FIBER PRODUCTION AND SHEEP BREEDING IN SOUTH AMERICA

R.C. Cardellino* and J.P. Mueller**

Delta Consultants, Montevideo, Uruguay*, National Institute for Agricultural Technology, Bariloche, Argentina**

SUMMARY
The production of wool and other fibers, in particular those produced by camelids (special fibers) in South America is reviewed. The two main production systems, named commercial and smallholding are described, including their geographic locations. Wool is by far the main animal fiber produced in South America with a volume of 143 million kg (greasy) followed by the alpaca fiber with 4 million kg.

Sheep breeding programs in the four South American countries with the largest sheep populations are summarized. Argentina and Uruguay have the most developed sheep genetic improvement programs. Their evolution from the beginning in the 70’s until now is reviewed, including a description of the present programs.

A description of the production of fibers from the four South American camelid species (alpaca, llama, vicuña and guanaco) as well as mohair, is also included.

INTRODUCTION
The South American sub-continent covers a range of environments in which sheep, goats and South American domestic camelids (llama and alpaca) produce meat, fiber, milk and skins for a large number of farmers, contributing substantially to their livelihoods and to the national economies. Given the variety of ecological and socio-economical conditions it is difficult to generalize on production areas, production systems and breeding practices. Sheep are most common in the vast temperate rangelands and deserts of the south, while goats are more common towards the north-east of the subcontinent, and camelids are largely found along the Central Andean region. Sheep are for the most part dual purpose (wool-meat) whereas goats are bred for meat and camelids are multipurpose. Dairying with small ruminants is not common in South America. Notable exceptions to this general description are hair-sheep in the northeast of Brazil, bred exclusively for meat, and Angora goats and criollo goats in southern Argentina which besides meat produce mohair and cashmere.

Wool is by far the most important animal fiber in South America, but other fibers, usually called “special fibers” like alpaca, llama, and mohair are also produced in large quantities. In addition, vicuña, guanaco, angora (produced by rabbits), silk and cashmere fibers have great potential for development but at present the amount of fiber produced is still low (Table 1).

Table 1. Production of wool and other animal fibers in South America.

<table>
<thead>
<tr>
<th>Species</th>
<th>Animal Population</th>
<th>Fiber</th>
<th>Fiber Production (kg, greasy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>57,500,000</td>
<td>Wool</td>
<td>143,700,000</td>
</tr>
<tr>
<td>Alpaca</td>
<td>3,503,774</td>
<td>Alpaca</td>
<td>4,055,595</td>
</tr>
<tr>
<td>Llama</td>
<td>4,080,596</td>
<td>Llama</td>
<td>3,342,866</td>
</tr>
<tr>
<td>Angora goat</td>
<td>550,000</td>
<td>Mohair</td>
<td>825,000</td>
</tr>
<tr>
<td>Vicuña</td>
<td>319,547</td>
<td>Vicuña</td>
<td>5,580</td>
</tr>
<tr>
<td>Guanaco</td>
<td>577,697</td>
<td>Guanaco</td>
<td>1,500</td>
</tr>
</tbody>
</table>

Source: Cardellino and Mueller (2008), Quispe et al. (2009).

SHEEP PRODUCING AREAS
The main sheep production areas in South America are shown in Map 1. Three main sheep areas can be distinguished. The largest one, indicated as wool producing sheep area, includes the majority of Argentina, southern Chile, Uruguay and southern Brazil. In that area, wool or dual purpose sheep breeds predominate mainly derived from the Merino. The second area, the criollo sheep region, includes the northern part of Argentina, and the Andean Altiplano regions of Bolivia and Perú. There is a third area, specifically a dry region in northeastern Brazil, where woolless hair sheep are raised basically for meat and skins.

---

1 Comunicación Técnica INTA EEA Bariloche Nro. PA 552.
SHEEP PRODUCTION SYSTEMS

Two major sheep production systems can be distinguished: commercial and smallholder. Commercial systems include farmers with a variety of flock sizes depending on the region, but oriented mainly to the production of wool and meat for the market. Main areas of these production systems include in Argentina the regions of Patagonia (dry and cold, Merino and Corriedale), Mesopotamia (mixed cattle-sheep farming, Corriedale and Polwarth) and the Pampas (mixed cropping-sheep farming, Corriedale, Romney Marsh and Lincoln) with about 50,000 growers. Argentina’s wool exports amounted to 230 mill USD during 2007/8. Uruguay, with 38,000 growers in mixed farms with beef cattle, running dual-purpose sheep (Corriedale 60%, Merino 25%, others 15%) and wool exports of 240 mill USD in 2007/8. Brazil, with 40,000 growers running mixed farms located in the southern region, with predominance of dual-purpose sheep and wool exports of 25 mill USD. In Chile there are about 60,000 growers. The Patagonian region in Chile concentrates 60% of the total sheep population in the country, involves medium to large farmers and dual purpose sheep breeds. Wool exports represent 15 mill USD.

Table 2 shows that commercial production systems comprise some 60% of total sheep numbers and account for 85% of the wool produced. It also can be seen that most wool marketed is fine or medium. It must be stressed that these figures do not include wool processed on farm. It is estimated that about one third of coarse wool and cameld fibers produced by smallholders are not marketed and rather used in the household or transformed and sold with aggregate value as handcrafts.

Table 2. Sheep population and wool production in South American countries (2008).

<table>
<thead>
<tr>
<th>Country</th>
<th>Nº sheep (mill)</th>
<th>Prod. System</th>
<th>Fine &lt; 24.5 mic</th>
<th>Medium 24.6 – 32.5 mic</th>
<th>Coarse/Criollo &gt; 32.5 mic</th>
<th>Wool Production (mkg, greasy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>16.0</td>
<td>commercial/smalholders</td>
<td>40.3</td>
<td>22.7</td>
<td>2.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Uruguay</td>
<td>10.4</td>
<td>commercial</td>
<td>12.0</td>
<td>27.0</td>
<td>2.0</td>
<td>41.0</td>
</tr>
<tr>
<td>Chile</td>
<td>3.9</td>
<td>commercial</td>
<td>0.2</td>
<td>10.8</td>
<td>0.2</td>
<td>11.2</td>
</tr>
<tr>
<td>Brazil</td>
<td>3.5</td>
<td>commercial</td>
<td>1.0</td>
<td>8.5</td>
<td>1</td>
<td>10.5</td>
</tr>
<tr>
<td>Perú</td>
<td>14.7</td>
<td>smallholders</td>
<td>0</td>
<td>5.0</td>
<td>7</td>
<td>12.0</td>
</tr>
<tr>
<td>Bolivia</td>
<td>9.0</td>
<td>smallholders</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>57.5</td>
<td></td>
<td>53.5</td>
<td>74.0</td>
<td>16.2</td>
<td>143.7</td>
</tr>
</tbody>
</table>

Source: Cardellino, RC. based on FLA, SUL, ODEPA, IICA, IWTO.

Historically the production of sheep meat has been a by-product of wool production with practically no areas specialized in the production of fat lambs. However, as a result of low and fluctuating wool prices, meat production has increased its importance on sheep production systems in the last years.
Uruguay has become the third export country of sheep meat, though well behind Australia and New Zealand. Sheep meat consumption is rather small in all countries (Table 3) as beef is much more popular.

Table 3. Sheep meat production, exports and consumption in South American countries (2008).

<table>
<thead>
<tr>
<th>Country</th>
<th>Annual slaughter (head)</th>
<th>Meat exports (ton)</th>
<th>Domestic consumption (kg/capita)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uruguay</td>
<td>1,526,000</td>
<td>21,773</td>
<td>6.2</td>
</tr>
<tr>
<td>Argentina</td>
<td>1,461,000</td>
<td>6,096</td>
<td>2.5</td>
</tr>
<tr>
<td>Chile</td>
<td>763,000</td>
<td>5,079</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Source: Cardellino and Abella based on DICOSE, INAC, SAGPyA, ODEPA. Official data from Brazil, Perú and Bolivia are currently unavailable.

The second sheep production system is the smallholder system which corresponds to low input, low productivity small farms with subsistence economies. Flock size is small, 20-40 head and usually mixed with goats or camelids. Sheep are of the criollo type (derived from the original sheep introduced by the Spanish settlers) or non-defined criollo crosses. Main areas where these types of production systems can be found include: the Altiplano of Bolivia, a region at 3000-4500 masl, involving mostly native communities; the Sierra Central Region of Peru and the area north of the Titicaca Lake, with 43% of very small producers and 32% of peasant communities. The Altiplano sheep production systems extend to the northwest of Argentina (Tempelman and Cardellino, Eds., 2007).

SHEEP BREEDING PROGRAMS

Argentina. As in other countries of South America, Spanish sheep were introduced into Argentina soon after the discovery. More than 200 years of natural selection developed sheep well adapted to the different environments. Early XIX century these populations called “criollos” were upgraded to Saxon, Negrete and Rambouillet Merinos aiming for a better carcass and finer wool. Selection within the resulting genetic pool gave origin to the Argentine Merino. By the end of that century an active European mutton market and the advent of cold-storage plants and ships encouraged the use of the large British Lincoln and Romney Marsh breeds. Both breeds were used for crossing and upgrading. In the 1930s the decreasing demand for sheep meat and increasing wool prices were responsible for the preference of Australian Merinos, Polwarths and Corriedales which were imported from Australia and New Zealand.

Within breed improvement was initiated by pioneer breeders who later associated into Breed Societies and implemented pedigree registration following British Flock Book rules. These Societies are largely responsible for the present genetic structure, production level and genetic improvement rate of most breeds. Today a hierarchical genetic structure characterize Argentine sheep breeds, however the relationship between parent and daughter studs is not as close as it is in Australia.

Performance recording started in the 1960s, heavily influenced by Australian scientists such as Helen Newton Turner and Brian Jefferies who visited and worked in Argentina as consultants for a FAO funded Patagonian Sheep Production project run by the National Institute for Agricultural Technology (INTA). Following their advice, a fleece testing laboratory was constructed and objective fleece testing was promoted. A performance testing scheme was implemented in 1970 as a selection aid for Merino and Corriedale ram breeders in Patagonia. By 1985 the scheme became a Pilot Improvement Program offering selection indices based on body weight, fleece weight, clean yield and fiber diameter. In 1990 the program developed into the National Sheep Evaluation Service (PROVINO) based on a joint agreement between INTA and several breed societies. Initially the program provided within contemporary group breeding values and sire-summaries.

In 1991 Central Progeny Testing (CPT) of sires started in the Merino breed followed by Corriedale, Romney Marsh and Polwarth. Particularly successful is the Merino CPT scheme which is still operating. Interestingly the Merino CPT scheme often includes show champions and imported sires on invitation. It has to be remembered that major Argentine Merino studs regularly import rams or their semen from Australia. Amongst the imports are Australian show champions including supreme champions (see for example Top Sire, 2005). Several of these studs furnish PROVINO with pedigree information allowing the calculation of within flock BLUP of expected progeny differences (EPDs). Since 2006 the accumulated data from these studs and those from the CPT sites are merged enabling across flock evaluations which are published by the Argentine Merino Breeders Association (see sire evaluation results at AACM, 2009).
Thus, at present PROVINO provides two types of genetic evaluations: within flock EPDs and across flock EPDs, in a somewhat similar fashion as Sheep Genetics Australia does with its “flock” breeding values and “Australian Sheep” breeding values. At the end of the 2007/8 clip PROVINO evaluated about 16,000 ram hoggets from a total of 176 farms and ranked 236 Merino sires. These figures highlight that selection procedures are still largely based on visual inspection only. An important step towards the use of objective measurements was taken by the Argentine Merino Breed Society with its “Pure Registered Merino” program based on identification of rams performing above average (on breeder chosen PROVINO index) in its contemporary group and visually accepted by an authorized classer. More than 60,000 sheep were already inspected by means of this program.

A further important development for the Argentine sheep industry in general and sheep breeding in particular has been the enforcement of a “National Sheep Recovery Law” in 2001. This Law provides state funds for stock recovery, farm infrastructure, feed production, breeding plans, large scale sheep health programs, AI projects, semen imports and central progeny testing. It also finances the National Wool Quality Program called “Prolana”, which promotes and rewards proper shearing, skirting, baling and testing of wool.

**Brazil.** Brazil has around 14 million sheep concentrated in two main regions: South (wool sheep) with 33% and Northeast (hair sheep) with 56% of the total population. In the southern region temperate and subtropical climate predominates. Sheep improvement began with the absorption of mixed criollo flocks of Spanish origin (mainly Churro) by traditional wool and meat sheep breeds during the first decades of the XX Century (Australian Merino, Polwarth, Corriedale, Romney Marsh and Hampshire Down), followed by 50 years of visual selection by breed standards. In 1942 the Brazilian Sheep Breeders Association (ARCO) was created.

In 1978 the Sheep Genetic Improvement Program (PROMOVI), based on objective measurement of wool traits, was initiated and remained officially active from 1981 to 1995. The wool crisis affected the internal market and production of tops virtually ceased in the country. The importation of meat breeds (Ile-de-France, Suffolk and Texel) increased in the 1990s. From 1995 to 2000 ARCO implemented the Central Performance Test for meat breed lambs and a Performance Test on farms. Since 2000 no objective evaluations that could serve as basis for sheep genetic improvement programs have been carried out in this region (Cardellino, 2009).

Semiarid conditions predominate in the Northeast region of Brazil. Hairy sheep originated from African and Caribbean stocks and resulted in well defined naturalized breeds (Santa Ines, Morada Nova, Rabo Largo, Cariri). Since 2002 a research institute in Paraiba State (EMEPA) and the sheep national center in Ceara State (EMBRAPA) have conducted feedlot performance testing in Santa Ines males. Other initiatives are the Genetic Improvement Program for Goats and Meat Sheep (GENECOC) by EMBRAPA and the Genetic Improvement Program for Santa Ines breed by the University of Sao Paulo.

All current programs have a very low level of participation by sheep breeders, especially studs. In an expanding market, these breeders obtain good prices for their sheep stock (rams, hoggets and ewes) based only on visual selection and aggressive marketing. In 2008 EMBRAPA proposed the development of a Research Network for Sheep Genetic Improvement with the participation of its research units, universities and state research organizations. It is being currently developed under a service contract with ARCO and aims at establishing a national sheep genetic improvement scheme with enough versatility to include all breeds of wool and hair sheep in both main sheep producing regions of the country (Benítez *et al.*, 2008).

**Chile.** At present there are no regional or national sheep breeding programs operating. In the Chilean Patagonia, where most of the sheep are concentrated, a cooperative nucleus breeding scheme in the Corriedale breed was set up in the 1980s supported by the National Institute of Agricultural Research (INIA). More recently a number of breeds were introduced and evaluated, including Dohne Merino, Poll Dorset, Suffolk and East Friesian. (Lira, R., 2009, personal communication). Breed improvement relies heavily on conventional procedures, including visual classing of replacement candidates and promotion of show champions. Nevertheless Corriedale rams have ranked high in progeny tests including New Zealand and Argentinean sires (Mueller *et al.*, 2007).

**Peru.** Sheep population in Peru is estimated in 14 million head, 85% of which is run by peasant communities, and belong to the criollo breed and their non-planned crosses (Vivanco, W., 2009, personal communication). The remaining 15% correspond to Corriedale and Junín (a local breed based on the Corriedale, Polwarth and Panamã breeds), and are in the hands of communal cooperatives and private farmers. There do not exist well structured and organized sheep breeding programs in the country, nor performance recording systems and genetic evaluations. Large scale improvement programs have been
successfully implemented with support of the University of La Molina (Mueller et al., 2002). Recently, the Dohne Merino and the East Friesian have been introduced.

**Uruguay.** The predominant breeds in Uruguay are Corriedale, Merino and Polwarth, which represent 60, 20 and 10 per cent of the national sheep flock, respectively. These breeds can be defined as multi-purpose in the sense that they generate income from the sale of wool and sheep meat (surplus offspring and cast for age animals), forcing breeders to consider several traits in their selection programmes. Traditionally, wool has been the main product of the system. However in recent years, the importance of the sheep meat (lambs and mutton) has increased significantly. The breeding structure of sheep industry in Uruguay follows in general the common hierarchical pattern with “top”, and “multiplier” studs, reflecting their relative importance in terms of dissemination of genes to the commercial flocks. Flock size in studs is large enough to allow effective “within flock” programs of genetic improvement (on average 500 breeding ewes). The evolution of sheep breeding programs and genetic evaluation procedures since 1970 to date has followed the same pattern than more developed sheep producing countries, mainly Australia and New Zealand.

**Performance recording schemes within flocks (Flock Testing Service):** A performance recording scheme started in 1969 with the purpose of introducing more effective breeding methods, through the objective measurement of economically important traits. This service was implemented and supervised by the Uruguayan Wool Secretariat (S.U.L), a private growers’ organization. Ram hoggets without obvious faults and shorn as lambs are recorded at 10 to 12 months old: fleece weight, live weight, and a visual appraisal of quality, character and colour of the wool. A mid side sample of wool is taken and scouring yield, staple length, average fibre diameter, CV of diameter and comfort factor are determined. The Flock Testing service is still operating and involves at present 120 studs and 22,000 animals in 2008. The rate of adoption by the most important studs (top studs) has been very high (95% in Corriedale, 80% in Polwarth and Merino studs).

**Breeding objectives and selection criteria:** After many years of operation of the flock testing service, it gradually became obvious that a formal definition of the breeding objectives and selection criteria was essential. It was recognized that such a formal definition would enable to determine more precisely the relative importance of different traits and also offer breeders the possibility of combining various selection criteria in an index (Cardellino and Ponzoni, 1986). In recent years, new updated selection indices were developed for general use.

**Central progeny test:** In 1994, with the objective of comparing the genetic merit of rams from different studs, several Central Progeny Test (CPT) operations started in the Corriedale and Merlin breeds, with the support of their Breeders’ Associations and the technical support of SUL. In 1995 it started another one in the Merino breed, and in 1997, the first CPT in the Polwarth breed began to operate. All the CPTs were located in private farms and supervised by technical staff of SUL. Until year 2000, dam identification was not recorded, so genetic evaluation of different traits was performed with a sire–model. This period of functioning of CPT’s was considered very important in the evolution of sheep genetic evaluations in Uruguay. Gradually the concept of reference sires was introduced, allowing the genetic comparison of rams used in different CPTs and years and also the feasibility of performing across–flock genetic evaluations became more obvious. Multi–trait BLUP methodology was then introduced as well as the concept of EPD’s (Expected Progeny Differences), replacing the traditional use of phenotypic values in the selection of the animals. At the same time, new traits were included in the breeding plans: FEC (faecal egg count), as indicator of genetic resistance to internal parasites, weaning weight, eye muscle area and fat depth. Table 4 presents for each breed, the numbers of CPT, the years of operation, the number of studs and participating rams.

**Table 4. Central Progeny Test for different breeds in Uruguay.**

<table>
<thead>
<tr>
<th>Breed</th>
<th>Number</th>
<th>Years</th>
<th>Studs</th>
<th>Rams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corriedale</td>
<td>3</td>
<td>94-09</td>
<td>36</td>
<td>234</td>
</tr>
<tr>
<td>Merino</td>
<td>5</td>
<td>95-02</td>
<td>36</td>
<td>170</td>
</tr>
<tr>
<td>Merlin</td>
<td>1</td>
<td>94-99</td>
<td>15</td>
<td>37</td>
</tr>
<tr>
<td>Polwarth</td>
<td>1</td>
<td>97-00</td>
<td>19</td>
<td>55</td>
</tr>
</tbody>
</table>

**Across – flock genetic evaluation:** The experience acquired and the results produced by CPTs, created a suitable environment to start with genetic evaluation across–flocks, through the use of reference sires
among the participating studs. Corriedale and Merino breeders were the first in initiating these evaluation programs. At present the number of studs involved in across–flock evaluations is: Corriedale (24), Merino (14), Polwarth (6), Merlin (5), Texel (5) and Romney (3) (see sire evaluation results at SUL, 2009). Genetic evaluation analysis are performed by SUL and INIA. Every year special meetings with stud breeders and technical staff are carried out, to define the use of “reference sires”, checking that the whole system remains well connected.

Central data base: The initial system of collecting and storing data was not reliable enough which represented a limitation to the growth of a sire reference scheme with a high standard. SUL developed a software called SULAR (breeder’s module) which performs quality control of data when it is incorporated (mating, lambing, pregnancy test, weighting, etc.). It also produces internal reports for the stud, and pre-printed data forms to be filled in the field. Special emphasis was placed in the registration of information on the performance of dams, and survival of lambs with the objective of producing EPD’s for these traits. Once the information is sent by the breeder, wool laboratory data, faecal egg counts and pedigree records of registered animals are incorporated. The central data base stores the identification of the animals, plus information on production and pedigree records (Gimeno and Cardellino, 2006).

Fine Merino Nucleus: In 1998, it started a Fine Merino Project which included the participation of the Merino Breeders’ Association, INIA and SUL. A highly selected screened nucleus was formed with the objective of generating and distributing genetically superior sires for the production of fine and superfine wool less than 19.5 microns (Montossi et al., 2005). The initial nucleus included 742 ewe hoggets selected from 37 contributing flocks, screened from a population of 5170 ewe hoggets. Contributing producers annually receive genetically superior hogget rams, for their own use. Frozen semen from highly selected Australian merino rams has been used, particularly from the New England area. Results so far have shown very good progress in reducing diameter, while maintaining fleece and body weights.

THE PRODUCTION OF OTHER ANIMAL FIBRES

In South America these fibers are produced almost exclusively by smallholders in low input systems where they are critical for the subsistence of its producers by contributing raw material for homemade clothing, handicrafts for local markets or fiber for the textile industry. Most fiber production systems are located in marginal areas with goats and camelids grazing natural rangelands. Alpacas, llamas and vicuñas are typically found in high altitudes of the central Andes while goats producing mohair or cashmere and guanacos are largely found in the Patagonian desert.

Alpaca. The Alpaca (Vicugna pacos) is a domesticated South American camelid species whose wild ancestor is the vicuña. Alpacas are raised in the highlands of Peru, Bolivia and Chile. More than 80% of the world’s alpaca population can be found in southern Peru, northwest of Lake Titicaca at 3700-5000 masl. The alpaca is a symbol of Peruvian national identity. 85% of the alpacas are run by smallholders with less than 50 animals each, or are kept in farmer communities. Alpacas are particularly prized for their fiber, which is noted for its fineness, softness, light weight, exceptional warmth, hygroscopic features, resistance, elasticity, prestige and natural colors. Its fabric is soft to handle and shiny in sight. The soft touch is related to the fineness of the fiber but also to the arrangement of the scales along the fiber. “Baby” alpaca fiber diameter averages 22 mic and alpaca “fleece” averages 26 mic. An adult alpaca produces 1.5-2.8 kg of fiber per year. Alpaca is the main special fiber produced in South America.

Llama. The llama (Lama glama) is the other domesticated South American camelid species, its wild ancestor being the guanaco. Both, llamas and guanacos are larger animals than alpacas and vicuñas, therefore more meaty. Most llamas in South America are found in Bolivia and Peru. Bolivia has the largest llama population, about 2.4 million, largely on the high-plateau (Altiplano) at 4000 masl in the western of the country. Peru with 1.2 million llamas is the second producer, while Argentina ranks third. It is estimated that in Bolivia there are 54,000 producers, 80% having less than 90 llamas each. Llamas are multipurpose animals; they are raised for their meat, power and fiber. As with alpacas, there is a strong cultural tie between llamas and their producers and communities. The fiber produced by llamas is not as fine as that of the alpacas. In Bolivia adult llamas produce fiber with an average diameter of 33 mic, and may yield up to 93% of its original weight when processed. Llama fiber is extensively used for clothing and handicrafts. Due to its multiple breeding objectives, llamas were selected for high body weight and fleece weight (1.5-3.5 kg) but less for fiber traits such as fineness and uniformity of color.

Vicuña. The vicuña (Vicugna vicugna) is the smaller of the two wild South American camelids and its undercoat fibers are extremely valuable and “special”, not only for its textile characteristics but also for
its rareness and association to exotic environments and culture. After a period of near extinction, the vicuña population recovered substantially in population size in all Andean countries. In Peru the vicuña population is now 140,000 and increasing, as well as in Argentina with a population of 133,000. Vicuñas are captured, shorn and released using different methods. Although a few vicuñas are kept in captivity systems, in general they are captured during large scale community based events. At present Peru is producing most of the vicuña fiber, about 5500 kg/year with a fiber diameter between 10-15 mic. Yarn and fabrics made of vicuña fiber have the highest market price of all special fibers but its production is not easy due to its short staple length and the necessity of separating manually guard and dead fibers from the fine down fibers.

**Guanaco.** The guanaco (*Lama guanicoe*) is the biggest of the two wild South American cameldid species and its population is much larger than that of the vicuña. More than 90% of the world guanaco population is in Argentina and the remainder in Chile and Peru. The population of 550,000 guanacos in Argentina is largely concentrated in the southern part of the country (the Patagonian desert). Guanacos roam freely in this sparsely inhabited region where sheep production is the main agricultural activity. Capture of guanacos is difficult as they can easily jump regular fences to escape at very high speed when mustered. Special techniques have been developed in order to capture, calm, shear and release guanacos avoiding unnecessary fear and injury. Fleece weight is approximately 1 kg for a two-year growth. Guanaco fiber is not as fine as that of the vicuña (16-22 microns) but otherwise quite similar, including its color variations of brown.

**Mohair.** About 550,000 Angora goats are run in the northwest of Argentina’s Patagonia where they produce 825,000 kg mohair of competitive quality. Argentina is among the top world producers of mohair. About 4,500 families make their living on mohair and meat produced by Angora goats. A large proportion of the mohair clip is exported. Only a minor part is processed locally and mohair handcrafts are not common. Mohair is a fiber well known for its luster, resistance, length and smoothness. Notable of Angora goats in this part of the world is the uniformity in color. Almost all Angora goats in Argentina are white, as opposed to central Asian Angora goats where other colors are very common. Angoras are shorn twice a year and produce a total of about 1.5-2.5 kg mohair. Mohair from young animals, (first and second shearing) is much finer (24 mic) than mohair from adult animals (29 mic and more).

**ACKNOWLEDGEMENTS**
The authors wish to thank Dr. Daniel Benítez (Brazil), Ricardo A. Cardellino (Brazil), Raúl Lira (Chile) and William Vivanco (Perú) for their reviews, comments and useful information used in this paper.

**REFERENCES**
Requests to rcard@ufpel.edu.br.
Comunicacion Técnica INTA EEA Bariloche PA 515.
Within this special genetics issue, experts from around the country discuss many different breeding technologies. Here's a list, in no particular order: * Cloning * Marker-assisted selection (MAS) * Genetic prediction * Gene transfer * Sex control * Systematic crossbreeding and composites * Animal identification (DNA and biometric methods) * In vitro fertilization and embryo transfer * Marker-assisted mating.

Alpaca and llama fibers are of the finest quality. Sheep wool tops today's animal fiber industry. So, what's different about the fleece of these herding animals? Alpaca and llama fleece are classified as specialty or luxury fibers, but sheep fleece or wool tops the list of animal fibers used today. The camelids (alpaca and llama) are quite similar to each other in fiber and background, and though they bear some similarity to sheep, the differences between the fibers of these herding animals are outstanding. Alpaca. And as worldwide appetites continue to grow, North America continues to deliver superior alpaca fibers and products. Llamas. The llama is also a native of the Andes Mountains and has been domesticated for as long as the Alpaca. Artificial breeding offer benefits and options to woolgrowers wanting to assess traits that are hard to measure.Â Sex Semen; The University of Sydney. Improving the success of sheep AI programs; South Australian Research and Development Institute (SARDI). Semen Standards. Sensing technologies to improve AI protocols without PMSG. Cervical artificial insemination. Continuing investment from AWI in The University of Sydney’s current research projects support Associate Professor Simon de Graaf and Dr Jessica Rickard to build on the pioneering work in oestrus synchronisation, frozen semen and laparoscopic insemination technology undertaken by The University of Sydney with the support of AWI’s predecessors.
The Suffolk sheep breed have been around for a while now and are a large, sturdy breed with a long body, black faces and legs. They are quiet docile breed that can be used as a dual-purpose sheep breed for both their meat and wool. They have an excellent meat quality with lambs maturing early and market ready by 9 to 12 weeks. They are today quite a popular meat sheep breed in a lot of countries throughout the world including America, Australia, New Zealand and countries in Europe. The Texel is very popular for its high-quality meat it produces. They have a high dress out percentage with excellent meat to bone ratio. They are known for the high-quality meat production. Lambs can grow to their required weight without putting on any excess fat and therefore eliminating wastage. Hair breeds have more hair fibers than woolly fibers and usually shed their coats annually. Some hair breeds have few if any wool fibers in their coats, especially if they are being raised in a warm climate. Hair sheep usually do not require shearing, crutching, or docking. In contrast, wooled breeds have more woolly fibers and need to be sheared, usually at least once per year. Ideally, wooled sheep should be crutched, if they are not sheared prior to lambing. Crutching is the removal of wool around the vulva area and udder. Originally, all sheep were hair sheep. The soft, short undercoat (“down”) of hair sheep was favored in selection programs and led to the development of the wooled breeds of today. Fiber production and sheep breeding in South America. Proc. Assoc. Adv. Anim. Breed. Genet. 18: 366–373. Google Scholar. Breed is the largest of sheep breeds and it also boasts the longest, heaviest and most lustrous fleece of all sheep breeds in the world. Their wool is ideal for handcrafts, spinning and to blend with other fiber such as mohair in order to lend strength to the shorter stapled wools. It is even blended with Mohair at times for a stronger fiber. They are a dual-purpose breed bred for both their top-quality wool and meat.