Progression of data recording technology and implications for information-sharing across the beef supply chain

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Abstract

Tracking of whole-herd performance data on virtual platforms has been utilized since the early to mid-1990's. Primarily established to promote the sales of elite breeding genetics and value-based marketing of live cattle, relatively slow adoption rates, risks associated with information sharing, and overall level of understanding surrounding the use of electronic platforms as a data management tool have presented barriers to increasing information transparency across the beef cattle supply chain. Access to such tools that facilitate improved transfer of information and enhance management practices are crucial to further development of the beef cattle industry and ultimately, the continued creation of quality beef products to exceed heightened industry and consumer expectations.

Primary objectives of this project are to build upon the original framework established for the mobile cattle record-keeping application referred to as the "CalfDex", distribute the platform for beta-testing across a diverse demographic of producers, and continue development of the tool based on feedback received through inquiries and survey responses from users. To examine the efficacy of the information sharing function, arguably the most beneficial aspect of CalfDex, the beta-testing trial was conducted to determine the number of users who had exported and shared cattle information from the mobile application. A combination of exported data and survey results revealed that precisely 90 operations had tested or utilized the data export feature, and that entries for 2,709 head of cattle were recorded. Intriguingly, survey results revealed that only 27 percent of respondents had used the available data storage and export functions, yet 58 percent of participants in the survey indicated a desire to learn more about these features. Further revisions and additional beta-testing trials are necessary to comprehensively evaluate the effectiveness of CalfDex as an information-sharing and animal data management system.

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Chapter 1 - Introduction

1.1 Background

A variety of challenges are prevalent within the beef production industry, including continued adaptations to government policies, striving to exceed ever-changing industry standards and consumer preferences, and the adoption of new technologies. Many current challenges observed across the beef production system are evident and widely acknowledged among producers and employees involved in the industry. A less acknowledged yet increasingly prevalent difficulty encountered in the beef industry is the lack of uniform and consistent recording of animal information across segments of the beef supply chain. The process of recording animal information encompasses methods by which individual and whole-herd animal data are stored, any performance metrics are evaluated, shared amongst various players in each sector of the supply chain, and ultimately utilized by beef producers and consumers. Greater access to and information-sharing of individual animal and whole-herd data is a valuable asset for producers to improve cattle management practices and increase genetic potential in their herds, and for consumers to make well-informed decisions when purchasing a beef product.

Despite an observed expeditious increase in technological innovations across numerous agricultural industries, the beef production sector has not kept pace with advancements in whole-herd and individual animal record-keeping and information-sharing capabilities (Hefley, 2022). Record-keeping practices in farming and ranching operations are a notable time commitment in addition to other tasks necessary for the functionality of an operation, hence they can be considered an opportunity cost. Additionally, the integration of electronic record-keeping systems for data collection and storage comes at a cost, and access to modern technologies is often limited in remote areas where agricultural operations are typically located. Current

electronic data management systems such as CowSense or CattleMax range from $150 to $600 solely for one-time installation of the software. In addition, subscription prices for these services can range from $40 to $950 on an annual basis (Bir and Ladd, 2022). A notable divide amongst urban, suburban, and rural residents can also be observed in access to broadband internet, ownership of a smartphone, and ownership of a desktop or laptop computer. Approximately 72 percent of rural Americans surveyed in 2021 indicated that they had access to and regularly utilized home broadband services, in contrast to 77 percent of urban residents and 79 percent of suburban residents (Vogels, 2021). Correspondingly, 80 percent of rural residents stated that they own a smartphone, whereas 89 percent of urban and 84 percent of suburban residents indicated the same results. Rural residents also ranked in the lowest percentile for ownership of a desktop or laptop computer (Vogels, 2021). A combination of time, cost, and technology constraints are indicative of the evident hesitation to implement advancements in record-keeping (Hefley, 2022). Although a variety of platforms currently exist to improve efficiency in individual animal and whole-herd record-keeping, such as the implementation of radio frequency identification (RFID) for traceability purposes, utilization of electronic record systems in the cow-calf production sector are relatively low with an approximate 20 percent adoption rate (Hefley, 2022; Pruitt et al., 2012).

1.2 Objectives

The primary objective of this study is to build upon the framework established for the development of a mobile beef production record management platform, referred to as “CalfDex.” Through consideration of original producer feedback, further development of existing features, and promotion and distribution of the application, a more comprehensive assessment can be made of attributes deemed necessary and desired for an animal data management tool. A

secondary objective is to collect and examine user herd data from the application for any notable trends, such as the number of user accounts and types of data most frequently entered. This information is then utilized to adjust and implement additional features in the application to maximize the benefits accrued by producers at the cow-calf level and passed down throughout the beef supply chain.

1.3 Framework and Distribution

CalfDex is a mobile application designed as an animal record-keeping platform. The initial objective behind the development of CalfDex was to encourage a heightened level of calving data collected in the first phase of the beef production cycle, enhance the information-sharing process to downstream customers, and ultimately promote information transparency amongst all participants in the beef supply chain. Within the platform, users have the capability to record and store data including calving, illness, treatment, weaning, and postweaning information at both individual animal and whole-herd levels. Moreover, the smartphone application design of CalfDex allows for rapid and efficient data collection in the field while simultaneously mitigating the risk of clutter, data loss, and misplacement often encountered while utilizing paper records. Access to cellular service is often limited in remote rural areas where many cow-calf operations are located. To address this challenge, CalfDex was created with a local database where information can be securely stored within the app so long as the user presses “Save” when they are finished recording animal data. Once a mobile device logged into a given CalfDex account returns to an area with a supported cellular network or is connected to a wireless internet service, use of the “Export Data” function uploads all data present on the app to a cloud database, where a record of current and historic data can be accessed through the user’s registered email address. The data retrieved from this export provides a report of recorded animal

information in an Excel sheet format, which creates an additional opportunity for producers to organize their data as desired and share their information with downstream beef supply chain participants in an effective, simplified manner.

The functional framework design for CalfDex was tested by developers and completed in early December 2022. The future progression of the app can be categorized into the following phases: promotion, innovation, revisions and refinements, and adoption. Once the application was approved for release by respective review teams for both the App Store and Google Play Store, a primary focus was placed on the development of promotional tools to inform producers across the United States about the data recording services CalfDex offers. Promotion of the application included the development of informative brochures distributed at industry events catered to cattle producers, such as Kansas State University's annual Cattlemen's Day, and a National Cattlemen's Beef Association (NCBA)-sponsored Stockmanship and Stewardship conference located in Ontario, Oregon. For promotion on virtual platforms, two slideshow presentations were given to livestock pharmaceutical representatives from Elanco and Merck in June 2023, and additional brochures were distributed via email to producers, industry contacts, and university extension personnel in numerous states spanning across the Pacific Northwest, Southern, Midwest, and Southeastern regions of the United States. Target audiences for promotion of the app were identified through a combination of prior industry contacts, events with a beef production focus hosted by Kansas State University, radio broadcasting, and events located in areas with a notably large presence of cow-calf producers.

Transitioning into the adoption phase of CalfDex, initial interest in the program and overall adoption of the app can be attributed to the initial design incorporating responses from producer surveys, and promotion efforts made in the first progression phase. To ensure

maximum functionality and a positive user experience with the CalfDex data recording tool, a KSU-based contact email address was created as well as a “report problem” feature within the app for producers to reach out to with any questions, feedback, or concerns. Relatively low adoption rates of other animal data management tools illustrate a hesitation to adopt, learn, and implement new technologies in beef production operations, and further emphasize the need for a simplified data recording program that effectively records animal information and facilitates communication and data sharing with downstream producers.

Chapter 2 - Literature Review

2.1 Current Information-Sharing Pathways in the Beef Supply Chain

Largely due to the implementation of various technological innovations over the past few decades, dramatic improvements in the capabilities of and producer access to information management platforms have been observed, specifically within the collection, organization, and tracking procedures for beef production records. However, there is still much ground to be covered to keep pace in an ever-changing industry environment. A majority of current information systems for performance evaluation of beef cattle are most often utilized by and under the ownership of registered breed associations (Garrick and Golden, 2009). Considering that performance-tracking programs supplied through the various breed associations are primarily funded through registration income (Middleton and Gibb, 1991) much of their recorded data comes at a cost to access, and often requires some form of membership to continue to track and enter desired metrics.

A 1991 survey analysis of beef improvement programs conducted by Middleton and Gibb concluded that recording of beef improvement metrics in the U.S. was relatively fragmented and inconsistent compared to metrics utilized for other species, or even in other countries. For instance, numerous national databases exist to track performance of other species, such as the National Sheep Improvement Program or the Dairy Herd Improvement Program (Middleton and Gibb, 1991). One likely contributor to the fragmentation and inconsistencies observed in beef improvement programs is the continued introduction of new breeds. Thus, a corresponding increase in the number of associations and other performance-tracking programs can also be observed. Although the United States currently lacks a designated national database to record beef animal performance metrics, efforts toward unification have been and continue to be made

to address these noted inconsistencies. An example of such unification efforts is the establishment of the Beef Improvement Federation (BIF) in 1968. Of the numerous associations and state performance recording programs in existence, the BIF currently counts over 23 breed associations and even more state organizations in its membership, and this number continues to climb.

2.2 Benefits of Information Sharing in the Beef Supply Chain

Across all food production sectors, transparency in the food supply chain is essential to guarantee product quality and provenance (Trienekens et al., 2012). Specific to the beef supply chain, collaboration and data sharing amongst producers in each segment of the beef production cycle promotes a heightened level of transparency, which in turn aids in establishing improved market efficiency, enhanced methods of product traceability, and strengthened information exchange throughout the entire production system. End impacts of collaboration and data-sharing foster greater consistency in beef product quality, additional support for product differentiation, and logistical and process optimization (Trienekens et al., 2012).

Benefits accrued from animal information sharing are recognized by many participants in the beef industry, however, the level of benefits received varies by production stage (Hefley, 2022). An analysis of beef cattle utilized for breeding can classify the respective national population into two different enterprises: the bull-breeding and bull-buying sectors (Garrick and Golden, 2009). Registered purebred operations comprise the vast majority of the bull-breeding sector, which then supplies herd sires to cow-calf enterprises in the bull-buying sectors. This can be achieved through either the physical sale of breeding bulls or the utilization of artificial insemination (AI) technologies. Through these two processes, genetics from bull-breeding operations have the capacity to transfer specific qualities and performance capabilities to small

and commercial herds, those from “elite” operations often coming at a cost, yet dramatically improve a producer’s opportunity to capture value-added premiums for producing top-quality genetics.

Information-sharing across each segment of the beef supply chain is a key component of genetic advancement and in determining overall end-product quality, as evidenced through heightened usage of expected progeny difference (EPD) calculations and the pricing of live cattle on a grid. Across the United States, industry trends over roughly the past two decades have indicated a greater willingness to pay for cattle that are expected to reach certain quality benchmarks. Throughout the early 2000s, cash-negotiated trade comprised an estimated 55% of the total weekly U.S. fed cattle volume (Schroeder, Coffey, and Tonsor, 2021). Within this same timeframe, formula trade represented 30% of the total volume, and forward contracts and negotiated grid pricing made up the remaining percentage. By the year 2020, a notable transition was observed in the methods through which fed cattle are marketed. Cash negotiated trade sharply declined to a mere 20 to 25% of all U.S. fed cattle contracts, whereas formula purchases increased to 60 to 70 percent of the total fed cattle volume, with the remaining estimated 15% sold under negotiated grid and forward contracts (Schroeder, Coffey, and Tonsor, 2021).

Correspondingly, substantial improvements in the overall quality of U.S. beef products have been attained over the past three decades. Within the beef production sector, the average dressed weight has increased an average of 73 pounds since the year 2000, or a gain of 10 percent (Melton, 2018). Beef products evaluated under the USDA grading system have also experienced a dramatic upward trend in the quality grade achieved. As recently as 2006-2007, an estimated 40% of all graded beef products received a Select quality grade based on the product’s carcass maturity and a low degree of marbling. By 2017, this percentage sharply declined to

around 18% and is continuing to decrease. Additionally, from 2007 to 2017, an industry-wide, positive marbling EPD shift of 0.12 to 0.13 was observed for all larger bos taurus breeds (including Angus, Red Angus, Hereford, Simmental, Gelbvieh, Charolais, and Limousin cattle). This shift would be the equivalent of 120 to 130 marbling score points (Red Angus Association of America, 2018). Considering that cattle attaining a Select quality grade often miss the minimum benchmark for Low Choice by increments of a few marbling points, this positive, industry-wide shift has pushed many previously Select quality cattle into meeting a Low Choice or higher quality grade standard. These upward trends observed in both dress weight and overall quality grade have been primarily attributed to collective improvement efforts made across various segments of the beef industry. Such efforts include rigorous genetic selection through a greater emphasis placed on EPD's and phenotypic traits at the cow-calf sector, heightened capabilities for research in ruminant nutrition at land grant institutions and feedlots, and increased use of formula and grid-pricing in feedlot to processor transactions as a strategy to estimate end-performance of certain lots and incentivize the production of high-quality cattle. Ultimately, results of these efforts conducted and improvements made in each sector share one common factor: greater access to and capabilities of information sharing.

2.3 Challenges of Enhanced Information Sharing

Often, the potential for new developments in commercial and purebred operations are inhibited by existing infrastructure and asset fixity, considering that the beef industry is the least vertically integrated amongst all livestock sectors (Ward, 1997). Within individual sectors of the beef supply chain, a prevalent disconnect in information exchange has been noted between participants employed in the cow-calf and feedlot production enterprises (Marshall, 2023). As reflected by the heightened usage of EPD's and continued introduction of new measures to

predict genetic merit, cow-calf producers are demanding greater detail in genetic information which in part explains the common variation observed in sale prices of breeding bulls. In a 2022 survey of 25 cow-calf producers across the Midwest, only 42% of respondents indicated that they maintain contact with buyers after their cattle have been marketed. 33% of respondents in this same survey stated that they receive data back from downstream buyers to assess performance (Hefley, 2022). However, further down the supply chain, communication between the feedlot and processing sectors continues to expand with the increasing utilization of formula and grid pricing to market fed cattle, directly corresponding with elevated consumer demand for high quality beef products (Marshall, 2023).

Significant time, cost, and privacy constraints must also be considered when assessing the relationships and communication channels between each sector of the beef production cycle. In a traditionally risk-averse industry, a lack of trust amongst individual sectors and conflicting objectives have often been indicated as reasons behind the hesitation to implement supply chain mentality and adopt related information-sharing tools (Marshall, 2023). Regardless of enterprise, establishing any partnership or producer-clientele relationship requires a certain degree of risk. The larger the number of parties and level of commitment required for a given decision, the greater the level of risk. This same concept can be applied when examining producer attitudes behind maintaining cattle health and production records (CHPR) and their willingness to adopt new technologies. Jumper et al. (2022) indicated five primary contributing factors to historically low adoption rates of electronic CHPR. These factors are (1) a lack of understanding surrounding electronic recordkeeping platforms; (2) significant time constraints associated with inputting data; (3) no perceived advantages to keeping electronic records; (4) a larger quantity of costly instruments are needed to maintain electronic records; and (5) no observed or perceived financial

benefit has been observed for collecting any form of CHPR, as little research has been conducted in this area.

To reach these observations, Jumper et al. (2022) surveyed 14,294 cow-calf producers with membership to the National Cattlemen's Beef Association and received a 26.2% response rate. Among these respondents, 3,641 (97.3%) were actively involved in cow-calf production, and 3,169 respondents indicated that they utilize some form of CHPR, with 62.8% being handwritten, and 37.2% being some form of electronic records (Jumper et al., 2022). In the second question series of the survey, Jumper et al. (2022) questioned the same 14,294 NCBA members on their access to and usage of technological devices and services, including smartphones, desktop and laptop computers, and wireless internet. Additionally, 92.9% of respondents indicated that they had access to a computer to maintain CHPR records with. Correspondingly, 88.7% of the same respondents stated that they had internet access at either their home base or the cow-calf operations headquarters, and that 85.2% currently use a smartphone. Considering that a vast majority of cow-calf producers have access to computers, a smartphone, and wireless internet services, the results reflect that electronic CHPR-keeping systems have been historically underutilized in the cow-calf sector. Considerations made for continued development and distribution of the CalfDex application have accounted for factors that have been indicated to influence the adoption of electronic CHPR platforms, as well as attributes that producers have expressed a desire for including in an information management system.

Chapter 3 - Methods

3.1 CalfDex Promotion and Beta-Testing

As a continuation of the original framework design for CalfDex that was launched in December of 2022, a variety of informative promotional tools were utilized to distribute information and identify interested parties to beta-test the application. In the interest of providing resources where prospective users could search for information about the CalfDex platform and provide inquiries, a website providing basic information and tutorials on how to navigate the app was created in collaboration with Stasyx, the software development team designated to develop the CalfDex mobile platform. An outline of topics the website addresses is illustrated in Table 3.1. In correspondence with the creation of the website, a Kansas State University-based email address was also developed and posted on the site to serve as a point of contact and to field respective inquiries from interested individuals. To reach a target audience of cow-calf producers, emphasis was placed on attending industry-related events with a specific focus on animal data management and cattle handling techniques, as well as promotion via radio and social platforms. Such events included social networking and the distribution of informative brochures at Kansas State University's annual Cattlemen's Day, Owyhee Cattlemen's Summer Meeting, and the Pacific Northwest Stockmanship and Stewardship conference. Social platforms were also influential in the early promotion of CalfDex, from a podcast feature with Agriculture Today, article publications with various industry magazines, and distribution of information via Facebook and other social platforms. Notable publications included those with Drover's, Beef Magazine, the Kansas Livestock Association, and the AgManager.info Extension website.

The app was officially released for beta-testing in March of 2023. Original features were developed based on the framework design which encompassed survey responses from cow-calf

Table 3.1. CalfDex webpage layout

CalfDex Webpage Organization *calfdexapi.azurewebsites.net*	
Tab Category	Information Category
Home tab	● Basic overview of the mobile app ● Contact email to field questions
Tutorials tab	● Create Account ● Create Herd ● Create Animal ● Treat Animals ● Treat Herd ● Edit Calf Dates ● Export Your Data

and feedlot producers across the states of Kansas, Missouri, and Arkansas. It is acknowledged that utilizing survey results from a small pool of respondents in a limited region introduces a possible selection bias (Hefley, 2022). To mitigate this risk of bias in the beta-testing period of CalfDex, the app was made live on the App Store and Google Play Store for any user of an iPhone or Android device to access and download. To best meet the needs of an expanded user base across multiple geographic regions, features of the app were continually updated on a per request basis from producer feedback gathered through the CalfDex email server and through direct networking at target industry events. Ultimately, promotion of the CalfDex platform at events outside of the Midwest region and through social media were utilized as strategies to acquire a larger and more diverse user demographic. Specific emphasis was placed on promotion and testing of the tool at industry events hosted in or around the West and Pacific Northwest regions, considering that three of the top 10 counties in number of beef cows are located in Southeastern Oregon and Northern Nevada (Henderson, 2019).

3.2 Store and Export Data Features

Upon release of the application, interested users could create an account with CalfDex through listing a registered email address and the creation of their own unique password. In collaboration with the Stasyx development team, a notification with the new user's email address was sent to the original server from which the CalfDex was developed each time a new account was created. To protect the confidentiality of user data, only email addresses were accessible from this server and not passwords. To encourage use of the information-sharing functions within CalfDex, a figure depicting the "Store Data" and "Export Data" functions was included in the September 2023 AgManager publication "Introduction and Emerging Features of CalfDex – A New Calving Information Recording Tool for Producers". Visual tutorials on how producers could export and access their respective data were also uploaded to the main CalfDex website. A representation of these features can be found in Appendix B. It is recognized that a certain degree of inconsistency is prevalent in the collection and analysis of exported data, as the time a user spends familiarizing themselves with the app is likely attributed to the level of detail kept in individual records, and that users from various types of cattle operations may be utilizing the app for different purposes.

To develop a method of analysis for the exported data, the Stasyx development team assisted with the creation of a unique login through the CalfDex webpage solely for app developers to access and download a comprehensive data file from each user that had completed an export. With any developer's own unique login, this file was designed to be downloadable in real-time to best correspond with the gradual adoption of CalfDex as additional users discovered the app and completed respective data exports. This strategy was also deemed to be the most

industry relevant as different operations calve at varying intervals of the year, though primarily over the spring and fall months.

For the purposes of this analysis, an initial count was calculated utilizing Stata statistical software (StataCorp, 2023, College Station, TX) to display the number of unique ranch names. Correspondingly, the number of unique ranch names displayed provided an indicator of how many accounts had completed a data export, thus providing insight as to how many producers had utilized the available data export features in comparison to how many were testing the app. Observations that were listed as “test” or “practice” were dropped from the data set. Once a number of unique ranch names had been determined, quantitative and qualitative variables were grouped together for further evaluation. Table 3.2 depicts a representation of all variables included in the exported data and their respective categories.

Summary statistics were calculated for the quantitative variables, specifically, birth and weaning weight, to provide a comparison across cattle in similar stages of development and to identify any notable outliers in the data. To account for biological differences in sex, dummy variables were created to assign a numeric value to each animal listed as “Male” or “Female”. Once the two dummy variables were incorporated into the data set utilizing the Stata platform, all birth and weaning weights that originally appeared with a value of zero were replaced to be depicted as a missing value, considering that the recording of this information type is typically conducted amongst purebred operations as opposed to commercial operations. A preliminary summarization of the numerical observations was then conducted to reflect the mean, standard deviation, minimum, and maximum values. This preliminary summarization, specifically of the observed minimum and maximum weights was utilized to identify any inaccurate outlier values that would skew the results of the final analysis. Any outliers that were identified as unrealistic

Table 3.2. Information types included in exported data

Variables Included in Exported Data	
Variable Category	Measured Attributes
Quantitative	● Dummy variables for sex ● Birth weight ● Weaning weight

Qualitative	● Ranch
	● Herd
	● Status –Cow or calf
	● Sex
	● ID
	● Dam
	● Sire
	● Calving Complications
	● Notes
	● Birth date
	● Processing dates
	  • Branding and castration
	  • Weaning
	● Illness treatments
	● Vaccination dates

values (i.e. not biologically attainable for a birth or weaning weight) were correspondingly dropped from the data set, and the final summarization was conducted. Useful analyses of cattle growth metrics can be generated through the evaluation of summary statistics for weight attributes, particularly as additional observations from calves and more years of data are added to the analysis. Similarly, the primary objectives of this summarization were to provide growth information from calves included in the exported data as a sample of the United States beef cattle

population, and to provide a visual representation of the quantitative data types that producers can access through use of the data export function within the CalfDex app to potentially share with downstream business partners.

In addition to the calculation of summary statistics for the quantitative variables, frequencies were also measured for applicable categorical variables. These frequencies were utilized to determine which of the available features in CalfDex were used most often among producers who had conducted an export, and to provide further indicators for additional developments to make these features more accessible to users. Based on the functional design of the CalfDex, the categorical variables of “Ranch Name”, “Herd”, “Status”, “ID”, and “Sire” were omitted from the frequency measurements considering that a ranch name, status of cow or calf, and unique identification are required fields when entering a new animal into the app. Likewise, these variables appear each time a new animal is entered. The sire field was omitted due to the nature of the target audience for the CalfDex application, which is commercial producers who typically don’t record detailed pedigree information. Purebred producers who choose to use CalfDex in their operations may find more benefit in this feature. The 9 variables included in the frequency analysis were “Dam”, “Calving Complications”, “Notes”, “Birth Date”, “Weaning Date”, “Branding Date”, “Castration Date”, “Illnesses”, and “Vaccinations”. To best align with the analytical capabilities of Stata, each time an entry appeared for one of the 9 variables, it was counted as a unit of frequency. The number of times a variable appeared in the data set was then added together in a table format to display a total frequency for each unique variable. For the comprehensive frequency analysis, the total frequencies for every included variable were combined into a singular bar chart to compare values across categories and identify

notable results. A visual representation of this chart is depicted by Figure 4.1, respectively located in chapter 4.1 which summarizes the results of this investigation.

3.3 User Survey Design

Following the promotion and distribution of CalfDex to interested producers across the United States and the acquisition of exported data, a follow-up survey was designed to gather feedback on the app and determine how the platform's information-sharing capabilities are being utilized. The survey was created using Qualtrics survey software (Qualtrics, Provo, UT), and distributed to over 1,500 registered accounts through the use of email technology as well as on the AgManager.info website. Target respondents were identified through the email addresses that each user listed upon creation of their CalfDex account. Although rare, it is important to note that a user could create multiple accounts under different email domains. To mitigate inconsistency in responses, a question was incorporated at the beginning of the survey where respondents were prompted to indicate their state of residence and results could be compared across responses from a similar geographic region. Furthermore, emphasis was placed on acquiring responses from producers that had utilized the "Export Data" feature within CalfDex, as feedback from users that had entered a larger volume of data within the app were predicted to provide more detailed responses on their usage and familiarity with the available information-sharing functions. The proposal to deploy the survey to registered CalfDex users was submitted to the Institutional Review Board (IRB) at Kansas State University and was determined to be exempt from further review. A copy of the respective exemption letter can be found in Appendix A.

The CalfDex user survey consisted of 18 questions, organized into five categories, or blocks. The first category encompassed basic demographic information of the individual respondent and their operation, such as the user's home state, sex, age range, type of operation,

Table 3.3. Question types included in the CalfDex user survey

CalfDex User Survey Questions	
Question Block	Information Type
Demographics	● Home state ● Respondent's sex & age category ● Size of operation in number of cows ● Type of production operation • Purebred Cow-calf • Commercial Cow-calf • Stocker/backgrounder • Feedlot • Other
App Usage	● Where respondent initially heard of CalfDex • AgManager, social media, App Store, etc. ● Available CalfDex tabs the respondent has utilized • Calving • Processing/vaccination • Treatment • Weaning • Postweaning ● One or multiple users to the account
App Features	● Familiarity with the store and export data functions ● Primary reason for usage of data exporting ● Likelihood of impact on producer decision-making
Services	● Feedback on industry-sponsored advertisements • Free service with ads • Fee for ad-free experience ● Estimate of willingness to pay for a subscription
Feedback	● Optional comment box for additional suggestions

and size of the operation in number of cows. Survey blocks two and three addressed information pertaining to respondents' interest, usage, and knowledge of available features in the app. The remaining two survey categories were primarily user-feedback based, and presented questions about CalfDex services and an optional comment box where respondents could record any additional thoughts or suggestions they had about the application. Table 3.3 summarizes the respective question categories and response options evaluated in the survey.

To effectively determine the applications to industry and decision-making impacts of information sharing features such as a data export tool, the survey inquired about respondents' primary reasons behind their use of exported data. The options provided depicted a list of typical reasons behind a producer's initial interest in and use of electronic cattle health and production records, as indicated from previous literature. In the interest of developing an accurate, comprehensive summary of producers' responses to this portion of the survey, respondents were given the ability to select for multiple attributes, along with an "other" option if one of their reasons for electronic data usage was not displayed. Selectable options were organized into three primary categories, including the transfer of whole-herd data to a home computer system, identification of chronically ill animals, and the sharing of herd information with business partners or other downstream producers. Specific to the information-sharing features within CalfDex, respondents were then asked to indicate the likelihood of the tool's impact on respective management and economic decisions within their operations. This question series was also organized into two categories: overall capabilities of the app and use of the data export function. Respondents were provided with a series of five options for which they could rank the impact of the two categories on their own decision-making process, ranging from not at likely to highly likely. Results from the app features section were compared alongside each other to

provide further insight on producer use for electronic recordkeeping platforms, and the overall efficacy of the CalfDex application.

In correspondence with analysis of the impact of electronic recordkeeping platforms on producer decision-making processes, an estimate of willingness to pay (WTP) was generated through responses to the services section of the survey. Respondents were initially prompted to record their thoughts regarding the use of industry-sponsored advertisements to keep CalfDex as a free platform, with five options ranging from “Strongly Oppose” to “Strongly Favor”. Once producers had indicated their input on integrating advertisements into the CalfDex platform, each respondent was navigated to a series of four questions that displayed two options at a time, one of which showed an annual subscription price and the other option providing the choice for a user to indicate if they would not be willing to pay the listed price. Each question in the series was displayed one at a time, beginning with the lowest annual subscription price ($50) and ending with the highest possible option for an annual subscription ($200). Increments of $50 were selected for this analysis to gauge initial interest from producers to pay for enhanced features, and to provide a low-cost range of prices in comparison to other data management systems with a wide variation in subscription fees, which range from $40 to $950 on an annual basis (Bir and Ladd, 2022). If a respondent indicated their WTP for one of the beginning subscription prices then opted to not pay for the next highest price, that individual was navigated to the remaining survey questions which focused on additional feedback and suggestions for the CalfDex application. The response window for the survey was kept open for an interval of one month, from January 1st, 2024, to February 1st, 2024, to best align with the beginning of the spring calving season. A reminder to complete the survey was sent out at the two-week interval to encourage feedback and achieve an optimal number of responses.

Chapter 4 - Results

4.1 Exported Data Results

To conduct a comparison between the number of producers simply testing the CalfDex application to those using the information sharing features, a count was generated for both the total number of downloads and number of operations that had conducted a data export. Analysis of both attributes provided further insight into the overall adoption rate of the available information sharing function. Additionally, the use of data exports evaluated a summary of growth metrics amongst all observations for individual animals and frequency measurements for applicable categorical variables. These analyses provided an overview of the demographics of cattle herds included in the exported data, and indicators of the most frequently entered fields within the CalfDex application. Evaluation of these frequency measurements was utilized as a tool in the identification of features in need of revision to enhance user accessibility. Data from all ranches revealed a total of 1,553 downloads, and 90 operations that had conducted a data export which accounted for 2,709 head of cattle. 32 users out of all downloads were identified as duplicate accountholders. Of the 90 operations that had exported data, herd size in total animals entered into the application ranged from 454 head of cattle to 1 head. Approximately 1,928 of the observations were cows, 629 were calves, and 152 of the observations were bulls. Some variation in entries that differentiated between cows and calves was expected, considering the March 2023 release date of CalfDex and that the app was not widely publicized until September 2023, aligning with the start of the fall calving season. In the analysis of numerical variables depicting a measurement of growth, summary statistics were calculated amongst all observations for which birth weight, weaning weight, or both were recorded. Variations in animal sex and the amount of available data were taken into account in evaluation of the final results. A visual

Table 4.1. Summary statistics for weight variables by sex

Sex Category	Summary Statistic	BW	WW
Female	Mean	69.25	---
	SD	9.05	---
	Min.	50.00	---
	Max.	90.00	---
	N[1]	118.00	---
Male	Mean	74.33	---
	SD	9.55	---
	Min.	47.00	---
	Max.	100.00	---
	N[1]	118.00	---
Total	Mean	71.80	522.72
	SD	9.63	145.95
	Min.	47.00	200.00
	Max.	100.00	802.00
	N[1]	236.00	39.00

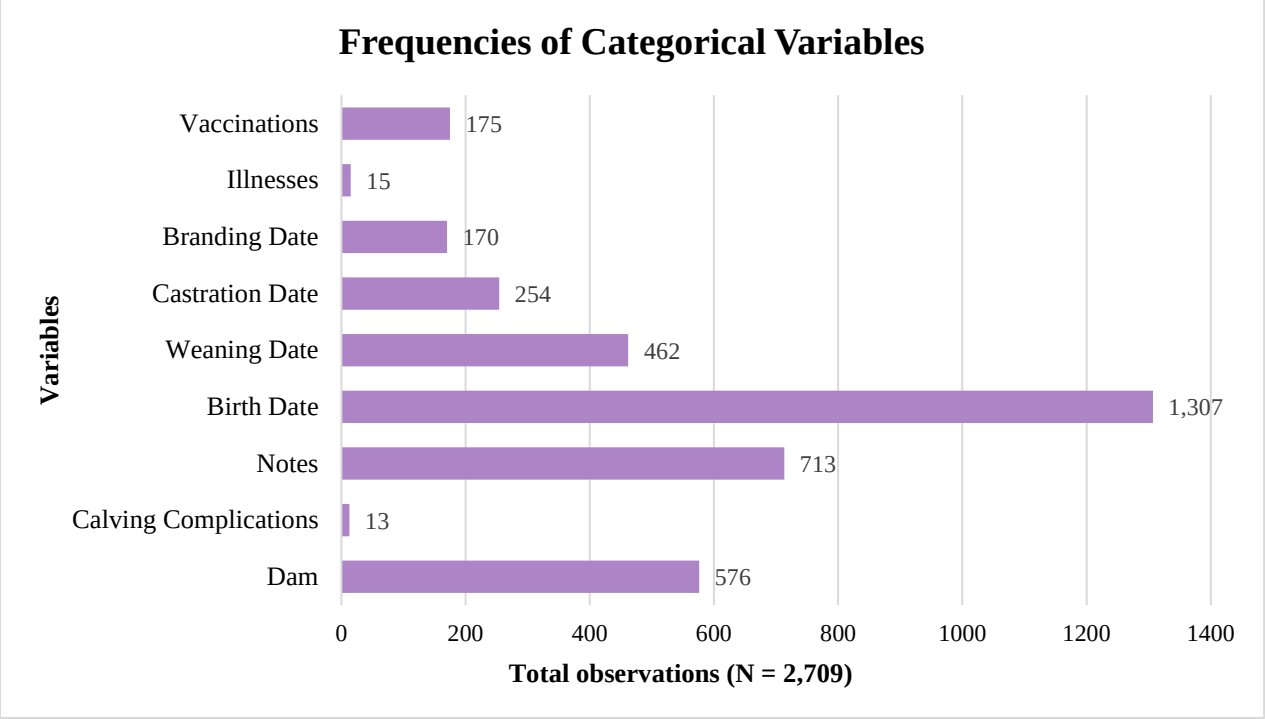
[1] Number of observations for which a birth or weaning weight was recorded in CalfDex

representation of these results is located in Table 4.1, which is categorized by male, female, and total observations.

Results for each respective category reflected some variation amongst birth and weaning weights. As expected, the mean observed weights yielded higher values for bull calves in comparison to their heifer calf counterparts, reflecting an average birth weight of 74.33 pounds. Mean values for the heifer calves depicted an average birth weight of 69.25 pounds. Standard deviation in birth weight was comparable across both sexes, and larger fluctuations were observed for standard deviation in weaning weight. To account for these variations while protecting user confidentiality, summary statistics pertaining to weaning weight for individual

sex were omitted from this report and incorporated into the final section of the table which displays total findings. These results are likely attributed to the presence of less recorded observations for weaning weight than for birth weight, and notable differences between the minimum and maximum values for the weaning weight variable. In any evaluation of livestock growth and performance metrics, it is also important to consider other factors that can drastically impact an animal's natural aptitude for growth, including breed, environmental attributes, age at weaning, and level of nutrition received. While CalfDex does allow for the recording of sex and weight characteristics, more complex attributes would be required to be added through the "Notes" section available within the application. Thus, the scope of this analysis was to provide a summary of the exported data as a sample of the United States cattle population, and to depict an example of the type of performance-related information that users can acquire for their individual herds through use of the data export function.

Figure 4.1. Frequency measurements by categorical variable



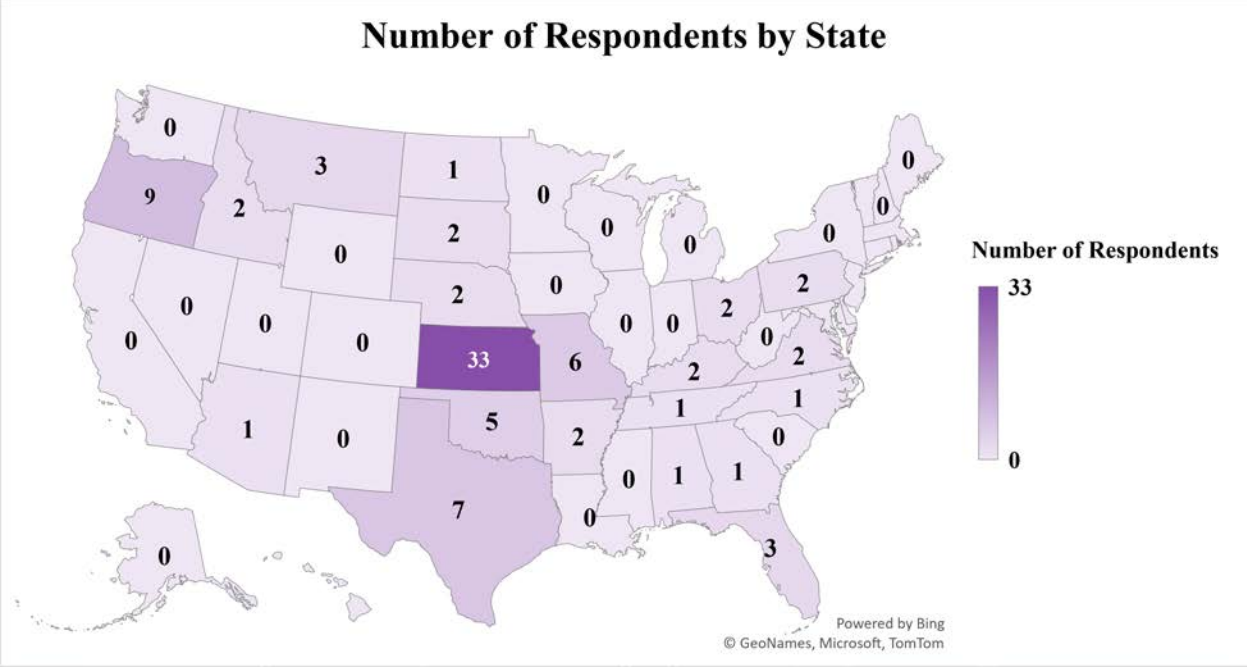
In correspondence with the evaluation of all quantitative variables measured in the exported data set, a measurement of frequency was determined for each applicable categorical variable. Out of a total of 16 categorical variables, 9 were utilized to calculate individual frequencies. Most variables that were excluded from the frequency calculations were fields where an entry of some form was required for functionality of the app, such as identification of individual animals. The qualitative variable “Ranch” was excluded from the frequency measurements as a count of unique ranch names which identified the number of operations who had exported data was conducted earlier in this analysis. In the scope of this assessment, frequencies were defined as the number of times a given observation for each variable appeared in the data set. For instance, “Birth Date” spanned over a variety of different dates denoting when an animal was born, yet each recorded observation represented the same variable. The number of recorded observations were then added to calculate a total frequency for each of the 9 variables, which is represented in Figure 4.1. Aligning with results acquired for the summary statistic calculations, a total of 2,709 observations were recorded.

4.2 CalfDex User Survey Results

As a complement to the results obtained from exported data within the application, the CalfDex user survey collected a variety of information pertaining to respondent demographics, app usage, and further insight on metrics to improve. Recorded responses from the user demographics section were used to determine if the target audience of commercial producers was reached, as well as in the analysis of remaining sections. Aligning relatively close with 2019 USDA Economic Research Service (ERS) statistics which reflect that 30 percent of principal operators in livestock production are female, approximately 24 percent of survey respondents were female, and 74 percent were male (Whitt and Todd, 2021). The remaining percentage of

participants opted not to indicate their sex, and responses were collected from a total sample size of 90 producers. Respondent age reflected an even distribution across categories. To gain a more comprehensive profile of producers who were testing the CalfDex platform, inquiries pertaining to age were divided into the following 6 ranges: 18 to 24, 25 to 29, 30 to 39, 40 to 49, 50 to 59, and 60 and up. All age categories except the 25 to 29 range obtained a volume of 13 or more responses, indicating that age was not a major factor in a producer's decision to create a CalfDex account. Geographically, respondents were dispersed across the United States as well as a small number from South America, with the highest concentrations coming from the Midwest as depicted in Figure 4.2. Other notable areas of concentration that are represented in this analysis include the Pacific Northwest, Southeast, and Eastern regions of the United States.

Figure 4.2. Respondent distribution by state



In the evaluation of demographic factors on a per operation basis, participants were asked a series of questions pertaining to their herd size in number of cows, and the type of operation

Figure 4.3. Size of operation in relation to number of respondents

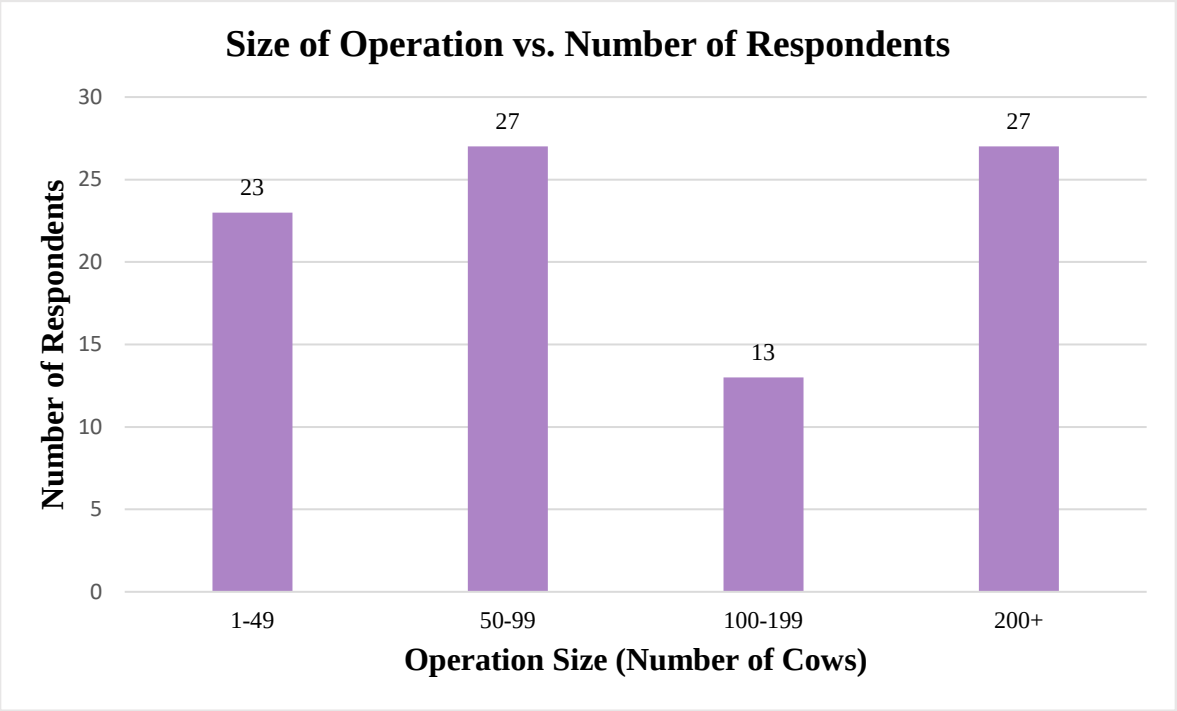
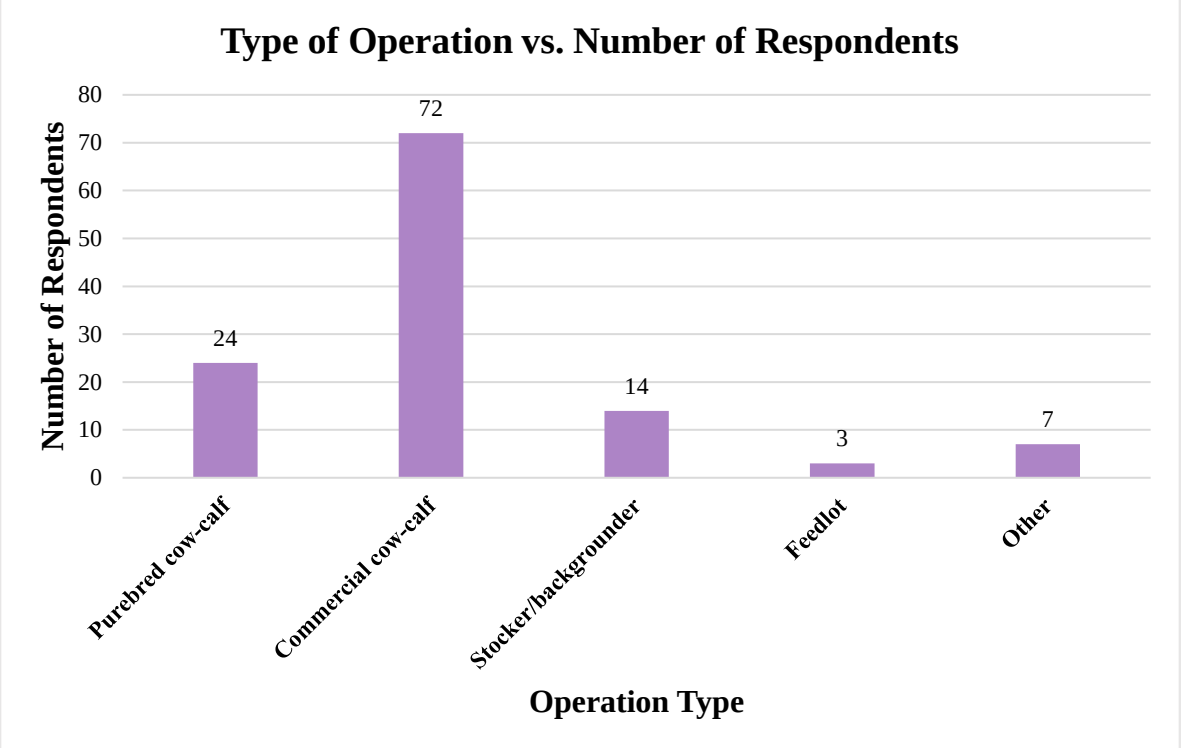
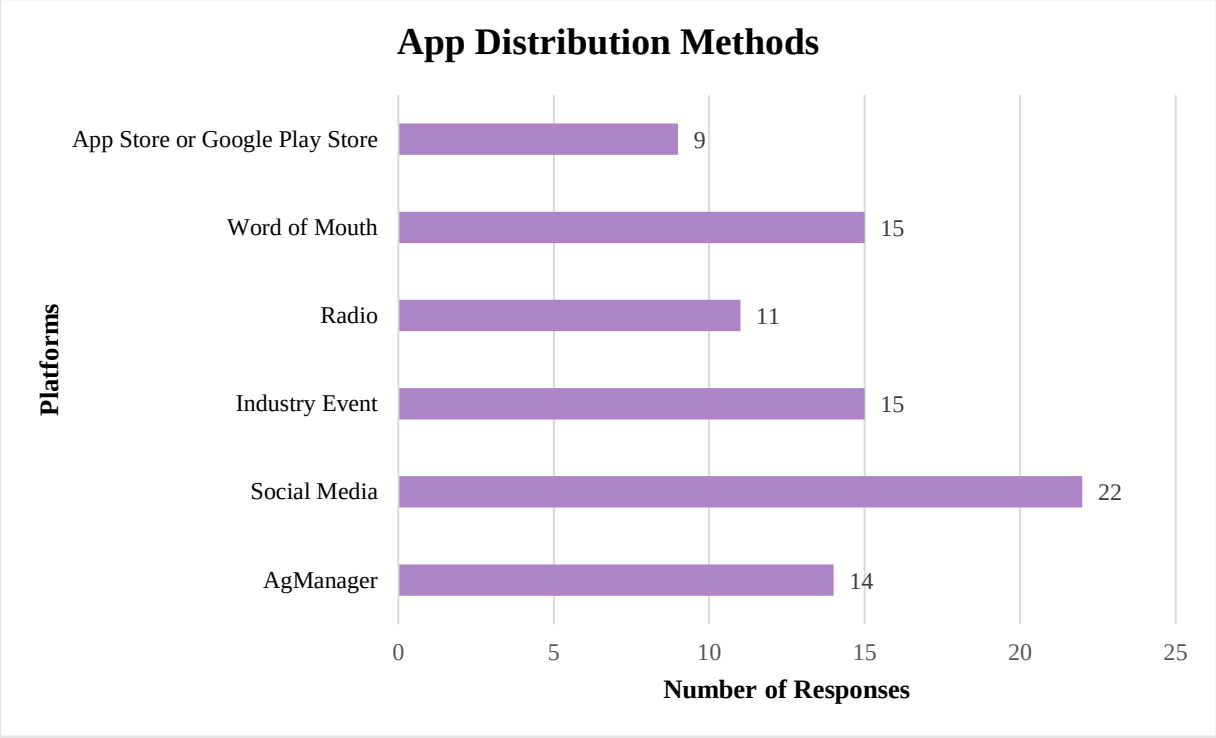


Figure 4.4. Type of operation in relation to number of respondents



that their farm or ranch is most closely associated with. A depiction of these measures can be found in both Figures 4.3 and 4.4, which display the volume of cattle and type of operation in relation to number of respondents. A strong majority of respondents indicated that they operated either small or very large herds, ranging from 1 to 99 head, or 200 or more head of primarily commercial cattle. To account for diversified operations that raise cattle through multiple phases of production, respondents were given the ability to select multiple operation types. Out of 90 total participants, 72 producers indicated that they raised a commercial herd, whereas 24 producers stated that they operated a purebred herd. These results closely align with the intended target audience of commercial cow-calf producers, considering that the functional design of CalfDex was intended to be utilized as a mobile calving book rather than a complex record-keeping program for detailed pedigree information (Hefley, 2022). Participants were also questioned about the various platforms from which they discovered the CalfDex mobile app to

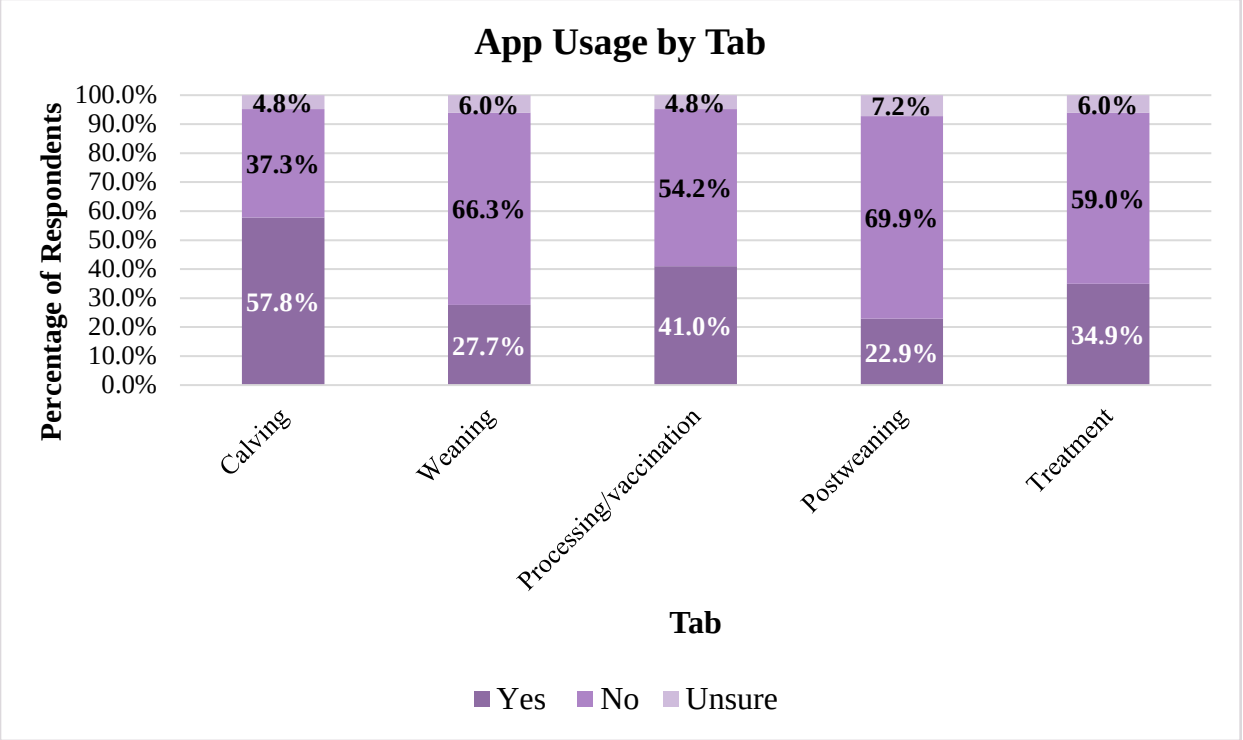
Figure 4.5. Producer responses to promotional tools



determine which distribution methods were most effective at reaching a large number of producers. A majority of respondents indicated that they learned about CalfDex through social media or word of mouth, for which the results are displayed in Figure 4.5.

Figure 4.6 depicts the usage of each available tab in CalfDex based on responses. This question series was presented to respondents on a three-point Likert scale, where users could indicate a response of “yes”, “no”, or “unsure” as to whether they had used a given tab or not. These responses were utilized to cross-reference with earlier results from the exported data, which examined frequency distributions for how many times a variable appeared in the data set. Considering that each variable or field had to be entered within a certain tab to appear in the exported data, for instance, birth dates would be entered within the “Calving” tab, the variables that appeared with the greatest level of frequency could be compared with producer responses which indicated the specific tabs in CalfDex that had been used the most in their operations.

Figure 4.6. Percent usage of individual tabs in CalfDex



However, not all survey participants recorded a response for individual tabs they had utilized. To address this scenario, responses were converted to reveal percentages of a whole out of total answers collected for each tab category.

The comparative results reflect that the CalfDex platform was primarily used to record calving records, which was the intention of the original design. All percentages displayed in Figure 4.6 correspondingly align with the measured frequency distributions, as entries for birth date and dam recorded the first and third-highest frequencies amongst every measured categorical variable. To evaluate the statistical significance between information types captured by use of each CalfDex tab, a series of pairwise chi-square tests were conducted for every possible combination of tabs using the Stata platform. The formula utilized for this series of tests is listed accordingly, where χ^2 represents the numeric value generated from a comparison between observed and expected values, O_i denotes the observed number of responses, and E_i reflects expected responses for each information tab category.

$$\chi^2 = \sum\left(\frac{(O_i - E_i)^2}{E_i}\right)$$

Any statistically significant p-values derived from the analysis at the 95 percent confidence interval indicated an observable difference in responses attributed to variation in producers' intended use of the application. These results are summarized in Table 4.2. Of the 10 possible pairwise combinations, four were statistically significant at a 95 percent confidence level, and one was statistically significant at the 90 percent confidence level. Approximately half of the quantifiable tab combinations in the CalfDex displaying a certain degree of statistical significance show that the percentage of survey respondents using a combination of those features vary in distribution. Likewise, the pairs of tab combinations that did not display any statistical significance were tabs that possessed similar features and encompass information types

Table 4.2. Chi-square test p-value results for each information tab category

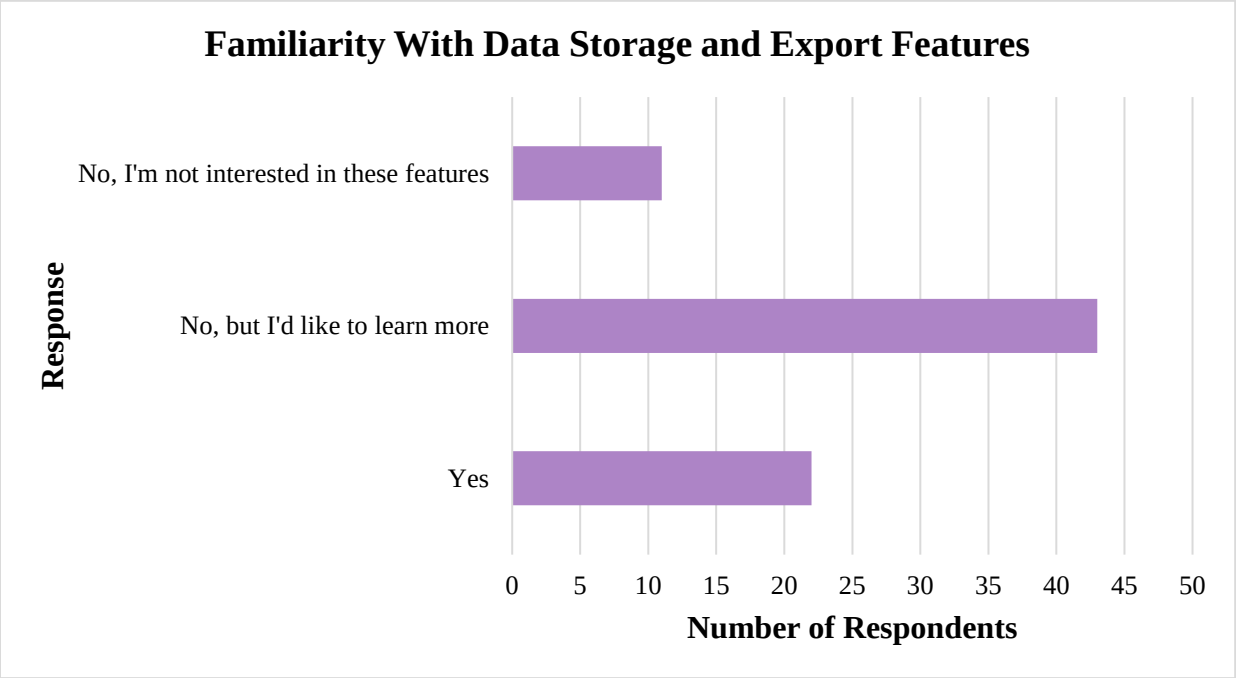
Information Tab	Calving	Weaning	Processing/vacc	Postweaning	Treatment
Calving				**Reject H_o at $\alpha = 0.05$**	
				Reject H_o at $\alpha = 0.10$	
Weaning	<0.001				
Processing/vacc	0.083	0.199			
Postweaning	<0.001	0.759	0.043		
Treatment	0.012	0.595	0.712	0.231	

Note: H_o assumes the number of observed and expected responses per tab are not expected to differ significantly

that are often entered at the same time in a production setting. For instance, the combined recording of processing and treatment as well as weaning and postweaning data displayed the least significant values out of these results.

To capture an estimate of approximately how many users were familiar with and utilizing the available information-sharing features within CalfDex, respondents were then asked a series of questions pertaining to the number of users associated with their account and how many account holders were storing or exporting data from the application. A majority of producers indicated that they were the sole user of their account, whereas 17 percent of respondents stated that multiple individuals were using their account. Intriguingly, 30 percent of survey participants indicated that they were unaware of the dual-use feature. Likewise, 27 percent of producers

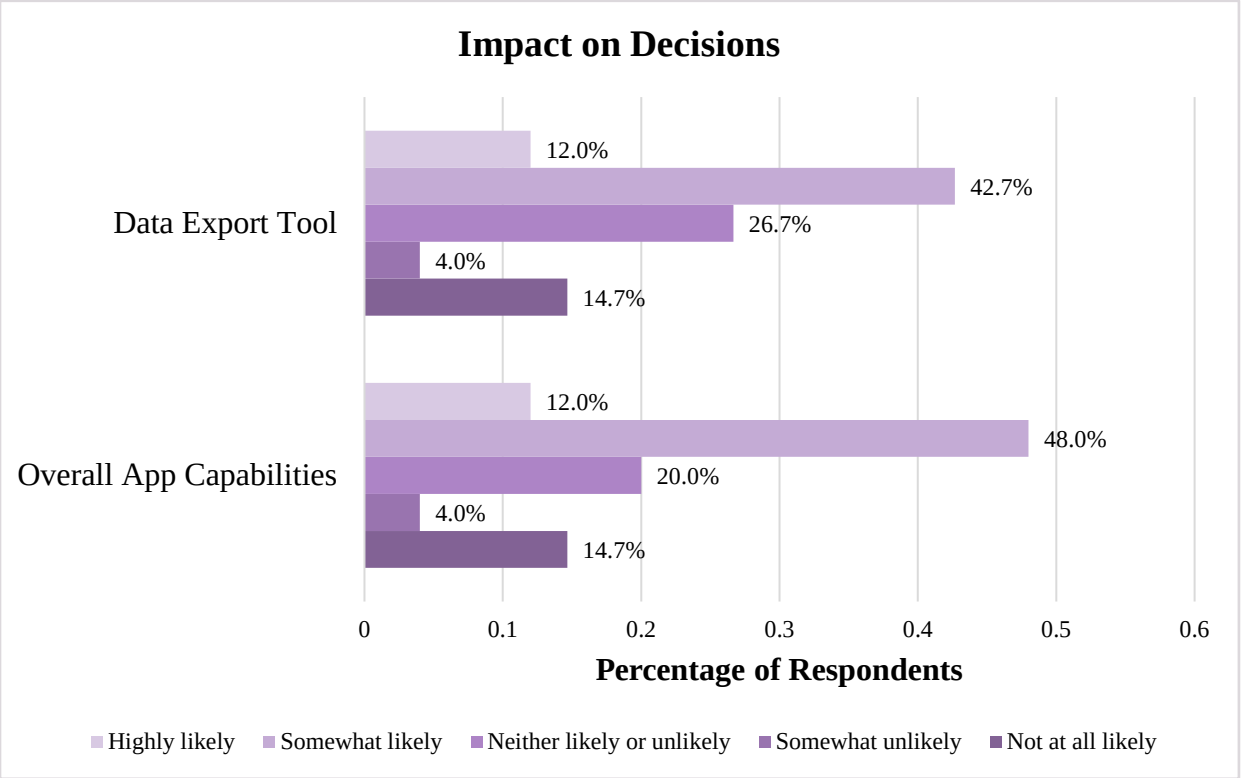
Figure 4.7. Survey results depicting use of data export features



indicated that they had used the data storage and exporting functions, as opposed to the 58 percent of respondents who stated that they had not conducted an export but would like to learn more about the available feature. Only 14.8 percent of respondents indicated that they were not interested in using the app for data storage and export purposes. These results are summarized in Figure 4.7, which portrays a visual representation of producer responses to the question inquiring about their usage of data export and storage features. A strong majority of participants indicated that their primary use for exported data would be to transfer whole-herd data to a home computer system. Despite continued adaptations made to the CalfDex and similar electronic recordkeeping platforms, results from this portion of the survey demonstrate the need to promote user knowledge in data transfer and heighten accessibility through the creation of additional tutorials and services.

To gain additional insight on the extent to which CalfDex and specifically its data export

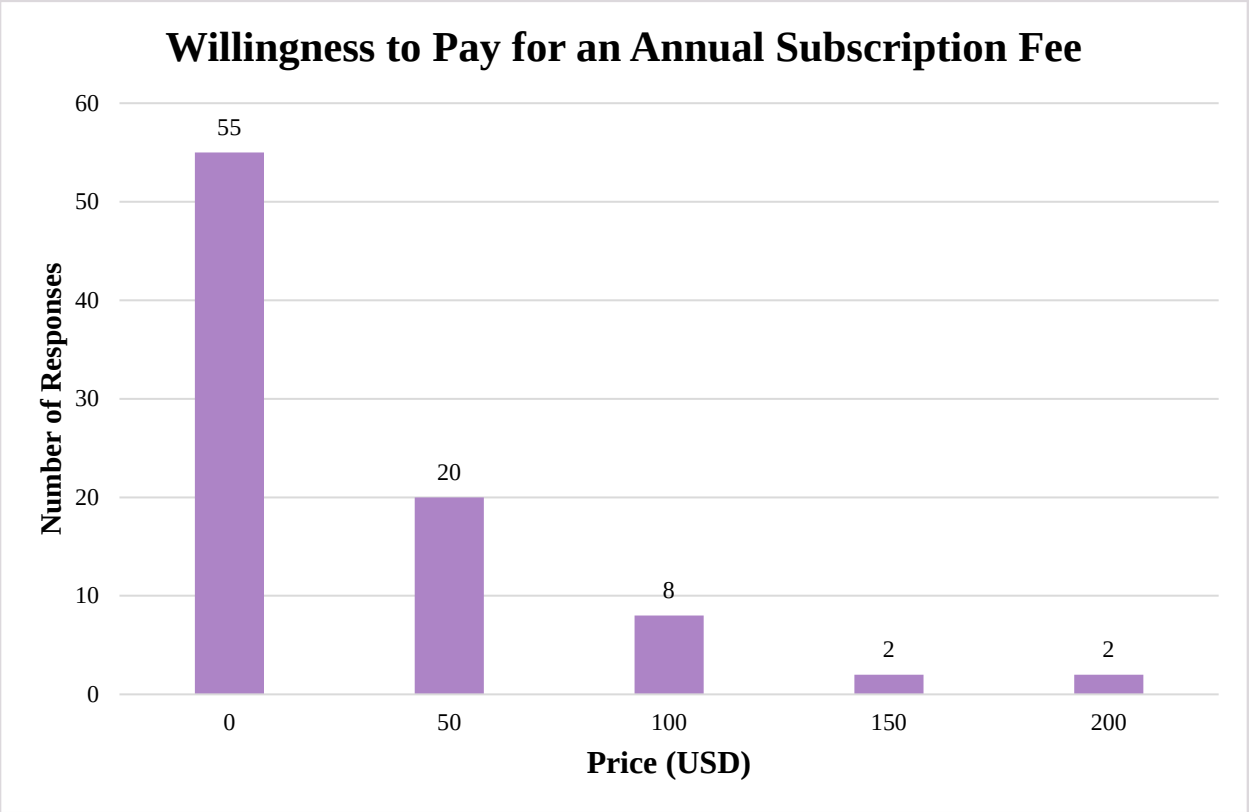
Figure 4.8. CalfDex functions and their influence as a decision-making tool



functions impact the producer decision-making process, participants were asked to rank the likelihood of keeping animal information stored under a single platform impacting their individual management decisions. A series of five choices were presented to respondents in Likert-scale format, ranging from “not at all likely” to “highly likely”. Figure 4.8 provides a visual representation of producer responses, categorized by the impact of overall app capabilities and specifically, the data exporting tool. Most respondents were either neutral or somewhat likely to alter their decision-making based on their knowledge of the overall capabilities of the CalfDex mobile application. Similarly, 54.7 percent of participants indicated that efficient use of a data export tool would likely impact their management or economic decision-making, while 26.7 percent recorded a neutral preference in their responses.

For the final portion of the survey, participants were questioned about ideas for additional

Figure 4.9. Responses of willingness to pay at various price points

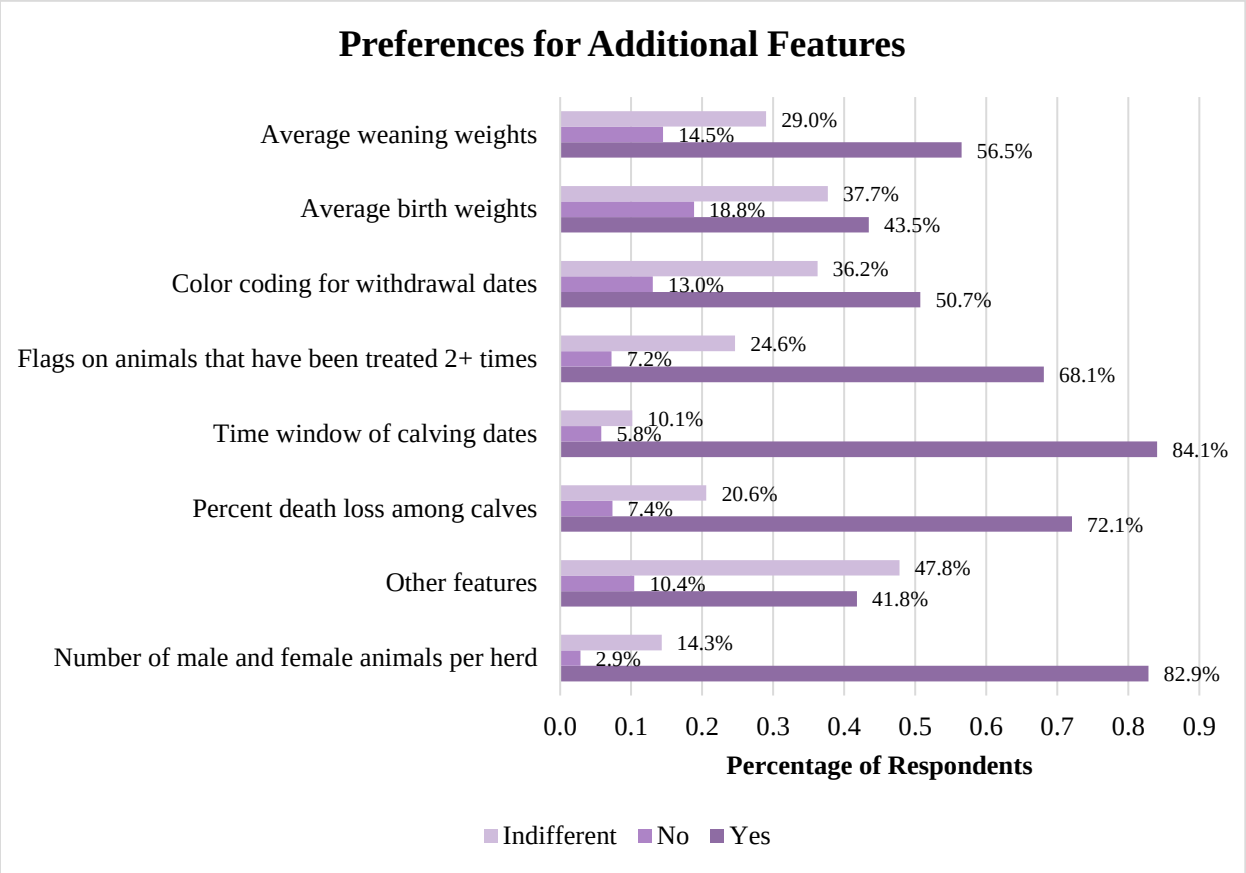


modifications to the CalfDex and their WTP for enhanced services. In the calculation of WTP, participants were shown a range of possible subscription prices. The beginning price portrayed a free service with industry-sponsored advertisements, or the option to select an annual subscription price of $50. Through a discrete choice application method, respondents were navigated to the final survey question if they indicated they were not willing to pay for an annual subscription, or to a follow-up question which portrayed the next highest price if the decision to pay the first annual subscription rate was selected. Each subscription rate increased by an increment of $50, with a maximum of $200 annually. Nearly half of respondents (49.3%) indicated a neutral preference to the inclusion of industry-sponsored advertisements in the interest of continuing CalfDex as a free platform. All other preferences showed a relatively even

distribution between the number of individuals opposed to the implementation of advertisements, in comparison to the number of individuals who favored the idea to include advertisements within the application. Correspondingly, results from the question series which estimated WTP indicated a strong preference from users to continue offering the CalfDex as a free service, as shown in Figure 4.9. In the calculation of a mean WTP estimate, survey responses from each individual were summed to determine the total number of responses. The number of responses for each given price point were then summed to yield a total value for all price points. Through the use of Stata statistical software, the total calculated price value was divided by the total number of responses to generate a mean estimation for WTP, which was determined to be $28.23 per year. These results are indicative of a strong user preference for a cost-effective yet functional platform to collect and organize cattle production records on a year-to-year basis.

The final section of the survey collected feedback on additional attributes that users expressed an interest on incorporating into the CalfDex application. Approximately 7 optional features were presented to respondents on a three-point Likert scale, with the option to select “yes”, “no”, or “indifferent” as a preference to each attribute. If a certain feature that a user desired was not listed in the survey or already included in the app, the option to indicate a preference for other features was also available. These results are summarized in Figure 4.10, and reflect that a vast majority of producers (greater than 80 percent) expressed a desire to see a comprehensive summary on the number of male and female animals per herd, as well as a time window of calving dates. Other attributes that were heavily favored included the summarization of percent death loss among calves, as well as incorporation of the ability to place “flags” on animals that had been treated for an illness two or more times. Likewise, analysis of these responses illustrate that the indicated preferences most closely align with information sources

Figure 4.10. User preferences for inclusion of additional features



that are recorded on cow-calf operations and further demonstrate the need for adaptable, dual-use data management systems that promote uniformity in recordkeeping and consequently, facilitate a more structured transition of information to downstream sectors.

Chapter 5 - Conclusions

Advancements in data recording technologies for use in the cow-calf production sector have made substantial improvements over the past decade, however, modifications are still needed to accelerate the efficient exchange of animal information. Frequency measurements and the number of operations who exported data from CalfDex indicated a notable level of interest from producers to adopt and maintain cattle production records under a singular platform, yet also revealed underlying issues including inconsistencies in data recording methods as well as an overall lack of understanding in the field of electronic recordkeeping. Results from the CalfDex user survey further illustrated this information gap due to 58 percent of participants indicating their lack of knowledge behind data export and storage functions and an evident willingness to learn more about these features. Approximately 27 percent of respondents were familiar with the data export and storage functions introduced through CalfDex, and only 14.8 percent indicated no interest in the use of electronic information sharing functions. Intriguingly, nearly 57 percent of respondents expressed an interest in the implementation of a Bluetooth feature with the capacity to read electronic identification (eID) tags. A majority of criticisms received from the optional feedback portion of the survey dealt with issues pertaining to the login process, password changes, and access to tutorials that assist with navigation of the mobile platform. Feedback received from participants continues to be a crucial factor in the development process and emphasizes the need for a database which allows for seamless communication between developers of the application, a continually growing volume of users, other industry participants, and downstream business partners.

For continued distribution and use of CalfDex in a production setting, further revisions are needed to construct a straightforward design that suits a variety of operations. An evaluation

of initial feedback from producers yielded a variety of suggestions, such as the capacity to directly enter calves into the platform as a new animal rather than having to specify a dam under the “Calving” tab. This feature would be particularly applicable to operations who don’t individually tag or identify their calves and are seeking a platform for which whole-herd information can be tracked. Other areas of feedback addressed revisions to the functional design, including the ability to manually input birth, weaning, processing, and treatment information under the respective tabs designated as “Calving”, “Processing/vaccination”, “Treatment”, and “Weaning”. The current version of CalfDex is automatically programmed to set any dates associated with a new entry to the date the entry was created, rather than the date the event actually occurred. This method may result in unintended organizational issues for users as many producers tend to update records periodically rather than daily. Although incorrect treatment and processing dates can be edited in the spreadsheet format after a data export is conducted, inconsistencies in recorded data between the mobile app and the spreadsheet version can become frustrating for producers and potentially discourage future use of the application.

As evidenced through the development of a variety of cattle data management platforms such as CattleMax, Gallagher Animal Performance, CattleTrace, and currently the CalfDex, no individual platform has yet been established as a universal record-keeping tool. To effectively promote the exchange of animal information throughout a vertical supply chain and mitigate inconsistencies in data recording, compatibility between platforms will likely become a necessary adaptation as technology dependence increases across various production sectors. Upon release of a revised version of the CalfDex, future beta testing trials are needed to determine the tool’s efficacy as an animal data management and information-sharing platform for a diverse demographic of production operations.

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Appendix A - CalfDex User Survey

IRB exemption letter

KANSAS STATE UNIVERSITY | University Research Compliance Office

TO: Ted Schroeder
Agricultural Economics

Proposal Number: IRB-11963

FROM: Lisa Rubin, Chair
Committee on Research Involving Human Subjects

DATE: 12/08/2023

RE: Proposal Entitled, "CalfDex User Survey."

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written – and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §104(d), category:Exempt Category 2 Subsection ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

Electronically signed by Lisa Rubin on 12/08/2023 5:22 PM ET

CalfDex User Survey Online Instrument

Welcome

Welcome to the CalfDex user survey. This survey will consist of 18 questions (some of which are optional) and five of the following categories:

1. **Demographics**
2. **App Usage**
3. **App Features**
4. **Services**
5. **Optional User Feedback**

As producers, your time is valuable to us. That being said, the estimated time of completion for this survey is about 10 minutes. Your interest in CalfDex and assistance with helping us build an improved user experience is appreciated!

Q1

What is your home state?

Alabama

Page Break

Q2

Which option best describes your sex?

- Male
- Female
- Prefer not to respond

Page Break

Q3

Which of the following categories does your age fall under?

- 18-24
- 25-29
- 30-39
- 40-49
- 50-59
- 60+

Q4

What type of production does your operation most closely identify with? Select all that apply.

- [ ] Purebred cow-calf
- [ ] Commercial cow-calf
- [ ] Stocker/backgrounder
- [ ] Feedlot
- [ ] Other

Page Break

Q5

In number of cows, what is the size of your herd?

- ○ 1-49
- ○ 50-99
- ○ 100-199
- ○ 200+

Q6 Select all that apply.

Where did you first hear about CalfDex? Select all that apply.

- [ ] AgManager website
- [ ] Social media
- [ ] Industry-related event
- [ ] Radio broadcast
- [ ] Friend, family, or colleague
- [ ] Found on the App Store or Google Play Store
- [ ] Other

Page Break

Q7

Which, if any, of the available tabs in CalfDex have you utilized for your operation?

	Yes	No	Unsure
Calving	○	○	○
Processing/vaccination	○	○	○
Treatment	○	○	○
Weaning	○	○	○
Postweaning	○	○	○

Q8

Are there multiple users for your account?

- ○ Yes
- ○ No
- ○ I was unaware of this feature

Q9

Are you (or another user of your account) familiar with the "Export Data" and "Store Data" features available within CalfDex?

- ○ Yes
- ○ No, but I'd like to learn more
- ○ No, I'm not interested in these features

Page Break

Q10 | Select all that apply.

If you plan to or if your operation is currently using exported data from CalfDex, which of the following reasons apply? Select all that apply.

- ☐ To transfer whole-herd data to a home computer system
- ☐ To identify chronically ill animals
- ☐ To share herd information with business partners or other downstream producers
- ☐ Other

Q11

Given your current knowledge of CalfDex and its data export functions, what is the likelihood that keeping information stored under one platform and being able to view herd data will impact any management or economic decisions pertaining to your operation?

	Impact on Decisions				
	Not at all likely	Somewhat unlikely	Neither likely or unlikely	Somewhat likely	Highly likely
Overall app capabilities	○	○	○	○	○
Data exporting tool	○	○	○	○	○

Page Break

Q12

Would an available Bluetooth feature within CalfDex that has the capability to read electronic identification (eID) tags be of use to your operation?

- ○ Yes
- ○ No

Q13

Skip to

End of Block if No Is Selected

Have you ever used or considered any other electronic animal data management platforms?

- ○ Yes
- ○ No

Q14

If yes, which other platforms have you used, and why did you transition to CalfDex?

Q15

To continue offering CalfDex as a free platform, what would your opinion be on sponsored, industry-related advertisements being included on the app's home page?

Strongly Oppose	Oppose	Neutral	Favor	Strongly Favor
○	○	○	○	○

Page Break

Q16

Skip to

Please indicate a preference for each... if I would not be willing to p... Is Selected

For an advertisement-free experience with CalfDex, how much would you be willing to pay for an annual subscription?

- ○ I would not be willing to pay for an annual subscription
- ○ $50

Q16

Display this question

If For an advertisement-free experience with CalfDex, how much would you be willing to pay for an an... $50 Is Selected

Skip to

Please indicate a preference for each... if I would not be willing to p... Is Selected

For an advertisement-free experience with CalfDex, how much would you be willing to pay for an annual subscription?

- ○ I would not be willing to pay $100 annually
- ○ $100

Page Break

Q16

Display this question

If For an advertisement-free experience with CalfDex, how much would you be willing to pay for an an... $100 Is Selected

Skip to

Please indicate a preference for each... if I would not be willing to p... Is Selected

For an advertisement-free experience with CalfDex, how much would you be willing to pay for an annual subscription?

- ○ I would not be willing to pay $150 annually
- ○ $150

Q16

Display this question

If For an advertisement-free experience with CalfDex, how much would you be willing to pay for an an... $150 Is Selected

Skip to

Please indicate a preference for each... if I would not be willing to p... Is Selected

For an advertisement-free experience with CalfDex, how much would you be willing to pay for an annual subscription?

- ○ I would not be willing to pay $200 annually
- ○ $200

If a user dashboard were available within CalfDex that summarizes whole-herd and animal information, which features would you prefer to see? Please indicate "Yes", "No", or "Indifferent" as corresponding with your preference.

	Yes	No	Indifferent
Number of male and female animals per herd	○	○	○
Percent death loss among calves	○	○	○
Time window of calving dates	○	○	○
Flags on animals that have been treated for illness 2+ times	○	○	○
Color coding if a user chooses to enter withdrawal dates for a treatment (ex: green denotes out of withdrawal period)	○	○	○
Average birth weights (separate for males and females)	○	○	○
Average weaning weights (separate for males and females)	○	○	○
Other features	○	○	○

Text/Graphic

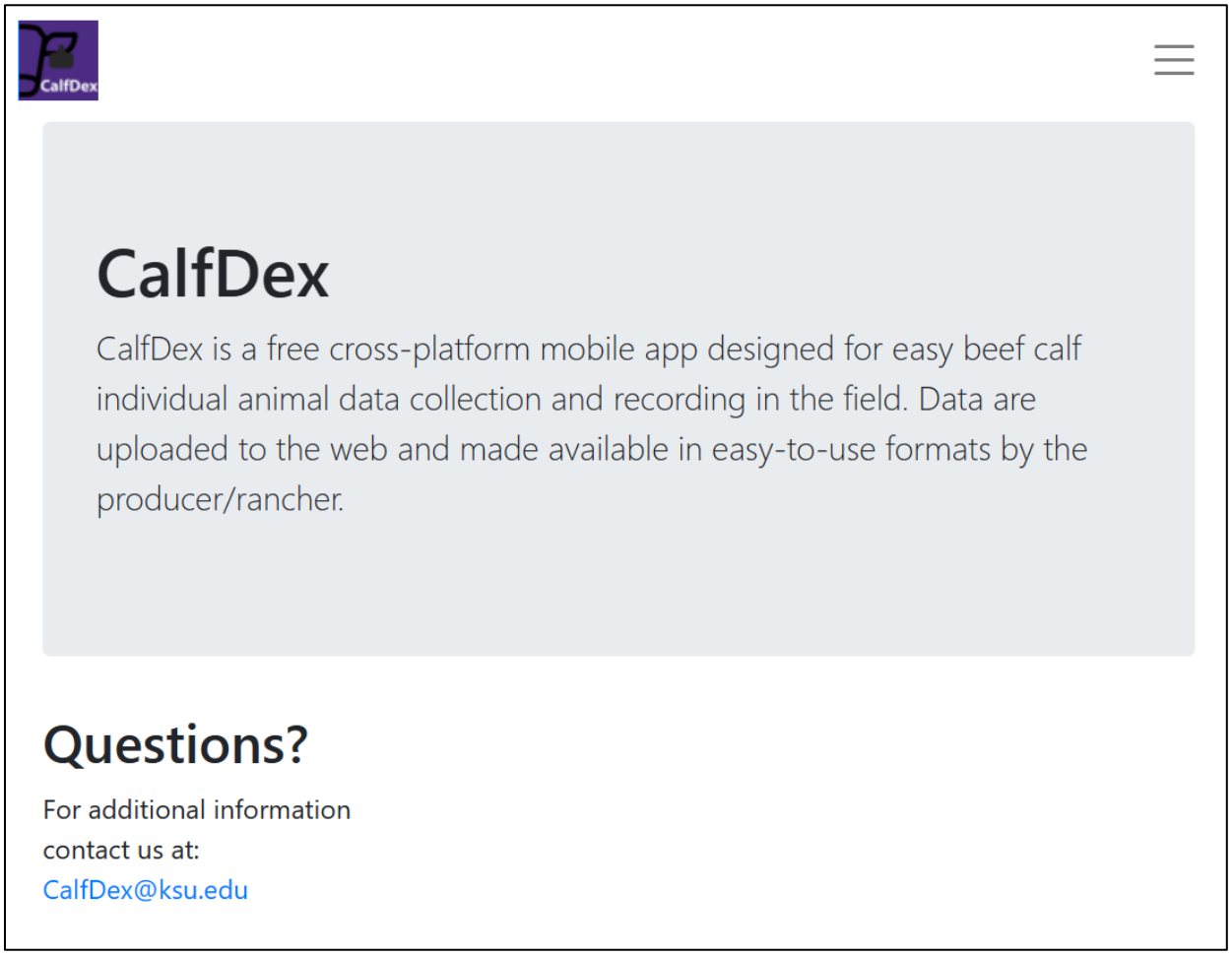
Your input is valuable to us as we continue to develop the CalfDex platform. As producers ourselves and as researchers at an educational institution, we strive to incorporate your feedback into CalfDex to provide users with a high-quality, individually tailored app experience. Please provide us with any comments or suggestions you may have in the final question.

Q18

Do you have any additional feedback for the developers of CalfDex?

Appendix B - CalfDex Website and Tutorials

CalfDex home page



Create account tutorial

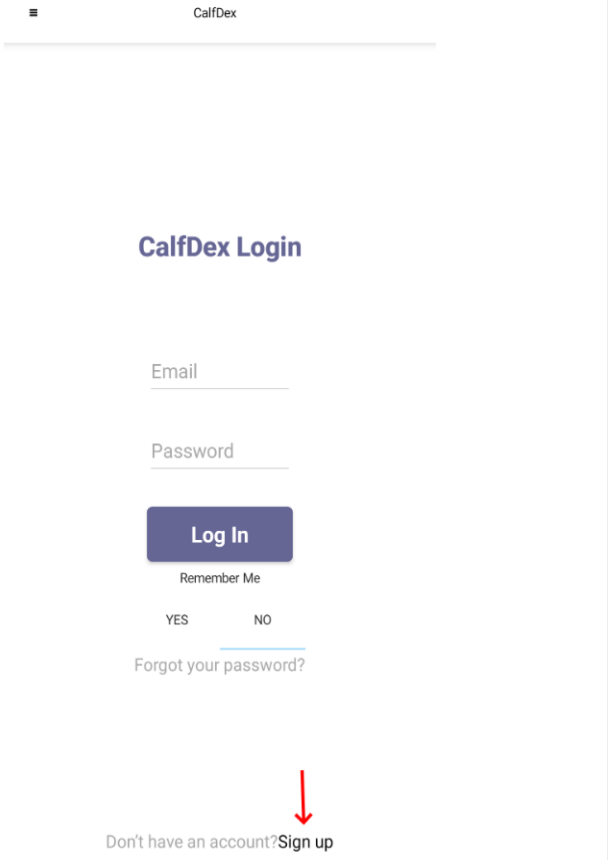
Create Account

Before using the CalfDex app you must create an account.

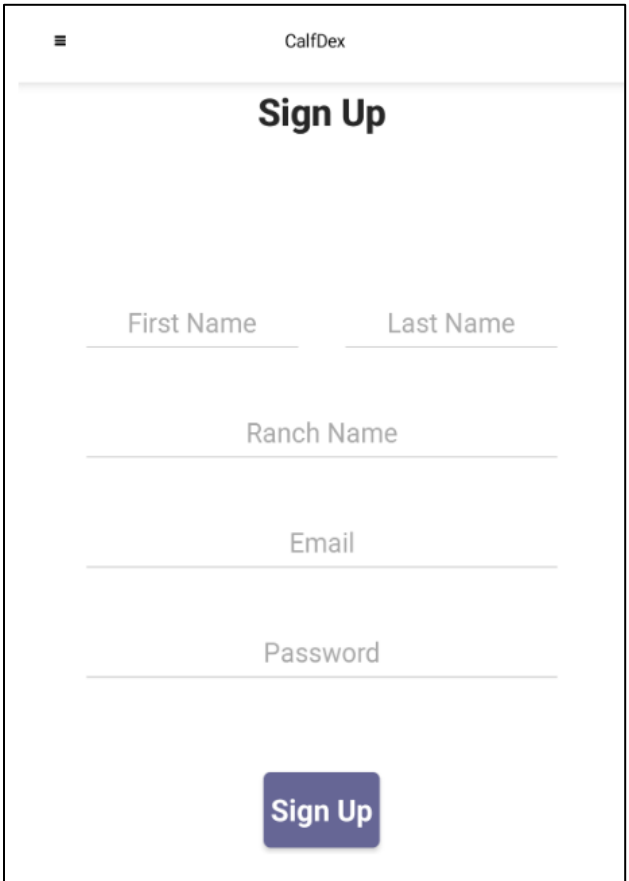
1. Search "CalfDex" on the App Store or Google Play Store and download

2. Once downloaded, open the app and the login page will appear

3. Click "Sign up" at the bottom right corner of the screen as indicated in the image below

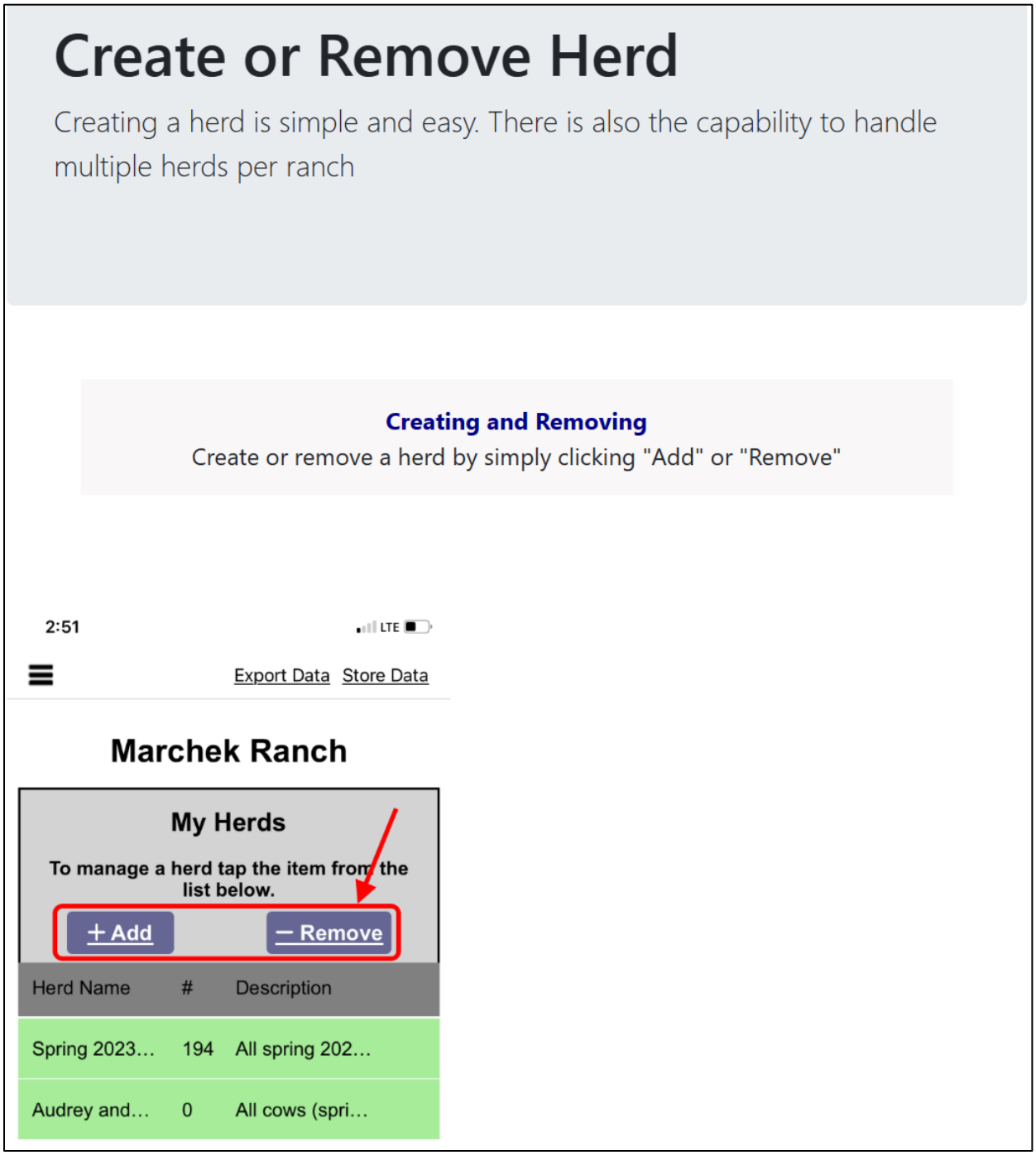


4. The next page will prompt you to enter your account information



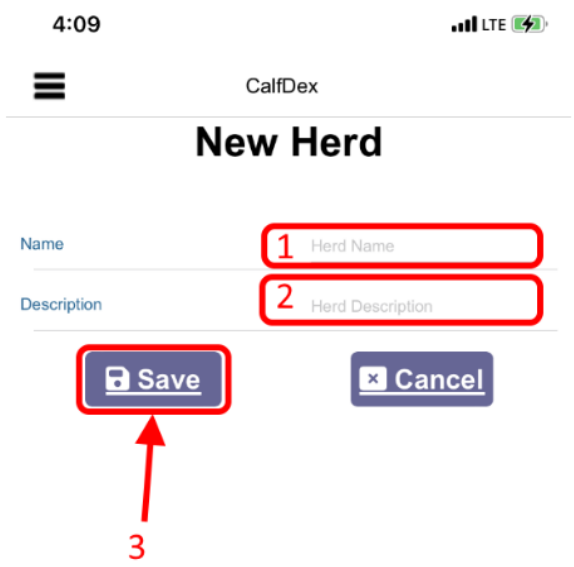
5. Upon click "Sign Up" your account is created!

Create and remove herds tutorial



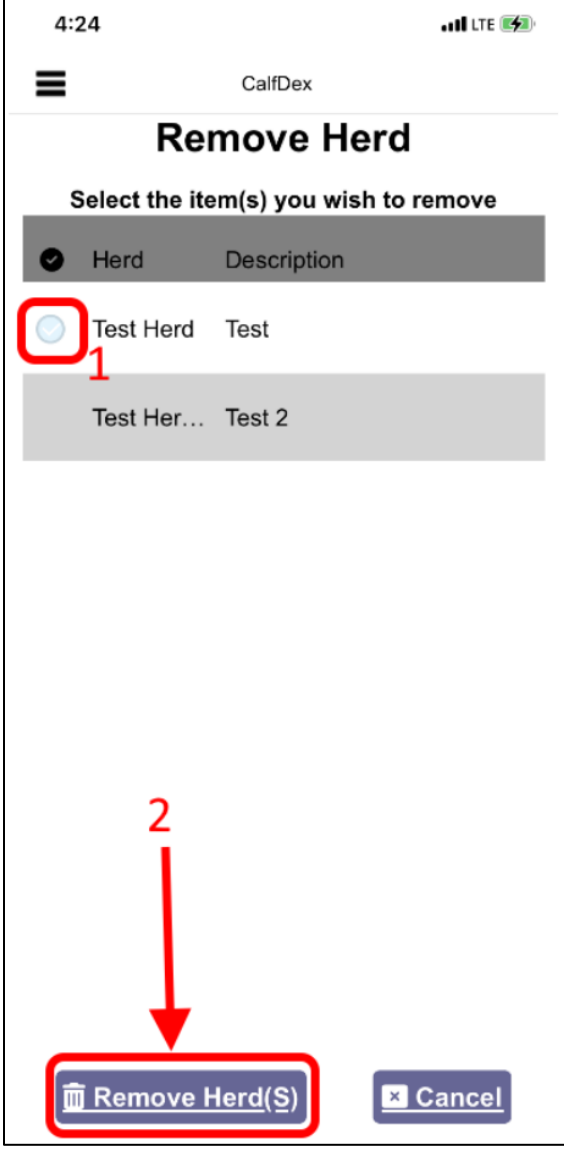
Create a new herd

To create a new herd, enter a name and description and press "Save"



Remove a herd

Select which herd you'd like to remove (indicated by the check mark) and press "Remove Herd(s)" again



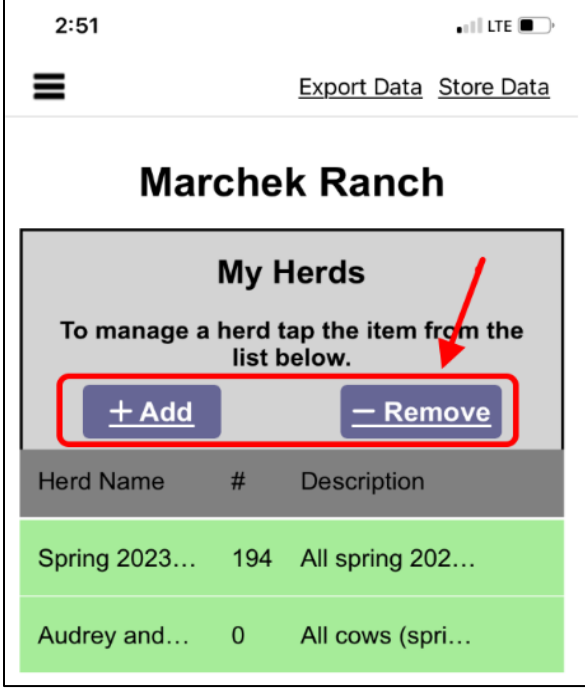
Adding and removing animals tutorial

Adding and Removing Individual Animals

Login to your account and select a herd from the home page to add/remove animals

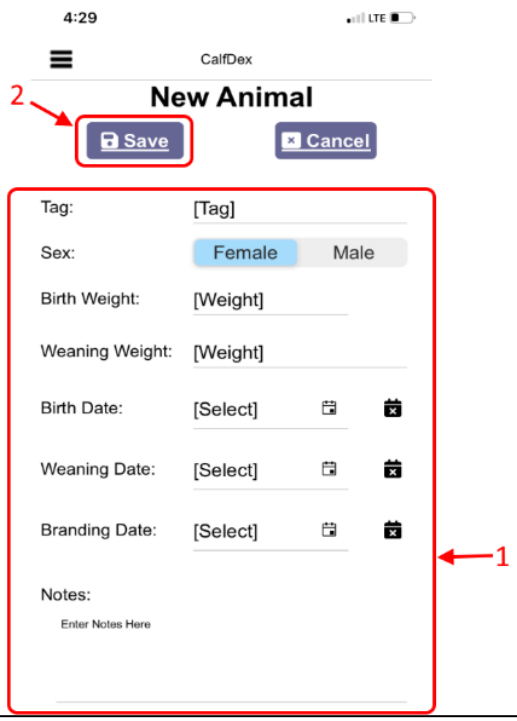
Creating and Removing

Create or remove an animal by simply clicking "Add" or "Remove" from the "My Herds" screen



Create a new animal

Clicking "Add" from the "My Herds" screen displays the "New Animal" page.
Enter any desired information and press "Save"



Remove an animal

Select"Remove" displays a list with options for the reason why the animal is being removed from the herd. Select an animal you'd like to remove, then enter a removal reason. Press "Confirm"

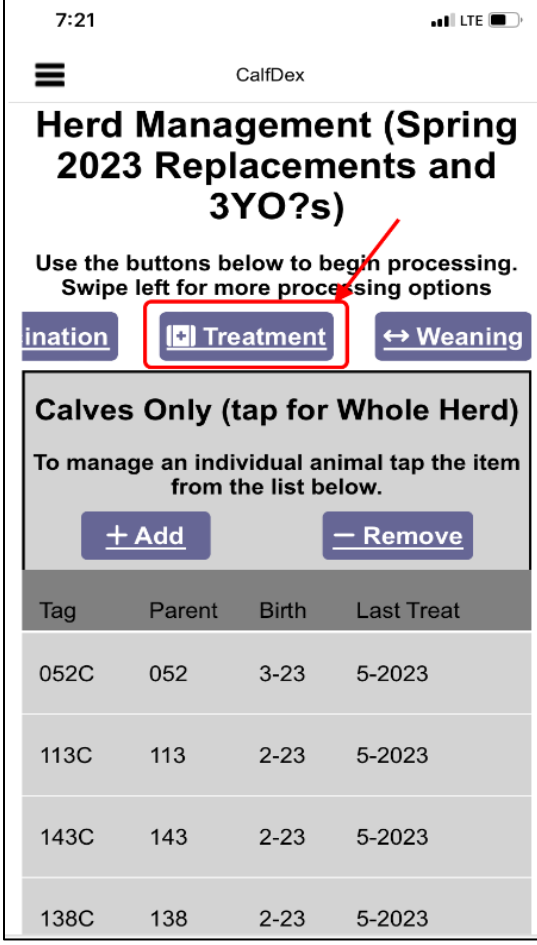
Individual animal treatment tutorial

Treating Individual Animals

When treating an animal you have the option to choose the an illness and the associated treatment

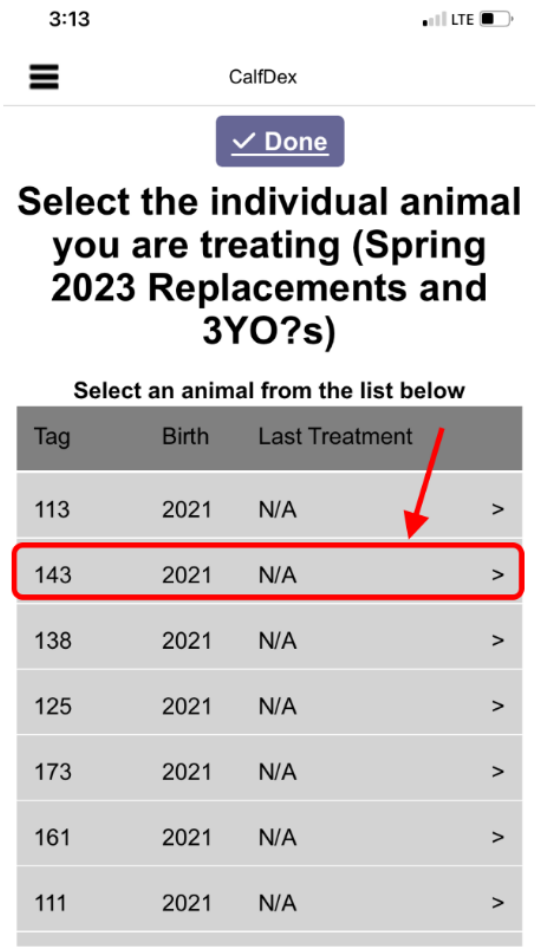
Applying Treatment

Start by selecting a herd from the home page and click the "Treatment" tab as seen in the image



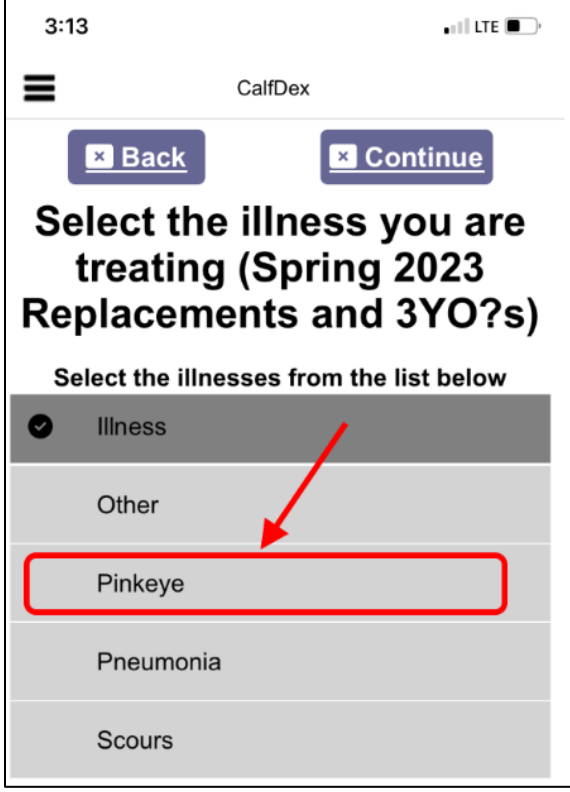
Select Animal

Once this tab has been selected, you will be prompted to select an animal from the following screen:



Select the Illness

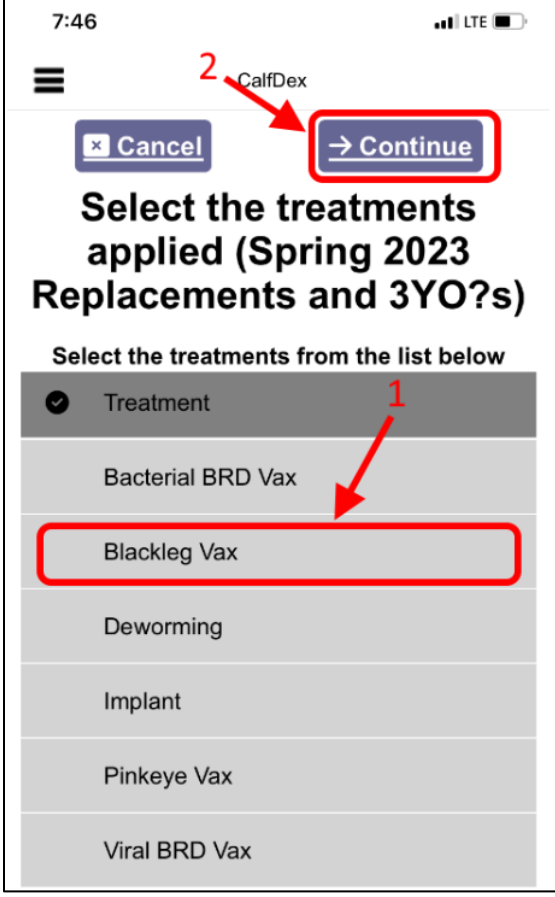
The second screen will ask which illness is being treated. Select a listed illness or "Other"



Select the Treatment

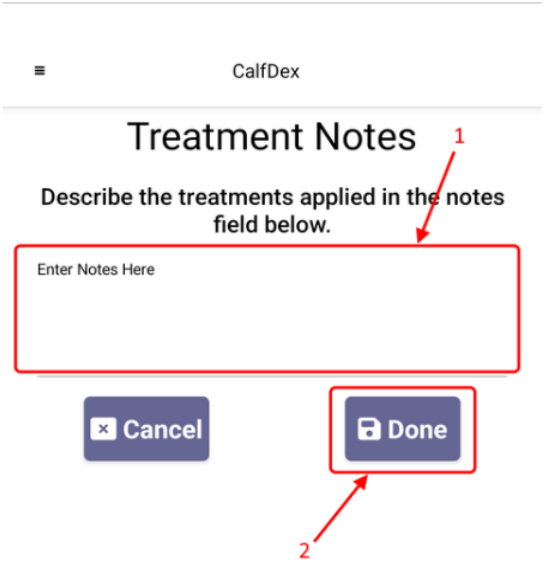
Upon selecting the illness you can select the applied treatment (multiple treatments are allowed to be entered at once)

Once all appropriate fields have been selected, press "Continue"



Enter Treatment Notes

Once the illness and treatment have been selected you may enter notes. Note, if "Other" was selected as the illness the notes are required



Whole herd treatment tutorial

Applying Whole Herd Treatments

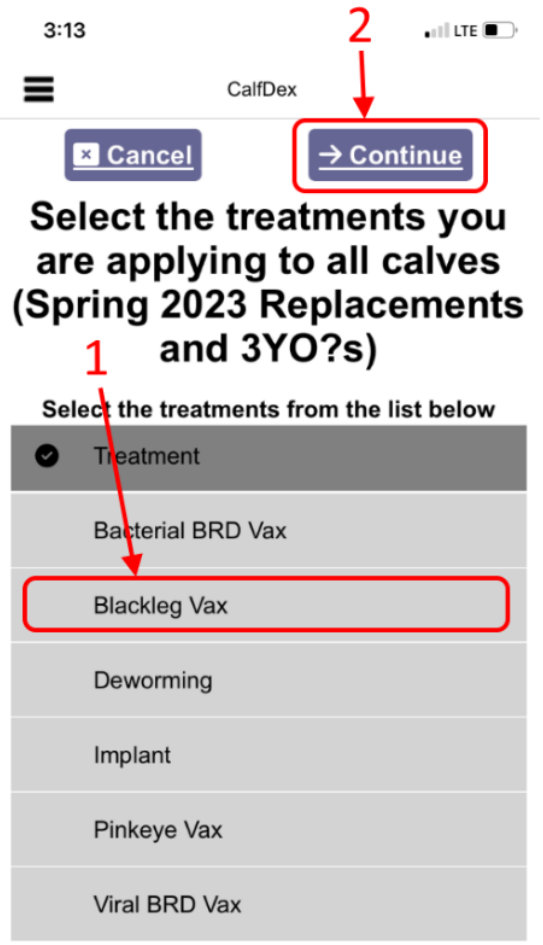
Applying treatments to the calves in your herd can be accomplished in both the "Processing/Vaccination" and "Weaning" tabs available on the home page. Treatments in both tabs are nearly identical.

Applying Treatment

Start by selecting a herd from the home page and click the "Processing/Vaccination" or "Weaning" tab as seen in the image. The process for processing and weaning are different, but very similar

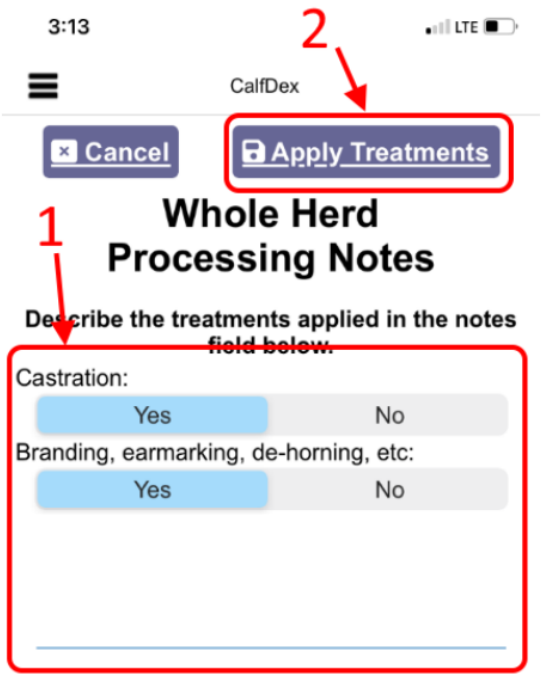
Select Treatment

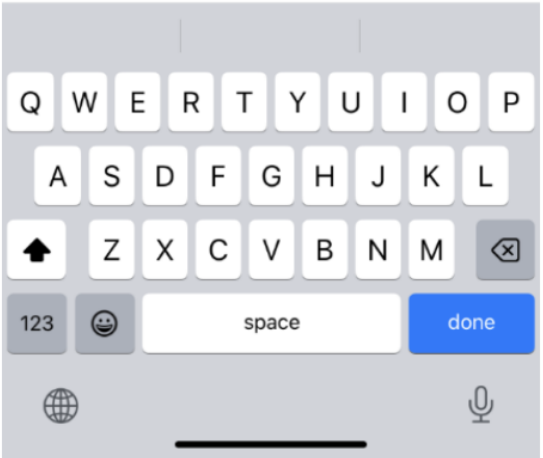
Once this tab has been selected, you will be prompted to select a treatment to apply to all calves in the herd. Click "Continue" when all desired options are selected



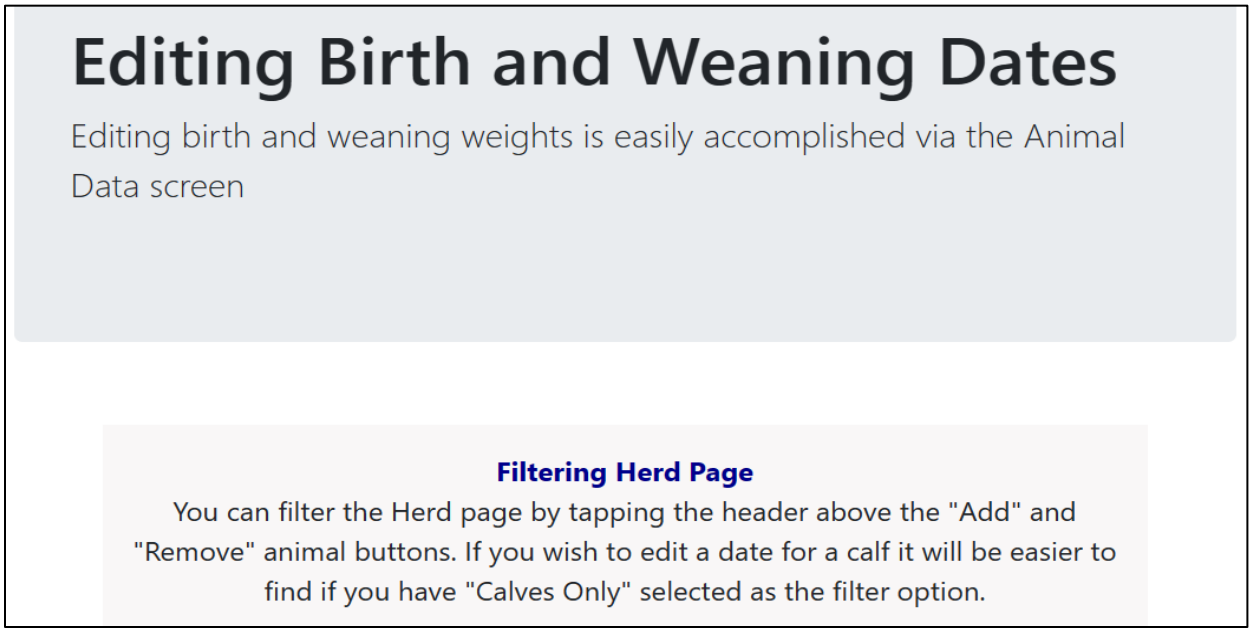
Enter Notes and additional info

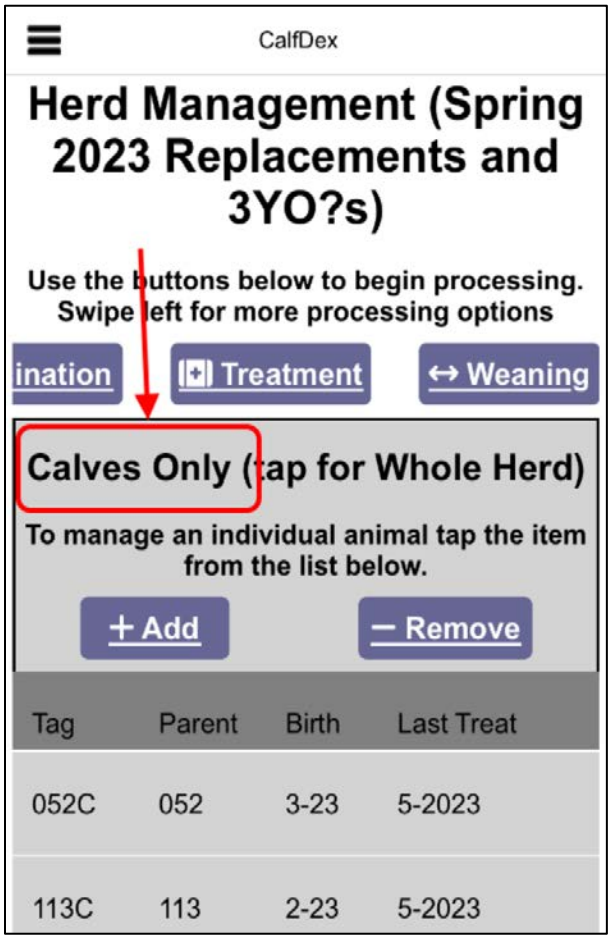
On the final screen you are given the option to enter optional treatment notes as well as other possible procedures.





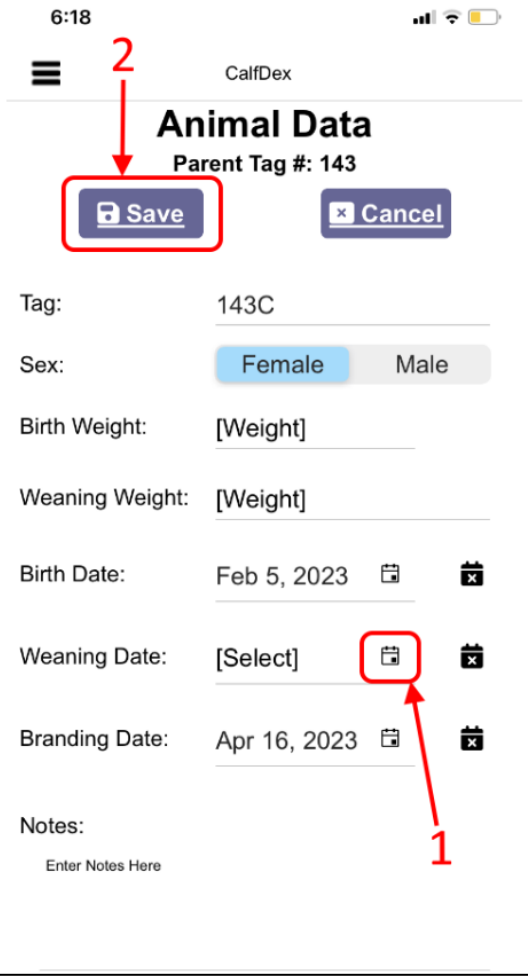
Editing birth and weaning dates tutorial





Editing Date

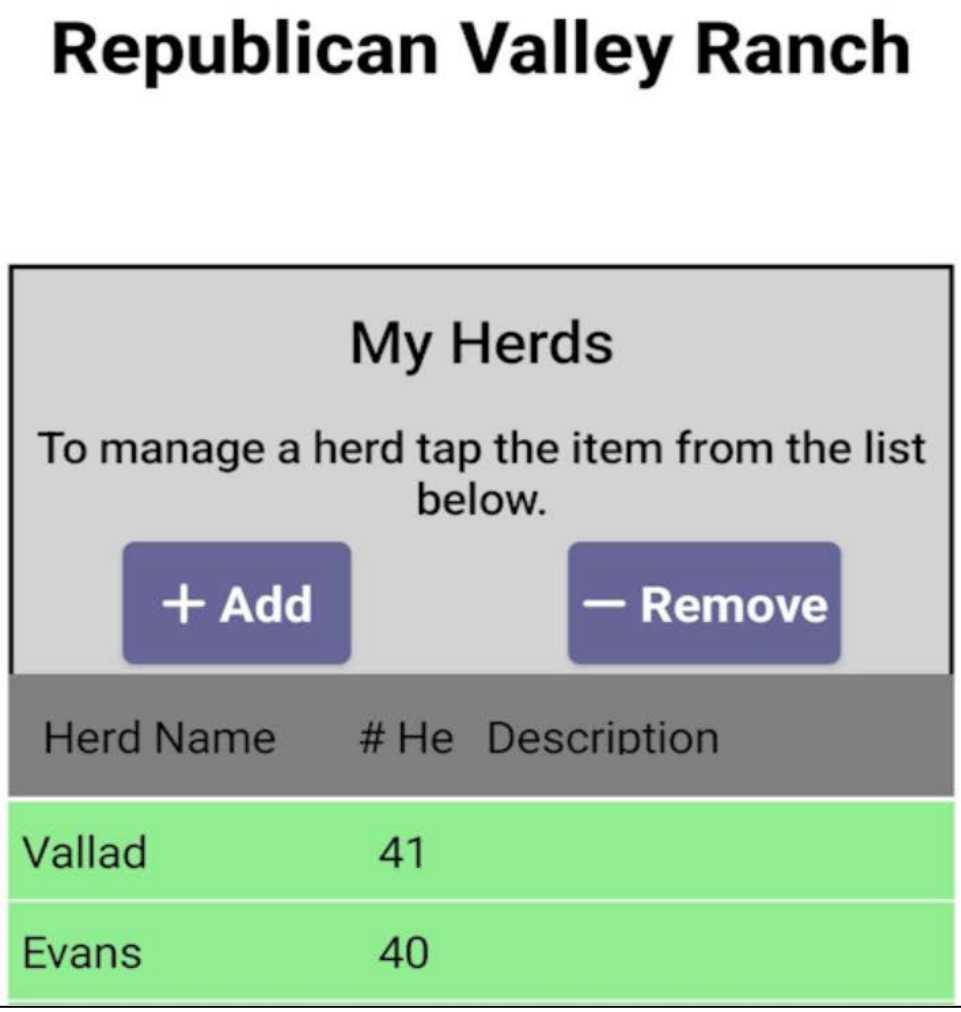
Click on the white calendar icon next to "Birth Date" or "Weaning Date". Enter the appropriate monoth, day, and year, and press "Save" when complete. Note: Other data types such as weights and additional notes can also be edited using this method.



Data export tutorial

Where to Find the "Export" Command

1. Log into your CalfDex account and view the home page.
2. Make sure that all animals you'd like to appear in the export are entered into CalfDex.
3. Navigate to the top right corner of your device's screen and press the "Export Data" function



- 4. After completing the "Export Data" command, check your email inbox for a message from the CalfDex platform (the same email for which you created your account with). If the email does not appear in your primary inbox, be sure to check your junk and spam folders as well. Your data will come from the email address "calfdex.ksu@outlook.com".
- 5. Download the attached Excel file from the email and edit as desired.