OVIS ARIES

Agricultural Class Monograph

Juan David Aristizábal

Colegio Bolívar 12 Grade

Introduction

Ovis aries, also known as sheep, have existed for approximately 60 million years before common era (Czaplewski, J. J., n.d). These species used to be wild, maintaining themselves in groups. However, they were often indefensible to predators like wild dogs and wolves. Later on, ancient people started to domesticate these species, since it was a source of food, milk and skin. Ancient people often used their skins and wool to make coats and other kinds of clothes, but they were primarily used as a source of food. Over time, sheep started to leave certain attributes behind like for example, genetic deficits caused by incest. This allowed new species and new attributes to be developed, like better kinds of wool, better efficiency in terms of milk and meat production. Some of this mutations and changes were caused because of the close care of humans (domestication), the climate and the geography. The close care of humans (domestication) made them become animals with more muscle and milk production. The climate allowed new kinds of wool to be developed. Allowing humans to have each day better skins and better wool for the protection form the cold. Getting close to the 21st century, sheep have become part of scientific studies and other discoveries. For example, in 1997, the experiments done to sheep Dolly, in the United Kingdom, were used for the first cloning made in animals. This scientific experiment was successful, although not in the way scientist wanted. This was due to the fact that the DNA was successfully cloned as well as the other factors it had. The diseases and other illnesses caused by the age, were copied also from the original DNA, causing the cloned sheep to experience these in a young age (Center of Regenerative Medicine, s.f.). To finish with, this species (including lamb) and its market has obtained lots of strength in the previous years all around the world. New markets have developed in Colombia, Ecuador, Brazil and Mexico, increasing each day the lamb production as well as the consumption. This study first will focus on the species, the market, the

proper management of animals, and development of the lamb and meat business. Later on, the study will focus on analyzing the factors affecting this business, especially in the intensive and extensive production methods. Finally, this study will finish with the proposal of a business plan for Valle del Cauca, based on the intensive lamb methodology production.

Chapter 1: Ecology

1.1 Affinities

Sheep make part of the Animal kingdom, where they can be cataloged as vertebrates and later on as hollow-horned ruminants. This cataloging is due to the fact that they possess four stomachs, that function by feeding of the bacteria they have inside these organs. They also have a process in which they decompose the grass by eating and re-chewing it. This process is done while resting, and when it's completed, they feed the bacteria in their stomachs with the remainings of this process (commonly called "chewing the cud"). On the other hand, they are also cataloged as mammals, having gestation periods of approximately 150 days [Shapiro, n.d]. To finish with, this species has many kinds of breeds, including Katahdin, Dorper, Charollais, Santa Ines and many others, that vary on their different sizes, weights and fiscal composition.

Taxonomy of *Ovis Aries* (Wilson, 2005)*:*

- Domain: *Eukarya*
- Kingdom: *Animalia*
- Phylum: *Chordata*
- Class: *Mammalia*
- Order: *Artiodactyla*
- Family: *Bovidae*
- Subfamily: *Caprinae*
- Genus: *Ovis*
- Species: *Ovis Aries*

1.2 Fossil Record

Fossils from this species have only been found in Europe, Africa and Asia (Figure 1.1, below). Most of these were found in South Africa, but as well, fossils were found in Kenya,

Algeria, and Libya. The time period estimated of these fossils is about 66 million years. Where these are located in the Phanerozoic era, and to be more precise in the Quaternary and Cenozoic era. The blue points in the map reflect the fossils found from the Phanerozoic era, and the yellow reflect the ones found from the Cenozoic era. In addition, many of these fossils were found in caves, but as well they were found in coastal, eolian, fluvial-lacustrine places. On the other hand, the fossils found in Europe were located on the north and the south of the continent. Near Netherland and Italy, where these were also found in caves. Looking at the displacement of sheep, a theory states that sheep come from the south of Africa that later migrated into Europe and Asia. However, there is a more precise theory, stating that *Ovis aries* had two main beginnings. One of them in central Europe and the other in south Africa, generating the thise species to have different characteristics. (Czaplewski, J. J., n.d)

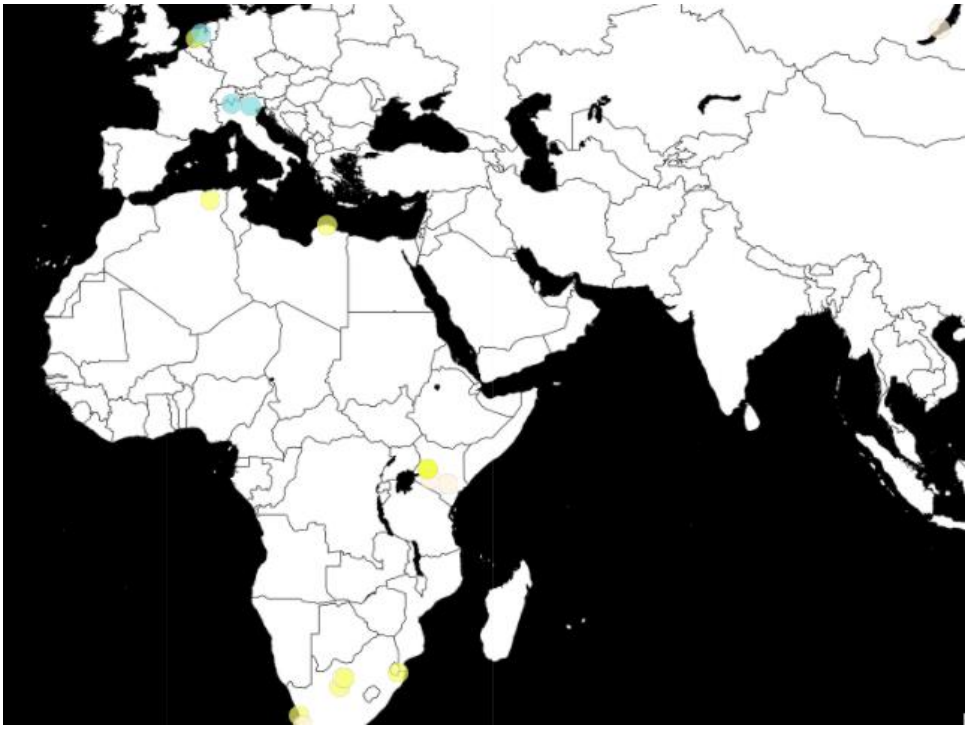

Figure 1.1: Location of Fossil Records. (Czaplewski, J. J., n.d)

1.3 Origin

Although is still uncertain, studies form their ancestors help to understand the different aspects from their origin. Their ancestors are mainly wild sheep, like Urial, Argali, Mouflon of Europe and Asia. The Mouflon of Europe is a descendant from the Mouflon of Asia, which was brought by humans into the Mediterranean region (Dohner, 2001). On the other hand, another theory states that the European Mouflon is a descendant of primitive sheep, that later spread and made other subspecies (Mungall & Sheffield, 1994). DNA studies support that ancestor of the species, *Ovis aries,* were first seen 60 million years before common era. These studies allow the theories to be more confident and precise, when referring to the periods of evolution and their origin (Shapiro, n.d).

1.4 Present Distribution

In present time, the distribution of sheep is worldwide, but significant populations are distributed on some specific locations. Countries like the United States, Canada, Mexico, Brazil, South Africa, United Kingdom, China, India, Australia and New Zealand poses high population concentration rates. However, Australia, New Zealand, and China are the countries with higher sheep population, having the possibility of exporting lamb to the United States, Europe, and middle east countries (Czaplewski, J. J., n.d). Sheep domestication has a large influence on its present worldwide distribution, as a result of its easy adaptability (International Lamb Profile, 4/12).

Chapter 2: Environmental Factors

2.1 Environmental Factors in distribution

Domestic sheep are very versatile and they can live in almost every part in the world. They are able to live in deserts, forest, savanna, and mountains. The maximum altitude sheep can survive is around 5,000 meters above the sea level and its due because of the lack of oxygen available. Sheep are capable of adapting in cold weathers, developing wool in order to preserve their body temperature. As well, in hot areas, sheep are capable to adapt, developing hair instead of wool, allowing them to maintain a stable body temperature (Hiendleder, Wassmuth, & Janke. n.d.).

Wild sheep have developed their bodies in order to survive in the remote areas of mountains, deserts, and forest. Although their rusticity (resistance and toughness), sheep domestication by humans have developed some other different traits. As a result, sheep have improved their quality, but maintaining as well the rusticity of wild sheep for certain climates. Sheep crossings and genetic modifications have permitted to obtain excellent quality sheep with an exceptional efficiency in the production of wool, milk, and meat. Maintaining at the same time their rusticity for specific climates, that pure breeds will have trouble of getting used to. (Hiendleder, Wassmuth, & Janke. n.d.)

2.2 Climate & Elevation

Sheep are characterized for living in all kinds of habitats as a result of their easy adaptation process. They can live from deserted areas to plateau environments located 5000 meters above sea level. The climate isn’t a limitation for the distribution of sheep, because they adapt easily to the temperatures exposed, with the variation of their wool thickness and

development. As well, food isn't a limitation factor, due to the fact that sheep are herbivores and can find food easily in any environment (Reavil, 2000).

2.3 Relations

Ovis aries have caused lots of pests in island habitats, like Hawaii and Santa Cruz islands. These pests were very destructive, damaging trees and the habitat of endemic birds (Scott et al. 1984). This species affects the habitats of herbivore animals, because they eat almost every type of grass and plants. As a result, this species may cause serious damage to habitats, affecting the population of other herbivores and other animals related to herbivores. *Ovis aries* main source of food is any type of herbs like grass and flowers. On the other hand, their main predators are Wolfs and Coyotes (A-Z Animals, 2008). Sheep also tend to have *Melophagus* obvious that is an external parasite that resides in the sheep's wool where it sucks the blood of the sheep causing irritation (BioWeb, 2009)There are also internal parasites that are cataloged in two groups, bacteria, and worms. Bacteria makes part of the digestive system of sheep that sometimes can transform into parasites like *Fusobacterium Nectophore* that causes foot rot in sheep that then damages the soft tissue of the foot making the sheep limb fall off due to the pain (BioWeb, 2009)

Chapter 3: Biology

3.1 Chromosome Complement

The chromosome number reported varies from 33-60 (Berry, n.d.). It all depends on the technique used and the kind of species its being analized. *Ovis aries* chromosome complement has evolved over time, reducing from 2n=58 to 2n=52 (Bunch & Foote, 1977). This genetic reduction has been caused due to the selective fusions of their ancestors. The genetic swapping has made the inherited selections go towards a lower chromosome number. One ancestos of *Ovis aries,* is the Mouflon, that has a chromosome number of 2n=54. As a result of the crossings with the Mouflon, the chromosome number has fallen, compared with the Argali species, that has a chromosome number of 2n=56. The hybrid newborns, as a result, have a chromosome number of 2n=55. This is due because of the crossing of Ram (2n=55) and Ewe(2n=54) [(1/2(2n=55) + 1/2(2n=54)] making it drop slightly overtime. As a result, there is an alteration in the sex ratio (two female newborns per male newborn) that can be cataloged as a benefit in the population increase. As well, this alteration in the sex ratio will contribute to the shift of a lower diploid number, having in the future fewer chromosomes. (Bunch & Foote, 1977). This change might not have such a great impact, but if in the future the diploid number gets smaller, there would be fewer genes that cause debilitation in some aspects of the species.

3.2 Life Cycle

Sheep are cataloged as mammals, indicating that they feed their newborns with milk. As a result, newborns are automatically dependent from their mothers, making them learn how to walk immediately. They are always exploring new places and food resources where they learn to become ruminants eating different kinds of vegetation (Reavill, n.d.). Within seven months, lamb become sheep having a life expectancy is of 6-11 years of age.

3.3 Reproductive biology

The reproductive biology of sheep relies on natural insemination, that is made by a physical reproductive procedure. This process is based on the (PBDB Navigator, n.d.) sperm joining the ovules fertilizing the female. The sexual maturity for both, females and males is reached in the first 18 months of life ("Sheep - Ovis aries - Overview," n.d.). In adition, the female ovulates every 14-20 days and the time of ovulation lays for about 20-30 hours. In places with seasons, sheep usually ovulate in the fall and midwinter seasons, different from the ones that live in places that have no seasons that ovulate without interruption (Reavill, n.d.). As well, the average gestation may take around 146 days or 5 months, where the female has an average offspring per birth of 1.3 and an average of 1.5 births per year. At the birth, the newborn has approximately a weight of six pounds that can vary depending on other factors, like the possibility of a multiple birth. It's very common to see a double birth, but it all depends on their life quality. There is almost a 30% chance of having a birth with two newborns at the same time, but in some cases this ratio may be higher.

3.4 Physiology

To begin with, *Ovis aries* have a heart rate between 60-90 beats per minute and a rate of 12-20 breaths per minute with a stable body temperature between the 102-103º F ("Basic information about sheep," 2015). There is also a group of 7 different types of blood (A, B, C, D, M, R & X) that have been identified in sheep that most of them are compatible with one another ("Blood types," n.d.). The majority of the blood transfusions made on sheep have a positive acceptance of the receiving body. Some effects it can make when the body doesn't assimilate the blood transfusion is dizziness and uncoordinated movements, but in most of the cases, sheep

finish assimilating the blood type either in a short or a long process. They have a complex digestive system composed of four chambers where cellulose from all the leaves and vegetation they eat ("Sheep," 2016). First, sheep re-chew the food they have eaten where it's stored in the first chamber and when the food parts are small enough they pass to the other three chambers. These three chambers are filled up with bacteria where these decompose the food into proteins, fats, and minerals that the organism takes for its development and also as an energy resource. Sheep on a desert environment have the mechanism in order to adapt to these places. One of them is in their metabolism and the water retention in their bios vessels and their renal cells. Also, organs adapt in order to have a better energy optimization. These involves its metabolic system, the development of their body (size), and their saline-alkali tolerance. This last one is usually increased and is directly proportional to the energy optimization and resistance to dehydration. In a plateau environment, sheep tend to develop other attributes, like the way the circulatory system works. This system is developed differently due to the way the vascular system is formed. Also, sheep in this environment tend to develop certain genes that can be found in vascular smooth muscular contraction pathway. These genes are helpful for the sheep adjustment of the diameter of their blood vessels that allow them to have a better performance of oxygen distribution. (Hiendleder, Wassmuth, & Janke. n.d.). Although altitude don't impede sheep survival, studies have perceived a change between sheep located in high altitudes and arid areas.

Since they are herbivores they suffer a great impact due to environmental change because of the difference habitats of the different altitudes. Herbivores tend to have problems on their thermoregulation and other aspects in their metabolism due to different plant quality and biomass. Sheep different from other herbivores tend to change their metabolism along with the

habitat change allowing them to easily adapt to high and low altitudes (Hiendleder, Wassmuth, & Janke. n.d.).

Chapter 4: Propagation and Management

4.1Natural Regeneration

Ovis aries have a reproduction rate of 3 births every 2 years. Almost 50% of the total year births are double. As a result, the probability of getting a third newborn increases, but it´s not common. Artificial insemination is also a process that is usual when genetics are being manipulated. Females located in seasonal places become fertile in the early fall until midwinter (Vuren, 2010). Different from sheep located near the equator that are fertile year-round like males. Female estrus cycles vary from 14-20 days where the heat last for an average period of 30 hours.

The place where sheep start the fertilization process needs to be cleaned up before its use. It is first sterilized with lime (cal) in order to then, put the bed of sawdust or dry rice shell. This bed allows the sheep to live in a dry area, preventing lots of diseases developed by humidity. In the preparations, there is also the protocol of cutting the wool and cleaning their hoofs. Then the females are exposed to the male that fertilizes them while they are on heat. When the pregnancy is confirmed by an ultrasound examination they enter into the gestation state. This state is usually very calm in order to prevent abortion from stress. Females are only intervened if they have symptoms of sickness or if there is a need of any minimum intervention like moving them for a different fold. They stay in the gestation state until the pregnancy is getting to the end where they enter to the pre-birth stage. In this last stage is where they give birth and it's the most critical stage of all. Everything needs to be on observation in order to prevent deaths from bad position procedures. The birth is only human intervened if there are any problems with the natural birth procedure. The final stage when the sheep has completed a successful birth is postpartum. In this stage, the newborns are vaccinated and it is raised by his mother in a different fold. The newborns

are fed with the ewe's milk as well as other supplements in order to maintain them in good shape and healthy (Aristizabal, pers.comm, 2016).

Managing the propagation is mainly influenced by the type of female and the ram it is exposed to. According to Sheep Genetics Organization, there are many types of genetic crossing depending on the type of business. The four types of crossings depending on the industry, that are lamb, wool, breeders, and milk. These crossings have different attributes, that later can be inherited by the newborns obtaining as a result different kinds of genetic traits. These traits, will eventually increase their performance in each of the different sectors making them to be more profitable (Sheep Genetics Organization AU, n.d.). These crossings can be obtained by different ways. One is the natural pregnancy and the other is by an artificial insemination process that will be explained in the second part of the chapter.

4.2 Artificial Propagation

4.2.1 Artificial Propagation

Artificial insemination is a different way of obtaining pregnancy that has become popular over the years. There are different types of artificial insemination, it all depends on the traits being looked for. The simple way is by having a non-manipulated ovule and achieve fertilization by semen pallets. The other two ways, are egg wash and embryo washing that are two similar ways of achieving the same purpose differenced by the process and the quantity of the fertilized ovules (Aristizabal, pers.comm, 2016).

4.2.1.1 Pre-preparation

The pre-preparation consists on a series of protocols in order to complete a successful artificial insemination. These protocols can vary depending on the procedure and the country.

The first step in an *in vitro* insemination is to get semen pallets of outstanding rams. These semen pallets can be found very easily; they are sold on websites and on different organizations although sometimes they can be expensive. Their value depends on the ram quality as well as their descent without taking apart the number of prices it has won over the competitions made in their countries. The process of obtaining them is not very complex. It is based on the natural pairing that is altered by a tool that imitates the vagina of the female as well as the temperature. This allows the male to ejaculate in the tool maintaining the sperm on a test tube that then is refrigerated. Sometimes sperm gets into additional treatments in order to have higher probabilities of having either a female or a male. Then in order to use the sperm straw, you can either fertilize the female or the ovule by completing an *in vitro* process. When the *in vitro* process is being done, there is a need to first make an egg wash. In this process, the veterinary takes the ovules form the female, fertilizing them in a laboratory becoming into embryos. These embryos then can be placed into receiver ewes that completes the rest of the gestation process in order develop the newborn. This is only practiced on high-quality animals as well as a high pedigree. The quality of the sheep is based on certain traits, that are significant depending on sector and the focus of the business. (Clarke, 2015)

4.2.1.2 How to Maintain the Pregnancy & Gestation

The process in order to maintain the pregnancy is simple and not very complex. Females first need to be in a very calm area that is separated from all of the other sheep that are not in the gestation period. They need be in a separate fold where they will receive more supplements in order to maintain the pregnancy and their weight. Females will stay in this stage until they give birth, then they will be moved into lactation stage. Abortions are mainly caused by stress, and other factors that prevent them from staying calm and in rest. Diseases also contribute for an

abortion to occur because these make the ewes to be unstable to maintain the pregnancy (Aristizabal, pers.comm, 2016). Another key factor in order to maintain the pregnancy is the quality of the nutrition. This aspect has also a high influence on the newborns weight, as well as their chances of surviving when born. Newborns low weight due to poor nutrition make them be weak during the birth causing a high mortality rate. After the birth, newborns weight gain for dairy breeds goes from 50-150 grams per day different from meat breeds that may go from 50-250 grams per day (PennState, n.d.).

4.2.1.3 Storage

The storage of embryos and semen pallets is based on constant refrigeration process. The cooling agents and recipients need to be clean off any other animal derivate, it needs to be for exclusive use for the management of this product. Dry ice is also used to maintain the cold cycle and prevent contamination of the semen pallets or the embryos. As well, semen and embryo pallets need to be sterilized and stored on pallets in order to maintain the productivity of the product. There is also the need of having legal notice of product in the destined country. This notice is made in order to prevent the spread of new diseases or illnesses that may affect either *Ovis aries* or another species in that country. (Clarke, 2015)

Chapter 5: Emerging Products & Potential Markets

5.1 The Overall Picture

Ovis aries mainly produces three kinds of products that are meat, wool, and milk. Although all of these products may seem that can be taken from the same sheep species, these vary according to the product it is being produced. Also, farms and their locations vary according to what they are producing. For example, the wool sheep industry is mainly in cold areas as a result of the health issues. On the other hand, the food industry can be located in different areas but the farms need to have different characteristics in order to maintain efficiency in their production. Developed countries are the ones that mainly produce these kinds of goods due to the high complexity of the process.

5.2 Food Industry

Sheep products have expanded and gained force during the past decades' worldwide. Food production has a huge industry that each day needs more products in order to feed the increasing worldwide population. The biggest sector is the meat industry but there is also the dairy sector where it is produced milk and other derivatives such as cheese and butter. The high demand in countries in the Middle East and Asia have made sheep production expand in many countries like for example, Brazil, Mexico and Colombia.

5.2.1 Meat Industry

The lamb industry is the biggest in the sheep sector, where its production can be placed anywhere worldwide. There are 3 main breeds for the meat industry and these are Dorper (Figure 5.3), Charollais (Figure 5.2), and Katahdin (Figure 5.1). These are breeds where the animal can

develop bigger body physiology due to its genetics. In order to have a better production, these breeds are crossed in order to maintain physical traits as well as milk production. Due to their genetics, pure animals from breeds like Dorper and Charollais have a low production of milk

Figure 5.1: Katahdin Breed (Aristizábal, 2016.)

Figure 5.2: Charollais Breed (Farmers Weekly, n.d.)

Figure 5.3: Dorper Breed (Aristizábal, 2016.)

compared to others. That is why it is crossed with the Katahdin breed, so the high production of milk is maintained as well as the physical characteristics from Dorper and Charollais.

5.2.1.1 Consumption Inventories & Demand

The industry has expanded over the last years due to the high demand the product has all over the world. The largest producers are China with a production of 4.4 billion pounds followed by European Union (1.9 billion lb), Australia (1.4 billion lb) and New Zealand (1 billion lb) (Brester, 2012). Although sheep inventories have declined in the past 50 years the production has increased or maintained the same in some countries due to the high efficiency in production. The demand has also increased, although in some countries of the Americas have declined their

consumption of lamb. The consumption per capita is still very low compared to other animals. Studies suggest that the increase in consumption is proportional to the increase in personal income, urbanization and population growth (Brester, 2012). Also, publicity against red meats and the increase on their prices gave great impulse towards the consumption of lamb. The highest demand is located in Asia, Middle East, and Europe.

5.2.1.2 Exports & Imports

The principal exports are located in Australia and New Zealand. Australia in previous years has exported almost 650 million pounds that correspond to 44% of its total production (Brester, 2012). The total value of the Australian lamb export is equivalent to 700 million US dollars since 2011. On the other hand, New Zealand exports 750 million pounds of lamb since 2011. These are equal to 84% of its total production yearly and 2 billion US dollars in the market. The European Union, on the other side, is the world's greatest importer of lamb with 490 million pounds per year followed by the United States and China with 140 million pounds. As well as the imports, the consumption per capita has also increased in many countries. For example, China has increased by 6% in their per capita lamb consumption since 1980. Due to this increase in the consumption and their population, that is over a billion people, their imports have also increased since their production is not enough. As well as China, the US imports have also increased. Different from the European Union that has maintained stable. The US imports all of its lamb consumption from Australia and New Zealand (Brester, 2012). Finally, the importations, as well as the demand in Middle East countries, have increased dramatically. Due to increase in the demand, the production of lamb has expanded into some Latin American countries, like Brazil, Chile, Mexico, and Colombia.

5.2.2 Dairy Industry

In the dairy industry, there are six main breeds for this kind of industry. The breeds are Alpine, LaMancha, Nubian, Oberhasli, Saanen, Toggenburg. These breeds control the milk production but its diet also has great influence on the amount and the quality of the production. Sheep can start production at the age of 7 months. So, it's crucial to start young in order to increase the efficiency. As well, discarding animals that have low production rates and replacing them with new ones can increase the production as well as the efficiency. Reducing birth synchronization (the possibility of having many or all births in only one period of time) is very important because when reduced it allows milk production to be year-round (PennState, n.d.).

5.2.2.1 Consumption Inventories & Demand

Dairy sheep products are mainly produced in the Mediterranean countries in Europe like Italy, France and Greece (Australian Government, n.d.). These countries produce more than half of the worldwide production of 10 million tons per year. To complement the worldwide production, Australia, New Zealand and China are the next countries to follow in the list. The production of dairy products is mainly based on secondary products like cheese and yogurts than the actual milk. Australia produces almost 500,000 liters of milk yearly with a gross value of 4.2 million US dollars (2012). The dairy farms in Australia are located in the southern part of the country, as red colored in figure 5. The area showed in yellow by the other side in figure 5 represents the potential growth for the dairy industry. The demand of dairy products its increasing although it isn't as significant as the meat demand (Australian Government, n.d.).

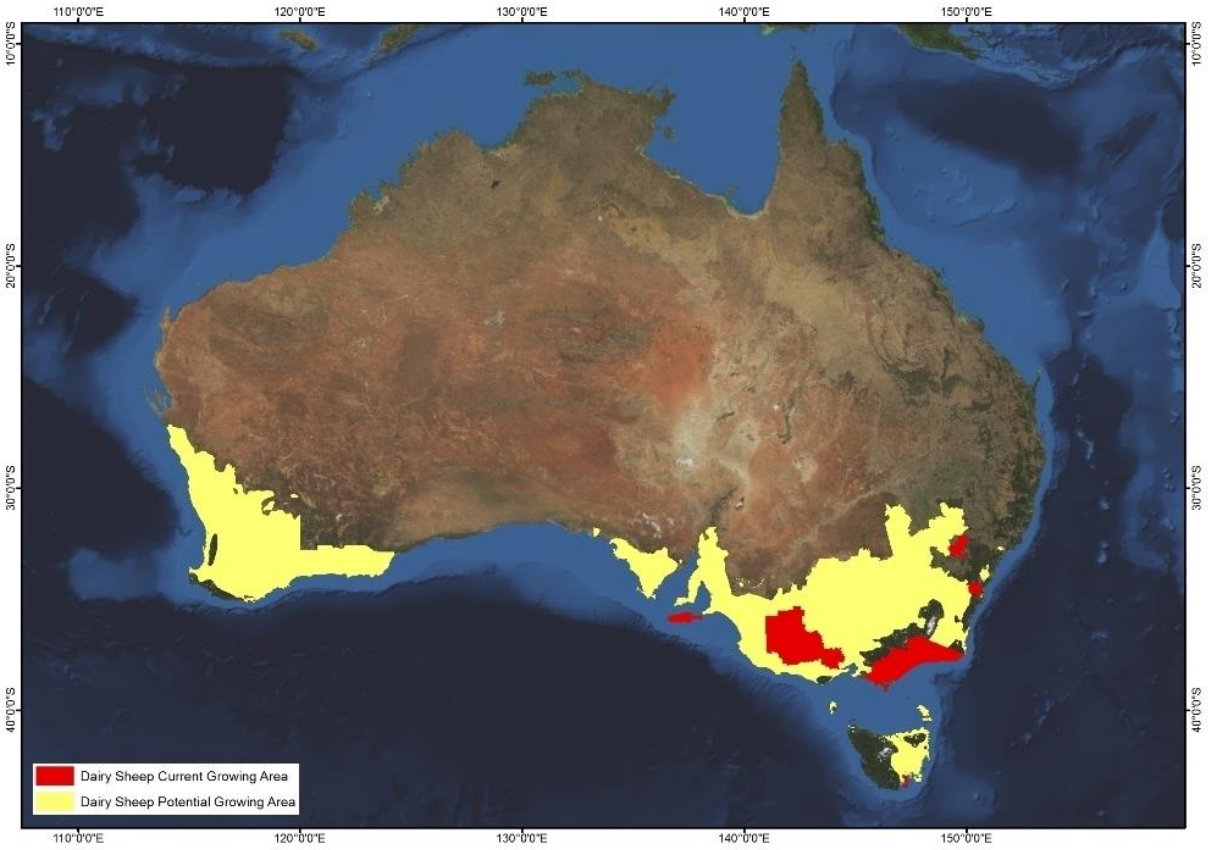

Figure 2 :Location of Dairy Sheep and Potential Growing Area (Australian Government, n.d.)

5.2.1.2 Exports & Imports

The exportation is based on secondary products like cheese and yogurts. Certain characteristics like the richness in fats, solids, and minerals make it ideal for the production of these secondary products (Australian Government, n.d.). Countries like France, Italy, and Greece are specialized in the production of cheese like the Feta, Ricotta, Haloumi and Pecorino. These products are exported worldwide due to its exclusive recipes and its high production. On the other hand, the countries with higher importation rates are the ones that make secondary products like the ones mentioned before as well as China and United States (Schoenian, 2015)

5.3 Textile Industry

The textile industry is based on the production of wool. There are certain breeds for wool production where they are categorized by different characteristics. These characteristics define the value of the wool, as well as the amount that is produced. The value depends basically on the fiber diameter where the smallest is finer and expensive. Fine wool is produced by breeds like Rambouillet, Shetland, and Icelandic. These breeds produce low amounts of wool different from breeds like Romney, Columbia, and Lincoln that produce large amounts of wool. The price, as said before, is established by the fineness of the hair, but it's also influenced by how clean and the contamination (organic matter) the wool has. The white wool is more valuable than colored wool due to the fact that it can be easily dyed (Schoenian, 2015).

5.3.1 Consumption Inventories & Demand

The world's production of wool is around 2 million tons (2012) where the biggest consumer and producer is China due to its economy and the numerous textile companies located in their territory. China produces around 400,000 tons of wool yearly followed by Australia with 362,000 tons and New Zealand with 165,000 tons. Manufacturing companies have the greatest demand for this product because it's used to make all kinds of clothing. All kinds of breeds produce wool but not all kinds can be used to make wool (Wilcox, 2016).

5.3.2.1 Uses

Wool is used primarily as wool where many secondary products are made. This wool is divided into fine and medium where their products differentiate on their quality and their complexity. Medium wool is used to make sweaters, blankets or socks. Fine wools are used to make different types of clothing due to the fact that is less likely to itch (Schoenian, 2015).

5.3.2 Exports & Imports

The biggest importer country is China followed by the United States where it's also used for manufacturing factories. On the other hand, Australia and New Zealand are the biggest wool exporters although many of the other breeds in this country don't produce high-quality wool (Wilcox, 2016).

Chapter 6: Case Study Ovinos Buenvivir

6.1 Introduction to Ovinos Buenvivir

The foundation of this ovine farm first started in 2015 where at first, it was practiced as an experimental business. The farm is located in Zanjonondo, near the town of Buga, where its temperature can vary between 20ºC and 33ºC (map or farm plans). The rainfall in this area is based on the seasons and in recent years, the summer and the winter seasons have been very intense and extreme. Due to this factor, the farm has been conditioned. For example, in order to have irrigation during the summer, ground water installations were constructed. On the other side, although it's very unusual, ditches have been made in order to prevent flooding in winter.

The farm is approximately 25 Ha (25,000 square meters) were it is divided into three lots. The first lot is approximately 1.2 Ha, where the following crops are located: *Leucaena* (sp), *Tithonia diversifolia* (*Boton de Oro*), *Gliricidia sepium* (*Mataratón*), *Cuba 22*, Purple grass (Pasto Morado) and *Pasto Estrella*. In order to be more productive and cut the grass at its optimal nutritional point, the lot has been divided into smaller sections, where the crops are planted at different times. The second lot has three houses, in which two of them are used for recreation purposes. The last plot house is where the administration of the farm is held. In this house is where the workers live, security cameras are located and the tools are stored. Downhill in the second lot, fodder banks are located, as well as the sheepfold and the water sources used for irrigation. Additionally, in the third lot, more crops are located, accompanied by another shed and a stable. The shed in the third lot is used to save silage and hay, and it's also used as a zone for quarantine and nursery for sick and new sheep.

The farm's main use is for family recreation, but we decided to start the business as a hobby. We used to have cattle, but later in 2015, we decided to change to sheep and lamb production. This change was due to the difficult market and business of cattle in Colombia. Most of the installations for the cattle were reconditioned in order to be compatible with sheep.

6.2 Development of the Farm

The farm has stayed in the family for over three generations and has always maintained the ideas from the anterior before them. The first generation started around the 1990s and focused on planting the area with trees and crops. The second generation then focused on building the houses and starting a business in order for the farm to be self-sustainable.

The first business started with cattle production (Brangus cattle). During this period, the cowshed, the stable, and a deep well were constructed. After ten years, the third and second generation decided to migrate slowly into the sheep and lamb business. In order to make a proper migration to this new business some new accommodations were built as well some others were restructured. The cowshed was the first to be restructured enlarging the roof. In order to have sheep in the cowshed, the roof needed to be extended in order to cover all the constructed area, so that the sheep could stay dry and in shelter. Also, the height of the roof was increased, this was due to the fact that there was a need of a higher ventilation. Feeders were modified increasing their height. Later on, as a result of increasing sheep population in the farm, the sheepfold was divided into several sections where later on the sheep were divided.

The divisions for females depend on the cycle that they are in. There are five different sections which are mount, gestation, pre-birth, lactation, and raising (*levante*). There is one other

section, but this one is only used for the sheep designated for meat production and its cataloged as the feeding stage (*ceba*). The shed located in the third lot, was also reformed. This was due because at first it was actually made for vermiculture "*lombricultura*". This shed was then transformed into the nursing section, the quarantine section, and the silage storage. In addition, some of the crops had to be replaced as well. The Purple grass (*Pasto Morado*) and the *Pasto Estrella* were replaced with *Cuba 22* grass, Corn, *Tithonia diversifolia* (*Boton de Oro), Gliricidia sepium (Mataratón) and Trichanthera gigantea (Nacedero plants).* To finish with, an expansion of the sheepfold was undertaken and as well some other expansion in reactional areas were made.

6.3 Current Situation

Currently, the farm is in the process of reaching the break-even *(punto de equilibrio)* business point (where there is no loss or gain in profit). This point is estimated to be reached when the farm has about 150-200 female sheep. At the end of 2016, there we reached the 100-female sheep. The projection on reaching the 150 sheep is estimated to be at the end of 2017. Also, the farm currently produces around 2-5 lamb per month but the processing of these may vary depending on the demand.

INSTITUTO COLOMBIANO AGROPECUARIO
Gerencia Seccional Valle del Cauca

ica

Certifica :

Que el predio **CRIADERO BUEN VIVIR**

Ubicado en el departamento de **Valle del Cauca**, municipio de **Buga**, vereda **Zanjón Hondo**, propiedad de

GONZALO A. ARISTIZABAL, Identificado con CC o NIT **No 16.346.322**

cumple con

LAS BUENAS PRÁCTICAS GANADERAS EN LA PRODUCCIÓN DE OVINOS Y CAPRINOS CON DESTINO AL CONSUMO HUMANO

De conformidad con lo establecido en la reglamentación sanitaria y de inocuidad vigente.

El presente certificado se expide a los 28 días del mes de Diciembre del año 2016 y tiene una vigencia de **Tres (3)** años a partir del **27 de Diciembre de 2016**.

JANNETH CECILIA ORTIZ CABRERA
Gerente Seccional Valle del Cauca

SEBASTIÁN DUQUE PATIÑO
Líder Proyecto Inocuidad Pecuaria

Forma 3-781 Certificado. DTIIV_2923

Figure 3: I.C.A Certificate for Good Cattle Practice in the Production of Sheep & Goats for Human Consumption (Aristizbal, 2016.)

6.3.1 The Management of the Farm

The farm has only one worker which is helped by his wife for certain tasks. The day-to-day work is based on the cuttings of the grasses and the fodder banks in the lots. Then the next step is to transport them into the sheepfold so later the sheep can be fed with it. The farm usually buys around 24 bags of concentrate per month. Also, it's estimated that its spend around COP Pesos $100,000 on medicine and sanitary supplies per month. When the winter comes, silage packaging is made so when the summer comes there is still food available for the sheep. Every three months

the beds of the sheepfold are replaced and are taken into the compost area, making natural fertilizers with it.

Talking about the management of the animals, the ewes are sheared when they give birth. Later on, the newborn is then vaccinated and dewormed feeding them with excess of concentrate so they gain good weight until they are weaned. For the ewes, the amount of concentrate given depends on the stage at which they are. Stages of lactation, gestation, and pre-birth require high quantities of concentrate. Different from raising, mount and the feeding stage, that need way less concentrate. Vaccination and deworming procedures for females are done when they enter into pre-birth and birth stages. The hooves are also cleaned after giving birth and again before entering the mounting stage.

6.3.1.1 Quality Analysis

With the analysis done by BALAR Ruminant Solutions, we got to the conclusion that the best quality is obtained depending on the breed, the period of raising and the kind of food and concentrate they are being given, as seen below:

6.3.1.1.1 Breeding Quality

The quality according to the breed relies on the kind of breed being managed. There are certain breeds that are specific for meat production. For example, Charollais and Dorper (Figures 5.2 and 5.3) are mainly used as meat production breeds. These later on are usually crossed with good milk production breeds, such as the Katahdin. This is due because usually the meat breeds have a low production of milk compared with others. Due to this it is crossed to optimize the production and the weight gain of the newborns. As well, some other breeds may increase the

amount of marbling in the meat giving it a better flavor and texture. The Katahdin breed differentiates from all others due to its efficiency in milk production and a great meat conversion, according to BALAR Ruminants Solutions. Kata (Behrendt & Weeks)hdin females are usually crossed with Dorper or Charollais. This is done so the newborns can inherit an excellent meat conversion maintaining as well a good mother with a high milk production increasing the conversion of meat.

6.3.1.1.2 Food Quality

In order to maintain a good food quality, Ovinos Buenvivir has increased its protein crops. The main source of food for the sheep is grass cuttings but these only contribute as a fiber source and not as a protein. This is why there has been an increase in the plantings of *Botón de Oro, Mataraton, and Nacedero*. Although these plants are contributing with high amounts of protein, concentrate is still needed in order to keep boosting the milk production and the meat conversion. The variable of protein increase does not only make the animals create more muscle, it also allows the meat increase the marbling, giving it a better flavor.

6.3.2. Breeding and fattening (Feed lot)

In the farm, there are two types of business. One is the breeding, which the main focus is to produce good quality ewes. Then the business is based on later selling them as replacement or as starting ewes. The demand for this market is strong and its planned to be the main income due to its high profits. There would always be a demand for this sector, but now since it's a new business in Colombia the demand is pretty high. We want to take advantage of this, so we focus on producing good quality ewes so we can sell to new farms as starting mothers. Later on, when there is no more demand for this market its planned to keep selling them but as replacement of

the old ones. The other business is the lamb fattening (*ceba*) business. This one is the one that generates cash flow for the farm. This is not as profitable as the breeding but it has a constant flow of money allowing the farm to cover its expenses. The cycle can last from 8 to 11 months since the pregnancy has been confirmed. When the ewes give birth, the lamb is fed first with milk produced by their mothers. Later, by the age of three months, the lamb starts fattening with grass, protein, and concentrate. Then the lamb can either be sold standing or processed but in order to increase the earnings, it is sold processed by Ovinos Buenvivir.

6.3.3 Management of the Meat process

The management of the meat process is made by a private entity in order maintain a premium product. This entity employs highly trained butchers giving us well-managed and presented products. They also count with IMVIMA (*Instituto Nacional de Vigilancia de Medicamentos y Alimentos*) certification that allows us to be sure that the products are being manipulated in good sanitary conditions. Finally, this entity uses natural or non-chemical preservatives like smoking and vacuum packaging maintaining our premium product

6.3.4 Management of the Meat Marketing

The meat marketing has been very difficult due to the fact that is a new and a very exclusive product, having a small market. Ovinos Buenvivir has started to open this new market by selling their products to friends and family. We have also participated in small markets like the Colegio Bolívar Farmers Market but the commercialization has mainly expanded by word of mouth. Usually selling our products to restaurants and butcher shops has been difficult due to the production rate and the price.

Figure 4: Lamb Products by Ovinos Buenvivir (Aristizabal, 2016.)

Works Cited

Australian Goverment. (2016, 10). *Dairy Sheep*. Retrieved 12 2016, from Farm Diversity: http://www.farmdiversity.com.au/animal/0b7bc79c-8c73-434d-ba6e-a32a0091a327

A-Z Animals. (2008, 11). *Sheep*. Retrieved 10 2016, from A-Z Animals: https://a-z-animals.com/animals/sheep/

Behrendt, K., & Weeks, P. (n.d.). *MLA Market Information Report* . Retrieved from How are global and Australian sheepmeat producers performing?: https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/agri-benchmark/mla_agribenchmark-sheepmeat-results-report_jan-2017.pdf

BERRY, R. O. (1941, 8 1). *Journal of Heredity.* Retrieved 10 2016, from Flesh and Bone Genes In The Fowl: https://academic.oup.com/jhered/article-abstract/32/8/261/818017/Flesh-And-Bone-Genes-In-The-Fowl?redirectedFrom=fulltext

BioWeb. (n.d.). *Ovis aries: More about Mary's Little Lamb.* Retrieved 10 2016, from BioWeb: http://bioweb.uwlax.edu/bio203/s2009/rana_prit/classification.htm

Brester, G. (2012, 5). *International Lamb Profile*. Retrieved 10 2016, from Agricultural Marketing Research Center: http://www.agmrc.org/commodities-products/livestock/lamb/international-lamb-profile/

Center of Regenerative Medicine. (n.d.). *The Life of Dolly*. Retrieved 2 2017, from Dolly the Sheep: http://dolly.roslin.ed.ac.uk/facts/the-life-of-dolly/

Center of Regenerative Medicine. (n.d.). *The Life of Dolly*. Retrieved 02 10, 2017, from Dolly the Sheep: http://dolly.roslin.ed.ac.uk/facts/the-life-of-dolly/

Clarke, G. (2015, 6 22). *Import Health Standard: Semen and Embryos from Sheep (Ovis aries) and Goats (Capra hircus).* Retrieved 10 2016, from https://members.wto.org/crnattachments/2015/SPS/NZL/15_2602_00_e.pdf

Condon, J. (2016, 4 05). *China Changing Dynamics of World Sheepmeat Trade*. Retrieved 5 19, 2017, from Sheep Central: http://www.sheepcentral.com/china-changing-dynamics-of-world-sheepmeat-trade/

Czaplewski, J. (2016, 09 29). *Ovis Aries Species*. Retrieved 10 2016, from PBDB Navigator: https://paleobiodb.org/navigator/

Dohner, J. V. (2001). Retrieved 10 2016, from The Encyclopedia of Historic and Endangered Livestock and Poultry Breeds: http://www.itpnews.com/uploads/2017/03/(Historic%20and%20Endangered%20Livestock%20and%20Poultry%20Breeds).pdf

Foote, T. D. (1977, 6 2). *Evolution of the 2n = 54 karyotype of Domestic s(h1ee)p (Ovis aries).* Retrieved 11 2016, from International Sheep and Goat Institute and Departments of Animal, Dairy and Veterinaty Sciences: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2764653/pdf/1297-9686-9-4-509.pdf

Janke, S. H. (1998). *Spinger Link.* Retrieved 11 2016, from The Complete Mitochondrial DNA Sequence of the Domestic Sheep (Ovis aries) and Comparison with the Other Major Ovine Haplotype: http://link.springer.com/article/10.1007%2FPL00006401

PennState. (n.d.). *Agricultural Alternatives*. Retrieved 11 2016, from PennState Extension: http://extension.psu.edu/business/ag-alternatives/livestock/sheep-and-goats/dairy-goat-production

Reavill, C. (2014). *Ovis Aries (Mouflon).* (Michigan University) Retrieved 10 2016, from Animal Diversity Web: http://animaldiversity.org/accounts/Ovis_aries/

Schoenian, S. (2015, 02 04). *Sheep 101.info*. Retrieved 03 17, 2017, from About Wool: http://www.sheep101.info/wool.html

Shapiro, L. (n.d.). *Ovis Aries*. Retrieved 10 2016, from Encyclopedia of Life: http://www.eol.org/pages/311906/overview

Sheep Genetics Organization AU. (n.d.). *Sheep Genetics*. Retrieved 1 2017, from Sheep Genetics Organization AU: http://www.sheepgenetics.org.au/Home

Sheffield, E. C. (1994). *Exotics on Range: Texas Example.* Retrieved 12 2016, from http://www.jstor.org/stable/1382731?seq=1#page_scan_tab_contents

Vuren, V. (2013, 3 4). *Ovis Aries (Sheep).* Retrieved 11 2016, from Cabi: http://www.cabi.org/isc/datasheet/71349

Weekly Farmers. (n.d.). Charollais. *Image.*

Wilcox, C. (2016, 04 04). *Wool Industries*. Retrieved 11 26, 2016, from Wool Market in the Balance: Global Wool Prices, Supply and Demand: http://www.woolindustries.org/EN._Item_3_Chris_Wilcox_World_demand_and_supply_2016_overview_presention.pdf

Wilson, D. E. (2005). *ITIS Report*. Retrieved 05 19, 2017, from Ovis Aries Isphahanica: https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=898797#null

Yang, J., Li, W.-R., Lv, F.-H., He, S.-G., Tian, S.-L., Peng, W.-F., . . . Liu, M.-J. (2016, 7 8). *Molecular Biology and Rvolution.* Retrieved 10 2016, from Whole-Genome Sequencing of Native Sheep Provides Insights into Rapid Adaptations to Extreme Environments: https://academic.oup.com/mbe/article/33/10/2576/2925566/Whole-Genome-Sequencing-of-Native-Sheep-Provides