Egg Industry Center

2023 IMPACT REPORT

THE EGG INDUSTRY CENTER

CONTRIBUTING TO A SUSTAINABLE EGG SUPPLY

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From the EIC Director

Each year, the Egg Industry Center publishes this impact report to highlight some of our many ongoing applied research efforts made possible by our generous donors. To date, EIC has funded 14 different research partners in the USA and Canada to investigate and explore challenges facing the industry. Persistent challenges in egg production and management, layer and pullet health and welfare, and environmental impact all demand dedicated, focused, and creative approaches. In 2023, the EIC and its funders supported a new round of three projects totaling nearly $400,000 to directly address industry-identified issues.

This year, we completed an updated Life Cycle Assessment (LCA) for the US egg industry and obtained an ISO certification on that work. Next, we will develop related consumer, science, and policy messages in collaboration with our colleagues at the American Egg Board, the United Egg Producers, and the US Roundtable for Sustainable Poultry and Eggs (US-RSPE). The LCA results will directly impact the advancement of the US-RSPE's sustainability framework and provide research-based guidance as we work toward on-farm assessments to better tell each egg farmer's sustainability story.

Our dedicated EIC Board members have worked to increase our capacity to support additional scientists through a fundraising campaign separate from our Forum sponsorships. As I wrote last year, our short-term goal is to double our annual research funding so EIC can invest at least $500,000 per year in this critically important EIC program that directly benefits all egg producers. By 2025, our aim is to grant research funds of $1 million per year.

I thank each of you who has already contributed to this ambitious and much-needed campaign — our work would not be possible without you. If you have not donated, I personally welcome you to contact me to discuss how you can become a part of this significant work.

Please keep in touch! And many thanks for all you do to support the egg industry.

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

ECONOMICS

CAGE-FREE COSTS

EIC completes first economic survey comparing the costs of cage-free and conventional egg production

With the increase in cage-free (CF) egg production in the U.S., understanding production costs is vitally important. Since 2014, EIC has generated reports on the cost of production (COP) for conventional systems (CC). In 2023, a special report conducted at the Egg Industry Center features an economic comparison of both production methods.

From January to April 2023, business analyst Maro Ibarburu conducted EIC's first survey designed to benchmark COP for CF systems, which currently represent about 38% of the U.S. flock. The survey did not include organic egg farmers since the additional requirements of organic production systems make COP much higher than non-organic CF systems. Responses represent all regions of the country and approximately 124 million layers allocated across both housing systems.

The small number of survey responses (18 out of 100) and high variability of reported costs between participating companies limits the representativeness of the report's estimates. Survey questions addressed costs related to feed milling, growing pullets, and egg production sites, including labor and benefits (for in-house employees or contractors); housing and equipment; repairs and maintenance; utilities (electric/gas/phone/garbage/water); vaccine or health-related services; supplies, including biosecurity, other services, and overhead; and miscellaneous expenses, including property taxes and insurance.

CF production efficiency is lower than that of CC for all the variables included in the survey. In summary, CF systems require:

- 6% more feed needed to grow pullets
- 22% higher non-feed item costs for growing pullets
- 9% fewer eggs produced per hen housed
- 11% greater feed conversion (requiring more feed per dozen eggs produced)
- 45% higher non-feed item costs for hens in the laying barn

As a result of overall lower production efficiencies reported in CF systems, the COP difference between CF and CC eggs increases as feed cost increases, ranging from 17 to 21 cents/dozen for feed cost of $150 to $350 per ton.

"There is potential to improve some of the production inefficiencies, such as feed use and number of eggs produced per hen housed as management techniques are learned and implemented," Ibarburu said. "This would help to reduce the gap in the cost of production."

He believes research and outreach of scientific information could play a key role in improving that efficiency.

"While we have room to improve on efficiencies, the higher capital costs of building CF facilities, and the additional labor required to operate them, will result in higher costs even if the production efficiencies reach a similar point," Ibarburu said.

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PREPARING FOR A MARATHON

Newly funded study looks at synchronizing photoperiod and body weight for optimizing the start of reproduction

While some see pullets as a burden, Dr. Charlene Hanlon, assistant professor at Auburn University, views them as an investment.

“We have an opportunity to give laying hens the resources they need to lay eggs for 100 weeks, while taking very few off days,” Hanlon explained. “They are working overtime, so it is important to set them up for success from the beginning. The pullet phase is like training for a marathon, and we want to give these hens the healthiest start possible.”

Hanlon, along with co-principal investigators from the University of Guelph and Auburn University, was awarded an Egg Industry Center (EIC) grant to study physiological changes in layer hens in cage-free environments and the relationship between increased activity, food intake, body composition, and the onset of reproduction.

“Modern commercial hens in cage-free environments are beginning to reproduce before they hit photostimulation because of body weight and composition,” she shared. “The light cue we thought was the be-all, end-all for controlling reproduction is not the only factor that matters.”

In this new study, Hanlon’s team will monitor the body weight, body composition, metabolism, and behavior of white layer hens in a vertical aviary system as they begin to reproduce. They also will study the relationship between body composition and skeletal structural integrity, particularly related to keel bone fractures.

The team’s research goals are: 1) to identify the relationship between metabolic and photoperiodic cues in laying hens; 2) to determine the minimum thresholds to achieve optimal entry into egg lay; and 3) to establish the influence of the cage-free environment on activity levels and its impact on body composition and bone quality as it relates to the timing of sexual maturation in laying hens.

Variation in how birds use the cage-free system impacts their ratio of muscle to fat, and if a layer has less fat, she has less opportunity to lay a proper egg. Hens need to eat more as they move more, and if they run out of nutrients will decrease production. The increased cost — recently estimated by EIC to be around 25% depending on feed cost — impacts farmers and consumers. Hanlon aims to increase the industry’s understanding of how these factors are interrelated and how that knowledge can improve sustainability.

“We want to cater to the birds and provide what they need,” Hanlon said. “Animal health underlies every reproductive study because if a bird is not healthy, she won’t reproduce. We want to be sure she has what she needs to reproduce without sacrificing herself.”

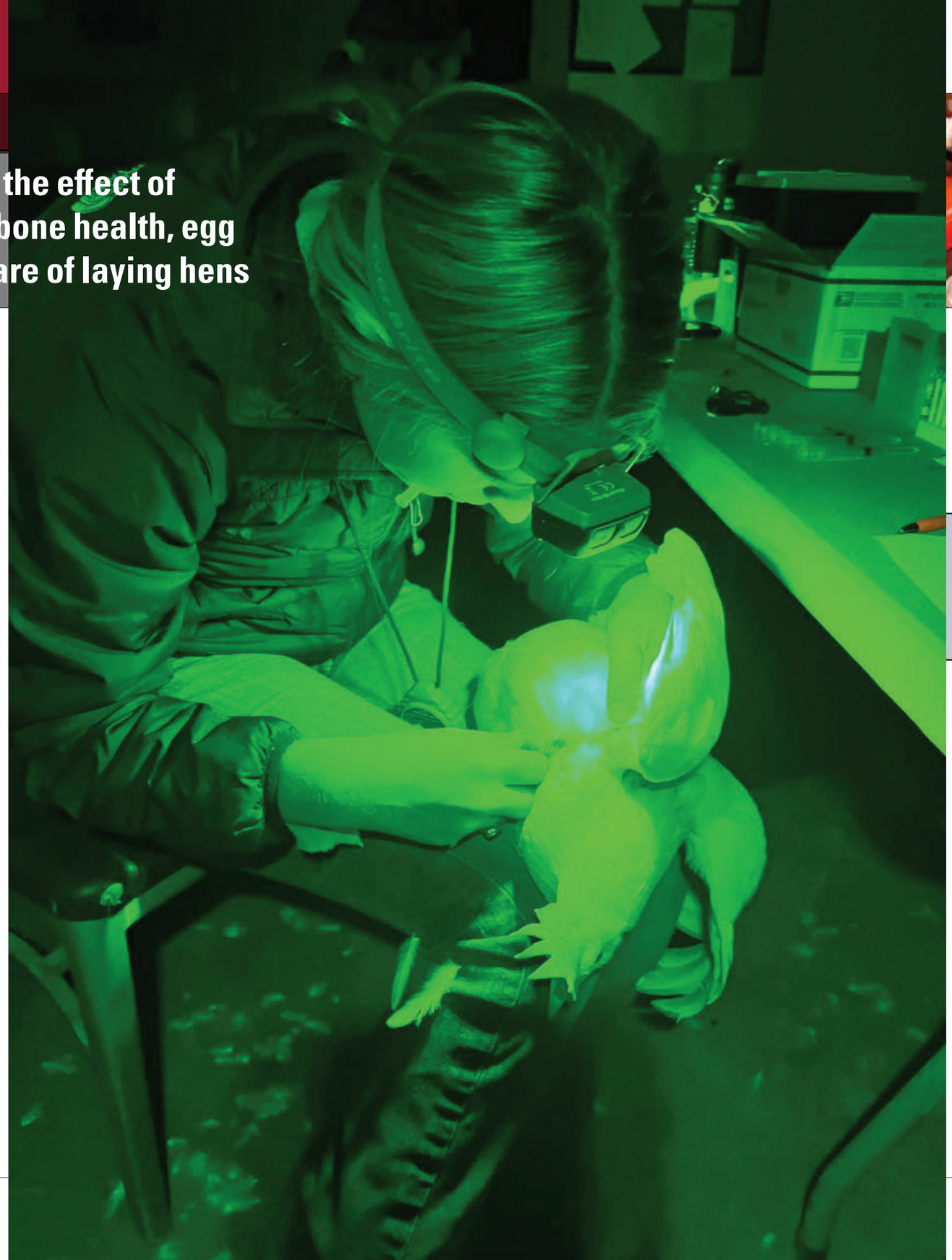
Decades of research helped fine-tune caged systems to maximize production efficiency. Now, the scientific study of cage-free systems and how they impact the hens is critically important for bringing up production efficiency levels. Better understanding of how to manage CF systems will help the industry move forward and further improve sustainability.

“We want to give egg producers a second management strategy when it comes to reproduction,” Hanlon shared. “A metabolic cue would be one more tool in the toolbox for maximizing egg production while maintaining animal health. If we can get production back up in the cage-free environment, it will help ease margins for farmers.”

The hens for this study will be housed at the Arkell Poultry Research Station in Guelph, Canada, following the minimum specifications of the Layer Code of Practice by the National Farm Animal Care Council of Canada, as well as consideration of the specifications outlined by the United Egg Producers. The Egg Farmers of Canada provided funds to EIC to support this research.

IN SEARCH OF THE WIN-WIN

Animal behaviorist studies the effect of interrupted dark period on bone health, egg quality, behavior, and welfare of laying hens



As a veterinarian and assistant professor, Dr. Ahmed Ali brings extensive experience in animal welfare and behavior to the improvement of intensive poultry production systems. Originally from Egypt, Ali started his academic career at Clemson University in the fall of 2019 after having practiced as a veterinary surgeon in several countries before obtaining his doctorate.

"The transformation in laying hens due to genetic selection is incredible," Ali said. "Heritage breeds lay 30–40 eggs per year, and modern commercial layers produce 300–350 eggs per year. Add to that an intensive production system, and we have a lot of challenges to the birds' well-being."

One challenge laying hens face is the need to consume more daily calcium for eggshell production. Chickens' short gastrointestinal tract processes and secretes their food within four to six hours, which means calcium needed for eggshell formation is required when the birds are not eating and their stomachs are empty.

"The hen's body will leach calcium from its bones to build up the eggshell," Ali said. "By the end of the extensive laying cycle, these birds can suffer from osteoporosis and keel bone fractures. Previous research revealed that almost 90 percent of commercial layers suffered from damage and/or osteoporosis to the primary bone of their body."

Additionally, by the end of the laying cycle, egg quality decreases, and shell fissures are common. This translates to potential contamination that could impact human health and a financial loss from egg breakage for farmers.

"I asked myself if there was anything we could do to improve bone health, calcium intake, and egg quality without requiring more food or food additives," Ali said. "In my work, I consistently strive to balance the welfare of animals and the financial prosperity of farmers. The only way to solve this dilemma is by finding a win-win situation — something that will not cost more money but might improve bird well-being and egg quality at the end of the laying cycle."

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DR. AHMED ALI, CLEMSON UNIVERSITY

If successful, the work of Ali and his co-principal investigators from Clemson University and the University of Georgia would incorporate a simple lighting management change.

His novel approach is to increase the amount of calcium that hens can absorb by adjusting the standard exposure of light hours. Typically, laying hens experience 16 hours of light and 8 hours of darkness. In Ali's study, they experience intermittent light and dark periods that add up to the traditional amount of light and dark hours.

Ali's research started with day-old chicks raised identically to create a homogenous flock. Now, at the mid-point of his research, the birds are all in good health and producing eggs according to production system guidelines. Blood tests at five-week intervals beginning at 20 weeks of age will show the long-term effects of the interrupted dark hours, with the most critical evaluation still to come.

"The late stage is the most problematic, from 55 weeks upward, in terms of either a positive or negative chronic effect," he said. "Production is excellent now, but time will tell."

After overcoming delays due to the complexity of lighting 32 separate research pens and the challenges of securing the needed research subjects, Ali should conclude his research in 2025.

"EIC is the only foundation that helps scientists financially when it comes to studying laying hens," Ali said. "While the egg industry is not as large as the broiler industry, laying hens are still significant and producing large amounts while being raised in super-intensive environments. I appreciate EIC focusing on this aspect of poultry production systems."

UNDER THE MICROSCOPE

Experienced researcher leads inquiry into costly avian viruses and bacteria

Understanding the viruses and bacteria that cause poultry diseases, and how they react to mitigation efforts, helps poultry farmers make informed decisions about threats to flock health. From 2018 to 2022, Dr. Huaguang Lu studied the newly emerged field variant strains of avian reovirus (ARV) and *Gallibacterium*.

Avian Reovirus

Lu, a retired avian virologist at Pennsylvania State University, and his colleagues began gathering ARV field isolates in 2011. They determined about 80 percent of the ARV isolates were novel strains of genotypes 2, 3, 4, 5, and 6. Thus, he proposed a study of the infectivity of these strains and the efficacy of "soft" disinfectants to mitigate their spread.

"The newly emerged ARV variant strains were highly pathogenic to chickens, and commonly used ARV vaccine strains offer limited or no protection," Lu said. "Both broiler and layer chickens have suffered significant disease and economic losses in recent years."

Lu evaluated Hy-line brown and White leghorn W36 layer hens for ARV infectivity (virus shedding), length of infections, and immune responses by conducting ARV experimental infectious experiments in these two breeds of egg-laying hens.

Research findings indicated that the experimentally ARV-infected hens retained normal egg production without observable clinical signs. However, the ARV-infected hens started virus shedding via intestine/feces as early as 24 hours post inoculation (PI), with heavy virus shedding occurring at 2-3 days PI and light shedding at 5-7 days PI. The hens were rarely shedding after 12-14 days PI. The ARV variant-affected egg-laying hens produced high titers of serum and egg yolk antibodies at 2-3 weeks PI and were 100% protected against second and third challenges to the same ARV variant strains.

Non-metallic, or "soft" disinfectants

Historically, harsh chemical products have been used to disinfect and sanitize poultry facilities and processing plants. However, these treatments cannot be used with live production flocks. While Lu had an ARV clinical trial underway, it made sense to evaluate the efficacy of available treatment products.

"Two soft disinfectant products (Shield Plus and Reliant Tabs) that we tested effectively inactivated or killed ARV, low path avian influenza virus, newcastle disease virus, Fowl adenovirus and other avian viruses in a lab setting and controlled bird trial conditions," Lu explained. "However, the concentrations required to be effective when applied in drinking water were not palatable to the chickens. Applying as a spray had limited contact time, which rendered the treatments less effective and required further investigation studies."

Gallibacterium

Dr. Lu expanded his research to include layer farms with flocks experiencing peritonitis due to *Gallibacterium*.

Pandemic travel restrictions and the risk of highly-pathogenic avian influenza transmission required Lu to modify the study to focus on clinical cases of broiler and layer chickens submitted to the Penn State Animal Diagnostic Laboratory.

All case flocks had a clinical history of bacterial infection in the respiratory tract, reproductive tract, and other related serosal surfaces. Researchers collected tissue and swab specimens from each of the clinical cases and processed them for the isolation and identification of suspicious pathogens.

Lu and his team identified the phenotype and hemolytic pattern of each of the 69 archived *Gallibacterium* isolates. Next, they extracted genomic DNA which was sequenced at the Genomics Core Facility at Penn State. Finally, they evaluated the isolates' response to eighteen antibiotics commonly used in poultry production.

"While the isolates showed variable susceptibility to antibiotics, the key take-away is that all 58 of the isolates that progressed to this stage of our research were sensitive to enrofloxacin, ceftiofur, florfenicol, and gentamicin."

DR. DR. HUAGUANG LU, PENN STATE UNIVERSITY

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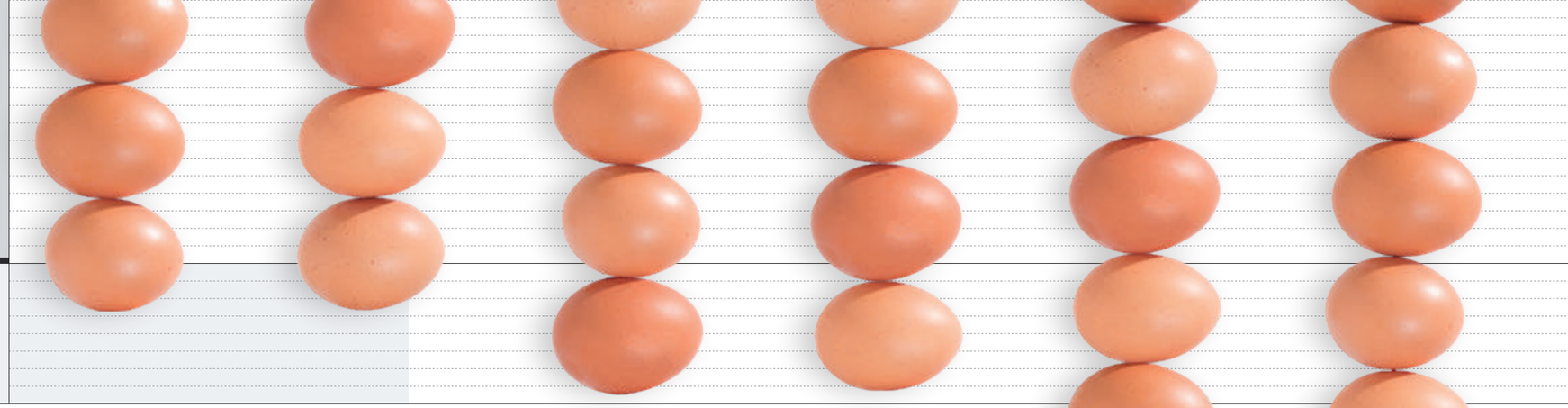
Dr. Lu retired in 2023 and is now a professor emeritus at Penn State.

Data paves the way to informed decision-making



From an overall egg industry snapshot to an individual farm, the Egg Industry Center (EIC) remains focused on research-based information to help egg farmers make sound decisions to improve their sustainability.

EIC Director and Iowa Egg Council endowed professor, Dr. Richard Gates, recently reflected on the center's role in advancing research that helps the industry become more sustainable.

LCA: An Evolution in Understanding

EIC's original Life Cycle Assessment (LCA) work, referred to by most as the 50-year study, provided the foundational understanding of the industry's environmental footprint by comparing production standards between 1960 to 2010. This benchmark study supplied the scientific data egg farmers needed to engage proactively with customers and industry stakeholders and show the incredible sustainability strides made over time.

This year, EIC completed an LCA for the 2019 production year. This comprehensive study was formally adopted under ISO rules on July 31, 2023. The newly adopted LCA quantifies the industry's carbon footprint and five other environmental metrics. "While we have results from each LCA, they cannot be compared directly because of the change in underlying models and metrics," said Gates. He explained that as industries undergo change there is an inherent inefficiency, which can be captured in the LCA process. As new methods and technologies develop, a norm develops for an industry. "This new LCA captured much of the early cage-free adoption and many of these farms do things differently today than three or four years ago," said Gates. "Therefore, EIC and its industry partners are already planning a future LCA that can help further quantify the environmental impacts as the cage-free adoption evolves."

LCA Challenges

Gates acknowledges there are challenges when conducting an LCA, which is currently the only internationally and scientifically approved methodology to assess an environmental footprint.

- LCAs are built upon many assumptions. "Some of these do not accurately reflect operations on a particular farm, and others may over-simplify important activities such as manure management," Gates shared.
- The underlying LCA models used to create the calculations change over time and can cause challenges related to interpretation of LCA results.
- Obtaining sufficient high-quality data from individual egg farmers is a challenge. This affects the ability of the LCA to provide a holistic egg industry snapshot of sustainability metrics.
- A challenge arises from different allocation methodologies within an LCA. When a production process has multiple final products, it is necessary to allocate how much of the environmental footprint goes into each of those final products. The two main allocation methods used are called economic and biophysical. While many if not most LCAs in the livestock and poultry sector utilize economic allocation, those results will generally not agree with those that use a biophysical allocation method. This is confusing for stakeholders.

"With today's concerns about greenwashing, I think it is best to ask ourselves what our stakeholders want - results that reflect inputs' environmental costs or those reflecting biophysical processes," said Gates. "In 2010 and 2019, EIC's LCA chose the biophysical allocation method to ensure the robustness of our reporting for the industry's stakeholders, but we can run both allocation methods so the industry can be aware of their differences when talking with others."

On-Farm Assessments: The Key to Making Decisions

EIC's latest LCA sets the stage for the next step in the sustainability journey: on-farm assessments.

"The LCA tells the industry where it sits with respect to the six key environmental aspects of sustainability, but it doesn't really help an individual farmer know which practices to adopt in order to see the greatest improvements to their sustainability profile," Gates said. "Determining which practices might be the best candidates will depend on each farmer's unique situation."

Gates explained the long-term goal is for egg farmers at all levels to have a robust decision-making tool at their fingertips that can show them, in real-time, how a decision they make for their operation can impact their farm's footprint.

Working Together: The Future Looks Bright

Gates highlighted some opportunities for the future. "We have tremendous opportunities to improve how manure management is handled in an LCA," Gates said. He feels this can both improve accuracy of the industry's sustainability assessment and guide other egg farmers on measures that might improve profitability and sustainability.

"As we collect more data on manure management activities, we may be able to impact the notably simplistic models used for the national LCA on manure management, and subsequent assumed losses from land application as a crop fertilizer," he said.

Gates also believes the industry needs to move towards an on-farm assessment. "We need to be using as much real data as possible, and not estimates, so everyone in our industry has more representative results when using LCA methodology in the future."

For 15 years, EIC has worked to advance the science of egg production. "I've said it before, but it bears repeating: Our job is to be at the table to ensure we are engaging the proper scientists to assist in maintaining and improving our operations in a logical and defensible manner," Gates said of EIC's role. "We can help with the methodology itself, to make sure assessments are done properly. And by actively participating, we can learn about problems that individual egg farmers are having with implementing their unique sustainability strategies and help them find solutions."

Looking to the future, Gates anticipates continued growth in EIC through partnerships, sponsorships, grants, and donors.

"I am excited that we have partners gathering around EIC to support the growth of our research grant program so we can help with challenges like sustainability and much more. We have seen visionaries in leadership on farms and in the finance sector, in equipment and other allied positions who see that this industry cannot move forward without a scientific undergirding," Gates said. "This industry has a history of making scientific information core to its operational decisions and EIC is excited to lead the charge to continue to bring production-related scientific information from North America's researchers to the egg industry."

FUNDING CRITICAL RESEARCH AT 14 UNIVERSITIES ACROSS NORTH AMERICA TO SECURE SCIENTIFICALLY BASED SOLUTIONS FOR THE ENTIRE EGG INDUSTRY.

Egg Industry Center

Thank you EIC supporters!

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.

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

The Egg Industry Center is administered by the College of Agriculture and Life Sciences at Iowa State University.