Dairy × Beef: Fad or Sustainable Future?

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TAKE HOME MESSAGES

- Beef cattle and meat prices may decrease slightly in 2020, but then increase continuously to 2028 because cattle inventory and calf crop are peaking in 2019.
- Growing U.S. population (maintained at current per-capita beef consumption) will increase demand for beef.
- U.S. beef exports may likely continue to thrive until 2028 (with a peak in 2021) if not suppressed by retaliatory tariffs.
- Beef semen is a good management alternative for medium to high reproductive performance herds in the foreseeable future. Distinct combinations of beef, conventional and sexed semen according to reproductive performance, herd turnover ratio and calf mortality may be used as alternatives to maximize the income from calves over semen costs
- Herd reproductive performance is a critical factor to determine if beef semen should be employed. Poor performance is a limiting factor even when market conditions are favorable.
- Dairy-specific and market-targeted beef sire selection are critical to guarantee quality dairy × beef crossbred calves for maximum revenue.
- Diversification towards dairy × beef crossbreds may help dairy farmers to overcome challenging dairy market conditions and maintain liquidity.
- Optimal use of beef semen, which normally entails some combination with use of sexed semen, promotes faster genetic progress of the dairy herd.

INTRODUCTION

Beef semen utilization on dairy farms has gained notoriety in recent years because of various factors. On one hand, there has been an excess supply of replacements in dairies because of the wide adoption of female-sorted semen, improved reproductive performance, and retention of nearly of the heifers for replacement (Overton, 2019a; Middleton, 2019). Raising more heifers than needed resulted in a sharp drop in heifer prices as indicated by De Vries et al. (2008) and Weigel (2010). Currently, the nationwide price received for a dairy springer is approximately $1,200/head (USDA - NASS, 2019) while the estimated rearing cost from birth to freshening is around $2,100/head (Overton, 2019b; Akins and Hagedorn, 2015). On the other hand, economic margins for dairy farmers have decreased because of depressed milk price and expensive feed costs. This situation has decreased farm profitability and increased rearing costs. Therefore, farmers have been looking for alternatives to maintain liquidity and eliminate extra heifers. One such alternative is the use of beef semen.

Attractive beef prices have led to high prices in the whole beef supply chain, which has enabled dairy farmers to take a share of these rewards. Using beef semen to inseminated dairy cows has become a solution to produce only the required number of replacements at the same time obtaining more cash from dairy × beef crossbred calves. In addition, some researchers have concluded that well-managed farms could benefit economically (McCullock et al., 2013; Mur-Novales and Cabrera, 2017; Li and Cabrera, 2019) and/or genetically (Ettema et al., 2017) by using sexed semen on genetically superior cows while breeding the inferior cows to beef semen.

As it can be seen in Figure 1, historically from 1979 to 2018, U.S. beef semen sales have largely increased, but this increase has been enhanced during the last 5 years because of the use of beef on dairy (Geiger, 2019). This reveals a popular trend of dairy × beef where farmers are seeking alternatives to increase profitability.

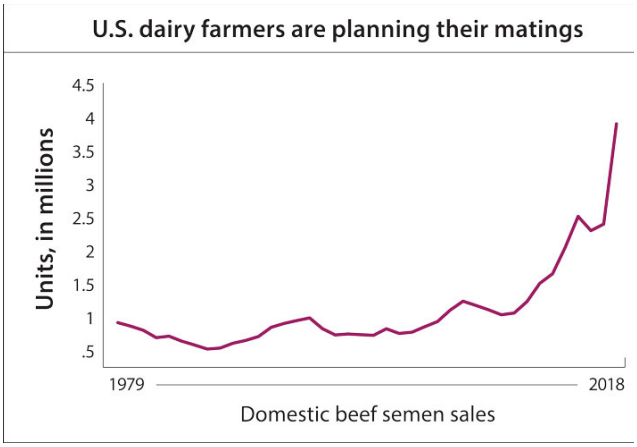

Figure 1. Beef semen sales from 1979 to 2018 (Geiger, 2019).

It is clear that use of beef semen in Holstein cows has dramatically increased in addition to boosted sexed semen use during the past 5 yr to achieve up to 19% of all breedings in 2019 (Figure 2 (left panel); Nehls, 2019). Therefore, the increase in beef semen sales was because farmers are substituting sexed and beef semen for conventional semen. Use of both sexed and beef semen guarantees an increasing number of dairy × beef crossbreds while providing enough replacements to keep up with herd turnover (DeVries et al., 2008; Weigel, 2010). A large amount of beef and sexed semen utilization also is occurring in Jersey herds and this started even earlier than Holsteins (Figure 2 (right panel; Nehls, 2019). One reason for this historically greater use of beef semen in Jersey herds is the insignificant value of Jersey bull calves (Bechtel, 2018). There is evidence that partnerships between Jersey herds and feedlots, breeding dairy cows to beef sires, have remained a successful business model for a long period of time (Bechtel, 2018). The diversification of dairy farms towards a beef raising enterprise might provide an additional future model for implementation of more dairy × beef offspring.

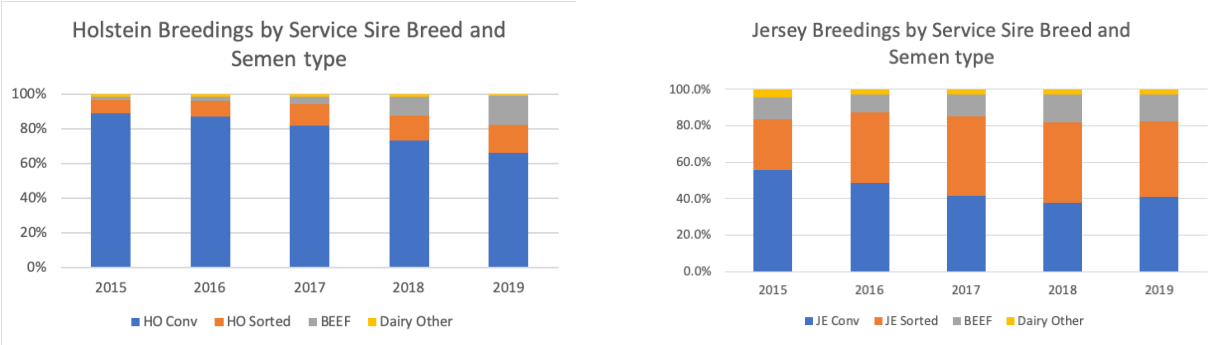

Figure 2. Holstein (left panel) and Jersey (right panel) breedings by service sire breed and semen type (Nehls, 2019). HO Conv = Holstein conventional, JE Conv = Jersey conventional, JE Sorted = Jersey female sorted sexed semen, BEEF = beef semen.

Dairy beef including dairy steers and culled animals are always an important source for the beef market. It represents approximately between 20.5% and 22.7% of the U.S. beef production (Schaefer et al., 2017; DelCurto et al., 2017). In some states such as Michigan, for example, the dairy contribution to the beef production could be as much as 80% in some local markets (Gould and Lindquist, 2018). The growth of Holstein feeder steers is generally more consistent than for conventional beef breeds, but above 1,000 pounds of live weight, feed conversion for Holstein steers is less efficient and with a 6-8% lower dressing percentage (Grant et al., 1993). Thus, crossbreeding of dairy × beef results in a medium-quality carcass seems to be a good option to substitute for inferior beef from dairy cattle.

As the beef semen becomes more commonly used in dairies, farmers are becoming more cautious about its use. The reasonable question is then: "How long will the thriving beef market last?" A follow-up question: "Will crossbred dairy × beef cattle qualify for the meat quality and supply

requirements of the market?" Therefore, our goal in this study was to assess the technical and economic sustainability of using dairy × beef in the foreseeable future.

TECHNICAL SUSTAINABILITY - USING BEEF SEMEN ON DAIRY

Premium Dairy × Beef Program

Determining the optimal percentage of beef semen use on dairy herds could be complicated. Generally, farmers will find combinations of sexed semen and beef semen that would provide sufficient replacements and extra revenue. Those combinations, however, may not be optimal. In addition to that, each farm is different and variant in terms of reproduction performance, culling policy, calf mortality, and other management factors and are affected by ever changing market conditions (Mur-Novales and Cabrera, 2017).

Complex interactions among these factors make it hard to best capitalize on the outcomes. Hence, simulation models and associated decision support tools are required to better inform farmers how to optimize the use of dairy × beef for maximum net return. One example of such a simulation model, decision support tool, is represented in Figure 3 (Cabrera and Lopes, 2014).

The decision-making tool, Premium Dairy × Beef Program, developed by Cabrera and Lopes (2014), updated in 2018 (Li and Cabrera, 2019) is available at http://www.dairymgt.info. It may help farmers and consultants to determine the proportion of beef semen use and combinations of Holstein female sex-sorted semen, beef semen, and Holstein conventional semen while monitoring the economic value of outcomes (income from calves over semen cost, **ICOSC**) and the number of replacement heifers needed for a specific farm.

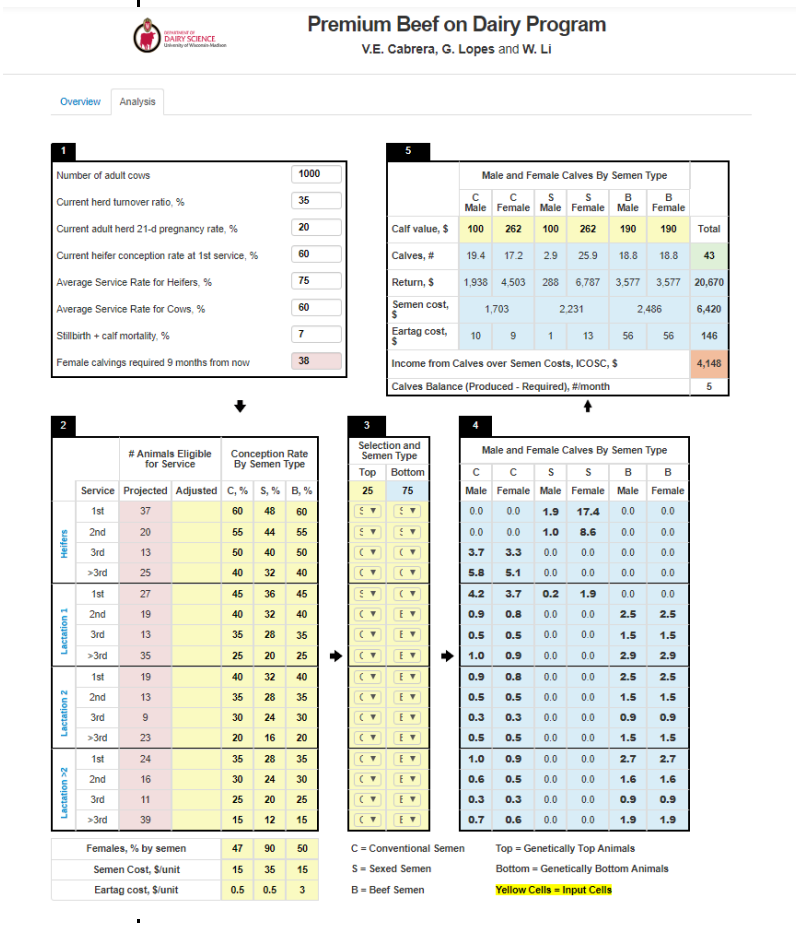

Figure 3. Interface of Premium Dairy × Beef Program (Cabrera and Lopes, 2014).

Based on this tool and the analysis by Mur-Novales and Cabrera (2017), an adjusted study conducted early this year has comprehensively evaluated the optimal semen combination for various farm management under distinct market scenarios (Li and Cabrera, 2019). One constraint of the analysis set that the optimal semen combination with highest ICOSC to be chosen only from outcomes with positive replacement female calf balance. That is, enough replacements to compensate for herd turnover. The simulation also restricted dairy heifers only to be bred with sexed and conventional semen because a detrimental calving ease might occur if beef semen were used on smaller-frame heifers compared with mature cows.

In summary, they found:

- benefits from beef semen could financially support more sexed semen utilization;

- reproduction performance was one vital limiting factor for using beef on dairy;
- farms with greater reproductive success are more sensitive to calf prices of all kinds;
- farms with lesser reproductive success are more sensitive to semen costs.

As a follow up, we used the above tool with a 1,000-cow herd under current market conditions (August 15, 2019) to find the best combination of using sexed semen and beef semen at a breakeven point in which there would be sufficient replacements and the ICOSC would be positive (Table 1). A summary of the breakeven dairy × beef crossbred calf price for various reproductive levels with a typical U.S. culling rate of 35% while holding everything else constant is displayed in Table 1.

As noted, for a farm with greater reproductive success, the breakeven crossbred calf price could be as low as $59/head when using beef semen for 50% of the adult cows without using any sexed semen. The 1,000-cow farm's ICOSC would be $117 per month and would produce enough replacement heifers. In contrast, a farm with lesser reproductive success would not benefit from the use of beef semen unless dairy × beef crossbred calf price would be as high as $699/head. It is worthwhile to observe that these farms with less reproductive success needed to use sexed semen to produce the required replacements.

Table 1. Breakeven prices of dairy × beef crossbred calf at distinct reproductive performance levels under the Wisconsin market conditions[1] for a 1,000-cow farm at 35% herd turnover

21-d pregnancy rate	Breakeven dairy × beef crossbred calf price ($/head)	Optimal semen combination at breakeven	ICOSC ($/mo)	Replacement female calf balance[2] (head/mo)
High (30%)	59	NS, 50%[3]	117	0
Medium (20%)	149	1H, 50%[4]	12	2
Low (15%)	699	TOP, 25%[5]	2	0

[1] Wisconsin statewide livestock market prices were averaged according to Stratford Market Report (08/15/2019), which are summarized in Table 2.
[2] Replacement female calf balance: the quantity difference between female calves produced on farm and required for replacement.
[3] No sexed semen in the herd (NS); beef semen for 50% adult cows; other cows with conventional semen
[4] Sexed semen for all heifers at 1st service; other heifers with conventional semen (1H); beef semen for 50% adult cows; other cows with conventional semen
[5] Sexed semen for all heifers at 1st and 2nd services and for the 20% top genetically superior adult cows (TOP); rest of heifers with conventional semen; 25% of the rest adult cows with beef semen; other cows with conventional semen.

We should also note that each market condition has a unique optimal semen combination for breakeven replacements and ICOSC. As the dairy × beef crossbred calf price changes (and other prices also change), the optimal semen combination would change. That's why the dynamic use of an interactive decision support tool is critical. In the current Wisconsin market situation (dairy × beef crossbred calf price at $200/head; Stratford Market Report, 2019), the optimal semen combination is:

- For successful reproductive performance farms: sexed semen for all heifers at first service; other heifers bred with conventional semen (**1H**); and beef semen for all adult cows (100%), resulted in an ICOSC of $5,263 per month.
- For medium reproductive performance farms: use sexed semen for all heifers at first service; other heifers bred with conventional semen (**1H**); but beef semen for only 50% adult cows (other adult cows bred with conventional semen), resulted in an ICOSC of $1,327 per month.
- For low reproductive performance farms: No use of either beef or sexed semen as the ICOSC would be negative in those situations and short of replacement heifers (4 head per month because of poor reproductive performance and no sexed semen utilized).

Table 2. The Wisconsin market conditions in August 2019

Item	Value
Conventional semen price ($/dose)	15.00
Sexed-sorted semen price ($/dose)	35.00
Beef semen price[1] ($/dose)	15.00
Statewide livestock market prices[2]	
Price of Holstein female calf [3] ($/head)	49.00
Price of Holstein male calf [3] ($/head)	67.50

[1] Beef semen price is average quality and does not distinguish specific traits for dairy beef purposes.

[2] Statewide livestock market prices were averaged according to Stratford Market Report (08/15/2019).

[3] The average Holstein female price does not consider the added genetic value of females from sexed semen.

Tailored Beef Sires for Dairy

To properly crossbreed and improve the marketability of dairy × beef crossbred cattle without compromising cows' performance of next lactation, tailored beef sires specifically for dairy might may need to be considered. A survey conducted in Wisconsin, Iowa, and Michigan demonstrated that farmers usually get a discount because of spotted hair coat, female gender, and low growth rate for dairy × beef crossbred beef calves (Halfman and Sterry, 2019). Crossbred calf buyers normally select by gender and hair coat (Weigel, 2010) and because of that, dairy farmers could be penalized in the price. An alternative business model for dairy farmers could be to raise dairy × beef crossbred animals in farms to capitalize on added value. Dairy farmers, however, are not likely to invest more assets in a new business enterprise, neither be interested in learning how to raise calves for beef, which would complicate even more the already complex dairy business.

In addition, more comprehensive market criteria for crossbred beef sire selection on dairy needs to be established towards long-term sustainability. Research conducted by the University of the Wisconsin Extension is underway to explore better Expected Progeny Differences when selecting beef sires for dairy beef production (Cauffman and Sterry, 2019). They propose to include considerations of implementing strategies of semen costs, calving ease, and hair coat color on the dairy selection; and carcass value, ribeye area, moderate frame size and feed efficiency for the beef selection. With the advanced beef sire selection for dairy, cost of tailored beef semen is likely to increase, resulting in higher breakeven prices for dairy × beef crossbred calf.

ECONOMICAL SUSTAINABILITY – MARKET RESTROSPECT AND PROJECTION

The future beef market condition is the largest driving force on dairies taking actions regarding use of beef semen. Because there are two major biological time lags such as gestation length

(dairy) and fattening duration (beef), it is critical to guarantee that the investments and opportunity costs pay off at the time crossbred calves are being produced, sold, or crossbred steers are being slaughtered.

Beef Cow Inventory and Calf Crop

Beef cow inventory as well as closely related calf crop could reveal directions of the cattle industry. Adjusted data from the Food and Agricultural Policy Research Institute, University of Missouri (**FAPRI-MU**), show the beef cow numbers and calf crop during the last 20 years and their projection for the next decade (Figure 4). Starting from the second millennium, beef cow numbers decreased. Historically high grain prices in 2010 forced cattle feeders to convert to pasture raising, imposing greater risk of weather-related impacts. Then, a severe drought in 2013 in the southern U.S. affected approximately 25% of the U.S. beef herd (Reese, 2016), which decreased beef cow numbers to a record low in 2014.

Since then, there has been a beef population recovery that is expected to peak this year (2019). Calf crop shares a very similar pattern (Figure 4). Noticeable in the projection is that inventories of beef cows and calf crop will soon start a continuous decline until 2028.

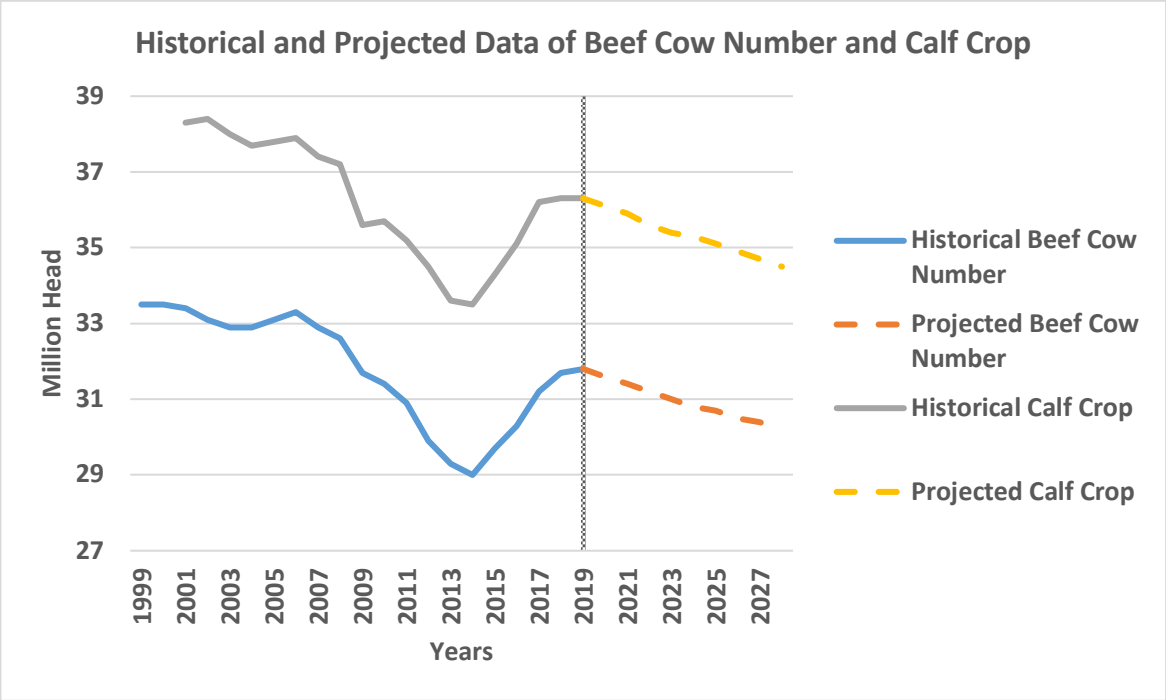

Figure 4. Historical and projected data of beef cow numbers and calf crop. Integrated and adapted from US Baseline Outlook, FAPRI – MU, 1999-2019.

Beef Meat Production and Exports

Historical beef production is proportionally aligned with cattle inventory (Figure 5). The projected curve illustrates beef production peaking in 2020 (instead of 2019) resulting from the fact that many beef cattle are already in feedlots (raising lag time). As beef cows and calf crop decline, meat production will also decline.

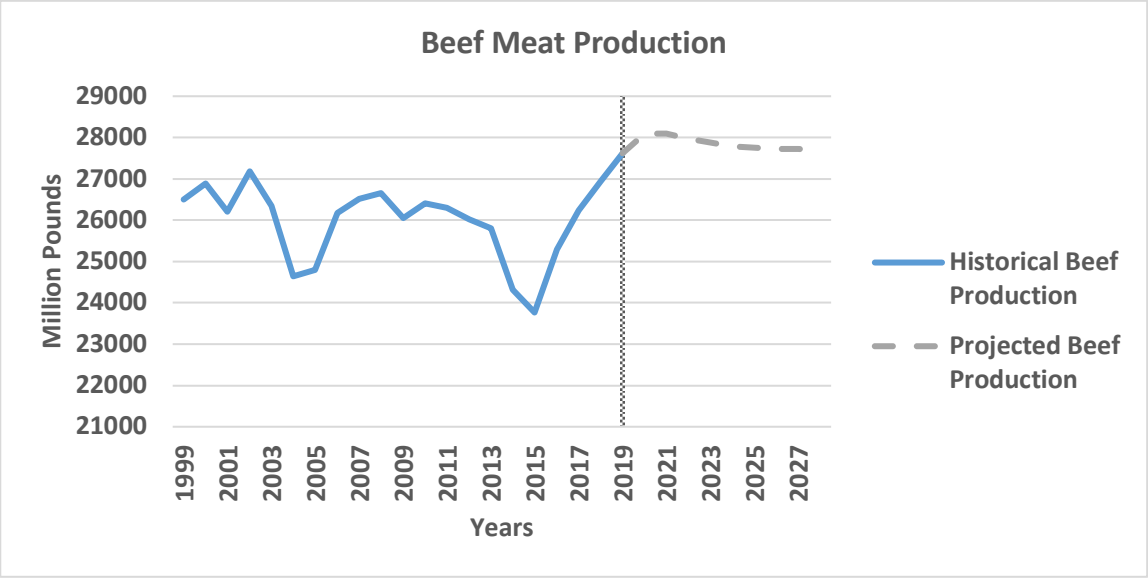

Figure 5. Historical and projected beef meat production. Integrated and adapted from U.S. Baseline Outlook, FAPRI – MU, 1999-2019.

Beef exports have grown in recent years (Figure 6). This fact has promoted increased profits with cattle and meat industries. It seems that exports will continue increasing until 2021 and then will gradually decrease. Although the decrease in exports could be explained, in part, by the reduction of domestic supply, yet another important factor could be the possible retaliatory tariffs that also might suppress export potential.

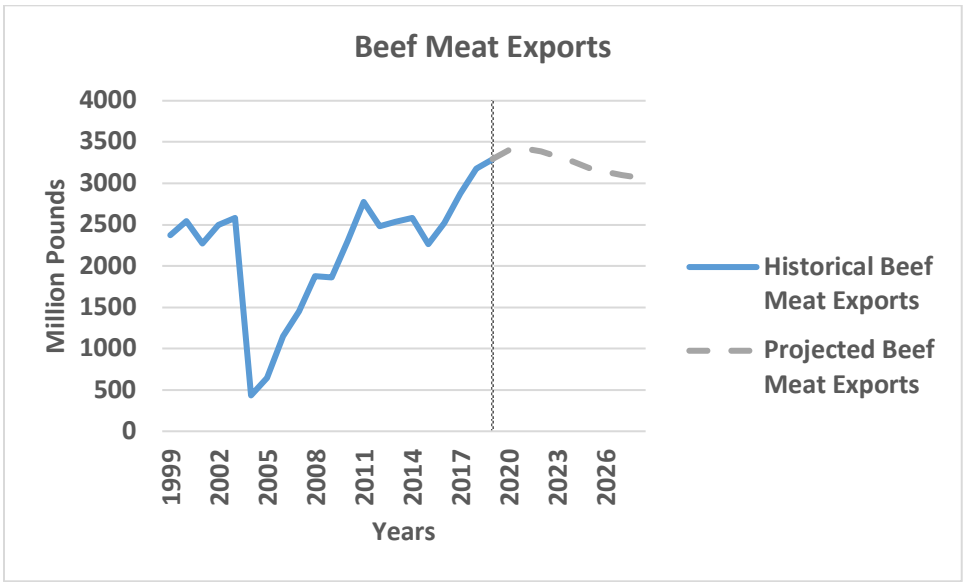

Figure 6. Historical and projected beef meat exports. Integrated and adapted from U.S. Baseline Outlook, FAPRI – MU, 1999-2019.

Beef Consumption

Another factor affecting beef demand is domestic consumption. The FAPRI-MU projection concluded that beef consumption per capita would slightly decline in the following years (Figure 7). In contrast, growth of the U.S. population would play an essential role in future meat consumption (Figure 7; U.S. Census Bureau, 2017). It seems that the population increase will overcompensate the reduction of per-capita beef consumption leading to a potential increase in domestic beef demand, especially when the price is acceptable.

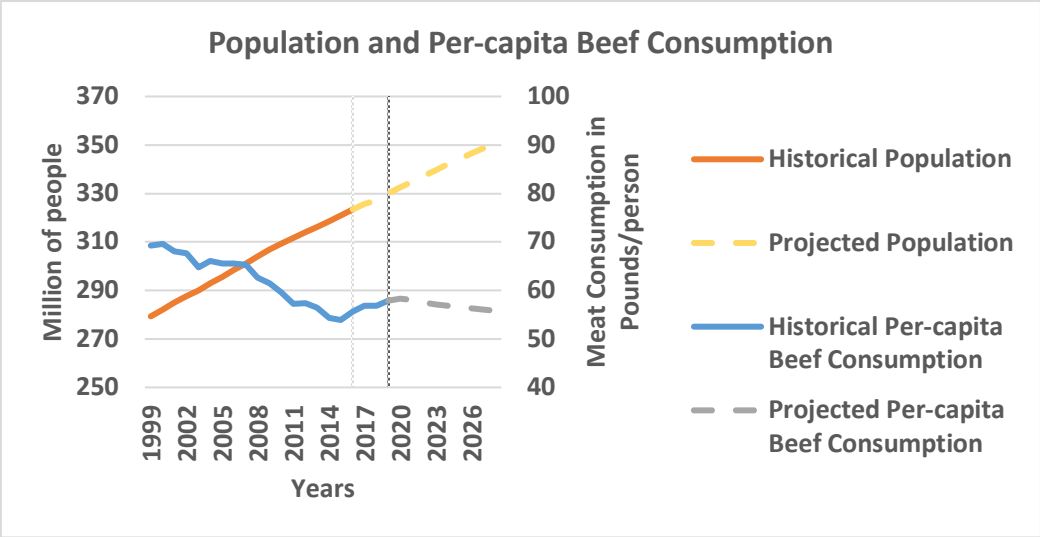

Figure 7. Historical and projected per-capita beef consumption and U.S. population. Integrated and adapted from U.S. Baseline Outlook, FAPRI – MU, 1999-2019 and 2017 U.S. Census Bureau.

Beef Price Trend

The interaction of beef demand and supply can be reflected by resulting prices. The shortage of beef cattle around 2013 prompted beef cattle prices and beef retail prices to rise dramatically (Figures 8 and 9). Prices of fed steers and feeder steers started to decrease after this peak and likely will continue to decrease until 2020. Then, cattle prices may rise until at least 2028.

The beef retail price looks more stable in recent years, but it has a strong upward trend, at least until 2028 (Figure 9).

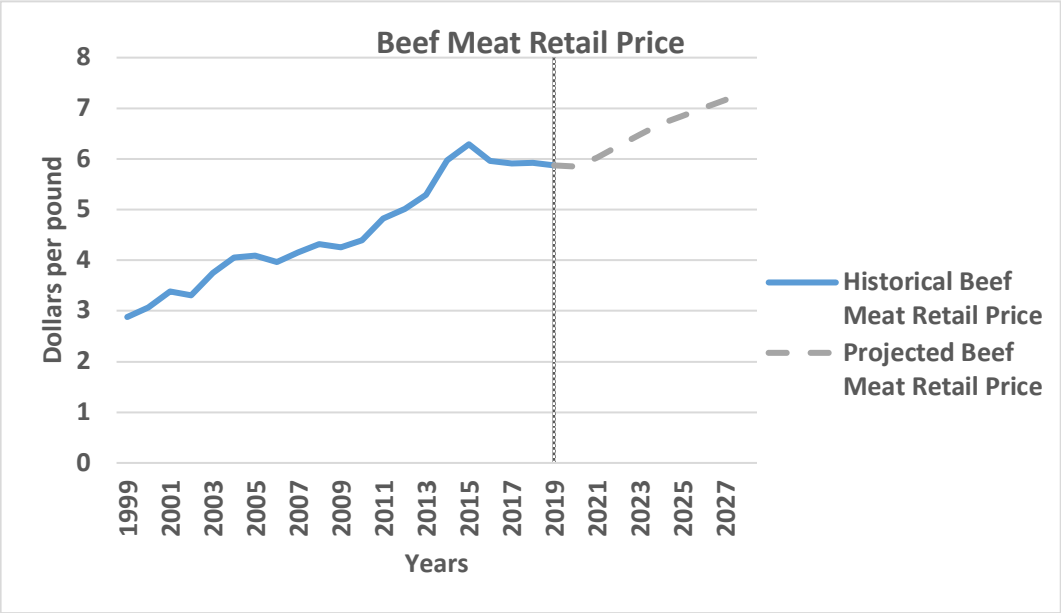

Figure 8. Historical and projected prices of fed steer (ready for slaughter) and feeder steer (ready for fattening). Integrated and adapted from U.S. Baseline Outlook, FAPRI – MU, 1999-2019.

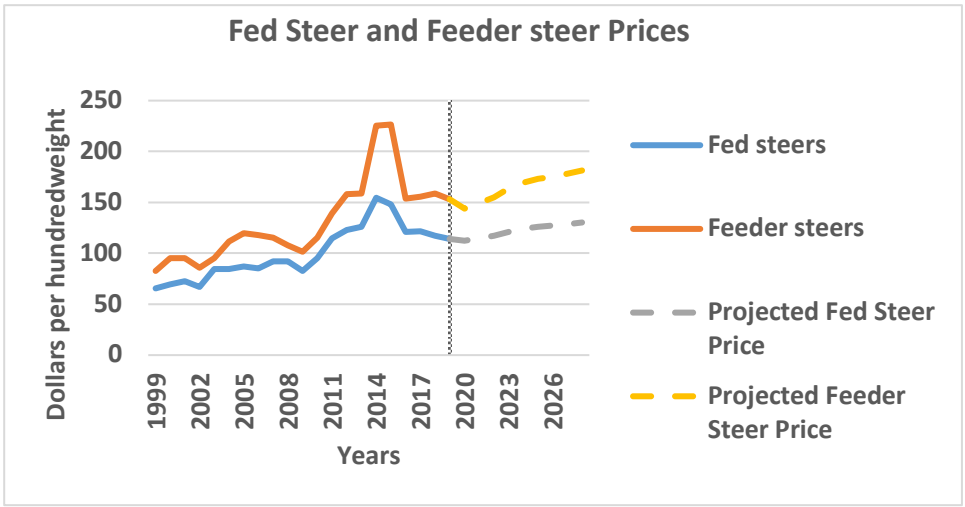

Figure 9. Historical and projected beef meat retail price. Integrated and adapted from U.S. Baseline Outlook, FAPRI – MU, 1999-2019.

Market projections discussed above indicate that a favorable economic climate may be available for dairy farmers to capitalize on beef semen strategies towards improved ICOSC that will last at least a decade. Growing population and open exports might even enlarge the beef demand, which would cause the beef market to maintain a

high demand. It seems that dairy x beef is here to stay, at least in the foreseeable future.

CONCLUSIONS

The sustainability of dairy × beef can be supported by technical and economic data. Advanced beef sire selection for dairy could technically improve quality of crossbreds for the beef industry. In addition, a projected downward cattle cycle and favorable beef prices will continue for the next decade, which could facilitate favorable environment for dairy farmers to sell more dairy × beef. There is still potential for domestic consumption and exports to increase beef demand, which could prompt even higher prices. Dairy × beef strategies that eliminate extra heifers, accelerate genetic progress, and increase revenues is feasible, sustainable, and could help dairy farmers overcome the dairy market's swings and maintain liquidity.

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