INITIAL ASSESSMENT OF CALF PERFORMANCE AND COW REPRODUCTIVE TRAITS IN A DOMINICAN REPUBLIC BEEF HERD

A Thesis

By

AMY ELIZABETH SILLER

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Chair of Committee,	Andy D. Herring
Co-Chair of Committee,	Daniel S. Hale
Committee Members,	Elsa A. Murano
Head of Department,	G. Clifford Lamb

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ABSTRACT

The objective of this study was to establish a benchmark analysis regarding beef herd productivity in a private, commercial beef cow operation in the Dominican Republic. Historical records (approximately n = 4,000) from January 2002 to July 2016 were obtained; the majority of cows were Brahman crossbreds. Calf weaning weight (**WWT**, n = 1,905) was influenced ($P < 0.001$) by cow age, cow color, calf sex, and calf age at weaning covariate. Mean WWT was 183.9 kg at 230 days of age, with males 10.9 kg heavier than females. As expected WWT was lowest from two (151.6 kg) and three year old cows (164.0 kg), and peaked with eight year old cows (199.7 kg). There was no obvious pattern for differences in WWT due to cow color, and ranged from 180.2 to 190.6 kg with the exception of one color code. Weaning age had an overall negative effect on WWT with a regression coefficient of -0.33 ± 0.05 kg/d; however calf weaning age ranged from 153 to 293 days. Calving interval (**CI**, n = 567) and cow reproductive productivity index (**CRPI**, n = 794) were both influenced by cow age ($P < 0.001$), but not color code. The mean CI was 462 (SD = 66) days. Range in CI means across cow age were 413 to 508 days, but had no obvious pattern across ages. Four and nine year old cows had the shortest CI with a mean of 413 and 418 days, respectively. The mean CRPI was 0.91 ± 0.27. In general, CRPI became lower as cows got older, especially for cows 13 and older (0.68 ± 0.045). Cumulative cow expense and cumulative income from calf sales were estimated with means of $RD 45,419 and $RD 33,016, respectively, with an overall negative net return of $RD -12,403 (-261.42 US$). Lifetime net return per cow was variable (SD = $RD 13,149, CV = 106%), ranging from -91,061 to 31,530 $RD. In

this herd cow reproduction and calf survival restricted economic efficiency, not calf size; CI and CRPI variability in this herd show that large improvements for economic measures are possible.

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INTRODUCTION

Cattle production systems have proven to be successful throughout the world, including Central America and the Caribbean. According to the Food and Agriculture Organization of the United Nations (FAO, 2017), livestock production systems are more suitable socially, economically and culturally when considering the welfare of local communities**,** due primarily to livestock production contributing to food security within those populations. Approximately 1 billion people worldwide rely on livestock production, many of which are poor smallholder farmers in developing countries (FAO, 2017). Livestock production has significantly increased since the 1960s, especially beef cattle production (Thornton, 2010). According to Thornton (2010), beef production has grown twice as large in number of animals and productivity and carcass weights have increased by 30% from the early 1960s to the mid-2000s. Latin America is specifically responsible for producing 23% of beef and buffalo meat worldwide (FAO, 2017). Even though cattle production provides many Central America and Caribbean countries with a variety of resources and benefits, many countries in Central America and the Caribbean have been unable to fully capitalize on their natural resources to become a strong leader in the market. Central America and Caribbean countries have many challenges to overcome before they can become a leader in the cattle production within their region.

One aspect of cattle production that is critical to Central America and Caribbean countries is forage-based cow-calf production. Cow-calf production is the first stage of the beef supply process that focuses on breeding the cows to successfully calve and wean once a year (or as close as possible). The success of the cow-calf production process depends on multiple interacting factors such as reproduction, nutrition (forage quality and quantity), management conditions, health, animal genetics and climate, many of which are challenging and difficult to control in Central America and Caribbean countries.

The overall objective of this study was to establish a benchmark analysis of factors contributing to beef herd productivity in a private, commercial operation in the tropical environment of the Dominican Republic.

LITERATURE REVIEW

Bos indicus vs *Bos taurus* breeds

Most of the cattle in tropical and sub-tropical regions of Central America and the Caribbean are of *Bos indicus* or *Zebu* influence. *Bos indicus* cattle have characteristics that allow them to better adapt to the tropical environments. They contain a high degree of heat tolerance, which is due to their low heat production and their ability to dissipate heat (Cunningham and Syrstad, 1987)**.** In addition, *Bos indicus* cattle are more resistant to parasites in comparison to *Bos taurus* cattle. These traits are beneficial for cattle in tropical regions because there is a higher prevalence of ticks and tick-borne diseases in these environments. Although *Bos indicus* cattle are better adapted to tropical environments, they do not contain specific traits that improve overall quality and productivity. In addition to having decreased tenderness and carcass quality, *Bos indicus* breeds also reach puberty at an older age in comparison to *Bos taurus* breeds (Randel, 2005). *Bos indicus* cattle also have longer gestation lengths and extended postpartum periods thus making it difficult to maintain a 365-day calving interval (Randel, 2005). According to Mackinnon et al. (1991), the growth rate in tropical regions depends on both the capability of cattle to grow and their ability to adapt to environmental stresses such as heat stress and parasites. Two specific tick-borne diseases prevalent in Central America and the Caribbean are bovine anaplasmosis and babesiosis, both of which negatively influence the cattle industry.

Disease prevalence

Bovine anaplasmosis and babesiosis

The occurrence of parasites is common in tropical and sub-tropical climates due to the high temperatures and rainfall, which promotes the development and perseverance of parasitic organisms (Beckley et al., 2016). Bovine anaplasmosis and babesiosis diseases stem from the parasites *Anaplasma marginale, Babesia bigemina* and *Babesia bovis* and are transmitted by a variety of tick species or other biting arthropods (James et al., 1985). *Anaplasma marginale* can also be introduced into susceptible cattle through contaminated needles (when vaccinating cattle against diseases), dehorners, ear taggers, castrating knives or other surgical instruments (Whittier et al., 2009). These tick-borne diseases create a range of financial losses resulting from a reduction in meat and milk production, illness, abortion and in worse cases a complete loss due to death.

According to Montenegro-James (1992), approximately 175 million cattle of the estimated 250 million in Central and South America are in tick-infested areas (between latitudes 33° North and 35° South of the equator). Montenegro-James (1992) estimated the annual economic loss in Central and South America to cost approximately $850 million and $1.4 billion dollars, respectively, with 58 million cattle affected in Central America, and 215 million affected in South America. The *Babesia* species specifically attacks and destroys erythrocytes, causing a multitude of symptoms such as severe anemia, anorexia, high fever, neurological symptoms, the enlargement of the spleen and liver, and ultimately death (TAHC, 2017). Cattle infected with the *Anaplasma* organism can also display similar symptoms caused by the *Babesia* species in addition to malaise, weight loss, constipation, labored breathing, and abortions in pregnant cows (Whittier et al., 2009). In addition, cattle with light skin will initially appear pale around the eyes and the muzzle but then change to a jaundice appearance due to the destruction of blood cells released into the bloodstream (Whittier et al., 2009).

Bos indicus breeds and their crosses are more resistant to these tick-borne diseases when compared to *Bos taurus* breeds. According to Jonsson et al. (2008), of the 1524 cases caused by *Babesia bovis* in northern Australia, 5%, 9%, and 48% were from *Bos indicus*, *Bos indicus* crossbreds and *Bos taurus*, respectively. Additionally, of the 206 cattle infected by *Anaplasma marginale*, 6%, 8%, and 58% were from *Bos indicus*, *Bos indicus* crossbreds, and *Bos taurus* breeds, respectively (Jonsson et al., 2008). Although *Bos indicus* and *Bos indicus* crossbred cattle are more tolerant to infection, it does not necessarily imply that they are immune to the disease. Those that become infected may not have been exposed to the disease at a young age and therefore do not develop a strong immunity against it. Bovine anaplasmosis and babesiosis are not the only common diseases affecting cattle in tropical environments. In addition to these tick-borne diseases, cattle in these environments often suffer from other diseases that cause both direct (death or reduced production) and indirect losses (cost of treatment and control).

Brucellosis, tuberculosis and leptospirosis

Tick-borne disease are not solely the cause of reduced cattle production in tropical environments, bacterial diseases such as brucellosis, tuberculosis and leptospirosis also have an effect on the cattle industry. Brucellosis is one of the most widespread bacterial zoonosis, specifically common in developing countries. The pathogen species responsible for bovine brucellosis is *Brucellae abortus* and spreads to humans through the consumption of untreated milk or milk products or through direct contact with the contaminated cattle (Lamy et al., 2012). Brucellosis is a reproductive disease that causes abortions in the third trimester of pregnancy, reduces milk production, and weakens calf performance (Lamy et al., 2012). According to Rushton (2009), the prevalence of brucellosis in Nigerian cattle was between 7% and 12% in a population of 18,222 animals. Rushton (2009) also estimated an economic loss of 12.6 million naira or approximately US $83,000 (XE, 2017a).

Bovine tuberculosis is another bacterial disease that causes illness and death in livestock and humans. It is caused by *Mycobacterium bovis* which is transmitted through the inhalation of aerosols or the ingestion of contaminated material (OIE, 2009). Bovine tuberculosis is characterized by the formation of granulomas, known as tubercles, commonly found in the lymph nodes (head and thorax), lungs, intestines, liver, spleen, pleura and peritoneum of affected animals (OIE, 2009). Cattle infected with bovine tuberculosis may not display symptoms during the early stages of infection; however, they may show clinical symptoms at later stages such as weakness, anorexia, emaciation, dyspnea, enlargement of lymph nodes and cough (OIE, 2009). Production losses include condemnation of carcasses and organs of infected animals and losses in milk production (Rushton, 2009). Although there are substantial losses associated with the control and eradication of bovine tuberculosis, the expenses are justified in order to meet the needs of the public health and the cattle industry (Rushton, 2009).

Another common zoonotic disease in tropical environments is leptospirosis. Leptospirosis is caused by the bacteria of the genus *Leptospira* and can cause abortions, stillbirth, deaths, decreased milk production and infertility of the infected animal (Ellis, 1984). The disease can be spread through the direct contact between hosts or through contact with the urine of persistently infected animals (Lunn, 2016). There are more than 250 serovars of the *Leptospira* bacteria, with each being prevalent in specific regions of the world and having a specific type of host that serve as reservoirs for infection (Lunn, 2016). The most common serovars among cattle are Hardjo, Pomona and Grippotyphosa (Grooms, 2006). Abortions caused by the Hardjo infection are typically sporadic and can occur many weeks or months after infection; whereas, abortions associated with Pomona and Grippotyphosa occur in groups or “abortion storms” (Grooms, 2006). In addition, the Hardjo infection can persist for more than a year in the male and female reproductive organs and other serovars, like the Pomona, can last for shorter periods (Grooms, 2006).

Vaccines are an essential tool used to protect herd health and reduce undesirable outcomes caused by diseases. Although vaccines do not prevent against disease, they do increase herd immunity and resistance among individual animals (Bagley, 2001). There are vaccinations available for both brucellosis and leptospirosis. The brucellosis vaccine, composed of Strain 19 or RB51, is used to increase resistance to the infection, specifically in regions of high-incidence (Nicoletti, P., 2016). Vaccinating against leptospirosis is usually performed with a five-strain vaccine to provide an extensive range of protection (Bragley, 2001). Separation and treatment of infected animals from healthy animals can also reduce the distribution of the disease.

Bovine viral diarrhea and Infectious bovine rhinotracheitis

Other economically important diseases in many temperate and tropical environments are bovine viral diarrhea (BVD) and infectious bovine rhinotracheitis (IBR). Bovine viral diarrhea, caused by bovine viral diarrhea virus (BVDV), creates respiratory and reproductive problems in cattle (Solis-Calderon et al., 2005). The BVDV can be transmitted through various forms such as transplacental infection to the fetus, direct contact between susceptible cattle and persistently infected cattle shedding the virus, and by indirect exposure to secretions containing the virus (Solis-Calderon et al., 2005). According to the APHIS (2009), fetuses are the source of persistently infected cattle. Fetuses that survive the BVDV infection between 18 and 125 days of gestation become immunotolerant to the virus and afterwards become persistently infected with the virus that allows them to spread the virus to noninfected cattle (Grooms, 2006). If recently infected cows become pregnant, they can spread the infection to their calves and thus create the next generation of persistently infected calves (APHIS, 2009). Symptoms of BVD include abortion, stillbirth, fever, lethargy, loss of appetite, ocular and nasal discharge, diarrhea and decreased milk production (APHIS, 2007). The most common birth defect caused by BVDV is cerebellar hypoplasia, which can also cause ataxia, tremors, stumbling and failure to nurse (APHIS, 2007). Hessman et al. (2009) evaluated the economic effects of cattle exposed to 21,743 high-risk calves with BVDV and found the costs to be $67.49 per head, with the majority of the loss being performance (average daily gain and feed-to-gain ratios).

Infectious bovine rhinotracheitis is an infectious respiratory disease caused by Bovine Herpesvirus-1 (BHV-1). The virus can be transmitted through direct contact with infected cattle and by the reactivation of latent persistent infections during stressful events (Kahrs, 1981). The virus enters the mucous membrane of the upper respiratory tract or genital tract (Muylkens et al., 2007). Unlike BVD, where persistently infected animals constantly shed the virus, the BHV-1 persists in the nerve cells where it becomes inactive until it is reactivated by stress (Muylkens et al., 2007).In addition to causing respiratory distress, BHV-1 can also cause reproductive, ocular and neurological issues in cattle. Symptoms include fever, coughing, reduced appetite, lesions, conjunctivitis, ocular discharge, infertility and abortion (Kahrs, 1981).

Although the diseases discussed in this review differ from one another, they do share one common attribute and that is the impact it creates on the industry through the decrease in cattle health and therefore productivity. Fortunately, vaccines have proven to be effective at reducing the prevalence of disease that harm cattle production. Most of the cattle diseases found in Central American and Caribbean countries, specifically the Dominican Republic, can be controlled by veterinary preventative programs such as vaccines, spraying, dipping, and other methods (World Bank, 1971). Bayer, Pfizer, and Merck are a few veterinary products that are available for importation from more developed countries (World Bank, 1971). However, the resources needed to ensure positive results are costly and challenging to secure in developing tropical environments. Many countries have established programs to control or eradicate bovine diseases that cause major production losses but such programs require investments and funds that are not always available and thus make the programs ineffective. In order to prevent or reduce the effects of diseases on cattle in Central America and the Caribbean, management practices should be implemented that focus on not only improving herd health but also on maximizing growth and productivity overall.

Cow longevity

Culling

Perhaps the most important and desired production trait in cow-calf operations is cow longevity. Longevity is described as the reproductive lifespan of cows (Tanida et al., 1988). Longevity is associated with other imperative traits such as fertility, conformation, disposition, milking production, calving ease, health status and weaning weight- all of which are influenced by genetics, environment and production conditions. A decrease in cow longevity ultimately leads to culling. Culling cattle that are performing poorly is an important tool used to eliminate unprofitable, unproductive or undesirable animals. Culling criteria is selected based on specific production goals, conditions and environment. According to APHIS (1999), the two primary reasons for culling cows are age/teeth and pregnancy status. Approximately 39.8% and 24.3% of cows that were culled in 1997 were sold due to old age or bad teeth and pregnancy status, respectively (APHIS, 1999). According to Bascom and Young (1998), culling cows can be a multifactorial decision. Bascom and Young (1998) conducted a study to determine whether cows were culled for various reasons and found that farmers identified a secondary reason for culling for 35% of all culled cows, and a tertiary reason was documented for 11% of culled cows. Recording causes for culling cows allows cow-calf operations to identify problems, create solutions, and consequently improve overall productivity and profitability.

Factors influencing longevity

The productive lifespan of a cow is variable. Older cows are more likely to encounter problems such as losing their calf, producing an undesired weaning weight or grazing ineffectively due to teeth deterioration. In addition, the overall body condition and health of the cow influences both the performance of the cow and her calf (Riley et al., 2001). Cattle of different breeds also exhibit different characteristics in longevity. Riley et al. (2001) studied the lifetime productivity in F_1 *Bos indicus* x Hereford cows and found that Nellore crossbreds had the highest cow survival to 14 years and the highest longevity. Bailey (1991) also found that breed type significantly influenced the reproductive lifespan of beef cows, specifically in the number of mating seasons per cow and the total number of calves born and weaned in the lifetime of the cows. Bailey (1991) found that F_1 *Bos indicus* dams crossed with Angus or Hereford sires had a longer productive life than *Bos taurus* breeds and crosses. The study found the lifetime total number of calves weaned for Hereford, Red Poll, Hereford x Red Poll, Red Poll x Hereford, Angus x Hereford, Angus x Charolais, Brahman x Hereford and Brahman x Angus were 4.54, 5.45, 4.45, 5.49, 5.98, 5.57, 6.95, and 6.22, respectively (Bailey, 1991). Although *Bos indicus* breeds and crosses have a higher lifespan when compared to *Bos taurus* breeds, they also have some disadvantages in that they take longer to reach puberty, have longer gestation lengths and overall reduced meat tenderness.

The deterioration and loss of teeth influence the ability of a cow to graze, which alters the amount of nutrients received to maintain a proper body condition and reproductive function (Riley et al., 2001). Riley et al. (2001) evaluated mouth scores and found that 14 year old Angus crossbreds had lower mouth scores and were missing more incisors than *Bos indicus* crossbreds. Núñez-Dominguez et al. (1991) also analyzed the condition and size of the teeth of 10 to 15 year old cows of Angus, Hereford, and Shorthorn breeds and found that crossbreds had significantly better and longer teeth than straightbreds. In addition, the Núñez-Dominguez et al. (1991) observed a higher incidence of teeth wear on the incisors located in the middle of the mouth (compared to those located towards the sides of the mouth), a decrease in teeth size with age, and a higher wear rate at younger ages.

The udder is one of the most important physiological and conformational characteristics of the cow due to its significant role in milk production, milk consumption, and calf growth (Velazquez, 2000). Various studies have shown a correlation between milk yield and calf performance. Velazquez (2000) reported that approximately 60% of the variance in weaning weight is influenced by milk production. Boggs et al. (1980) found that an additional kilogram of milk per day increased weaning weight by 7.20 kg and added 0.34 kg/day of average daily gain (ADG). The soundness of the udder affects the amount of milk each calf receives and thus cow longevity

(Kersey DeNise et al., 1987). A healthy udder should be firmly attached with four teats proportional to body size. Pendulous udders and large balloon shaped teats can prevent the calf from effectively nursing and consequently affects milk consumption and calf performance. In addition, pendulous udders and large balloon shaped teats can cause udder health problems such as subclinical mastitis or intramammary infections; however, such problems can be eliminated by culling cows with unsound udders or teats (Persson Waller et al., 2014).

Production traits

Reproduction efficiency

Open cows expend resources such as feed, forage or vaccines, without producing a calf to compensate for the expenses. In order for cow- calf operations to be profitable, cows must be able to produce marketable calves every year until they are no longer capable in which producers will make the decision to cull them. To maintain a 365-day calving interval, cows must rebreed within 80 days after calving. Calf-crop or weaning percentage is an essential tool used in beef production to determine reproduction efficiency. It is measured by dividing the number of calves weaned by the number of cows exposed to the bull times 100. Body condition and nutrition influence reproduction efficiency.

Body condition scores (BCS) are assigned at various stages (i.e. weaning, breeding, and calving) to suggest the body composition of a cow (Eversole et al., 2009). BCS ranges from 1 to 9, with 1 representing a very thin cow and 9 being extremely fat.

Beef cows, on average, have a BCS of 3-7; however, before calving, cows should have a BCS of 5, 6 or 7. A low BCS can reduce calf growth rate and pregnancy rate and increase calving interval (Eversole et al., 2009). Rae et al. (1993) analyzed pregnancy rates in association with cow parity (number of calvings) and body condition scores in Florida beef cattle. Cows were organized into groups of parity and BCS (1-9), but due to insufficient observations in BCS greater than 6, were categorized into groups of BCS ≤3, 4, and ≥5 (at breeding). Groups of cows with a BCS of ≤3, 4, and ≥5 had pregnancy rates of 31%, 60%, and 89%, respectively (Rae et al., 1993). Eversole et al. (2009) found a substantial difference in profitability in percent calf crop between cows with a BCS of 4 and 7, thus having a direct impact on profitability and consequently the overall success of an operation (Eversole et al., 2009).

Body condition score that estimates body composition is an accurate method for determining the nutritional status of beef cows (Herd and Sprott, 1986). Body condition score is associated with various reproductive factors that are also interrelated with nutrition, such as postpartum interval, calving interval, calving ease, milk production and weaning weight (Funston, 2014). In addition, BCS at calving can indicate when beef cows will resume cycling after parturition (Funston, 2014). Nutritional requirements differ based on reproductive status. Cows with nutritional restrictions during the pre-partum period tend to have a lower BCS at calving, extended postpartum anestrus, and an overall decrease of cows displaying estrus during the breeding season (Lamb, 1999). Lamb (1999) also reported that cows with a BCS of 3 or 4 had longer post-partum intervals on return to estrous cycles than beef cows calving with a BCS of 5, 6 or 7.

Another study found an increase in estrus during the first 20 days of postpartum in cows with a BCS of 4 and 6 when fed a 0.85 kg/day versus 0.44 kg/day; however, the percentage of estrous response increased more with the BCS 6 (40% to 85%) than the BCS 4 (33% to 50%) (Funston, 2014).

Establishing an appropriate feeding program for beef cows is crucial. This is especially important for cows in the last trimester of pregnancy and in lactation due to their increase in nutritional demands. According to Funston (2014), positive energy balance after calving is vital for rebreeding cows calving in low body condition. Lalman et al. (1997) conducted a study to determine the correlation between weight change and body condition on postpartum interval of thin first-calf beef heifers and found that postpartum interval decreased as dietary energy density increased from 198 to 305 kcal ME/kg $BW^{.75}$.

Milk production and weaning weight

Milk production is an important factor affecting calf weaning weight which consequently influences the profitability of cow-calf producers (Minick et al., 2001). Milk specifically containing high fat and protein is linked to improved pre-weaning weight gain of calves (Edwards et al., 2017). Although a correlation exists between milk production and weaning weight, there is a high cost of production to maintain cows with a greater milk yield (Edwards et al., 2017). Expected progeny differences (EPDs) have been used to estimate the genetic merit of cattle for different traits (Minick et al., 2001). Minick et al. (2001) found that daughters of high-milk EPD sires produced more milk and weaned heavier calves than those of low-milk EPD sires, but had a lower BCS than low-milk cows. In addition, Minick et al. (2001) found that spring-calving cows produced more milk and weaned heavier calves than those calving in the fall probably because they spent most of their lactation on summer grass, whereas fall-calving cows spent their lactation time on winter feed. Buskirk et al. (1995) found an inverse relationship between milk consumption and forage intake where calves consumed more forage when their dam's milk production was reduced. Buskirk et al. (1995) also found that heifers receiving low and high amounts of ground corn supplement gained 0.43 and 0.62 kg/d, respectively. In addition, Buskirk et al. (1995) found that the heifers receiving high amounts of corn supplement were 26 kg heavier at a year of age than those that received the low amount. Milk production data were obtained at 54, 104, and 153 days postpartum through calf weigh-suckle-weigh procedures and was found that heifers fed the high corn supplement produced 10% more milk which resulted in heavier calves at 54, 104, and 153 days of age (Buskirk et al., 1995).

In addition to milk production, other influential factors affect weaning weight such as environment, breed, genetics, age of dam, health, calf sex, and age at weaning. Cattle in tropical and sub-tropical regions are exposed to high temperatures and humidity, which increases heat stress and the prevalence of ticks and disease. Trail et al. (1985) compared *Bos taurus* and *Bos indicus* crosses with straightbred *Bos indicus* cattle and found that the progeny from crossbred dams (Angus and Red poll males x indigenous Ankole, Boran and small East African Zebu females) weighed 23.2 kg more at weaning than calves from straightbred dams (Ankole, Boran, and Zebu). According to

Tewolde (1986), this may be due to a heterosis interaction that plays a significant role in the tropics. Tewolde (1986) reported 9.12%, 3.71% and 10.56% heterosis values for weaning weight of Brahman x Santa Gertrudis, Santa Gertrudis x Criollo, and Brahman x Criollo crosses, respectively, in Costa Rica. Mpofu et al. (2017) studied the effect of calf sex on weaning weight in different climatic regions of South Africa and found that male Nguni calves (a Sanga breed of Southern Africa) weaned 19.56 kg heavier than female calves, regardless of region (128.18 kg vs. 108.62 kg, respectively). Mpofu et al. (2017) also reported heavier weaning weights for male calves in humid regions when compared to the female calves. In addition, male calves in the humid region performed better than all calves in arid, semi-arid and dry sub-humid zones (Mpofu et al., 2017).

Animal identification

Animal identification plays an important role in production systems and allows producers to identify animals that are unproductive. Cattle can be identified through ear tags, notches, tattoos, or brands. Proper record keeping is a crucial management tool that can influence the efficiency of an operation. Identifying individual animals in a herd allows producers to collect records on cow ID, calf ID, sire ID, cow birthdate, calf birthdate, calf birth weight, weaning weight and weaning date, and breed. Record keeping can be used when making culling decisions to improve the overall profitability and productivity of an operation.

Summary

Latin American countries face many specific challenges preventing them from maximizing beef cattle production. Most of the cattle in tropical and sub-tropical regions are of high percentage *Bos indicus* (Zebu) influence, which possess characteristics making them more tolerant to the stresses of heat, parasites or disease, but also are lower for many desired production traits that *Bos taurus* cattle possess. The success of beef cattle production in these countries depends on many interacting factors such as reproduction potential, management conditions, health, animal genetic resources and climate. An important and desired production trait in cow-calf operations is cow longevity, which is highly based on reproductive efficiency and degree of adaptation in combination with production, environment and management practices. Cows that are no longer productive or profitable should be identified and removed from breeding herds.

This thesis evaluates existing production data collected from a single cow-calf producer in the Dominican Republic, based on available information. This analysis is an initial assessment and provides a benchmark regarding cow fertility and calf production to improve overall herd productivity in that tropical environment.

MATERIALS AND METHODS

Animal background and management

Historical records (approximately n= 4,000) were obtained from a commercial beef cattle operation in the El Seibo Province of the Dominican Republic. This operation had recorded several years' worth of information but, for research purposes, only data from January 2002 to early July 2016 were obtained. Breeds of sires and crossbreed females included Angus (AN), Red Angus (AR), Brahman (BR), Charolais (CH), Chianina (CA), Senepol (SE), Simbrah (SI) and Simmental (SM). The majority of the cows were approximately 50% to 75% Brahman. This operation uses natural service as well as AI sires.

In 2016, this tropical environment had an average annual temperature of 28 °C and an average yearly rainfall of approximately 1,450 mm, with the most precipitation falling in May, September and October (WWO, 2017). The annual rainfall in 2009, 2010, 2011, 2012, 2013, 2014 and 2015 was approximately 2,589 mm, 2,389 mm, 1,305 mm, 755 mm, 662 mm, 695 mm, and 835 mm, respectively (WWO, 2017). The breeding of females in this operation is year-round to help supply beef for a custom meat shop and restaurant, with approximately 5 to 6 animals harvested per week. Calves are weaned at approximately 7 months of age. Male calves are surgically castrated (which is a not a typical DR practice) at approximately 6 months of age, but were castrated with elastic bands for several years up until 2016. The cattle destined for beef sales are grass-fed through intensive rotational grazing on improved pastures and do not receive growth promoting hormones. In addition, cattle are vaccinated for brucellosis (heifers only), leptospirosis, BVD, parainfluenza-3, IBR, and bovine respiratory syncytial virus. There have not been any structured or strict culling criteria regarding fertility among breeding cows.

Data assessment

The data were stored in CattlePro (Global Livestock Management Systems LLC, Sadieville, KY). These records contained detailed cattle information that required translation from Spanish to English and organization into a useable format for formal statistical analysis. The data were organized using R programming (R Foundation for Statistical Computing, Vienna, Austria) and were converted into three useable EXCEL (Microsoft Office, Redmond, WA) files (cow information, calf performance and reproductive history) to be imported in the Statistical Analysis Software (SAS Institute Inc., Cary, NC) for analysis. The "cow information" EXCEL file contained the following information: cow ID, birthdate, sire ID, dam ID, color, breed, estimated breed composition, and bought/raised information. "Calf performance" contained cow ID, calf ID, sire ID, birthdate, sex, weaning days of age, weaning weight, birth weight and status of the calf. "Reproductive history" file included cow ID, date of service, breeding date, estimated parturition, type of service (AI vs Natural), sire ID, palpation date and pregnancy status. The cow information and calf performance files were merged together and modified to include calf birth year, Julian birthday and cow age in days and years. Additional modifications to the data were made especially for cow color to obtain uniformity (many were the same color but were recorded differently). The new colors included the following: black, brindle, brindle with white, brown, brown with white, grey, grey with white, red, red with white, yellow and yellow with white. The “with white” indicated white marking anywhere on the body (face, belly, legs, etc.). A separate EXCEL file was also created that included cow age at calving and calf birthdate. Calving interval and cow productivity index were also documented in this file along with perfect calving records through six, seven, eight, ten and twelve years of age. The total number of calves produced and weaned were also calculated and documented in a separate file.

Total income per cow was calculated as (average weaning weight * total calves weaned) * 75, where 75 represented calf value (RD$75/ kg live weight) in the Dominican Republic. The annual cost per cow in the cow calf operation was estimated at RD$6,000. The calf value and annual cost per cow in the operation were provided by the producer. The total expense per cow was calculated as (cow age in years + 0.67) * 6000; the value of 0.67 was included to account for the additional time and associated expense of weaning an 8 month old calf (eight months divided by twelve). Net return per cow was calculated by subtracting expense per cow from income per cow. The exchange rate used for one USD and RD was 47.45 pesos (XE, 2017b). The simple means and variability for income, expense, and net return were evaluated, but were not statistically analyzed.

Statistical analyses

Traits in the dataset that could potentially influence calf weaning weight and cow reproductive performance were investigated through mixed model procedures (PROC

MIXED) in SAS. Calf's weaning weight (n = 1,905) were evaluated that included fixed effects of cow age in years, estimated breed composition, cow color, and sex of calf. Age at weaning and Julian birthday were included as covariates. Cows 11 years and older were combined and only crossbreds were evaluated in this model. Weaning weights were not analyzed for purebred calves due to many confounding variables associated with these cows, and the small numbers purebred cows per breed. Calving interval was calculated as the difference between calf birth dates and averaged across number of calves born minus 1. A cow reproductive productivity index was calculated as 2 – (cow age in years - 2) / number of calves born). This index approach calculates a value of 1.00 for cows calving first at three years with annual calving thereafter as a standard benchmark value useful for the tropics (for instance a cow that is five years old, and has produced two calves would have a calculated value of 2 – (5 - 2) / 2 = 0.50, etc.). Calving interval (n = 567) and cow reproductive productivity index (n = 794) were also analyzed using mixed model procedures and included cow age and color as fixed effects. Two year old cows were removed from the data, and cow ages of 13, 14, and 15 were combined.

Sire breeds were not used in any model because they were entered as placeholders, except for those that were used for artificial insemination. Potential 2-way interactions between main effects were also tested for significance.

Frequencies were analyzed for cows with perfect calving records from three through six, seven, eight, ten and twelve years. Two year olds and heifers that had not yet calved were removed from this analysis. Frequencies were also calculated for cow age, color and service type (AI vs natural service).

RESULTS AND DISCUSSION

A dataset from a single, commercial beef cow operation in the Dominican Republic was provided for analyses, with performance records and inventory available as of July 1, 2016. Table 1 summarizes the continuous traits of interest in the dataset. Weaning weight, weaning age, cow age, calving interval and cow reproduction productivity index are discussed in the subsections below. The mean, cumulative net return per cow for the operation was -$RD 12,403.32 (Dominican pesos), or -$261.42 (USD). This operation sells calves later in life (not at weaning), and whether or not this calculated net return is truly realistic for this operation is unknown. The traits with higher relative variation (CV) were cow age, income, and net return with a variation of 43.19, 75.56, and 106.01, respectively.

Table 1. General summary table for continuous traits

Trait	n	Mean	SD	CV	Min	Max
Weaning weight, kg	1905	183.8	26.94	14.66	89	281
Weaning age, d	2005	230.3	11.48	4.98	155	293
Cow age, yr	794	6.8	2.98	43.19	3	13
Calving interval, d	567	462.3	66.31	14.34	318	827
Productivity index	794	0.91	0.27	29.67	0	2
Income, RD$	794	33,015.85	24,947.30	75.56	0	96,600.00
Expense, RD$	794	45,419.17	18,158.14	39.98	19,356.99	91,061.10
Net return, RD$	794	-12,403.32	13,148.58	106.01	-91,061.10	31,530.00

Calf weaning weight

Approximately 60% of calving records contained a weaning weight record, and lack of a recorded weaning weight was assumed to represent calf loss; a calf loss of 40% from birth to weaning is extreme, and may not be realistic in these data. The overall mean for weaning weight was 183.8 kg at 230 days of age, which was similar to the adjusted weaning weight reported by Osorio-Arce et al. (2010) of 178.5 kg at 240 days for Brahman crossed with Charolais, Simmental and Brown Swiss breeds in the tropical environment of Tabasco, Mexico. On the other hand, weaning weights from calves in the U.S. differ from those in many developing tropical countries. For example, the Southwest Standard Performance Analysis (SPA) reported an average weaning weight of 230.2 kg at approximately 205 days of age for 44 herds (17,196 total cows) in Texas, Oklahoma, and New Mexico, which was substantially higher (Mathis et al., 2014).

The weaning weight analysis included the following as fixed effects: cow age, estimated breed composition, color of crossbred cows and calf sex. The model also included the regression of calf weaning age in days on weaning weight. Estimated breed composition ($P = 0.640$) was studied in the preliminary analysis but had no effect on weaning weight and was removed from the model. Julian birthday represented calf age and was also evaluated as a covariate in the initial analysis to determine its effect on weaning weight; however, Julian birthday ($P = 0.918$) was not influential and was removed from the model. Least squares means and standard errors for weaning weight by cow age in years and calf sex are presented in Table 2. Age of the crossbred cows had an influence on weaning weight ($P < 0.0001$). Least squares means for calves from eight year olds were higher (*P* < 0.0001) than cows at any other age, but were not different (*P* > 0.05) as compared to calves from nine or ten year old cows. Weaning weight increased with cow age until eight years of age and plateaued afterwards. This finding was not surprising as calves from younger cows are generally lighter than calves produced by older cows (Raphaka and Dzama, 2009; BIF, 2010). First-calf heifers and other young cows are not at full maturity until later in life and therefore produce smaller calves. In addition, cows at a mature age will reach their production peak and then decrease in efficiency when they reach old age (Raphaka and Dzama, 2009). Raphaka and Dzama (2009) reported mature cows as between 5-12 years for Composite and Tswana breeds in Southern Africa and found significant calf weaning weight performance from cows in these age categories compared to calves of three and four year old cows that performed significantly different (*P* < 0.05) . Approximately 244 records did not include cow birthdate.

Sex of calf was also important for weaning weight (*P* < 0.0001) as expected. Male calves (189.7 kg) were on average 10.9 kg heavier at weaning than female calves (178.8 kg). This finding was similar to reports by Tuah and Nyamma Danso (1985) where N'Dama and West African Shorthorn male calves were heavier at weaning than females by 9.36 kg and 10.59 kg, respectively. Mpofu et al. (2017) also found that Nguni male calves averaged 20.9 kg more than female calves at weaning in the humid regions of South Africa, 131.7 kg vs. 110.8 kg, respectively. Cow age x sex of calf interaction had no effect on weaning weight (*P* > 0.05). Table 3 shows the frequency distribution for calf sex. These observations include female and male calves born by all cows in the dataset (crossbreds and purebreds), but only calves from crossbred cows were analyzed for weaning weight. Table 3 also shows the frequency for sex of calf containing weaning weight records.

Table 2. Least squares means and standard errors for weaning weight (kg) by age of crossbred cows (yr) and calf sex.

Effect	n	LSM ± SE, kg
Age, yr		
2	57	151.6 ± 3.20[a]
3	244	164.0 ± 1.83[b]
4	166	180.3 ± 2.06[c]
5	176	186.4 ± 1.99[di]
6	168	186.8 ± 2.06[defi]
7	109	192.1 ± 2.39[efhi]
8	107	199.7 ± 2.40[gh]
9	103	194.1 ± 2.44[fghi]
10	92	195.5 ± 2.55[fghi]
11+	87	192.1 ± 2.66[defhi]
Sex of calf		
Female	691	178.8 ± 1.38[a]
Male	618	189.7 ± 1.44[b]

[a-i]Means with different superscripts differ ($P < 0.05$)

Table 3. Frequency of calf sex across all birth date and weaning weight records

	Birth records		Weaning records	
Sex	n	Percentage (%)	n	Percentage (%)
Female	1,562	52.1	1,012	52.3
Male	1,435	47.9	922	47.7
Total	2,997	100	1,934	100

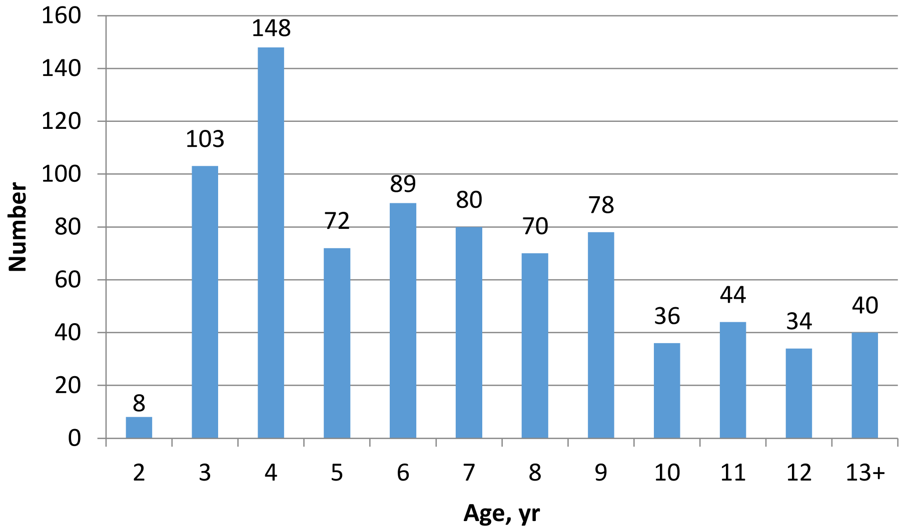

Figure 1. Frequency distribution of cow age in July 2016 inventory among cows with calf birth date recorded (n = 802).

Although the specific breeds or percentages were uncertain in several cases, the majority of cows were documented as crossbreds of Brahman with Charolais or Simmental. Because exact pedigree information was not consistently available, but cow color code was, it was investigated as a proxy for genetic influence. Cow color had a large influence on weaning weight (P = 0.0002), and in these analyses the colors likely reflect breed and family line effects rather than color alone. The least squares means and standard errors for weaning weight across cow color codes are shown in Table 4. The cow color x sex of calf interaction did not influence weaning weight (P > 0.05) in preliminary analyses and was not included in the final model. Most of the cows in the analyses were Brahman crossbreds. Grey cattle most likely reflect a higher percentage of Brahman. Cows with white markings may have Charolais influence. Red cows could be

Red Angus, Senepol, or Simmental influence. Grey cows with white markings had the highest least squares mean for weaning weight.

Table 4. Least squares means and standard errors for weaning weight (kg) by color of crossbred cows.

Color	n	LSM ± SE, kg
Brindle white	5	163.7 ± 10.04[a]
Grey	336	180.2 ± 1.26[ac]
Black	17	189.4 ± 5.47[bc]
Brindle	21	181.5 ± 4.91[bc]
Brown	156	186.7 ± 1.82[bc]
Brown white	166	184.8 ± 1.76[bc]
Grey white	70	190.6 ± 2.71[bc]
Red	194	186.4 ± 1.63[bc]
Red white	143	189.5 ± 1.89[bc]
Yellow	118	185.5 ± 2.09[bc]
Yellow white	83	188.2 ± 2.47[bc]

[a-c]Means with different superscripts differ ($P < 0.05$)

The regression of weaning weight on weaning age was also statistically significant ($P < 0.0001$). There was an overall negative effect of weaning age on weaning weight with a regression coefficient of -0.33 ± 0.05 kg/d. This relationship was unexpected as older calves are generally heavier than younger calves, and weaning weight increases with weaning age. The Beef Improvement Federation Guidelines (BIF, 2010) has stated that calves in a 90-day window (160 to 250 days of age) may be adjusted to 205-day basis. However, in these data there was no limitation on the age range which was from 155 to 293 days. This negative estimate may also indicate that it may be detrimental to both the calf and the cow to not wean calves earlier for this operation.

Calving interval

The calving interval analysis included cow age in years and color code as fixed effects. Cow age had a significant influence on calving interval ($P < 0.0001$); however, color did not ($P = 0.527$). The least squares means and standard errors for calving interval by cow age are presented in Table 5. There were 567 records analyzed for calving interval with an overall mean of 462 days. Five-year-old cows had the longest calving interval of 508 ± 11.49 days with the majority of this age group having produced two calves within this interval. Four and nine-year-old cows had the shortest average calving interval with a mean of 413 ± 16.80 and 418 ± 20.52 days, respectively. The target optimal calving interval is 365 days (one calf per year) in order to obtain the highest economic return and productivity; however, this target number may not be as realistic in tropical environments due to breed differences and their ability to adapt to unfavorable weather conditions, in addition to other factors (Medina et al., 2009), and its interpretation may be different in herds with year-round calving as compared to defined breeding and calving seasons. The average of 462 days in this dataset was similar to that reported by Medina et al. (2009) of 467 ± 100 days for Brahman, Brangus, Angus and Brown Swiss breeds in the tropical region of Mexico. Medina et al. (2009) also reported an influence between cow age and calving interval and observed shorter intervals (442 days) in cows with four or more calvings compared to the longer interval of 485 days for second calving cows. Mukasa-Mugerwa (1989) reported similar calving intervals in Nellore and Zebu breed cattle in Brazil of approximately 15 months (456 days) and 14.4 months (438 days), respectively. Mousel et al. (2012) studied the effect of heifer calving date on longevity in U.S. *Bos taurus* and reported an increased longevity for cows that calved during the first 21 day period of their first calving season when compared to those that calved in later periods (21 days and after). Calves also had heavier weaning weights when born during the first 21 day period.

Figure 2 shows the percentage of cows with perfect calving records from three years of age to six, seven, eight, ten and twelve years of age. Approximately 10% of cows in this dataset had perfect calving records from three to six years, and indicate animals with superior fertility. Engle et al. (2016) found that higher percentages of 50% *Bos indicus*-50% British heifers were able to maintain perfect calving records through 5, 6, and 7 years of age when they calved in the first 21 days of their first calving season when compared to those that calved later in the first calving season. Similarly, Mousel et al. (2012) reported a perfect calving record through ten years of age in *Bos taurus* heifers that calved during the first 21 day period of their first calving season.

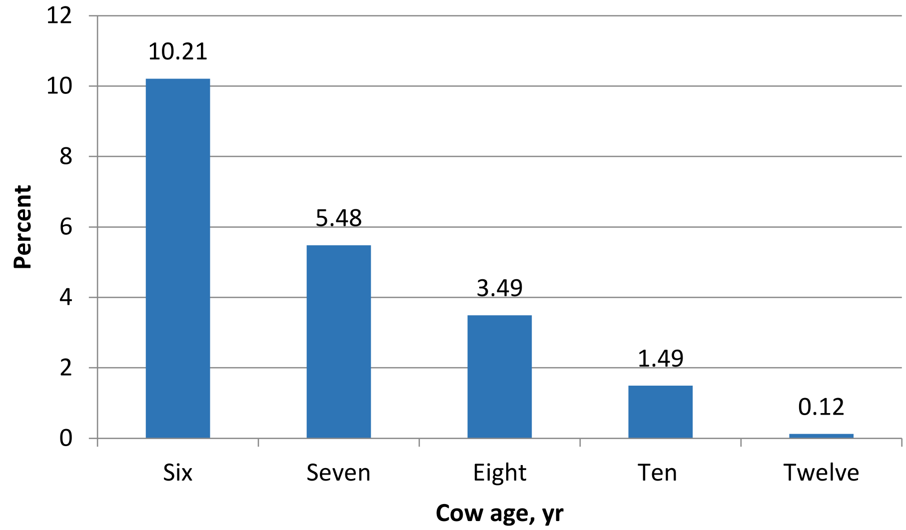

Figure 2. Percent of cows, 3 years of age and older, with perfect calving records through various ages (n = 803).

Cow reproduction productivity index

The cow reproduction productivity index analysis, similar to the calving interval model, included cow age in years and color code as fixed effects. Two year old cows were removed from the model. Age at last available calving record (based on July 2016 inventory) and the total number of calves were used to calculate this reproductive productivity index. Cow age had an effect on the cow productivity index ($P < 0.0001$), but color code did not ($P = 0.755$). The least squares means and standard errors for cow productivity index by cow age are presented in Table 5. Cows with a calculated productivity index of 1.00 calved first at three years and gave birth to a calf every subsequent year, and cows with values just under 1.00 had very few skips over the course of several years (which were common in this dataset). Nine year old cows had a productivity index closest to 1.00 with a mean of 0.90 ± 0.080 ($P < 0.001$). Age at first calving for many three year old cows was at 2 or 3 years (most at 3) which resulted in their productivity index being close to 1 (1.18 ± 0.038). The productivity index decreased with age for those that did not produce a calf once or more.

Table 5. Least squares means and standard errors for calving interval in days and cow productivity index by cow age

Cow age	n	Calving interval	Cow age	n	Productivity index
			3	71	1.18 ± 0.038^{a}
4	17	413 ± 16.80^{aefg}	4	97	1.04 ± 0.034^{bf}
5	48	508 ± 11.49^{b}	5	54	0.89 ± 0.041^{cdfg}
6	61	463 ± 10.60^{cdf}	6	61	0.88 ± 0.039^{cdfg}
7	79	450 ± 9.81^{cdefg}	7	79	0.87 ± 0.035^{cdefg}
8	25	465 ± 14.55^{cdf}	8	25	0.76 ± 0.055^{defgh}
9	11	418 ± 20.52^{adefg}	9	11	0.90 ± 0.080^{bcdefg}
10	29	442 ± 13.91^{cdefg}	10	29	0.80 ± 0.052^{cdefgh}
11	38	440 ± 12.26^{acdefg}	11	38	0.80 ± 0.046^{cdefgh}
12	33	431 ± 12.22^{adefg}	12	33	0.82 ± 0.047^{cdefg}
13+	40	461 ± 12.07^{cdefg}	13+	40	0.68 ± 0.045^{egh}

[1]Calculated as 2 – (cow age in years - 2) / number of calves born, where a value of 1.00 indicates a cow calving first at three years with annual calving thereafter.
[a-h] Means with different superscripts differ ($P < 0.05$)

Additional considerations

Table 6 shows the frequency distribution for calves born for each cow age category. Three and four year old cows produced at least one calf with some having a second calf by the age of four. Few cows calved first at five years, and there were no records of older cows (6 to 13+ years) producing their first calves at any age past 5. Hopefully there were no cows that first calved at any age later than 5 years. Fifty two cows had produced two calves by the age of five, and 12 produced three calves. Six, seven, eight and nine year olds cows followed a similar trend and likely first calved by the age of three. Several age categories had 1, 2, 3 or 4 cows produce very few calves. The removal of these unproductive cows can influence profitability and overall productivity.

Table 6. Number of calves born across cow age in years.

	Calves born										
Cow age	1	2	3	4	5	6	7	8	9	10	Total
3	103	0	0	0	0	0	0	0	0	0	103
4	117	30	0	0	0	0	0	0	0	0	147
5	7	52	12	1	0	0	0	0	0	0	72
6	0	9	55	24	1	0	0	0	0	0	89
7	0	1	14	45	19	1	0	0	0	0	80
8	0	0	3	16	39	12	0	0	0	0	70
9	0	0	0	3	34	38	3	0	0	0	78
10	0	0	0	0	4	18	13	1	0	0	36
11	0	0	0	0	3	10	15	14	2	0	44
12	0	0	0	0	0	3	6	14	9	2	34
13+	0	0	0	0	0	2	11	11	14	2	40

Table 7 shows the cow age distribution by the number of calves weaned. The table includes a column, “0”, that shows the number of calves that were not successfully weaned. Of the 103 cows recorded to calve at three years, 22 did not have a calf weaning weight recorded, and are assumed to have lost their calves. Most of the calves with missing weaning records belonged to the three and four year old cows.

Table 7. Cow age distribution by number of calf weaning records.

Cow age	Calves weaned 0	1	2	3	4	5	6	7	Total
3	81	22	0	0	0	0	0	0	103
4	35	111	1	0	0	0	0	0	147
5	2	37	31	2	0	0	0	0	72
6	0	14	35	37	3	0	0	0	89
7	1	4	8	38	28	1	0	0	80
8	1	0	8	34	23	4	0	0	70
9	1	1	2	17	37	18	2	0	78
10	1	0	0	2	16	15	2	0	36
11	1	0	1	5	15	19	2	1	44
12	0	0	0	6	10	13	5	0	34
13+	1	0	3	4	15	13	3	1	40

Pregnancy rate for cows that were artificially inseminated and cows that bred naturally are presented in Figure 3. Of the cows that were artificially inseminated, 37.76% of them became pregnant, whereas 92.55% of cows that were bred naturally became pregnant. Low pregnancy rates caused by artificial insemination can also negatively influence calving interval and thus reduce profitability. The number of times a cow had AI attempted was not factored into calving interval or productivity index, but its possible influence is acknowledged.

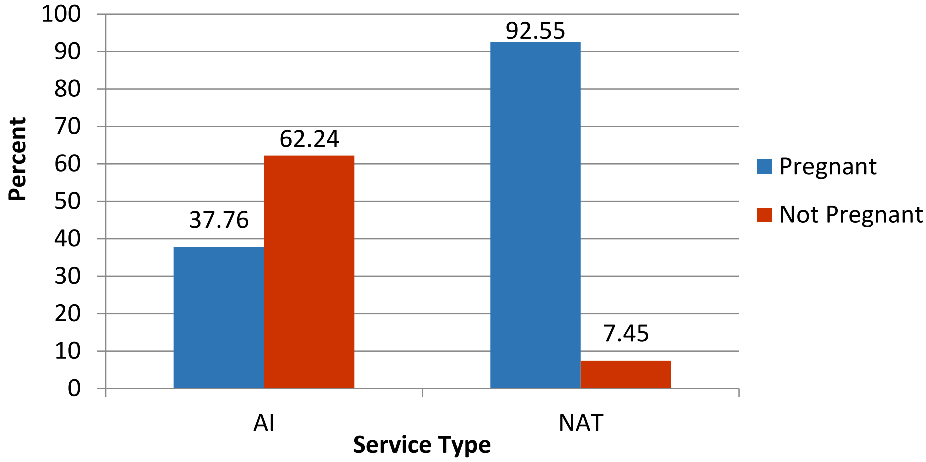

Figure 3. Percentage of pregnancies by artificial insemination or natural service (n = 3,977 service records).

SUMMARY

The goal of this project was to evaluate existing production data from a private cow-calf producer in the Dominican Republic. This analysis was an initial assessment that provided a guideline regarding cow fertility and calf production to improve overall herd productivity in that tropical environment. Traits that could influence calf weaning weight and cow reproductive performance were evaluated through the mixed model procedure of SAS. Frequencies of cows with perfect calving records and percentage of pregnancies were evaluated. The cumulative expense and the cumulative income per cow based on cow age and weaning weight records for this operation were also calculated based on values provided by the operation owner.

The weaning weight analysis included cow age, cow color, and sex of calf as fixed effects. A different model was used for weaning age to also determine its effect on weaning weight. Estimated breed composition and Julian birthday were evaluated in the preliminary analyses but did not influence weaning weight and were removed from the model ($P = 0.640$ and $P = 0.918$, respectively). Cow age had an effect on weaning weight with eight year old cows having the highest least squares means of 199.7 ± 2.40 ($P < 0.0001$). Weaning weight increased with cow age until about eight years and plateaued afterwards. Cow color also had a large influence on weaning weight ($P = 0.0002$) and was used as an alternative for genetic influence since exact pedigree information was unavailable. Sex of calf was also important for weaning weight ($P < 0.0001$) with male calves averaging 10.9 kg heavier than female calves. Weaning age

had an unexpected negative effect on weaning weight with a regression coefficient of -0.33 ± 0.05 kg/d, but age at weaning varied substantially, from 153 to 293 days.

The calving interval analysis included cow age in years and color code as fixed effects. Cow age had an effect on calving interval ($P < 0.0001$); however, color did not ($P = 0.527$). Four-year old cows had the shortest average calving interval of 413 ± 16.80 days while five year olds had the longest of 508 ± 11.49 days. Although the target optimal calving interval for economic efficiency in intensively managed herds is 365 days, this target may not be as realistic in many tropical environments. The average calving interval in this dataset was 462 days which is similar to other reported values for tropical environments globally. The cow productivity index, that related number of calves born relative to cow age, also included cow age in years and color as fixed effects. Cow age was important ($P < 0.0001$) but color code was not ($P = 0.755$). The overall calculated mean reproductive productivity index was 0.91. Cows with values just below 1.00 had very few skips over the course of several years, which were much more common in this dataset than those that had an index of 1.00 that calved first at three years and had a calf every subsequent year.

There were 10.21%, 5.45%, 3.49%, 1.49% and 0.12% of cows that had perfect calving records from three through six, seven, eight, ten and twelve years of age, respectively. Frequencies of pregnancy percentages were 92.55% for natural service matings, but were much lower, 37.76%, for those artificial inseminated. The mean, cumulative expense for this operation was $RD -12,403.32 (Dominican pesos) or -

261.42 (USD) per cow; however, there was a significant range of $RD -91,061.10 to $RD 31,530.00.

Although there are challenges in improving production in the Dominican Republic as with all tropical environments, this initial assessment can provide insight that will allow the producer to identify and evaluate components affecting this operation, and, implement the necessary changes to improve overall herd productivity. Some recommendations for this producer, based on the observations of this data are enumerated below.

1. Implement proper record keeping and documentation of information. Examples include documenting accurate sire breed, calf weaning weight, body condition scores, reasons for culling cows, and other imperative information that can be helpful to the operation and useful for statistical analyses. Sire breeds were not statistically analyzed because they were entered as a “best guess” for natural matings and having this information would have allowed for statistical interpretation. In addition, many calving records did not include weaning weight and were assumed to represent calf loss. Documenting weaning weight and those that were unable to wean is also important. This would have provided a more realistic calf loss percentage and weaning weight analyses.
2. Establish strict culling criteria. This can save the operation money and resources if unproductive and unprofitable cows were removed from the herd. For example, the only fifteen year old cow (in the data collected) had seven calves but did not successfully wean any. This cow accumulated a mean, cumulative net return of

$RD -91,061.11, and the cow should have been removed years ago. By implementing these criteria, the percentage of cows with perfect calving records can also increase. The culling criteria should be based on specific production goals, conditions, and environment.

3. Standardize age of calf. This means weaning calves at appropriate ages instead of at many different ages. It is crucial for this operation to not wean calves at an early or older age. Weaning weight can be standardized to a 205-day basis if calves are weaned within the 90-day window of 160 to 250 days of age to evaluate for differences in weaning weight (BIF, 2010).
4. Educate employees, especially animal handlers. High stress handling such as that repeatedly observed in the operation (constant yelling, excessive use of electric prods and overcrowding in a pen leading to the squeeze chute) can lower productivity, overall immune function, and increase chance of injury to people and animals. The tying of accurate (and inaccurate) records to individual employees can aid in payroll compensation decision. Also educating and understanding why following label directions for vaccines and other animal health products is critical for effectiveness and consumer food safety.

There were many productive and profitable cows identified in this herd, and the potential for overall improvement in production efficiency and profitability are high in this operation. The owner of this operation is to be commended for recognizing the need to maintain production records on individual animals and to begin this assessment.

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