



A Review of Current Information Seasonality of the US Lamb Industry

Executive Summary

Seasonality of lamb production is an issue that causes inefficiencies and market volatility in the US lamb industry. Each sector of the industry should consider management alterations to better supply a more consistently available product. This white paper pulls together information on the topic so that members of the industry can understand it in more depth and make informed decisions.

An estimated 80% of the US lamb crop is born in the first five months of the calendar year. Sheep are seasonal breeders and fertility is highest from September through December, resulting in late winter and spring born lambs. The combination of seasonal constraints on reproduction and a lower availability of inexpensive feed resources means it is relatively uncommon for lambs to be born other times of the year in the US. There are, however, a relatively small number of flocks that do specialize in either fall or year-round production and have evolved the genetic background, as well as both reproductive and nutritional management of their flocks, to be able to do this efficiently.

The lamb packing industry prefers a supply of year-round lamb to serve its clientele. To understand when shortages of lamb occur, it is essential to know the general markets for lamb. The US lamb industry can be categorized into two sectors: traditional and nontraditional markets.

The traditional market prefers a larger and fatter lamb that weighs 120 to 160 lbs. live weight, which most commonly takes 8 to 14 months from birth to harvest. Therefore, supply of most late winter and spring born lambs to the traditional market occurs during the months of November through June. Most traditionally marketed lambs are fed in a feedlot prior to slaughter. In the spring, inventory of harvest-ready lambs often outpaces the rate of lamb harvest; therefore, lambs gain extra weight in the feedlot resulting in larger carcasses. Large, overly-fat lamb carcasses are common during the months of April through July. Volatility in carcass size makes it challenging to supply a fresh, consistent product to the consumer.

Generally, traditional lamb prices are seasonally stronger from July to October, providing some incentive for producers to market in this time frame.

The two most common methods to produce traditional lambs during this timeframe are:

- **Lamb some or all of the ewe flock** in the fall or early winter and maintain lambs on a moderate rate of gain; or
- **Lamb ewes in the late winter**, early wean lambs and feed lambs for a fast rate of gain.

Texas and California are large lamb producing states that have environmental conditions favorable to fall and winter lambing operations. At least half of Texas sheep producers have transitioned to hair sheep breeds that supply lamb primarily to the nontraditional market. Midwestern operations are the primary source of late winter born lambs that reach market weight by late summer. The Intermountain West represents the largest portion of the US lamb production. Due to environmental conditions, nearly all producers in this region lamb in the spring, wean in the fall and supply finished lambs in the winter or spring.

Sales volume of retail lamb is steady year-round, with the exception of two spikes in volume prior to Christmas and Easter holidays. This increase in sales volume is primarily for legs and racks. In some cases, cold storage allows processors to stockpile these (and other) cuts prior to holiday demand. But many buyers are accustomed to fresh, never frozen, products from other meat sectors and require this of lamb as well.

The nontraditional lamb market generally prefers lighter and leaner lambs than the traditional market. The highest volume of lambs entering the nontraditional market are 50 to 90 lbs. of live weight and generally 3 to 7 months old at harvest. Therefore, the supply of most winter and spring born lambs to the nontraditional market occurs during the months of April through October. There are premiums paid for nontraditional lambs during both peak demand periods often associated with religious holidays, as well as when supply is low during the December to March period.

Introduction

In the US, most lambs are born during the first five months of the year. Yet, commercial lamb harvest remains somewhat constant throughout the year (USDA, ERS), except for minor shifts in slaughter rate prior to months with higher lamb sales. As a result, there are periods throughout the year when the supply of lamb is inconsistent. Inconsistent supply creates industry issues: market price volatility, supply of market ready lambs, and irregular supply of carcass size and/or quality.

The primary goal of this white paper is to provide information on the current situation of seasonality of lamb supply so that members of the industry can make informed decisions. This will include:

- Factors that affect seasonal supply of US and imported lamb
- Demand for lamb by season for both traditional and nontraditional markets
- Factors that influence seasonal supply of lamb from the farm/ranch gate
- Opportunities to alter the seasonal supply of US lamb
- Case studies of producers who have shifted their season of production to meet a shortage of lamb.

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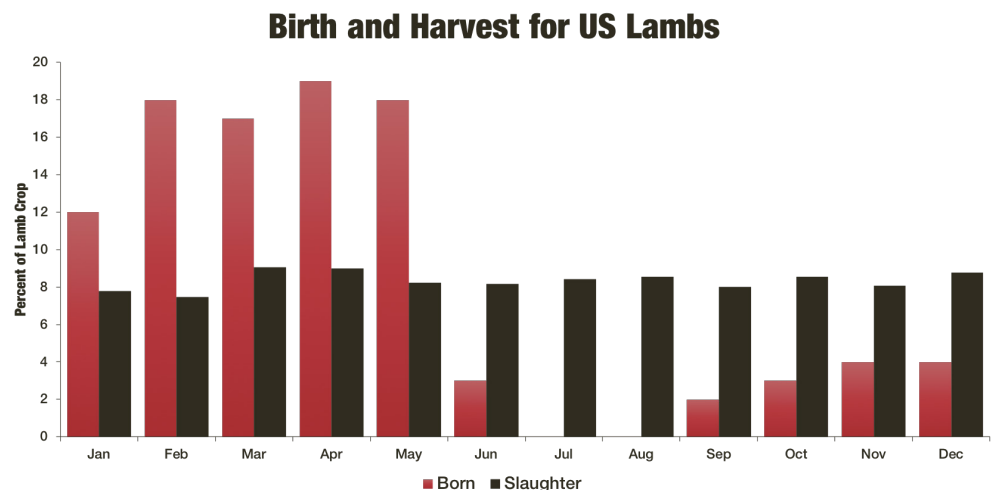
Seasonality of Lamb Supply: Domestic Production

The majority (~85%) of lambs in the US are born from January through May (USDA APHIS, Sheep 2011). This is due to three primary reasons.

- **First, sheep are seasonal breeders.** They are most fertile in the fall, so they lamb in the spring.
- **Second, most sheep farms/ranches have access to more abundant feed resources in the spring and/or summer.** Therefore, they time lambing to match the availability of cheap and abundant feed resources.
- **Third, many operations lamb at a certain time of year to avoid harsh weather that impacts lamb performance.** Northern producers avoid lambing in the winter to prevent neonatal lamb loss from hypothermia. Whereas, Southern operations may lamb in the winter to avoid the effects of summer heat stress and parasitism on lamb production.

Most lambs are harvested at 6 to 12 months of age. In a perfect world, the range in harvest date could be used to spread out the lamb supply throughout the year. For instance, if most all winter born lambs were managed to reach market weight at 6 to 8 months of age and most spring born lambs were managed to reach market weight at 10 to 12 months of age, domestic lamb supply would be fairly consistent. However, coordinating 80,000 farms and ranches, who all have unique management systems, to produce a specific product at a specific time of year is a daunting task and may not be the most cost effective means of producing lamb.

The US lamb market can be classified into two major



Source: USDA APHIS & NASS

categories: traditional and nontraditional. In both markets the end consumers are typically located in major metropolitan markets. The traditional market prefers a 120 to 160 lb. live weight lamb. Most of these lambs are sold off the ranch as feeder lambs and sent to a feeding facility for 50 to 150 days. The lambs are harvested at a large commercial slaughter plant and sold to retail or foodservice outlets as primal or further-processed cuts. The nontraditional market prefers a 50 to 100 lb. live weight lamb. Most of these lambs are sold off the farm or ranch as slaughter lambs.

Traditional Supply

The supply of traditional lambs tends to come from the larger sheep operations that can supply semi-loads of lambs to ship from ranch to feedlot, or ranch direct to harvesting plant. These farmers/ranchers tend to run larger-framed breeds of sheep and to be located in the Western part of the US, specifically the Southwest, Midwest, West and Intermountain West.

The largest segment of the US sheep industry, 30% to 40% of the national flock, is based in the Intermountain West. These are large sheep operations (1,000 head or more) that have white-faced ewe flocks of fine wool origin. Due to the harsh winter and public land grazing permits, the majority of flocks lamb ewes in the spring of the year and wean in the late summer or fall. These lambs go to feeding facilities and are ready for market in the late fall, winter and spring. Some lambs will be placed on pasture in areas such as the Imperial Valley of California for backgrounding prior to movement to a feedlot.

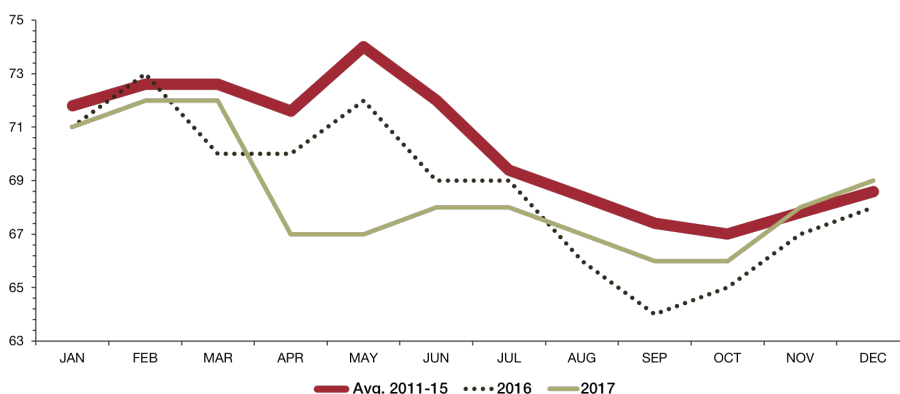
If surplus lambs in the feedlot during winter and spring cannot be harvested on time, they will remain in the feedlot until supplies diminish. These lambs are harvested at much heavier weights (85+ lb. carcass) than ideal for their frame size. Notice in the figure below that the average carcass weight increases as the bulk of Western lambs reach slaughter. These overly-finished lambs have a lot of extra fat that needs to be trimmed (at a cost to the producer, packer and consumer) and there are concerns that eating quality is diminished. Another concern is the variability in carcass weight of lambs harvested by month, as noted in the figure on the next page. This provides challenges for the packers to market a consistent product based on season of the year.

The traditional industry utilizes feedlots to manage supply of slaughter lambs throughout a given year. Feedlots can help to reduce the variability in slaughter lamb numbers by accelerating or decelerating the marketing of lambs, often in response to market supply and demand conditions as well as feed costs. Feedlots allow lambs born in regions that lack adequate resources to finish lambs solely on forages to be taken to market-ready weights. Sometimes, feedlots are used to mitigate issues created by drought conditions. At times,

lambs are kept on feed past the point where they are market-ready. As noted earlier, this can result in a backlog of slaughter lamb supplies or old crop, overly finished lambs, which tends to have a negative impact on the industry.

Due to mild winter conditions, Texas ranchers have the option to lamb on pasture in the fall, winter and spring. Historically, Texas provided a supply of feeder lambs from late spring to late fall. The spring feeder lambs would fit a void of market ready lambs in the summer and fall for the

Monthly Average Dressed Weight of US Sheep and Lambs

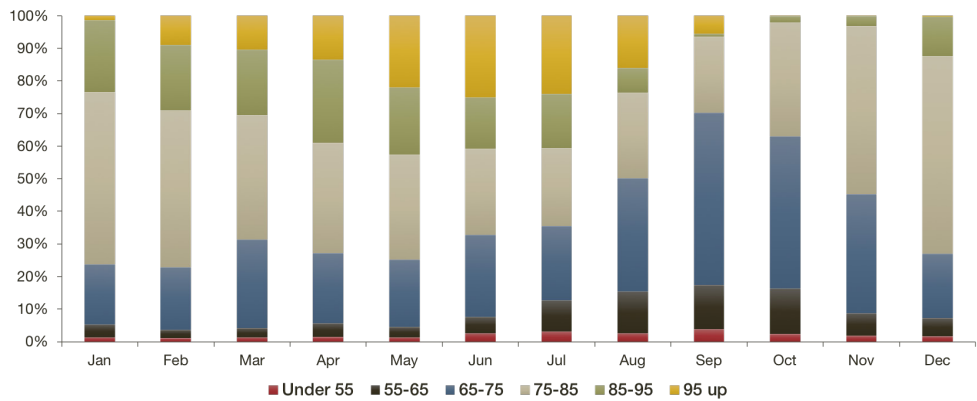


Source: USDA NASS



traditional market. However, in the past decade, approximately half of the sheep industry in Texas has shifted to raising hair sheep breeds instead of fine wool sheep breeds. In general, hair breeds produce smaller carcasses than breeds of fine wool origin, making them a better fit for the nontraditional market. This has transitioned Texas lambs from being sold as feeder lambs directed to the traditional industry to light weight slaughter lambs directed to the nontraditional industry. The reason for this transition is twofold.

Percent Lamb Carcasses within Weight Category



Source: USDA APHIS & NASS

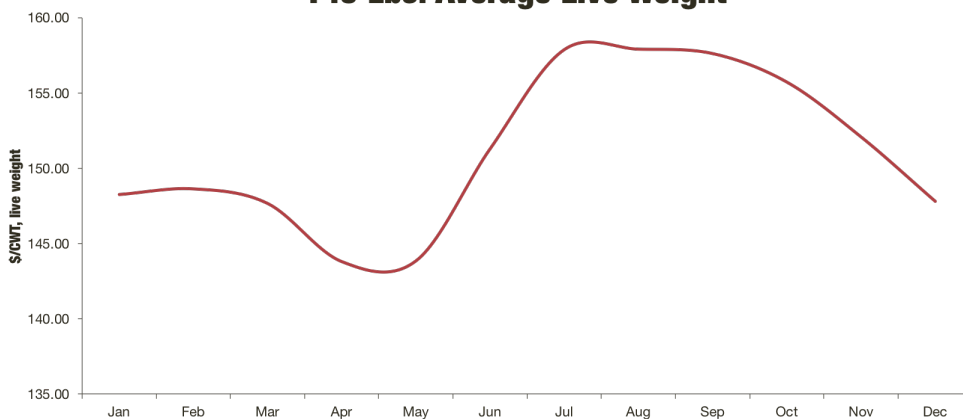
- First, Texas has the largest population of meat goats** and the nontraditional market demands goat meat and lamb. Therefore, it is a good location for nontraditional buyers to be able to source both.
- Second, Texas has transitioned to hair sheep breeds** because hair sheep tend to require lower management inputs than wool sheep in extensive range conditions.

The majority of California commercial sheep production implements an out-of-season production system that compliments both crop production of California in terms of crop residue use, and the rain season, or green grass period, of California. The typical green grass period of California starts in late December and ends in early May. The majority of the commercial sheep production is located in the San Joaquin Valley where producers will breed their ewes starting in late April to early May so they start to lamb in late September and early October. Similar to Texas, many producers are able to manage lamb supplies on pasture and/or crop residues during the fall, winter and spring. The opportunity for expansion of out of season production in the San Joaquin Valley is limited due to competing forces for land use given the extremely high value of this land.

The figure below illustrates the impact monthly supply of lamb has on the slaughter prices of traditional lambs.

The remainder of the traditional supply comes from the Midwestern states, where there is a variety of different management systems,

Traditional Slaughter Lamb Market 2014-2017
145 Lbs. Average Live Weight



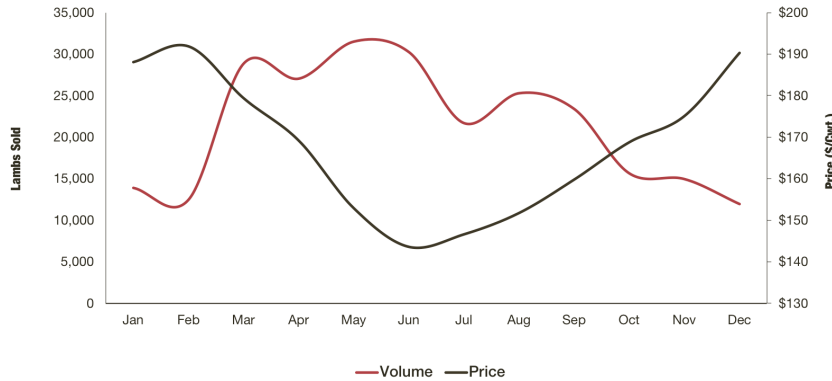
Source: LMIC

lambing periods, and types of sheep. Most operations feed lambs a high energy diet to reach market weight at 7 to 10 months of age. In the upper Midwest, most commercial operations lamb in the winter using indoor lambing barns. These lambs will be market ready in summer and early fall. However, the volume of lambs produced in these states is not as large as the aforementioned flocks, but the potential for expansion of this supply is greater.

► Nontraditional Supply

This segment of the industry has been growing over the last decade. The supply of nontraditional lambs tends to come from the smaller sheep operations that sell direct to the consumer or to auction barns that have buyers representing the nontraditional market. These farmers/ranchers tend to run smaller-framed wool and hair breeds of sheep and tend to be located in the Eastern and Southern part of the US, but there are nontraditional suppliers spread across all parts of the US.

**Nontraditional Lamb Slaughter 2010-2016 by Price and Volume
68 Lb. Average Live Weight**



Source: Texas A&M AgriLife Research and Extension and Producers Livestock Auction, San Angelo, TX

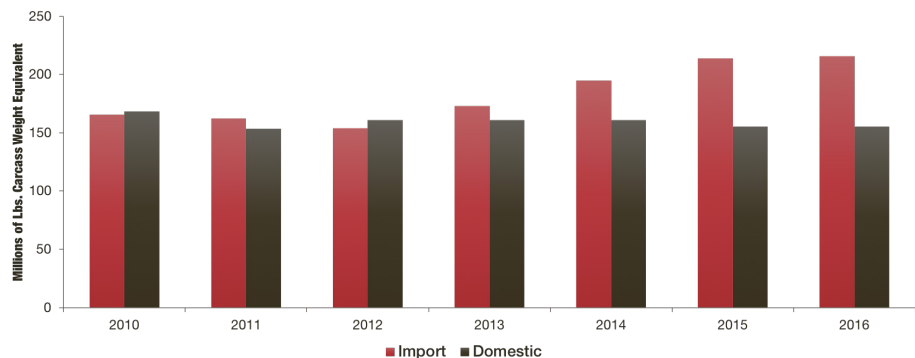
In general, nontraditional suppliers of lamb are marketing a smaller, younger and leaner lamb. As such, there is less flexibility to spreading out the supply than with traditional suppliers. Similar to the traditional lamb suppliers, most of the lambs are born in the winter and spring months, although there are a growing number of larger suppliers that are lambing throughout the year. In contrast to traditional lamb suppliers, the largest supplies of market ready lambs are in the spring and summer. And the shortest supply is in the fall and winter. This has a noted impact on the market price of lambs as can be seen in the figure to the left.

In summary, we have two different markets for lamb in the US. Both markets are affected by an inconsistent seasonal supply of lamb. However, the shortages of lamb are at two completely different times of the year.

► Seasonality of Lamb Supply Imports

US imports of lamb meat have increased significantly over the last two decades. Currently, imports account for more than one-half the total annual supply of lamb meat in the US. Imports, for the most part, serve as a substitute to US domestic lamb supplies. Two countries, Australia and New Zealand, supply nearly all (99.5%) of US lamb imports. Australia accounts for approximately 70% of annual imports, with New Zealand accounting for the balance.

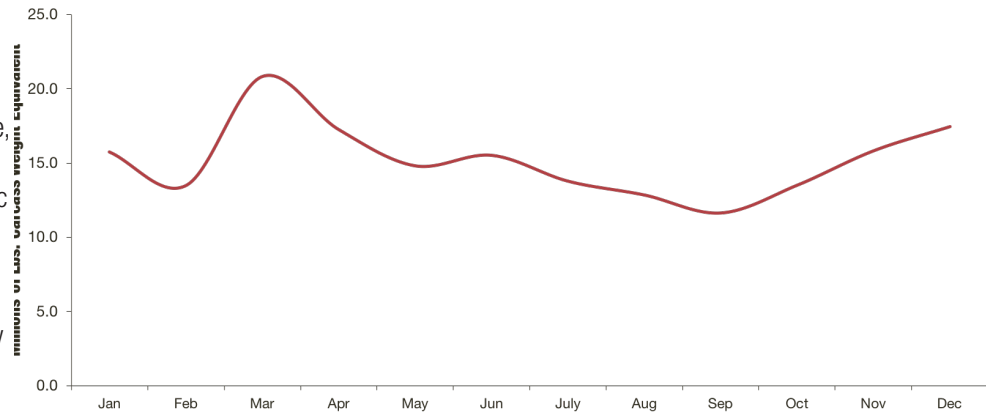
Domestic and Imported Lamb Supply



Source: USDA ERS

Imports are influenced by a variety of factors including domestic supply, market demand and prices, exchange rates, Australian/New Zealand sheep and lamb supplies, and competing markets (i.e. Europe, Asia). Historically, imports served as a residual supply to the domestic market in periods when domestic lamb supplies were not large enough to supply market needs, such as during the peak holiday demand seasons. Today, imports from Australia and New Zealand continue to supply the domestic market when supplies are expected to be tight due to such factors as drought or stronger product demand. Imports also provide for some end-use markets that demand specific criteria such as portion size, that may be more price sensitive, or that are willing to substitute imported product if lower in price.

Monthly Average of Imported Lamb 2010 to 2016



Source: USDA ERS

In addition, imports have compensated the traditional market supplies for the 30–40% of lamb supply directed to the nontraditional market.

The majority of imports are legs and racks, in addition to other items such as shanks and shoulders. The demand of the market determines the type and quantity of imports. For example, with holiday consumer demand for legs, or high-end restaurant demand for racks, domestic processing may need additional lean trim products such as shoulders to supply the demands for ground lamb. The volume of imports tends to be seasonal, with imports being largest in March to meet Easter demand. Import volumes can fluctuate during the year in response to a variety of factors. Exchange rates can shift the normal seasonal import patterns resulting in more variability during a given year or compared to prior years.

The price of imports can impact domestic lamb product and slaughter lamb prices. Favorable exchange rates allow US importers and processors to supply a lower-priced product relative to domestic product in markets that perceive imported and domestic lamb as substitutes, whereas a weaker US dollar may result in stronger demand for domestic

lamb and higher market prices for slaughter lambs. The dynamics of international lamb meat trade have a significant role and impact on today's US slaughter lamb market and US lamb consumer markets.

From a seasonality standpoint, Australia and New Zealand lamb production mimics California and Texas production systems. Down under, lambs are born in the latter part of the year and are ready for market in the early part of the year. Lambs born in the Southern Hemisphere are largely produced in-season, however, these seasons are naturally exactly opposite those in the US, which provides potential to dampen some of the US seasonal supply deficits.

► Lamb Demand

Lamb demand is difficult to measure and often times confused with per capita consumption, per capita supply, or sales at retail. Demand is impacted by the following factors:

- Consumer income
- Consumer tastes and preferences
- Prices of substitute meats.

Increasing demand means consumers will buy more lamb at constant or higher prices. An increase in quantity sold at retail assumes lamb demand has increased, but the price at which the lamb was sold is crucial. If a large quantity of lamb was sold, but prices declined, then lamb demand did not increase. However, if the same quantity of lamb sold with increased or steady prices, then it is possible lamb demand increased. It is important to remember that any amount of lamb can be sold at some price, but it does not indicate demand.

For more information, see the American Lamb Board Lamb Demand Analysis report at <http://lambresourcecenter.com>.

Further adding to the challenges, demand for lamb can be evaluated in a variety of ways. Demand can be analyzed by industry segment (nontraditional/foodservice/retail), type of lamb, primal cuts or individual cuts, domestic or imported, year over year timeframe, and seasonal demand.

The lamb industry has seen increased demand across many segments. Nontraditional demand for lamb has increased throughout the years. Different cultural and religious populations grow and become more prosperous. And direct-to-consumer opportunities have become more prevalent, with a foodie culture that wants to know where its food comes from, coupled with an increase in small farms.

► Nontraditional Demand

This market is a very diverse group of consumers. The largest segment of nontraditional consumers is typically immigrant families from less developed countries, with the largest peaks in demand centered around religious holidays. Specific feasts within the Muslim faith will result in spikes in demand. There may be a specific increase in demand during the month-long daytime fasting period of Ramadan because at sundown lamb is often part of the evening feast.

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- **Eid al-Fitr** is a two-day feasting celebration that marks the end of Ramadan; and an increase in light lamb demand should be realized at this time.
- **Eid al-Adha, or Sacrifice Feast**, occurs approximately 68 days after the Eid al-Fitr. For the Eid al-Adha, meat from healthy, non-pregnant, and blemish-free young lambs, goats, cattle and camels is distributed by men without financial constraints to less fortunate families within the faith. Intact male animals are often preferred for this holiday.

The timing of Ramadan, Eid al-Fitr and Eid al-Adha are determined by the Islamic calendar, which is based on the lunar calendar. Therefore, the timing changes from year to year, and eventually from season to season, generally 10 to 12 days earlier each year. Due to this, the available supply of lamb for the traditional markets can be negatively impacted when these holidays coincide with those periods when traditional demand is at its highest (i.e. Easter) or slaughter lamb supplies are at their lowest (i.e. summer).

Of note, nontraditional ethnic demand tends to shift after the initial first generation of immigrants. Second generation and later immigrant purchasing habits will tend to shift from nontraditional to more traditional purchasing methods (i.e. moving more toward purchases by the cut rather than by the carcass). Over time, this may result in a decrease in the percentage of lambs diverted into this segment and diverted back to the more traditional marketing channels.

Direct marketing is another aspect of the nontraditional market. Direct marketing can be differentiated into two main facets:

- Farmer's markets
- Small regional marketers

The lamb industry has seen increased demand across many segments.

- Retail
- Foodservice.

Sometimes suppliers to these two direct markets do both. Common among direct marketers is the farmer-focused connection to those buying their lamb. Farmer's market suppliers tend to sell frozen product, thereby minimizing the need for fresh lamb year-round.

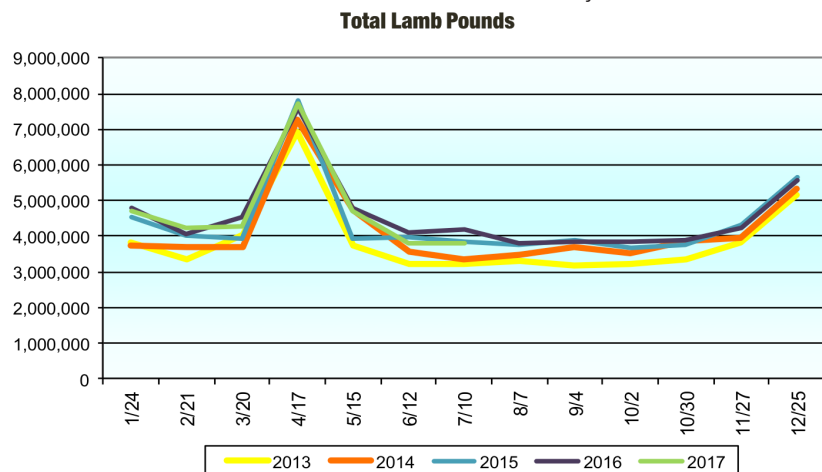
Regional foodservice and retail suppliers might work across a multi-state region, within a state, or even within their own community. For their customer base, fresh lamb is often preferred.

► Traditional Demand

Within the traditional market, retail and foodservice demand varies throughout the year and often by cut. For the most part, domestic lamb slaughter and imports will align with traditional market demand.

Metrics to gauge foodservice demand by cut and season are limited, creating a reliance on industry analysis and institutional knowledge from within the industry. On the retail side, point-of-sale scanner data collected by the Fresh Look Marketing Group is provided by the American Lamb Board for industry stakeholders. This report details retail sales of lamb (both dollars and weight) throughout the US by month, and then dives into by-cut retail sales for key markets and regions. The Fresh Look report captures approximately 80% of total retail sales for both domestic and imported lamb via scanner data at the store level. The data collected by Fresh Look does not allow differentiation between domestic and imported retail sales. However, it does provide an opportunity to look at cut-specific sales over the year. Although the Fresh Look sales data is not a substitute for measuring consumer demand, this data does provide insight into the types of products demanded throughout the year.

The following graphs, utilizing the Fresh Look report dated July 9, 2017, show the very large spike in retail around spring holidays, along with a smaller uptick just prior to the winter holidays. This is expected because consumer demand for lamb is greatest during these two holiday periods.



Source: Fresh Look July 9, 2017

These graphs show a large variation in quantity of lamb purchased throughout the year, which contrasts with how the industry harvests lamb throughout the year. The retail volume purchased is similar to what is seen at foodservice, however there is a more prominent softening of volume purchased from July through mid-September.

When evaluating lamb sales by cuts, there are similar volume patterns for legs, racks and miscellaneous (breasts, necks, and shanks) cuts as is shown in the overall lamb volume sales.

The leg primal cut comprises approximately 33% of a lamb carcass. The majority of legs are sold for the Easter and winter holidays. Legs are not a very popular cut in foodservice compared to retail market re-processing builds during the year to supply the expected holiday season. Due to limited data, information on cold storage stocks for lamb by product type is not available. This would be useful in gauging expected market demand for legs and other items.

The rack (rib) primal consists of approximately 11% to 12% of the lamb carcass. Foodservice desire for racks is often strong. Chefs prefer racks as a center-of-the-plate item as a high-value item that can be offered year-round, similar to a tenderloin or filet. Seasonal

uptick in rack usage by foodservice will be from Thanksgiving through Christmas (holiday parties), and a smaller increase for Valentine's Day and Mother's Day.

The miscellaneous segment largely consists of braising items (such as the foreshank, hindshank and necks). The volume pattern here shows a larger dip during the summer, with a sustained increase starting in October as customers turn to these braising items during colder-weather. This demand pattern mimics foodservice demand. Braising cuts tend to be more acceptable to buyers and distributors as frozen items.

Shoulders, loins and ground lamb have seen steadier volume throughout the year in both retail and foodservice. These are consistently offered at retail due to lower price points compared to racks or legs, and cooking method versatility, as well as being perceived as substitute products to competing proteins such as ground beef and pork chops.

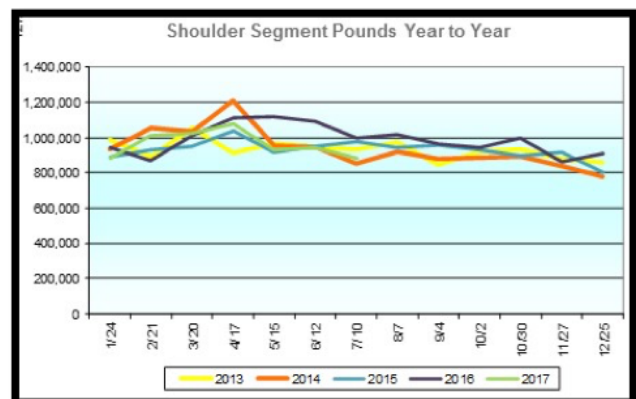
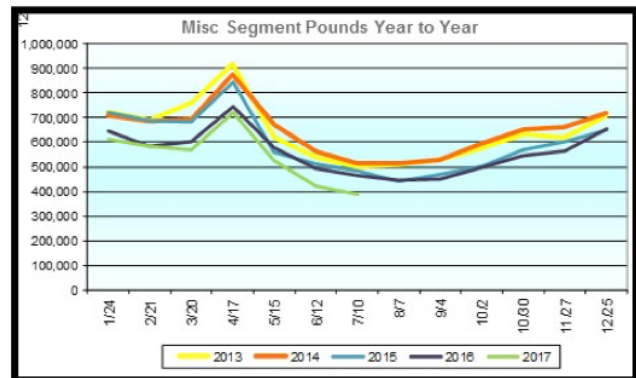
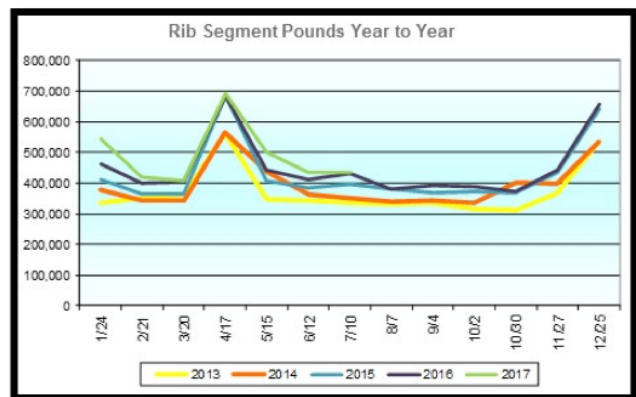
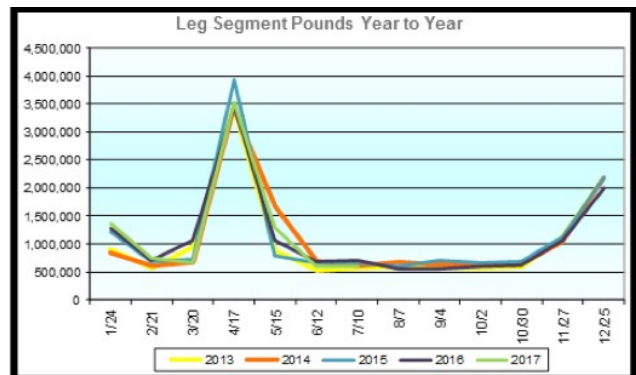
Shoulders make up approximately 24% of the carcass. Demand for shoulders at foodservice have been on the increase as chefs look for value cuts they can make a center-of-the-plate dish at a lower cost compared to racks or loins. At retail, shoulder chops are seen in the case during grilling season and are often run on feature.

The primal drop loin contributes approximately 13% to 14% of the weight of the overall carcass. It also contributes to the very widely recognized lamb loin chop which is a staple at retail and can often be found at foodservice.

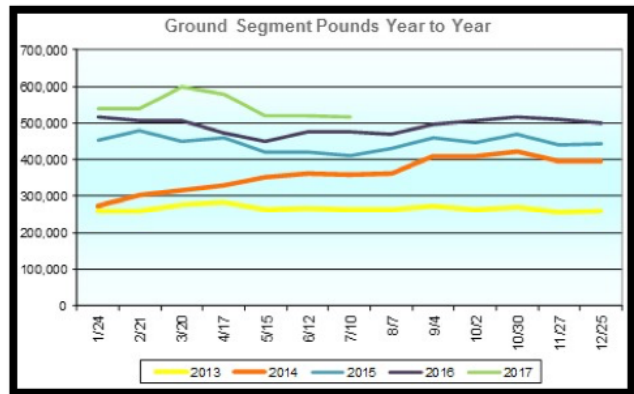
The considerable increase in ground lamb sales at retail – nearly a doubling in four years – is a bright spot for the lamb industry. This increase at retail is mirrored in foodservice. A lamb carcass produces very little trim, typically less than 4% of the carcass weight, depending on other cuts produced. As such, ground lamb can be a cost-effective way to utilize surplus legs and shoulders. In addition, when the value for ground lamb is greater than the value for legs or shoulders, often times these items will be directed to the ground market. Ground lamb is versatile and approachable for the home cook and chefs throughout all seasons and is a strong substitute for ground beef at both foodservice and retail.

Shortages in Supply and Demand

Traditionally, lamb retail sales are greatest during the Christmas and Easter holiday seasons. This demand period can be met with traditional spring-born lambs that are harvested at 8 to 12 months of age. In addition, imported lamb supply increases prior to both holiday events. The greatest shortage of lambs occurs



June through August. There are not enough new crop lambs (6 to 8 months old) or fall born lambs (8 to 10 months old) ready for slaughter. And summer born 12-month-old lambs are nearly non-existent. Production systems that can produce more fall born lambs on a moderate rate of growth, or winter born lambs on a fast rate of gain, are most likely to fit this market shortage. Although summer is not a high demand period for lamb, there is a demand for slaughter lambs during this time to meet market needs. This is evident in higher slaughter prices in recent years. However, the need for a larger available supply of lambs may or may not have a large enough net benefit to producers and/or the industry. This could be one reason why very few producers have adopted a management program to produce lambs that are market ready during the summer. During this period, processors utilize cold storage and feedlots to manage lamb supplies to align with current and expected market demand (e.g. contracted sales, future sale expectations, spot sales.).



Source: Fresh Look July 9, 2017

Traditionally, lamb retail sales are greatest during the Christmas and Easter holiday seasons. This demand period can be met with traditional spring-born lambs that are harvested at 8 to 12 months of age.

The majority of foodservice and retail distributors, as well as chefs and retailers, are averse to buying frozen lamb. There is a sentiment that since domestic beef, pork and poultry are available fresh, then lamb should be, too. That said, there are certain cuts some customers will buy frozen. Suppliers to the traditional market will often stockpile braising items (such as shanks and necks) in the summer to prepare for cold weather demand. Likewise, legs will be frozen to prepare for holidays. Typically, those legs are thawed by the packer and further fabricated into cuts desired by the retailer.

Ethnic demand for lamb is highest for a 90-day period beginning with the start of Ramadan and ending with Eid Ul-Adha, the Festival of Sacrifice. When these holidays are in the summer, they are consistent with supply of lamb. However, when they shift to winter and spring, supply of lightweight lamb will be a challenge. Keep in mind that these ethnic holidays don't always demand young animals. At times culled breeding stock can be marketed during these holiday seasons, which has less of an impact on lamb supply.

Market Incentives to Alter Production Season

Lamb packers have had to find new supply options during late May through September because the two locations that previously supplied lambs have changed: Texas largely shifted toward the ethnic market and ewe numbers have decreased in California due to higher production costs.

There are limited examples of market incentives to provide lambs during the summer months. In general, the packer has viewed the higher prices during this time as an incentive to increase summer supply.

The greatest shortage of lambs occurs
June through August.

Packers have also employed techniques that allow them to stretch supply to cover demand. Some of these techniques include:

- Contracting for aseasonal lambs from the upper Midwest.
- Forward-contracting using a “no-less-than-price” for 12 to 15 month old lambs to guarantee a base supply.
- Marketing ewe lambs earlier.
- Backgrounding larger-framed crossbred wether lambs on forage diets for slower gain that result in leaner lambs at higher weights and holding them until needed, at which time they go into feedlots. Wether lambs can be marketed as USDA graded lamb at an older age compared to their ewe lamb contemporaries.
- The use of 4-H and FFA projects shown at county and state fairs. They are typically winter born lambs fed to reach market weight in the late summer.
- Utilizing cold storage of fresh/chilled and frozen product to manage and extend domestic and imported supplies to meet foodservice and retail market supply needs.

► Seasonality of Sheep Breeding

The principle factor affecting reproduction in sheep is season. Most sheep show the greatest reproductive activity in the fall when days begin to get shorter. Peak breeding season tends to be September through December; however, this can vary depending on latitude. The closer to the equator, the sooner reproductive activity resumes. For instance, this may be as early as July in Texas and as late as October in Idaho. In addition, lambing rate increases through the early part of the breeding season. Typically, ewes will ovulate at a higher rate one month or more after they resume reproductive activity.

Day length is the primary factor that signals the breeding season. Melatonin, the hormone that signals the return of the breeding season, is produced at night. Temperatures are normally getting cooler; however, temperature does not have a large effect on reproduction except that high ambient temperatures can cause rams to become infertile for several weeks while new sperm are developing.

Season can have a different effect on reproduction depending on the breed of sheep. Dorset and Rambouillet are common US wool breeds that are known for aseasonal breeding. In addition, most US hair sheep breeds are aseasonal breeders, whereas long wool and down breeds of sheep tend to be seasonal breeders. In general, breeds that originated from Northern Europe are more seasonal than breeds developed closer to the equator. Within breeds, genetic selection can improve the fertility and prolificacy of sheep breeding out of the normal season.

Nutritional status of the ewe is a critical element that influences reproduction. Ewes in poor body condition are less likely to breed out-of-season, especially those with excessive weight loss during lactation.

Intact male sheep can stimulate a non-cycling ewe flock to begin cycling. This is called the “ram effect.” The ewes will ovulate within a couple days of ram introduction but typically do not show estrus and do not breed then. Then, 2 to 3 weeks later, the ewes will show a normal estrus and breed. This is more prevalent in breeds of sheep that are more aseasonal breeders. The ram effect is more prominent if the ram is actively trying to mate with the ewes. Some rams are seasonal in libido and they aren’t as effective.

Ewe lambs and yearlings typically take longer to begin cycling at the start of the breeding season than mature ewes. In particular, fall born ewe lambs normally don’t breed in the spring to lamb at 12 months of age.

► Management Challenges to Aseasonal Lambing

Efficient production systems for lamb generally result when the seasonal supply of grazing forage meshes well with the nutrient requirements of the flock. Therefore, in pasture-based aseasonal systems, this would require the availability of high quality grazing forage during late summer through mid-winter to meet the higher nutritional requirements of late pregnancy and lactation of the ewe, as well as that of lambs as they approach weaning. Climates that match this requirement include Mediterranean climates of the far-West as well as regions of the mid-South. In addition, pasture-based systems are better suited to an annual aseasonal lambing system rather than one that accelerates production by decreasing the birth interval to less than 12 months (8 months is a common accelerated production birth interval).

It is very challenging to meet the higher nutrient requirement of accelerated production in a purely pasture-based system as the nutrient density of grazing forages is often not sufficient to allow adequate and fast replenishment of body reserves needed for high conception and ovulation rates during Spring mating. Therefore, pasture-based systems for aseasonal lamb production favor an annual production system and should be located in climates allowing forage growth from late summer to mid-winter.

It is possible to overcome the constraints of pasture/forage availability in aseasonal lamb production systems through supplementation on pasture or development of efficient stored forage feeding systems. This allows expansion of aseasonal production either in annual or accelerated systems to any part of the US. The profitability of these more intensified production systems is dependent on the cost of the feeding system and other overhead costs, and the productive output of ewes lambing out-of-season.

There is a natural reduction in ovulation rate and conception even in breeds selected for aseasonality, indicating that genetics that are fully aseasonal have not yet been achieved. Therefore, the loss in productivity of aseasonal lambing must be considered when evaluating this mode of production. In general, conception rate is reduced 10% to 40% and ovulation rate 10% to 30% in aseasonal systems with natural mating programs. This is a wide range of loss indicating that improved management (reproduction and nutrition) and genetics offer potential to minimize these deficits. The impact of these deficits on profit is lower in accelerated production compared to annual aseasonal production because typically two-thirds of the breeding periods in accelerated systems are during more optimal breeding photoperiods, whereas the breeding period in an annual aseasonal system is always during the suboptimal breeding period.

It is possible to overcome the constraints of pasture/forage availability in aseasonal lamb production systems.

Accelerated aseasonal lamb production improves production efficiency by decreasing the amount of time a ewe is in a non-productive state.

The profitability of aseasonal lamb production is calculated the same as for any production system: the returns from lambs sold during periods of more limited supply must be greater than the total investment in labor, feed and overhead needed to produce these lambs.

Accelerated aseasonal lamb production improves production efficiency by decreasing the amount of time a ewe is in a non-productive state. In annual aseasonal lambing systems this is not the case, so the decrease in productivity must be accompanied by product price incentives or lower cost of production for this mode of production to remain profitable.

Labor and facilities may be a constraint or an advantage of aseasonal lamb production, depending on farm resources. In general, labor will be distributed more evenly over the year in aseasonal lamb production, which may be an advantage to many farms. Greater investment in facilities may or may not be necessary with aseasonal lamb production. By lambing at distinctly different times of the year, the potential for increased efficiency in terms of facility use is possible because fewer ewes are lambing at one time compared to a conventional, once-per-year lambing system.

► Current Techniques to Alter Aseasonal Production

Field evidence indicates that the plane of nutrition influences reproduction during the suboptimal breeding season more dramatically than during the optimal breeding season. This applies to both male and female reproduction. Producers with successful aseasonal management programs feed ewes well during the pre-breeding period. In accelerated production, the need for better feeding extends into prior lactation. The precise nature, amount and duration of nutritional inputs required to optimize aseasonal reproduction remain to be defined, however.

Breeding management is also a critical aspect of out-of-season breeding success. Field evidence indicates the ram-to-ewe ratio needs to be increased during aseasonal breeding periods as compared to the normal breeding season. Ram coverage as high as 10% (1 ram

per 10 ewes) has been used during spring breeding periods. More typical coverage rates used by farms with high conception rates using natural mating are in the range of 3% to 5%. This coverage is higher than that recommended for fall mating periods.

Another method to augment out-of-season breeding success is the “ram effect.” Producers employing the ram effect typically use vasectomized males at a coverage of 2% to 5%, replacing them with intact males after a 4- to 14-day exposure period. This management technique has been shown to induce estrus in ewes on the edge of the anestrus period while also synchronizing estrus activity. It is unclear, however, if the ram effect can induce estrus in ewes deep within the anestrus period. Evidence is mounting to indicate that the presence of any ram (vasectomized or intact) is a key stimulus to get even aseasational ewes to start to cycle in the spring. This underscores the importance of having high ram coverage in the spring.

Nutrition and breeding management are critical aspects of out-of-season breeding success.

Male fertility can be optimized with the use of lighting therapy to create an optimal photoperiod. This requires the use of a facility that can be darkened nearly completely, which may be feasible to create for a small population of breeding rams within a farming program. With light therapy, even rams from breeds with extremely seasonal reproductive patterns can obtain high libido and fertility during the spring breeding period.

Another important consideration to reduce the risk of poor conception is to screen all rams for fertility using semen analysis as part of a breeding soundness exam (BSE). This can effectively remove non-fertile rams from the breeding group. A ram BSE will effectively screen for fertility but cannot measure ram libido, which may become uncoupled from fertility during the spring breeding period. Therefore, use of BSEs will reduce the risk of infertility, but not eliminate it, as some rams may be fertile but lack in active mating behavior in the spring.

Technologies to improve aseasational fertility of the ewe include the use of exogenous progesterone-based therapies delivered either orally or intravaginally. Oral administration of progesterone analogues is not approved within the US, however use of controlled internal drug release devices (CIDRs) inserted within the vagina to deliver progesterone are approved for sheep, including those used in food animal production. CIDR use offers an opportunity to both synchronize and induce estrus, however, the promise of this technology is tempered by the fact that conception rates achieved remain lower than desired in both seasonal (30% to 50%) and aseasational (50% to 80%) breeds. Perhaps the chief advantage of CIDRs is their utility as an estrus synchronization tool rather than one to induce estrus during the anestrus period. The disadvantage is the additional cost of the product and labor to implement a CIDR protocol for large scale operations.

Lighting protocols have also been used very successfully to increase reproductive performance of ewes during sub-optimal breeding periods. The most effective protocols require creation of both light and dark periods, thus requiring a facility capable of creating dark conditions. The cost and feasibility of such a facility would likely be a limiting factor for many farmers. This investment may be economical under certain conditions, as the productivity of sheep in this system is exceptional because the photoperiod can be optimized to achieve maximum conception rate and ovulation rate regardless of breeding seasons. Another technique that does not require the use of dark housing is often referred to as “extended day” lighting. In extended day protocols, ewes are exposed to 60 days of 24-hour light, followed by 60 days of ambient lighting, followed by exposure to rams. The hypothesis for how extended day may work is that the relative change in light mimics the physiological response to decreasing day length occurring in fall, therefore inducing ovulation in ewes during spring. This protocol is easy to apply to housed ewes fed indoors in winter, however, its efficacy has not yet been proven.

The heritability of out-of-season breeding is estimated to be relatively low at 8%, yet there is evidence that long term selection for ewes with the capacity to breed out-of-season can improve spring flock conception rate to greater than 85%. Breeds vary tremendously in their capacity for aseasational reproduction, somewhat explainable by the latitude of breed origin and by selection pressure applied by breeders for this trait in higher latitudes. Heterosis may also impact aseasational reproductive success, however this has not been rigorously evaluated.

Technology Needed to Improve Aseasonal Production

The development of methods to estimate the genetic merit of a sheep's ability to breed out of season would have great value for improving aseasnal production. The rate of progress through selection is predicted to be slow, just as it is for many other reproductive traits, due to the high impact of the environment on these traits as expressed by its relatively low heritability of 8%.

The use of traditional quantitative genetics approaches for out-of-season breeding selection is challenging because it takes a few years to evaluate this trait. Expression of this trait is only measured in one sex, and uniform opportunity for all ewes to lamb out-of-season is often not provided on farms. The use of genomic methods to estimate genetic merit would have great value in overcoming these limitations. Development of this approach would require large reference populations with accurate records of reproductive performance; this opportunity is currently lacking.

There is evidence that long term selection of ewes which breed out-of-season can improve spring flock conception rate to greater than 85%.

The use of hormone therapies to improve out-of-season breeding success has been explored and considered extensively. The results obtained using these approaches have not been better than that obtained using natural mating with careful reproductive management. There is certainly room for improvement in increasing out-of-season conception; there are few large farms that exceed 80% conception during the suboptimal breeding season. Given the concern of consumer acceptance of products derived from technologies using hormone therapies, a better and more sustainable path forward may be through improved selection methods and management of sheep for out-of-season breeding success.

Light protocols do offer promise to reduce the risk associated with poor out-of-season breeding success, but more work is needed to validate and improve these methods. Within these methods, an emphasis should be placed on those approaches that do not require significant facility investments to create dark housing conditions for a large part of the flock population.

An area that has received relatively little attention is the possibility of improving both conception rate and ovulation rate during spring mating through improved nutritional management. The deficit observed in reproductive performance of rams of fine wool breeding has been shown to be minimized by increasing the plane of nutrition during spring breeding. This may apply to female reproduction as well, but this has not been carefully evaluated. An understanding of the nature, timing and extent of the nutritional inputs that may lead to improved out-of-season reproduction could make a big impact in successful adoption of an out-of-season production program. Establishment of benchmarks for body weight changes and/or body condition targets to optimize aseasnal lamb production would be a great aid in improving management of these systems.

Examples of Successful Aseasonal Producers

MIDWEST

The Rafter P Ranch accelerates production through fall, winter and spring lambing. The operation manages around 1,000 Polypay commercial ewes. Most ewes are lambed in a winter-based confined lambing system. Lambs are early weaned and placed on a high quality diet to maximize growth rate. Winter-born lambs are marketed in the late summer as traditional 140 pound slaughter lambs and typically receive a market premium due to shortage of lambs during this season.

Ewes that lamb in January and February are naturally bred in the spring to lamb again in October. Conception rate has ranged from 10% to 75%. Fall-born lambs are marketed in the spring as traditional slaughter lambs. The fall lambing ewes are exposed to rams in November/December during lactation. The conception rates for this period have been around 85 to 90%. Spring-born lambs are marketed in the fall.

Spring lambing ewes are exposed to rams in August/September to lamb in the winter. No market premiums have been available for fall-born or spring-born lambs marketed in the spring or fall as traditional slaughter lambs. Aseasonal lambing is done to maximize ewe productivity and maximize use of confined lambing facilities. Lambing facilities are the limiting factor in flock size; therefore, lambing ewes at three different times allows for a larger operation.

NORTHEAST

Kyle Farms practices an accelerated lambing program near Rochester, New York, with a flock of 3,200 ewes. Its production system is designed to allow ewes to lamb as often as every eight months with six lambing periods per year (30 days each). In this system, the farm has a lambing period every other month.

The flock primarily consists of Dorset x Finn x Ile de France genetics. During each eight month production cycle, ewes are maintained on pasture 50% of the cycle (four months) from the onset of ram introduction until 30 days before lambing. Ewes are then brought indoors and fed a high quality total mixed ration during late pregnancy through lactation, during a 30-day recovery period following weaning and just prior to ram introduction. During the winter, ewes on pasture are provided supplemental forage to maintain body weight.

All lambs are kept indoors following weaning, and fed to maximize gain and limit time on feed. Lambs are marketed in a variety of ways, depending on opportunity. This ranges from milk-fed lambs at weaning to large, 140-lb. lambs destined to the

traditional lamb market. The lambs brought to greater weights are sired by large-framed terminal sires and reach target weights by 7 months of age. All ewes are bred via natural matings, with conception in the 75% to 85% range in spring and more than 90% during the remainder of the year. Mature ewes produce an average of 2.5 lambs per year. The combination of indoor lambing and rearing has eliminated major parasite and predation issues.

SOUTH

The Fisher-Askew ranch is located in Sonora, Texas, and produces approximately 1,500 fine-wool and speckle-faced lambs that are marketed as feeder lambs in April and May. Sheep are grouped into pastures of about 500 acres and 100 ewes. Rams are introduced in mid-June. Typically, one ram per pasture is used so the rams will run with ewes and not stay together as a group of rams, which is often the case with rams in June. A week or two later, more rams are turned out to breed. Rams are left with ewes for most of the summer.

Ewes will begin lambing in mid- to late-November. Most lambs (90%) are born by the end of December and are marked/docked around January 1. Some lambs will be born in January/February; however, most will be from the ewe lambs or yearling ewes. Depending on ewe body condition and forage quantity/quality, winter supplemental feed will be provided to ewes during late gestation and/or lactation. Supplemental feed is in free-choice bulk feeders, with a higher rate of salt used to lessen intake. By February/March, spring has normally arrived and good quality pasture is available for ewes and lambs.

Lambs are weaned and shipped at around 150 days of age. Depending on year, fine wool lambs will average 85 to 105 lbs. at weaning, with crossbred lambs weighing 5 to 15 lbs. heavier. In general, the lamb market is quite strong for feeder and light slaughter lambs in April/May. An added benefit of fall/winter lambing is that lambs are weaned and shipped before peak parasite season. Minimal drenching is required to maintain good animal health.

WEST

Hamilton Brothers, based in Rio Vista, California, implements an out-of-season production system. The breeding season begins in mid-May so that lambing starts mid-October. The sheep production system is designed to complement the farming operations, optimizing use of crop residue, allowing for weed management, as well as utilization of native grassland. Hamilton Brothers differs from almost all other California commercial

sheep operations is the genetic approach started in the 1970s, when Finnsheep were added to the Targhee/Rambouillet base ewes.

The reasoning for a progressive approach in genetics was they felt the sheep operation could not sustain itself in the future compared to other agricultural opportunities if they did not increase production. Incorporating the Finn genetics with ewes that are acclimated to out-of-season production would increase prolificacy with more twinning and reduce the percentage of open ewes. The composite ewe consisting of 3/8 Finn, 3/8 Targhee and 1/4 Rambouillet has a fall lambing percentage of about 1.57 lambs per ewe, with less than a 2% open ewe rate. A composite terminal sire is used which is 1/2 Suffolk, 1/4 Columbia and 1/4 Texel. These rams can easily breed up to 100 ewes in a 60-day aseasonal breeding system, maintain their body condition, and live more than three breeding seasons. For 30 days prior to breeding season, they use 3/8 Finn single ram lambs as teasers, which may enhance twinning rate of fall lambing ewes.

Conclusion

Seasonality of lamb production is an issue in the US sheep industry. Most sheep producers choose to lamb in the months of February to May. Traditional market lambs reach slaughter weight (120 to 160 lbs.) in the winter and spring. Whereas, nontraditional lightweight slaughter lambs (60 to 80 lbs.) are marketed in the summer and fall. In both markets, the supply is inconsistent, creating market volatility.

Demand for lamb in both traditional and nontraditional markets is year-round. Fortunately, the largest demand for retail lamb sales is during the Christmas and Easter holiday season, which aligns with current production. Volume of imported lamb follows the same trends as domestic lamb, and imports increase prior to months with higher domestic sales. Therefore, imports are not necessarily serving a role of supplying lamb during periods of low domestic production.

Over the last few years, the largest demand for nontraditional lamb has occurred during the summer when supplies are the largest. In the future, this holiday-linked demand will move up in the calendar and put more pressure on the industry to produce a nontraditional lamb at nontraditional times.

To even out supply of lamb through the year, the industry must shift lambing season or alter rate of gain to reach market at a different time. Producers must have access to sufficient resources needed to alter lambing season or growth rate. A major challenge to aseasonal lambing is low and inconsistent fertility of sheep. Currently, producers can manage around these

challenges; however, it is not simple and requires considerable effort. A better long-term solution would be improved genetic selection technology to identify sheep that breed consistently out-of-season, without compromising lambing rate. Accelerating rate of gain is well understood and feasible with adequate feed resources and proper genetics.

More importantly from a producer standpoint is whether or not the market provides a large enough incentive given the additional direct and indirect costs of changing lambing management practices. In recent years, the market appears to have provided a price incentive. However, whether or not this incentive is large enough in the short and/or long term is unknown. Of note, as in all perfectly competitive markets, as the supply of lambs increases to fill the voids, market incentives over time will diminish. Each producer will need to weight the advantages of change against the cost of management changes required.

Lamb processors face challenges with an inconsistent supply of lamb. It is difficult to find enough lambs during certain times of the year to keep the plants operational and supply fresh product to the consumer. Processors are often tasked with distribution of variable weight lamb carcasses depending on the time of the year. One potential solution would be cold storage of frozen lamb during times of oversupply; however, many buyers, distributors and consumers do not view frozen lamb favorably.

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ABBREVIATIONS

LMIC – Livestock Marketing Information Center

USDA – US Department of Agriculture

APHIS – USDA's Animal and Plant Health Inspection Service

ERS – USDA's Economic Research Service

NASS – USDA's National Agricultural Statistics Service

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