THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Section 23 - Guidelines for Wool Recording in Sheep

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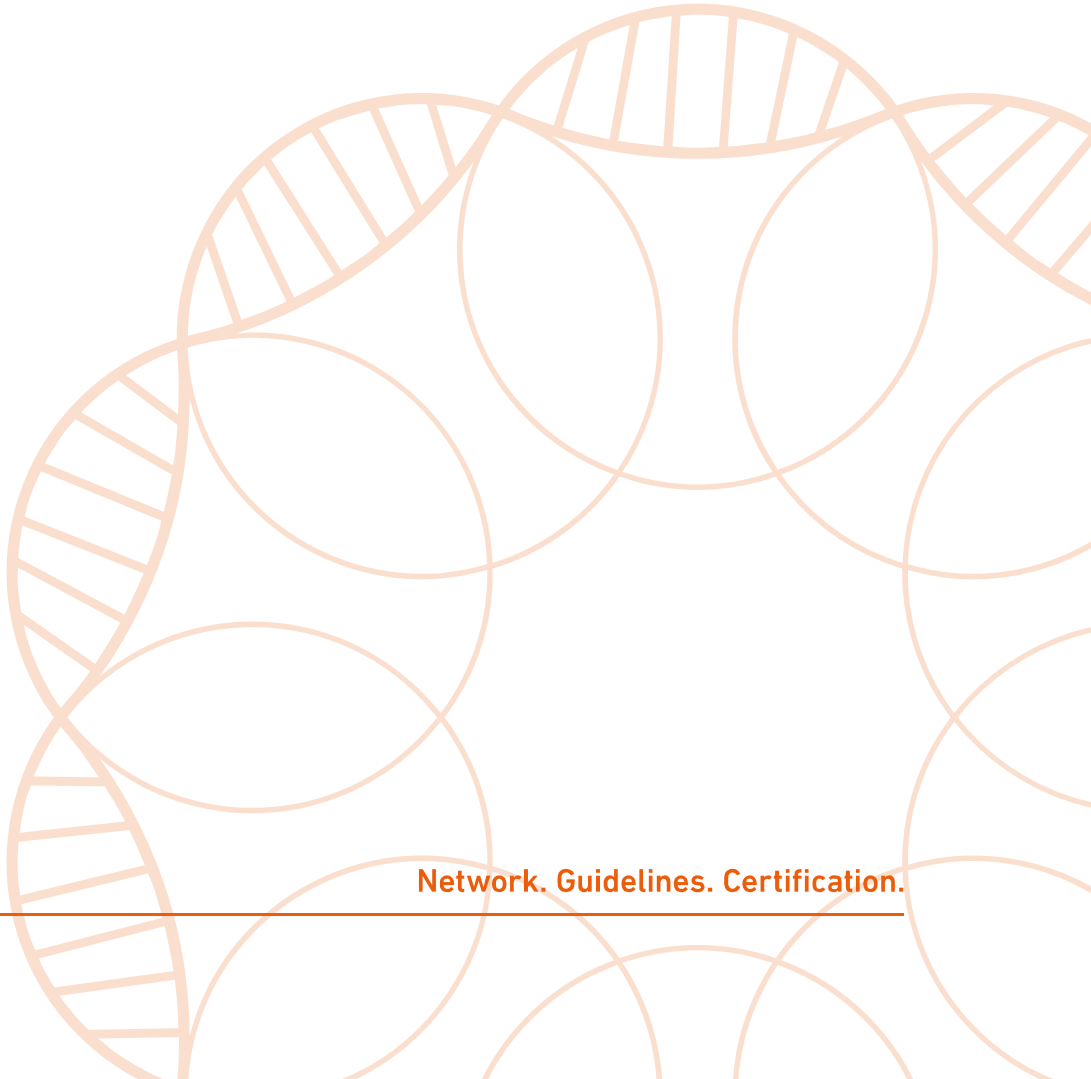
Version February, 2024



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Change Summary

Date of Change	Nature of Change
Feb 2023	Creation of document.

1 Introduction and scope

Wool production represents an important sector of genetic improvement and performance recording, especially in some countries of the southern hemisphere mainly those with Merino sheep production. For countries that are mainly dairy or meat producing nations (such as most European countries), the costs associated with sheep shearing often do not cover the revenue received from the wool clip and therefore wool represents an additional cost to the sheep farmer.

There was a growing request to ICAR to produce recommendations for recording wool traits. The Sheep, Goat and Camelid working group decided to carry out a survey on wool recording in 2020-21, to gather the information on wool recording around the world. That survey became the basis for these recommendations for wool recording, basically targeting genetic improvement of wool producing countries, but relevant for any region of the world.

The guidelines here include information related to the performance recording of wool traits to be considered for the genetic and genomic improvement of sheep wool. The guidelines below assume that a planned breed improvement programme at a population level will be put in place to compare animals either:

a. Within a breed.
b. Between breeds, and/or
c. At national or international levels.

The information provided is for use as a guideline only. The report will give some general considerations, the definition of the traits that may be collected or calculated, the reason for recording them and recommendations for performance recording. It also provides guidelines for the genetic model to be used for genetic evaluations, including typical genetic parameters. We will consider common wool traits, additional traits, and traits requiring a sample of wool.

The guidelines do not cover the organisation of a breeding programme and the different locations where selection is made (on-farm, in a central test station) and the type of selection (mass selection, progeny test). They are focused on the traits collected in performance recording.

In addition, the working group has produced recommendations for a wool collection and promotion centre, initially targeting European wool production but which could be relevant for any other region in the world. This document, even though in some extent outside the scope of performance recording, may be considered as guidelines on the management of wool from on-farm sheep breeding to delivery and management at a collection centre, through the prism of three points of view: the terrain where wool production takes place, the farming system (from the breeding to the collection centre), the collection and promotion centre itself. The recommendations for a wool collection and promotion centre are displayed in the annex 1 of these guidelines.

As a final comment, it is important to consider these guidelines as a document that might be improved and completed. The working group on sheep, goat and camelids will be happy to gather any comments and suggestions in order to update and upgrade the present recommendations.

2 Wool recording

The ICAR Sheep, Goat and Camelid Working Group based on the interests of breeders' organisations and ICAR stakeholders has decided to include wool performance recording in

its guidelines. For this purpose, the Working Group has established an Expert Advisory Group with the objectives to determine the traits of interest, their collection and genetic evaluation.

2.1 The wool survey

In order to achieve these objectives, representatives of breeding organisations and other relevant institutions responsible for sheep recording were asked to fill out an on-line survey on sheep wool. The survey, carried out in 2021, included information on the wool sheep populations (breeds involved, the size of the recorded and non-recorded population, the number of farms with wool records) and information on the traits recorded, phenotyping methods and protocols, genetic evaluation, and selection indices. Additional relevant data on management of animals (e.g., shearing) were also collected in the survey. The results of the survey have been presented at the ICAR meeting in Montréal (Spehar et al., 2022). Altogether, seventeen breeding organisations responded to the on-line survey. As expected, the most common breed in wool recording was Merino, followed by Dohne Merino, and other local breeds. The traits involved were fleece weight, clean fleece weight or yield, fibre diameter, fibre diameter variation, staple length, staple strength, homogeneity of fleece, fibre density, fibre curvature, colour, visual appreciation, additional traits, and traits requiring a sample of wool. The most frequently recorded phenotypes were fibre diameter, staple length, fleece weight, fibre diameter variation, visual appreciation, and colour. The survey results provided useful insight into wool recording and served as the basis for these guidelines.

2.2 Wool traits

Wool fibre is one of the most utilised animal protein fibres due to its thermal insulation property, being breathable, warm and moisture-wicking used as a textile raw material for clothes and home textiles. The market demand of the fibre products is determined by its quality in terms of its physical characteristics (Hatcher et al., 2010; Swan, 2010), processing performance, durability (Swan et al., 2008) and textile attributes (Warn et al., 2006). Physical characteristics of wool vary and are determined by the sheep genetics, environment and management strategies (Poppi and McLennan, 2010).

2.2.1 General considerations and rationale

These guidelines do not intend to overlap with recommendations produced by the International Wool textile Organisation (IWTO). IWTO maintains the global standards for wool testing and arbitration. These are published in the IWTO Red Book (Test Methods and Draft Test Methods developed for the measurement of wool fibre, yarn and fabric properties), White Book (regulations that define the sampling and certification procedures), and Blue Book (International Wool Textile Arbitration and other agreements). These guidelines just refer with wool recording, that means at the animal level.

Wool traits are mostly collected on-farm by farmers and technicians. Experts are involved in collecting specific traits (such as visual appreciation). For example, in the UK, apprentices train for 5 years to become a certified wool visual appraiser. For traits requiring practical knowledge (e.g., fibre curvature, staple strength, fibre density, and homogeneity), data collection is performed by technicians and laboratory staff. The age of the animal at recording might range from 3 to 28 months, but wool traits can also be recorded annually throughout the life of sheep. Wool growth period ranges from three to 18 months. Samples of wool are taken both from males and females.

Methods used for recording wool are trait-related. Some traits are weighed, others are either visually recorded, scored by scale, tested with different methods, or measured with special

machines, instruments and devices. In the case when traits are weighed or measured, the equipment used for this purpose was also specified.

For ewes and rams, the following data should be recorded to obtain information on the 'environmental' (non-genetic) influences of wool production:

a. Unique identification of ewe/ram (includes ID number, Birth Year information, Gender, Breed)
b. Identification of the genetic sire and dam
c. Whether or not the ewe/ram was born as a result of Artificial Insemination (AI) or Embryo Transfer (ET)
d. Birth type (litter size) and rearing type
e. Age of dam
f. Birth flock/herd, rearing flock/herd, current flock/herd
g. Date of birth
h. Recording date
i. Recording if the animal was previously shorn (as lamb/yearling) and date of the last shearing
j. Management mob groups (e.g. grazing group)
k. Death (or culling) date and reason
l. Date of measurement and scorer responsible.

2.2.2 Sampling wool

a. Some of the traits defined above require one or several samples of wool.
b. Samples may be collected from the following part of the body: midrib, shoulder and hip, midside of the animal. As an example, in Australia and New Zealand the midside is the standard location for obtaining samples. The midside location is centred on the third last rib, halfway between the midline of the back and the midline of the belly on the left-hand side of the animals.
c. Samples can be collected by the farmer, technician, or wool preparation staff.
d. The amount of wool required for assessing fibre diameter, yield, colour is about 40-60 g.
e. Samples can be collected during or prior to shearing. If it is during shearing, the comb used has to be recorded (snow comb, cover comb, standard comb).
f. Samples are sent to the laboratory by the farmer or the technician.

2.2.3 Trait definitions

Analysis of wool traits is an effective means of determining and differentiating wool quantity and quality. Knowledge of these characteristics aids management of product end-use, consumer comfort, and processing intensity. The collection of data, the methods and devices used differ with each country's evaluation system. The traits described below are: fleece weight, clean fleece weight or yield, fibre diameter, fibre diameter variation, staple length, staple strength, homogeneity of fleece, fibre density, fibre curvature, colour, visual appreciation, additional traits.

2.2.3.1 Fleece weight

a. Definition: the fleece weight is the mass of greasy wool at the time it was shorn from the sheep. It is expressed as greasy fleece weight (pre-scouring, pre-skirting, full fleece). It can be with or without belly wool.

b. Unit: it is expressed in kg (with 2 or 3 decimals) and g.

c. It can be measured at different ages, most commonly from 8 to 28 months, generally at 1 year of age, at the first shearing. However, wool traits can also be recorded annually throughout the sheep's life. The growth period for this varies from 3 to around 12 months.

d. Fleece weight can be recorded by the farmer or by a technician.

e. Fleece weight should be measured with weighing scale (manual or electronic).

2.2.3.2 Clean fleece weight and yield

2.2.3.2.1 Definitions

a. Clean fleece weight is the amount of clean wool left after scouring and the non-wool components have been removed from the grease fleece (i.e. post-scouring). It refers to total greasy fleece weight multiplied by the washing yield described next.

b. Yield is defined as the percentage of greasy fleece that is clean. Yield is usually expressed as a percentage (Thornberry and Atkins, 1984; Rogers and Schlink, 2010). It thus refers to the yield of usable wool fibres within unprocessed wool (Cottle, 1991), hence it is a function of non-fibre constituents level flux within a fleece (Thornberry and Atkins, 1984; Rogers and Schlink, 2010). Clean fleece weight is calculated from greasy fleece weight and yield.

c. Units: Clean fleece weight is expressed in kg (with 2 or 3 decimals) or in g; yield is expressed in % (percentage of clean wool).

d. It can be measured at different ages, from 6 to 28 months, generally at 1 year old. However, wool traits can also be recorded annually throughout the sheep's life. The growth period varies from 3 to 12 months.

e. Clean fleece weight can be collected by the farmer or by a lab technician.

f. The yield may be estimated in a sub sample of wool (for example a mid-side sample of an individual) and then clean fleece weight is calculated as the product of greasy fleece weight by yield. Each fleece is not washed independently.

g. Clean fleece weight is usually measured with weighing scale after washing (manual or electronic).

2.2.3.3 Fibre diameter (or fibre fineness)

2.2.3.3.1 Definition

a. Fibre diameter is referred to the average thickness (diameter) of the fibres.

b. Unit: it is expressed in micrometres or microns (μm). Higher values denote coarser, and lower values indicate finer wool. Average fibre diameter determines end use and hence the monetary value of wool.

c. It can be recorded at different ages, from 6 to 28 months, generally at 1 year old. However, wool traits can also be recorded annually throughout the sheep's life. The growth period varies from 3 to 18 months.

d. Fibre diameter is usually measured by lab tests using a sample of wool (normally from the midside) collected before or at shearing time. Fibre fineness can also be visually assessed by the farmer, technician or by a wool classer.

e. Fibre diameter should be measured with specific instruments (airflow, laserscan or optical fibre diameter analyser - OFDA).

2.2.3.4 Fibre diameter variation

2.2.3.4.1 Definition

a. Fibre diameter is not homogenous, but ranges from 10-70 µm (Wood, 2003). Consequently, fibre diameter values from either OFDA or laserscan, are best represented as normal distributions, which permit evaluation of the degree of variation present (Aylan-Parker and McGregor, 2002; Greeff, 2006; Botha and Hunter, 2010). This level of variation can be expressed in terms of fibre diameter standard deviation (SD) or coefficient of variation (CV). Both provide different values but are still reflective of actual fibre diameter variation, affirmed by their typical positive correlation to fibre diameter (Baxter and Cottle, 1998; Wood, 2003).

b. Unit: it is expressed in micrometre or micron (µm) for SD or % for CV.

c. It can be measured at different ages, from 6 to 28 months, generally at 1 year old. However, wool traits can also be recorded annually throughout the sheep's life. The growth period varies from birth to 18 months. Fibre diameter variation is in general collected by the lab staff thanks to samples of wool.

d. Fibre diameter variation should be measured with instruments (laserscan or OFDA) and is normally done using a sample of wool (normally from the midside) collected before or at shearing time.

2.2.3.5 Staple length

2.2.3.5.1 Definition:

a. The staple length is the length of a cluster of wool fibres (staple). Target staple length is approximately 7-8 cm (3 inches). Generally, staple length is categorised into staple (≥ three inches) or clothing (< three inches). Generally, if average staple is shorter than 7-8 cm (3 inches), its use is limited, and wool price is heavily discounted. However, overgrown wool (≥ 12-13 cm or 5 inches) can cause manufacturing difficulties during carding and combing and may also be heavily discounted.

b. Unit: it is expressed in mm, cm or class (1 to 4 for example).

c. It can be measured at different ages, from 3 to 12 months, after the first shearing. However, wool traits can also be recorded annually throughout the sheep's life. The growth period varies from birth to 18 months.

d. Staple length is in general collected by the lab staff using a sample of wool (normally from the midside) collected before or at shearing time. Staple length can also be measured on the live animal prior to shearing.

e. Staple length is usually measured with instruments (Automatic Tester for Length and Strength – ATLAS, Staple Length Detector, Wool ruler).

2.2.3.6 Staple strength

2.2.3.6.1 Definition

a. Staple strength is a measurement of the degree of resistance a staple of wool has against severing upon the application of incremental force (Reis, 1992; Thompson and Hynd, 2009). Wool staple strength is objectively measured as the maximum force required to break a staple. It is express relative to a measurement of linear staple density, cross-sectional thickness or area, which has been standardised at one gram of clean dry wool per metre of SL (Reis, 1992; Adams et al., 2000).

b. Unit: it is expressed in Newtons per kilotex (N/ktex).

c. It can be measured at different ages, from 8 to 18 months after the first shearing. However, wool traits can also be recorded annually throughout the sheep's life. The growth period varies from 6 to 12 months.

d. Staple strength can be collected by the technician or lab staff using a sample of wool (normally from the midside) collected before or at shearing time.

e. Staple strength is usually measured with instruments (ATLAS) or subjectively whereby personal appraisal is used for quantification by an experienced and trained wool handler.

2.2.3.7 Fibre density

2.2.3.7.1 Definition

a. Fibre density is the mass of fibres per unit of volume.

b. Unit: it is expressed in units (1 to 5) or measured in grams per cubic centimetre (cm^3).

c. It can be assessed at different ages, from 3 to 18 months at the first shearing. The growth period varies from 10 to 12 months.

d. Fibre density can be collected by a technician or lab staff.

e. Fibre density is usually assessed by visual appreciation using a sample of wool (normally from the midside) collected before or at shearing time. Fibre density can also be assessed on the live animal prior to shearing.

f. There are also 2 related traits which can be measured.

g. Wool bulk: Wool bulk is the measure of the space filling capacity of a fibre mass, expressed as (cm^3/g). New Zealand Bulk is calculated from micron and curvature to give an estimate of loose wool bulk. Higher bulk infers higher resilience.

h. Resistance to compression: Resistance to compression is defined as the force per unit area required to compress a fixed mass of wool to a fixed volume. It is related to fibre diameter and the frequency and form of the wool crimp.

2.2.3.8 Fibre curvature

2.2.3.8.1 Definition

a. Fibre curvature describes crimp frequency (McGregor, 2003) as the number of crimps per unit of length (Hatcher and Atkins, 2000), amplitude, and aggregation (Rogers, 2006).

b. Unit: it is expressed as degrees/millimetre, or as standard deviation of curvature.

c. It can be measured at different ages, from 8 to 12 months. However, wool traits can also be recorded annually throughout the sheep's life. The growth period varies from 3 to 12 months.

d. Fibre curvature can be collected by a technician or lab staff using a sample of wool (normally from the midside) collected before or at shearing time.

e. Fibre curvature is usually measured with instruments (laserscan and OFDA instrumentation).

2.2.3.9 Greasy wool colour

2.2.3.9.1 Definition

a. For non-coloured fleeces, wool colour can vary from near white through to shades of cream and yellow, with intense yellow discolouration in greasy wool known (Merino). Other wool colours also exist such as grey, black and brown.

b. Units: it can be visually assessed on a scale (1 to 5) or measured as a mixture of three defined colours (notionally red, green and blue) expressed by the derived tristimulus values X, Y and Z (see below in point e. for explanation).

c. It can be measured at different ages, from 8 to 18 months at the first shearing. The growth period varies from birth to 12 months.

d. Colour can be determined by the farmer or by a technician using a sample of wool (normally from the midside) collected before or at shearing time. Wool colour can also be assessed on the live animal prior to shearing.

e. Colour is usually determined either visually (subjective assessment) or using a spectrophotometer or a colourimeter, as recommended by IWTO (measured assessment). It can be assessed on clean or greasy wool. Colour measurement systems allow colours to be represented by a mixture of three defined colours (notionally red, green and blue) expressed by the derived tristimulus values X, Y and Z (Wood, 2009). In wool colour measurement, the Y value is indicative of brightness and the Y-Z value indicative of yellowness. Brightness of wool increases as Y value increases and its yellowness increases as Y-Z value increases. The colour is best described in yellowness (Y-Z) units, which can range from 7 to 18 units. Most Australian fleece wools have Y-Z values between 7 and 12 units.

2.2.3.10 Visual appreciation

a. Definition: Visual appreciation can be defined through different traits (fleece rot, wool colour, staple structure, character/style, crimp, weathering and dust penetration, presence of medullated or kempy fibres in the fleece). This appreciation is by definition a subjective assessment. The characteristics are generally scored in a scale of 0-9 or 1-9 or 3 classes. They are scored at different ages, from 8 to 18 months,

at the first shearing. The growth period varies from 8 to 12 months. They can be collected by the farmer, the technician, or the wool classifier. Some of the wool characteristics have been described above.

b. Below is a list of relevant traits for visual appraisal. Visual traits should be recorded consistently and according to a documented guide. Some countries have published score guides to follow such as the Australian Wool Innovation Visual Sheep Score Guide (see reference).

- Wool colour.
- Staple structure.
- Crimp frequency and definition (character).
- Dust penetration, Weathering penetration.
- Medullation, presence of medullated or kempy fibres in the fleece. Medullated fibres are hair found in fleece wool that are hollow fibres that do not take dye well at the processing stage.
- Pigmentation (wool and skin).
- Staple structure
- Lustre. This corresponds to the silky feeling It can be assessed through a score from 1 to 5 (1-very dull to 5-very shiny)
- Homogeneity of fleece, expressed in units (1 to 5). It can be measured at different ages, from 3 to 18 months at the first shearing. The growth period varies from 3 to 12 months. Collected by a technician, assessed appraisal.
- Fleece score. At 12-month-old through a score from 1 to 9. 1-Poor 9-Excellent.
- Fleece rot.
- Character/style.
- Presence of black hair and white spots. Not allowed in some populations.

2.2.3.11 Additional traits

Some additional traits were mentioned in the survey. They are listed below.

a. Comfort Factor. It is the percentage of fibres finer than 30µm in a sample.

b. Spinning fineness. Spinning Fineness is a number which attempts to combine the Mean Fibre Diameter (FD) and the Coefficient of Variation of Diameter (FDCV) into a single measure of fineness to estimate the performance of wool when it is spun into yarn. Assessed from a wool sample.

c. Shedding traits: as some populations with low wool value try to breed animals shedding the wool (to avoid shearing and fly strike), shedding traits might be described.

2.2.4 Recommended prerequisites for recording of the animal

See list in section 2.1 “General considerations and rationale”.

2.3 Use for genetic evaluation

Breeding values have been estimated for the most of wool traits with the exception of fibre density and homogeneity. Proposed traits have been mostly included in the economic index. The survey also included additional information on traits such as average phenotypic value, annual genetic trend, and genetic parameters (genetic variance and heritabilities) to provide an overview of how heritable these traits are.

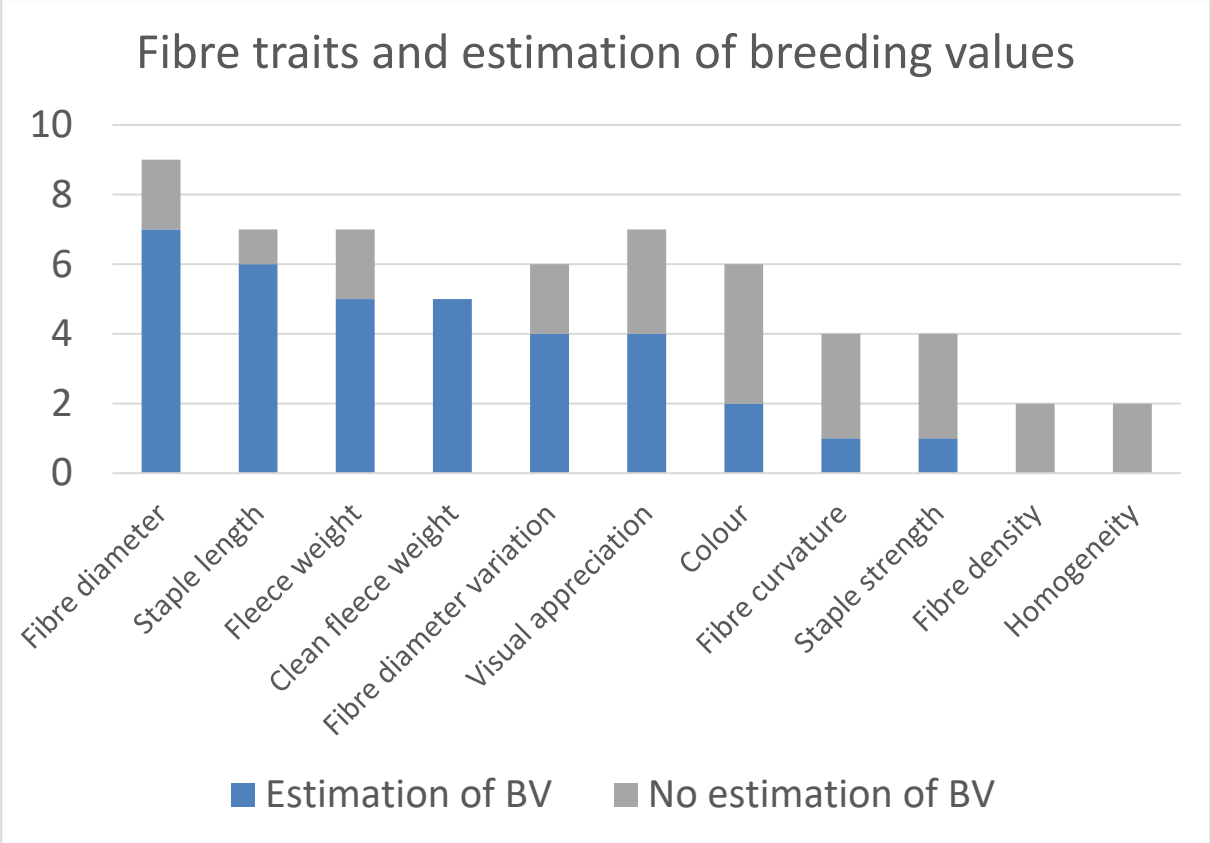

Figure 1. Number of countries which estimate breeding value of the traits (in blue), out of those which record the trait (blue + grey).

2.3.1 Genetic parameters

It is highly recommended to use the genetic parameters that have been estimated in the population that is to be evaluated. Each country should use its own genetic parameters for each population [genetic, permanent environment and residual variances, covariances (for multi-trait evaluations)]. If there is no reservoir of data available in order to establish these genetic variances, we would suggest using those that have been published from other breeding programmes with similar management and flock size structure until such time there is enough data to establish variances from within the breeding programme. For information, a common range of genetic parameters is given below.

Table 1. Typical genetic parameters for some wool traits for mainly wool-producing breeds.

Traits	Average phenotypic value	Heritability
Fleece weight	4 - 6 kg	0.30 – 0.45
Clean fleece weight or yield	2 - 4 kg	0.25-0.45
Fibre diameter	15 - 30 microns	0.50-0.70
Fibre diameter variation	15 – 17 microns	0.30 – 0.40
Staple length	50 - 150 mm	0.30-0.40
Staple strength	15 – 75 N/Ktex	0.25-0.35
Homogeneity of fleece		
Fibre density	1 – 5 g/cm2	
Fibre curvature	20 – 150 deg/mm	0.40 – 0.50
Colour		0.15-0.30

Source: ICAR survey on wool and Safari et al, 2005.

Wool traits are mostly moderately to highly heritable and have significant genetic variation, so improving quality and quantity of a wool is genetically feasible. Selecting rams and replacement ewe lambs that meet the goals is the most effective way to improve and increase wool productivity. However, it is important to use multi trait selection, because if traits are antagonistically correlated, selection for one trait may negatively impact another. For example, selecting sheep solely with the goal of decreasing fibre diameter may decrease adult live weight, fleece weight, staple length and yield.

2.3.2 Model of evaluation

The Best Linear Unbiased Prediction (BLUP) animal model as computation method is considered as being the standard for the genetic evaluations. In addition, the BLUP method has been extended to SSGBLUP, by including molecular data for genomic evaluation of wool traits in Australia.

The most common and recommended fixed effects are listed in the Table 2 below, which gives a summary of guidelines for evaluation of wool traits. Some of these are listed in 2.2.1 above. Sometimes breed is also included in the model, depending on the evaluation.

The random effects are usually the animal, and the maternal genetic effect if the population structure suffices. If the animals being evaluated have repeated measures of wool, the permanent environmental effect of the animal (and possibly a maternal permanent environmental effect) must be included in the model.

Table 2. Summary of evaluation for wool traits.

Trait Name	Definition	Recording	Fixed effects
Fleece weight	Weight of the fleece. It is expressed as grease fleece weight (pre-scouring).	Weight scale (manual or electronic)	hys[1], birth year, age at measurement, age of dam, sex, mob, birth and rearing rank
Clean fleece weight	Clean fleece weight is expressed as the amount of clean wool and refers to total greasy fleece weight multiplied by the washing yield. The yield may refer to the whole batch as the greasy fleece weight is an individual measure.	Weight scale after washing (manual or electronic)	hys[1], birth year, age at measurement, age of dam, sex, birth rank rearing rank, age at measurement, mob
Fibre diameter	The average thickness of the fibres.	Measured with instruments (laserscan or optical fibre diameter analyser – OFDA)	hys[1], age at measurement, age of dam, age at shearing, sex, birth and rearing rank, mob, measurement specifications
Fibre diameter variation	The standard deviation or the coefficient of variation of fibre diameter.	Measured with instruments (laserscan or OFDA)	hys[1], age at measurement, age of dam, age at shearing, sex, birth and rearing rank, mob, measurement specifications
Staple length	It is categorised into staple (≥ three inches) or clothing (< three inches).	Measured with instruments (Automatic Tester for Length and Strength – ATLAS, Staple Length Detector, Wool ruler)	hys[1], age at measurement, age of dam, sex, birth & rearing rank, mob
Staple strength	It is a measurement of the degree of resistance a staple of wool has against severing upon the application of incremental force.	Measured with instruments (ATLAS) or subjectively whereby personal appraisal is quantified by an experienced wool handler	hys[1], age at measurement, age of dam, sex, birth & rearing rank, mob
Fibre curvature	Fibre curvature describes crimp	Measured with instruments	hys[1], age at measurement, age of

Trait Name	Definition	Recording	Fixed effects
	frequency as the number of crimps per unit of length, amplitude, and aggregation.	(LASERSCAN and OFDA instrumentation)	dam, sex, birth and rearing rank, mob
Colour recording	Wool colour can vary from near white through to shades of cream and yellow, with intense yellow discolouration in greasy wool known (Merino).	Determined using spectrophotometer or a colourimeter	hys[1], age at measurement, age of dam, sex, birth and rearing rank, mob
Visual appreciation	Defined through different traits (fleece rot, wool colour, staple structure, character/style, crimp, weathering and dust penetration, presence of medullated or kempy fibres in the fleece).	Subjective measure with linear assessment (3 to 9 classes).	hys[1], age at measurement, age of dam, sex, birth and rearing rank, mob

[1]hys= 'herd/flock-year-season' effect which takes out the variation emanating from different flocks in different seasons in different years.

2.4 Use for flock management

No relevant use for flock management were collected in the survey.

It was just indicated that animals were shorn once or twice a year, usually in the spring and autumn.

This sub-section should be updated in the future.

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g. Kevin Mc Dermott, Sheep Ireland, Ireland
h. Gabriel Ciappesoni, INIA, Uruguay

i. Ignacio de Barbieri, INIA, Uruguay

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3) Document 1

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5 Annex 1: European wool collection and promotion centres

5.1 General considerations and rationale

In almost all European countries, the sheep and goat breeding systems are widely represented by extensive and semi-extensive methods of management.

Europe, as well as the Middle East, are the regions of the world with the longest history and tradition of sheep breeding. In Europe sheep breeding systems contributed strongly to shape the landscape and culture, as well as to the basis of the wealth of each nation.

The different European environmental conditions along with the local historical cultures have derived the breeding system in different ways, producing differences between the breeding systems and the relative sheep population. A great variability of sheep breeds and populations have been selected throughout Europe together with a great genetic variability, which represents an important resource for the European animal biodiversity. For this reason, we find more dairy sheep breeds in southern Europe and more meat sheep breeds in the central and northern European countries.

With regards to wool production in Europe, sheep were selected for wool production until about the beginning of the 20th century. With the advent of the Australian and New Zealand Merino selection together with the arrival of the new artificial fibres, European wool production has gradually decreased along with wool quality. Over the last 50 years, wool has not created much revenue for the European breeders and indeed it has progressively become a cost to the system due to the low wool price received in relation to the cost of removing wool from sheep.

In recent years, the interest on European wool has returned. This is because of the decrease in the quantity of wool produced in Australia and New Zealand and the attention has been turned towards the production of meat for food consumption as well as wool production. As a result, their breeding goals have broadened for that reason. Although the quality of European wool continues to be relatively poor, Europe is now the third largest wool producer in the world.

The European textile sector has started to pay attention to the local wool production. Small processing chains have been started again, firstly at breeders' level, then at textile companies' level. Particularly the Italian textile industry has provided expertise and infrastructure for the European wool production systems, and at the same time has given them the opportunity to access international markets.

There is a need to create new markets for our wool (such as insulation for housing, mulching and composting for horticultural us) which has created the need to identify new strategies for managing European wool.

5.2 The territories of production

The present document is focused on territories where there is no rational system of wool production and management as it occurs in some countries of the southern hemisphere with Merino production, and where the pastures availability allows extensive sheep breeding management for wool and meat production.

Extensive grazing allows the use of areas with little agronomic potential, i.e. the valorisation of otherwise unusable available biomass. Sheep grazing plays a fundamental environmental role ranging from fire control to the reduction and spread of weeds and brambles, up to the more useful fertilization of pastures.

5.2.1 The farming system: from the breeding to the collection centre

The wool, collected according to the standard shearing method, has to be packaged correctly. There are several different packaging methods. Such methods require clean bags which are not stained and which must also not introduce contamination (i.e. plastic from plastic bags).

Generally, bags of strong and uncontaminated material are preferred, where the fleeces can be well pressed and are easy to store.

Each bag must also have an individual label, which contains two kinds of information, one referring to the farms and consisting of:

a. Farm code number
b. Farm name
c. Farm address
d. Telephone number

and one referring to the fibre as follows:

a. Fleece category (code) [as a first grading]
b. Colour (code)
c. Length (code)
d. Shearing year
e. The average diameter of fibres if and when laboratory analyses have been carried out

The wool lots with the correct label, are shipped directly in the territorial collection and promotion centre where they will be processed as below.

5.2.2 The collection and promotion centre

It is proposed that Wool Collection and Promotion Centres (WCPC) facilitate the organisation of the raw material production and are linked closely to the textile factories. An appropriate technical and administrative management of wool lots, from the farms to the WCPC, enhances the value of the raw material and therefore the wool processing chain.

WCPC are the sites where the work of the farmers related to the flock and fleece management will have to be evaluated critically in respect to the quality of wool for the textile sectors.

The location of the WCPC will have to be planned carefully in consideration to:

- the number of sheep in the territory
- the infrastructure availability: logistics and transport, office and storage areas
- ability to train local workers in wool classification and grading.

5.2.2.1 STEP 1 - Materials (wool) reception sector

The wool must arrive at the WCPC warehouse. The wool should already arrive there having already been sorted out according to the standard method carried out at farm level by expert shearing contractors and / or wool classifier in the following main categories for each breed:

a. Fleece (the bulk of the wool from the body of the sheep – divided in adult, weaned lambs and hoggets and lambs)
b. Pieces (marginal part of the fleece generally contaminated and dirty)
c. Bellies (wool from the belly region of the sheep)

d. Crutchings (wool from the tail area, with urine and/or dung)

e. Locks (short wool collected on the floor during shearing)

f. Stain (wool containing urine stain)

Wool must be supplied having been:

a. carefully packed, in proper wool bags such as those typically used in Australia and the UK (made from hessian or nylon) supplied to the farmers by the WCPC (each bale of wool should not exceed EU regulations for farm health and safety on farm regulations)

b. well closed by typical metal hooks or by stitching

c. absolutely dry

d. accompanied by a self-declaration form by the producer / wool collector that certifies the indemnity of the reportable diseases, in accordance with the local laws for sheep and other small ruminants.

In addition, there should be a loading/unloading register for the in-coming product to identify batch number, date and source of product. Similarly, there should be documentation associated with out-going wool, to verify the stock inf the warehouse.

Present action is necessary according to the different origins of providers: sheep farmers, collectors/intermediaries/traders, and other warehouses. This method guarantees a sufficient traceability of the batch, as well as providing the conditions for the sanitary certifications, necessary for any exports of the products.

5.2.2.2 STEP 2 - Materials (wool) management sector

A warehouse management has been organised for the traceability purpose of the different wool lots which have been stored in different storage areas organised according to:

a. type of wool delivered,

b. period of delivery

c. territories of production, when possible

Present organisation of the management sector allows a flow of information necessary for the next actions of selection, grading and definitive packaging for the dispatch.

The flow of action is described below:

The incoming bales of wool are opened, the greasy wool is pulled out from the bales and deposited on the table. An expert operator/grader (health protected with suitable devices) classes the wool for quality and places them in specific boxes for each class.

The different wool quality lots are packed by oleo-dynamics press and packaged with suitable metal bands and polythene sheets.

The packaged and classified greasy wool is:

a. stored in wool warehouse.

b. Tested (core-test) for fineness, washing yield, vegetable content and colour.

c. Proposed on international market.

5.2.2.3 STEP 3 - Materials (wool) trade sector

Administrative activities are carried out to spread the return between the farmers, provider of greasy wool, according to the quantity, the quality and the correct management of the WCPC (shearing and classification at farm level). Even if the organisation involving a WCPC would depend on the national and territorial situations, the WCPC might manage the economic part (paying the breeder and selling to textile manufacturers) and the incentives to farmers to improve wool quality.