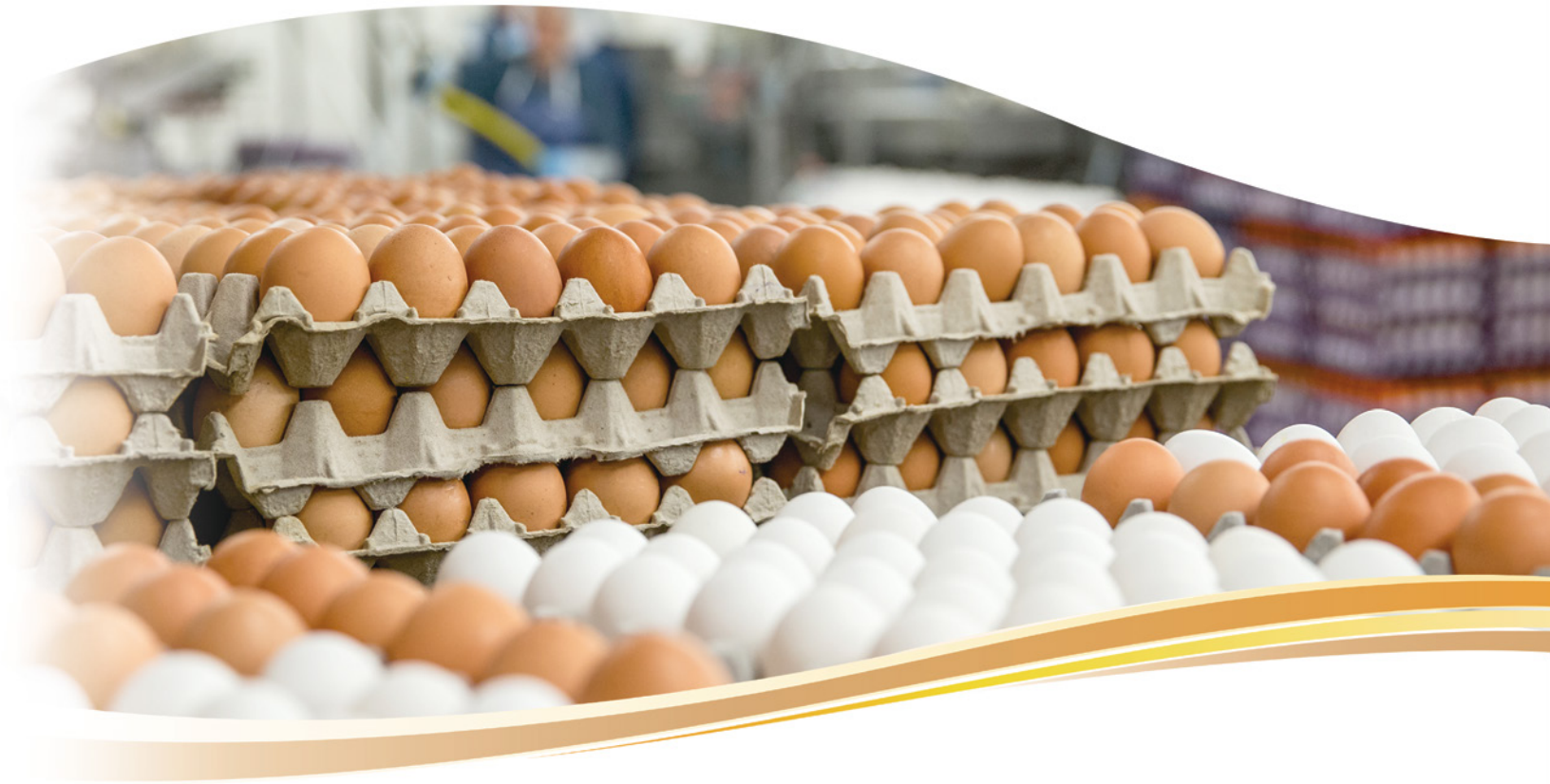
white paper



Landmark 50-year Study Documents U.S. Egg Industry Reduced Environmental Footprint

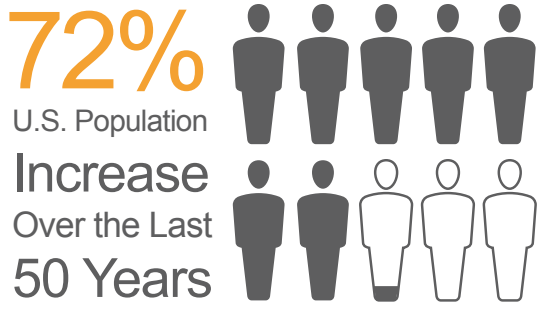
Improved hen feed, better disease control, advancements in hen housing systems and subsequent reduction of natural resource use — reduced environmental footprint.

incredible!

American Egg Board

Research Summary

A new study demonstrates how the egg industry has reduced its environmental footprint over the last fifty years through improved hen feed, better disease control, advancements in hen housing systems and subsequent reduction of natural resource use. This life cycle analysis of U.S. egg production also showed the industry reduced its environmental impact while increasing hen supply by just 18% to meet the demands of a **U.S. consumer population that grew 72%** over the same 50-year period. The egg industry is dedicated to further improvements in efficiency and waste reduction while contributing an affordable source of high-quality, bioavailable protein to the U.S. food supply.



An Overview

In order to meet the nutrient requirements of a rapidly expanding global population, food systems must improve their efficiencies. Increased food production and environmental awareness are linked. New technologies and in the case of animals, new husbandry methods must be implemented in order to wisely utilize and preserve finite resources such as land, water and energy.

The Egg Industry Center released a landmark study comparing U.S. egg production in 2010 to the industry in 1960 to show that while egg production has increased over the past 50 years, the industry has also been able to significantly decrease its environmental footprint. Researchers conducted a life cycle analysis of U.S. egg production from 1960 to 2010 to evaluate environmental performance measures for the complete life cycle from crops to hens to the farm gate. Study findings indicate that the environmental efficiencies are the result of a wide range of factors, including the reduction of natural resource use, improved hen feed, better disease control and advancements in hen housing systems.

★ Key study results comparing 2010 to 1960:

- Egg production releases significantly less polluting emissions, including **71% lower greenhouse gas emissions**.
- Today it takes **32% less water** to produce a dozen eggs.
- Today's hens use a little over **half the amount of feed** to produce a dozen eggs.
- At the same time, today's hens produce **27% more eggs per day** and are living longer.

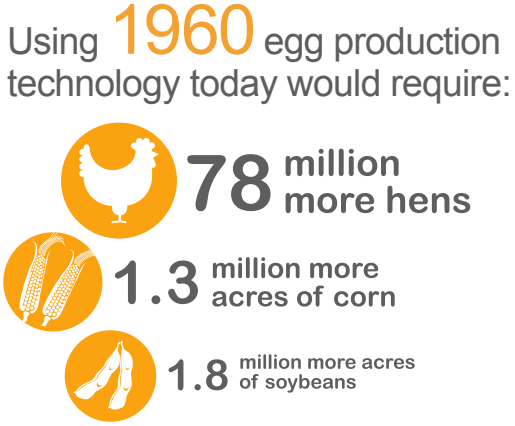
Egg farmers have improved their production practices, allowing them to provide an affordable source of high-quality protein while using fewer resources and producing less waste.

"The U.S. egg industry has evolved remarkably over the past five decades by incorporating new technologies to protect natural resources," said Hongwei Xin, agricultural and biosystems engineering and animal science professor at Iowa State University, director of the Egg Industry Center and the study's lead researcher. "Egg farmers have improved their production practices, allowing them to provide an affordable source of high-quality protein while using fewer resources and producing less waste."

Keys to Improvement

Due to increased feed efficiency, advancements in hen housing and manure management, egg farms now use less water and energy on a daily basis and release less polluting emissions. Every aspect of the egg production process, from cultivating feed to raising the laying hens, has led to a reduced environmental footprint.

- **Feed efficiency** plays a key role in reducing environmental impacts. Because of advancements in nutrition and bird breeding, young hens now require 48% less food during the rearing period than they did in 1960, and the laying hens have 42% better feed conversion. Using 1960 technology to produce the 2010 egg supply would have required 78 million more hens, 1.3 million more acres of corn and 1.8 million more acres of soybeans.
- **Advancements in hen housing**, such as improved building ventilation, temperature control, better lighting and a more secure housing environment, help to ensure that hens are protected from disease-carrying wildlife. These techniques have been widely adopted by egg farmers across the country, leading to healthier hens with a lower mortality and higher rate of egg production. In addition, advancements in the development of preventative medicine to eliminate avian diseases have greatly improved hen health.
- **Manure management** has played a role in minimizing the egg industry's environmental footprint. The vast majority of manure from laying hens is recycled into crop production, providing nutrients for plants, contributing to healthy soils, saving energy and reducing commercial fertilizer use.



Study Methods

Life cycle assessment (LCA) is the most widely used tool for studying environmental performance in food systems from a supply chain perspective. LCA is an ISO (14044) standardized framework for characterizing the material and energy flows and emissions along product supply chains, and quantifying how these contribute to a variety of resource use, human health and environmental impact potentials. In this study, Egg Industry Center used ISO-compliant LCA to quantify the environmental performance of U.S. egg production in 2010 vs. 1960.

Using industry-supplied activity data that was collected using anonymous surveys, this study first characterized the material, energy inputs and emissions associated with contemporary egg production supply chains in the United States. The system boundaries for this analysis included all cradle-to-facility gate direct and indirect inputs and emissions arising from: the agricultural and industrial production systems from which raw materials for feed inputs are derived; the processing of raw materials; the production of feeds; the production of chicks; and farm-level material and energy use and emissions of pullet and layer facilities. The data collected directly represented 57.1 million pullets and 92.5 million laying hens, or 26% and 33% of the respective stock populations in the United States in 2010. Subsequently, a parallel model of U.S. egg production in 1960 was developed based on published literature sources and in consultation with industry experts for comparison with 2010 production conditions. The environmental footprint indicators used in this study were acidifying emissions (acidification), eutrophying emissions (eutrophication), greenhouse gas (GHG) emissions, global warming potential, (GWP), and cumulative energy demand (CED).

Observations

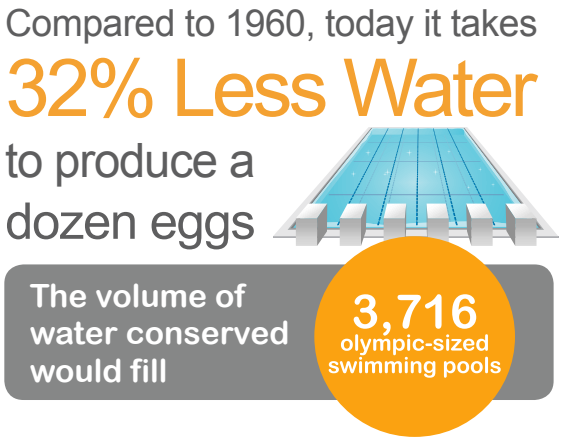
The following changes in production performance of U.S. pullets and laying hens were observed over time.

Compared with 1960 pullets, 2010 pullets have:

- **30%** lighter body weight at onset of lay
- **48%** less feed use over pullet-rearing period
- **70%** lower mortality over pullet-rearing period

Similarly, compared with 1960 laying hens, 2010 laying hens have:

- **26%** less daily feed use
- **27%** higher hen-day egg production
- **42%** better feed conversion
- **57%** lower mortality
- **32%** less direct water use per dozen eggs produced



The analysis showed the following reductions in the environmental footprint per kg of eggs produced in the U.S. over the 50-year time interval considered:

- **65%** lower acidifying emissions
- **71%** lower eutrophying emissions
- **71%** lower GHG emissions

- **31%** lower CED

The total supply of 77.8 billion eggs produced in the U.S. in 2010 was 30% higher than the 59.8 billion eggs produced in 1960. However, the *total* environmental footprint for 2020 is:

- **54%** lower for acidifying emissions
- **63%** lower for eutrophying emissions
- **63%** lower for GHG emissions
- **10%** lower for CED

Further analysis found that using 1960 technologies to produce the amount of egg supply for 2010 would require the following additional resources:

- **Raising 27%** (78 million) more hens
- **Growing 72%** (1.3 million acres or 0.53 million hectares, or 5.2 metric tonnes) more corn
- **Growing 72%** (1.8 million acres or 0.73 million hectares, or 1.7 metric tonnes) more soybean

Demand for these additional resources would, in turn, translate into greater environmental impacts.

Conclusions and Recommendations

The study analysis of the distribution and magnitude of life cycle impacts for egg production in the U.S. in 1960 compared to 2010 provides a clear indication of the scale of environmental performance gains, both per unit production and in aggregate, achieved by the industry over the past 50 years, as well as insights into the primary contributing factors. Several key insights emerge. From a supply chain management perspective, the key leverage point for environmental performance improvements in egg production has been and will continue to be efforts to maximize feed use efficiencies because feed production accounts for the largest share of impacts in egg production both in 1960 and at present. The feed conversion ratio for egg production improved from 3.44 kg/kg in 1960 to 1.98 kg/kg — **a gain of 42%**. Nonetheless, achieving feed use efficiencies comparable to the best performing contemporary facilities (the range reported by survey respondents was 1.76-2.32 kg/kg) industry-wide would do much to further reduce aggregate impacts.

Changing feed composition has also played an important role in reducing impacts — in particular, both reduction in the total amount of animal-derived materials used, as well as increased use of porcine and poultry materials in place of ruminant materials. The concept of least-environmental cost feed sourcing is therefore of particular relevance for additional targeted performance improvements for this industry. It is recommended that similar biophysical accounting methods to those applied in the current study be used to model potential alternative feed input supply chains to ensure methodological consistency and comparability with the present analysis.

Managing feed supply chains for environmental performance must also take into account nitrogen use efficiencies. Nitrogen (N) losses from poultry manure are the second largest contributor to acidifying and eutrophying emissions, as well as a non-trivial contributor to GHG emissions in both pullet and layer facilities. Moreover, upstream impacts of N fertilizer production and use are a primary determinant of feed input-

related impacts. Feed formulation, breeding and selecting manure management strategies for optimal N use efficiencies are therefore powerful tools in supply chain environmental management. Here researchers modeled N losses using standard Intergovernmental Panel on Climate Change (IPCC) protocols. Given the margin of error associated with manure N sampling, they recommend using this IPCC-based modeling approach. This will also maximize inter- and intra-company and product comparability. However, researchers also suggest continued efforts to improve and standardize company-level manure-N sampling accuracy, in order to allow for differentiation between facilities and production strategies looking forward.

Overall, study analysis provides compelling evidence that considerable strides in resource use efficiency and animal husbandry performance in the U.S. egg sector over the past 50 years have much reduced both the relative and absolute impacts of U.S. egg production.

Looking Ahead

Progress has been made on many fronts, including animal genetics, nutrition, disease prevention, housing equipment and environmental control and efficiency of feed production and use. Contemporary productivity would have been difficult to imagine 50 years ago.

Also apparent, however, is that there remains substantial scope for continued improvement. Moreover, in light of continued declines in Energy Return On Investment (EROI) for energy carriers consumed in egg supply chains, continuous improvement will likely be necessary simply to maintain the current status quo environmental footprint of the U.S. egg sector. The benchmarks reported here, as well as the reported ranges for resource use and production efficiencies in what are, ostensibly, otherwise similar production facilities, provide an excellent reference point for industry-led initiatives for further improving the environmental performance of U.S. egg production.

Egg farmers are dedicated to providing safe, nutritious food while maintaining the highest quality care for their hens. At the same time, farmers understand the importance of protecting the land, water and air for their communities and future generations, and continually look to identify ways for improvement.

Efforts to further improve feed efficiency, hen housing facilities and manure management will facilitate even greater environmental footprint reductions in the future.

The study was funded by the American Egg Board, the U.S. Poultry and Egg Association, the United Egg Association Allied and the Egg Industry Center. To obtain data for 2010, researchers conducted anonymous surveys with egg farmers and collected data on 57.1 million young hens and 92.5 million laying hens.

Study Authors/References

Egg Industry Center

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A professor of Agricultural and Biological Systems Engineering and Animal Science at Iowa State University; and Director of Egg Industry Center, Xin conducts research and extension programs. His focus is on air quality issues related to animal feeding operations, and impacts of housing and management factors on animal behavior, welfare, environmental impact, production efficiency, and ultimately sustainability of livestock and poultry operations.

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The Egg Industry Center's Associate Scientist — Business Analyst focuses his work on providing marketing and statistical information as well as flock and price projections to egg producers and allied egg industries. Ibarburu researches production efficiencies, marketing, and environmental footprint aspects for conventional and alternative production systems. He holds a M.S. in agricultural economics from Iowa State University.

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View entire study online at: **ANS.IAState.edu/EIC**

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