated in today's consumption?
- How can we explore consumers' habits and practices related to wool?
- What are the possibilities and barriers related to increased use of wool?
- What are the benefits of wool in terms of the use phase?

In order to answer the first two questions we used the wardrobe studies method. As explained in the methodology section, we have primarily only illuminated parts of this material. The analysis we present here is built around some of the informants, while the rest functions as background. While doing the work with wardrobe studies, a new question arose: what can be said to be "Norwegian" in the Norwegian wardrobes? The answer to this question which would be most in line with the rest of the report would have clearly been "Norwegian wool", but as we will see, the consumer's conception of the relationship between finished product and commodity is quite insubstantial. This does not mean that they do not relate to their wool wardrobe as "Norwegian", so we have looked into this more broadly. In order to bring up the "Norwegian" in the wardrobes, we compared three Norwegian and three British families with socio-cultural commonalities. This has resulted in two article drafts which are both in the process of being published. We present here the main points of these findings.

Regarding the next question - What are the possibilities and barriers related to increased use of wool? - We see from the wardrobe studies that the challenges in the England have to do with the perceptions of wool as something strictly

for warmth, and as something itchy. The latter is a barrier in both countries. To better understand itchiness as a barrier we added a material test to the wardrobe studies. The idea behind the material test was to gather more knowledge around which different materials were perceived by the informants as comfortable enough to be in close contact with the skin. By not telling the informants what the samples were made of, we were able to find isolated perceptions of the softness of the different fibres. This was the intention when we developed the method. The result was, however, that we also discovered how wool- and other materials- are identified and what kinds of expectations the informants have with different fibres. In other words, it was not that the test gave a picture of the way they experienced the materials, without their expectations around certain fibres playing a role. We have thus done an analysis which looks at these very relationships. This is material which is not published elsewhere at the moment, but is planned for an article revolving around sensory reactions.

The last question which has been important in the work with consumption has been: What are the benefits of wool in terms of the use phase? To answer this question we have conducted laboratory tests. This work has taken the knowledge regarding the use of wool, which came out through the other methods, as its starting point, and had two purposes. First, we wished to contribute to making it easier for consumers to use wool. New information, or better documentation, of how one can keep woollen clothes clean in the simplest and most environmentally-friendly way has been important. This has been followed up with widespread popular dissemination in Norway. The other purpose with these studies has been to direct the attention towards the user phase in LCA studies and point out the large differences between the different fibres in this phase. By cutting out use in comparisons between the environmental impact of different fibres, one of wool's environmental advantages - low wash frequency and long lifetime and durability, are cut out. We have also worked with many articles where one, regarding fabric softener's effect on the development of smell will soon be published, while the others are not ready for publication. Since the wardrobe studies do not deal with clothes made of fibres other than wool, we cannot comment on the durability and lifetime of wool clothing versus clothing made of other fibres. The question on durability can nonetheless be addressed and we plan to work further with the question around homemade repairs in the wool wardrobe. This is a question that will not be taken up in this report.

In this chapter, the first and the last sections summarize the main findings from other publications in the project; while the middle part, which concerns the experiences of softness in the material test, has not been published prior to

this report. The entire chapter concerns primarily wool, though not necessarily “Norwegian wool”. This means that we do not seek here to discuss the question around Norwegian wool outside of the wardrobe or other properties in relation to use and laundering.

The material concerning the use of wool from the three different methods we have used consists altogether of a large spread of information with many opportunities for analysis which we have not had the time to exhaust. This applies also to important questions in this report around the meaning of the local, national, and the environment in relation to the value and use of wool. We hope to be able to further develop this work by documenting use such that this phase is included in the debate around the environmental impact of different textiles.

#### 4.1 Wool in Norwegian and British Wardrobes

The section builds upon material from wardrobe studies conducted within three families from Norway and the England, respectively. The informants were asked to present all their woollen garments to the fieldworker for photographs and interviews. Interviews were conducted whilst holding and examining the visual and textural properties of the garments. The families were interviewed with respect to the wool found in their wardrobes.

Families were selected following set criteria, and the project focused on middle-class and/or professional households as this group were seen to be able to allocate income for goods that adhered to world view and personal political belief and preferences. This meant that these informants were considered by the interviewers as educated and socially and culturally aware and more likely to understand environmental issues and concerns. The choice of informants was done to reduce the significance of the financial aspect regarding the acquisition of woollen garments. In other words we wished to see past the potential financial barrier to using wool as woollen garments generally are more expensive than garments made of fibres such as cotton and synthetics. All the families are made up of a mother and father and children under 9 years old. This was decided in order to for the material to be most easily compared. All together, we have looked at the wardrobes of 15 individuals. Research shows that women conduct a large part of clothes purchases both for themselves, their partners and their children (Laitala, Hauge, & Klepp, 2009). Thus, interviews were conducted with the mother of each family and each were asked a series of set questions and asked to participate in sample testing, wardrobe study and discussion of wool. When we chose families with younger children, it was partly because the mothers would then be able to be good informants on

their children's cloths, but also because we believed younger children were a more interesting group to study than teenagers. We hoped to get an idea of what is perceived as a correct and healthy consumption, and not discussions related to rebellion, opposition, etc.

**Table 4-1: Norwegian and British informants.**

<p>The Norwegian informants:</p> <ul style="list-style-type: none"> <li>- Family A (the Andersen family) – child (1)</li> <li>- Family B (the Berg family) – child 1 (7), child 2 (9)</li> <li>- Family C (the Christensen family) – child 1 (1), child 2 (4)</li> </ul>
<p>The British informants:</p> <ul style="list-style-type: none"> <li>- Family A (the Lloyd family) – lecturer (mother, 47), artist (father, 41), child 1 (9) child 2 (4)</li> <li>- Family B (the Smith family) – publisher (mother, 48), publisher (father, 48), child 1 (8)</li> <li>- Family C (the Thomas family)– costumier (mother, 52), photographer (father, 55) child 1 (9)</li> </ul>

In this section we will present and discuss the contents of the wardrobes. Below you will find an overview of the different types of garments and the quantities of these garments found in the Norwegian and British wardrobe s respectively.

**Table 4-2: Quantity of garments in the Norwegian and British wardrobes.**

<b>GARMENTS</b>	<b>NORWAY (QTY)</b>	<b>%</b>	<b>UK (QTY)</b>	<b>%</b>
Underwear sweater	60	11,50 %	0	0,00 %
Underwear t-shirt	12	2 %	0	0,00 %
Underwear tights & briefs	42	8 %	0	0,00 %
Underwear singlet	4	0,75 %	0	0,00 %
Underwear total:	118	22,25 %	0	0,00 %
Socks	110	21 %	0	0,00 %
Sweater	77	15 %	25	27,50 %
Jacket/cardigan	42	8 %	18	20,00 %
Hat	36	7 %	2	2,00 %
Scarf	29	5,50 %	3	3,00 %
Mittens	14	2,50 %	1	1,00 %
Dress	14	2,50 %	8	9,00 %
Slippers	10	2 %	0	0,00 %
Gloves	10	2 %	0	0,00 %
Coat	12	2 %	8	9,00 %
Skirt	6	1 %	6	6,50 %
Breast pads	5	1 %	0	0,00 %
Vest	5	1 %	5	5,50 %
Suit jacket	2	0,50 %	9	10,00 %
Folk costume	2	0,50 %	0	0,00 %
Shawl	1	0,25 %	1	1,00 %
Leg warmers	1	0,25 %	1	1,00 %
Traditional jacket «kofte»	1	0,25 %	0	0,00 %
Baby dress	4	0,75 %	0	0,00 %
Baby body	8	1,50 %	0	0,00 %
Baby jacket	7	1,25 %	4	4,50 %
Baby pants	7	1,25 %	0	0,00 %
Baby nightwear	1	0,25 %	0	0,00 %
<b>SUM</b>	<b>522</b>	<b>100 %</b>	<b>91</b>	<b>100 %</b>

The wardrobe study conducted within the Norwegian and British families has revealed an array of woollen garments inherent in each wardrobe. Underwear, socks and sweaters are garments represented by the highest quantities in the

Norwegian wardrobes. When thinking about Norwegian woollen garments, the ‘famous’ Norwegian sweater soon comes to mind, and as could be anticipated the sweater is represented by quite high quantities in the Norwegian wardrobes.

The UK study shows a different picture, with many fewer (over 1/3) less woollen garments in wardrobes. Although sweaters, cardigans and suits accounted for the largest proportion of garments in this sample, there were no examples of underwear, baby wear or ‘traditional’ garments. Indeed, the suggestion that wardrobes might contain woollen underwear was met with amazement as if this might be possible. Although there were huge numbers of items in the wardrobes, very few contained wool (either pure or mixed).

The difference in quantity of woollen garments in the Norwegian and British wardrobes is significant. The Norwegian wardrobes contain almost six times as many woollen garments as the British ones. Despite the small sample this study is based on, this might point to a significant divergence in consumer practices and attitudes related to woollen garments in the two countries.

#### 4.1.1 Norwegian wool wearing

In Norway there is broad consensus that experiencing nature and performing physical activities outdoors is healthy, important and ‘typically Norwegian’. Physical activities in the outdoors are often referred to by the expression *friluftsliv*, a nationally symbolic word embraced by Norwegians and conceived by the Norwegian explorer Fridtjof Nansen (Breivik and Løvmo 1978; Klepp 1998). The Norwegian eco-philosopher Arne Naess claimed it has the potential to evoke a deep respect and love for nature and provide an escape from urban society, modern technology, stress and noise; it refers to a simple life in harmony with nature where little or no equipment is used (Witoszek 1998), a view that coincides with the official definition of *friluftsliv* (from now on referred to as ‘outdoor life’) (The Norwegian Ministry of the Environment [1987] 2001; Tordsson 2003). A large part of the Norwegian population participate in outdoor activities (skiing and hiking in the woods and mountains). The tradition of owning a winter or summer cabin is also commonplace in Norway (Vittersø 2007). In 2011, Statistics Norway registered 405,883 cabins in all of Norway, and a population of 4.9 million Norwegians. Woollen garments have been essential to these activities and to cabin life through the centuries, as they offer comfort and warmth during the cold months. We found these perceptions to be significant in the minds of the informants, and outdoor life an important factor concerning the use of woollen garments.

In Norway, dressing in woollen layers is advocated by sports brands, stores, kindergartens, parents and outdoor life organizations, such as the Norwegian Trekking Association (DNT), and can be considered an extensively mediated way of thinking throughout society. Consumers are constantly being ‘trained’ in this skill of dressing in the ‘right’ way in winter. It is therefore not surprising that respondents were concerned with layered dressing for themselves and their children during the cold months. They stated that layering should include a woollen layer close to the skin (as demonstrated by the amount of woollen undergarments documented in the wardrobe study). A common strategy of layering for everyday occasions was identified, starting with a thin merino sweater as an undergarment, followed by, for instance, a sweater, blouse, or shirt, followed by a thick woollen cardigan and topped with a woollen coat. The cardigan is just worn from A to B, getting to work for instance, and is then removed until the trip home again. The degree of ‘warmth’ can be regulated through the numbers of layers and the materials of the layers, i.e. a cotton sweater might substitute for a woollen one on a day of mild temperatures. The goal of this layering system is of course to keep warm when outside. Once inside, the layers are peeled off to avoid overheating. Likewise, the outdoor temperature affects this practice, as does the level of physical activity. Dressing for high-level activities such as jogging or cycling might involve less clothing, or layers, than dressing for lower-level activity inside.

Based on how informants spoke about Norwegianness, we suggest that garments in themselves can be seen as traditionally Norwegian, in relation to origin or traditional patterns, but Norwegianness applied also to the use of the garments. Thus, the Norwegianness is ascertained by both imagined and realized fabric, fibre and garment uses. Through conversations with informants about each garment whilst they were holding it physically, the informants have communicated interesting descriptions of the way each was used and the activities performed in them. Thus, ideas, opinions, theory and practice have been fused. What is revealed is the close connection between the properties of woollen garments and traditional Norwegian activities, as well as Norwegian perceptions and sartorial codes and clothing consciousness regarding how to dress smartly during the cold months, promoted through national bodies and the passing on of familial knowledge. Indeed, how to dress in woollen layers was emphasized repeatedly both concerning everyday activities, such as travelling to work, and for outdoor activities.

#### 4.1.2 Knowledge and attitudes

Both Norway and the England have long and similar histories in processing wool, but the position of wool in the two countries could be quite different

today. Knowledge about the value chain of wool is evenly poor in both countries, and the regional aspect of woollen garments is not especially acknowledged amongst the Norwegian nor the British respondents. However, wool seems to hold a more profound place in the minds of the Norwegian informants and in their common ideas about how to dress than is the case with the British informants. This can be observed through the quantity and content of the wardrobes and the activities described by the informants in which the woollen garments are put to use. Although Norwegian and British informants share most of the visual and tactile preconceptions about what woollen fabrics are and looks like, in general Norwegian wool seems to be stronger attached to the idea of specific ways of use and embeds stronger traditional and cultural connotations than British wool. This can also be observed by the difference in the branding of woollen garments in the two countries. The British branding is more focused on fashion than the Norwegian branding which emphasizes Norwegian traditions and activities such as skiing, hiking and cabin life.

Comfort and thermal comfort are aspects that influence wool use in both countries. The British informants, however, seem more concerned with negative comfort in terms of itching and temperature. In general they explain their absent use of wool in terms of it being too hot to wear and too itchy, whilst the Norwegian informants focus more on the thermal function of wool keeping them warm and enabling them in their outdoor activities. These ideas about comfort influence how the informants perceive the applicability of woollen garments, meaning how and when woollen garments should be used.

We find that although there are some similar barriers against use of wool (e.g. itching) the use, attitudes and perception of woollen garments differ substantially between the Norwegian informant group and the British informant group. Whilst there can seem to be a Norwegian way to wear wool in context with for instance outdoor activities, we have not found the corresponding British way to wear wool in our material.

Nonetheless, both conditions provide a potential for reinventing woollen garments in the minds of the British as well as the Norwegian consumers. To increase the use of woollen garments we argue that old ideas about the applicability, comfort, aesthetic appeal and value of woollen garments must be challenged. This can be done by creating new contexts and new contemporary styles suitable for woollen wear of different kinds, by enlightening consumers on the many unique and favourable attributes (e.g. regarding quality, comfort, function and environment) of woollen garments through new communication strategies applied by business and research communities, and to add value to woollen garments by communicating origin and environmental benefits.



However, since our analysis shows that these ‘old ideas’ can be very different between the two countries, the above described strategies must be adapted accordingly.

## 4.2 Experience of fabrics in different fibres

As described in the methodology section, the informants were asked to feel the different samples made of wool, cotton and synthetics, describe how they looked and felt, explain what they thought of them, and guess which material they were made of. This test not only allowed us to study which samples were identified correctly or incorrectly, but also gave us insight into how the informants made their guesses and what kinds of attitudes, expectations, and associations they have for each of the textiles. The six groups of informants are categorized as:

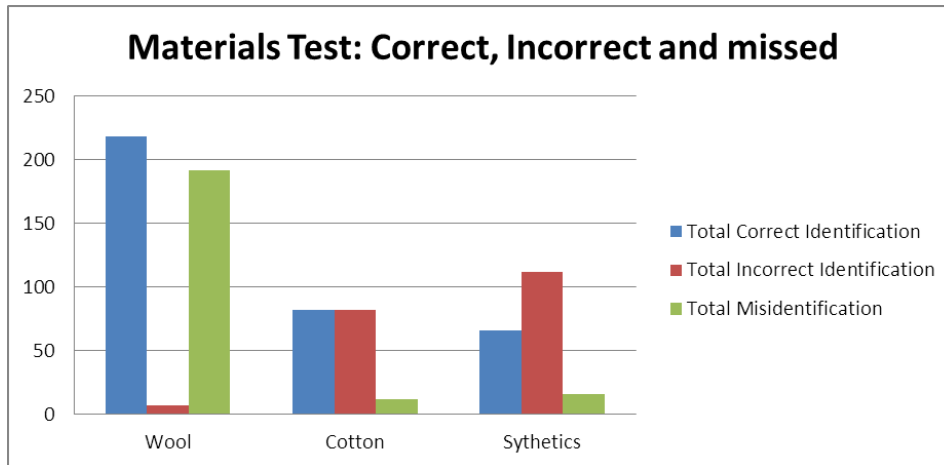
1. Working class: between 40-65 years old, low income
2. Middle class: between 30-40 years old, middle income, academics
3. Economic capital: between 40-50 years old, high income
4. Senior Citizens: around 80 years old
5. Immigrant background: from India
6. Youth: 17 year old boys

We asked the informants to guess which material they were made of. One of the purposes of this question was to discuss the physical properties of wool, such as its itchiness. If respondents felt that wool was itchy/scratchy - but were not able to distinguish wool from other fibres - it is likely that the experience of the itchiness is not only a quality of wool, but the informants’ expectation of wool. To what degree are they able to guess the correct fibre will also shed light on the knowledge of fibres and textiles in general.

### 4.2.1 Wool Samples

70% of the samples in the test are made of wool. The test shows that the informants are predominantly correct when they guess that a textile sample is wool, yet at the same time they tend to overlook almost half of the total wool samples. In other words, they are seldom wrong when they guess wool, but confuse a large part of the samples to be something else. This may indicate that certain types of wool textiles are more difficult to correctly identify as wool than others. Regarding the cotton samples, the informants make incorrect guesses just as often as correct ones while with the synthetic samples they tend to guess more often incorrectly than correctly. This may indicate that

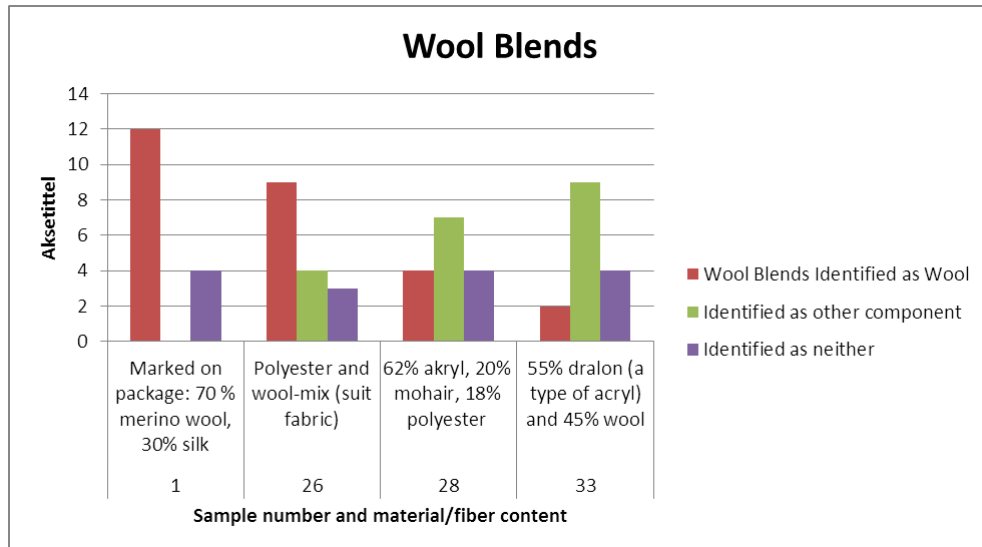
these types of textiles are generally more difficult to distinguish from one another.



**Figure 4-1: Materials test – Correct, incorrect and missed guesses.**

## 4.2.2 Blends

There are four textile samples in the test that are composed of a blend of two or three fibres. When assessing these samples, the informants tend to identify the dominant fibre in the textile sample (e.g. if 70% wool and 30% silk, they more commonly guessed “wool” than something else.)



**Figure 4-2: Materials test - Wool blends**

From the below graph representing the results, it appears that the informants find it easier to correctly identify the Norwegian wool samples as wool. When the samples are made of another kind of wool (non-Norwegian) or a blend of textiles, the respondents are more often wrong, guessing instead that the sample is cotton or synthetic.

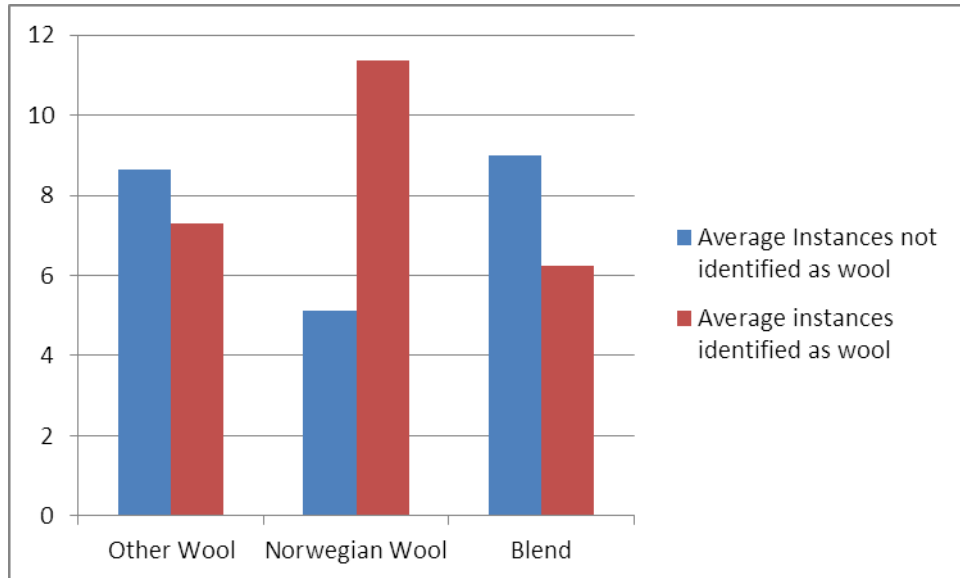


Figure 4-3: Materials test – Other wool, Norwegian wool and wool blends.

#### 4.2.3 How is wool identified?

Analysis of interviews from the materials test indicate that there are clear expectations, associations, and attitudes linked to woollen textiles. The expectations are visual, tactile and functional while the associations are to specific materials or products made of wool. How one uses wool, and how close to one's skin wool can be worn are the attitudes that the respondents expressed in the study.

##### Visual Expectations

Concerning the visual expectations, it is clear that knitted textiles are associated with wool. Such samples are generally made of thick, coarse yarn, and there is generally a pattern. The colours can be bright in the pattern, but are otherwise generally natural and soft.

### **Tactile Expectations**

The tactile expectations, or how the wool textile feels both against the skin and when it is held, are twofold. On the one hand it is expected that wool will feel slightly stiff, coarse and prickly and will likely be loosely knitted. On the other hand it is easy to recognize the soft, thin wool textile which is used in woollen long underwear, and associate such textiles with wool. Wool is therefore expected to be both rough and soft depending on the type of garment. The informants express low tolerance for having coarse wool close to their skin, however thin, soft wool is considered suitable for woollen long underwear. It is expected that wool will feel itchy and prickly, but in this case the informants are thinking mostly of the rougher variation. Many of the informants also sought to judge whether the sample felt “warm” since they expected that wool should feel warm.

The woollen samples that the majority of the informants were not able to identify as wool are particularly those that deviate from these expectations: the textile samples that are thin and woven. These samples are generally identified as cotton or synthetic instead of wool. It also appears to be difficult for some informants to identify the samples which are neither woven nor knitted, or which had an uneven surface.

### **Associations to Garments and Products**

It is common for the informants to associate a sample with a garment or product the fabric sample reminds them of and that they know was made of wool. They used this reasoning to guess the unknown fibre of the sample they held in their hands. The knitted samples are associated with sweaters and wool socks; the thin woollen samples with woollen long underwear; and the woven samples with dress fabric, curtains and upholstery. This can indicate a relatively strong conception amongst the informants of which garments or products are best fit for wool.

### **Season and Function**

The majority of the informants connect season with the use of the different textiles. They are generally in agreement that wool is fit for winter while cotton belongs in the summer. The fact that wool keeps one warm is a function that is highlighted by all the informants. Many say that they choose wool garments when they are looking for something that will keep them warm in the winter. Many also explain that they find wool garments to be expensive, but since they are focused on the function of “staying warm” when they buy

it, and there are no viable alternatives to wool when warmth is the goal, the price becomes less important.

#### 4.2.4 Barriers and Possibilities

In connection to the material test, we conducted interviews on the attitudes towards the use of wool. The informants appear to not be particularly preoccupied with price; they are rather more interested in appearance, design, colour and comfort. They claim to rarely check clothing labels to see what material a garment is made of unless they come across a garment that seems to be synthetic, which they tend to perceive as negative. Negative features of synthetic materials are described, among other things, as feeling like plastic, unpleasant, sticky and easily taking on the smell of sweat. The informants were also asked which material was most environmentally-friendly. While the majority answer “wool” or “cotton,” some are sceptical about cotton as they have heard about the water consumption required in cotton production. Nonetheless, all are in agreement that wool is likely fairly environmentally-friendly while synthetic textiles are not.

This study is valuable as it provides us with an idea of barriers and possibilities for innovation in the wool industry that can be taken from this study. The potential barriers include the notion that wool itches and feel prickly, the focus on wool for specific seasons, and traditionally too much focus on the insulating characteristics of wool. The relatively low number of respondents that guessed what was wool correctly suggests that there are still more that believe that wool itches, than those that actually have experienced that thin types of wool are itchy. This suggests that the use of wool can still see an increase. The possibilities for innovation presented by this study include the perception of wool as environmentally-friendly as well as the potential to focus on other seasons by highlighting other characteristics than wool’s insulating ability. There is also room for innovation in stirring interest in the “unexpected” product categories of wool and replacing certain products normally made with cotton or synthetics with thin, woven wool.

### 4.3 Washing wool

Several experiments on wool wash have been performed to test the effect of spin drying speed and boiling, and to look at soil repellence and stain removal properties. Consumers have many misconceptions when it comes to washing wool. These experiments were intended to present the properties of wool in relation to laundering. As mentioned in the introduction, the purpose was also

to document the properties of use in connection with the comparisons of environmental impact.

#### 4.3.1 Washing wool with other fabrics

Consumers may have trouble filling their washing machines up to the suggested level with their wool wash, because they don't necessarily have enough wool garments to be washed at once. The consequence of this is often that the wool garments either have to wait in the laundry basket for long periods of time, or that they get washed with only one or two garments at a time. It is usually not recommended to store woollen materials dirty over long periods of time, and it is more resource demanding to wash with unfilled machines. Therefore, we wanted to study options for filling the machine with garments made of other materials. The most similar wash program to wool wash is considered to be the delicates wash, and we have therefore decided to compare the cleaning effect by varying parameters connected to these programs. The parameters considered were the cleaning effect of both wool and polyester when altering the washing program, the type of detergent used, and the fibre content of the wash load materials.

#### 4.3.2 Method

Six different washing series were designed. Series 1-4 measure the cleaning effect on pre-soiled polyester strips and series 5-6 on wool strips. The different comparisons are:

1. Cleaning effect on synthetic materials (polyester):
  - Wool wash program versus delicates wash program (comparison between series 1 and 2)
  - Wool detergent versus common detergent for coloured materials (comparison between series 2 and 3)
  - Pure polyester wash load versus mixture between wool and polyester (comparison between series 1 and 4)
2. Cleaning effect on wool:
  - Mixture between wool and polyester wash load versus pure wool (comparison between series 5 and 6)

#### 4.3.3 Conclusions: polyester vs. wool and polyester loads

There is no significant difference in the total washing effect between series 1 and 4. This means that polyester gets equally clean independent of whether the wash load consists of a mixture of synthetic materials with the wool or only pure synthetic materials. When comparing the different washing programs, we see that the delicates program washes more efficiently than the wool program. When comparing the different detergents, we see that the OMO Color detergent washes more efficiently than the wool detergent Milo, when the same delicates wash program is used.

If synthetic materials are washed in a wool program, they do not get quite as clean as they would get on the delicates wash program, especially if wool detergent is used instead of detergent for coloureds.

#### 4.3.4 Conclusion wool vs. wool and polyester loads

There is no significant difference in the total washing effect. This means that wool gets as clean independent of whether the wash load consists of a mixture of synthetic materials with the wool or only pure wool materials. Note that the results are valid for the tested material only.

#### 4.3.5 Shrinkage, pilling, stain removal, and soil

In this study we want to investigate the possibilities to fill the washing machine to full capacity and wash woollen products with other fabrics, using the wool program and detergent. We will focus on properties such as shrinkage, pilling, stain removal, and soil repellence.

#### 4.3.6 Dimensional change and pilling

Laboratory tests were designed in order to study whether woollen products can be washed with other textile materials without increasing pilling and shrinkage. All textiles were exposed to standard atmosphere 20° C, 65 % RH for 24 hours. Three samples from each textile were cut, labelled with specimen number A and B plus one sample for reference. The specimens were marked according to a template for dimensional change 500mm x 500mm or 250mm x 200mm depending on available sample size. The edges were parallel to the length and width of the fabric. Edges were overlapped to avoid unravels during the test. The length and width dimensions were determined before washing, after one wash and flat drying and after five washing cycles and flat drying at the end. Four woven and two knitted pure wool samples were



washed either together with wool or with textiles made of other materials in the same laundry load. Wool samples labelled A were laundered separately from other fibre types. Textiles of mixed fibres were laundered together with wool samples labelled B. Polyester samples were both washed separately and with the mixed textiles. The mixed textiles were line dried. All wool- and polyester- samples were evaluated, in a viewing cabinet illuminated by a white fluorescent tube D 65 daylight, for pilling and fuzzing according to ASTM D 3512 photographic standard after 1st and 5th wash. In addition, woollen specimens' dimensional changes were measured according to ISO 5077.

#### 4.3.7 Results: pilling and fuzzing

The results of pilling and fuzzing after five washes were the same for all 6 wool specimens and 2 polyester specimens: no pilling (grade 5). This was valid independent of whether the materials were washed together with similar fibres or with other materials. This result would probably have been different with materials that were more sensitive to pilling. Some fuzzing was observed, but no significant differences could be found between the two different ways of washing. Our current research did not show any additional significant danger of pilling or shrinkage during the first 5 washes. However, more research in these themes is needed with a wider range of materials and higher number of washing cycles in order to draw final conclusions.

#### 4.3.8 Results: dimensional change

When the specimens washed with wool and specimens washed with other materials are compared, we can see that on some materials there is no difference in shrinkage, whereas on others there are small variations in both ways. If an average value for all specimens is calculated, it indicates that there is 0.5% higher average shrinkage on specimens that are washed together with other materials. However, this is within the 95% confidence limits of the method and therefore is not significant.

**Table 4-3: Dimensional change results for wool specimens after washing them either with wool or with other textiles Results after the 1st and 5th washing cycle are given as an average of length and width dimensions. A negative result indicates shrinking.**

No	Fibre content	Structure	1 <sup>st</sup> wash [%]		5 <sup>th</sup> wash [%]	
			Washed with wool	Washed with other materials	Washed with wool	Washed with other materials
01	wool merino	woven	-2.3	-2.3	-2.9	-2.8
10	wool	woven	-1.8	-1.1	-2.8	-2.7
18	wool	woven	-2.8	-3.6	-5.8	-6.5
19	wool	woven	-3.2	-4.2	-7.1	-8.6
20	wool merino	knitted	-1.7	-2.8	-2.3	-2.6
22	wool	knitted	-2.1	-2.8	-2.4	-3.8
Average all			-2.3	-2.8	-3.9	-4.5
Average woven			-2.5	-2.8	-4.6	-5.1
Average knitted			-1.9	-2.8	-2.4	-3.2
Average merino			-2.0	-2.5	-2.6	-2.7
Average wool			-2.5	-2.9	-4.5	-5.4

#### 4.3.9 Spinning speed

Wash programs for wool often have reduced spinning speed in the area of 400-1000 rpm. This can result in more residual moisture on the garments after washing than when washed at higher spinning speeds. This therefore requires longer drying time. In this study we wanted to investigate if the low spinning speed is required to prevent shrinkage in wash, or if the garments could be dried more effectively with a higher spinning speed. We have also measured the residual moisture content.

Three wash series were designed with different spinning speeds, 400, 900 and 1400 rounds per minute. The shrinkage was tested on two different woollen materials, standardised shrinkage test fabrics, and woollen underwear. According to the producers, the woollen underwear has a “super wash” treatment, whereas the standardised test fabrics do not. The shrinkage was measured after the first and the third washes.

The results showed that none of the woollen test materials shrank more when the spin-drying speed was increased to 1400 rpm. There were no significant differences in shrinkage.

The effect on residual moisture was significant, as specimens spin-dried at 400 rpm had much higher moisture content than the specimens spin-dried at 1400 rpm (47% as opposed to 24%). The spin drying speed results indicated that the drying time of garments can be significantly reduced by increasing the spin speed and that wool can be spin-dried at high speed (at least up to 1400 rpm) without causing additional shrinkage. However, when interpreting the results one still has to take into account that wool does shrink readily if the mechanical action is performed in the way that the wet fibres move and get entangled. Therefore, the spinning program has to have rapid accelerating and decelerating phases, so that the centrifugal forces will keep the garments trapped in place against the walls of the drum during the spin-drying.

**Table 4-4: Average residual moisture after 1st and 3rd wash at different centrifuge speeds**

Spin speed	Residual moisture
400 rpm	47.0 %
900 rpm	29.2 %
1400 rpm	24.0 %

#### 4.3.10 Boiling wool

The purpose of the test was to see how different woollen products tolerate being boiled. We wanted to see if wool can be boiled enough to decrease bacterial counts without causing additional shrinkage. According to “Hygiene requirements and guidelines for the treatment of textiles used in health institutions,” textiles that are in contact with patients or personnel should be treated at 85 °C for a minimum of 10 minutes (Helsedirektoratet, 1994). We also were interested in boiling wool, because many consumers assume that wool does not tolerate more than 30-40°C water temperature, because most wool wash programs use these temperatures. However, many wool treatments during production, such as dyeing, do include subjecting wool to warmer temperatures or even boiling. Of course, the essential difference between washing and other treatments that use hot water is the level of mechanical processing.

Six new woollen samples were boiled in tap water in a large kettle on a stove. All specimens were boiled separately. In addition, one pre-washed sample was tested. The dimensions of samples were measured before and after the

treatments to document the dimensional changes and shrinkage percentage (ISO 5077:2007). Furthermore, changes in appearance were evaluated.

#### 4.3.11 The effect of boiling

The new woollen specimens shrank 1-4% during the boiling process. Sample 20, which had been washed beforehand, did not shrink anymore in boiling. The same materials have been tested for dimensional change in wash at 30 °C wool program with Milo (the most widely used wool detergent on the Norwegian market), the results are available in the test report 12-2011 (Kjeldsberg et al., 2011). These are compared in Figure 4-6. Four out of the six specimens shrank less in 10 minutes boiling than during one wool wash, and five boiled specimens shrank less after boiling than after five washes. These results indicate that careful boiling on a stove does not cause more significant shrinkage to woollen specimens than washing at 30°C with the wool program.

All specimens were either white or off-white. Some of them became less white during the wash, and some even were stained yellow. This could be a problem for both white and coloured textiles.

The results showed that wool tolerates boiling as well as being spin dried at high velocity (at least 1400 rpm) without causing additional felting shrinkage, as long as there is no mechanical action that could cause the fibres to get entangled. Therefore, the acceleration and slowing-down phases of a spin-drying program have to be rapid, so that the centrifugal forces will keep the garments trapped in place against the walls of the drum.

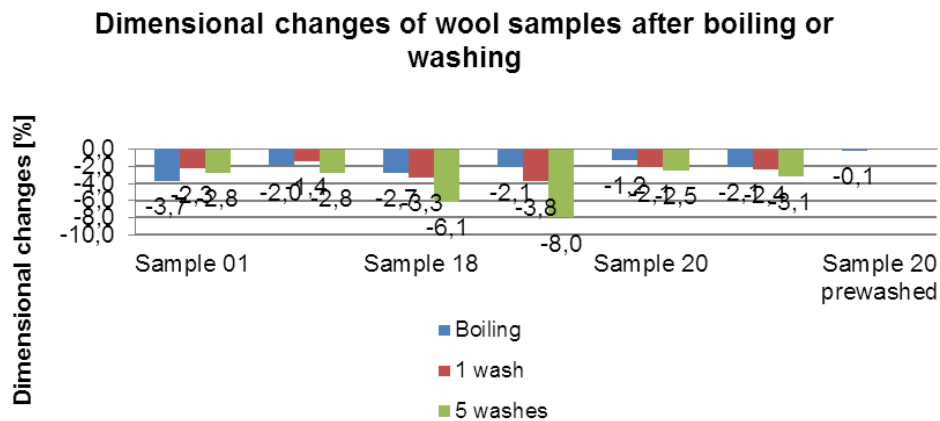


Figure 4-4: Dimensional changes of wool samples after boiling or washing.

#### 4.3.12 Stain removal

In order to study wool's stain removal properties, and to compare wool with other textile materials, 19 different types of textiles were soiled, washed and evaluated. The soiling agent selected were: red wine, coffee, olive oil, hot chocolate, tomato sauce, and banana and mango smoothie. This selection was made because substances containing protein, fats and colour dyes are known to make problematic stains that are difficult to remove in laundering. The chosen products are known among Norwegian consumers and available in grocery stores. The substances were also chosen due to their ability to be applied using a micropipette. All textiles were white or very light in colour and washed five times before the test in order to remove non-durable finishes. The same specimens used for dimensional change and pilling were used in this test.

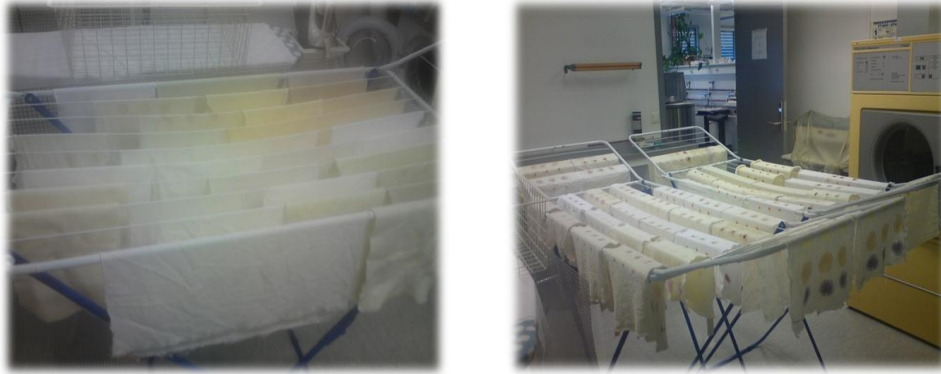


**Image 4-1: The left panel shows soil substances used in the test and the right panel shows stain application.**

Soiling was conducted at 23°C and 55 % RH. The soiling substance was at room temperature 23°C when applied on the textiles. The test specimens were placed on a smooth horizontal surface with the face-side up. Small drops of soil, 200 µl were placed carefully on the fabric surface using a micropipette and a plastic laminated template. See Image 4-1.

In most cases penetration or wetting and wicking occurred. Some test specimens showed resistance to wetting indicated by a clear, well-rounded drop with high contact angle. This is characteristic of a fabric whereby it resists absorption of soil. In this test the aim was to compare wool with other fibres and fibre mixes due to stain removal. To help the stain to stick to the fabric, the droplet was carefully stirred with a needle in order to disturb the surface tension for letting the wetting and wicking occur. This was the case of some wool and woollen mixture samples, besides for olive oil that was readily ab-

sorbed by all fabric types. The test specimens were line dried overnight and then laundered all together and line dried. Ref. Image 4-2.



**Image 4-2: The left panel shows line drying after staining and the right panel shows line drying after laundering.**

#### 4.3.13 Soil repellence

Soil repellence was studied in order to see whether it is possible to remove the soiling before it causes permanent staining. Resistance to wetting and thereby soiling is indicated by a clear, well-rounded drop with a high contact angle, as in Image 4-3. This kind of liquid droplets may touch lightly on the surface and easily roll off before being absorbed into the fabric. This allows time for liquid spills to be wiped from fabric before they can cause permanent staining. To investigate this phenomenon, three types of liquid soiling, red wine, coffee and hot chocolate, that had showed some resistance to wetting in the stain removal test, were selected. The 22 specimens included different types of wool, synthetics, silk and fibre mixtures. These samples were washed 10 times before the test prior to being soiled. The test specimens were placed on a smooth horizontal surface with the face-side up. Small drops of soil, 200  $\mu$ l, were placed carefully on the fabric surface using a micropipette. After about 5 seconds, paper towels were used to wipe and soak up as much of spilled liquids as possible. Two observers rated the specimens independently according to the procedure described in the stain removal test.



**Image 4-3: The left panel shows red wine droplets on knitted wool and the right panel shows coffee droplets on woven wool**

After the first and fifth washing cycle with the wool program and detergent and after the wiping that occurred five seconds after soiling, four observers rated the test specimens independently. Evaluation was performed in a darkened room in a viewing cabinet illuminated by white fluorescent tube D 65 daylight. The rating took place according to the following scale:

- Very visible stain
- Visible stain
- Slightly visible stain
- Hint of stain
- No visible stain

**Table 4-5: Average soil repellence and stain removal results divided by stain types and fibre groups.**

Soil type	Cleaning	Wool	Wool-mix	Synthetic	Cotton	Silk	Knitted	Woven
Red wine	Wiping	2.4	1.3	1.0	1.0	1.0	1.8	1.4
	1 wash	2.2	2.1	3.9	1.4	1.0	1.7	3.0
	5 wash	2.6	2.1	3.4	1.8	1.6	1.8	3.1
Coffee	Wiping	3.3	1.6	1.8	1.0	1.0	2.2	2.4
	1 wash	2.6	2.7	4.8	2.5	1.9	2.6	3.5
	5 wash	2.9	2.7	4.8	2.5	2.0	2.6	3.6
Olive oil	1 wash	4.7	4.8	5.0	4.8	3.4	4.7	4.8
	5 wash	4.9	4.7	5.0	4.9	4.5	4.8	4.9
Hot chocolate	Wiping	2.4	1.4	1.0	1.0	1.0	1.9	1.4
	1 wash	3.3	2.9	3.5	1.5	1.5	2.6	3.3
	5 wash	3.9	3.1	4.3	1.6	2.0	2.8	3.9
Tomato sauce	1 wash	2.9	2.8	3.9	2.3	4.2	2.5	3.6
	5 wash	4.5	4.4	4.8	4.0	4.8	4.1	4.8
Banana and mango	1 wash	3.3	3.0	3.2	3.0	5.0	2.9	3.5
	5 wash	3.9	4.4	3.3	3.8	4.8	4.0	3.9
Mean	Wiping	2.6	1.4	1.3	1.0	1.0	2.0	1.7
	1 wash	3.2	3.0	4.0	2.6	2.8	2.8	3.6
	5 wash	3.8	3.6	4.3	3.1	3.3	3.4	4.0

#### 4.3.14 Results for stain removal and soil repellence

Many woollen fabrics are soil-repellent against water based soils but if stains do occur they are more difficult to remove than on synthetics or knitted fabrics. This may be explained by the denser structure that did not allow the soils to be absorbed to the same degree as on knitted fabrics. However, soil repellence properties are easily affected by surface treatments and can therefore be modified for the different fibre and fabric types.

Soiling of textiles may occur in a number of ways : accidental spillage of liquids, static attraction of dirt and dust, and re-deposition of soils during laundering. Untreated woollen fabrics in particular showed good soil repellence against water based soils, as the outer layer of woollen materials is hydrophobic. While the wool often repelled initial spills, if the staining had the oppor-



tunity to set in, it was more difficult to clean wool compared to synthetic fabrics. Cotton materials got even more soiling, but it tolerates more efficient washing and detergents than wool does. For further research, different techniques for stain removal on wool could be studied.

#### 4.3.15 Wool in healthcare and beyond

These results indicate that there are several properties in wool and wool cleaning which can make the use of wool more practical, particularly in healthcare. The use of wool has the potential to increase the comfort of the people living in health care facilities while also meeting standards for hygiene. One has to also take into account that hygiene is just one of several reasons for washing clothes. Other important reasons are aesthetic. Newly washed clothes have a different smell, feel, and texture than used clothing. Washing frequency has increased rapidly since the second half of the 1900s up to the present day. Thus we wash much more frequently today than what is necessary for hygienic reasons [Klepp, 2003; Klepp, 2005]. The frequent washing of clothes causes wear and tear on clothing, creates extra work and environmental consequences. Woollen products are washed less frequently than products made of other fibres [Laitala et al., 2011]. Therefore, an increase in the use of wool can be a way to reduce washing frequency. We will continue the discussion on lowering washing frequency by using wool in the context of sportswear and the smell of perspiration.

#### 4.4 Wool, smell, and sweat

Our informants have noticed that wool tends to hold smell less than other fabrics and that airing is a method for keeping wool clothing clean and fresh. In order to determine whether these conceptions were accurate, and to document these characteristics of wool that are poorly documented, an experiment was conducted to test the development of the smell of sweat in various sportswear textiles, including wool. The questions addressed in this experiment are particularly salient at this time where there is an increased amount of attention paid to body odour in relation to clothing. In recent years there has been an introduction of odour resistant textiles onto the sportswear market which are made using technology whose effect on humans and the environment is still unclear (Joshi & Bhattacharyya, 2011; Kemikalieinspektionen, 2011). These questions surrounding odour and various textiles are therefore important to discuss.

#### 4.4.1 The smell experiment

This experiment developed a method for gathering sweat and judging smell in textile samples in order to research how various materials that are used in exercise clothing smell after use, airing, and wash. The following tests were also carried out: the item mass per unit area, method according to the standard NS-EN 12127:1997, water retention rate according to the modified method based on standard NF G 07- 166: 1993.

Thirteen different textiles; divided into the categories of odour resistant, wool, cotton and synthetic; were tested. All the textiles were washed five times before the testing in order to remove non-durable finishes. The effect of fabric softener was also a point of interest for this research, with a few samples being washed with unscented fabric softener. The samples were evaluated by a consumer panel comprised of 12 SIFO employees. The results are based on 3200 observations and the calculations were performed using Excel and SPSS. The test was carried out in partnership with Myren Sportssenter in Oslo in the time period from the 12th to the 26th of September, 2011.

In the sensory test, we sought to determine whether fabric softener affects odour properties of different types of textiles over time, and whether it is easier to remove the odour by airing and washing textiles made of some fibres than others.

Four different materials used in sports clothing were tested for odour formation (Table 4-4). Textile samples were pre-washed five times before testing either with or without fabric softeners, and then sewn to gym mat covers that were used by 30 circuit training participants that sweated on the samples (Fig. 4-1a). All samples went through several use, washing, and airing rounds and their odour was evaluated at eleven stages during a 15 day test period (Table 4-5). The only exception was a cotton specimen washed with conditioner, as it was included in the test only from stage 7 and forward. Therefore, average results on this specimen are less reliable than on other specimens.

**Table 4-6: Test material**

Sample	Product	Brand	Fibre content	Structure	Information on the fabric/product
1	Sweater	Janus	100 % merino wool	Knit	Keeps the body warm. No itch. Eco-Tex labelled
2	Sweater	Craft	100 % polyester	Knit	Keeps your body dry and comfortable during intense exercise in fair to cold conditions
3	T-shirt	Skillmill	100 % cotton	Knit	
4	T-shirt	Casall	85 % polyester 15 % cotton	Knit	Dri-release® microblend performance fabric contains Fresh Guard® eliminates odour in garments by blocking odor causing sebaceous body oils from attaching to the fabric.
5	T-shirt	Pro Touch	92 % polyester 8 % elasthan	Knit	Dry plus climate regulation. Moisture wicking fabric keeps you dry and comfortable during activity.
6	Sweater	X-Bionic	90 % polyamid 9 % elasthan 1 % polypropylen	Knit	Bionic energizer™, Skin NODOR® nano technology preventing bacteria growth, air-condition channels lead moist away from the skin.
7	Shirt	Haglöfs	57 % recycled polyester 43 % polyamid	Woven	Stay fresh active odour control Polygiene® based on natural silver salt inhibiting the growth of odour-causing bacteria.
8	Shirt	Norrøna	77 % tencel 12 % recycled polyester 11 % polyester	Woven	Fast drying fabric treated with Polygiene™ anti-smell technology according to retailer's homepage. No labelling.
9	Metre fabric	Dovre	100 % cotton	Knit	
10	Metre fabric		100 % polyester	Knit	
11	Knit sample	Curtis Wool Direct	100 % Norwegian wool	Knit	Single jersey tubular

12	Knit sample	Curtis Wool Direct	100 % Norwegian wool	Knit	1x1 rib double jersey
13	Sweater	Nøstebarn	100 % wool	Knit	100 % kbTSchurwolle IVN zertifiziert best naturtextil übertrifft global organic textile standard
14	See 4				Washed with fabric softener
15	See 10				Washed with fabric softener
16	See 1				Washed with fabric softener
17	See 3				Washed with fabric softener

Samples were aired and dried flat on a perforated steel table indoors (Fig. 4-1b). Airing time is given in Table 4-4. All samples were laundered according to the instructions given in the care label at 40°C in a domestic washing machine. Wool specimens were washed with the wool program and wool detergent, while the other samples were washed with the regular program and liquid detergent for coloured textiles. To test the effect of fabric softener, the washing was done either with or without a commercially available, fragrance-free, rinse cycle fabric softener for domestic use that included 5-15% cationic surfactants. Scented fabric softeners are more commonly used than fragrance-free softeners. We chose to use fragrance-free type in the test for several reasons. We were more interested in the general properties of softeners, not specific fragrances that can be added to the basis formulation. Secondly, the use of fragrances would be methodologically difficult as fragrances can have a very strong odour that might "hang" in the specimens and air making repeated observations difficult. Thirdly, there are great personal differences in whether perfume odours are experienced as positive or negative, and there are a great variety of different scented softeners in the market. In general, however, sweat smell on clothes is experienced only negatively.

**Table 4-7: Test treatment**

Treatment of sample	Judging time
Sweat 1 moist samples	1
Aired 16 hours	2
Sweat 2, aired 62 hours	3
Washed 1, sweat 3, aired 12 hours	4
Aired 28 hours	5
Washed 2	6
Sweat 4, aired 62 hours	7
Sweat 5, aired 12 hours	8
Washed 3	9
Washed 4	10
Aired 17 hours	11

Odour intensity was evaluated at eleven stages during testing by a panel consisting of 12 consumers with equal gender distribution and between the ages of 23 and 55. Assessors did not know what happened to the samples between each stage. None of the participants was trained sensory analysts, and therefore they received a brief introduction to what can affect the human senses and odour evaluation. The use of perfumes, soaps or lotions with strong odours was advised against, and the evaluators were told to avoid smoking and eating right before the tests. The test area was kept as odour free as possible and conditions were kept stable at a humidity of  $55 \pm 5\%RH$  and temperature  $23 \pm 2^\circ C$ . Not all panellists had the opportunity to evaluate at every stage, and therefore the number of assessors varies from six to eleven, with an average of nine. Fabric samples were placed in an opaque container anonymised so that assessors could not know which sample they evaluated. Samples were placed in the containers in the morning immediately before they were evaluated, with the exception of the first evaluation when they were inserted in the containers moist and sweaty directly after exercise, and stored overnight in the container before they were assessed the day after. This was done to emulate a situation when sports clothing is left in a bag after a workout. Sample containers were washed and dried between each evaluation.

Each sample was measured twice per assessment day by each panellist in order to ensure reliability and internal consistency. One-way ANOVA analysis of variance (comparing means) showed no significant differences between these two assessments. The samples were evaluated for odour intensity on a scale from one to five (only integers), with one indicating “no odour” and five, “very strong odour.” It was also possible to characterize the odour in the evaluator’s own words. Moreover, the assessors indicated whether they would launder the clothes with this odour. The data were processed statistically using SPSS and Excel software. More details of test procedure can be found in the test report [Kjeldsberg et. al.].

#### 4.4.2 Wool smells like wool – not sweat

The textiles made of wool smell the least, while odour resistant textiles smell less than other textiles of polyester, but more than cotton and wool. The use of fabric softener increases the odour intensity and likelihood of putting the textiles back in the wash for polyester and odour resistant textiles. On wool, however, fabric softener has the opposite effect. Wool and cotton respond well to airing, while the odour resistant and synthetic textiles do not.

In other words, there are materials which have a lower smell intensity and can be washed less often because of their lack of smell than textiles which claim to control odour. For outdoor exercise, wool would be an alternative which smells less intense, while also having many beneficial qualities such as the ability to regulate body temperature, requiring less washing (and thus saving energy), and proving to be highly durable (Laitala, Klepp & Boks, 2012; Tortora, 1982).

Additionally, the lower smell intensity relating to wool implies that it could have less environmental impact deriving from frequent washing. The use of wool, due to its ability to be washed less frequently, can thus be an advantage both for the environment and the consumer.

### 4.5 Concluding remarks

Understanding the use of textiles and the characteristics around the use of each textile, requires knowledge of fibres, practices and attitudes. While scientific experiments shed light on the physical and mechanical properties of the textiles, the material test and the wardrobe study combined with interviews illuminates the relationship between the physical/mechanical and the use, attitudes and knowledge around the textile. This has consequences both

for the opportunity to respond to the question we have posed regarding the analysis of the material. The question, how is wool incorporated into today's consumption, is only partly answered. The comparison between England and Norway shows that there are great geographical or national variations in these consumption patterns. This suggests that many comparisons are necessary to map these consumption patterns. The relationship between the wardrobes and the development of the market and marketing is also a question that should be looked more into. We need, in other words, both a better analysis of the material we have, a wider range of information on the use of wool today, and not least an historic analysis in order to respond to this question in a satisfactory way.

The next question we looked at was: What are the possibilities and barriers related to increased use of wool? This question relates to the first. Why is wool's warmth experienced as a problem in England and an advantage in Norway? Is this only a question of climatic differences? As far as the itchiness of wool, this is also an unsolved question. When half of all the samples in the material test were not recognized as wool, it means that wool is not so easily identified as "itchy". The relationship between expectations, attitudes, and experienced characteristics must therefore be studied more closely. This has meaning for Norwegian wool because the focus on softness is one of the changes that has led to favouring a wool fibre other than Norwegian crossbred. How can this focus transform from what Norwegian wool does not have (such as softness) over to properties such as sheen, colour and resilience?

We have come a long way in documenting the last question, benefits of wool in terms of the use phase. But for a breakthrough in regards to the large comparative aspect of this work, it needs to be continued. We need many different type of fibres to be included and many samples of each material in relation to studies of smell.





## 5 In search of a label for Norwegian wool

A large majority of Norwegian textile firms - and in particular the wool based part of them use Norwegian nature, flags, names etc. in their marketing of the products. As we have shown, there is a clear correlation between wool, the perception of Norwegian nature and the traditional Norwegian outdoor activities. Our rich textile tradition, clean nature, and cold climate make such a link obvious. However, we have also seen that Norwegian wool as raw material is not highlighted in any particular way by those who use Norwegian wool. On the other hand, we find the use of Norwegian flags, nature, names, and sheep breeds etc. on products that do not contain Norwegian wool. There is missing a common brand for Norwegian wool. The issue of labelling is complex and is influenced by both written and unwritten rules. We wish to contribute to this debate through this report. In this section we collect some of the background information that may contribute to such a debate. First we will discuss what Norwegian wool is, before we look at some of the labelling found on textiles. Then a review of origin labelling of food will help put the textile labelling issue in perspective. We end the chapter by looking at the origin labelling of textiles in other countries, and discuss the need for labelling of Norwegian wool from various stakeholders viewpoint.

### 5.1 What is Norwegian wool?

Initially we thought that the answer to this question was obvious. Within the title "Valuing Norwegian Wool" we have always understood *Wool* as a raw material from sheep in Norway. During the course of the project we have met other ways of perceiving what Norwegian wool is. These different definitions can be summarized as follows:

1. Wool from Norwegian sheep breeds
2. Wool from sheep that live in Norway

3. Products made of wool and capitalised on in Norway regardless of the origin of the wool
4. Products made of wool by Norwegian companies
5. Products that are based on traditional Norwegian patterns

The first definition of the 'Norwegian'; *Wool from Norwegian sheep breeds* - we find amongst those who are working with older Norwegian breeds. They believe, rightly - that a lot of Norwegian textile tradition is rooted in the Norwegian sheep breed spelsau with its special characteristics of the cover wool's strength and shine and the softness of the bottom wool. The interest in these older breeds is growing, but the utilization of the wool is currently poor. The understanding of Norwegian wool as wool from the Norwegian breeds is also an attitude that manufacturers of merino wool in Norway meet. However, according to Leine Merino this attitude is becoming weaker. This is probably also an attitude manufacturers of wool from animals other than sheep (ex. alpaca) may meet. There is a need to find better uses especially for the naturally coloured wool, and for the "old" sheep breeds - spel and villsau (wild sheep). This may include machine-less action and more hands-on processes, but then the price has to reflect the labour-costs. This will again depend on how one tells the story of these fibres, including how they are labelled. Looking at the challenges that exist in the supply chain for wool the main problem is connected with where the big volumes are: Norwegian crossbred. Nevertheless, it is still important to preserve diversity in the Norwegian production of wool - also within a potential labelling system.

The second definition; *Wool from sheep that live in Norway* - is the one we have used in the project and which is also the most common definition amongst the majority of our informants. This definition corresponds with how other agricultural products are referred to - for instance is the definition of Norwegian tomatoes and potatoes not dependent on the origin of the specific types.

The third definition; *Products made of wool and capitalised on in Norway regardless of the origin of the wool* - is based on the value creation the processing industry represents. In this definition wool as raw material is not emphasized. Later in this chapter we will look at rules of country of origin labelling - which have much in common with this definition.

The last two definitions of Norwegian wool; *Products made of wool by Norwegian companies* and *Products that are based on traditional Norwegian patterns* we have not encountered amongst our informants. However, we see them frequently in the marketing of woollen products. For instance, there are

product names based on Norwegian sheep breeds such as 'Spelsau' applied to products manufactured from merino wool abroad, and Norwegian flags and other strong Norwegian symbols are used on similar products. The aim of a common marketing and labelling of Norwegian wool must be to make clear to the consumer what is made of wool from Norwegian sheep, what is produced in Norway, and what are merely products marketed by Norwegian companies.

## 5.2 Labelling textiles

This section about textile labels is mainly based on the *paper «Environmental and ethical perceptions related to clothing labels among Norwegian consumers»* by Kirsi Laitala and Ingun Grimstad Klepp (in press), as well as an unpublished note about textile labels (Stø & Laitala 2011).

We can distinguish between mandatory and voluntary labels in the following way (Rubik 2002):

- Mandatory labels like the EU energy label, relevant for household appliances and chemical products
- ISO-type I eco labels, classical second-party labels like the EU-flower, the German Blue Angel and the Nordic White Swan.
- ISO-type II eco labels, self-classification by industry or retailers
- ISO-type III eco labels, quantitative environmental product declarations (EPD)
- Other relevant labels, including social labels and fair trade labels
- Other not relevant labels, including recycling symbols like the green dot

The mandatory labels are based upon EU-directives and are valid for household appliances and some chemical substances. This is not the case for textile; the only mandatory textile labels deals with fibres and washing instructions. The country of origin labelling is not mandatory in the EU at the moment, but it is under evaluation for clothing imported to EU (IMCO 2011). At the same time, labelling of animal-derived materials may become mandatory.

The most common labelling of textiles includes fibre content, zesting and brands. Labelling fibre content is mandatory in Norway and many countries such as the USA and EU. This legislation only applies for the fibrous part of the garment and should therefore not be confused with content labelling. The country of origin labelling is mandatory in the USA, but not in Norway or the EU (Federal Trade Commission, 2005). For a product which has been pro-

duced in more than one country the product shall be determined to have origin in the country where the last substantial transformation took place. To determine exactly what was the last substantial transformation, three general rules are applied:

1. Change of tariff classification
2. Value added-rule
3. Special processing rule, the minimum transformation is described. For instance, in the EU non-preferential rules of origin for T-shirts (HS6109), the origin is supposed to be in the country where the complete making-up was done. According to the non-preferential rules a product always has exactly one country of origin. However, the non-preferential rules may differ from country to country; the same product may have different origins depending on which country's scheme is applied. Usually it is the rules of the country into which a product is being imported that apply. However, the labelling is under evaluation for clothing imported to EU (IMCO, 2011).

### 5.2.1 The Blue Angel and the White Swan

The Blue Angel in Germany was the first voluntary ISO-type I label in the world, established in 1978. During the 90ties similar eco-labels were established in nearly all EU and EFTA countries (Rubik and Sheer 2002). Most of the labels are national based and are run by national eco labelling bodies, with the exception of the White Swan established by the Nordic Council of Ministers and valid for all the Nordic countries. The labels cover both consumables, durables and services, and the main focus is the environmental impact of the product, in a life cycle perspective. However, in most cases the classical eco-labels do not include foodstuffs. There are usually developed own national labels for organic food. The criteria are developed in a multi-stakeholder perspective and the actual label is a positive, well known symbol

### 5.2.2 The EU-flower

The EU-flower covers goods and services within the European Economic Area and was established by EU directive in 1992. The EU-flower has so far not managed to function as an effective environmental product information scheme in Europe (Rubik and Frankl, 2005). Labels are found on a limited number of textiles and clothes in the most common classical labelling schemes.

### 5.2.3 ISO

A large number of ISO-type II like labels are found in the European market, established and run by the industry or retailers. These self-classifications are normally one dimensional, covering only certain aspects of the product, like recycled paper products.

ISO-type III labels – Environmental Product Declaration (EPD) - are under development in Europe. These quantitative data will, however, be more relevant in a business-to-business communication. Made By, Higg Index and EcoMetrics are tools that producers can use for evaluation of the environmental effects of different production methods. These are meant to be used for calculating an overall score for a particular fibre, product or process. Some are based on total life-cycle of a product and consider the impact on water, energy, use of non-renewable resources and pollution, others evaluate just the fibre (Kviseth, 2011).

### 5.3 Woolmark



**Figure 5-1: Woolmark labels.**

The label that is most commonly used on Norwegian wool is neither an eco-label nor a label of origin, but a trademark owned by Australian Wool Innovation Limited (AWI). A survey, conducted in order to investigate consumer attitudes towards eco-labelling on textiles, reveals that 67 percent of the Norwegian respondents associate Woolmark with quality. Only 19% do not know the label. In comparison only 14 percent associate the EU flower with the environment, and 58 percent do not know what it means (Austgulen, 2012).

AWI licenses Woolmark and the label can be used by affiliated vendors on their products as an assurance that the product conforms to a set of standards defined by the organization. AWI claims that the label is used on wool textile

products to assure that the product is made of 100% pure new wool. The brand was originally owned by the International Wool Secretariat founded in 1937, which later became the Woolmark Company Private Limited. The trademark was acquired by AWI in 2001. The brand's history goes back to the emergence of synthetic fibres in the 1950s, when there was a need to label the textile products with fibre content. The Norwegian regulations for fibre labelling are addressing the same issue. Many Norwegian textile companies use the brand that is well known in the Norwegian market.

#### 5.4 Labelling of origin; food

The following section is based on the report «Selection and ignorance: consumer strategies to manoeuvre the diversity of labels» (*Seleksjon og ignorering : forbrukerstrategier for å manøvrere i merkemangfoldet*) (Heidenstrøm et. al. 2011).

Labelling has become an increasingly important and frequently used tool to signal where products originate from and how "authentic" the ways of presentation are regarding food. This applies especially to food labelling where products are related to nation, region or specific locations (Amilien a al.2006). Some of these schemes are defined by EU-regulations, others have been created through cooperation between national and regional authorities and the food industry. In Norway, a generic labelling system called "Godt norsk" (Positively Norwegian) been replaced with "NYT Norge" (Enjoy Norway). The new scheme has come as a result of cooperation which includes primary producers, industry and trade. The scheme is linked to the quality control system KSL and administered by the Foundation KSLMatmerk.

The NYT Norge website states: "All items marked with NYT Norge meet certain standards of quality throughout the value chain - from the farmer to the table. When you buy foods labelled NYT Norge you can be assured of foods where the interests of animals, humans and the environment are safeguarded in a good way. "The NYT Norge label has been on Norwegian consumer products since the fall 2009" (NYT Norge). KSLMatmerk gets its funding from and operates on behalf of the Norwegian Ministry of Agriculture and Food (MAF), which helps to give the system a public stamp to it. KSLMatmerk also manages several other labelling systems in the food sector. For instance "Spesialitet Norge" (Specialty Norway) and "Beskyttet geografisk betegnelse" (Protected Geographical Indication). They are also responsible for the promotion of organic goods.



Figure 5-2 Origin labels.

#### 5.4.1 Spesialitet Norge

The label “Spesialitet Norge” endorses Norwegian produced food products with special qualities. The scheme covers both innovations and more established products, often with a local or regional association (KSLMatmerk). The label aims to offer consumers “real food experiences”. The label is designated to a product after an extensive application process and the recommendation of an independent advisory board. About thirty manufacturers had earned this label in Norway in 2011.

#### 5.4.2 Beskyttet geografisk betegnelse

The label “Beskyttet geografisk betegnelse” is administered by KSLMatmerk according to EU rules and regulations (Regulation on 5 July 2002 No. 698 on the protection of designations of origin, geographical indications and designations of traditional character of Agricultural food products, fish and fish products, § 15). To earn the label the designation of the food product must specify the name of a geographic area or a place. The product must have originated in this area or site. A distinctive quality, reputation or other characteristics must be attributed to the defined area or the site's geographical environment. The food product must be produced (raw materials), worked or processed within the defined area. As of February 2011, there are 18 products that have earned the right to this label.

Looking at the design of the label "Beskyttet geografisk betegnelse" the “Selbu rose” is a dominant figure. This is probably the most used knitting pattern

in Norway, which is also used abroad as a symbol of Norway and Norwegian folk art. The Selbu rose is sometimes called the Selbu star and the Norwegian star. The Norwegian retailer Husfliden has a colourful Selbu rose as their brand. Although this pattern is found in folk art in other countries and in Norway in other materials – it is closely associated with Norwegian textiles - especially the knitting tradition. However, the label only applies to food products.

### 5.4.3 Olavsrosa



**Figure 5-3: Olavsrosa.**

The label communicating Norwegian heritage, Olavsrosa, can be found on a few products. Olavsrosa is administered by the member organization Norsk kulturarv founded in 1993 by Oppland fylkeskommune. Several public and private actors have later joined the organization that has an advisory board that awards the Olavsrosa to products after an overall assessment of the product quality. The assessment emphasizes the product's cultural value, how the cultural-historical values are safeguarded, and how the product is organized and conveyed to the audience (Kulturarv). The Olavsrosa can be found on several kinds of products, not solely on food.

## 5.5 Labelling of origin; wool

The initial report on the findings from the Central Research Office for Agricultural Associations (CROAA) suggested that farmers value the fact that his or her wool is used in fashionable design- and heritage-products rather than squandered on non-origin, generic products (Hillestad & Fjellhammer, 2011b). Of those surveyed, 89 per cent responded yes to the question of whether they think that an increase in the use of Norwegian wool in Norwegian design and fashion products would lead to a better reputation for Norwe-



gian agriculture and wool. When the sheep farmers were asked whether a Norwegian wool label would increase pride and the prioritization of wool production, 83 per cent respond that such attention and labelling would be positive. There are 721 sheep farmers that responded to this question. Thus pride might have been under-estimated as a motivational factor. The report revealed that participants wanted to know more about what use is made of the wool, they wanted to learn more about the supply-chain.

From a consumer perspective, the question is a little more complicated. The knowledge about the relationship between raw wool - and woollen products is as we have already pointed out - deficient. Many people are surprised when they hear that sweaters and folk costumes from Norwegian suppliers are not made of Norwegian wool. Thus consumers lack necessary prerequisites to demand this missing information.

The key-note speaker at the IWTO congress in New York 2012, the designer Joseph Abboud, said that if he was to use American wool in any of his collections, there would have to be a label which clearly signalled this. As other countries are increasingly labelling their indigenous wool, and Woolmark is positioning Merino as a “different” type of wool that is guaranteed not to itch; one will have to look a lot closer at what a Norwegian wool label would entail also in terms of environmental benefits. The same argument was conveyed by the two CEOs of Gudbrandsdalen Uldvarefabrikk. The first order of business if they were to start using Norwegian wool, would be an eco-label accompanying the wool.

### 5.5.1 Viking Wool

Curtis Wool Direct has developed the brand Viking Wool for Norwegian wool. The brand has not been introduced in Norway, but is used in the marketing of Norwegian wool abroad. However, Curtis Wool Direct wishes to introduce it in Norway as well. We find this brand not to be suited for marketing of apparel textiles, especially not in Norway due to the connotations associated with Vikings and how the tourist-trade has cheapened the value of this cultural heritage. There is also a yarn on the market called Viking Yarn which is made in China from wool of unknown origin. An important challenge within the wool industry is to establish a system for branding Norwegian wool that can work for a larger part of the value chain and on several different products.



**Figure 5-4: Viking Wool.**

This is also a question of credibility. The tops and wool bales that return from Haworth Scouring and Curtis Wool Direct may or may not be 100% Norwegian. The origin is not being confirmed by said companies. If one is to develop an origin label, this will have to guarantee that the wool is Norwegian. The “Norwegianness” will also have to be defined as it is scoured abroad, along with ownership of such a label. There is also a question of wool quality. Inquiries into this issue has implicated that Viking Wool tops are not based on the Norwegian wool classes A1 or C1.

#### 5.5.2 Examples from New Zealand, Iceland, Australia, Switzerland and Britain

Two of the wool countries competing with Norway, New Zealand and Iceland have beautifully designed labels of origin, and New Zealand wool has attained the EU Eco-Flower. Swiss Wool with its control over the entire value-chain and product-development is another interesting example of how other countries are positioning themselves in the market. The same applies to Britain.

Norilia now is looking at its own label for Norwegian wool. Sadly, Norwool is taken, but Nordwool is not – this used to be a cooperation amongst others Sandnes Ullvarefabrikk (before it became Sandnes Garn) and Gubrandsdalen Udlvarefabrikk in the 1950's. They had agents in Germany. Supposedly, the biggest tops-maker in Germany before World War II was called Nordwolle.



Figure 5-5: Examples of labels of origin.

## 5.6 Concluding remarks

How an improved labelling of Norwegian wool can be developed is an open question. Several issues must be addressed; including who will develop, own and control the brand, and whether it is appropriate to cooperate with labelling for other agricultural products. From sheep, we do not only get wool, but also meat, and it is thus possible to envisage a common labelling system. No matter how a brand defined and organized, it is essential that it gives the finished product added value. This will depend both on the brand's appearance and credibility.



## 6 Conclusion - Challenges and opportunities

The research on the value chain of Norwegian wool has shown that there are substantial challenges within the industry, both in relation to the value chain itself, but also in making visible the production and products that are in fact made in Norway with Norwegian wool. However, we have more to be proud of than we realize, but we have a long way to go to utilize and develop the potential of Norwegian wool in the best possible way. In this section we wish to summarize the identified challenges and opportunities for Norwegian wool and the implications of our findings.

### 6.1 The production of wool – Norwegian agriculture and agricultural authority

The two main challenges within the industry of wool production is 1) to succeed with breeding for wool quality and 2) with improved processing of high quality wool that is in demand at the manufacturers of woollen products. Increased education and training within these two important aspects of wool production seems imperative. Even though meat is the most important and profitable product derived from sheep, it is feasible to simultaneously consider wool quality during breeding. To consider wool during breeding is imperative. This is not reflected in the size of the wool grants compared to the grants for meat. The radical reduction in grants for wool has led to poorer handling and prioritizing of wool. To improve the quality of Norwegian wool it is thus crucial that grants are increased and that wool quality is considered systematically in breeding.

Crossbred wool is dominating the Norwegian wool production, which means that other breeds are in minority. Wool from these breeds are not being treated optimally as it not either scoured nor classified in a proper way. Developments regarding the Norwegian breed spelsau must be closely observed due to

the special properties of its wool and important status within the Norwegian textile tradition. This is also the case with the Norwegian villsau (wild sheep) which is increasing in numbers. Wool from this breed is utilized successfully in other North Atlantic areas, but is mainly discarded in Norway. Turning wool from villsau into waste is especially unfortunate in areas that are investing in heritage and protection of landscape.

## 6.2 Classification, scouring and sales

During the course of this project work has been initiated to address the possibility of defining finer classes of wool; for instance lambswool and C1X.

What seems to be a challenge is that the process of scouring now is almost monopolized by Haworth Scouring company in the United Kingdom. Only the mills Sandnes Spinneri, Hoelfeldt Lund and some other small-scale mills do their own scouring in Norway. Stakeholders have called for increased transparency regarding the origin of the wool returning from scouring in the UK, is it in fact the Norwegian wool? There is also little knowledge of the environmental impact of the scouring process and if it could be eco-certified according to the EU flower as the wool coming from New Zealand is.

The brand Viking Wool developed by Curtis Wool Direct has caused some disagreement between the company and Norwegian stakeholders. SIFO and NICE find the brand to be unfit for the Norwegian market, and potentially harmful to the work that is going on in order to find a way to create added value to Norwegian wool through branding.

To ensure that capacity and knowledge remain in Norway it is imperative that mills with scouring facilities are not shut down, but rather are expanded. There are several challenges connected with the fact that the largest part of Norwegian wool is scoured abroad. The environmental impact of transport is one important issue, further the Haworth Scouring company has been criticized for insufficient quality systems, poor wool purity, lack of environmental certification, and for withholding information regarding how the Norwegian wool is being processed.

## 6.3 Manufacturers of woollen products

A positive aspect of this part of the value chain is that Norwegian wool is being processed into a vast selection of high quality yarn. Sales are dominated

by knitting yarn which has increased substantially during the last decade. The profitability of knitting yarn is leading to increased investment and expanding businesses. Small-scale businesses are developing as well and are investing in minority breeds. These businesses are however struggling to be profitable although there is demand for their goods. Nevertheless, this is an industry that is producing high quality products and is providing stable jobs where investments are made into new equipment, space and knowledge.

Designers and manufacturers do however meet some challenges if they set out to use Norwegian wool in their products. The main challenges are the lack of availability of suitable products made of Norwegian wool, and the poor marketing of Norwegian wool. Designers are often demanding softer and thinner yarn than is made of Norwegian wool, and the lack of marketing is not creating the awareness amongst designers and consumers that could create added value. The product groups that are on the market today are mainly knitting yarn, plaids, sweaters, socks and some vadmél.

There is a need to address the issue of how Norwegian manufacturers of woollen products communicate *Norwegianess*. Wording such as “Norwegian wool” and “Norwegian product”, as well as Norwegian flags and symbols in advertisement of products that are not made of Norwegian wool, nor made in Norway, cause confusion about what is actually Norwegian. This confusion about the correlation between how products are marketed and of what and where they are made is making it difficult to capitalize on added value through origin.

A common labelling system for Norwegian wool is part of the solution, however, increased knowledge and awareness of what products can be considered to be Norwegian, and the added value of the Norwegian origin is imperative to make Norwegian wool once again a sought after commodity. More collaboration and solidarity amongst the different stakeholders with less focus on competition would also contribute positively. The fact that Norilia is looking in to the possibility of a “Norwegian wool” label is positive, but would this be a label that could be attached to the wool from Fatland Ull AS as well?

It is important that the Norwegian industry addresses this challenge. Norway is a small textile nation, but it possesses certain advantages that should be better exploited and that can contribute to economic growth for the whole industry. The large traditional and successful Norwegian textile companies are corner stones of the Norwegian textile industry. However, to bring forward niche products and diversity smaller craft like companies are important contributors. These are important in order to foster innovation and development.

The opportunity to scour smaller amounts of wool in Norway may be important to the small stakeholders. Today, the lack of financial resources that can go into product development and for hiring designers is a problem that hampers innovation.

## 6.4 Fashion and design

There has been increasing attention directed towards eco-design and local design, as well as Norwegian and Scandinavian design during the last decades. The prerequisites for creating local eco-products are however poor for Norwegian designers. Closer collaboration between designers and local manufacturers may offer new opportunities for creating environmentally friendly products locally. Several of the Norwegian businesses possess production facilities that can produce small-scale collections. This will however demand some investments that will not be profitable in the short run, but may prove to be a good investment in the future due to increased attention towards Norwegian wool, design and fashion.

## 6.5 Consumption

Wool consumption has increased in Norway especially due to the soft merino products that have flooded the market. However, consumers seem to possess little knowledge about Norwegian wool and the value chain it is part of. The branding and marketing of Norwegian woollen products by Norwegian brands that are not made of Norwegian wool, but of merino wool, creates confusion about the origin of woollen garments on the Norwegian market. Consumers seem unaware of the fact that Norwegian wool is so little used in Norwegian production of clothes, and do not relate to wool as a raw material with an origin.

It is important that the awareness amongst consumers is raised regarding the significance of the properties of wool as raw material to the finished product, as well as quality requirements and the environmental aspects related to wool. An information campaign similar to the one that has increased awareness regarding local food, will be necessary to create the same awareness and pride regarding local products and the uniqueness of Norwegian wool. There are several ways this challenge can be approached. For instance would a joint venture between stakeholders promoting Nordic design and use of local resources be a good way to join forces and create a visible impact on the market. Consumer awareness can also be improved by information campaigns,



branding of Norwegian wool, and environmental certification, for instance according to the EU flower.

## 6.6 Effect and policy implications

The project Valuing Norwegian wool has aimed to contribute with knowledge on how the value of Norwegian wool can be increased. This is an ambitious aim for a limited research project. Nevertheless, the project has already had some influence. Some businesses and designers have begun to use Norwegian wool again, others are considering it, networks have been created and processes have been initiated. However, some of the challenges we have identified are not so easily met. Agricultural politics will need to focus more on other local products than food, such as wool, and make sure that these products are made viable and are supported economically in the same way. The positive development that we have seen regarding local food should be replicated. The Norwegian industrial policy seems to suffer from the same narrow focus that the agricultural policy does. The outsourcing of textile production to low-cost countries has resulted in shut downs and loss of jobs and knowledge in Norway as in the rest of Europe. However, when this trend of outsourcing comes to an end, the Norwegian wool based textile industry will be able to contribute to new growth.



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## Appendix 1

### **2010: The International Journey begins**

The project itself got international attention early on, as a small item appeared about the project in the international magazine for dyers and colourists, *The Colourist*, in their first issue in 2010. Since we had discovered the existence of the International Wool Textile Organization, we contacted them and were invited to talk about the project in Paris in May 2010 at the IWTO Congress. We, Ingun G. Klepp and Tone S. Tobiasson, travelled here together, and after our presentation, “everyone” wanted to talk to us. The big debate at the conference circled around the Dutch organization Made-By’s assessment, which had placed wool alongside conventional cotton in the “red zone” – as a fibre textiles companies should avoid using. This was the first fibre assessment published which claimed to be a Life Cycle Assessment tool. The IWTO had hired a professor at University of Leeds to do an LCA on one kilo wool (any wool, no specific origin) based on Made-By’s premise – which we strongly advised against. The reason being that the Made-By assessment only followed the environmental impact till the yarn was spun, and also would not release the basis for their conclusions. Since they had not included any evaluation of the user-phase and end-of-life phase, this hurt wool as a fibre more than necessary – and since in apparel these are crucial phases for the total impact, we wanted to stress the importance of this. The President of IWTO at this time, Günther Beier and the Secretary General, Henrik Kuffner, were very much in favour following Made-By’s demands, even if it would cost them 1 million Euros. Klepp also presented the first results on energy consumption in relation to wash and care which gave an understanding of how the wool’s environmental footprint could improve and how it could boost wool’s standing with consumers and designers by including the user-phase and not just production – adding longevity and washing-frequency. Beier and Kuffner remained sceptical, but over time we saw that we did plant a seed in Paris for new approaches.

Mulesing was also an issue at the conference, as an out-side demonstrator entered the stage during a discussion on animal welfare. Most surprising to us, was the lack of concern from the Australian growers, who clearly said this is a “Northern hemisphere issue” and pointed to that their main market is China. The point being that the US and Europe and the animal welfare issues that are very much at a forefront here, do not have the economic clout of the Chinese – who don’t really care how animals are treated. But it was clear that animal welfare is a growing issue globally, even in a recession, and the question around predators in Norway is something that needs to be addressed. Later on Tobiasson was contacted by American apparel organizations and asked to rally the Nordic counterparts, and NICE, to sign a strong petition against mulesing practices.

A third debate was how to counter the decline in wool sales and prices, and our presentation was welcomed as a fresh approach to how a country embraces wool as part of their culture and that the use of wool – specifically next-to-skin wool – has increased significantly. The way in which we dress children in wool underwear and our national costume traditions certainly got the audience’s attention and made it clear that something we have taken for given is very country-specific.

We also had a lively talk with Peter Thorley, who presented HRH the Prince of Wales Campaign for Wool, and asked if they would be interested in a launch of the campaign in Norway. Initially they were rather hesitant, but this would change – as would the discussion about the LCA – which we will write more about later on in the report. We also met Jo Dawson, who buys the wool from Fatland Ull and who scoffed a bit of his “Norwegian” competitor, Curtis Wool Direct, who we discovered was a sponsor of the Campaign for Wool.

However, Tobiasson had one burning question, which she had asked everyone about and not gotten an answer: What is eco-wool? Having read the label-guide published by the RITE Group (Reducing the Impact of Textiles on the Environment), the IWTO had evidently two “environmentally friendly” labels: Organic wool and eco-wool, but the explanation for the latter was rather fuzzy. Finally, on the last night, we met the person who heads the (now named) Labelling Group, Jens Nielsen – a Dane living in Germany. As he explained, eco-wool is equivalent to whatever eco-label a country uses for fibres; so in Norway it would either be the Nordic Swan or the EU Eco-Flower. But no one uses “eco-wool” as a label. For the most part OekoTex is the most-used label for wool, which is a health and not an eco-label. GOTS – the standard for organic fibres – is trying to position itself in the wool area, as

we later learned through the RITE (Reducing the Impact of Textiles on the Environment) Group.

We also visited an exhibit which was organized by Atelier, an international wool organization working with showing off different breeds' wool and how they are used, mainly by artisans. Here we for the first time heard about so-called "mini-mills". The point being that they are constructed for fleeces that contain two types of wool, the way the spel sheep's fleece does. We were pursuing this because we had been told that even if the bottom-wool from the spel sheep is very soft (down to 11 my) it was too costly to separate from the coarser top-wool, since this must be done by hand. We later learned that hand-spinning is usual with vicuna and musk-ox, because of the high value of the raw-material, but more on this later.

As Tobiasson was reporting for EcoTextile News from the IWTO Congress, and a three-page article was published in the fall issue. The whole discussion on the Made-By assessment was also followed up in the magazine, where Klepp wrote a very critical piece on the short-comings of the Made-By classifications.

The trip to Paris was in many ways a pivotal point in the project's international reach. We learned that not only did we have a lot to learn we also had a lot to teach. This was mainly on the use of wool in Norway and understanding of LCA-weighting on use and life-time for the further research on environmental issues.

#### **Fall meeting in Oslo and other travels (2010)**

In September we arranged a big meeting in Oslo with potential stake-holders for the Eco-Innovation call by the EU where we had two IWTO visitors (Henrik Kuffner and Jens Nielsen) and Tom Podkolinski from Finisterre (who we had found through EcoTextile News). The object was two-fold: The application for funds to look at Cradle To Cradle Norwegian wool, a project we named Renewawool. But also to get Norway into the IWTO. Norilia was unable to attend, but arrived at the tail-end of the meetings. Fatland Ull however was present during all the meetings. D2 magazine ended up doing a big feature on the potential project, focusing on Selbu spinneri, Tom Podkolinski and the IWTO. Sadly the application didn't go through because of a technical glitch. However the seminar ensured that we got to know potential and current partners, both nationally and internationally – and an understanding of new projects that could generate innovation and new knowledge – working intensely in such an international setting for two whole days proved both inspiring and productive. Franz Schmidt from KHiO stressed the archives as the

key to innovation when he presented his project with Sjølingstad, which very much impressed our international guests.

A year later the EcoInnovation application was sent off, this time without technical glitches, however our application was not among those chosen.

While travelling in the US, Tobiasson was asked to give a talk at the Cooper-Hewitt museum in New York together with Summer Rayne Oakes from Source4Style. The theme was sustainable textiles and fashion – and Valuing Norwegian Wool was mentioned and generated the most questions from the audience. Not long after the RITE group invited Tobiasson to speak in Hong Kong at the Interstoff Asia fair on the same theme, and again the wool issue brought Patagonia to discuss if looking at indigenous wool could be a solution for them as they were not happy with organic wool. (Talking with Rick Ridgeway from Patagonia at the Fashion Summit in Copenhagen un-earthed that they now source only wool from areas where there is no over-grazing in South America and also base their choice on animal-welfare and other local impact issues.)

Our next big trip took place in the beginning of November the same year, when we had a paper accepted as part of the Centenary Conference in Manchester for the Textile Institute. We decided to combine this with a trip to Bradford, to see the “Norwegian” scouring plant and visit the University of Leeds, where Professor Richard Blackburn had developed a very eco-friendly way of dyeing wool. In connection with the conference, we were asked to write a page in the centenary issue of Textiles, which was quite an honour. The issue that all delegates got of the Textiles included a two-page spread on the project with the title “Valuing wool”. Our talk this time was based on a paper where we looked at the international wool area in relation to the organizing bodies, e.g. Woolmark and the history behind the AWI and the IWTO. Our talk was also centred a lot on the project, as this is what seems to interest the attendees the most.

But our trip to Bradford and Leeds were perhaps even more interesting. We headed to Leeds first, and met with Dr Blackburn who explained that a new dyeing for wool is actually developed for human hair, but works on all hairs – also wool. It is completely safe and non-toxic. He also told us that the University of Leeds was built for the wool industry, but that today’s textile engineering students all were from Asia, European students wanted to study design, not production.



Our next stop was Bradford, where we were picked up by Martin Curtis, one of two brothers running Curtis Wool Direct, along with Haworth Scouring, which is the scouring plant that is 50% owned by Nortura. We saw the wool balls from Gol about to be scoured, and were shown around by Mr. Curtis who was about to get a visit from Prince Charles. He told us that the scouring of the Norwegian clip took about a week every half year and that they were the largest operator in the UK, hoping soon to be the only operator. They also own a lab that tests for chemicals in the wool, and wanted to test the Norwegian clip, since there is little use of pesticides and therefore it supposedly is very environmental-friendly. But there was as of now no proof of this, which could be a selling point for Norwegian wool. Mr. Curtis was sceptical to mini-mills when we discussed the possibility of using the bottom-wool from spel-sheep, but said they could use a process called de-hairing to separate the spel-sheep wool. (This was later countered by one of his employees, Daniel Isbeque.) He also was very enthusiastic for two things: The Campaign for Wool and Viking Wool, a brand-name he had patented for Norwegian tops. He was very eager for Norwegian designers to use yarns made from these tops, and he wanted the Viking Wool label to be a prominent part of this use. The label itself, which depicts a coarse Viking wearing a helmet with horns, was not at all what one would associate with high fashion, so we tried to tone down this side of the product. We were, however, met with deaf ears: Viking Wool was a big success, everywhere it was presented, according to Mr. Curtis.

### **2011: The international knit becomes tighter**

In January Tobiasson was invited by the IWTO to speak at HeimTextile in Frankfurt on wool as a sustainable fibre, and the talk of course also mentioned the indigenous angle and Valuing Norwegian Wool.

In the following months, Mr Curtis and Tobiasson communicated about the Royal Campaign for Wool, since Curtis wanted a launch of the campaign in Norway, and the new wool marketing person hired by Norilia, Tony Barman, wanted a wool week in the fall. Mr. Curtis put Tobiasson in touch with several key-people and the wheels were set in motion. In February John Thorley from the Campaign for Wool and Ian Hartley from the British Wool Marketing Board both came to Oslo for Oslo Fashion Week (OFW), and the launch of The Cool Project, a wool and knit competition that is a collaboration between OFW and Heimen. They had been instructed by Mr. Curtis to mention Viking Wool, but we begged them to drop the actual name, and they happily obliged. Jens Nielsen from IWTO and Daniel Isbeque from Curtis also came, and during a dinner we discussed the problem with the Viking Wool label itself, ex-

plaining why this would never work in Norway to the British guests. Jens Nielsen backed our concerns.

According to Mr. Curtis he had gone out on a limb to get Mr. Thorley and Mr. Hartley to come to Oslo. But they thoroughly enjoyed themselves and had a slightly different version of the story. In the early spring Tony Barman, Mr. Curtis and Tobiasson had a phone conference call discussing the details of the CfW in Norway and everyone was happy with the plan. But, when Tobiasson told Mr. Curtis that the Viking Wool logo would not, under any circumstances, be used as part of the campaign, Mr. Curtis refused to have any communication with her and wanted Norilia to cancel the event. Norilia, on the other hand, decided to go ahead and use Tobiasson as the organizer. They also backed Tobiasson's decision on the label.

Our next trip went to Copenhagen in April 2011 – for a conference held by KEA (Københavns Erhvervs Akademi) where two papers were presented, one for the wool project and one for another project under SIFO. This time the wool paper was called: The dirty business of LCAs, pulling wool over our eyes. It was a paper written by Kjersti Kviseth from 2025design and Tobiasson, presented by both. We were immediately asked if some of the information from the presentation – most importantly the visual illustrations of how and what the different LCAs cover and don't cover, could be used by the up-dated Guidelines for fashion and textiles, that the Danes will be publishing shortly. We agreed that they could use our illustrations, as long as they were properly credited. This will of course further boost the interest for the VNW project, as the updated Guidelines will gain a lot of attention. Here we also discussed with Copenhagen Business School and Kate Fletcher a possible project on indigenous fibres in general, looking at the “Northern region” including the Nordic countries and the UK.

In May Charlotte Bik Bandlien from SIFO presented the paper “Reconstructions” at the Conference Material Culture, Craft & Community: Negotiating Objects across Time and Space at the University of Alberta in Edmonton, Canada. The theme was the project Franz Schmidt had done at Sjølingstad museum where he reconstructed wool woven fabrics from the old factory's swatches and work-books.

In late June, Kirsi Laitala, PhD candidate working at SIFO, mainly with the Textile Waste as a Resource project, presented the paper written with Ingun Grimstad Klepp, Marit Kjeldsberg and Kjersti Eilertsen – on Potential of woollen materials in health care at the International Conference on Fibrous Products in Medical Health Care, at Tampere University in Finland, where the

paper was also published. Later we learned that Woolmark is very interested in the whole link between wool and health, something which has been a starting-point for discussing new projects.

For Oslo Fashion Week in August, the Woolmark representative who covers Norway as a region, Lars Ulvesund, turned up for the Cool Project presentation of the designers we had picked – and met some of the designers who work with wool. At this point in time Woolmark was becoming interested in what we were doing, and had found Kviseth's paper online – and wanted to see if our way of approaching the Made-By assessment perhaps was a better avenue. There had also been a change at the helm of the IWTO, now Peter Ackroyd was the president and they had no Secretary General. So when we were heading to Bath for a conference in the so-called Wardrobe Network in September, Peter Ackroyd wanted to meet us.

In Bath (September) at the Trans/national Clothing Conference with “Production and Consumption” as the theme at Bath Spa University we gave two talks: one on “unravelling the knots” in the wool project, and one on the wardrobe study that Klepp was collaborating with Joanne Turney on – comparing Norwegian and British middle class families and their use of wool. The results were very clear: In Norway families' wardrobes consist of a lot of wool underwear and socks, and to a lesser extent traditional knitted sweaters – even though they think they have most of the latter. The British families have no wool underwear, but more suits, coats and skirts. Their knowledge and perception of wool was also very different. While the Norwegian families knew all about “layering” and wearing wool for comfort and activity outdoors, they knew nothing about the value-chain. The British families knew more about merino being Australian for the most part, but little about dressing for cold weather. Here we also met with a young woman, Orla O'Carroll from Coleg Sir Gar in Wales working with a project very similar to VNW. We have kept in touch with her since then.

In London we had a meeting with Kara Hurry from Woolmark and Peter Ackroyd. They were very happy that we were doing the Campaign for Wool in Norway, and wanted us to stay for the opening of the Wool Modern Exhibit some days later. (Where Prince Charles and his Camilla, along with Livia and Colin Firth, and Vivienne Westwood were guests of honour – Tobiasson had gotten Livia Firth's interested in wool a little earlier when she interviewed her for OFW magazine.) Mr. Ackroyd also invited Tobiasson to come to the Round-Table meeting in London the IWTO was holding in November to present the work Kviseth and she had done on the LCAs. By then we had also been introduced to Dr. Paul Swan in Woolmark and had several skype-

meetings with him on the LCA issue. We also tried to get the British Wool Marketing Board interested in further financing the comparative wardrobe study between the UK and Norway, but failed to do so.

While we were in London we also stopped by the Royal Norwegian Embassy and talked to them about the wool project – several working with the cultural area were interested in the project. There was also yarn from Curtis waiting for us, to be transported back to Norway – since Helle Frogner – the designer working with Fabel – would be using it for a piece she would be exhibiting at a Nordic Council of Ministers’ exhibit in Riga. Mr. Curtis had sent along Viking Wool brochures, which – for some reason – never left the embassy.

The second week of October saw the launch of the first Wool Week in Norway, sponsored by Norilia, and both Jens Nielsen and Daniel Isbeque came. The kick-off was sheep-shearing behind the Parliament, followed by the opening of an exhibit at Steen & Strøm department store – show-casing the value-chain and the uses of wool in Norwegian garments and some interior items. The exhibit was open a full week and had several curious visitors. Norilia invited all the international guests for a dinner – and SIFO held a stakeholder meeting with summaries of the work so far, which Jens Nielsen also attended parts of.

The following day, Kviseth and Tobiasson left for the RITE conference in London where they would be participating in a break-out session looking at LCAs where Kviseth presented the findings from the paper. Made-By had two representatives at this session, and rather grumpily insisted that their assessment was not meant to be “the Bible” and that they worked very closely with companies to tell them the limitations of the system. They would, however, not accept that their “negative” way of seeing land-use was hurting wool more than necessary.

In October, Tobiasson attended the Nordic Fashion Biennale at the Nordic Heritage Museum Heritage Conference in Seattle, Washington, where she met several Icelandic, Fair Isle and Greenland designers working with wool and musk ox. Even if Iceland has a very good indigenous wool label – Icewool – they struggle with many of the same issues facing Norwegian sheep-farmers, as does the Fair Isle wool industry – where women used to have hand-knitting of sweaters as their main income. Tobiasson was mainly there to talk about NICE, but as always the wool project generated the most questions and interest. One of the Fair Isle designers asked for specific guidance related to wool sourcing.

In late October the theme for the Textile Panel meeting was sports and textiles, and we had two international speakers, one from the European Outdoor Group and once from the Swedish company OrganoClick. But this was also the first time SIFO presented results from its study on sweat and smell in textiles. The results were positive for wool, and not for synthetics – even those treated with so-called silver-salts or nano-silver. This could be a big selling-point for wool in sports-clothing, but also make a big difference in environmental considerations.

At the IWTO Round-Table in November; Tobiasson, Jens Nielsen and Paul Swan met to discuss several issues surrounding the LCAs and other possible collaborations. Tobiasson and Paul Swan also presented their recommendations in relation to dropping the one kilo wool LCA “demanded” by Made-By’s and instead finding better ways of communicating with the public, designers and producers, including information on the consumer-phase impact. To demonstrate how “wearing wool the Norway” could be one way of looking at this, Tobiasson stripped down to her wool under-wear. All in the interest of research, of course. She did get her message across. What was also interesting was that the IWTO had used a Norwegian knit-border for the program of the Round-Table, and the Secretary General (Elisabeth van Elden was named SG during the Round Table) said this was on purpose. She also announced that she wanted to visit Norway in the fall and buy wool underwear.

In the December issue of EcoTextile News one of Kviseth’s illustrations from the paper on wool and LCA’s appeared in a two-page article on the Round-Table conference in London, and drove home the point that this had been a major issue during the day’s discussions.

In November Klepp also presented the findings from the sweat and smell study in Copenhagen under the title: “Nano is the solution – but what is the problem? Cracking a nut with a sledgehammer”. The conference was Spandex to Sportstech – Fashion and Innovation in Sports-wear at the University of Copenhagen. As whenever this study is presented it generates a lot of interest, and a lot of questions linked to silver-treatments and their impact on nature; as well as the whole issue of smell.

### **2012: International cooperation reaches new heights**

In January, Klepp, Kviseth, Tobiasson and Paul Swan all met in Munich for the ISPO fair, where Kviseth had been asked to be part of a panel discussion at a the Snow, Ice and Rock Summit along with Paul Swan – where the theme was the return of natural fibres. The following day, Kviseth and Tobiasson

made a presentation of the Wool Project and the LCA findings for the European Outdoor Group's breakfast session – one of the most prestigious and well-attended events during ISPO. Greenpeace and the European Commission were among the other speakers. Elisabeth van Elden, Paul Swan, Jens Nielsen and the Norwegian delegation also had several talks. A main goal with these talks was the push for the IWTO to develop a new strategy where we had several ideas, and to look at possible new projects. The first project application was sent right after our return and is under the Research council's BIA program, a BIP with Janus. (BIP is an abbreviation for a type of business initiated innovation project that the Norwegian Research Council funds.) This project, called Flexiwool, has as partners Woolmark, IWTO, SIFO, 2025Design, L&J of Norway, and NICE, as well as Liudmila Aliabieva from Russian Fashion Theory (as part of the Wardrobe Network who will be looking at Russian perceptions and use of wool). Several other projects and applications will be put forward. We also understood that Woolmark had initiated a project where they would be looking at wool in wardrobes and how consumers treated their clothes along with longevity. This work has been initiated and we will have access to the results. Woolmark was also informed of the findings from the smell and sweat research, findings that they found very interesting.

Here we also talked to Friedrich Baur who has the labelling of Swiss Wool and Bayern Wool, who has the entire value-chain under control, including developing new uses for local wool as filling in down jackets. Jens Nielsen was the one who made the introduction, back at HeimTextile.

In January the aforementioned Wardrobe Network held a meeting in Kolding in Denmark, and several "woollies" were invited for a separate day dedicated to indigenous natural fibres – from the UK, from Iceland, from Greenland and the Fair Isle Islands – the same designers Tobiasson had met in Seattle at the Biennale and some through Tom Podkolinski's network – Johanna Korndorfer who works with older breeds in the UK ([www.ccanw.co.uk](http://www.ccanw.co.uk)) and artisans. She was not happy with the British Wool Marketing Board and how they pressured sheep farmers who were outside of the main system to become members.

We also had met Tom in Munich, where he told us he had quit his job in Finisterre and was setting up his own company that would continue working with the breed he wanted to use for his products – the Bowmont. The goal of the first day was to see if Valuing Norwegian Wool could be expanded to a project with a focus on indigenous and natural fibres (the fur trade was also represented) in a bigger region, but no concrete suggestion came out of the semi-

nars. However, Anita Høegh from Qiviut on Greenland explained that she had found a way to spin the musk-ox wool that might be transferable to spelwool.

Findings from our project were presented in both arenas, as a new audience arrived for the actual Wardrobe Network meetings. Here it was also discussed how one could work together on projects, with the wardrobe-way of doing things, linked to sustainable issues.

The rest of the spring included trips to St. Petersburg, Riga and Lima (Fora Textile, with an audience of close to 1000), where the theme was Nordic co-operation and environmental issues in the textile and fashion industry; but also here the wool project was presented – and in Peru it generated a lot of interest because of their focus on alpaca. The lack of LCA information on alpaca is just one of the issues of concern. But it was interesting to see the focus on baby alpaca and vicuna – which is only hand-spun and is extremely expensive. Scarves made from vicuna were locked behind glass in the Lima airport. Their my-level is about the same as the bottom-wool of spel. Tobiasson was also told that alpaca does not fade in natural shades of brown and black.

The smell-study was presented by Klepp at Making Sense of Consumption, the 2<sup>nd</sup> Nordic Conference on Consumer research in Gothenburg, Sweden, organized by the Center for Consumer Science, CFK, this time with the title: Smell of Sweat: An interdisciplinary twist on materials' invisible qualities. At the same conference other aspects of the wool project were presented through the paper "It's home-made" on the wardrobe-studies.

During the Copenhagen Fashion Summit, which is arranged by the Nordic Fashion Association and under the NICE project, Kviseth spoke with a representative from H&M, which resulted in the company asking for the LCA report – as they were using the Made-By assessment and had become more sceptical to wool. Tobiasson also spoke to Rick Ridgeway from Patagonia about the Sustainable Apparel Coalition and their new Higg Index – which was about to be launched. Her question was related to how they would be looking at land-use and other aspects of wool. Mr. Ridgeway informed her that they would be looking at landscaping vs. over-grazing, thereby not using Made-By's overall land-use as a negative factor approach. They are also looking at biodiversity as a plus-factor. This turned out not to be the case when the Higg Index was presented later in the summer. Wool came out even worse than before, in the materials-overview, with the worst score of all natural fibres. Tobiasson also participated in a conference call between the IWTO's Chairman and Secretary General, along with the CEO of SAC; where she

specifically addressed the land-use issues which seemed to start some internal thought-processes. The problem being that land-use is seen as negative, the more area used to produce a fibre, the worse score, something which does not compete with sheep grazing on non-arable land. The IWTO and AWI wish to keep Tobiasson and Kviseth involved in the on-going discussions on these issues and will be paying them for their contributions.

This spring's trips also included New York and the IWTO congress: Wool and the City. Norilia joined the conference for the first time, as Tony Barman travelled with Tobiasson. On the first day, before the Congress officially started, Tobiasson was invited to present what Mr. Ridgeway had said in Copenhagen to the Labelling Group, which was later cited by Jens Nielsen for the Congress. Tobiasson presented a "woollen fantasy" about The Thief hotel-project, which is a Choice hotel opening in May 2013 where we have tried to implement wool as much as possible into the interior-elements, and Norwegian wool being a focal point. This project has also uncovered a lack of coherence in the value-chain, and in spite of a great enthusiasm by the head of the project, Siri Løining, the project has far from landed. However, L&J of Norway has cooperated with Røros Tweed on designer-throws made from lambs' wool, specially sorted by Norilia from the C1 class for the first time in many years. The result will be lighter and softer blankets than Røros Tweed generally deliver and where they have otherwise been experimenting with alpaca blends.

Tobiasson had also ensured that Stian Tolnæs from With & Wessel (an American apparel company started by two Norwegians and with a store in New York) presented their story on selling wool as something very cool and sustainable. This resulted in Stian getting his hands on finer merino-wool than he previously has been able to and a deal with The Wool Room for sales in the UK. The audience also enjoyed hearing an apparel company using social media and simple devices like the store-window and shopping-bags – to tell the story of wool's many positive aspects.

On the way to New York Tony told Tobiasson a rather interesting story: In connection with Prince Charles' trip to Norway, Curtis had contacted Norilia to have him visit the wool station at Gol on his way between Oslo and Bergen. Select guests were going to be invited, which meant most of those involved in the Valuing Norwegian Wool project. Invitations were about to be sent out, when Tony discovered that this was to launch Viking Wool in Norway and immediately said this was out of the question. The result: No royal trip to Gol.



We have also shown the Viking Wool tops to Dale Yarn and Sandnes Yarn. Both immediately said the tops were of a much worse quality than they would consider using for knitting yarn. They also asked what the actual class of wool is in the tops, but Curtis refuses to tell, which makes these spinners even less interested.

However the naturally coloured wool is still something that the farmer receives very little money for, and as one does not know what sheep do fade and what sheep do not fade – it is impossible to sell as “colour-fast” the wool that would be. The spel-sheep wool – if one is able to utilize the finer and softer bottom wool – it seems only possible with hand-spinning and how could this be done? Through the resurgence of interest in hand-spinning? Through sending the wool to Peru or Greenland? With & Wessel want to try to use the local value-chain and the spel-wool, but how to get this financed through a project is more of a problem. Norilia has offered some of the spel-wool they will be getting in September for this, but the wool needs to be scoured and spun. And the yarn needs to be strong enough for industrial knitting.

We have also just learned that Dawson now has stopped scouring at Haworth, which means they lost their biggest customer. How this affects the operation in the UK, is an open question. We have also tried to find out if Sandnes could scour more Norwegian wool (they have the capacity), but so far they say they will not. One thing is they would have to invest in a wool press, the other is they no longer have machinery for worsted processes, only for woollen.

On a positive note: Norilia and Fatland Ull have decided to jointly apply for membership in the IWTO, which means the international contacts that have been established are now spreading to other organizations in the value-chain, enabling further cooperation and knowledge-transfer.

It is also interesting to note that after a Woolmark representative visited the launch of Oslo Fashion Week's The Cool Project, Woolmark has launched both “Cool Wool” as a concept and the International Woolmark Prize, a competition similar to TCP in many ways. They did have a competition back in the 1950's – but the relaunch followed the success of the Norwegian competition. OFW was asked to handle all the logistics around the competition in Norway, and Tobiasson picked the designers representing Norway and Sweden. Norway's contestant, Nina Skarra, wants to include Norwegian wool in her collection, but has so far not been able to find a way of doing this. Her preference would be outer-wear and working with Sjølingstad. She will be showing during New York Fashion Week in the fall, which would have been a fantastic arena to show such a piece and tell the story. The value of such sto-

ries has been echoed by designer Fam Irvoll's UK PR-company who have asked if it would be possible for her to produce some pieces in Norwegian wool for the sake of story-telling.

### **Concluding remarks**

Since several in our international network will be present during the Wool Week in October 2012, and both Tobiasson and Kviseth will be attending the RITE conference the same week and meeting up with others; there are still loose ends. However, some conclusions are clear: It has turned out that the international wool sector has had a lot to learn from our talks about the project, surprisingly; as we thought the project would be gaining most from the international networks. There is a significant international interest in the "Nordic" (or Norwegian) model with focus on health, out-door activities, freedom to roam and how we use our natural resources – both geographically and actually. This potential is largely untapped. We need to have a better documentation of the changes in use of wool in Norway in order to understand why this happened in Norway and not in other countries, in order to further this work.

There is also a significant potential for further international cooperation on projects with a win-win result for the Norwegian value-chain and the international wool producers. Through Valuing Norwegian Wool we now have the network to instigate such projects if funding is secured. This has a substantial economic potential both for the wool trade as a whole, and since Norway already has an established business – we have a head-start.

Many questions remain unanswered; one of the main ones being what actually triggers such a wide-spread use and understanding of wool and its positive properties. The environmental profile of wool also needs to be addressed, as the Higg Index and the Made-By assessment both have torpedoed the environmental claims of wool as an eco-friendly fibre. It has also been a pleasant surprise that the ideas we have had around focus on longevity and the user phase has been well-received internationally and had ramifications for our international cooperation and work. This emphasis has also been seen in some British literature (Kate Fletcher is among the leading voices in this area), but it seems we have made head-way in the way the "wool world" sees consumption, production and design as interconnected and thereby opens up for new perspectives.

Our input also seems to have triggered a wider interest in the world of wool, as the IWTO is playing with the idea of having wool in sports as a focus at their Congress in South Africa in 2014. This is part of an over-all picture

where it is rather interesting to see how a small country with its cultural and trade-related heritage can influence the rest of the world.

There are, though, some other issues around pricing, subsidies and the ties to the British wool market rather than a more international and different trade pattern that need to be looked more closely at. This project has, however, come up against too many walls and conflicting information on these issues to make any solid claims or conclusions.