The objective of this study was to quantify the effect of dry period length (days dry, DD) in the current lactation on the risk of culling in the subsequent lactation. For this retrospective study, we obtained DHI test records of 1,287,659 Holstein cows from 5,155 herds with the last dry date in 2014 or 2015 from DRMS, NC, USA. Three groups of adjacent lactations were constructed: 1 and 2 (par12; n = 605,082), 2 and 3 (par23, n = 362,169), and 3 to 6 (par36, n = 320,408). Included cows had between 21 to 120 DD which were classified into 9 categories (shortest 21–30 DD to longest 101–120 DD). Survival analysis was conducted with proc GLIMMIX in SAS with a 30-d piecewise exponential model with 9 DD categories, 2 time-dependent variables (4 seasons, winter, spring, summer, fall) and 4 reproductive statuses (open, pregnant, bred ≤ 30 d, bred > 30 d), and 5 covariates including total milk yield in the current lactation, milk yield on d 14 before dry-off, and DIM at dry-off. Next calvings, lactations in progress or cows sold for dairy purposes or reason-not-reported were censored. The model was run separately for each group for 0 to 60 and 61 to 450 DIM after calving to quantify the effects of dry period length on culling in early and later lactation. Hazard ratios (HR) for each DD category were calculated with the HR of the 51–60 DD category set to 1. The HR for the 0–60 DIM ranged from 0.81 (21–30 DD) to 1.73 (101–120 DD) for par12, 0.77 (21–30 DD) to 1.64 (101–120 DD) for par23, and 0.74 (21–30 DD) to 1.52 (101–120 DD) for par36. The HR for the 60–450 DIM were also generally greatest for long DD and smallest for short DD, but were closer to 1, implying that differences in DD had greatest effects early in lactation. Models without time-dependent variables and covariates showed greater HR for short DD (closer to 1) and greater HR for long DD (>2) compared with models that included these variables. In conclusion, a longer dry period length in the current lactation increased risk of culling in the subsequent lactation and needs to be considered when optimizing dry period lengths for individual cows.

Key Words: dry period, culling, survival

Production, Management, and the Environment 2

**T74** Potentials and flaws of using 3-dimensional models to describe changes in energy reserves in dairy cattle. J. H. M. Vi-ana1, E. K. N. Arashiro2, L. G. B. Siqueira2, and L. G. R. Pereira2, 1Embrapa Recursos Genéticos e Biotecnologia - Embrapa, Brasília, DF, Brazil, 2Universidade Federal Fluminense, Niterói, RJ, Brazil, 3Embrapa Gado de Leite, Juiz de Fora, MG, Brazil.

The mobilization of energy reserves during lactation determines changes in body shape, which are used to score body condition (BCS) by visual inspection. Recently, new strategies have been proposed to automatize BCS evaluation. Three-dimensional (3D) scanning can be used to obtain geo-
metric data from body surface, however, its use to predict energy reserves still needs validation in cattle. In this study, structured infrared light scanning (Kinect sensor, Microsoft) was used to create 3D models of the rump and dorsal regions of Holstein x Gir crossbred dairy cows (n = 65). The 3D models were used to measure the average (right and left sides) area (A3D; mm²) between the sky surface and a reference line drawn: 1) between transverse and spinal processes of the lumbar vertebra near the 13th rib, for the loin; 2) between tuber coxae and tuber ischiiae prominences, for the ilium-ischium depression; and 3) between both tuber ischiiae prominences, for the ischiorectal fossa. Measurements were performed with a 3D modeling software (Rhino3D 5.0, McNeel). The subcutaneous fat thickness (SFT) was measured by ultrasonography, using a 3.5 MHz, linear array probe (Aquila Vet, Esaote), at the insertion of biceps femoris muscle and at the region of longissimus dorsi muscle, between 12th and 13th ribs. Cows were visually scored for BCS in a 1 to 5 scale. The association among A3D, SFT, and BCS was evaluated by correlation and regression analysis, correlations were compared using the Pearson and Filon’s test (comparingcorrelations.org). All estimations of energy reserves by SFT and A3D were correlated with BSC (P < 0.05). However, A3D was equivalent to SCF for describing changes in BCS when measured at the rump (R = 0.72 vs. R = 0.81; P > 0.05), but not at the loin (R = 0.47 vs. R = 0.81; P < 0.001). There was a quadratic effect of BCS on A3D, and in cows with BCS above 4, SCF was better than A3D for describing variations in energy reserves (P < 0.05). In summary, changes in rump 3D surface geometry can be effectively used to estimate energy reserves in non-obese cows.

**Key Words:** 3-dimensional imaging, BCS, precision dairy farming

**T75 Integrated solutions to maintain dairy production resilience under six different future scenarios in a regional food, energy, and water systems analysis.** M. E. de Haro Martí*, J. Wilson¹, S. Elmer², P. Williams³, and A. Kliskey¹, ¹University of Idaho, Gooding, ID, ²University of Idaho, Twin Falls, ID, ³University of Idaho, Moscow, ID.

Using the Magic Valley (MV), Idaho, as our case study of the integration of food, energy, and water systems (FEWS), we co-developed future scenarios and over 90 integrated solutions with local stakeholders. Agriculture and dairy production and processing are primary economic drivers in this system. Water from the Upper Snake River Basin supplies irrigated crops, cities, dairies and processors. All agriculture in the MV is irrigated. Idaho is the fourth largest dairy producing state in the USA and 73% of the dairy cows in Idaho are in the MV. We tested the resilience of the MV under 6 different scenarios of changing climate, demographics, adoption of resource recovery technologies, adoption of BMPs, and socio-economic development. Stakeholders and researchers explored reactions of the system to each scenario, and plausible integrated solutions to maintain the resilience of the FEWS. Watershed dynamics were modeled, as well as the impact of the different drivers on water availability, quality, and its impact on the rest of the FEWS. We describe 6 scenarios and the top 5 solutions per scenario that are pertinent to the dairy industry and could allow it to maintain resilience. Some of the scenarios would greatly impact dairies, including a mega drought, or drastic changes in demographics and economic activity. Under other scenarios the dairy industry thrives. In general, dairy can maintain a good level of resilience within the FEWS but may need to implement drastic solutions to be able to maintain its operations and economic viability, reduce environmental impacts, and adapt to new realities depending on the scenario. Solutions include changing feed crops, adopting several operation efficiencies like changes in breed selection or cow longevity and heifer replacement variations, type of dairy facilities, and implementation of BMPs and technologies for manure and nutrient management.

**Key Words:** food, energy, and water systems (FEWS), dairy resilience, sustainability

**T76 Implementation of animal and herd phosphorus balance in the Ruminant Farm Systems (RuFaS) model.** T. L. Hansen*, M. A. Sotirova¹, J. M. Tricarico², and K. F. Reed¹, ¹Cornell University, Ithaca, NY, ²Dairy Management Inc, Rosemont, IL.

Dairy cattle require P for growth, energy metabolism, and acid-base balance, but excess P in agricultural systems is related to P runoff and eutrophication. Tools to assess nutrient management decisions and environmental implications are often static and evaluated at single time points; thus, the use of a dynamic model would improve decision making and evaluation of P nutrient flow. The Ruminant Farm Systems (RuFaS) model is a modern, modular approach to dairy system simulations incorporating nutrient flows through soil, crop, feed, storage, animal, and manure management modules. The objective of this study was to build a dynamic P tracking module that maintains P mass balance at the animal, herd, and barn level. Initial P values of animals are calculated from P gestation requirements for simulated calves or as 0.72% BW for purchased cattle. Two strategies to update daily animal P values were tested: (1) estimate fecal P as the difference of intake and absorbed P or (2) estimate retained P as the difference between intake, secretion and excretion. For the first approach, NRC requirements were used to calculate absorbed P, and the constraint of P mass balance was established at the animal level. In a simulation of 125 lactating dairy cows with P intakes from 25 to 179 g/d, fecal P excretion ranged from −3.3 to 150 g/d. Negative fecal P excretion occurred at very low P intakes (≤0.2% DMI). Therefore, a second approach to calculate fecal P excretion and retained P in the animal module was developed using empirical equations to estimate fecal P excretion from P intake. Retained P ranged from −18.2 to 39.6 g/d and was highly correlated with P intake (P < 0.001, r² = 0.979). Animal P values are updated daily to account for individual animal P retention and excretion. Therefore, the second approach is more biologically relevant, accounts for BW changes, and maintains P mass balance at a herd level. Modeling the utilization and flow of P in addition to other nutrients within the animal module is critical to meet RuFaS objectives to identify and improve whole-farm production efficiency and minimize environmental impacts from dairy farms.

**Key Words:** cattle, mass balance, phosphorus

**T77 An integrated sensor network for monitoring pastured cattle health and location.** B. R. dos Reis* and R. R. White, Virginia Tech, Blacksburg, VA.

Although systems exist for monitoring health and location of cattle housed in confinement operations, analogous monitoring systems for pastured cattle are not commonly available. Our objective was to demonstrate an integrated sensor network for monitoring pastured cattle health and location. The integrated sensor network (Mahlinda & Mahindra; Mumbai, India) links data obtained from a subcutaneous temperature sensor (Livestock Labs Inc., Pittsburgh, PA) with GPS data obtained from a solar-powered collar sensor (Sodaq; Hilversum, the Netherlands) via a satellite gateway (HiPer Global, Amsterdam, the Netherlands) to a cloud-based data storage platform. The subcutaneous temperature sensor is implanted surgically through a 5 mm vertical incision in the neck. After initiation, the sensor logs temperature and activity hourly and transmits data using a Bluetooth communication protocol to a solar-powered base station. If animals are out of range of the base station, the logger has capacity to store data for 2 weeks, or until animals come back into range of the station. Battery life on the sensors is expected to last 2 years. The base station is designed to use cellular communication but was retrofitted with LoRa communication for the purposes of this demonstration. The GPS collar sensors are commercially available and use solar power and LoRa-based communication. Data from the GPS collars and the implantable temperature sensors was transmitted via LoRa communication to the satellite gateway. The sensor network was deployed on 10 grazing cattle over a 6-mo period to test data reliability. The subcutaneous sen-
sors were able to detect within-animal differences in body temperature associated with diurnal cycling, but improvements to base station design are needed to optimize data reliability (recover rates ~50%). Collars were able to reliably report on animal location for the duration of the trial. Further refinement of the data processing is needed to maximize the utility of this sensor network for monitoring cattle health and location.

Key Words: cattle health, GPS, precision technologies

T78 A time-series analysis of increasing milk productivity and yearly seasonality. M. Li*, V. E. Cabrera1, and K. F. Reed1, 1Department of Dairy Science, University of Wisconsin-Madison, Madison, WI, 2Department of Animal Science, Cornell University, Ithaca, NY

US dairy cows are increasing their milk productivity due to improved genetics and farm management. Also, milk productivity shows seasonal patterns. It is critical to understand these trends and patterns for projecting production fluctuations. The objective of this study was to accurately forecast lactation performance to be used in a whole-farm simulation model, the Ruminant Farm System model (RuFaS). We quantified the seasonal effect and the trend of improvement on milk and milk component yields over the years. As input, we used a data set containing 10 million lactations records from 6 million Holstein’s during the years 2006 to 2016. Each record included complete milk, fat, and protein yield standardized yearly. Although the data included 47 states, most records were from Wisconsin (26%), Pennsylvania (14%), and New York (13%). Lactation records were 40% 1st lactation, 28% 2nd lactation, and 32% later lactations. We decomposed a time series of the data with an additive model \( y_t = S_t + T_t + R_t \), where \( y_t \), \( S_t \), \( T_t \), and \( R_t \) were the yield, the seasonal, trend, and error terms, respectively, at time \( t \). We found a strong seasonality effect and increasing trend for milk (MY), fat (FY), protein (PY), and energy-corrected milk (ECM) yields for all parities across the studied years (Table 1). The seasonality pattern indications (peak and trough period) and averages for the year 2016 and their change from 2006 are shown in the table. For forecasting yields in RuFaS, we used the Holt-Winters’ seasonal forecasting method, which applies a triple exponential smoothing for milk production level, trend in milk production, and season, giving higher weight to the most recent data. The accuracy of forecasting was tested by identifying patterns from 2006 to 2015 and comparing our 2016 forecast with 2016 observed data. Observed values were in the 95% confidence interval of our predictions.

Table 1 (Abstr. T78).

<table>
<thead>
<tr>
<th>Lactation</th>
<th>Trait</th>
<th>Peak</th>
<th>Trough</th>
<th>2016 (kg/cow per yr)</th>
<th>2016-2006 (kg/cow per yr)</th>
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<td>Jan</td>
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<td></td>
<td>PY</td>
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<td>Mar</td>
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<td>PY</td>
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Key Words: RuFaS, calving season, time series

T79 Thermoelectric energy harvesting for wearable precision agriculture technologies. B. R. dos Reis*, B. Poudel1, S. Priya1, and R. R. White1, 1Virginia Tech, Blacksburg, VA, 2Penn State University, University Park, PA

Wearable precision agriculture devices are growing in popularity in dairy production systems globally. Currently, these devices rely on batteries with or without solar support as power sources. Although solar power works well for technologies deployed on pastured animals, equivalent alternative power sources for technologies deployed on animals in confinement systems are needed to improve the lifetime and usability of wearable technologies. Thermoelectric energy generators (TEG) are a promising technology that may be able to replace batteries in low-power wearable technologies. Our objective was to test the feasibility of using a TEG to power wearable precision agriculture technologies. The TEG harvests heat from the temperature differential between the animal’s body and the ambient environment and converts that heat into available electrical energy that can be used to power microprocessors and associated sensors. To test the feasibility of leveraging the TEG to power microprocessor-based sensors, we constructed a prototype sensor consisting of a TEG mounted on a halter and connected to a Track-It Data Logger which measured and logged the voltage harvested by the TEG. We logged the average voltage harvested from 3 animals during 30-min measurement intervals. Animals were not clipped and had approximately a 2 mm hair coat. Data were analyzed with a mixed model using animal as a fixed effect and sampling time as a repeated measure. Throughout the duration of the experiment a sampling rate of 10 Hz was used. Data recovery from the loggers was high (96%) with 4% of data reflecting either open voltage (data logger errors) or no connectivity with the animal (mV <5). After cleaning poor quality data, the average voltage harvested over the data collection period was 53.6 mV. Animals differed significantly (P < 0.001) in harvested voltage over the 30-min period and ranged from 45.9 mV to 65.3 mV. Microprocessors typically require a 3.7 V power supply, suggesting additional work on refining the efficiency of energy harvest from TEG is needed before these devices can be used to reliably power wearable precision technologies.

Key Words: thermoelectric generator, renewable energy, precision technologies

T80 Control charts to monitor growth in dairy heifers. P. Turiello*, B. Mancilla1, C. Visioso1, and A. Larrestra1, 1UNRC, Río Cuarto, Córdoba, Argentina, 2IDAS UNRC-CONICET, Río Cuarto, Córdoba, Argentina

There is a need to monitor processes in dairy systems, and there are methods of statistical quality control, like control charts, to effectively do it. Although widely applied in manufacturing industry, control charts have not been much used in animal growth processes. The objective of this study was to build a control chart application as a management tool in a commercial dairy for monitoring and surveillance of the growing process of replacement heifers. Control charts were built from BW data of 295 9-mo old heifers born during the years 2016 to 2018 in a commercial dairy farm in Córdoba province. During the first phase we built the control charts for X-bar and R from 30 samples of 10 heifers each, following the instructions of Montgomery (2005). The center line of the X-bar chart was the average of the sample means (260 kg), and the upper and lower control limits (UCL and LCL, respectively) were calculated with the average of the sample means, the mean range and a constant: \( \text{UCL} = X_{\bar{X}} + A_2 \times R; \text{LCL} = X_{\bar{X}} - A_2 \times R \). For the R chart, the center line was the average of the sample ranges (70 kg), and the UCL and LCL were the average of the sample ranges multiplied by a different constant for each: \( \text{UCL} = D_4 \times R; \text{LCL} = D_3 \times R \). The constants \( A_2 \), \( D_3 \), and \( D_4 \) are tabulated values for different sample sizes. Control charts were built and 5 samples out of control were removed after finding assignable causes. From the final graphs the dairy manager can add future sample results and determine that the process is under control if its
average is between 238 and 281 kg and the range is between 16 and 124 kg. If the contrary happens the manager can suspect that an assignable cause has occurred, and some investigation should be made and corrective action should be taken to remove the unusual source of variability. These control charts could be used to monitor the growing process of the heifers in the evaluated farm, to detect when some changes are required to take the process back to an in-control state thus reducing the process variability, and to estimate heifer weight among other process variables.

Key Words: quality control, management, replacement program

T81 Concentration levels of butyrylcholinesterase in cows as an indicator of the use of agrochemicals in farms in Colombia. A. Celemin-Sarmiento* and L. Bernal-Bechara, Animal Science Research Group (ASRG), Animal Science Program, Faculty of Agricultural Sciences, La Salle University, Bogotá, Cundinamarca, Colombia.

The use of agrochemicals in agriculture to increase productivity is well known. However, the impact of these chemical compounds to the environment and livestock products is still limited. The aim of the study was to identify if butyrylcholinesterase (BCh) concentration levels in milk serum and blood plasma of cows can be a good predictor for the use of agrochemicals. The study was carried out in 3 agricultural production systems located in the cities: Sopó, Sibaté, and Chípas, Cundinamarca state and one production system where agrochemical compounds are not used Sumapaz moorland. Milk samples and blood serum were taken from the cows to determined butyrylcholinesterase concentration. For this, a commercial kit from Wiener lab was used for enzyme determination. Six cows were used as control and 6 cows (2 per farm) that were exposed to agrochemicals products. The data was analyzed as a random complete design by ANOVA and Tukey test was performed to find differences between treatments. Significant differences in blood serum were found between treatments (P < 0.05) by BCh. Control reports 233.91 U/L vs Treatment 120.71 U/L. Furthermore, no significant differences in milk serum (P > 0.05) was found. Control reports 70.97 U/L vs Treatment 34.07 U/L. Agrochemical compounds was found at low concentration of the enzyme in blood serum compared with the control. Agrochemicals such as organophosphates and carbamates decrease enzyme concentration in the blood plasma of animals exposed to these chemical compounds. So it is suggested to perform the same test in milk in the future to determine the enzymatic concentration of butyrylcholinesterase to evaluate if milk samples can be used for enzymatic butyrylcholinesterase determination.

Key Words: butyrylcholinesterase, milk serum, blood plasma

T82 Associations of milk production and quality with management and housing of robotic milking herds. R. D. Matson*, M. T. M. King, T. F. Duffield, D. E. Santschi, R. M. Maupin, G. B. Penner, T. Mutsvangwa, and T. J. DeVries, 1Department of Animal Biosciences, Guelph, ON, Canada, 2Department of Population Medicine, University of Guelph, Guelph, ON, Canada, 3Lactanet, Sainte-Anne-de-Bellevue, QC, Canada, 4Faculty of Veterinary Medicine, University of Calgary, Calgary, AB, Canada, 5Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, SK, Canada.

The objective of this study was to identify housing and management factors associated with milk production and quality in robotic milking herds. We visited 197 Canadian robot farms (Western Canada: n = 50, Ontario: n = 77, Quebec: n = 59, Atlantic Canada: n = 11) from April to September 2019 and collected details of barn design and herd management practices. Milk recording data for the 6 mo before farm visits were collected. Farms averaged 111 ± 101 lactating cows, 2.4 ± 1.9 robot units/farm, 47.3 ± 9.1 cows/robot, 36.6 ± 4.9 kg/d of milk, and a herd average SCC of 200,882 ± 94,276 cells/mL. Univariable models were used to screen independent variables (as fixed effects) in mixed-effect linear regression models and variables with P < 0.25 were offered to multivariable models, with herd treated as a random effect. A greater number of cows per robot was associated with lesser milk yield; every 10 additional cows was associated with 0.76 kg/d less production per cow (P = 0.02). The predominant bedding type used was wood products (n = 64; with sand = 52; straw = 41; and other = 28); herds with sand bedding had +1.5 kg/cow/d greater milk production (P = 0.02) compared with herds that used wood products. Herds that pushed-up feed ≥ 24 (n = 33) and 12–24 x/d (n = 51) had greater (P < 0.01) average production of +2.6 and +1.8 kg/cow/d, respectively, compared with herds that pushed up 1–5 x/d (n = 31). Milk production was associated with region (P < 0.01), with Western Canadian farms producing +2.1 and +2.8 kg/cow/d more when compared with Ontario and Quebec farms, respectively. SCC was associated with bedding type; use of sand bedding was associated with a lesser herd average SCC (125,951 cells/mL) when compared with wood products (206,443 cells/mL; P = 0.005), straw (269,030 cells/mL; P < 0.001), and other bedding types (212,227 cells/mL; P = 0.02). The results of this study demonstrate that greater milk production and milk quality are being achieved on robotic milking herds by increasing feed push-up frequency, reducing the stocking density of cows per robot, and using sand to bed their freestalls.

Key Words: automated milking systems, management, production

T83 Does 500 ohms accurately describe the electrical resistance of Idaho dairy cows? R. Norell*, M. de Haro Martí, J. Wilson, M. Chahine, J. Packham, and K. Kruger, 1University of Idaho, Idaho Falls, ID, 2University of Idaho, Gooding, ID, 3University of Idaho, Twin Falls, ID, 4University of Idaho, Burley, ID.

By Idaho statute, a 500-Ω shunt resistor is used when investigating stray voltage on dairies and represents the “worst case” body resistance value for adult dairy cows (USDA stray voltage handbook 696, 1992). In recent studies, we have shown that cow electrical resistance (ER) is lower with wet feet, standing in manure, and wet hair coats. Our objective was to compare ER between 3 cow pathways and 2 housing types on commercial dairies. Cow pathways were: muzzle to 4 feet (M4), shoulder to 4 feet (S4) and rear udder to 4 feet (R4). Electrical connections included: cow standing on electrically isolated concrete with 2.5 cm of manure plus a metal mesh on muzzle (M4), metal pipe on wet shoulders (S4), or a metal pipe on wet rear legs + rear udder (R4). These pathways mimic a cow touching a metal watterer with muzzle, touching a manger lockup with wet shoulders and touching parallel parlor pipework with wet rear udder+ legs. Six dairies were enrolled and each provided 15 cows from a freestall barn (FS) and 15 cows from an open lot (OL). Data were analyzed as a randomized complete block design using Proc GLM/MIX in SAS. Mean ER (Ω) and % <500 Ω by pathway and by housing were: 254±17, 100; 236±17, 99; and 305±17, 91; 279±14, 96; 251±14, 98; for M4, S4, R4, FS, and OL, respectively. Mean ER was different between cow pathways with R4 being significantly higher (P < 0.01) than S4 and M4. ER in FS tended to be higher than ER in OL (P < 0.06) but the housing × pathway interaction was not significant (P < 0.9). Minimum ER (Ω) by pathway within dairy ranged from 188 to 226; 141 to 183; and 170 to 221; for M4, S4 and R4, respectively. The risk of wet hair coats due to precipitation is greater for OL and motel style FS than gable roofed FS, thus, dairy housing should be considered in stray voltage investigations. All 3 cow pathways and body contact conditions commonly occur on Idaho dairies and measured ER are well below “worst case” from USDA 696. Using a lower value shunt resistor appears desirable to more accurately assess stray voltage risk on Idaho dairies.

Key Words: electrical resistance, stray voltage

T84 A dynamic model to predict herd consistency and milk deliveries of a dairy herd. A. S. Atzori*, R. A. Gallo, 1Dipartimento di Agraria, University of Sassari, Sassari, Italy, 2Department of Animal Science, Food and Nutrition (DI-
Dynamic modeling applied to dairy farming allows improving the farm decision making process through prediction of future performances. This work aimed to define a preliminary model structure able to minimize the system complexity and to reach a satisfactory prediction dynamics of a given Mediterranean dairy herd and milk deliveries. The modeling process had the objective of farm output. The modeling process followed a System Dynamics approach and included: i) a preliminary farm survey to gather technical info and data; ii) the development of a Stock and Flow model on Vensim (Ventana Inc.), to mathematically and graphically simulate the dynamic connections among variables; iii) the model evaluation against farm records. The survey provided aggregated monthly records, from Jan 2015 to Dec 2018 (4 years), of consistency, feed supply, milk deliveries, reproduction indexes, mortality and health of herd categories. Average farm characteristics in the same period consisted of 1154 ± 58 milking cows, 205 ± 35.7 dry cows, 1375 ± 45.2 heifers whereas dry matter intake (DMI) and milk yield were on average equal to 24.2 ± 2.4 and 34.0 ± 3.4 kg/d per head, respectively. The model included 25 variables distributed on a closed aging chain of 4 stocks (replacement heifers and open, pregnant and dry cows) and the respective flow rates of calving, breeding, drying off and culling. Initial settings were based on farm values observed in Jan 2015. Two farm inputs (monthly average of consumed feed from lactating cows and conception rate) were included as exogenous variables resulting of fundamental relevance in model predictions. The simulation showed a good accuracy in predicting the oscillating seasonal pattern of historical farm records of milk deliveries. Cow consistency and milk deliveries were predicted with a RM-SPE of 3.5% and 7.2% of observed values (being 57% and 68% due to random variability of data), with high accuracy (Cb = 0.90 and 0.97), with good precision (r² = 0.68 and 0.72), and with a satisfactory concordance correlation coefficient (0.74 and 0.82), respectively. Model updates should focus on wheater effects on intake and reproduction at farm level.

Key Words: system dynamics, dairy management, weather

T85 Development of an identification system to recognize individual animals based on biometric facial features. R. E. P. Ferreira*, L. G. R. Pereira, T. Bresolin, G. J. M. Rosa, and J. R. R. Dorea, 1University of Wisconsin-Madison, Madison, WI, 2Embrapa Dairy Cattle, Juiz de Fora, MG, Brazil.

In livestock systems, animal identification and traceability are central for food security, data transparency, and consumer trust. A contemporary approach for animal identification is based on image analysis and computer vision, which in general exploit coat color differences among animals using color images. Such method, however, is not efficient for animal species and breeds with homogeneous color patterns. Point cloud deep learning has emerged as a promising machine learning technique that is able to extract features associated with 3D shapes. The objective of this study was to evaluate the efficiency of point cloud deep learning approach for animal identification using 3D images of dairy cattle faces. Images from 9 Holstein cows were acquired at the Dairy Research Cattle Center of the University of Wisconsin-Madison. The images were segmented to remove background and to extract animal faces. This approach was adopted to prevent potential bias toward an overoptimistic model due to recurrent environment noise present in the background of each animal image. A depth sensor (Intel RealSense model D435) was used to acquire 354 images, which were divided into train (n = 214), validation (n = 64), and test (n = 76) sets. A VoxNet point cloud deep learning network was implemented to generate the predictions. Data processing and analyses were implemented in MATLAB 2020a. The accuracy on the testing set was 75%, varying from 50% (for an animal with only 6 images used for training) up to 88.9% (for an animal with 33 images used for training). The results indicate that point cloud deep learning can be a powerful tool for animal identification based on their 3D biometric facial features. Such an approach can be adapted for application in other animal species with homogeneous coat colors and patterns.

Key Words: computer vision, pattern recognition, precision dairy farming