

Species, breeds and potential for improvement in animal fibre production in Europe

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EAAP Animal Fibre Working Group (AFWG)

* Presenting author

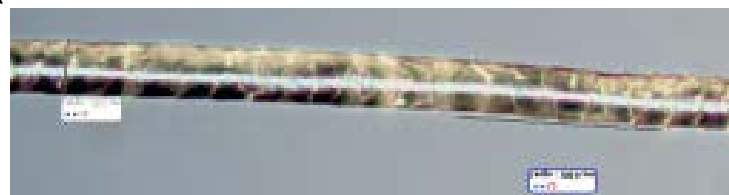
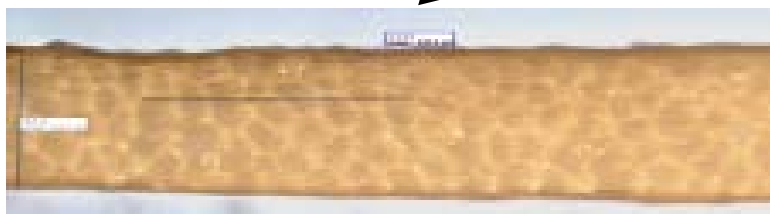
c/o INRA, UMR 1338 GenPhySE, CS52627, 31326 Castanet-Tolosan, France



Animal fibre is Keratin-based "Wool", produced by hair follicles in skin

Evolutionary development benefiting thermoregulation in animals:
seasonal/natural shedding; more continual- need shearing (welfare!)

Different follicles types (eg 1° and 2°) produce fibres with varying properties



End uses of wool are determined by the main fibre properties, eg.:

Diameter, length, strength, colour, crimp, medullation, lustre, insulation, AND

Presence of "faults" eg. contaminating fibres, vegetable matter and felting

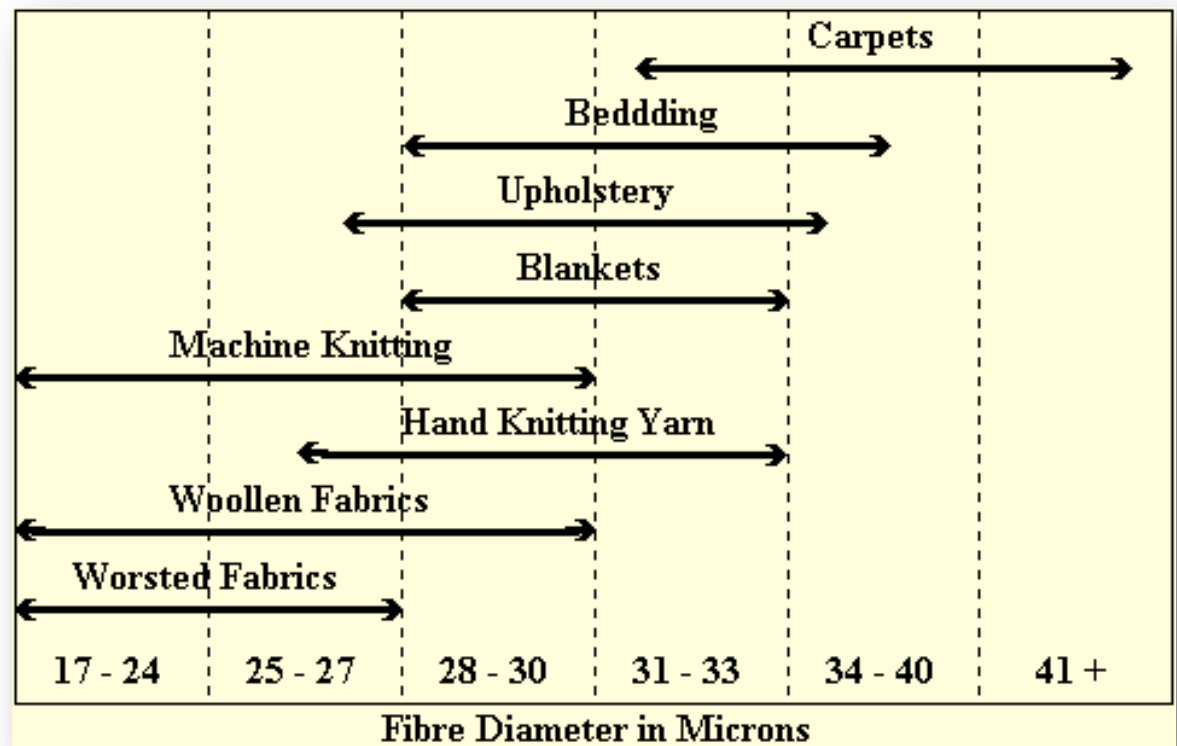
Note; processing of raw fibre; cleaning; designer properties...

Animal fibre is Keratin-based "Wool", produced by hair follicles in skin

"End uses of wool are determined by the main fibre properties":

"Fineness" (diameter) is particularly important for end use

Fibre diameter...



Focus On Europe:

What are the species and breeds of importance?
Producing fibres varying in yield and fineness

1. Goats: "Cashmere", Angora (mohair)



2. South American camelids:
- (alpaca (mainly), llama, guanaco, vicuña, varying genotypes..)



3. Rabbits: (Angora wool)



4. Sheep (wide range of breeds)
(Wool.... _)



Note: Camel: Musk ox...also; No data for Europe)

Scientific Background in *Europe? eg. Context: husbandry to genomic sciences

7th European Symposium on South American
Camelids (SAC)

and

3rd European Meeting on Fibre Animals

June 12 - 14, 2017

Assisi, Italy



<http://dolly.roslin.ed.ac.uk>



*BMBS COST Action TD1101 A Collaborative European
Network on Rabbit Genome Biology (RGB-Net)*

*Note: collaboration with major producing countries for SAC (eg Peru and Bolivia)
and Cashmere (China including Inner Mongolia)

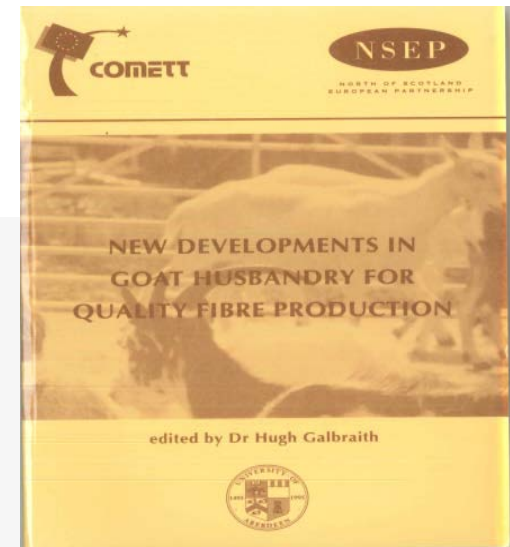
Species 1;a. Goats... Cashmere

(Contrasts with utilisation of imported cashmere)



“Double-coated” animal (1° : 2° follicles): Seasonal growth;
(2°) cashmere; fineness (diameter), 12-18 μm : Yield,, 0.06-1.0kg

Cashmere: major interest in Europe in 1980`s and 90`s



From (Russel, 1998) “The establishment of cashmere production in the European Union”

.. “ cashmere production ..a viable alternative to traditional ..livestock farming throughout the EU, and also ... benefits to the European textile Industry”.

2016 perspective:

- Development unsuccessful; inadequate numbers
- producing the required yield and quality.
- Limited small-scale production and “craft” manufacture

Species 1;b. Goats... Angora (mohair) Greater production, although decreasing

Single coated animal (2^o follicle product); permanent fibre growth
(22-35 µm: yield, 2-5 kg): World ~ 5000 t/year



Turkey:

2009- 147,000 head (from 1,185,000 in 1991)

- Mohair yield: 174 tonnes (from 1,379 in 1991) from;
- G K Yigit, 2011; <http://scholarsresearchlibrary.com/aasr-vol3-iss3/AASR-2011-3-3-145-153.pdf>

UK:

- 2015 : 2.8t auctioned in South Africa via British Mohair Marketing Ltd
- Adult fleece value/kg - 8-9£. (10-11 €) From;
<http://www.angoragoats-mohair.org.uk/2016/05/2015-mohair-fibre-collection-sale-results/>

France:

- *5000 head; 5.00kg/animal; 25t
- http://w.w.w.capgenes.com/pdf_angora.anglais.pdf

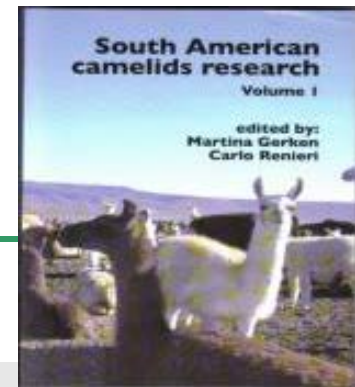
Utilisation:

Used alone or mixed with other fibres to make luxury garments, a variety of wools, cloth, velvet...

*D Allain, 2016)

Species 2. South American Camelids

(2^o follicle products - typical diameter and yield)



Alpaca: "single" coated: 18-30 μm ; 1.5-5.5kg

*Breed types: Huacaya; Suri

Llama: 20-30 μm ; 1.5-2.0kg:

*Breed types; predominantly "single" (T'amphullis) and "double coated" (Q`aras)

Guanaco: "double coated" : 15-18 μm ; 0.5-1.5kg

Vicuña: "double coated" : 8-15 μm ; 0.5-1.5kg)

(EU populations: Comparison with 3.7m Alpaca , Peru)

*M Antonini

Species 2. South American Camelids, continued



Estimates from Bonavia D; 2009.

<http://escholarship.org/uc/item/7xs9j2zs>

Europe: "7000 llama; 2000 alpaca (!!); 1000 vicuña"

England ca. 2750 llama; 2750 alpaca

(25,000 in UK..(2008) <http://www.purealpacas.co.uk/AlpacaHistory/tabid/125/Default.aspx>)

France: 2000-3000 (llama and alpaca)

*2000 Alpaca- 2.0kg/head; 4t/year

Germany: 1700 llamas; 800 alpaca; 200 guanaco...

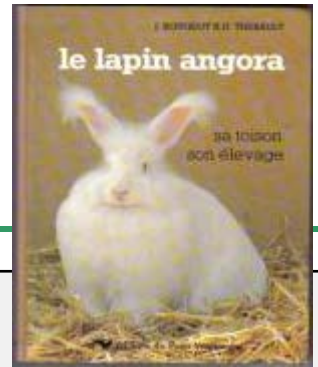
Italy - 60 alpaca, 6 llama, (Umbria) Roma area - 60 llama+
30 on Sardinia.

Utilisation: small scale; local craft; sell direct to public... (£12/kg: (Euro 14)...: UK Alpaca Ltd

*D Allain, 2016

Species 3. Angora (Rabbit) wool

Very fine medullated fibre; 14 -15 μ ; yield 1.5kg/year



World 10,000 tonnes (98% China - 50m rabbits)

EU: about 10t;

*France 3.5t (*2,500 rabbits) in 2015 (200t in 1990): **REDUCTION....**

Also Hungary, Germany, Czech Republic, Finland.....

***Breed types (Both double-coated)**

French type: Annual yield 1,5 kg: Harvested by defleecing (depilatory forage - mimosine);

Produces yarn with « fluffing» effect

German (Chinese) type: Annual yield 1,5 - 2.0 kg: Harvested by shearing

Produces normal fine yarn

- Warm and/or thermal clothes

Notes: cages; welfare issues...

*D Allain, 2016

Species 3. Angora (Rabbit) wool continued



*Angora wool price

- World market: 30 € /kg (China import)
- France : 60 €/kg (>120 € before 1990)

*French and EU Angora industry

- a niche market vertically controlled by farmer/ breeder organisation
- direct marketing of final products by farmers

- Uses: luxurious products
- Knitted clothes, such as pullovers, scarves, socks and gloves, producing a moderate "fluffing" effect.
- Angora fabric ideal for thermal clothing and for people suffering from arthritis and wool allergies.

Species 4. Sheep. Populations

Well adapted in Europe



From: http://www.britishwool.org.uk/assets/uploads/Factsheet_Mar16.pdf

Wool Statistics

Wool is a freely traded international commodity, subject to global supply and demand and representing only 1.5% world fibre production. While the BWMB only handles fleece wool, production figures also include skin wool from sheep handled through the abattoirs.

World

Sheep Population 000's



UK, 34m

World: Total
~1,148m

Europe sheep population (2010) (From <http://www.fao.org/dorep/017/i3138e09.pdf>)

[CIS Europe, 21.9m; South Eastern Europe, 5.96m;
EU Central and Eastern, 12.9m; EU other and EFTA, 90.1m]

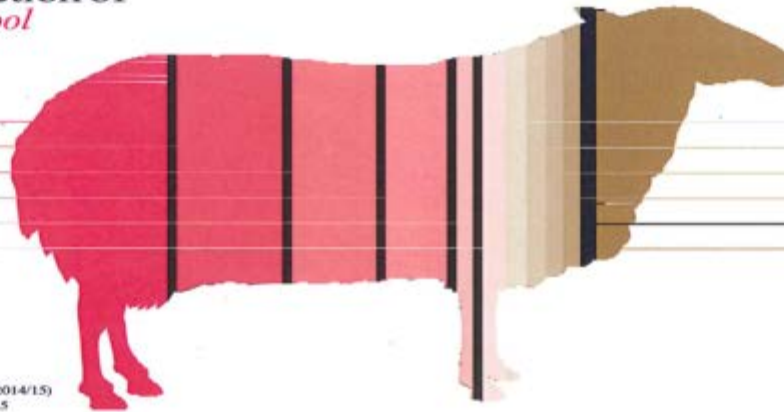
Total for European Regions: 130.9m

Species 4. Sheep. Wool Production

From: http://www.britishwool.org.uk/assets/uploads/Factsheet_Mar16.pdf

World Production of *Clean Raw Wool*

Australia* – 273,878
China – 176,198
CIS – 121,893
New Zealand* – 117,048
India – 38,400
South Africa* – 30,744



Sudan – 28,083
Iran – 27,825
Argentina* – 27,196
Turkey – 25,973
United Kingdom – 21,672
Other Countries – 274,284

Measured in tonnes
*Production on seasonal basis (eg 2014/15)
Source: IWTO Wool Statistics 2015

World Total:
(Including other Countries)
1,163,196

UK, 21.6k t

World total:
1,168,196 tonnes

European production (2010; tonnes (t)) (From : www.fao.org/dorep/017/i3138e09.pdf)

CIS Europe, 60,000t;

South Eastern Europe, 9,000t;

EU Central and Eastern, 31,000t;

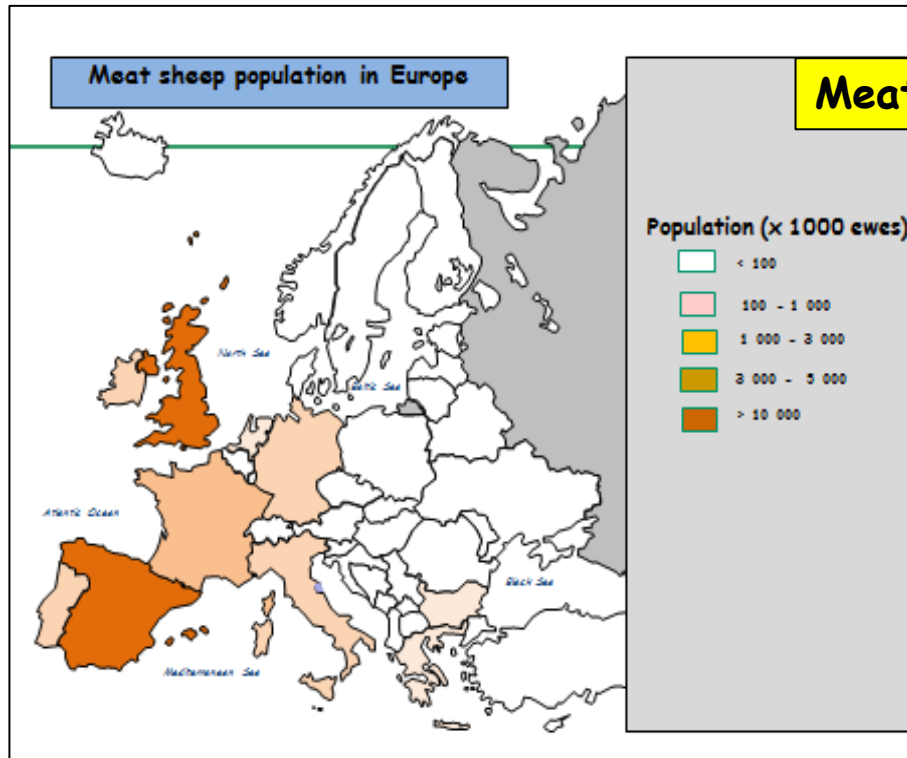
EU other and EFTA, 160,000t

(FAO stats, greasy raw wool)

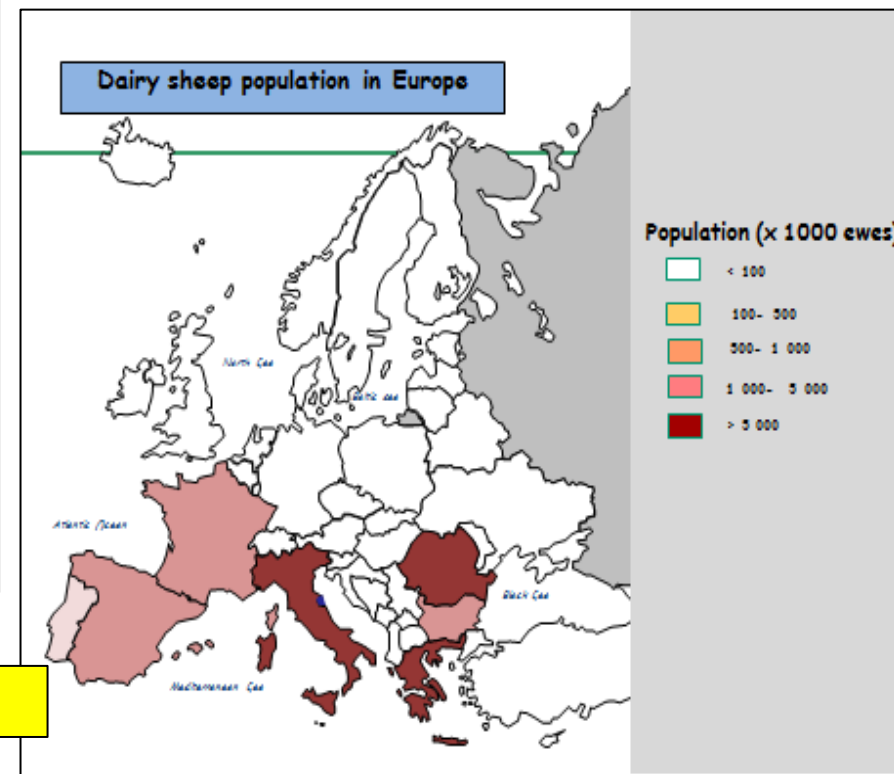
Total for European Regions: 260,000t

Species 4. Sheep. In EU.

Wool a secondary product to meat and milk...



Meat sheep



Dairy sheep

Breeds and wool properties in different countries :
Trends in Europe against time?

Examples: (Case studies) Breeds and production; Statistics for France.



	Population (no animals)	Annual wool production (1000kg)
*Dairy breeds	1,470,000 (33%)	1,537,000 (16%)
**Meat breeds	1,253,200 (25%)	3,901,600 (42%)
**Hardy breeds	2,150,520 (43%)	3,642,720 (39%)
Conservation breeds	89,200	248,720 (3%)
Total	4,962,920	9,330,040

* Dairy production: **meat production

Examples: Statistics for France. Breeds. Wool yield and quality



Valais Blacknose..

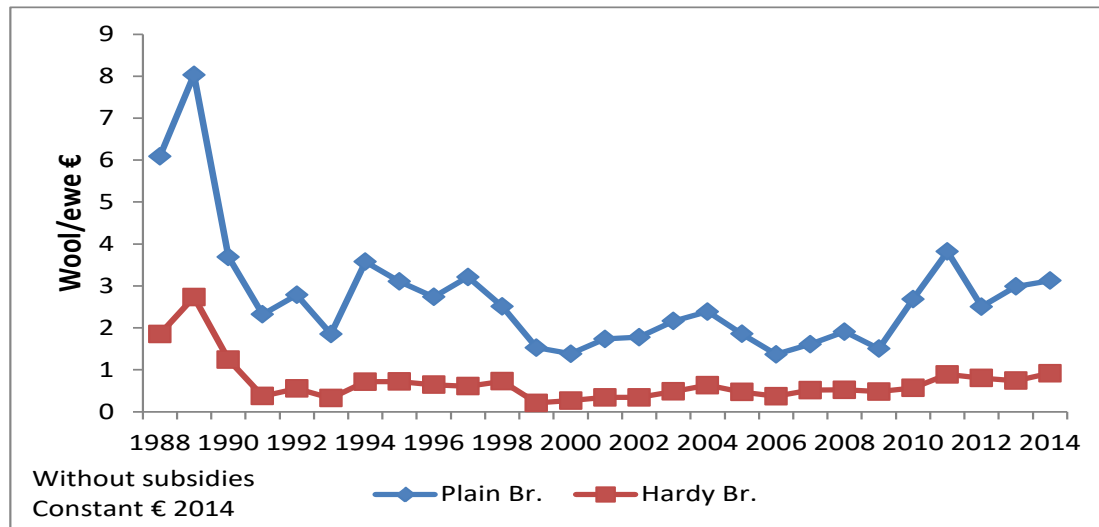
Wool quality type	Mean fineness (μ)	wool production (kg) / quality type
Fine merinos	21.0	780,000
medium merinos	25.0	351,360
Fine medium	28.6	4,117,500
Medium crossed	32.1	1,571,340
coarse	37.0	28,450
kempy	35.6	2,307,810
Pigmented	29.2	173,580
Total		9,330,040

Data compiled from « French Dispositif INOSYS Réseaux d'élevage - Institut de l'Élevage / Chambres d'Agriculture »

Economics (eg. France, UK). Example for France. Variation of wool gross product /ewe

(in constant € without subsidies)

from 1988 to 2014 for sheep plain (or meat) breeds and hardy breeds.



Cost of shearing:
1.5 - 2 € /ewe

Plain (8.0- 1.5 €)

Hardy (2.5 - 0.1 €) *

Source: Marc Benoit and Gabriel Laignel (INRA, UMRH, Theix), 2015
Personnal communication to D Allain.

**Hardy breeds: Better to move to breeds shedding fleece without shearing...??*

(eg. Romane breed in France, D. Allain 2014, 2015)

Economics: Information from UK

<http://www.britishwool.org.uk/sales.php>

For UK: BWMB: Latest Sale Results; 16 August 2016
(average clip value guide)

After all costs (excluding VAT)

For breeds :

Fine - £0.93: Medium -£1.00: Cross - £0.92

Lustre - £4.13 (Blue Faced Leicester !)

Hill - £0.78-1.18: Mountain - £0.4-0.6

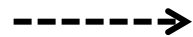
Average Price	Indicator (greasy)	Indicator (clean)	Offered	Sold	Clearance	+Cumulative Price
126 p/kg	131 p/kg	192 p/kg	1.97 million kgs	1.66 million kgs	85 %	129 p/kg

+1.56 Euro/kg)



Examples: Central and Eastern European Countries, 1990 vs 2010 .
Reductions in sheep population and greasy wool (tonnes) produced
 (FAOSTAT, 2012): (R Niznikowski)

Countries:	Year:			
	1990	(Greasy Wool, t)	2010	Greasy Wool, t)
Albania	1 646 300	2 900	1 806 000	3 300
Bosnia and Herzegovina	-	-	1 046 040	1 382
Bulgaria	8 130 310	27 811	1 400 250	7 000
Croatia	-	-	630 000	660
Czech Republic	-	-	205 923	310
Czechoslovakia	1 051 320	6 555	-	-
Estonia	-	-	76 500	154
Hungary	2 069 200	7 337	1 223 000	4 300
Latvia	-	-	70 700	40
Lithuania	-	-	52 500	109
Macedonia	-	-	778 404	1 025
Montenegro	-	-	220 653	327
Poland	4 158 470	14 783	258 262	950
Romania	15 434 800	38 167	9 141 500	17 600
Serbia	-	-	1 475 400	2 445
Serbia and Montenegro	-	-	-	-
Slovakia	-	-	376 978	800
Slovenia	-	-	138 108	188



Examples: Germany: Estimates of sheep population (1.6m: Statistisches Bundesamt. 2014)
Wool produced (no official statistics)

*Estimated Production: (Mainly meat with some milk).

- 3,000 t greasy/ raw wool. (0.5 to 1 Euro/ kg) (50% yield)
- 1,500 t of pure wool
- 51 registered breeds (Schafzuchtverbände Niedersachsen (2016)).
- Pre 1991 DDR Merino no longer economic

90% exported to Asian countries, particularly China.
End use including carpets

10% of greasy wool processed in Germany (about 300- 400 t/ year).
This wool (in excess of 28 μ) is mainly used for:

- Carpets
- Socks,
- "Regia wool" (Trade mark) for hand knitting.
- Insulation material (due to low flammability): e.g. for roofs and walls of houses
- Filling/ padding material: eg. in automobiles and airplanes
- Geotextiles: pads made from wool fitted with plant seeds for greening of land endangered by soil erosion

Addition to synthetic fibres in textile industry

*M Gerken, 2016

Examples: *Italian Wool Production

<http://www.fao.org/docrep/017/i3138e/i3138e09.pdf>



*BREEDS

14 sheep breeds with Stud Book: 3 are wool breeds:

- GENTILE DI PUGLIA (6,800:394 rams and 6406 ewes)
- SOPRAVISSANA (10,001: 592 rams and 9409 ewes)
- MERINIZZATA ITALIANA. (New breed 44,841: 2073 rams and 42138 ewes (2014, www.assonapa.it))

- 8 million sheep, mainly milk breeds
- 9000 tonnes wool of which
- 250 tonnes Merino breed type

*WOOL

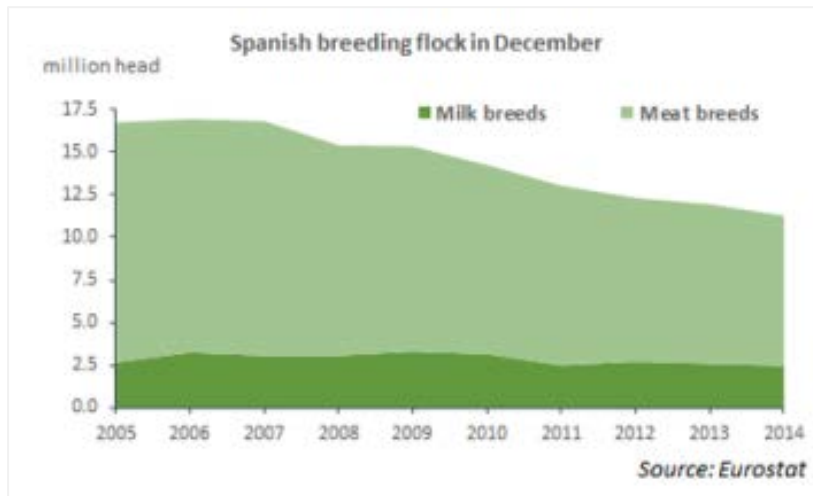
- 90 % of total exported in the international market.
- 10 % only processed in Italy.

Note: first Official wool collection Centre (Biella) by the Biella Wool Company Consortium,

- Also Abruzzo Region by the Gran Sasso and Monti della Laga National Park.
- New Wool collection Centres are in process of formalization in Puglia Region (Alta Murgia National Park), Sicily Region and Umbria Region.

(*C Renieri)

Examples. Wool production Spain.



***ESPAÑA:** Producción de lana (toneladas)

		Lana Blanca			lana negra	Total (t)
		Fine	Extra-fine	coarse		
2002	** (17.745m)	5.807	17.115	7.176	243	30.341
2014	** (12.369m)	4.179	12.784	4.792	174	21.930

**Number of animals sheared: *JP Gutiérrez, 2016

Examples. *Animals and Wool production in Austria

	2014
Number of sheep	**349 087
Number of sheep farmers	13 801
Number of goats	70 705
Number of goat farmers	9 029

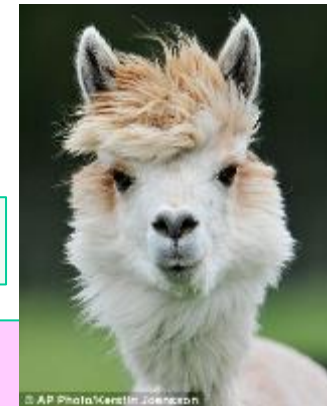
Table 1. Sheep and goat population and number of farms in 2012-2014
Source: BMLFUW, 2015; BMLFUW, 2014; BMLFUW, 2013

ca **1000t wool

Marketing by selling to trading companies or directly to end-consumers

Uses: Include, insulating material for house constructions.
Testing use - for organic fertilizers for crop production.
Out-door textiles.

<http://www.dailymail.co.uk/news/article-2137915/Austrian-alpacas-given-retro-hairstyles-annual-shave-Alpaca-Land.html>



Alpacas and llamas

6000 animals estimated in Austria.

Animals are shorn for processing fibre at home or giving to small companies for processing

*M Wurzinger 2016

Examples: Wool (clean raw) production in UK
Sheep population 33m: 21,600t tonnes:

Marketing



British Wool Marketing Board: Since 1950...
"Collecting, grading, promoting and selling
great British Wool"

<http://www.britishwool.org.uk/>

Priority in UK - meat, with wool sometimes a nuisance "by-product"

Many breeds recognised for wool production eg. "groups"- fine; medium; cross; lustre; hill; mountain; naturally coloured...

74 breeds - <http://britishwool.org.uk/british-sheep-breeds.php>

Historically: wool very important economically
(...William Shakespeare`s family)

Why fall in economic value?

-Impact of competition with synthetically (laboratory)-produced fibres

But...

- Cellulose-based; nylon; acrylic, polyester... microfibres ...
- limited (BIO)degradability
- Problem... microplastics (microfibres) shed from clothes (eg fleeces) may be major pollutant in oceans).

(Brown MA et al 2011. *Environ. Sci. Technol.*, 2011, 45 (21), pp 9175-9179)

Also competition from plant-based fibres (eg. Cotton...)

Examples. UK Breeds eg. Extensive Scottish "Black face" vs "Improved" Intensive cross breeds

Hardy, low quality and yield.
Contributes to economy on
"the edge"



Black face wool...

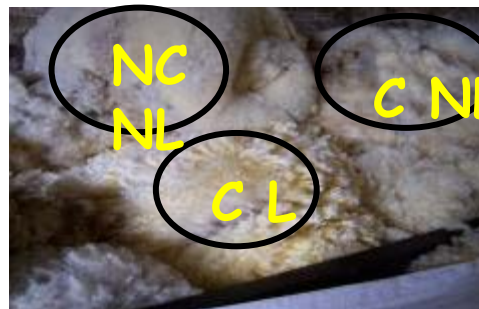
Yield 1-2kg likely unprofitable

In contrast: Breeds eg. Multi-purpose (New Zealand breedline approach
- Cross breed sheep (Leyn, Texel/Finn Dorset/ Shetland/Border Leicester...)

Yield 2-4 kg: Potentially profitable
(Low maintenance; + "Easycare")



Also. Produce
Heterogeneous fleeces
C- crimp
L- lustre
N- no (relatively absent)



Examples. UK Breeds eg.
Traditional Scottish "Black face..."
*Modern shearing system



New Zealand contract shearers



Also heterogeneous fleeces

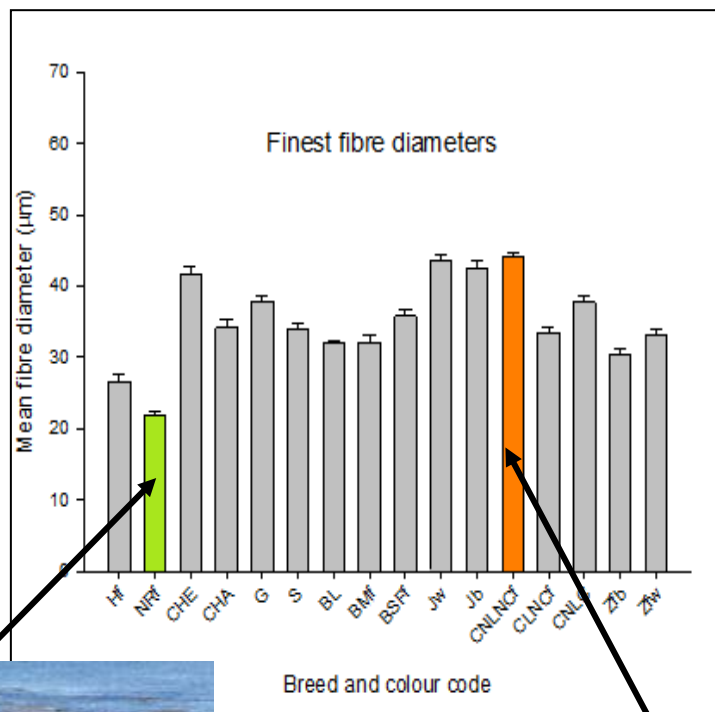
Note: Value of wool marginal over cost of shearing

***Better to have ++"Easycare" breeds.. Shed fleece without shearing...??**

Examples. UK Breeds

Variation in mean diameters of finest fibres across breeds

(Wool samples from BMWB: Moreno et al, 2010)



Cross NL NC	44.05
Jacob (white)	43.52
Jacob (black)	42.54
Cheviot	41.62
Greyface	37.80
Cross NL C	37.79
Blackface short fine	35.78
Charollais	34.19
Suffolk	34.00
Cross L NC	33.49
Zwartble (white)	33.19
Blackface Mattress	32.07
Bluefaced Leicester	31.94
Zwartble (black)	30.33
Hebridean	26.69
North Ronaldsay	21.96

<https://northernlace.wordpress.com/2013/03/>

Finest: North Ronaldsay

Coarsest: Cross; No lustre; no crimp.

Conclusions on wool as raw material

NOTE: additional value of meat, milk, hides (leather) and lanolin (for cosmetics...)

- Natural "wool" production is a valuable, renewing, natural resource
- Four major species and numerous breeds producing "wool" of variable properties
- Scale industrial and international: or small and locally-based

- Production, marketing and record-keeping, varies among countries

- Sheep wool, large scale with prices low and frequently loss-making
- Production of higher value goat, SAC and rabbit fibres, small by comparison
- Clear, (particularly for sheep wool: 150.000t + post slaughter wool), that there is under-utilisation in Europe

What are current approaches to improving utilisation?

Potential opportunities from biology and husbandry (Taking into account environmental sustainability)



- **Context; Socially responsible in recognising replacement of non-renewable oil-based hydrocarbons (noting also the suggested environmental pollution)**
- **More effective production and husbandry**
- **Exploiting new meat/milk breeds maintaining fleece quality and quantity**
- **Applying increased knowledge of hair follicle biology along with**
- **Application of new genetic tools for selection and breeding**
- **Better use of current and, development of novel, end-products (eg textiles and biomedical applications)**

UK sheep wool utilisation

Quality, design and marketing...

Scottish Italian tartan...



Famous tennis player

Designer footwear

BEIGE 베이지



Wool coat

Knitwear



https://www.ewm.co.uk/aran-cable-knit-jumper-2078698.html?__store=default

<http://www.amazing-shoes.co.uk/wp-content/uploads/2014/07/Beige.....>

International approaches... and places...



THE CAMPAIGN FOR WOOL
Patron: HRH The Prince of Wales

“The Campaign for Wool is a multi-national, cross-industry coalition working together to raise the profile of wool as the natural sustainable fibre for fashion and interiors”

“Launched in January 2010, the Campaign for Wool embraces leading figures from the fashion industry, interior design, wool carpet manufacturers as well as the world of insulation and building”

The Campaign for Wool (UK)



Carpets...

<http://www.swaledalewoollens.co.uk/>



<http://www.britishwool.org.uk/page/wool-promotions/campaign-for-wool.php>

Wool insulation



<http://www.campaignforwool.org/2015/12/21/campaign-for-wool-announces-wool-floor-show-london-is-a-sell-out/>

The Campaign for Wool... Netherlands

Knitting, garments...

The Making Of Wool Week Netherlands



The Campaign for Wool is coming to Italy 8 - 13 September!

Italy...

Clothes fashion!



Milano; Quadrilatero della Moda



The Campaign For Wool
e The Woolmark Company

Vi invita all'inaugurazione della
WOOL WEEK

Martedì 8 settembre dalle ore 10.30
Via Montenapoleone/ Corso Matteotti @cfw farm

The Campaign For Wool
and The Woolmark Company

invita you to the launch of
WOOL WEEK

Tuesday September the 8th from 10.30 am
Via Montenapoleone/ Corso Matteotti @cfw farm



#woolweek | #woolmark | @campaignforwool | www.campaignforwool.org



The Campaign for Wool... Germany...

Wool Week Berlin bringt Kunst und Wolle zusammen



<http://www.disana.de/en/about-us/oekologie/certificates/>

Campaign for Wool Paris 2015

France...

Wool Week Paris kicks off at the Palais de Tokyo



<http://www.campaignforwool.org/2014/10/19/qa-with-veronique-leysen-from-maurice-knitwear/>

Thank you for your attention, from AFWG

