

Dairy Herd Data Analytics

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Abstract

There is a big opportunity to apply technology and data analytics to the agriculture sector, specifically, to dairy farms. Dairy farmers are looking for solutions that helps them to increase their profitability, efficiency, and reduce labor variance. The Dairy Cows Data Transformation Software helps dairy farmers in the analysis of the data being provided by DHIA report. The application shows all the KPI to the farmer in a web-based dashboard fashion. This eliminates the need of hour of data analysis and manual calculations. The pilot implementation was performed with the support of the dairy farm “El Remanso” in Camuy, Puerto Rico.

Introduction & Background

Nowadays technology is everywhere. You can find it in your car, house, phones, work, etc. Maybe, the question is: where technology is not creating impact as it should? The revolution of technology in manufacturing started during the end of 20th century and continued its evolution during the 21st century. It was called the Industry 3.0 ERA. Computers and automation took control of the manufacturing of cars, drugs, and even agriculture in a reduced magnitude. Industry 3.0 brings with it a ton of data from field devices to automated systems. A decade ago, the Industry 4.0 revolution was born. This era is dealing with use of the data generated by the technology and automation to use it for analytics, predictive decisions, correlation, and so on. In summary, the researcher wants to use the data available to improve farmers’ processes and be more efficient with less. Industrial Manufacturing is already taking benefits from the use of data.

Dairy farms are the biggest single part of Puerto Rico’s agricultural economy, accountable for 37% of total agricultural production or \$390 million, in part, because the Island has set limits on fresh milk imports. There are around 266 dairy farms around the island averaging 200-240 cows per farm [1]. Figure 1 shows dairy farms distribution around the island.

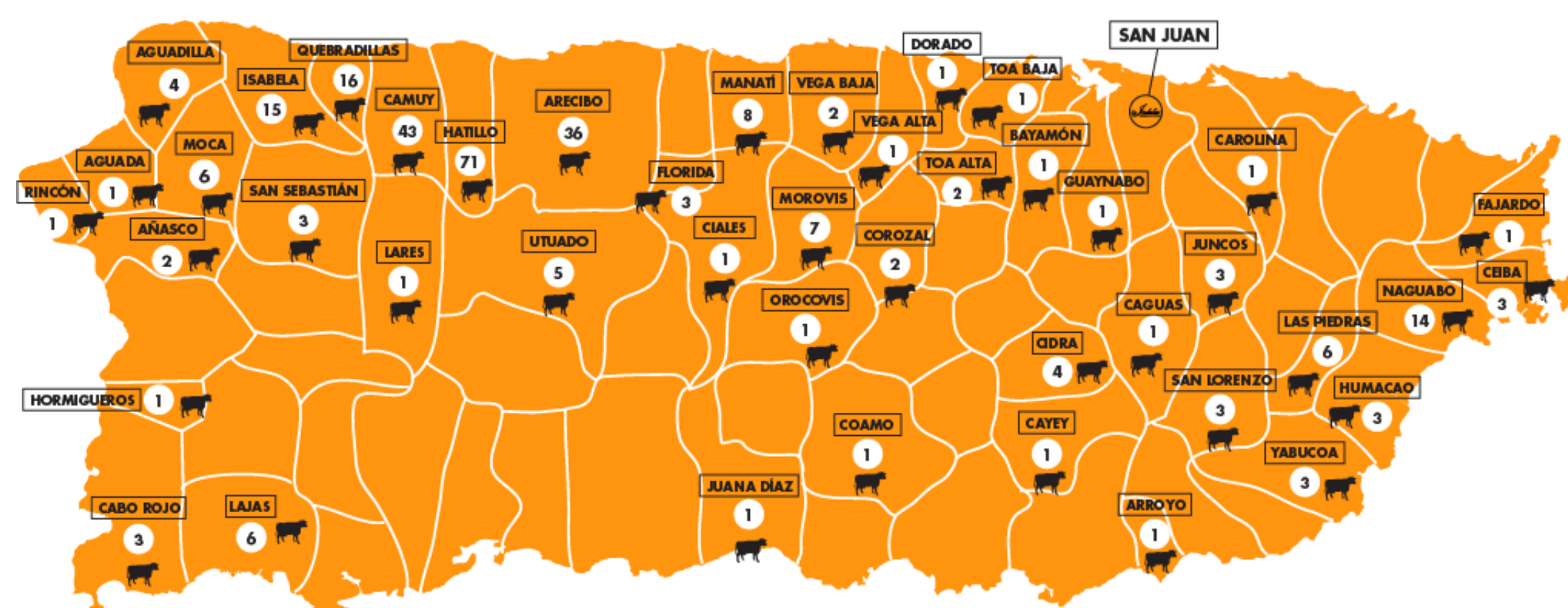


Figure 1 Dairy Farms distribution in PR

In total, dairy farms produce an estimate of 270 million quarts of milk per year. Most of the farms uses herringbone parlors with limited visibility on the performance of each individual cow due to lack of milk quality and yield sensors. Farmers relies on a Dairy Herd Improvement Association (DHIA) technician for a monthly average count of each cow’s milk somatic cell (SCC) and milking yield among other indications [2]. The report generated as part of the technician visit is send electronically to the farmer. These reports are a valuable tool to monitor herd performance, sickness, conception rates, among many other KPIs.

This paper will summarize the current process used by dairy farmers to analyze, use, and manage the DHI reports and will go into details of the solution developed to minimize their effort and get more value from the reports they received and analyzed.

Problem

Dairy farmers face daily challenges to run their business. They need to constantly monitor the health of the cows and calves, milk quality, nutrition (feed & water), cows' welfare, reproduction rates, and, finally, the economics and profitability of the business. Technology is moving its way into dairy farms but at a slowly rate, mainly due to the high cost of technology.

Nowadays dairy farmers rely on monthly reports to gather important information about their herd. These reports are managed by the National Dairy Herd Information Association (DHIA). DHIA sends a technician every 30 days to gather data of conception, cull, milk yield, and milk quality. Once all this data is gathered, DHIA will insert this data into their online database system and create a report that is send electronically to the farmer. This report consists of a Herd Summary and a Monthly summary section. In the Herd Summary section, there is information about feed cost, reproductive summary, birth summary, reproductive summary, and SCC, among many other KPIs. Figure 2 shows a portion of the monthly report and its data.

Figure 2 DHIA Monthly Milking Cows Section

As mentioned previously, farmer use this report to make critical decisions related to production, Herd health, conception, and udder health. In a report written by CROUSHORE, 2017 [3] it states that Dairy Herd Improvement Association (DHIA) testing is often underutilized on many dairy farms. Turning the raw data into something useful is important to take full advantage of the value of testing. Knowing what to do with the data, however, can be a little tricky. Udder health and mastitis, production and reproduction data are important information that will give the farmer the insight on how its business is running but more important, how is trending in order to detect anomalies that can impact the herd in the future. Managing all this data coming from the report manually is minimizing the benefits of this data to the farmer.

Research Questions

The following questions were used as baseline and guideline for the development of the application:

- How will the application help dairy cows and their farmers?
- Is the data relevant to multiple users (dairy farmers)?
- Will the farmer trust the system analytics to benefit from the manual data analysis?
- Are dairy farmers in general willing to pay for this data analytics application?
- How can this application be used to predict cow’s health issues and improve pregnancy rates?
- How many months the system will hold on to record?

Results and Discussion

To help the farmer to maximize the value of the monthly report from DHIA I will develop an application to automatically create dashboards with data from each of the Key performance indicators (KPIs). These are some KPIs collected:

- Milk per Cow per day
 - Cows with high yield
 - Cows with less than 20 liters (cows to dry)
- Days milked, Days Dry, Dates Open
 - List of Cows to breed
 - List of cows to dry
- Reproduction Data
 - Breed or Heat Date
 - Due Date
- Summary per Breed (Holstein, Jersey, Swiss, etc.)
- Health Data
 - SCC Count per Cow analysis
 - Higher cows
 - Month to month comparison

With this dashboard we can improve the visibility of the farmer by extracting the most important information from the DHIA report electronically and analyze it to show alerts to take the necessary actions. Figure 3 illustrates how we use DHIA data systematically. [4]

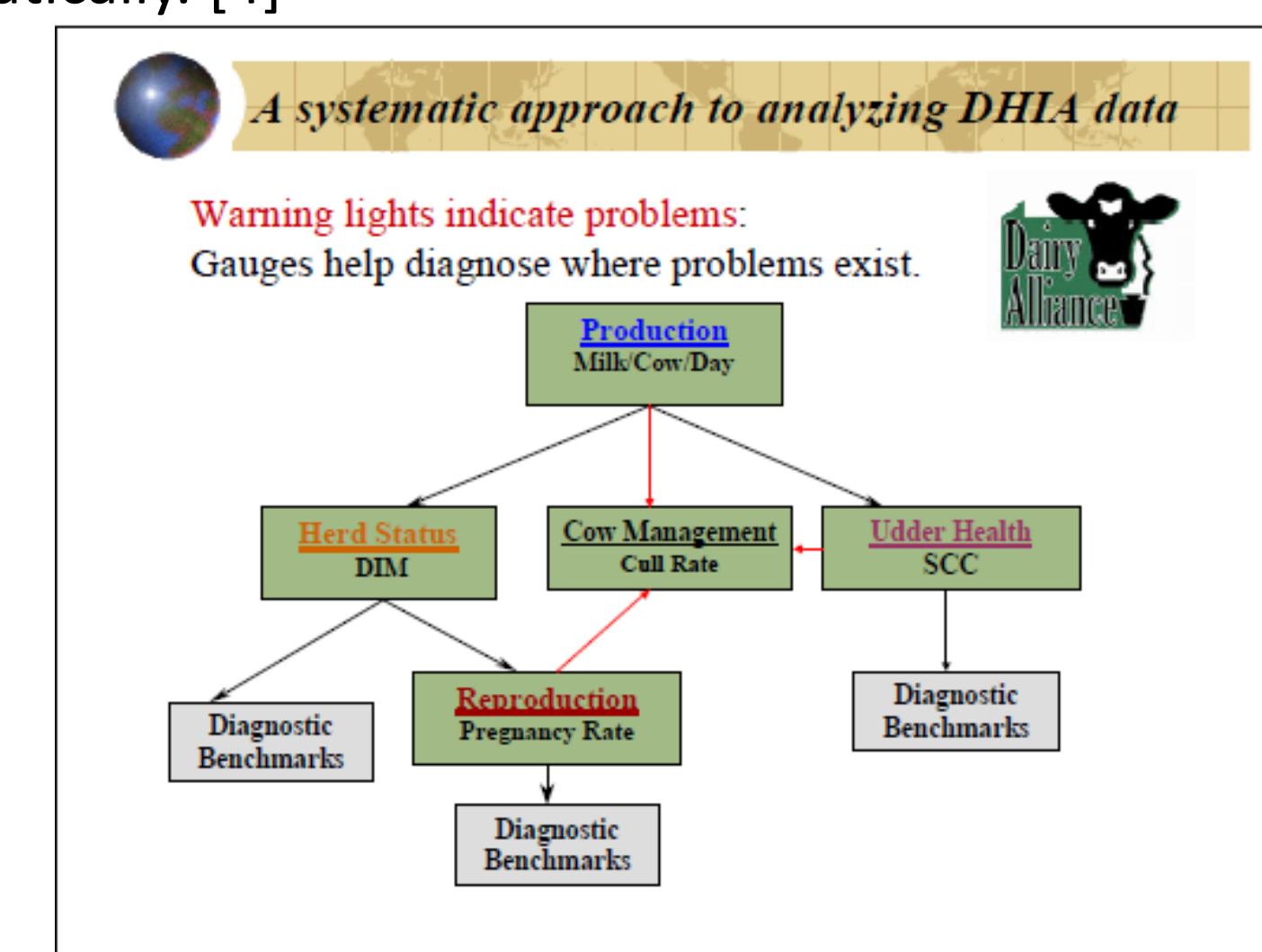


Figure 3 DHIA Systematic approach [Hilty,2009]

With the use of python as a backend, the application transform the DHIA pdf reports to a HTML file in order to “digitalize” the data in the report. Once the report is converted to HTML the application lookup the data needed to generate the KPIs. This data is then saved to a MySQL instance running in Azure in order to have the flexibility to run in the cloud for future enhancements. Using Flask framework, I was able to create a Web framework compatible with Python to be used to:

- Retrieve pdf file from the user.
- Show a dropdown of the possible reports.
- Show results of each defined KPI.

Figure 4 shows portion of the code used to extract the data from the HTML File.

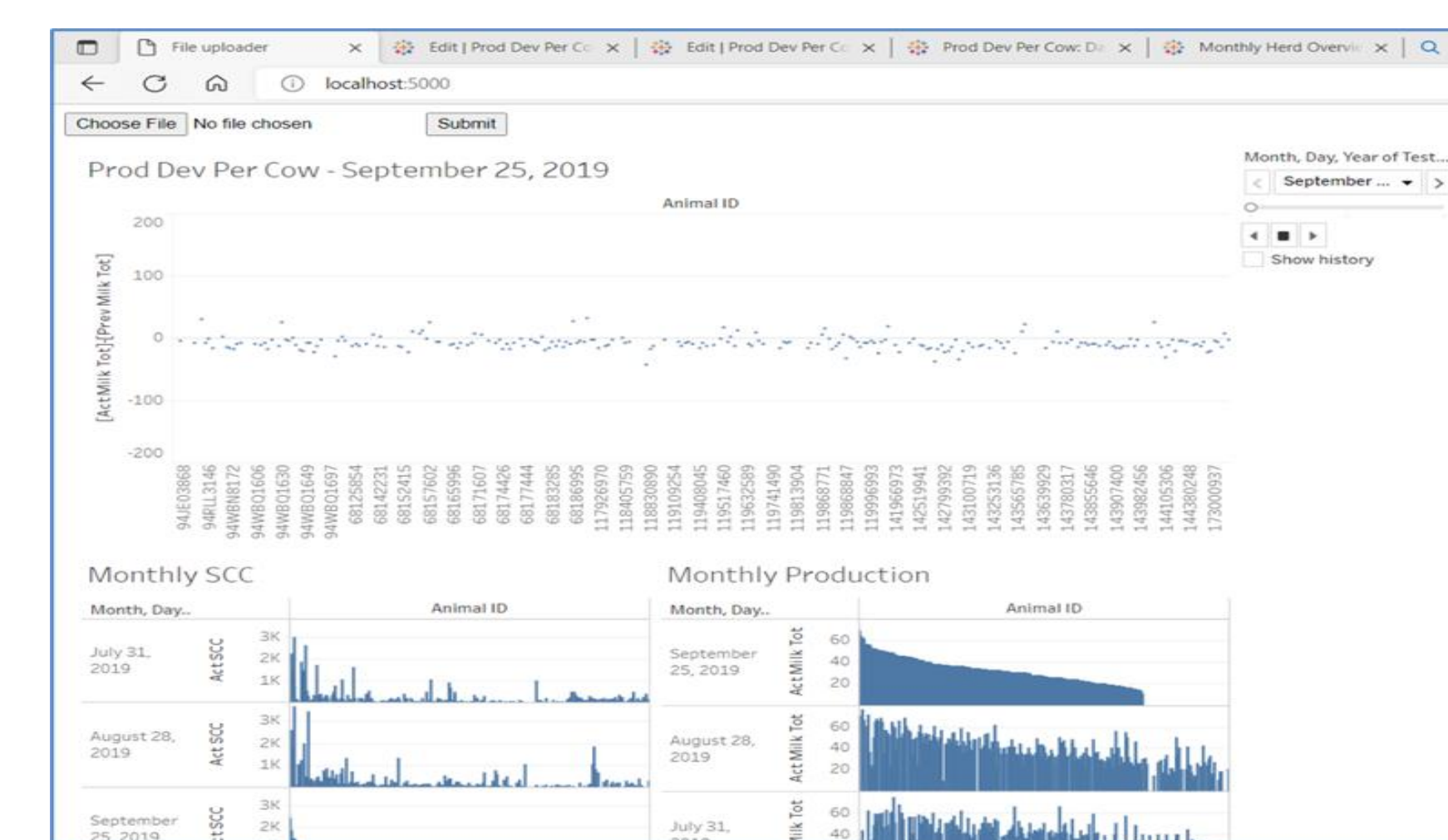


Figure 4 DHIA PDF report converted to a meaningful web-base Dashboard

Conclusions

The main value of Dairy Herd Improvement records (DHIA, Tester-Sampler and Owner-Sampler) comes from putting them to work. DHIA records provide an abundance of data for analyzing herd performance. However, many producers experience information overload when they receive their monthly reports. The result is information that is seldom or never used for its intended purposes: management of the dairy herd. Having a systematic approach to analyzing DHIA data can greatly improve dairy producer’s understanding of dairy records and will increase their use of these records in making management decisions.

The KPIs allow producers to obtain a broad overview of herd performance in several key management areas: production, lactation and reproduction status, reproduction performance, udder health and overall cow management. We can compare the KPIs to the warning light on the dashboard of a car. It can tell us something may be wrong, but it tell us little about what may be causing the problem. To determine where problems may exist in the production system, we need more detailed information. We can use diagnostic indicators to evaluate the various management areas of the overall production system.

Future Work

The Dairy Cow Transformation Software have the capability of expand its functionalities beyond what it has now. This provides the opportunity of increasing the capabilities of the system by including additional KPIs and reports for the farmer. Also, the researchers can add the generation of automatic alerts to the farmer with the data entered to the system, not only from the current month but from previous months stored in the database. This will increase the system value to the clients with the help of data correlation. Moreover, with the data transformation from the monthly PDF files to MySQL database the researchers have the flexibility of adding more value with minimum effort in terms of software development.

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