# New Zealand Goat Industry

## Report to
## Federated Farmers of New Zealand Incorporated

by

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**Summary**

Goat farming offers an option for low impact agricultural diversification when needed to meet the environmental compliance conditions. Industry information and population statistics were obtained via personal communication with goat farmers, industry bodies, processing companies and goat associations. There are estimated to be 92 farms running 66,100 dairy goats which are predominantly Saanen (85%) or cross-bred, with 72% of the dairy goat population located in the Waikato region. The small quantity of goat meat produced in New Zealand (1,400 ton carcass weight) is exported with 90% being from feral goats. Boer is the main meat breed with a national estimate of 7,175 Boer goats on 29 farms. The goat fibre industry predominantly produces mohair from Angora goats; however this industry is also relatively small with a current estimate of 9,320 Angora goats on 110 farms. Currently the dairy goat industry is expanding while the meat and mohair industries are very statistic with the main growing constraint being the lack of scale which limits the ability to consistently supply adequate product for export markets.

The dairy industry produces a range of products, has secure domestic and international markets, and is seeking to improve innovation and quality for international markets. The meat industry shows potential with the high international value of Boer goat meat, but requires a stabilized domestic industry in order to improve product quality and exports. The fibre industry has an established export market in South Africa and the potential to increase product value by introducing weaving fibre. Products from New Zealand goats can be improved with increased quality and quantity, and secure domestic and international markets.

Population statistics, industry outputs and market values were used to simulate the current and potential production and value of the New Zealand goat industry by 2025. Increasing the milk production per doe by 10%, the dairy goat industry has the potential to produce $25 million gross export receipts per ha by 2025. Increasing Boer meat exports by 20 tonne could increase the total export value by 10% and introducing production of weaving fibre could increase the average value of mohair exports by 10%. Although these predictions are limited by availability of costs of production, processing and marketing information, it is clear that the dairy industry currently has the greatest production and value, while the meat industry has the greatest potential for expansion and the fibre industry has significant potential to increase the average value of its exports.

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# 1. The current situation

Goat farming in New Zealand has a lower profile compared to dairy, sheep and beef (Country Magazine, 2016). However, goats offer an economic option for low impact agricultural diversification when needed to meet environmental compliance conditions. The environmental and commodity market constraints currently impacting pastoral systems in New Zealand provide an opportunity for the goat industry to make a greater economic contribution to New Zealand's agricultural production (Country Magazine, 2016).

In New Zealand, goats are farmed for milk, meat and fibre production and also act as a mechanism for controlling excess grass growth, enhancing clover in mixed pasture and controlling weeds (Batten, 2014). Dairy goat farming is a growing industry with the majority of farms located in the Waikato region. Angora goats are farmed for Mohair throughout the country; however this industry is relatively small. When compared on a global scale, New Zealand has some of the best genetics for meat goats (Malan, 2000). However, the number of goats raised for meat production is relatively small, and the majority of goat meat exported comes from feral goats. Feral goats are considered a pest with large feral populations in Taranaki, Hawke's Bay, Marlborough and Otago. It is not clear exactly how large the total feral population is, but there are a number of conservation projects in place aimed at population control.

## 1.1. History

The New Zealand farmed population is based on captured feral goats with a diverse genetic base after subsequent selection. In 1920, the Angora goat was introduced to encourage Mohair production (Sheppard and O'Donnell, 1979). In 1921, the Milch goat was introduced to stimulate the goat milk industry, however, due to the lack of market, most of them were subsequently slaughtered (Sheppard and O'Donnell, 1979). These animals have interbred, surviving natural selection in a variety of environments and also deliberate destruction policies aimed at preserving native vegetation, and capture on the margins for slaughter for export meat (Batten, 2014). By 1925, feral goats had spread throughout New Zealand with the largest populations in Taranaki and Northland. Goats soon became regarded as pest animals due to their rapid spread and reputation for damaging native trees. However, during 1927-1929, farmers recognised the usefulness of goats for controlling gorse, blackberry and other weed species. During 1928-1946, demand for goat meat fluctuated considerably, while goat milk production never reached a commercial level. From the 1990's Boer goats were

introduced for meat production and a small national herd has been developed in selected areas of New Zealand. The majority of goats slaughtered in New Zealand are feral, with the surplus males and cull does from the dairy goat population augmenting the minority Boer goat production. New Zealand has both large and small herds of dairy goats, predominantly of the Saanen breed, but also including British Alpine, Toggenburg and Anglo-Nubian breeds (Batten, 2014).

The following sections of the report will include information on the current situation of each of the goat production systems and industry organisations. Subsequent sections will include the current value of the New Zealand goat, including what products are made and exported and the final section will discuss the potential of expansion for the New Zealand goat industry.

## 1.2. Dairy goat industry

Dairy goat farming is a growing industry in New Zealand with a number of nutritional and medicinal attributes of the milk recognised as advantageous over cow milk (easier digestion, lower allergenic burden and other physiological benefits). These attributes enable goat milk to be used as an alternative base for the production of infant-formulas (Silanikove et al., 2010; Thum et al., 2015). Goat milk has more medium-chain fatty acids (C6-C14), omega 3 and 6 polyunsaturated fatty acids, conjugated linoleic acid, and calcium, phosphorus, magnesium and copper when compared to cow's milk (Ceballos et al., 2009). These nutritional properties of goat milk have increased the demand for goat milk for infant formula (Thum et al., 2015), particularly for the expanding Asian markets (Huitema, 2012).

Commercial dairy goat farming in New Zealand started in the late 1970s and early 1980s (Sheppard and O'Donnell, 1979), and was considered as an "emerging industry" by the 1990s (Singireddy et al., 1997). Despite some fluctuations, the national herd containing dairy, meat and fibre animals has been decreasing at a rate of 9,000 animals per annum from 2002-2012, from 111,981 to 79,977 goats (Gautam, 2012). In contrast during the same time period, the approximate number of milking does per herd had increased (Solis-Ramirez et al., 2011). Currently there are estimated to be 66,100 dairy goats in New Zealand from a total of 92 farms. However, the exact number is not known as there is no census undertaken for dairy goats in New Zealand (Stafford and Prosser, 2016). The majority of dairy goats are

intensively managed (Gautam, 2012), with approximately 72% of the dairy goat population located in the Waikato region (Table 1), with the remaining 28% being distributed throughout the rest of New Zealand (Orr, 2010a). Dairy farms which supply goat milk processing plants have an average flock size of 750 milking does, while the smaller farms, which make their own or supply local cheese makers, tend to have approximately 50 goats.

**Table 1.1.** Goat population throughout New Zealand in 2016.

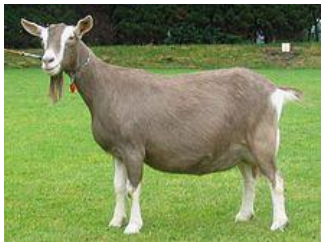
| Region | Flocks | Goats | % of Population |
|---|---|---|---|
| Auckland | 3 | 3,732 | 6.00 |
| Bay of Plenty | 1 | 9 | 0.01 |
| Hawkes Bay | 1 | 1,000 | 1.51 |
| Manawatu | 5 | 6,000 | 9.08 |
| Nelson | 1 | 60 | 0.09 |
| Northland | 4 | 2,555 | 3.87 |
| Otago | 1 | 30 | 0.05 |
| Taranaki | 8 | 5,154 | 7.80 |
| Waikato | 67 | 47,485 | 71.84 |
| Wellington | 1 | 75 | 0.11 |
| **Total** | **92** | **66,100** | **100** |

Waikato has a well-established dairy goat industry, thanks to the work achieved by the Dairy Goat Cooperative. Although goat milk production in New Zealand is insignificant on the world stage, New Zealand is the leading international manufacturer of goat milk powder for infants and young children (Stafford and Prosser, 2016). In recent years, the Manawatu region has also become home to hundreds of dairy goats (Galloway, 2015). Six farms have been developed for dairy goat production which will supply the Ashburton based dairy goat processor, NZ Dairy Collaborative Group (NZDCG). Goat milk from Manawatu is trucked to Hamilton for drying at a specialist plant in Ruakura, and then packaged in Ashburton for export (Galloway, 2015). Other regions are also considering the potential benefits of farming dairy goats, as it provides a high-value land-use option for pastoral country. Last year a report by Business Hawke's Bay indicated the region's dry, low-humidity climate was well-suited to goat farming, while the topography would lend itself well to an industry capable of creating 178 new jobs and bring $1.5 billion into the region (Bevin, 2015).

### 1.2.1. Breeds

Approximately 85% of dairy goats milked in New Zealand are the Saanen breed, due to its greater milk production capacity, with Toggenburg, British Alpine and Nubian type crosses comprising the remaining 15% (Table 1.2).

**Table 1.2.** Common dairy goat breeds in New Zealand.

| Breed | Description | Image |
|---|---|---|
| Saanen | Description: White/cream with a medium to large build<br>Characteristics: High milk yielding, docile, easy to handle.<br>Population: 85% of dairy goats in NZ |  |
| Sable | Description: Essentially a Saanen which is not white in colour.<br>Characteristics: Same milk yields as the Saanen.<br>Population: 0.5% of dairy goats in New Zealand |  |
| Toggenburg | Description: Slightly smaller than the Saanen with distinct white swiss markings on the face, legs, rump and tail.<br>Population: 5% of dairy goats in NZ |  |
| Alpine /British Alpine | Description: Dark coat with the same white swiss markings as the Toggenburg and medium to large body size.<br>Characteristics: Produce high total milk solids and have the advantage of milking for two years without kidding.<br>Population: 4.5% of dairy goats in NZ |  |
| Nubian /Anglo-Nubian | Description: medium to large size.<br>Characteristics: Originally bred for dual-purpose (meat and dairy) overseas but just used for dairying in NZ<br>Population: 5% of registered dairy goats |  |

### 1.2.2. Production systems

The majority of reproduction and animal health information was gathered from a visit to Scott Fraser's dairy goat farm, Manawatu, (February 8, 2017).

*Farm system and feeding*

Two types of farming systems are practiced in the New Zealand goat industry, with goats either being housed indoors, or in an outdoor system where they live and graze in paddocks (Robertson et al., 2015). The bulk of dairy goat farms are managed intensively (Morris et al., 1997). These indoor systems consist of the goats being housed in open-sided barns with wood-chip or sawdust lined floors and their food brought to them two to three times a day. Housing policies can vary, for example, one farm housed 850 goats in large sheds with around 250 goats in each pen, while another farm of 550 goats, housed all the goats in a 84 x 50-metre structure, divided into thirds (milkers, dry goats and kids). Farmers suggested 15-17 goats per ha can be accommodated in an indoor operation and 12 does/ ha in outdoor systems. Feed which is provided for the goats is generally fresh pasture or crops, which are grown and harvested on-farm and cut and carried to the side of the barn (Solis-Ramirez et al., 2011). Alternatively, feed can be brought onto the farm. On-farm forage usually consists of ryegrass-based pasture, lucerne and plantain/clover mixes, while other supplementary feed includes; maize, grains, and molasses (Robertson et al., 2015). Palm kernel extract and biscuit waste were also popular supplements fed to dairy goats, however, in 2011, due to the unknown effect of these supplements both were removed as allowable diets for NZDGC dairy goats (Huitema, 2012). Waste feed and manure is either removed periodically, or stored and spread on farm (Robertson et al., 2015).

In an outdoor system the goats live and graze in paddocks. Depending on the farm system, the goats will acquire sufficient energy from the pasture, however, in some situations supplements are provided. In these cases, the supplements are similar to those of an indoor farming system (Robertson et al., 2015).

Milking regimes mimic those of dairy cow operations, starting in early July and ending in the last week of May. Goats can be milked once they have their first kid at one year of age, unlike cattle where the heifers enter the milking herd at two years of age. Milking procedures are the same for both indoor and outdoor systems as the goats are walked to the milking shed twice daily for milking. Most farms provide supplementary feed during milking, such as

maize or grain. Does tend to be clean animals during milking and only defecate when standing in the yards. This minimal manure produced is stored and spread onto paddocks.

*Reproduction*

Goats are able to reproduce three times every two years. During the mating season buck to doe ratios can range between 1:22 and 1:50 in New Zealand (Solis-Ramirez et al., 2011), while the ratios used in overseas dairy goat systems range from 1:15 (Lindsay and Skerritt, 2003) to 1:75 (Mellado et al., 1996). Natural mating is common practice in dairy goats in New Zealand with only limited use of artificial insemination (Morris et al., 2006). Bucks remain in the herd until majority of does are scanned pregnant. The first pregnancy scan is generally six weeks after the buck is introduced to the does, when the majority (~95%) of the herd are already successfully mated. The gestation period of a goat is five months. Mating is in February and kidding is in July and August, and the kids produced are mated the following February and will then kid in turn the following July. Average kidding rate is two kids each year. The kids have their first feed from the dam, and then are separated and fed *ad libitum* milk replacer in a separate pen. Replacement rates are 10-20% for milking does and 5% for bucks. Culling rates tend to reflect replacement rates and are determined based on level of production, empties, and on some farms, mastitis or repeated bouts of mastitis. Currently buck kids are slaughtered at a young age with the meat utilised for pet food or rendering (Freeman-Rock, 2015). Once doe kids reach 10 kg live weight they are introduced to pellets, hay and barley straw, to introduce roughage to the rumen. As soon as kids reach 20 kg live weight they are weaned. Replacement bucks are kept for 3-4 years until they become too heavy for the does during mating.

*Animal health*

Industry mortality rates for dairy goats can be up to 30% (Freeman-Rock, 2015), with diseases such as ketosis a serious problem. However, the most common reasons for culling milking does are: low milk production (35%), poor fertility (14%), lameness (6%), mastitis (6%) and 13% due to other reasons (Solis-Ramirez et al., 2011). Approximately 85% of dairy goats milked in New Zealand are the Saanen breed, due to its greater milk production capacity, while the Toggenburg, British Alpine and Nubian type crosses comprise the remaining 15% (Solis-Ramirez et al., 2011). In some cases, meat breed bucks will be crossed

with does to produce kids for meat production (8 kg carcass weight by 5-6 weeks of age) (Solis-Ramirez et al., 2011), however, the cost of raising these bucks is generally more than their commercial value.

### 1.2.3. Production

Currently there are estimated to be 84 large (>300 heads) dairy goat flocks in New Zealand which supply the five commercial dairy factories. In addition to these larger dairy flocks, there are a large number of smaller goat farms which produce fresh goat milk for local supply and cheese production.

The New Zealand Dairy Goat Cooperative (NZDGC) is the largest dairy goat operation in New Zealand which operates as a seasonal production system, milking from July to May each year (Solis-Ramirez et al., 2011). Goats registered with NZDGC are herd tested every two months, throughout lactation. This herd test involves the measurement of the milk volume and constituents from each animal and is used to calculate breeding indices for each individual (Gautam, 2012).

Lactation length for goats farmed in indoor systems range from 190-324 days in milk (six-eleven months) (Robertson et al., 2015; Stafford and Prosser, 2016), with daily milk production of 2.7 L/doe/day and 3.5 L/doe/day at peak (Anon, 2011). The industry average is 625 milking does per farm and 86 kg milk solids per head per annum (Robertson et al., 2015; Stafford and Prosser, 2016). Yearling does produce approximately 75 kg MS/doe/year, while two and three-year old does can produce 100 kg MS/doe/year. These averages are based on the greater proportion of indoor farms, which tend to have increased numbers and greater production per animal (Robertson et al., 2015).

Milk production of goats in each parity for the 2015 season in Waikato is shown in Table 1.3. Does can start producing milk at one year of age and continue production until they are 10, depending on their production level and health. Based on these averages, the doe's peak milk production occurs in their fifth parity. One concern for the dairy goat industry is the high somatic cell count (SCC) in goat's milk, compared to cow's milk, however there is limited information on the relationship between SCC and milk quality in goats. However, the SCC

threshold for the milk pay out in New Zealand is based on a seasonally adjusted monthly average SCC (Apodaca-Sarabia et al., 2009).

**Table 1.3.** Milk production of goats located in Waikato for the 2015 season.

| Milk production of goats in each parity for the 2015 season | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Parity | | | | | | | | | |
| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Lactation length (days) | 192.1 | 217.0 | 223.6 | 216.0 | 246.2 | 237.5 | 230.4 | 208.0 | 190.3 | 232.0 |
| Yields[a] (kg) | | | | | | | | | | |
| Milk | 581.5 | 801.6 | 883.6 | 846.1 | 917.5 | 856.7 | 837.5 | 664.2 | 625.8 | 699.7 |
| Fat | 19.5 | 26.8 | 28.3 | 27.6 | 30.0 | 27.2 | 26.4 | 21.7 | 19.9 | 27.4 |
| Protein | 18.3 | 25.4 | 27.9 | 26.6 | 28.6 | 26.7 | 25.7 | 20.3 | 19.0 | 24.9 |
| Somatic cell score | 8.8 | 8.9 | 9.1 | 9.1 | 9.4 | 9.6 | 9.6 | 9.9 | 9.9 | 9.9 |

[a] Yields are kg liquid milk, not kg milk solids

## 1.3. Meat goat industry

Globally, consumption of goat meat has increased over the past 20 years (Madruga and Bressan, 2011). The carcass is very high in lean meat and low in intramuscular fat, resulting in it providing a source of high quality protein (Hogg et al., 1992). Despite the popularity of goat meat globally, New Zealanders do not consume large amounts of goat meat and the small quantity of goat meat produced in New Zealand is exported. In recent years, due to the downturn in lamb and beef prices and increased domestic demand for goat meat, there has been an increasing interest in farming goats for meat (Rural Delivery, 2010).

Landcorp was the first company to import Boer goats into New Zealand as embryos in 1987 and breeding stock were released to the farming public in 1993. Since then, farmers have taken up breeding Boer goats for meat consumption and 27 breeders are currently registered with the New Zealand Boer Goat Breeders Association. Although bred for meat production, the Boer is also suitable as a terminal sire for dairy and fibre goats. The other goat breed farmed for meat production in New Zealand is the Kikonui, an improved meat breed developed from the Kiko which was purpose-bred in New Zealand for meat production. However, there are only 300 Kikonui goats in New Zealand farmed at Kikonui Pastural Goats in Nelson.

Despite the slow start of goat meat production in New Zealand, numerous companies have

now been formed (GoatNZ Ltd, Shingle Creek Chevon) to supply and export high quality goat meat to national and international consumers. Farmers can face difficulties sending their goats to slaughter as there are limited processors which kill goats. However, with the increasing interest in goat farming, processors are beginning to open up their processing plants to slaughter goats.

Goats in New Zealand are mainly utilised for weed control, with meat and fibre production in many instances being a secondary benefit. In this situation, goats are generally run in association with other pastoral animals such as sheep and cattle, in an attempt to control weeds such as blackberry, gorse and Manuka. The common goat for weed control and meat production is the feral goat. Although the carcass weight of the feral goat is relatively lighter than that of meat breeds (20 kg vs. 30 kg), they are known for high prolificacy rates (140%) and thus, the number of animals available for slaughter from a culling program could be expected to be high (Sheppard and O'Donnell, 1979).

### 1.3.1. Breeds

Although the majority of goat meat produced in New Zealand is feral goat, the Boer is the main goat meat breed farmed in New Zealand (Table 1.4).

**Table 1.4.** Common goat meat breeds in New Zealand.

| Breed | Description | Image |
|---|---|---|
| Boer | Description: Large animal with bucks reaching 120 kg live weight. The average breeding does weigh 60-80 kg with a big doe, pregnant with twins reaching 95 kg. Characteristics: Rapid growth rates, quality carcass conformation, and high fertility. |  |
| Kiko | Kiko are purpose-bred in New Zealand for meat production. Kiko are produced from feral does mated with Anglo-nubian, Toggenburg and Saanen bucks. |  |
| Kikonui | Improved breed of Kiko does. Producing multiple kids to satisfactory weights and longevity on less nutritious pastures. Population: 300 goats |  |

### 1.3.2. Production systems

The majority of the farm system and feeding, reproduction and animal health information was gathered from personal communication with members of the NZ Boer Goat Breeders Association, (2017).

There are many benefits of raising meat goats. They improve pasture quality by eating weeds and poorer quality pasture. This diet of weeds results in saving money on weed and pest control and they bring in an income from meat (gross return around $15/goat stock unit) (Meat and Wool New Zealand, 2008). In addition, running goats for pasture management has shown to improve the clover percentage in pasture and, in comparison to cattle, goats have

lighter bodyweight, so produce less pugging on the heavy soils (Meat and Wool New Zealand, 2008).

*Farm system and feeding*

Goat meat farms vary in size and management depending on location. Boer goats thrive in dry climates and on rough terrain, making the South Island ideal for them (Piddock, 2013). Thus, most Boer breeders are scattered throughout the South Island, with only a few located in the North Island, with farms ranging in size from 20-600 goats. The smaller properties tend to be small scale breeders who are retired or have extra cash and like to show goats, while the larger scale operations are generally more commercial and run other livestock enterprises on the same property. All farm types feed a pasture-based diet with supplements provided during times of poor grass growth, such as during drought and winter periods. The supplementary feed used differs among farmers, but ranges from hay, lucerne, timothy, nuts, and concentrates.

*Reproduction*

Current recommendations are for does to reach 40 kg at mating (although this may vary between breeds), with a buck to doe ratio of 1:50 (Meat and Wool New Zealand 2008). Historically, New Zealand breeding flocks were relatively small scale, however, the introduction of South African genetics has led to increasing breeding flocks sizes (Rural Delivery, 2010). New Zealand has some of the best Boer genetics in the world, imported from South Africa (Malan, 2000). This has led to a demand for the export of live animals for use in breeding programs. In 2016, 14 live Boer goats were sent to New Caledonia and around 120 to Malaysia for breeding.

Boer does are known for high fecundity and good mothering, however, farmers are now selecting for traits such as footrot and scald resistance (Rural Delivery, 2010). To reduce mortality, natural or man-made shelter should be available for kidding. Both, embryo transfer and artificial insemination are breeding technologies used in the goat meat industry where the embryos of purebred Boers are implanted into crossbreeds. Kikonui Pastoral Goats, located in Nelson, provide semen and embryo services (Kikonui, 2016).

In the South Island, the breeding season is climatically controlled and partially dependent on pasture growth. Ideally the kids are born and begin eating grass (at two weeks of age) as the spring flush is beginning. Bucks are usually introduced to the flock in April, for two to three months. The gestation period is five months and kidding generally starts in September. However, due to differences in pasture growth and weather conditions, kidding occurs in August and September in Canterbury, and in October and November in Central Otago. Thus, kidding Boer goats in the South Island can range from July through to December and even January, depending on grass growth. Some Boer studs have attempted to have their does kid three times in two years, however, this requires good pasture and animal management. Boer kids are weaned from two to six months old; however, if the doe is losing condition, the kid will be weaned earlier. If does and bucks are weaned at six months of age they should have an average weight of 30 kg.

*Animal health*

As with sheep and beef farms, autumn is the worst time for health problems. Wet pastures without sufficient sunshine hours can result in parasite problems and, without strategic pasture management, can cause heavy worm burdens. All farmers try to drench as little as possible, to reduce creating parasite resistance, and only drench when needed (i.e. scours). Other techniques of reducing worm burdens are to cross graze, with sheep and cattle, or use refugia to prolong drench life.

The majority of farms bring their goats into the sheds each year for drenching and routine foot care, however, all farms differ in the intensity of treatment regimes. For example, farms with 20-300 goats bring their goats into the sheds four-five times a year for drenching and foot care. While, the largest Boer meat producers in the South Island (Norfolk Boers) run a 1200 ha farm holding 3,000-4,000 animals on three properties, and muster once or twice a year (Rural Delivery, 2010). In comparison, Kikonui stud runs a central herd of 300 does which are farmed unsupervised and unhoused on lower quality hill country. Costs are kept to a minimum with no foot care or vaccinations and minimal drenching (Kikonui, 2016).

### 1.3.3. Production

Goats are bred for meat production in New Zealand using a range of crosses. Farmers in the South Island tend to cross Boer with Saanen (a milking breed) to provide more milk for the

kids, and Cashmere (fibre breed) for a thicker coat against the cold climate (Rural Delivery, 2010). Other common examples include; purebred Boer, Kikonui and Feral, or a cross of Boer with Sannan, Cashmere, Feral, Kiko or Cashgora/Cashmere (Meat and Wool New Zealand, 2008). Despite this though, the largest proportion (90%) of goat meat slaughtered in New Zealand is from feral/wild goats (Meat and Wool New Zealand, 2008).

In New Zealand, goat farmers are paid according to the carcass weight (CW). Generally, goats are slaughtered to produce carcass weights of 9 – 18 kg. With high quality feed, kids can reach 14-18 kg CW by eight months of age (Meat and Wool New Zealand, 2008). However, these animals tend to be crossbreds of Boer with feral or dairy breeds, and a purebred Boer goat can reach 25 kg CW by eight months of age. Farmers located in central Hawke's Bay slaughter yearling kids at 13 kg CW and receive around $45 each ($3.50 kg schedule) (Meat and Wool New Zealand, 2008). This is much less than the $95 per head farmers currently achieve for lambs (Beef and Lamb New Zealand 2016a). Premium product is either a young (no older than 12 months) Boer or Boer Cross, which has no permanent incisors in wear and weighs up to 18 kg CW (Rural Delivery, 2010).

Despite the large number of meat processors throughout New Zealand, there is only a limited number who are able to process goats. Goats have a larger and longer body than sheep, which means they are not compatible for the machines used for slaughtering sheep. However, if there is sufficient demand, some processors may open up a chain (slaughtering line) specifically for goats, on a specific day, for a specific number of animals. Goat farmers then have to book in their goats to be processed at this time. Some processors such as Lean Meats in Oamaru and Blue Sky Meats are able to process goats and export goat meat, mainly to the USA and Japan (Rural Delivery, 2010). Other goat farmers, such as Shingle Creek Chevon (based in central Otago), produce and sell goat meat online and to the public (Piddock, 2013). Most commercial farms therefore send their goats to the limited number of meat abattoirs who process goats (Lean Meats Oamaru and Blue Sky Meats), while the small stud farms send their animals to Shingle Creek Chevon, the only company in New Zealand with the rights to buy and sell goat meat to restaurants around New Zealand (Shingle Creek Chevon, personal communication, 2017). The total numbers of goats processed in the last three seasons are shown in Table 1.5. However, 90% of these goats were feral.

**Table 1.5**. Total number of goats slaughtered and either exported or sold locally from 2014 to 2016.

| Year | Total killed | Exported | Local trade |
|---|---|---|---|
| 2014 | 115,984 | 89,703 | 26,281 |
| 2015 | 121,889 | 88,084 | 33,805 |
| 2016 | 123,375 | 77,376 | 45,999 |

## 1.4. Fibre goat industry

The fibre goat industry predominantly produces Mohair from Angora goats. Mohair is a luxury fibre commonly used for clothing and furnishing. A second even finer fibre is cashmere, the inner-coat on some types of goats (Sumner and Bigham, 1993). There is no specific breed of cashmere goat, rather many types (Table 1.6) produce this fibre. The cashmere produced in New Zealand is from goats derived from feral animals (Bigham et al., 1993). However, despite cashmere being of greater value, it is very laborious to harvest and very little is harvested in New Zealand (Rural Delivery, 2011). Cashgora is a cross between an Angora and a cashmere producing goat, and produces fibre which has a similar structure to the cashmere goat, rather than the Angora (Jonen et al., 1994).

The farming of Angora goats has declined since its peak in the 1980s. Farming goats for their Mohair was a profitable business, until limited breeding stock led to increased prices for Angora goats. The market price for Mohair at this time rose from $8 per kg to $18 per kg, and there were extremely generous tax incentives for anyone wishing to get involved (Mohair Producers NZ Ltd, 2016a). This unrealistic boom saw bucks being sold for more than $100,000 and by 1988 the number of goats farmed had reached 1.3m. A share market crash in the late 1980s led to a rapid decline, but farming Angora goats picked up again in the 2000s when low returns for wool and lamb forced farmers to diversify. In 2011, there were around 800 Angora farmers in New Zealand producing 80,000 kg/year with a top price of $30 kg for fine Mohair (produced from kids) (Rural Delivery, 2011). However, production has now declined to 30,000 kg/year of Mohair (Rae, 2014). Despite New Zealand providing small quantities of quality fibre, the industry suffers from fluctuating demand for Mohair and, to a lesser extent, cashmere (Morand-Fehr et al., 2004).

In 2014, goat companies throughout New Zealand came together for the first NZGoats conference in Queenstown. This was organised by Mohair NZ and Meat Goat New Zealand operating under the Federated Farmers umbrella. The main purpose of the conference was to explore ways to add value to the NZ Goat industry by fostering the development of a "reinvigorated and unified goat sector" (Rae, 2014). With goat meat leading global red meat consumption and Mohair becoming a popular niche fibre, goat farming was also well placed to capitalise on environmental constraints likely to increasingly affect New Zealand's wider pastoral system (Rae, 2014). However, in order for the goat industry to remain competitive, it

requires the use of modern breeding technologies to improve the quality of the animals and products (Rae, 2014).

### 1.4.1. Breeds

Angora is the common goat breed farmed for mohair, while cashmere is produced from most other New Zealand breeds (Table 1.6).

**Table 1.6.** Common fibre goat breeds in New Zealand.

| Breed | Description | Image |
|---|---|---|
| Angora | Originating from Asia Minor, however genetics in New Zealand were imported from South Africa. These goats have typically long, shaggy ringlet coats and are farmed for Mohair |  |
| Cashmere | Cashmere goats are a type, rather than a breed. Most goat breeds produce cashmere, apart from Angora goats. Flocks farmed for cashmere are the result of intensive selection of feral goats for fibre production and ongoing selection. | |
| Cashgora | Cashgora is a cross between the Angora and goats which are farmed for cashmere. The down fibre produced has a mean diameter of 19-23 microns (lustrous cashmere) and is produced in New Zealand and Australia. |  |

### 1.4.2. Production systems

The majority of the farm system and feeding, reproduction and animal health information was gathered from a visit to Richard and Lynne Milne's Angora goat farm in Patea (2017), and personal communication with Grant and Jackie Freeman (2017).

Angora goats have been adapted and bred to New Zealand conditions, thus the genetics of the animals in the 1980s have been greatly improved (Fox, 2015). Angora goats should not be farmed for scrub control. They are not as hardy as feral goats, requiring greater nutrition than that provided by scrubby vegetation, and their fleece is likely to become contaminated by vegetable debris, resulting in penalty or downgrading when shorn (Orr, 2010b).

*Farm system and feeding*

Production systems for Angora goats range from flat dairy land with perennial ryegrass pastures, to hilly sheep and beef country and undeveloped hill country grazing broom, briar rose and native pasture. Angora goat farmers feed a largely pasture-based diet with hay, bailage and sometimes grain during winter months (Stafford and Prosser, 2016). Does are fed calf pellets one month prior to kidding, over the shearing period and during kidding until grass growth exceeds demand. Kids and does are fed pellets again during spring so that the kids are conditioned for pellets. After weaning (February), pellets are re-introduced as required through the winter at a rate of 100-150 gm/goat/day.

Farmers who run alternative livestock enterprises, and only have Angora goats as an additional source of income or for pasture control, tend to manage the goats very differently to those farmers on primarily goat-focused farms. Since there is competition with cattle and sheep, the goats fit in with the other livestock. Does are brought down onto flats to kid and return to the gullies during winter. These goats are also shorn twice a year, returning an average of $50 per goat.

*Reproduction*

Unlike dairy goats, Angora goats are generally bred at two years of age (Dalton, n/a). Bucks are introduced to the flock around mid-March or April, for six to eight weeks (Stafford and Prosser, 2016). Some farms mate does once they reach 35 kg live weight (which can be as a two-tooth or four-tooth), while other farms start breeding once does reach 3 years of age. Breeding does can be bred for eight years, depending on their condition, however, does with poor fleece production will not be bred. Kidding occurs around August/September and the kids are kept with the doe until weaning. Some farms wean the kids at 3-4 months of age at a

minimum of 10 kg live weight while others wean at six months, regardless of size. If the does die, or are sick or have poor milk production, the kids may be reared on milk replacer.

All kids are kept for 12 months, and culls are selected at this point for inferior type fleeces, poor constitution or lameness. Most farmers tend to keep two to four buck kids for replacements, while the rest of the kid bucks are castrated and kept as wethers. Wethers are profitable in the flock as they are generally easy care and can produce 3 kg or more fibre as they are not under stress from breeding. However, some farms do not have the capacity to hold every animal, so wethers are culled after their fifth shear (2.5 years old).

Angora goats are shorn twice a year, in the last week of February and last week in August. The fleece is the number one priority on both the doe and kids. Poorly fleeced hoggets will be culled at 18 months of age, while does with good fleeces and/or producing very good fleeces on their kids may remain in the flock until they are 9-10 years old. Buck replacement animals are trial mated as two-tooths and if the resulting offspring produce good fleeces, or improve the flock standard, they will be used for a further two to three years.

*Animal health*

All systems provide access to clean water and shelter with some variations between farms and thus, animal health. Some Angora goat farms tend to have other stock enterprises on the farm so they are able to cross-graze. This cross-grazing technique helps pasture control, breaks the parasite life cycles and lowers the subsequent worm burdens of the goats. Farms which cross-graze have a policy of not drenching young stock for the first 12-18 months of their life, with the odd individual requiring a drench, while a drenching policy for a farm just farming goats will require the adult does to be drenched for parasites 2-3 times a year. Although Angora goats are seemingly more susceptible to parasites than sheep, they appear to be more resistant to facial eczema (L. Milne, personal communication, 2017).

Fibre growth is greater in summer than winter (Sumner and Bigham, 1993). However, the timing of shearing is important for cashmere-producing goats as these “moulting breeds” will remain virtually naked for some months after shearing, until growth recommences (Sumner and Bigham, 1993). Shearing times differ depending on the farming system; however the general practice is for twice a year, once in autumn and again in spring.

### 1.4.3. Production

Cashmere goats produce a mean fibre diameter of less than 18 microns (millionths of a meter), while cashgora down is less than 22 microns (Litherland et al., 1995). Cashmere production is much lower in New Zealand (down weights of 50 to 150 g), than traditional cashmere farmers, such as China (200 to 500 g) (Litherland et al., 1995). Mohair is measured by the diameter of the fibre and ranges from 19-27 microns. On average, New Zealand Angora goats are shorn twice a year producing a total of 4 kg of Mohair per animal. New Zealand only produces around 1% of the global production of Mohair, the majority coming from US and South Africa. In 2007, there were approximately 20,000 Angora goats in New Zealand, producing more than double the profit of lamb production (Rural Delivery, 2011). Although there are no official publications of goat numbers in New Zealand, it is assumed to be approximately 200 Angora goat farmers in New Zealand.

The main classes of Mohair are Kid (23-25 micron), Young goat (27-31 micron) and Adult (33-36 micron), as well as Stain (discolouration), Veg (vegetation in fleece) and Dags (dirt and faeces in fleece). The current national average is approximately $17/kg for Mohair. However, the price for Mohair in the top bracket can fluctuate between $26/kg and $36/kg, with current returns steady at $31/kg (Fox, 2015). Mohair fleeces are sent to either Ohuka Farms in the North Island, or Mohair Pacific in the South Island. Once at the warehouse, fleeces are sorted into classes and sent in bulk to South Africa. Once in South Africa, fleeces are processed, auctioned and exported to core markets such as Japan, China and Italy (Stafford and Prosser, 2016).

## 1.5. Goat population statistics

### 1.5.1. Tables of flocks and number and processors for each industry

Table 2.1 shows the number of flocks and goats in each region for each industry. Information for this table was collected from a range of sources;

- Personal communication with
    - Dairy processing companies
    - Meat processing abattoirs throughout New Zealand
    - Members of the NZ Boer Goat Breeders Association
    - Dairy, Mohair and meat goat farmers
    - Agribase
    - Beef and Lamb NZ
    - Saanens New Zealand
    - Department of Conservation
    - Cheese makers throughout New Zealand
    - Mohair Pacific
    - Mohair Producers
- During farm visits to an Angora farm and a dairy goat farm

Numbers for dairy flocks and goats were gathered from the dairy processing companies, and through discussions with dairy goat farmers. We are confident that these numbers are accurate. In regards to the meat and fibre industries the numbers are not as accurate. Some farmers did not want to participate in providing information so we think that this report provides an underestimation of the number of meat and fibre goats in New Zealand. The numbers for meat goats are largely based on discussion with farmers from the NZ Boer Goat Breeders Association. However, these are relatively small stud farms and the larger goat meat farms were more difficult to locate, as there is no association or census for goat meat farms. The meat processors were able to tell us the number of goats processed, but not from which farm. In regards to the Mohair industry, one of the warehouses was able to provide information on the number of goats and farms which supply them, but the other one was not. A large amount of information was provided by Agribase, however, due to confidentiality reasons they were unable to say whether the farms were dairy, meat or fibre.

**Table 1.7.** Goat population statistics for New Zealand.

| | Dairy | | Meat | | Fibre | | ND[a] | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Region** | **Flocks** | **Goats** | **Flocks** | **Goats** | **Flocks** | **Goats** | **Flocks** | **Goats** | **Flocks** | **Goats** |
| Auckland | 3 | 3,732 | 1 | 165 | | | 38 | 3,589 | 42 | 7,486 |
| Bay of Plenty | 1 | 9 | | | 2 | 280 | 11 | 1,615 | 14 | 1,904 |
| Canterbury | | | 15 | 1,485 | 63 | 2,396 | 25 | 2,706 | 103 | 6,587 |
| Gisborne | | | 1 | 63 | | | | | 1 | 63 |
| Hawkes Bay | 1 | 1,000 | 2 | 780 | 8 | 3,230 | 8 | 273 | 19 | 5,283 |
| Nelson | 1 | 60 | 1 | 300 | 15 | 550 | 1 | 6 | 18 | 916 |
| Northland | 4 | 2,555 | | | 1 | 165 | 29 | 4,590 | 34 | 7,310 |
| Manawatu | 5 | 6,000 | | | | | 11 | 3,499 | 16 | 9,499 |
| Marlborough | | | | | | | 4 | 445 | 4 | 445 |
| Otago | 1 | 30 | 6 | 3,952 | 19 | 2,375 | 19 | 842 | 45 | 7,199 |
| Southland | | | 1 | 300 | | | 3 | 328 | 4 | 628 |
| Taranaki | 8 | 5,154 | | | 1 | 214 | 13 | 2,899 | 22 | 8,267 |
| Tasman | | | | | | | 9 | 733 | 9 | 733 |
| West Coast | | | | | 1 | 110 | | | 1 | 110 |
| Waikato | 67 | 47,485 | 2 | 130 | | | 60 | 21,591 | 129 | 69,206 |
| Wellington | 1 | 75 | | | | | 6 | 209 | 7 | 284 |
| **Total** | **92** | **66,100** | **29** | **7,175** | **110** | **9,320** | **237** | **43,325** | **468** | **125,920** |

[a]ND = Not defined. ND numbers and location were provided by Agribase but were not able to disclose what type of farm. Based on this study it is assumed that flocks in Waikato region are dairy while the majority of the others could be for meat production, or are flocks of goats on other farm enterprises kept for organic weed control.

### 1.5.2. Maps of each industry and processors

*All goat farms*

All goat farms identified in this study are displayed in the map of the North and South Island (Figure 1.1).


**Figure 1.1.** Distribution of goat farms in New Zealand.

*All processors*

The main processors of goat milk, meat and fibre are displayed on the maps of the North and South Island (Figure 1.2). The triangles represent the dairy processors, squares represent the meat processors and the two circles represent the Mohair warehouses. It is difficult to identify the Mohair warehouse in the North Island, however it is located in Drury, Auckland.


**Figure 1.2.** Distribution of dairy and meat processors and fibre warehouses in New Zealand.

*All dairy goat farms and processors*

The distribution of dairy goat farms and the processing plant they supply are presented in the two maps of New Zealand (Figure 1.3). Large black symbols represent the different dairy processors and the small grey symbols represent the dairy goat farms which supply the corresponding processing plant. Although NZ Dairy Products Ltd is not yet operating, it is located as the black pentagon near the Hawkes Bay region.

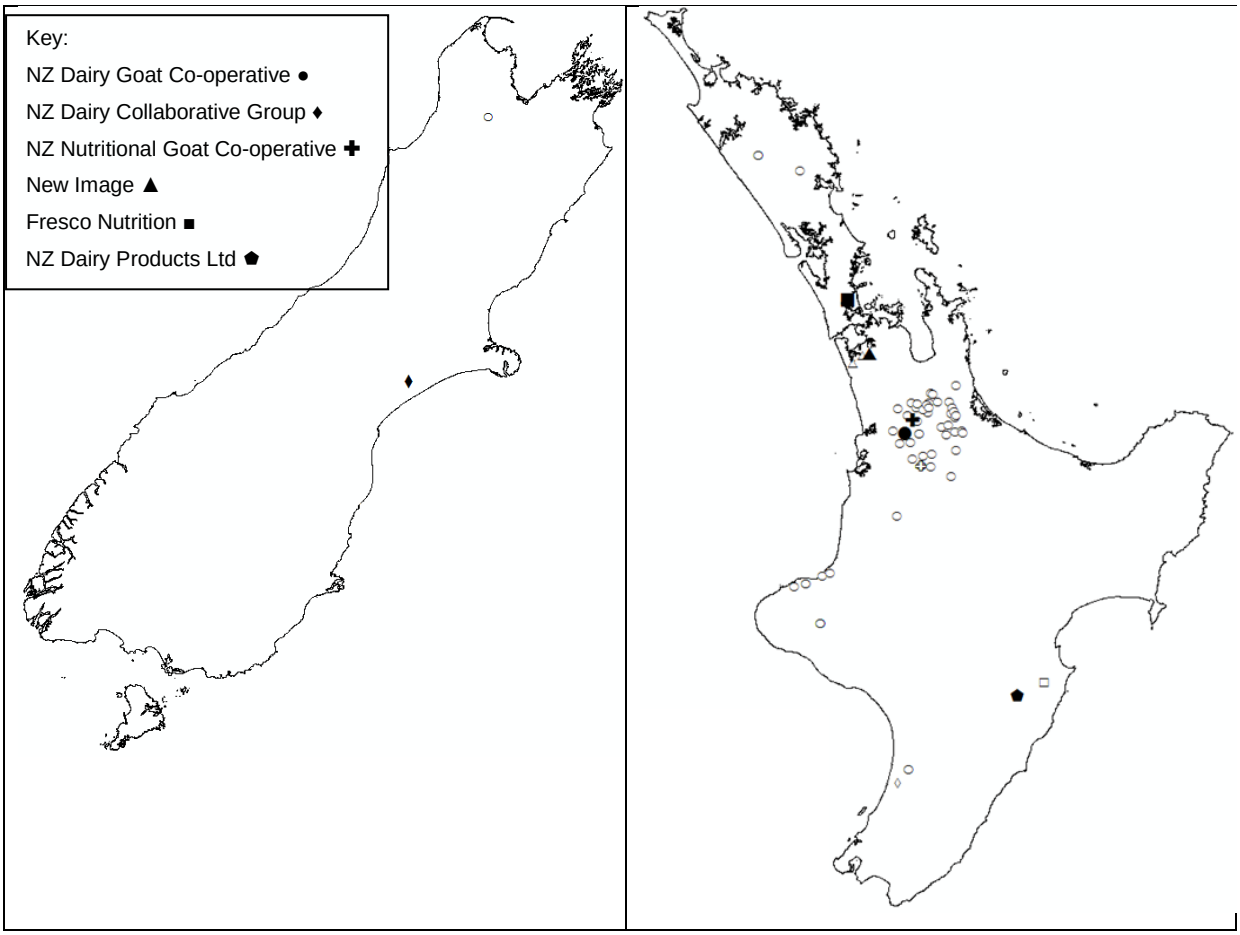



**Figure 1.3.** Distribution of dairy goat farms and processors in New Zealand.

*All goat meat farms and processors*

Meat farms (white squares) and processors which slaughter goats (black squares) are presented in the two images below (Figure 1.4). As it is not possible to identify which farms supply which processor, the grey squares increase in size in relation to the number of goats on the farm.

**Figure 1.4.** Distribution of goat meat farms and processors in New Zealand.

*All goat fibre farms and processors*

As with the goat meat industry, the goat fibre farms were plotted as white triangles (Figure 1.5). Both Mohair processing warehouses are plotted as the black triangles, one in each Island.

**Figure 1.5.** Distribution of goat fibre farms and warehouses in New Zealand.

*All goat farms not defined*

A large amount of information was provided by Agribase. While they were able to provide the number of goats and their location, they were unable to disclose what type of farming occurred. Therefore, all farms not identified on the previous maps/industries, are plotted in Figure 1.6. The diamond symbols represent the individual goat farms. From this study, the majority of these non-defined farms are assumed to be for meat production, or just contain herds of goats kept for organic weed control, or to improve pasture. However, by looking at the topography and previous data we have collected the majority of the goats located in the Waikato region are assumed to be dairy herds, as Waikato is the main region which has dairy goat herds and dairy goat milk processors are in close proximity.

**Figure 1.6.** Distribution of goat farms not defined in New Zealand.

## 1.6. Processors

There are a number of abattoirs, dairy processing plants and Mohair warehouses scattered around New Zealand which process goats, goat milk and fibre. The main processors for each industry are listed below, with further descriptions provided.

Dairy processors;

- NZ Dairy Goat Co-operative, Hamilton
- NZ Nutritional Goat Co-operative, Waikato
- New Image Group, Auckland
- NZ Dairy Collaborative Group, Ashburton
- Fresco Nutrition, Waikato
- NZ Dairy Products, Hawkes Bay

Meat processors;

- Shingle Creek Chevon, Central Otago
- Auckland Meat Processors, Auckland
- GoatNZ Ltd, Taupo
- Progressive Meats Ltd, Hastings
- Crusader Meats, Benneydale
- Te Kuiti Meat Processors Ltd - gets from Ovation
- Taylor Preston Ltd, Wellington
- Blue Sky Meats (NZ) Ltd, Invercargill
- Lean Meats, Oamaru

Fibre Processors

- Mohair Producers, North Island
- Mohair Pacific, South Island

### 1.6.1. Dairy Processors (6 processors)

*NZ Dairy Goat Co-operative*

The New Zealand Dairy Goat Co-operative (NZDGC) is one of the leading dairy firms in New Zealand (iFAB, 2013a), and are world leaders in the manufacture of goat milk infant formula and other goat milk based nutritionals (iFAB, 2013a). The New Zealand Dairy Goat Co-operative was established in 1984 from an amalgamation of divergent goat milk co-operatives around New Zealand. Once NZDGC achieved markets in New Zealand, Australia and Taiwan, they extended their export of goat milk formulas to around 20 countries (NZ Dairy Goat Co-operative, 2016). NZDGC is located in Hamilton with 73 supplying shareholders in Northland (5%), Waikato (85%) and Taranaki (10%), milking 51,100 goats with milk production of 45,000,000 litres in the 2015/16 season (K. Arnold, NZDGC, personal communication, 2016).

*NZ Nutritional Goat Co-op*

New Zealand Nutritional Goat Co-operative is also located in the Waikato region. It has three supplying farms located in Waikato which milk 2,500, 800 and 700 (4,000 in total)

predominantly Saanen goats. Goat milk is dried at the Waikato Innovation Park, Ruakura Hamilton (R. Soar, NZNutirionalfoods, personal communication, 2017).

*New Image Group*

New Image Group (NIG) manufactures and markets a range of nutritional products. New Image Group is based in the Auckland region with their head office in Mangere Bridge and processing plants in Paerata, Avondale and Penrose. Main products produced by NIG are infant formulas, powder blends, tablets and capsules, and skincare. However, goat milk is used for producing infant formula which is exported to China, the Middle East and South East Asia. In addition to infant formula, the company has also developed goat milk-based nutritional products for people with special health needs, and seniors. NIG has a supply partnership with two goat farms located in Waiuku farming 2,500 and 1,200 (3,700 in total) predominantly Saanen goats (P. Day, New Image Group, personal communication, 2017).

*New Zealand Dairy Collaborative Group*

The New Zealand Dairy Collaborative Group (NZDCG) is located in Ashburton. A blending plant was built in 2016 which was largely financed by Fineboon, its largest shareholder and the largest goat milk infant formula brand in China. The company has only been operating in New Zealand for a little over a year, and has secured milk supply from a number of farms in the Manawatu and the capacity to dry the milk in Hamilton (Galloway, 2015). At this stage, the company is taking a low profile to its growth, ensuring markets are well established and earning a premium, rather than risking significant volume growth that erodes potential margins. In the future its plans include a joint venture drier operation (Galloway, 2015). NZDCG currently have an agreement to receive 28 tonnes of dried goat milk from Palmerston North each month, until an adequate herd of dairy goats is established in Canterbury. Fresh milk is sent to Waikato Innovation Park for spray drying and then is sent down to the NZDCG factory in Ashburton. The factory is capable of producing 1,000 tonne/year, with eight to nine litres of milk required to produce a kilogram of milk powder, and with three or four production lines producing 50 cans a minute. This level of production requires around 12,000 milking goats. The company sees a big market in adult dairy goat formula, which will comprise of 100% goat milk.

*Fresco Nutrition*

Fresco Nutrition is a New Zealand owned company located in Auckland. Its goat milk products include, infant formula, follow-on formula, toddler milk drinks, family milk drinks and goat milk tablets. Products are only available in New Zealand and Australia. Only one supplier of goat milk to the company was identified in Havelock North, with 650 milking goats.

*New Zealand Dairy Products Ltd*

New Zealand Dairy Products Ltd is a company currently building a factory in Waipawa, Hawkes Bay. This factory will specialise in the production of goat and sheep milk based nutritional powders such as infant formula. The company want to manage the entire production chain by having a goat and sheep farming operation in Waipawa also. Although the factory is not yet complete, and the farms not yet started, this company plans to have its first infant formula range by mid-2017 (New Zealand Dairy Products, personal communication, 2017).

### 1.6.2. Meat Processors (9 processors)

*Shingle Creek Chevon*

Shingle Creek Chevon is located in Central Otago, just south of Alexandra. The operation owns Boer goats, as well as being supplied with Boer goats from throughout New Zealand. Shingle Creek is the only company in NZ which has the rights to buy and sell goat meat online and to local restaurants (Shingle Creek Chevon, personal communication, 2017).

*Auckland Meat Processors/ Wilson Hellaby*

Wilson Hellaby is one of the top meat suppliers in New Zealand and a leading supplier of goat carcass meat to supermarkets, butcheries and export markets. Wilson Hellaby is privately owned by Syminton Hellaby, which formed in 1998 and now has two plants in Auckland and employs 600 staff (iFAB, 2013b). They process a large number of goats weekly, but were unable to comment on exact numbers.

*GoatNZ Ltd*

GoatNZ is located in Taupo and is primarily focussed on exporting goat meat, but also supplies lamb and mutton. This firm has been operating since 2003 and processes goat meat as well as lamb and mutton. Although it is known that they process goats, they were unable to comment on exact numbers.

*Progressive Meats Limited*

Progressive Meats Limited (PML) was originally set up to process frozen lamb for export but has since extended its services to lamb, beef, venison and rams. Despite these main products, the Hastings-based firm also process goat meat (MPI, 2016). PML mainly processes under toll contracts with key industry partners Lean Meats, Ovation New Zealand, Firstlight Foods, Davmet, McCharty and Seaview Traders. Although it is known that they process goats, they were unable to comment on exact numbers.

*Crusader Meats*

Crusader Meats is located in Benneydale and primarily focussed on processing lamb and venison, however, they also process goat and mutton. Once processed, cuts are supplied to Continental Europe, USA, UK, Japan, Canada, Mexico and the Pacific Rim. Last season they processed 19,000 predominantly feral goats from King Country (50%), Wairoa (30%), Gisborne (10%) and North Auckland (10%). Dairy goats from Waikato are too long for the chains at the Benneydale plant so they are sent to the Venison Packers in Fielding which processed 4,000 dairy goats in the last season (S. Brown, Crusader Meats, personal communication, 2017).

*Te Kuiti Meat Processors Ltd*

Te Kuiti Meat Processors is owned and operated in New Zealand. This plant is located in the central North Island and processes beef (bobby calf only) sheep and goat (MPI, 2016). Last season they processed approximately 10,000 goats of which 10% were culled from dairy goat farms in the Waikato region. This number accounts for around 10% of the North Island kills for 2016 (H. Bayliss, Ovation, personal communication, 2017)

*Taylor Preston Limited*

Taylor Preston Limited is located in Wellington, is halal certified, and fully EU (European Union) and USDA (United States Department of Agriculture) licenced. This multi species plant processes around 1,500,000 head of goats, sheep, lambs, calves and beef annually and exports to over 60 countries worldwide including, USA, UK, France, Spain, Switzerland, Japan, the Middle East and Mexico. Although it is known that they process goats, the exact number of animals processed is uncertain.

*Blue Sky Meats (NZ) Ltd*

Blue Sky Meats is located in Invercargill and only source goat, lamb and veal from Southern New Zealand. Blue Sky employs 350 people and is both USDA and EU approved (iFAB, 2013b). They process between 300-700 goats each year which include predominantly Boer, feral goats farmed in captivity and Saanen. These goats are sourced throughout Otago and Southland with the average carcass weight of 16.5 kg. These goats are processed for the export market (Blue Sky Meats, personal communication, 2017).

*Lean Meats Oamaru*

Lean Meats was originally known as Oamaru Meats but was bought by the Chinese company Lean Meats, which intends to invest between $6 and $8 million to upgrade the facility. The majority (98%) of its product is exported to China, North America, Europe and the Middle East, while 2% is sold in New Zealand (Jamieson, 2016). Lean Meats kills about 5,500 goats a year, which is about 85% of the South Island goat kill, and exported mainly to the Caribbean in 2014.

Most of the New Zealand goat kill comes from the North Island (117,406 animals), and the South Island is a relatively small kill (6,500 animals) (Lean Meats Oamaru, personal communication, 2017).

### 1.6.3. Fibre Processors (2 warehouses)

*Mohair Producers New Zealand*

Mohair Producers New Zealand is a Mohair warehouse located in Drury and is the only warehouse for Mohair in the North Island. Ohuka Farms Ltd is the North Island pool which collects Mohair. Further information was not able to be obtained due to sensitivity issues indicated by Mohair Producers.

*Mohair Pacific*

Mohair Pacific Ltd are buyers, brokers and exporters of New Zealand Mohair. They are the only Mohair exporter in the South Island and are located 10 minutes from Rangiora in Canterbury. There are 100 farms located throughout New Zealand, which supply Mohair Pacific (J. Freeman, Mohair Pacific, personal communication, 2017). Mohair is mainly exported to South Africa where it is spun into yarns, then sold for high-end products such as suits. A small amount is sold domestically and made into blankets and scarves. Mohair Pacific says that there is a worldwide demand for Mohair due to under supply.

## 1.7. Issues within individual goat sectors

The main issues in each goat industry can be collected under two broad umbrella topics:

1- Industry structure
   - Industry information
   - Processing capacity, location and access
   - Critical mass of industry

2- Markets and marketing
   - Prices received
   - Products sold
   - Product markets

### 1.7.1. Dairy goat sector

Issue 1:

Currently, there is no current overview of the industry such as goat numbers and average production values. Farmers indicated they want a place where they can go to see what it would take to become a dairy goat farmer, such as a booklet/handbook. This booklet would include all the benefits of farming goats including improved pasture growth and profit per

hectare, as well as what would be required (husbandry policies). Farming goats is complex and requires high level management skills. There is a perception that goats can thrive on scrubby hills with poor pasture quality when in fact, dairy goats require high quality pasture with supplements and shelter to produce high yields.

### 1.7.2. Goat meat sector

Issue 1: Lack of information for managing goats

There are limited factual data on the requirements and management of goats for meat production. Some farmers suggested that 1-2 monitor farms in each island should be established to show and prove the productiveness of the goat industries and the productive side of the goat (i.e. production and return per hectare).

Issue 2: Lack of goat numbers

Although New Zealand has some of the best Boer genetics globally, we lack the animal numbers. However, farmers are reluctant to increase numbers as they do not get a fair price for the meat they produce.

Issue 3: Lack of coordination of supply

There is a current lack of coordination of meat supply as the procurement model is not efficient. Currently, goat farmers then have to book in for their goats to be processed. In the North Island professional musterers muster feral goats, keep them in yards for the night, then send to the works on the day specified. In the South Island, the musterers are often rugby clubs and other organisations who muster as a fundraising exercise, and who are not professional musterers. They tend to book in a certain number of goats but often fail to muster sufficient animals. This results in the processors becoming resistant to the idea of processing goats, as it costs them money.

Issue 4: Low pay out preventing the recruitment of new farmers

Pay-out is low (currently $2.50 kg/CW) which in turn prevents the retention and recruitment of farmers for goat meat production.

### 1.7.3. Issues within the goat fibre sector

Issue 1: Lack of industry information

There is no central resource which has industry values such as, the number of goats and average fibre production. Not only is this an issue for people interested and wanting to enter the industry, but also for people already in the industry. Without the exact number of goats, farmers aren't able to put together solid business cases for expansion etc.

Issue 2: Lack of understanding for new goat farmers

Some people buy Angora goats with the idea that they are rough and hardy goats which are able to survive on steep hills with poor quality pasture. This terrain can support feral and Boer meat goats, however, not Angora goats. The Angora goat requires high quality pasture and weed free areas to reduce the chance of contaminating or staining the fleece.

Issue 3: Poor Angora genetics

The genetic pool of the Angora goats in NZ has traditionally been small. Some farmers have imported Angora bucks from Australia in the last few years. The progeny from these animals have shown a major improvement in many Mohair characteristics and size. Distribution of these genetics into the industry gene pool would be beneficial, but, farmers do not want to share the genetics as they had to incur the cost of importation themselves.

# 2. The value of goat and its components

In a pastoral-based production system goats are a low-cost, non-chemical alternative for weed control, improve pasture quality and provide increased revenue from meat and fibre sales. Despite these benefits, the majority of farmers appear not willing to integrate goats into their farming system as they can be difficult to control. In addition, the goat industry in New Zealand has had a volatile history which has negatively affected the perception farmers have towards goat farming. In order for the New Zealand goat industry to move forward, farmer perception needs to be changed so that the potential benefits of farming goats can be realised and sheep, beef, dairy and deer farmers can begin to integrate goats into their current farm systems.

## 2.1. Dairy

Historically goats have allowed communities and families around the world to survive, with the milk and the products that can be created from goat milk. This is particularly true in developing countries and consequently goats are known affectionately as the “poor man’s cow” (De Vries, 2008). As technology and innovation progresses, new and refined products and the properties of goats milk has seen dairy goat milk production become more important to New Zealand.

New Zealand’s main dairy goat milk producers have 66,100 goats nationally (Table 1.7). The milk that these goats provide is powdered and exported to major markets in Asia. Other farms produce and distribute products domestically and although demand is increasing for artisanal products, these small scale farmers cannot compete against the larger cooperatives.

For production volumes to increase around New Zealand, commercial dairy goat enterprises are financially dependent on the willingness of discerning consumers to pay higher prices for traditional or gourmet products.

This part of the report will show the current range of domestic and exported products, with respective market values and also future potential products and their markets.

### 2.1.1. Goat milk composition

The components of milk include water, fat, protein, lactose and ash. Fat gives milk its characteristic creamy taste and colour. The amount of fat in milk depends of the species of animal and the breed (Gamble et al., 1939). The differences in the protein, lipid, mineral,

vitamin, and bioactive compound content of goat milk when compared to the milk of other common species such as the cow and sheep are shown in Table 2.1 (Gamble et al., 1939).

**Table 2.1.** Comparison of milk between goat, sheep and cow (Gamble et al., 1939).

| **Component** | **Goat** | **Sheep** | **Cow** |
|---|---|---|---|
| Fat (%) | 3.80 | 7.62 | 3.67 |
| Solids non-fat (%) | 8.68 | 10.33 | 9.02 |
| Lactose (%) | 4.08 | 3.70 | 4.78 |
| Protein (%) | 2.90 | 6.21 | 3.23 |
| Casein (%) | 2.47 | 5.16 | 2.63 |
| Whey proteins (%) | 0.43 | 0.81 | 0.60 |
| Total ash (%) | 0.79 | 0.90 | 0.73 |
| Ca (%) | 0.19 | 0.160 | 0.18 |
| P (%) | 0.27 | 0.15 | 0.24 |
| Cl (%) | 0.15 | 0.27 | 0.11 |
| Vitamin A ($IUg^{-1}$ fat) | 39.00 | 25.00 | 21.00 |
| Vitamin $B_1$ (mg per 100ml) | 68.00 | 7.00 | 45.00 |
| Vitamin $B_{12}$ (mg per 100 ml) | 210.00 | 36.00 | 159.00 |
| Vitamin C (mg per 100ml) | 20.00 | 43.00 | 2.00 |
| Vitamin D ($IUg^{-1}$ fat) | 0.70 | ND | 0.70 |
| Energy (Cal. per 100ml) | 70.00 | ND | 69.00 |

The differences between cow and goat milk in the chemical structure and composition of the milk fat is what sets goat milk apart (Park and Haenlein, 2008). According to Park and Haenlein (2008), the use of goat milk as a nutraceutical in human nutrition stems from the difference in fatty acid composition of the milk. Another significant difference is in fat globule size between goat and cow milk (Table 2.2). Smaller fat globules disperse better and produce a more homogeneous mixture of fat in goat milk, which enhances digestion when the milk is consumed.

**Table 2.2**. Size of fat molecules in goat, sheep and cow milk (Park and Haenlein, 2008).

| Diameter (mm) | Goat (%) | Sheep (%) | Cow (%) |
|---|---|---|---|
| 1.5 | 28.4 | 28.7 | 10.7 |
| 3.0 | 34.7 | 39.7 | 32.6 |
| 4.5 | 19.7 | 17.3 | 22.1 |
| 6.0 | 11.7 | 12.1 | 17.9 |
| 7.5 | 4.4 | 2.0 | 12.2 |
| 9.0 | 1.0 | 2.0 | 12.2 |
| 10.5 | 0.2 | 0.2 | 3.1 |
| 12.0 | - | - | 0.1 |
| 13.5 | - | - | - |
| 15.0 | - | - | - |
| 16.5 | - | - | - |
| 18.5 | - | - | - |
| Average | 3.5 | 3.3 | 4.6 |

The fat composition of goat milk may have at least three significant effects on human nutrition. The ester linkages of short and medium chain fatty acids are easier to break with the use of lipases, which results in a more rapid digestion. These fatty acids exhibit beneficial effects on cholesterol metabolism such as hypocholesterolemic action on tissues and blood. They have also been used therapeutically for treatment of various cases of malabsorption in patients suffering from steatorrhea, chyluria and hyperlipoproteinemia (Haenlin, 2004).
The availability of proteins, the size of fat molecules, the type of casein present in goat milk and its overall composition allows goat milk to be very versatile for nearly all areas of human health.

### 2.1.2. From farm to consumer

Figure 2.1 shows how dairy goat milk reaches the market as a product. Most farms will arrange for their milk to be processed at various plants around New Zealand, with some farms keeping their milk for cheese, yoghurt or wholesale at local markets or food-services. Farms that supply milk for large companies will have their milk collected and sent for processing.

Milk that is intended for export will be prepared and packaged in New Zealand before it is exported.

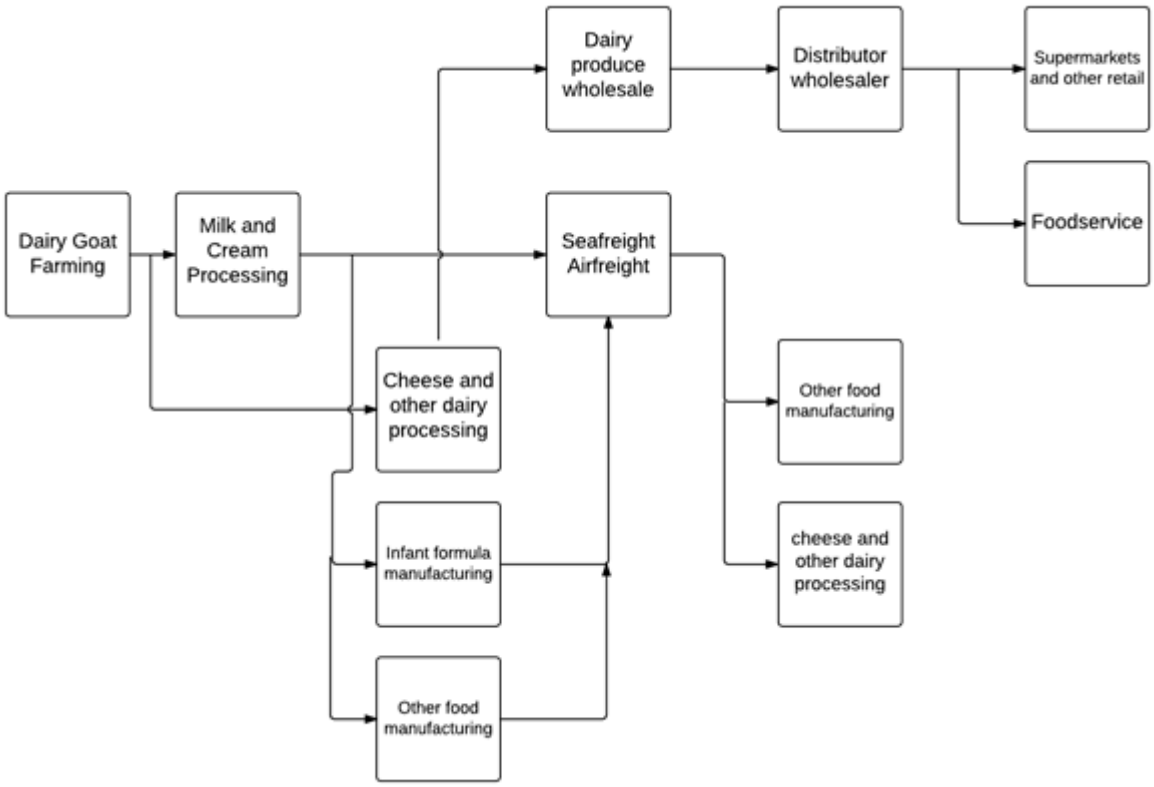



**Figure 2.1.** Diagram of how goat milk will reach product forms and markets.

### 2.1.3. Current domestic products

Most products sold on the domestic market, which include a range of cheese styles, yoghurt and some goat milk, is sold via supermarkets, specialty food shops and farmers markets (Table 2.3).

**Table 2.3.** Domestic products and their market value.

| Product | Description | Destination | Value $NZD/kg |
|---|---|---|---|
| Chevre Cheese | Common name for goats' cheese. Can have additional flavourings | Many small suppliers around New Zealand. Selling in either supermarkets, farmers' markets or own stores. Can be distributed to food-services. | $87.00 |
| Feta Cheese | Salty Greek cheese | Usually found in supermarkets as pure goats' feta or a mixture of cow and goat milk. | $59.40 |
| Powdered Milk | Spray dried goat milk, can have added ingredients depending on customer | Products created for international export, sold domestically online, in supermarkets or health stores | $55.00 |
| Yoghurt | Semi solid food prepared from milk fermented by added bacteria | Local supermarkets. | $17.70 |
| UHT Milk | "Long life milk", can be stored unrefrigerated due to heat treatment | Processed at large companies. Sold online or at large supermarket chains. | $7.60 |
| Whole Milk | Milk with no constituents removed | Farms supply local supermarkets and small stores with fresh goat milk. | $4.10 |
| Ice-Cream | Sweet frozen food made from cream and milk. Can have additional flavourings. | Farms can supply local food-services with cream and milk. | Sold in foodservice |

### 2.1.4. Current export products and their markets

The main processor in the dairy goat industry is the New Zealand Dairy Goat Cooperative which has developed markets in approximately 20 countries including New Zealand, Australia and Taiwan, (NZ Dairy Goat Co-operative, 2016). New Image Group has achieved a strong market for goat milk based infant formula in China, Southeast Asia and the Middle East. New Image Group nutritionals' research and development team are also leading the development of new goat milk-based natural health products. In 2015, goat milk infant formula accounted for seven percent of New Zealand's infant formula exports.

Domestic demand for goat cheese is increasing, but more promotion is needed to show consumers the range of cheese styles available and potential uses (MeadowCroft, personal

communication, 2017). Export opportunities exist in Asia for goat milk powder, UHT milk and cheese (Coriolis 2013). Powdered milk is the most prominent product exported internationally as it can be sold and later reconstituted into other products. Powdered milk is also regarded as medicinal in Asia and is used in a tablet form along with herbs (Coriolis 2013).

New Zealand exports 90% of the goat milk powder produced to Australia, South Africa, Europe and Asia (New Zealand Trade and Enterprise, 2015). This product is marketed to a small niche of mothers who cannot breastfeed and whose children have intolerance to cow's milk. New Zealand goat milk is popular with international markets because of New Zealand's "clean and green" image which is associated with safe food and healthiness (Stanley, 2012). Powdered milk is sold in cans which reinforces the safety and quality of the product. In 2011, NZ Dairy Goat Cooperative was listed in New Zealand's top ten dairy firms with an annual turnover of $118 million (NZD) (Coriolis 2015). Table 2.4 shows the major exported products from New Zealand and the intended international market.

**Table 2.4.** Exported products and their current market value.

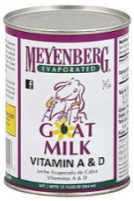
| **Product** | **Description** | **Export amount** | **Destination** | **Value $NZD/kg** |
|---|---|---|---|---|
| Infant Formula | Spray dried goat milk with added vitamins | 4,000 Tonnes | Asia, Australia, Europe. Smaller companies export to Australia and USA | $118.75 |
| Adult Formula | Spray dried goat milk suitable for adults | Unknown | Unknown | $66.70 |
| Milk powder | Spray dried goat milk | Unknown | Unknown | $45.00 |
| Goat milk tablets | Chewable tablets | 16 million tablets | Asia, Taiwan | $20.00/100 x 600mg |

### 2.1.5. Future products and markets

Fresco Nutrition is an Auckland-based company which produces nutritional tablets and powders for export. However, this is also the only NZ company to produce a goat milk formula for the domestic market (Freeman-Rock, 2015). The company plans to builds a $31 million spray drier in the Hawke's Bay which will process goat milk from farmers in the Hawke's Bay and Manawatu regions. Once a “reputable New Zealand brand” is established, the company plan to expand into Asia. Gregg Wycherley, owner of Fresco Nutrition said “We want to be demand-pull, not supply-push”. In addition to Fresco Nutrition, NZ Dairy Products also stated that they too would build an $80 million processing plant in the Hawke’s Bay. Chris Berryman, of NZ Dairy Products said their particular focus is on producing the world’s first ‘Shegora’ (sheep and goat milk blend) infant formula for the Asian market (Freeman-Rock, 2015).

There is a large unoccupied position for goat milk, especially in Asia. Market research carried out by Coriolis in 2014, shows gaps in various dairy sectors that are currently not filled with goat milk products. These sectors include; health, indulgence and convenience. Table 2.5 shows some future products and their potential markets. While some of these products do exist on the market, they are not currently exported from New Zealand.

**Table 2.5.** Future products and target markets.

| **Product** | **Destination** | **Picture** |
|---|---|---|
| Milk Formula | Italy, Taiwan, Vietnam |   |
| Drinking Milk Products | Asia |   |
| Yoghurt | Asia, Japan |   |
| Condensed/Evaporated | Taiwan |   |
| Cheese | Asia |   |
| Butter | South East Asia |   |
| Ice-Cream | South East Asia |   |

## 2.2. Meat

The production of goat meat in New Zealand over the last 10-years has shown an increasing value, as well as increased volumes exported to international markets. The number of goats in Oceania is less than 1% of the total number of goats in the world yet New Zealand is one of the top exporters of goat meat (Aziz, 2010). Major markets for goat meat in 2015 included the United States, North Asia and the Middle East. In 2015, 936 tonnes (72% of the total number of goats processed in New Zealand) were exported for a value of $6.9 million Free on Board (Beef and Lamb New Zealand, 2016b).

The recurring issue in New Zealand is the lack of a significant production base. This causes an inconsistency of product supply. Determining the value of goat meat and potential uses for existing or new markets domestically or internationally will indicate how much the goat is worth based on its composition and product development.

### 2.2.1. Goat meat composition

Goat meat can be considered as a healthy alternative to other red meats. Goat meat is becoming more widely accepted based on the composition of the meat and the health benefits it may provide. According to Anaeto et al. (2010), the molecular structure of goat meat is different to other meats and as a result goat meat is more easily digested. Research shows that goat meat (chevon) regardless of age, breed or region will supply a source of high quality protein along with a healthy fat profile with minimal cholesterol intake risk (Anaeto et al., 2010). A comparison of goat meat with beef and lamb show that goat has higher amounts of calcium and iron (Table 2.6), with the moisture, protein, fat and ash contents similar.

Goats are valuable domestic animals to households in many parts of the world as they produce milk, meat, manure, hide and skin which can be processed into leather goods, blood meal for human and animal feed, and horns, bones and hooves which can also be processed into saleable products (McMillin and Brock, 2005).

Chevon is meat from older goat kids slaughtered when they are 6-9 months old and weighing from 23-24 kg (Oberthur, 2009). The value of goat meat may be increased through production practices or meat processing, by increasing palatable and usable forms, or providing customers with meat at high demand periods. The ability of manufacturers to process goats into products and the capability of the farmers to supply goats consistently influence the availability of products.

**Table 2.6.** Comparative table for meat composition from goat, sheep and cow.

| Component (%) | Goat | Sheep (lamb) | Cow |
|---|---|---|---|
| Moisture | 75.04 | 74.12 | 73.10 |
| Protein | 20.80 | 21.20 | 23.20 |
| Fat | 2.80 | 3.50 | 2.80 |
| Ash | 1.23 | 1.24 | 1.20 |
| Calcium | 1.30 | 0.70 | 0.45 |
| Iron | 2.83 | 0.74 | 0.18 |
| Magnesium | - | 1.90 | 2.50 |
| Potassium | 38.50 | 31.30 | 36.30 |
| Sodium | 8.20 | 70.00 | 5.10 |

### 2.2.2. From farm to consumer

Figure 2.2 shows the general flow of meat from farms to international markets. Most of the goat meat produced in New Zealand comes from feral goats. These goats are sent to meat processors at certain times of the year on pre-organised dates, for processing. The meat is processed according to international market requirements. Usually it is sent as either whole carcasses, primal cuts or retail bagged cubes. This meat for export is shipped to its destination and the in-market processors will further process to consumer requirements. Some importers have also managed to ship live goats for their own breeding overseas.

For domestic markets, producers send animals to a processor with a specialised goat slaughter line and the cuts are predetermined based on sales requirements. The products are then sent to food services and butchers.

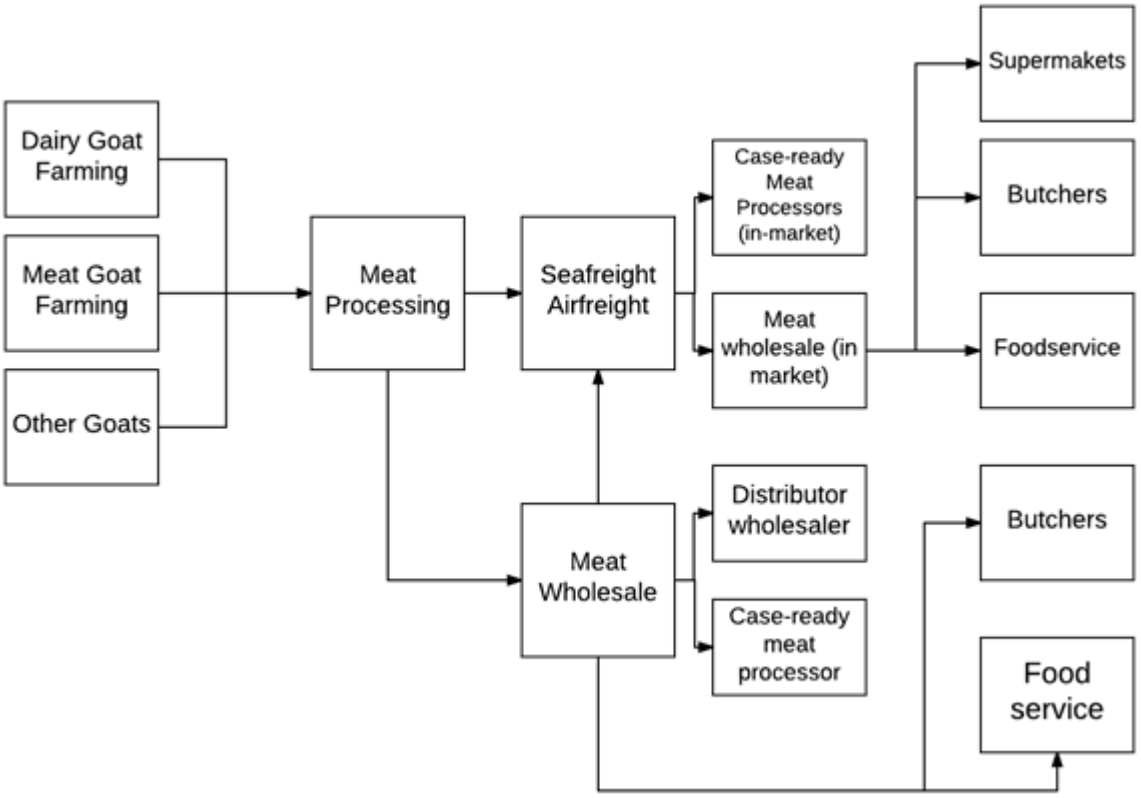



**Figure 2.2.** Diagram of how goat meat will reach domestic and international markets.

### 2.2.3. Current domestic products

Products derived from goat depend entirely on market demand. This results in a wide variety of products. Domestically the products processed in New Zealand mimic those produced for lamb. Table 2.7 shows current goat meat products sold in New Zealand, together with their use and cost per kilogram.

There are other products made from goat that can be bought from small scale farmers and businesses (Table 2.8). However, these products are currently not exported.

Currently most goat meat customers purchase their goat meat in their local communities. As goat meat is not yet a mainstream product, meat can be purchased from local butchers, the farmers themselves, or sometimes ethnic takeaway shops. There is currently no demand for goat pharmaceuticals in New Zealand. Goat organs and blood is instead utilised as fertilizer or pet food. Pharmaceutical companies will be able to process goat organs and blood once demand increases (Agri-lab, personal communication, 2017).

**Table 2.7**. Domestic goat meat products.

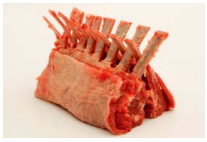
| Product | Picture | Use | Value $NZD/kg |
|---|---|---|---|
| French Rack |  | Roasted | 46.88 |
| Back strap striploins |  | Marinated and slow roasted | 37.50 |
| Rump with cap |  | BBQ, marinated, pan fried | 34.50 |
| Diced Chevon |  | Curry, tagine, kebab | 25.00 |
| Short leg roast |  | Roasted or grilled | 22.50 |
| Chevon leg roast |  | Slow roasted | 19.50 |
| Chevon Mince |  | Burgers, meatballs, meatloaf, ragu | 19.50 |
| Shanks |  | Cooked as lamb shanks | 18.13 |
| Boneless Shoulder |  | Roasted or BBQ | 13.75 |
| Pet food |  | For a variety of pets | 2.50 |

**Table 2.8.** Other goat products.

| Product | Picture | Use | Value $NZD |
|---|---|---|---|
| Horns |  | Decoration | 11-50 each |
| Skins and hides |  | Decoration, clothing, gloves | 110 per hide |
| Tallow |  | Soap, Beauty products | 2.00/kg |

### 2.2.4. Current export products and their value

For the year ending 30 June 2016, total exports of red meat and co-products from New Zealand were worth $7.5 billion, an increase of $200 million (2.7%) compared to 2015. This increase was primarily due to the increased value of both beef and sheep meat exports (MIA annual report, 2016).

Products exported from New Zealand are usually minimally processed. Once the meat arrives to the overseas importer, they will further process the meat based on market demand. Most importers are able to process meat based on customer orders, and they also create products such as sausages. Nearly all the goat can be sold, with trimmings from the processing also sold. Table 2.9 shows an example of current New Zealand exported goat meat and its products, its destination and cost per kilogram.

**Table 2.9.** Exported goat meat products from New Zealand.

| **Product** | **Description** | **Destination** | **Value $NZD/kg** |
|---|---|---|---|
| Overall meat export | Frozen, carcass, specified cuts | USA, Japan, Middle East, Caribbean | 6.92 |
| Live goat (under 23kg) | Bred on site | USA | 7.45 |
| Live goat (23-37kg) | Bred on site | USA | 12.10-8.43 |
| Live goat (over 37kg) | Bred on site | USA | 11.26 |
| Goat blood - pharmaceuticals | Used for proteins. Can be added to food | Turkey, India, China, USA | 73.60 |
| Goat organs - pharmaceutical | Used in pharmaceutical, cosmetic and food industry | Turkey, India, China, USA | Price unknown |
| Goat serum - pharmaceutical | Drugs for humans and animals | Turkey, India, China, USA | 152.74 |
| Goat plasma - pharmaceutical | Proteins in food, fertilizer and functional ingredients | Turkey, India, China, USA | Price unknown |

Table 2.10 shows products processed from New Zealand goat carcasses in international markets in U.S.A, Japan, and the Caribbean.

**Table 2.10**. Processed products from exported New Zealand goat meat.

| Product | Description | Value $NZD/kg |
|---|---|---|
| Goat mince | Processed on site | 45.82 |
| Goat cubes | Burnt skin, retail bagged | 42.61 |
| Goat leg | Bone in, burnt skin | 39.67 |
| Goat leg | Bone in skin off | 39.67 |
| Goat neck | Processed on site | 33.57 |
| Goat carcass | Primal cuts | 30.51 |
| Goat carcass | Skin off | 28.98 |
| Pet food | | 23.98 |
| Goat liver | | 21.34 |
| Goat kidney | | 21.34 |
| Goat tripe | Scalded | 21.34 |
| Goat head | Burnt skin | 18.20 |
| Neck bones | | 16.04 |
| Goat sausage | Processed on site | 22.22/4 sausages |
| Goat heart | | 15.12 |
| Goat feet | Burnt skin | 10.66 |
| Goat bones | | 6.07 |

### 2.2.5. Future products and their markets

Relative to the rest of the red meat sector, goat meat is currently a small market in New Zealand (Meat Export New Zealand, 2014). The main obstacle to growing exports is the limited number of goat farmers and goats. Currently there are 12 companies able to process goat meat. Other meat processing companies must organise a specific date for goats to be processed due to the size of goats and the machines for processing.

There is also the option of adding value to goat meat while it is been processed in New Zealand. Value can be added at many points in the goat meat system of production, distribution, processing and sale (McMillin and Brock, 2005). There is increasing interest in producing meat products that will appeal to existing and new markets.

## 2.3. Fibre

Angora goats are kept primarily for Mohair production. Mohair is made of strong elastic fibres that form a fabric which is easily dyed, and is mainly used in the textile industry. It is especially suitable for apparel, knitwear, curtains, upholstery material, socks, shawls and accessories (Hunter, 1993). Today Mohair is grown in several countries, in mainly arid areas such as the western USA (Texas, Arizona and New Mexico), Lesotho and in small quantities in Australia. Mohair is now grown in Great Britain and is also produced in New Zealand, although this tends to be by enthusiasts, with over 60% of the world supply coming from South Africa (Hunter, 1993).

### 2.3.1. Goat fibre grades

To characterise Mohair quality completely, there are several properties that need to be measured. In the past Mohair was graded subjectively, however today instrumental measurements of these characteristics have replaced the subjective techniques. This modern way of testing yields a high degree of accuracy (Mohair Technical information, 2017). The properties that need to be objectively measured, to characterise greasy Mohair quality completely, include the following:

1. Fibre diameter and its distribution (variability, e.g. CV)
2. Yield (i.e. amount of clean fibre)
3. Staple (or fibre) length and strength, and their variability
4. Vegetable matter content and type
5. Inorganic matter content (e.g. sand, dirt etc.)
6. Colour
7. Lustre
8. Medullation/kemp (objectionable medullated fibres)
9. Style/character

Once the Mohair is graded based on the quality of these properties, the Mohair is sold. After it is sold, processors take the Mohair through the following process shown in Figure 2.3. Once the Mohair is processed it can be sold to manufacturers to be created into products.

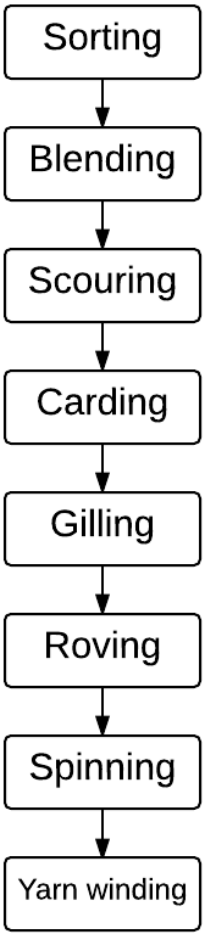



**Figure 2.3**. Processing Mohair.

Mohair is classified as shown in Table 2.11.

**Table 2.11**. Age of goat and diameter of Mohair.

| **Goat** | **Age (months)** | **Diameter of Mohair (µm)** |
|---|---|---|
| First shear kids | 6-12 | 20-29 |
| Young | 18-24 | 27-34 |
| Adults | 24+ | 30-40 |

Mohair obtained from the first two shearing's of goat kids is the finest and most highly valued. As the goat ages, the Mohair becomes coarser. Young goats and adult goats produce about 2-2.5kg of Mohair every 6 months, with bucks producing considerably more and coarser Mohair than does (Mohair Technical Information, 2017).

### 2.3.2. From farm to customer

Goat fibre from New Zealand is sent either to a processor in the north or south island where it is processed and sent to South Africa (see Figure 2.4). In South Africa, the fleeces are graded and auctioned to brokers and buyers, with the fibre then processed or sold raw. The processors will prepare the fleece for its use, such as yarn or fabric for lightweight suits. A small portion of fibre is kept from most farms to sell to local buyers for local manufacturing of yarn and fabric for socks, scarves and other fabrics.

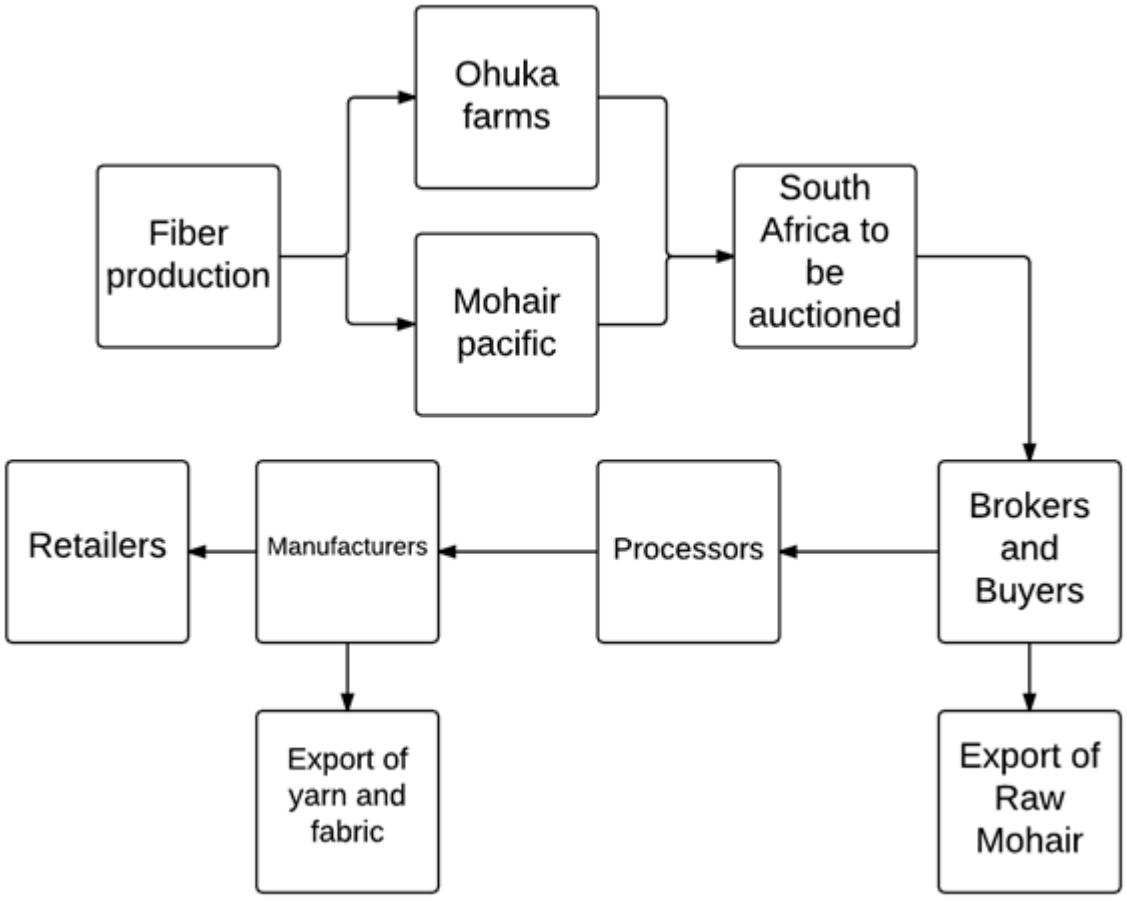



**Figure 2.4**. Diagram of how fibre will reach international markets and intended use.

### 2.3.3. Current domestic products

Currently the domestic market processes and makes fabrics for scarves, blankets and socks utilising 15% of fibre produced. Farmers sell their highest quality fibre for international sale (Mohair Pacific, 2016).

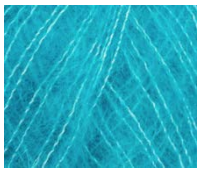
### 2.3.4. Current export products and their markets

Currently, nearly all the Mohair produced by farmers in New Zealand is sent for export (Table 2.12). High quality fibre from first shear kids is highly valued and sent to Japan and Europe for manufacturing into suits and high end textile fabrics (Table 2.13) (J. Freeman, Mohair Pacific, personal communication, 2017). Lower quality fibre is sent for manufacturing into socks and felting.

**Table 2.12.** Overall Mohair fibre export from New Zealand from 2015.

| Product | Amount Exported | Value $NZD/kg |
|---|---|---|
| Overall fibre export | 15 tonnes | 21.34 |

**Table 2.13.** Products made from fibre.

| Product | Picture |
|---|---|
| Knitting yarn |  |
| Lightweight suits |  |
| Fabric for scarves, blankets, socks |  |
| Furnishing fabrics such as upholstery velours |  |

### 2.3.5. Future products

One of the potential options for Mohair production is to run wether flocks. In South Africa a doe flock is run to maintain a large flock of fibre producing wethers. These animals require much less feed than a lactating doe which enables the farmer to run a higher stocking rate of fibre producing goats. Management and labour input are simplified because only a small proportion of the flock kid. The fibre industry in New Zealand is currently developing more weaving grade fibre, as it is an opportunity to increase the export value of fibre. Weaving grade fibre is worth 10% more than the average value of Mohair (Mohair Pacific, 2016).

# 3. The potential of the industry

There is still scope to expand the New Zealand goat industry. The New Zealand dairy goat industry has expanded into most overseas markets, but there are still some parts of Europe and Asia that can be explored as further potential markets. There is high potential for expansion of New Zealand Boer goat meat exports; as evidenced by reports that some New Zealand Boer goat farmers are contacted on a weekly basis by potential overseas buyers with demands for as much as 20 tonnes of Boer meat. Unfortunately, the Boer meat industry doesn't currently have the capacity to supply such export markets. There is a potential market for Mohair fibre that meets the weaving grade criteria of more than 115 mm in length. This grade is worth 10% more than the current average Mohair fibre produced in New Zealand (L. Milne, personal communication, 2017). A model was created to estimate the current population dynamics and production levels for the New Zealand dairy, meat and Mohair goat industries. This model was used to estimate the current value of the New Zealand goat industry and its potential value by 2025, exploring each of the potential scenarios described above. By using this model it is also possible to calculate the land requirements and goat populations that must be attained to achieve these potential situations.

## 3.1. Dairy goat industry

### 3.1.1. The current situation

Currently 80% of New Zealand dairy goat milk is processed by NZDGC. At NZDGC the milk is converted to milk powder and 90% of this is exported. It was assumed that the remaining 20% of milk produced is used to produce cheese, 15% of which is feta, and the remaining 5% is soft cheese (e.g. Brie). Whole milk powder (WMP) is the main export product, while cheese is produced mainly for the domestic market.

The estimated animal population statistics and industry production of milk, dairy products for the domestic and international markets are shown in Table 3.1, 3.2 and 3.3, respectively.

**Table 3.1.** The estimated current level of milk production from the current New Zealand population of 66,100 Saanen dairy goats (see appendix B).

| **Property** | **Value** |
|---|---|
| Lactating does | 66,100 |
| Surplus buck kids | 62,800 |
| Total volume milk produced (kg liquid milk) | 51,100,000 |
| Total fat (kg) | 1,680,000 |
| Total protein (kg) | 1,610,000 |
| Total lactose (kg) | 2,420,000 |
| Total milk solids (kg) | 5,710,000 |
| Average payout ($/kg MS) | 17 |

**Table 3.2.** The volume and value of products produced annually for the domestic market in this situation.

| **Product** | **Volume (kg)** | **Average market value ($/kg)** | **Total market value ($)** |
|---|---|---|---|
| Whole milk powder [a] | 456,000 | 45 | 20,500,000 |
| Feta cheese | 1,230,000 | 40 | 49,100,000 |
| Soft cheese (Brie) | 596,000 | 70 | 41,700,000 |

[a]10% of milk powder produced.

**Table 3.3.** The volume and value of products produced annually for the export market in this situation.

| **Product** | **Volume (kg)** | **Average market value ($/kg)** | **Total market value ($)** |
|---|---|---|---|
| Whole milk powder[a] | 4,110,000 | 45 | 185,000,000 |

[a]90% of milk powder produced.

For the current estimated of dairy goat population, it is estimated that 4,490 ha are required to support the industry. Approximately 4,440 ha are required for feed production, and the

remaining 48 ha are required for goat housing (see appendix G). Based on the total value of milk powder exports $ 41,200 is of gross export receipts is generated per hectare.

### 3.1.2. The potential of the industry by 2025

The majority of New Zealand dairy goat exports are in the form of health products containing milk powder, for which there is scope for expansion. In the three scenarios (outlined in Tables 3.4-3.7), levels of production have been increased and channelled into the milk powder market. The volume of cheese production remains the same.

For scenario 1 (Table 3.4), it was estimated that the land requirements would be approximately 4,540 ha, 48 of which are required for goat housing. This is an increase of about 3.2% due to the increased energy demands of a more productive lactation. Based on the total export value of the whole milk powder, 46,300 NZD gross export receipts is produced per ha (see appendix G). An increase in the average milk production per doe can be achieved by selecting for does with high production levels (Solis-Ramirez, 2014), and using herringbone milk sheds where it is easier to ensure that all does are milked out properly.

**Table 3.4.** Potential scenario 1: The average level of milk production per doe (kg/yr) is increased by 10%.

| Property | Current value | Potential value | Difference |
|---|---|---|---|
| Lactating does | 66,100 | 66,100 | -- |
| Surplus buck kids | 62,800 | 62,800 | -- |
| Volume of milk produced (kg liquid milk) | 51,100,000 | 56,200,000 | +10% |
| Total fat (kg) | 1,680,000 | 1,850,000 | +10% |
| Total protein (kg) | 1,610,000 | 1,770,000 | +10% |
| Total lactose (kg) | 2,420,000 | 2,660,000 | +10% |
| Total milk solids (kg) | 5,710,000 | 6,660,000 | +10% |
| Total WMP[a] (kg) | 4,560,000 | 5,130,000 | +10% |
| Volume of WMP[a] exported (kg) | 4,110,000 | 4,670,000 | +14% |
| Average export value ($/kg) | 45 | 45 | -- |
| Total export value ($) | 185,000,000 | 210,000,000 | +14% |

[a]WMP = Whole milk powder.

In scenario 2 (Table 3.5), the lactating doe population was increased by 30% to increase production of export goat milk products. There is no market for surplus buck kids. In the above scenario the number of surplus buck kids increases by 30%, exacerbating an existing welfare issue. A solution to this problem was explored in the first potential scenario; where the average milk production of each doe is increased by 10%. Another solution could be to introduce Boer sires for late kidding does, and to send all surplus kids to meat finishing farms.

**Table 3.5.** Potential scenario 2: Lactating doe population is increased by 30%.

| **Property** | **Current value** | **Potential value** | **Difference** |
|---|---|---|---|
| Lactating does | 66,100 | 85,900 | +30% |
| Surplus buck kids | 62,800 | 81,600 | **+30%** |
| Volume of milk produced (kg liquid milk) | 51,100,000 | 66,500,000 | +30% |
| Total fat (kg) | 1,680,000 | 2,180,000 | +30% |
| Total protein (kg) | 1,610,000 | 2,090,000 | +30% |
| Total lactose (kg) | 2,420,000 | 3,140,000 | +30% |
| Total milk solids (kg) | 5,710,000 | 7,420,000 | +30% |
| Total WMP[a] (kg) | 4,560,000 | 6,280,000 | +38% |
| Volume of WMP[a] exported (kg) | 4,110,000 | 5,840,000 | +42% |
| Average export value ($/kg) | 45 | 45 | -- |
| Total export value ($) | 185,000,000 | 263,000,000 | +42% |

[a]WMP = Whole milk powder.

The estimated land requirements for a lactating doe population of 85,900 is approximately 5,640 ha, 62 of which are required for housing (see appendix G). Based on the total value of milk powder exports in this scenario, $46,600 of gross export receipts are generated per ha. While the gross export receipts generated per ha is greater in this scenario, the increased land requirements may increase the costs of production and limit the net profit to be made by increasing export production.

Scenario 3 (Table 3.6) shows average milk production remaining at 51,100,000 kg liquid milk, but an increase in fat and protein yields. An increase in the protein and fat yields from the milk produced can be achieved through selectively breeding does with high fat and

protein yields in their milk (Solis-Ramirez, 2014). As the volume of cheese produced is determined by the protein content of the milk; increasing the protein and fat yield per kg of milk has a greater impact on the mass of cheese produced as opposed to the volume of milk powder produced. Consequently, this scenario has a greater impact on domestic products (Table 3.7), than export products (Table 3.6).

**Table 3.6.** Potential scenario 3: The export situation; average milk production (kg liquid milk/doe/yr) remains the same, but the fat and protein % of milk is increased by 10%

| **Property** | **Current value** | **Potential value** | **Difference** |
|---|---|---|---|
| Lactating does | 66,100 | 66,100 | -- |
| Surplus buck kids | 62,800 | 62,800 | -- |
| Volume of milk produced (kg liquid milk) | 51,100,000 | 51,100,000 | -- |
| Total fat (kg) | 1,680,000 | 1,850,000 | +10% |
| Total protein (kg) | 1,610,000 | 1,770,000 | +10% |
| Total lactose (kg) | 2,420,000 | 2,420,000 | -- |
| Total milk solids (kg) | 5,710,000 | 6,030,000 | +10% |
| Total WMP[a] (kg) | 4,560,000 | 4,830,000 | +5.7% |
| Volume of WMP[a] exported (kg) | 4,110,000 | 4,370,000 | +6% |
| Average export value ($/kg) | 45 | 18 | -- |
| Total export value ($) | 185,000,000 | 197,000,000 | +6% |

[a]WMP = Whole milk powder.

**Table 3.7.** Potential scenario 3: The domestic situation; average milk production (kg liquid milk/doe/yr) remains the same, but the fat and protein % of milk is increased by 10%

| Property | Current amount | Potential amount | Difference |
|---|---|---|---|
| Volume of WMP[a] sold domestically (kg) | 456,000 | 458,000 | -- |
| Average market value ($/kg) | 45 | 45 | -- |
| Total market value ($) | 20,500,000 | 20,600,000 | -- |
| Volume of feta cheese produced (kg) | 1,230,000 | 1,350,000 | +10% |
| Average market value ($/kg) | 40 | 40 | -- |
| Total market value ($) | 49,100,000 | 54,000,000 | +10% |
| Volume of soft cheese produced (kg) | 596,000 | 656,000 | +10% |
| Average market value ($/kg) | 70 | 70 | -- |
| Total market value ($) | 41,700,000 | 45,900,000 | +10% |

[a]WMP = Whole milk powder.

For scenario 3, it is estimated that 4,440 ha are required to support the industry, 48 of which are required for housing (see appendix G). Based on the total export value for this situation $44,300 of gross export receipts are generated per ha.

### 3.1.3. The cumulative potential of the industry by 2025

The most likely situation by 2025 is a combination of all three of the scenarios explored above, in an attempt to supply potential export markets.

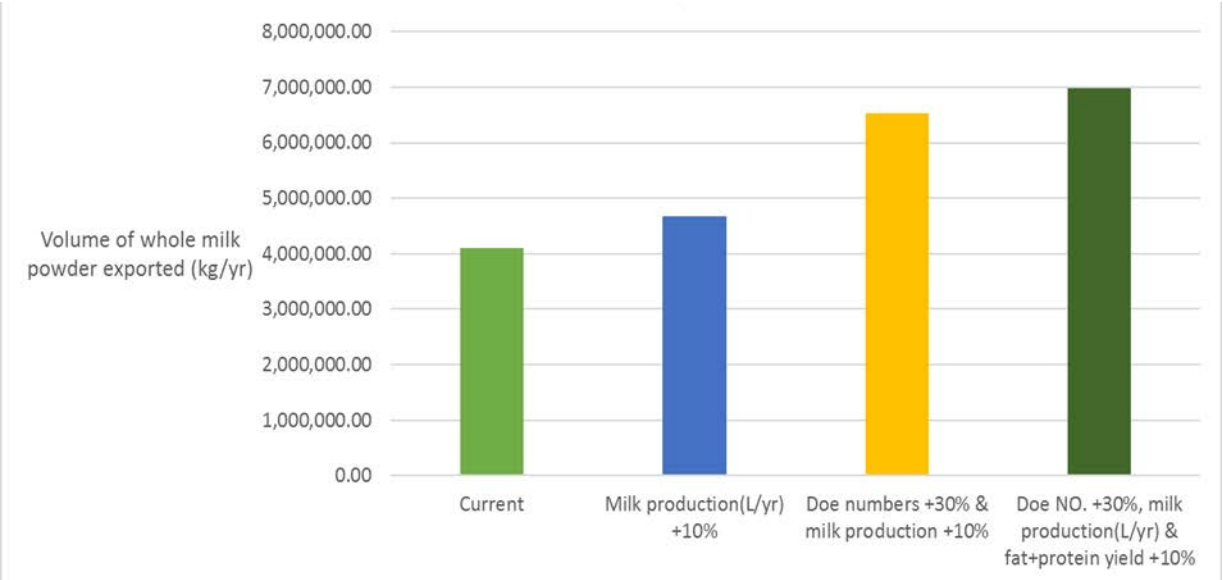



**Figure 3.1.** The potential volume of milk powder produced if all three scenarios were to be carried out by 2025.

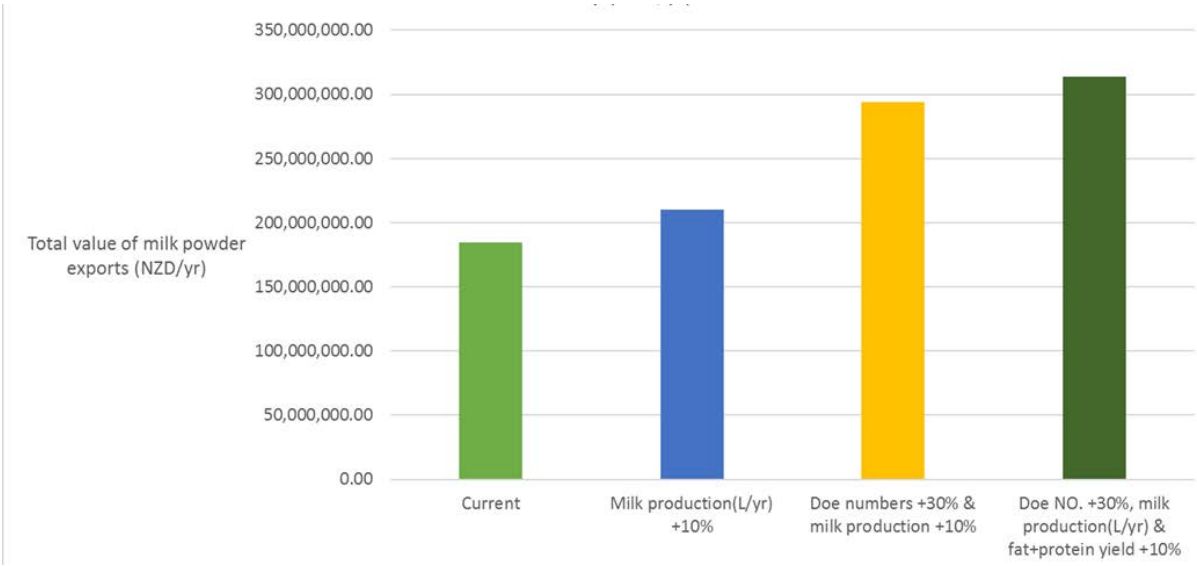



**Figure 3.2.** The potential export value if all three scenarios were to be carried out by 2025.

In the cumulative situation above, it is estimated that 6,100 ha would be required to support the industry, 62 of which are required for housing. Based on the total export value of the cumulative situation $NZ 51,800 can be made per ha, which is the greatest of all four scenarios

*Limitations of the predictions:*

The predictions above are based on the idea of there being an available market for the dairy products, so that even when the supply is increased the average market value for each dairy product still holds. The costs of processing and marketing were unable to be sourced in part 2 of the project. If costs of processing and marketing were available, the net value of each product could be calculated. However, the greater land requirements demonstrated in the above scenarios where production was increased may increase the costs of production and limit the net profit to be made by increasing export production.

## 3.2. Meat Goat industry

### 3.2.1. The current situation

An estimate of the current situation for the meat industry (Table 3.8) was made based on the total graded carcass weight produced according to Statistics New Zealand. It is understood that majority of goat meat produced in New Zealand is derived from feral goats. The percentage contributions from Boer goats, dairy and Angora culls have been based on the estimated current populations of these animals.

**Table 3.8.** An estimate of the current New Zealand goat meat production and value (see appendix C).

| Source | Number slaughtered | Average carcass weight (kg) | Total carcass weight (kg) | Average value ($/kgCW) | Total value ($/yr) |
|---|---|---|---|---|---|
| Feral (60.2%) | 91,200 | 9 | 821,000 | 2.50 | 2,052,000 |
| Boer (11.7%) | 6,380 | 25 | 160,000 | 4.50 | 718,000 |
| Dairy (24.0%) | 8,180 | 40 | 327,000 | 3.00 | 982,000 |
| Angora (4.1%) | 2,240 | 25 | 55,900 | 3.00 | 168,000 |
| Total | 108000 | | 1,400,000 | | 3,920,000 |

*Export situation:*

According to the slaughter data from Statistics NZ; New Zealand exports ~62% of the goat meat that it produces. The estimated value of New Zealand exports demonstrated below (Tables 3.9-3.11), is based on the total graded carcass weight exported according to Statistics NZ. It is understood that currently 90% of New Zealand goat meat exported is sourced from feral goats. While whole carcasses can be sold for ~30 NZD/kg, value can be added by separating the carcass into different cuts (Table 3.11).

**Table 3.9.** The estimated current export situation for New Zealand goat meat (see appendix C).

| Source | Number exported | Total carcass weight (kg) | Average export value (NZD/kg) | Total export value ($) |
|---|---|---|---|---|
| Feral (90%) | 84,600 | 762,000 | 6.93 | 5,280,000 |
| Boer (4%) | 1,350 | 33,800 | 30.00 | 1,020,000 |
| Dairy (5%) | 1,060 | 42,300 | 6.93 | 293,000 |
| Angora (1%) | 338 | 8,460 | 6.93 | 58,600 |
| Total export | 87,400 | 846,000 | | 6,640,000 |

**Table 3.10.** Export value of a Boer carcass broken down.

| Product | Average weight (kg) | Total volume (kg) | Export value (NZD/kg) | Export value (NZD/carcass) | Total value (NZD) |
|---|---|---|---|---|---|
| Whole carcass | 25 | 33,800 | 29 | 725 | 982,000 |
| Carcass-6-way cut | 25 | 33,800 | 30 | 750 | 1,020,000 |

**Table 3.11.** The total value that can be achieved if all of the Boer meat is further processed.

| Product | Fraction of carcass | Average weight (kg) | Total volume (kg) | Export value (NZD/kg) | Export value (NZD/carcass) | Total export value (NZD) |
|---|---|---|---|---|---|---|
| Goat leg +loin | 0.43 | 10.75 | 14,600 | 39.67 | 426.00 | 577,000 |
| Goat cubes (shoulder & ribs) | 0.28 | 7.00 | 9,480 | 42.61 | 298.00 | 404,000 |
| Goat mince | 0.12 | 3.00 | 6,770 | 45.82 | 137.00 | 186,000 |
| Goat neck | 0.09 | 2.25 | 3,050 | 33.57 | 75.50 | 102,000 |
| Total | | 25 | 33,800 | | 940.00 | 1,270,000 |

**Table 3.12.** Value added by processing to products of lower meat quality.

| Source | Product | Average carcass weight (kg) | Average product weight per carcass (kg) | Value (NZD/kg) | Value (NZD/carcass) | Total value (NZD) |
|---|---|---|---|---|---|---|
| Feral | Pet food | 9 | 5.4 | 23.98 | 129.00 | 11,000,000 |
| Dairy | Mince | 40 | 24 | 45.82 | 1,100.00 | 1,160,000 |
| Angora | Mince | 25 | 15 | 45.82 | 687.00 | 233,000 |

New Zealand currently exports carcasses, but as demonstrated in Tables 3.10 and 3.11, further processing can add significant value to meat products we export.

### 3.2.2. The potential of the industry by 2025

It was reported to us that potential export buyers have contacted Boer farmers directly requesting 20 tonnes of New Zealand Boer carcasses. This situation is explored below where the domestic sales of Boer meat remain the same, but the annual production and export volume of Boer meat is increased by 20 tonnes (Tables 3.13 and 3.14).

**Table 3.13.** Estimate of the potential meat production and value with Boer carcass production increased by 20 tonnes.

| Source | Number slaughtered | Average carcass weight (CW) | Total carcass weight (kg) | Average export value ($/kgCW) | Total export value ($/yr) | Difference |
|---|---|---|---|---|---|---|
| Feral (59.3%) | 91,200 | 9 | 820000 | 2.5 | 2,050,000 | -- |
| Boer (14.1%) | 7,200 | 25 | 180,000 | 4.5 | 808,000 | +13% |
| Dairy (23.6%) | 8,180 | 40 | 327,000 | 3.0 | 982,000 | -- |
| Angora (3.2%) | 2,240 | 25 | 44,000 | 3.0 | 134,000 | -- |
| Total | 10900 | | 1,400,000 | | 4,050,000 | +3% |

**Table 3.14.** The potential export situation.

| Source | Number exported | Total carcass weight(kg) | Average export value ($/kg) | Total export value ($) | Difference |
|---|---|---|---|---|---|
| Feral (87.9%) | 84,600 | 761,000 | 6.93 | 5,280,000 | -- |
| Boer (6.2%) | 2,150 | 53,700 | 30.00 | 1,610,000 | +59% |
| Dairy (4.9%) | 1,060 | 42,400 | 6.93 | 294,000 | -- |
| Angora (1%) | 338 | 8,660 | 6.93 | 60,000 | -- |
| Total export | 88,200 | 866,000 | | 7,240,000 | +9% |

**Table 3.15.** The potential total export value if all of the additional 20t of Boer carcasses were further processed into meat cuts.

| Product | Current total volume (kg) | Potential total volume (+20t Boer meat) (kg) | Export value (NZD/car cass) | Current total export value (NZD) | Potential total export value (NZD) | Difference |
|---|---|---|---|---|---|---|
| Goat leg +loin | 14,600 | 23,200 | 426.00 | 577,000 | 919,000 | +59% |
| Goat cubes (shoulder & ribs) | 9,480 | 15,100 | 298.00 | 404,000 | 642,000 | +59% |
| Goat mince | 4,060 | 6,460 | 137.00 | 186,000 | 296,000 | +59% |
| Goat neck | 3,050 | 4,850 | 75.50 | 102,000 | 163,000 | +59% |
| Total | 33,800 | 53,800 | 938 | 1,390,000 | 2,220,000 | +59% |

In order to increase Boer meat exports by 20 tonnes it was estimated that the current Boer goat population would have to be increased by 12.5% (~1,375 Boer goats). Currently abattoirs will only slaughter goats in the off seasons for other meat production animals. This limits the profit to be made from goat meat slaughter as well as the number of animals that can be slaughtered (Sheppard and Donnell, 1979). In order to meet the scale of production simulated in Tables 3.12-3.14, slaughter facilities designed specifically for goats may have to be built. Another potential way to meet market requirements would be to muster and slaughter feral bucks, and introduce Boer bucks to the feral population. This concept is being practiced in Australia and has succeeded in significantly increasing the overall value of their meat industry. This would be a more rapid way to increase the overall export value of our goat meat.

## 3.3. Fibre goat industry

The analysis below describes the estimated current production and value of the New Zealand Mohair industry.

### 3.3.1. The current situation

The estimated current production of Mohair in New Zealand from a population of 9,320 fibre goats is presented in Tables 3.16 and 3.17.

**Table 3.16.** The estimated current production of Mohair in New Zealand from a population of 9,320 fibre goats (see appendix D).

| Fibre grade | Fibre diameter (microns) | Number of goats producing | Average production (kg/goat/year) | Total production (kg) | Value ($/kg) | Total value ($) |
|---|---|---|---|---|---|---|
| First kid shear (6 mnth) | <26 | 2,950 | 1.47 | 4,330 | 29 | 126,000 |
| Kid (1-2.5 yrs) | <30 | 3,210 | 1.97 | 6,320 | 25 | 158,000 |
| Young goat (2.5-4 yrs) | <34 | 2,400 | 5.00 | 12,000 | 20 | 240,000 |
| Adult (4-6 yrs) | 34-36 | 1,410 | 5.50 | 7,740 | 17 | 132,000 |
| Strong adult (6+ yrs) | >36 | 111 | 6.00 | 666 | 15 | 10,000 |
| Total | | | | 31,000 | | 665,000 |

**Table 3.17.** The current export situation.

| Weight exported (kg) | Average export value (NZD/kg) | Total export value (NZD) |
|---|---|---|
| 15,000 | 21.34 | 320,000 |

### 3.3.2. The potential of the industry by 2025

The New Zealand Mohair industry has the potential to produce ‘weaving grade’ fibre. This grade can be attained by importing Australian Angora goats and cross-breeding them with New Zealand Angora goats to yield superior quality and quantity of Mohair. Weaving fibre (over 115mm in length) is worth approximately 10% more than the average New Zealand Mohair fibre (L. Milne, personal communication, 2017). If weaving fibre can be produced by the average New Zealand Angora goat by 2025 then the average export value of New Zealand Mohair has the potential to increase by 10% (Table 3.18).

**Table 3.18.** The potential for New Zealand Mohair if it were to be upgraded to weaving fibre (see appendix D).

| **Fibre grade** | **Fibre diameter (microns)** | **Number of goats producing** | **Average production (kg/goat/year)** | **Total production (kg)** | **Current value ($/kg)** | **Potential value ($/kg) (+10%)** | **Current total value ($)** | **Potential total value ($) (+10%)** |
|---|---|---|---|---|---|---|---|---|
| First kid shear (6 month) | <26 | 2,950 | 1.47 | 4,330 | 29 | 31.9 | 126,000 | 138,000 |
| Kid (1-2.5 yrs) | <30 | 3,210 | 1.97 | 6,320 | 25 | 27.5 | 158,000 | 174,000 |
| Young goat (2.5-4 yrs) | <34 | 2,400 | 5.00 | 12,000 | 20 | 22.0 | 240,000 | 264,000 |
| Adult (4-6 yrs) | 34-36 | 1,410 | 5.50 | 7,740 | 17 | 18.7 | 132,000 | 145,000 |
| Strong adult (6+ yrs) | >36 | 111 | 6.00 | 666 | 15 | 16.5 | 10,000 | 11,000 |
| Total | | | | 31,000 | | | 665,000 | 731,000 |

**Table 3.19.** The potential export situation with the production of weaving fibre.

| Weight exported (kg) | Average export value ($/kg) | Total export value ($) |
|---|---|---|
| 15,000 | 23.50 | 352,000 |

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# Appendix A

Estimation of the population dynamics of the national flock.

The population dynamics of the dairy goat industry have been estimated based on the total flock number of lactating dairy goats. The number of does in each class of lactating animals is based on the fraction of the flock that they make up. The fraction accounted for by each age class was estimated using Leslie matrix (Leslie, 1945); a calculation based on a combined average culling and death rate of 15%; a number that was derived from farmer reports. The fraction accounted for by each age class can then be multiplied by the total number of lactating does in the flock to yield an estimate of the number of does in each age class of the New Zealand flock. The oldest age class was set at 10 years of age (YOA), this is based on the thesis; *A genetic improvement programme for New Zealand Dairy Goats, Jose Solis-Ramirez 2014*. It was assumed that all cull animals in the dairy industry contribute to the meat industry.

The number of replacement kids required is calculated by dividing the number of does required in the youngest class of lactating does by the average survival rate replacements. The average survival rate of the replacements was assumed to be 90%. The average kidding percentage and proportion of does in kid sourced from dairy goat farmers are 200% and 95% respectively. These values have been multiplied out by the number of lactating does in each class to estimate the number of kids produced each year. It was assumed that 50% of kids produced will be buck and the rest doe kids. The number of surplus kids was calculated by subtract number of doe and sire replacements from the number of doe and buck kids produced, respectively.

Based on a doe to buck ratio of 40 to 1, the total number of servicing bucks required for a lactating doe population of 63,300 was estimated to be 1,583 bucks. It is understood that bucks are kept on farm till they reach 4 YOA. After this point bucks become too large to mate with the does, and they are culled. The fraction of bucks in each age class was calculated as it was for the does, using the same combined survival-cull rate of 15%.

The number of Boer goats servicing the meat industry was estimated to be approximately 11,000 Boer goats. This assumption is based on Boer farmer reports that while there are around 4000 registered Boer goats, there are approximately 6000-8000 unregistered Boer goats in New Zealand. Derived

from the population statistics provided by Boer farmers it was estimated that 33% is accounted for by kidding Boer does (~3600 does). Based on the recommended ratio of 50 does to 1 buck (Meat and Wool New Zealand, 2008), the number of servicing bucks was calculated as 90 (~1% of the Boer flock). The remaining 66% is accounted for by Boer kids, calculated as for the dairy kid numbers. The kidding % and proportion of does in kid was assumed to be 200% and 95% respectively. The proportion of does in each age class of Boer goats was calculated as for the does in the dairy goat industry, with an assumed combined culling and death rate of 15%. The kids that are not required as replacements become the numbers that are slaughtered for chevon meat production at 8 months of age (Barkley et al., 2012). It is assumed that all cull does are slaughtered for meat production as well.

The current number of Angora goats in New Zealand was identified as 9,320 goats. It was estimated that 30% of these goats are kidding does. This is based on population statistics supplied by Angora famers. The number of Angora bucks was estimated as 93 (1%), from a doe to buck ratio of 30 to 1, and wethers account for 20% of the Angora goat population. The remaining goats are accounted for by kids. The kidding % for each age class of doe was provided by Angora farmers, and they range between 100% and 200%. It was assumed that they are representative of the New Zealand Angora flock. The proportion of does in kid was based on the cull rates provided by Angora farmers, and also is specific to each age class, ranging between 70% and 86%. The number of kids produced per year and the proportion does in each age class have been calculated as for the dairy and Boer meat industries. It was assumed that all kids are kept as replacements or for fibre production; with the bucks that aren't required for servicing castrated to wethers for fibre production. This assumption is based on the population statistics provided to us by Angora farmers. Bucks are kept on farm for up to 5 years. It was assumed that bucks and wethers have the same cull rate as does, as the cull rates provided to us were for a mixed population of does, wethers and bucks. It was assumed that up to 3 YOA 80% of doe culls are redistributed to other farms, and the remainder contribute to the meat industry. After 3 YOA 100% of doe culls contribute to the meat industry.

## Appendix B

Estimation of the current production and value of the New Zealand dairy goat industry.

Data values for average annual production for each age class of liquid milk (kg) per doe, as well as volumes of milk constituents; protein (kg) and fat (kg), have been sourced from; Jose Solis-Ramirez 2014. These average parameters have been multiplied by the number of animals in each class to calculate an estimate of the annual milk products produced per class. The annual class production values are summed together, resulting in an estimation of the total milk production and milk constituents produced by the New Zealand dairy goat flock.

New Zealand Dairy Goat Co-operative (DGC) receives 80% of goat milk produced by the national flock and converts it to milk powder. An estimation of the total milk powder produced by the national flock was made by multiplying the volume of milk solids produced (protein, fat and lactose) by 0.8. It is assumed that the remaining 20% of goat milk produced gets converted into cheese for domestic markets; 5% towards soft cheese and 15% towards feta cheese. Based on this assumption the total milk solids available to produce soft and feta cheese have been multiplied by 5% and 15% respectively.

The total protein in milk is composed of two main types of protein; casein and whey protein. The volume of cheese produced is determined by the protein content of the milk, particularly the casein content. The casein percentage of total protein in goat milk is ~85%. The whey protein in the milk is proportional to the liquid fraction of the milk. A ratio of whey to liquid in milk was calculated by dividing the whey fraction of milk by the moisture content of the milk (0.0043/87.72). The whey ratio was then been multiplied by the moisture content of the cheese to yield the whey fraction of cheese. The whey fraction of cheese was then been subtracted from the total protein fraction of cheese to yield the casein fraction of the cheese. The volume of cheese produced was calculated by dividing the volume of milk casein available, by the casein fraction of the cheese. This was done for the average soft cheese and feta cheese compositions.

The export market value of whole milk powder is $45 /kg. This value was multiplied by the total export volume of milk powder to calculate the total value. The market value of Feta and soft cheese; $60/kg (Progressive enterprises, 2017), and $70/kg respectively (Maison Vauron, 2017), was used to

estimate the total value of cheese produced. The costs of processing and sales for cheese products were unavailable to us for calculation of the net value of cheese.

## Appendix C

Estimation of the current production of the New Zealand goat meat industry.

The estimation for total goat meat production in New Zealand was based on the slaughter data from Statistics NZ. For each meat source (feral, Boer, dairy cull and Angora cull) the total graded carcass weight (1,363,547 kg (Statistics New Zealand, 2017)) was multiplied by a fraction to yield the total carcass weight accounted for by each meat source. The total carcass weight for each meat source was then divided by the average carcass weight for each meat source, to provide the number of goats slaughtered. The number of goats sent for processing from the dairy, fibre and Boer meat industries was estimated based on the population dynamics calculation (see appendix A). The fraction used to estimate the meat volume accounted for by each meat source was calculated to yield the number of goats sent for processing that was estimated by the population dynamics calculation. This calculation has estimated that of the annual graded goat carcass weight produced by New Zealand 11.7% is accounted for by Boer goat slaughters, 24% from dairy goat culls, 4.1% from Angora goat culls, and the remaining 60.2% from feral goat musters.

Feral carcasses account for 90% of New Zealand exports. The remaining 10% was accounted for by Boer, dairy and Angora carcasses. The estimated exports of Boer, dairy and Angora carcasses have been calculated by attributing a fraction of the 10% based on the ratio in which they are supplied; 4% Boer, 5% dairy cull and 1% Angora cull.

The volume of meat cuts that can be produced from a Boer goat was estimated by multiplying the fraction of the carcass that contributes to each cut of meat by the total carcass weight. The leg accounts for ~30% of the total carcass weight and the loin accounts for around 13% (McGregor, 2000). The leg and loin are exported as a joint cut which together make up ~43% of the carcass. Goat cubes are derived from the shoulder and ribs, which accounts for ~28% of the carcass weight (McGregor, 2000). The goat neck accounts for ~9% of the carcass weight (McGregor, 2000). It is assumed that the remaining ~20% of carcass weight is converted to mince. This was achieved by multiplying 20% of the carcass weight by 60%, as 60% of a goat carcass is boneless meat (McGregor, 2000). The volume of each of these products produced from a Boer carcass was multiplied by the total number of Boer carcasses exported, to obtain an estimate the total volume of each product which can

be produced. For the poorer quality meat sources, it was assumed that all feral goats would be processed to pet food, and all dairy and Angora culls would be processed to mince. The total volume of these products produced was calculated by multiplying the total carcass weight by the proportion that is boneless meat (60%).

The value that a famer receives ($/kg CW) was multiplied by the total CW produced for each type of carcass (feral, Boer, Angora and dairy cull) to estimate the overall value of the carcases produced. The export value was calculated by multiplying the average export value for each carcass type ($/kgCW) by the total carcass weight exported for each carcass type. The average export value for feral, dairy and Angora culls is $6.90/kg CW, while the average export value of a Boer carcass is $30/kg CW.

## Appendix D

Estimation of the current and potential production and value of the New Zealand Mohair industry

An estimate of the annual production of each Mohair fibre class was calculated by multiplying the average annual production of each fibre class (kg/goat) by the number of goats in the classes attributed to each Mohair class (Mohair Pacific, 2017):

| Fibre class | Microns | Age class of Goat (yr) | Number of goats | Average volume produced (kg/goat/yr) | Total volume produced (kg/yr) |
|---|---|---|---|---|---|
| SFK (superfine kid) | <26 | all kids: 0.5 | 4913 | 1.47 | 4,913 |
| Kid | <30 | does:1-2 bucks & wethers:1-3 | 6651 | 1.97 | 13,102 |
| Young goat | <34 | does: 2-4 bucks & wethers: 3-4 | 4352 | 5 | 21,759 |
| Adult | 34-36 | all goats: 4+ | 2762 | 5.5 | 15,192 |
| Strong adult | >36 | all goats: 6+ | 218 | 6 | 1,311 |
| Total | | | | | 58,587 |

Bucks and wethers produce finer fibre classes for longer, as they do not have to make physiological adjustments that kidding does must do from 2 YOA. The total fibre production was calculated as 58,587 kg/yr. To estimate the total value of the industry, the average payout a farmer receives for each fibre class ($/kg) was multiplied by the total volume of each fibre class produced (kg). In the potential situation where weaving fibre is being produced, the average value of each fibre class ($/kg) was increased by 10%.

## Appendix E

Estimation of the potential value of the New Zealand dairy goat industry in 2025.

For scenario one the total volume of liquid milk produced (kg/yr), as well as the total volume milk fat, protein and lactose was multiplied by 110%. The entire extra volume of fat, protein and lactose from this calculation was fed into the whole milk powder calculation (see appendix B) to calculate the total volume of milk powder produced.

In scenario two the number of lactating does was increased by 30% and the model calculates the total volume of milk (kg), milk fat (kg), protein (kg) and lactose (kg) produced per year based on population dynamics and average heard production levels (see appendix A & B). The extra volume of milk fat (kg), protein (kg) and lactose (kg) produced was fed into the milk powder calculation to estimate the total volume of milk powder produced.

In scenario three the total milk protein (kg) and fat (kg) yields have been multiplied by 110%. The extra protein (kg) and fat (kg) was fed into both the cheese and milk powder calculations. All three scenarios have been multiplied by one another to obtain the values presented in the bar chart.

It was assumed that the average export and market values ($/kg product) are the same as for the current situation. The total potential value of the industry was calculated in each situation by multiplying the average value of each product by the volume of product produced.

## Appendix F

Estimation of the potential value of the New Zealand meat goat industry by 2025.

In this situation 20 tonnes was added to the current estimate of total Boer carcass weight (CW) produced (159,525 kg), all of which was added to the total Boer CW exported (33,845 kg). The total CW produced by the feral, Angora and dairy cull goats remains the same. The potential total CW of Boer goats was divided by the average CW (25 kg) to estimate the total number of Boer goats that must be slaughtered to produce 179,525 kgCW (~7181 goats). The population % increase required to achieve this number of slaughtered goats is as follows:

$$= \left(\frac{7181 - 6381}{6381}\right) \times 100 = 12.5\%$$

By this calculation the current estimated Boer flock must increase by 1,380 Boer goats, in order to produce an additional 20 t of Boer CW.

It was assumed that the average value of a Boer goat carcass and the products that can be made from it are still the same. The potential industry value was calculated as for the current industry value, but with the increased production numbers.

## Appendix G

Estimation of the land requirements for the New Zealand goat industry.

The estimate of the total land requirements for the dairy industry is primarily based on the energy requirements of the total number of goats that make up the national dairy goat flock. From calculating the energy requirements, it is possible to estimate the feed requirements, and therefore land requirements of the dairy goat industry. The goats are housed separately to the feed supply, so an additional 6 $m^2$ per goat (0.0006 ha) was allowed for housing.

The energy requirements for a given class of animal were calculated based on energy needs for maintenance activities, growth and lactation. These values have been calculated using equations from (AFRC, Agriculture and Food Research Council, 1993), and are in the units MJ/goat/year. The metabolic energy demands of each of these activities were then summed to give the average metabolic energy requirements for a goat in a given class. This value was then multiplied by the number of animals within that class to acquire the annual ME requirements for that class. The total class ME values were then be summed to yield the total flock ME requirements.

Maintenance energy requirements are based on the live weight of an individual. The live weight of a given individual were calculated using the equation below:

$$W(t)=W(1-0.959e^{-0.00254t})$$

Where W(t) is the weight of an animal at time (t), W is the end weight, and t is the age of the animal in days. The entry live weight of an animal of a particular class is then used to estimate its ME requirements using the equations below for maintenance and growth.

$$ME_M = \frac{0.315LW^{0.75} + 0.024LW}{K_m}$$

$$ME_{LWG} = \frac{\Delta LW(4.927 + 0.3274LW_t)}{K_f}$$

Where LW is the live weight of a given animal, and $K_m$ and $K_f$ account for the efficiency of the energy conversion for maintenance and growth activities respectively. ΔLW is the live weight gain over the time period for which the energy calculation was made. This was equal to a year for goats older than 3 years of age, but is measured daily for goats younger than this. From this age additional

physiological states have been accounted for such as lactation. Energy demands of lactation in dairy goats were estimated using equations that take into account the milk composition and annual production levels, demonstrated below.

$$E_l = 0.034(FY) + 0.00223(PY) + 0.0199(LY) - 0.108$$

$$ME_l = \frac{MY \times E_l}{K_l}$$

Where MY is the annual milk yield and $E_l$ is the energy of lactation; a parameter which is dependent on the protein, fat and lactose yield of the milk for an individual (g/kg milk). This estimation was made specifically for each class of goat, as the milk composition and volume produced varies between classes.

As the growth rate of kids during the first 3 years of life is rapid, a separate 'kid analysis' for energy requirements was made below the model. This calculated the energy requirements per day, per kid and summed them at the end of every 365-day block to yield a more accurate estimation of the annual ME requirements.

Based on the information collected regarding the feeding regimes from the farm surveys, and the ME requirement calculations as described above, the dry matter requirements and subsequently the land requirements for the dairy industry can be estimated. Approximately 20% of the diet is accounted for by maize, which has an ME value of 13.5 MJ ME/kg DM (Dairy NZ, na), the remaining 80% is accounted for by baleage, which has an ME value of 10 MJ ME/kg DM (Dairy NZ, na). This results in an average dietary ME value of 10.7 MJ ME/kg DM. The total herd energy requirements are then divided by the average dietary ME value to yield an estimate of the total dry matter requirements of the herd. The land requirements are then calculated by dividing the total dry matter requirements by the average dry matter produced per ha (14000 kg DM/yr).