Egg Industry Center

THE EGG INDUSTRY CENTER

CONTRIBUTING TO A SUSTAINABLE EGG SUPPLY

2021

IMPACT REPORT

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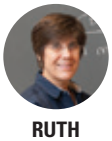
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HONORING BLAIR VAN ZETTEN

One of EIC's greatest champions, Blair's passion and contributions were honored in 2021 with EIC's LeggACY Maker Award.

FROM THE EIC DIRECTOR

Welcome to the Egg Industry Center 2021 Impact Report, highlighting some of our ongoing sponsored applied research. While there were unavoidable delays in some projects due to COVID-19, I'm delighted to see the progress made by our extensive network of academics and researchers working on your behalf to solve challenges. In addition to these research updates, we have an update on the Center's efforts on sustainability initiatives for the U.S. egg industry. We are updating the "50-year study" that compared 1960 and 2010 egg production practices, and which demonstrated how truly efficient and sustainable our industry had become.

Our sustainability update initiative involves an exhaustive survey of egg farmers and processors. That information feeds into a life cycle assessment (LCA) that we will complete during 2022. LCA is a critical first step to provide baseline sustainability metrics. Our long-term goal is to develop tools to help farmers understand their footprint and provide information to further improve the egg industry's sustainability. We are also working with the U.S. Roundtable for Sustainable Poultry & Eggs as they roll out their sustainability framework.

It is my pleasure to report that in addition to the sustainability work and cost study included in the report, EIC was instrumental in helping to develop market data and information to educate state and national leaders on the impact of COVID-19 on the liquid and shell egg markets. While much of this effort was behind the scenes and provided to commodity and government leadership, EIC's Maro Ibarburu was key in this effort, and he has been recognized with two awards this year.

Also of note, Project Manager and Communications Specialist Lesa Vold was honored by the Association for Communication Excellence for the editing of the Egg Industry Center 2020 Impact Report.

While it was a busy year, your award-winning staff looks forward to continuing to serve you. Please keep in touch, and join us for our next Egg Industry Issues Forum in the fall of 2022.

RICHARD GATES
Director, Egg Industry Center
Iowa Egg Council Endowed Professor
Iowa State University

Cover photo courtesy
Big Dutchman, Inc.

2020 DATA SHOWS LITTLE CHANGE IN COST TO PROCESS, PACKAGE, TRANSPORT EGGS

The U.S. egg industry needs to know the total cost of the eggs it delivers to retailers. An important component of that cost is the processing, packaging and transportation costs, or PCT. The Egg Industry Center, working with U.S. egg farmers, captured these costs creating a more accurate picture of the cost of eggs being delivered to its customers.

The Egg Industry Center initially conducted an assessment of PCT in 2019, and updated it this year using 2020 data. The new results indicate that U.S. egg farmers typically spend between 38 cents and 45 cents per dozen to wash, weigh, package, and transport eggs to a warehouse. Costs haven't changed much since the last time egg producer/processor companies were asked to report their 2018 costs.

"Most of the numbers reported in this new study are very consistent with what we estimated in our PCT study published in 2019," said Maro Ibarburu, associate scientist and business analyst for EIC.

The new PCT study draws from a survey of costs incurred during the 2020 calendar year. Total PCT costs are normally estimated for eggs delivered to the store door, which is typically higher than the PCT cost of eggs delivered to a warehouse. However, not enough survey responses were obtained about the cost of transporting eggs to a store door to be a representative sample for analysis and reporting, so the cost of eggs delivered to the warehouse was used in this report. Responses received for the 2020 survey represented approximately 80 million layers, or about 25% of the U.S. laying hen inventory and 35% of the laying hens dedicated to shell egg production.

The 2020 survey also was revised to better obtain information for facets of production—such as transportation and grade yield loss—that showed clusters of data or a lot of variability in the 2018 data. For example, in 2018 egg farmers were asked for their grade yield loss; in 2020, that data was estimated from the proportions of different sizes of eggs obtained when processing eggs.

"In the 2018 data, we saw a lot of variability in the grade yield loss responses. We believe this had to do with the way egg farmers were calculating this at the operational level," said Ibarburu. "Our new estimation methodology helps add consistency to the way that the grade yield loss is calculated, and represents a more accurate grade yield loss of processing conventional eggs."

The PCT study could be updated annually if the survey return rate is large enough so the responses are representative of the industry.

"Updating the figures more often can reduce the shock that happens when a number hasn't been estimated for a while, considering changes in areas such as inflation and technology," Ibarburu said.

The entire PCT study can be found on the Egg Industry Center website.

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Dr. Ahmed Ali at Clemson University will test how interrupting the scotophase period affects bone health, eggshell quality, behavior, and the welfare of laying hens.

STUDY COULD SHED LIGHT ON METHODS TO IMPROVE HEN BONE HEALTH AND EGGSHELL QUALITY

Two of the most prevalent problems facing the commercial laying hen industry are osteoporosis (bone weakening) that is linked to keel bone damage, and inferior eggshell quality that contributes to cracked eggs. The common denominator of the two problems is calcium, or its lack, but where the hen obtains calcium varies depending on time of day.

In modern commercial laying hen systems, birds are typically given 16 hours of continuous lighting (photophase) and eight hours of continuous darkness (scotophase) during the egg-laying period. In scotophase, birds reduce their physical activity, and feeding typically stops. However, physiological processes such as digestion, excretion, and eggshell formation remain active.

Most eggshell formation happens during scotophase, when hens are not eating and consequently may lack calcium in the digestive tract. When the digestive tract fails to supply enough calcium to the bloodstream for eggshell formation, calcium is instead drawn from the bone to continue the process. The production of a single egg requires approximately 2 grams of calcium to form the shell, which translates to approximately 10% of a hen's total body calcium stores. Progressively depleting this calcium supply during the scotophase period—with insufficient opportunity for rebuilding in subsequent days as the lay cycle continues—is believed to be a principal cause of osteoporosis and osteomalacia and inferior eggshell quality.

Dr. Ahmed Ali at Clemson University will test how interrupting the scotophase period affects bone health, eggshell quality, behavior, and the welfare of laying hens. This new research is funded by the Egg Industry Center.

"The long-term goal of this study is to support laying hen and egg industry producers by developing new, evidence-based, sustainable methods for maximizing bone quality and eggshell quality, particularly toward the end-of-lay period. This will help in extending the lay cycle by using management strategies that also minimize negative impacts on bird health, behavior, and welfare," Ali said.

Ali is a veterinarian and animal behavior specialist and assistant professor in the Department of Animal and Veterinary Sciences at Clemson. His research focuses on the effects of novel interventions on the health, behavior, and welfare of laying hens. Currently he is involved in a project examining the influences of different cage-free housing designs on incidence and severity of keel bone damage and bone health, and another project examining the effects of pullet activity and minerals supplementation on bone health and egg quality.

Ali will collaborate with Drs. Mireille Arguellas-Ramos, a poultry nutrition specialist, and Jeryl Jones, a certified veterinary radiologist, both in the animal and veterinary sciences department at Clemson; and Dr. Prafulla Regmi in the Department of Poultry Science at the University of Georgia, who specializes in quantifying skeletal structures in poultry.

Industry guidelines currently recommend interrupting the scotophase in laying hens to overcome the effects of heat stress by increasing feed consumption when the temperature is cooler during the night. However, according to Hy-Line management guidelines, light provided during the midnight feeding is an addition to the regular day length (16 hours), which subsequently promotes feed intake. There is no published research examining how to interrupt scotophase without increasing the total number of light hours and allowing hens to maintain a continuous gastrointestinal tract calcium release during nighttime to support eggshell calcification with respect to bone health. Research is also lacking on the possible impacts of applying such techniques on other important aspects such as bird behavior, welfare, activity levels, energy expenditure, egg quality, and hormonal balance.

Results from the study by the Ali team could help guide future decision-making by industry leaders in their efforts to develop and implement improved, sustainable solutions that will maximize animal production and welfare.

"Every single bit of feed not converted directly into an egg or to support the hen's maintenance is either being turned into metabolic heat or manure. Feed conversion has continued to improve markedly since 2010, and our study will quantify this too."

DR. RICHARD S. GATES, EIC DIRECTOR

CONTINUING THE SUSTAINABILITY STORY

It's been nearly a decade since the Egg Industry Center published a landmark research study that showed the U.S. egg industry operates at much greater efficiency and with a smaller environmental footprint than it did 50 years before. Between 1960 and 2010, egg production increased while its environmental impact decreased, with greenhouse gas emissions down 71%, water consumption by hens down 32% per dozen eggs, and hens producing 27% more eggs per day.

Not only did these findings generate national publicity and international interest, they greatly helped enhance the egg industry's image among consumers. But did egg producers tap the rich details of the study and transform their operations to become even more sustainable?

To answer that question, as well as to study the effect of significant changes on the egg industry since 2010, EIC initiated a new life cycle assessment (LCA) with its own funding and solicited the financial and logistical support of the United Egg Producers (UEP) and the American Egg Board (AEB). UEP has been instrumental in organizing the confidential dissemination and collection of survey results while AEB will utilize the LCA to develop focused outreach and education information for consumers, customers and egg farmers.

The new LCA surveys were developed by EIC and Dr. Nathan Pelletier, an international expert and Sustainability Chair at the University of British Columbia. These surveys will be analyzed and reported in a new LCA for the industry. The results will be shared with stakeholders, ensuring the egg industry continues to have an accurate, data-driven picture of its environmental impact.

"The Egg Industry Center has always supported not only the actual execution of research, but also the dissemination of objective science-based results," said Dr. Richard Gates, EIC director. "Sustainability has been an important part of the EIC mission since the center was started in 2008 and we are happy to continue this research for the industry."

WHAT'S NEW SINCE 2010?

"Since the last LCA, the industry has changed its approach to housing, genetics, feed conversion, and manure management," said Gates. "And really, the industry continues to remain committed to improvement so there will be a lot to analyze."

More states have passed legislation banning conventional cage housing and the sale of eggs from caged hens. In 2010, when the last LCA was done, only 4% of all hens were in cage-free production. By the end of 2020, 28% of hens were in cage-free facilities, according to UEP. In addition to an increase in cage-free housing, there has been a decrease in high-rise conventional facilities, which contribute relatively more to greenhouse gas emissions because of their unique in-house manure storage and management practices.

Gates also noted that rising feed prices have forced egg farmers to think more about feed conversion efficiency and consider the quality of rations as much as the cost.

"Every single bit of feed not converted directly into an egg or to support the hen's maintenance is either being turned into metabolic heat or manure. Feed conversion has continued to improve markedly since 2010, and our study will quantify this too," Gates said.

Over the past decade, sustainability has been a popular topic at the Egg Industry Issues Forum, the annual education and outreach event organized and facilitated by EIC that focuses on communicating science-based solutions to egg farmers and allied industry partners. Sessions related to sustainability have covered animal welfare, air quality, economics, regulatory changes, integrated sustainability approaches, sustainability-focused industry programs, and communication approaches on egg farmer values—like sustainability.

As the industry moves forward, EIC remains committed to researching issues related to sustainability and highlighting the importance of that research for the industry.

A SUSTAINABLE FUTURE

Anticipation is building around what the new LCA might reveal. Both AEB and UEP have included sustainability as a priority in their strategic plans. In addition, the U.S. Roundtable for Sustainable Poultry & Eggs drafted a sustainability framework it plans to launch in early 2022. Findings from the LCA should help inform the US-RSPE Sustainability Framework, which will engage multiple stakeholders in specific ways to measure their sustainability programs and make improvements.

As US-RSPE rolls out its framework and egg producers consider the next steps to further reduce their environmental footprint, EIC will be ready to answer questions about the sustainability improvement process in a scientific and defendable way. EIC is also making plans for regular future LCA surveys to accommodate further industry changes as cage-free production grows and influences facility construction, and to work with industry to develop company-specific and on-farm tools to assess specific practices that can further improve its sustainability "footprint."

"There's no question EIC has been a leader in the egg industry's sustainability efforts, ever since the LCA initiated by Hongwei Xin and his team back in 2010," said Tom Hebert, former deputy undersecretary for Natural Resources and Environment at the U.S. Department of Agriculture. "Now with results from this new LCA, EIC will be at the forefront in helping the egg industry develop science-based, sustainable practices going forward."

CHASING THE VIRUS VARIANTS THAT CAUSE FALSE LAYER SYNDROME

False layer syndrome (FLS) is a clinical condition associated with infectious bronchitis virus (IBV) and is a widespread problem causing significant economic losses in the egg and broiler-breeder industry.

Affected hens have the outward physical appearance of a normal bird, but no eggs are laid. For hens with FLS, researchers believe IBV affected their oviduct development, through early replication in the oviductal epithelium, inducing cystic oviducts and atrophy. Some affected hens have an active ovary and although ovulation occurs, their oviduct is not adequately developed to receive the ova and start egg formation.

Dr. Rodrigo Gallardo and collaborators are studying FLS associated with IBV, seeking to identify prevention and control strategies and their long-term effects. Gallardo is an associate professor in poultry medicine in the Department of Population Health and Reproduction at the University of California-Davis, in the School of Veterinary Medicine. He is a diplomate of the American College of Poultry Veterinarians, with expertise in virology, immunology, and respiratory diseases of poultry, particularly infectious bronchitis. His research collaborators are Drs. Simone Stoute and Ana da Silva, both of the UC-Davis California Animal Health and Food Safety Laboratory, Turlock branch; Drs. Holly Sellers and Brian Jordan, both of the Poultry Diagnostic and Research Center in the Department of Population Health at the University of Georgia College of Veterinary Medicine; and a commercial layer farm veterinarian from the Western U.S.

Gallardo and his team have plenty of experience with FLS. They have performed pilot projects trying to corroborate the effects of early IBV infection in the occurrence of FLS, and they work with West Coast egg farmers on prevention strategies against FLS.

In the current study, funded by the Egg Industry Center, Gallardo and his team are comparing the RNA sequence, or genotype, of IBV variants associated with FLS outbreaks at a commercial farm against common IBV genotypes plus variants that have induced FLS in other parts of the world. They have found that IBV variants associated with FLS—in particular, DMV/1639—have segments in several genes that resemble genotypes of the Connecticut variant of IBV, which are widely used vaccine genotypes.

"We have also found changes in the S gene and some non-structural genes. From a practical perspective, this means that changes in genes other than the spike might be related with tissue tropism, and that genetic changes plus environmental challenges lead to different pathological outcomes," Gallardo said.

In a pilot experiment, the team demonstrated the presence of inflammatory lesions in respiratory and urogenital systems of chickens challenged with FLS associated and common IBV strains. This might explain that several strains have the potential to cause FLS and might been associated to FLS cases in the past.

"In addition, our results also emphasized the importance of continued surveillance, especially when new vaccine types are introduced to control field strains. We have seen those vaccines and the FLS challenge virus persist in the environment. While IBV vaccination programs against FLS-associated IBV can control clinical signs, they can also create the perfect scenario for strain mutation, recombination, and generation of new variants," Gallardo said.

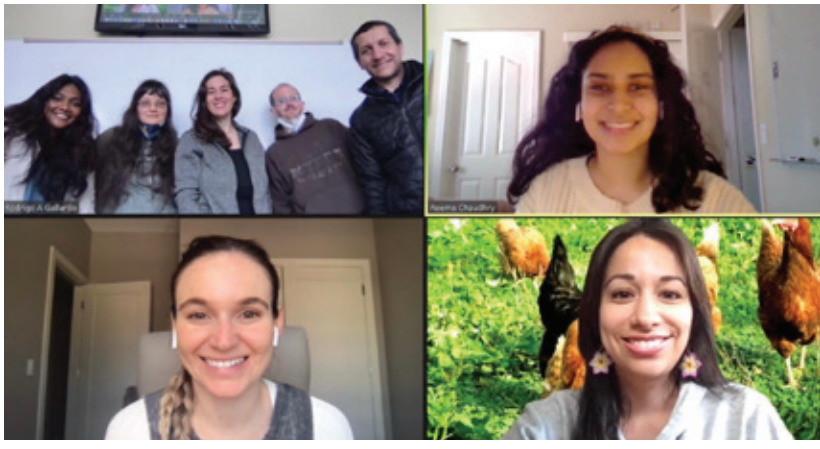
Currently, as part of this research project, the team is investigating the effects of maternal antibodies and currently-used vaccines administered at one day of age to prevent infection with IBV strains associated with FLS. The idea is to better understand the role of vaccines and maternal antibodies in the control of this disease and how the use of these vaccines might shape the formation of new variants.

"Our results emphasized the importance of continued surveillance, especially when new vaccine types are introduced to control field strains."

DR. RODRIGO GALLARDO, ASSOCIATE PROFESSOR, POULTRY MEDICINE, UNIVERSITY OF CALIFORNIA-DAVIS SCHOOL OF VETERINARY MEDICINE

"The most important practical application of this research will be extensive surveillance. This surveillance should provide enough information to strategize better vaccination programs. I envision that some of the findings in our experiments will change the way in which we will prevent this disease, maybe using a different vaccination strategy," Gallardo said.

Since starting the EIC-funded project, the researchers have learned of producers dealing with male broiler-breeder issues due to similar IBV challenges. Gallardo and his team have begun investigating these issues as well.



ABOVE: Collaborating virtually are (clockwise from upper left) Dr. Rodrigo Gallardo (far right in the photo) and part of his team, Reema Chaudhry, Ana da Silva, and Alejandra Figueroa.

LEFT: Pictured from left to right are Dr. Rodrigo Gallardo and graduate students Ruchita Uttarwar and Sofia Egaña. They are inoculating laying hens with various IBV strains and placing them into Horsfall Bauer units like those behind them. These units are animal living environments used for virus containment research. They have HEPA filters in the intake and exhaust and each is individually vented so they can be used with different diseases. In this study, the team also uses different research rooms to ensure the challenged birds and virus strains stay separate.

GUT REACTION

HOW HEN HOUSING SYSTEMS IMPACT INTESTINAL HEALTH

With substantial egg production moving from conventional cage housing toward cage-free housing, key factors to consider are hen performance and behavior, as well as the prevalence of injuries and disease.

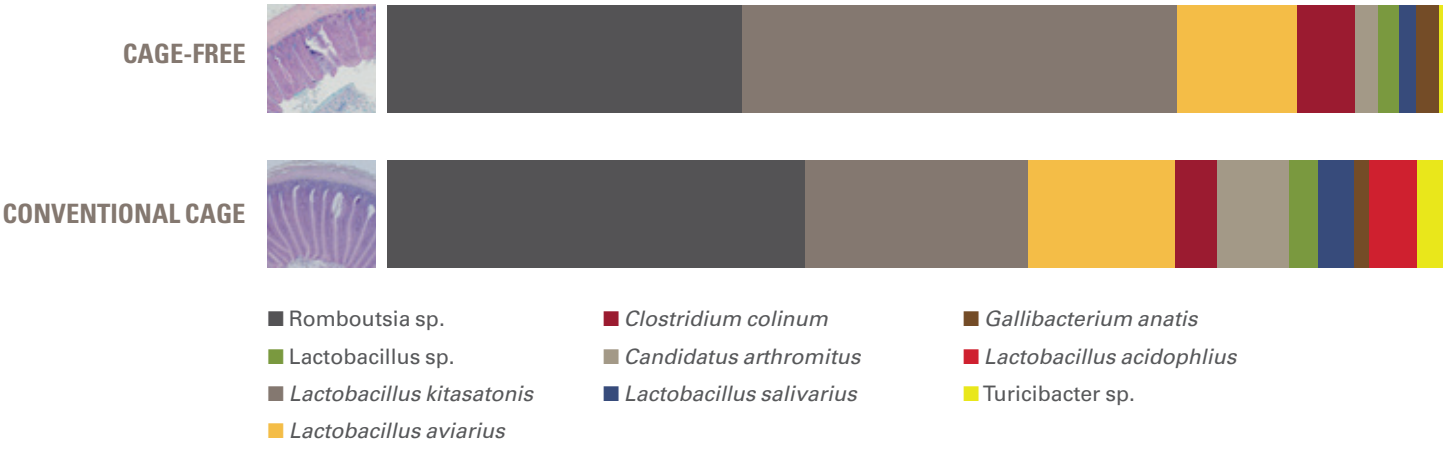
In cage-free housing, hens have a greater ability to interact more freely with each other and are more exposed to fecal material, which leads to increased exposure to bacteria that could affect their intestinal health. Ultimately, this could alter the hen's nutrient requirements to support herself and maintain egg production.

When Dr. Dawn Koltes was unable to find information detailing a difference in intestinal physiology in hens housed in either conventional cages or cage-free housing, she proposed to study how changes in housing systems would alter the microbial communities in hens. Koltes, assistant professor in the Department of Animal Science at Iowa State University, focuses her research on how environmental stressors impact gastrointestinal physiology and bird performance, specifically understanding hen and microbe interactions and their impact on overall performance.

"We know that the intestinal microbial community has both beneficial microorganisms that will help the hen succeed, as well as pathogenic microorganisms that can be harmful to the hen, and microorganisms that are opportunistic, or waiting on a moment in which they can bloom and then cause a problem," Koltes said.

In a study funded by the Egg Industry Center and published in November 2020 in *Poultry Science*, Koltes and colleagues compared the intestinal health of cage-free hens and conventional cage hens at a commercial facility in Iowa. Collaborating with her on this research was Dr. Stephan Schmitz-Esser, associate professor in animal science at Iowa State University, and several students in the Koltes and Schmitz-Esser labs. Koltes gave a presentation on the findings at the 2021 Egg Industry Issues Forum.

PROPORTION OF THE TOP MICROBES FOUND IN HENS WITHIN CAGE-FREE AND CONVENTIONAL CAGE PRODUCTION SYSTEMS



The study produced three key findings:

- Bacterial communities in the ileum—the last section of the small intestine—were more diverse in bacterial type in the hens from conventional cage housing systems compared to hens from cage-free systems.

"This would indicate the hens housed in the conventional cages would have a better ability to adjust to changes in the bacterial communities compared to hens housed in the cage-free system," Koltes said.

- Intestinal morphology and intestinal permeability—measures of potential nutrient absorption and intestinal dysfunction, respectively—were not very different between hens in the conventional cage and cage-free housing types.

- When exploring the relationship between bacteria and potential nutrient absorption and intestinal dysfunction, several well-known associations between bacteria and intestinal physiology were identified. For example, Lactobacillus, a well-known probiotic, was associated with decreased intestinal dysfunction as measured by intestinal permeability.

"Additionally, novel relationships were identified where either the function of the bacteria is unknown, or the function has not been associated with intestinal function, which provides insight into the roles these bacteria play in the hen-microbe ecosystem," Koltes said.

Koltes said additional studies are needed to "determine if the production cycle, hen lineage, or management strategies contribute to changes in the intestinal health of laying hens." She also noted that because the study examined only bacteria or prokaryotes in the microbiome and not fungi or parasites that also contribute to overall bird health, there is an opportunity for future studies to collect data that would assess the overall function of the intestine.

"While the intestinal physiology of healthy birds is not altered by hen housing systems, the effects of a slight decrease in diversity of bacteria type within the cage-free housing system could reduce the resilience to change of the microbiome under stress. However, the factors that cause or prevent these changes are unknown," she said.

"The effects of a slight decrease in diversity of bacteria type within the cage-free housing system could reduce the resilience to change of the microbiome under stress."

DR. DAWN KOLTES (LEFT), ASSISTANT PROFESSOR, IOWA STATE UNIVERSITY, WITH STEPHAN SCHMITZ-ESSER, ASSOCIATE PROFESSOR, IOWA STATE UNIVERSITY

KEY FINDINGS

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Egg Industry Center

SUPPORT RIGHT WHERE YOU NEED IT

2021 was marked by continued uncertainty for the egg industry, but EIC remained engaged in research, analysis and communication to help move the egg industry forward.

WITHOUT OUR DONOR'S AND PARTNER'S FAITH IN THE EIC MISSION, AND THEIR MATCHING FINANCIAL GENEROSITY, EIC COULD NOT HELP THE INDUSTRY THE WAY WE DO.
THANK YOU EIC SUPPORTERS!

To learn how you can help advance the work of the Egg Industry Center, please contact EIC today.

IOWA STATE UNIVERSITY