

2022 U.S. Egg Processing, Cartoning and Transportation Costs Report

6/28/2023

Compiled by

Maro Ibarburu[1], Alejandro Plastina[2], Richard Gates[1] and Lesa Vold[1]

[1]Egg Industry Center
Iowa State University

[2] Department of Economics
Iowa State University

Executive Summary

The U.S. egg production industry runs on small profit margins. As a result, understanding each input cost is important to the decisions egg farmers make each day. Processing, Cartoning, and Transportation (PCT) costs are key components associated with delivering eggs to a store.

Previously, the Egg Industry Center published special reports estimating the PCT costs for 2018, 2020 and 2021. This report updates these estimates for 2022 and outlines the process and methodology implemented for their calculation.

Key findings include:

- Most costs are higher than those estimated in the previous report for 2021.
- The largest difference with respect to the previous study is in the grade yield loss followed by the processing cost.
- The large price difference between large, medium, and small-size eggs in 2022 resulted in a much larger value for the estimated grade yield loss than in previous years.
- Cost line items with higher variability among survey respondents are probably where processors have most opportunities to reduce costs.

For this report, 18 responses were received representing approximately 124 million egg-laying hens in the U.S. The survey responses allowed for updates to the costs of processing Gradeable Nest Run Class-1 (GNR1) eggs, but there was insufficient information to update the costs of processing graded loose eggs.

This report includes a section comparing the 2022 results with the 2021 results (Ibarburu et al., 2021). It is the intention of the Egg Industry Center to continue updating these cost estimates on a regular basis to assist the egg industry benchmark its financial costs.

Survey Questionnaire

A survey of U.S. egg processors was conducted to estimate costs associated with washing, weighing, packaging, and transporting eggs. The 2022 survey questionnaire was based on the 2021 questionnaire, but since the 2021 survey results for the cost of processing showed two distinct clusters of cost structures (likely reflecting that a group of respondents incorporated marketing, administration and overhead costs into the reported costs, and the other group did not), the 2022 questionnaire separated the processing cost into three categories: processing, marketing, and administration & overhead.

The survey was organized into ten questions, some of which required multiple data entries. These questions elicited information on the cost of packaging materials, processing (washing, weighing, packaging), and other relevant factors that influence costs.

The survey included questions for egg type, packaging type, case type, and miscellaneous.

There were three different types of eggs included in the survey:

- Gradeable Nest Run Class-1 (GNR1) sourced in-line,
- Gradeable Nest Run Class-1 (GNR1) sourced off-line, and
- Graded Loose large.

In-line sourced eggs are processed on the farm where they are produced. Off-line sourced eggs are eggs that are trucked from the farm to a different facility for processing. Processing refers to cleaning, quality control checks, grading, packaging, and refrigerating.

For each egg type, the percentage of eggs of different sizes and classes were surveyed and then used to estimate the associated grade yield loss or gain.

Four different packaging types options were provided in the survey:

- 12-egg carton,
- 18-egg carton,
- 5-dozen packs, and
- filler flats.

Two types of cases were considered:

- regular corrugated cardboard case and
- reusable plastic containers.

The corrugated cardboard case costs were further separated by 30-dozen and 15-dozen cases.

The survey also included three questions related to:

- finishing costs for putting boxes of eggs in pallets, wrapping them, etc.
- losses from store returns, and
- differences in costs between USDA-graded eggs and non-USDA-graded eggs.

Anonymous Data Collection

In January 2023, the survey was sent to more than 100 egg producer/processor companies for which the Egg Industry Center had contact information. One person per company was chosen to receive the survey to avoid the possibility of duplicate responses. Participants were offered a variety of ways to return their surveys, all of which ensured that their identity was not traceable, therefore guaranteeing anonymity of the respondents and their companies.

The survey specifically asked for responses based on the PCT costs for the year 2022. Data collection was finished by April 2023.

Method of Analysis

The analysis was conducted in three stages, each of which is described in detail below. Briefly, outliers (extremely high or low values) were flagged and discarded prior to analysis. Then, two alternative measures of central location (a trimmed mean and the median) and the data dispersion (i.e., the interquartile range, IQR) were calculated. Finally, for responses with substantial scattering in their distribution, cluster analyses were conducted to identify groups within the distribution with high degrees of similarity within each group but with significant differences among groups. This step was conducted to understand whether a unique cost estimate could reasonably characterize all responses, or whether other influencing factors should be included.

Outliers

Outliers were identified using Tukey's method (1977) which consists of the following steps:

- Compute the interquartile range (IQR), i.e., the difference between the values of the 75th and 25th percentiles
- Multiply that difference by 1.5, or 1.5IQR
- Identify and discard any values less than the 25th percentile minus 1.5 x IQR, or greater than the 75th percentile plus 1.5 x IQR

Central Location

The most used measure of central location for a distribution of numerical values is the arithmetic mean, also called the simple average (i.e., the sum of the values across all responses divided by the count of responses). The average can be sensitive to bias when computed from data having asymmetric high or low values (i.e., a skewed distribution), even after removing outliers. Some survey response data presented extreme values and some of the distributions were skewed, thus two alternative measures of central location were used instead. These are the median and the trimmed mean, both of which are more robust to the presence of extreme values in skewed distributions. The trimmed mean in this report is the arithmetic mean after eliminating the top 20% and the bottom 20% of the observations. The outliers were eliminated before estimating the median, the trimmed mean, and the 25^{th} and 75^{th} percentiles.

The median is a robust central measure (Rice, 2006), but one of its key disadvantages is that it ignores the values outside the center, and such information might be valuable. An advantage of the trimmed mean over the median is that it incorporates information not only from the center of the distribution, but also from the 60% of the sample that was left after eliminating the top 20% and the bottom 20% of the observations.

Both median and trimmed mean have advantages and disadvantages but in general there is no best central measure for all skewed distributions and utilizing two measures is preferred by some (Rice, 2006) whereas the median is considered most appropriate by others (Snedecor and Cochran, 1989).

Dispersion of Responses

While the standard deviation is commonly used to represent the dispersion of data about a central location, in this study the single measure of dispersion is the IQR because it represents the dispersion around the median.

Clustering Analysis

K-means clustering analysis was conducted to identify groups of responses with similar values within each cost category.

Definitions and detailed information regarding the median, percentiles, trimmed mean and clustering analysis are fully described in the 2018 study report (Ibarburu et al., 2019).

Survey Results

A total of 18 responses were received, compared to 18 in the previous year's analysis. Although it is impossible to know the production of the laying hens represented by the responses due to the anonymity of the respondents, some estimates suggest this represents approximately 124 million layers. The assumptions used for that estimate were derived from the February 2022 edition of magazine *Egg-Industry,* published by WATT Media. This publication shares data about egg company rankings and helped provide the foundational data for the following assumptions:

- Farmers that process more than three million cases in a year would have on average 10.3 million layers,
- Farmers that process less than three million cases would have on average 1.5 million layers.

Under these assumptions, the survey responses represent approximately 40% of the U.S. laying hen inventory, and 57% of the laying hens dedicated to shell egg production.

It was estimated that approximately 64% percent of the eggs processed by the respondents were nest-run in-line eggs, 24% were nest-run off-line eggs, and 12% were graded loose eggs. If a respondent indicated

they didn't process any of the four egg types listed above, their responses related to those eggs were not included in the analysis.

Packaging costs:

Table 1 presents the survey results for the various types of packaging materials and their associated costs. The total number of usable responses is shown as well as the calculated median and trimmed mean costs, the dispersion, and the difference between the median and the trimmed mean expressed in both cents per dozen eggs and in percent.

Table 1. Packaging costs in cents per dozen

	Usable responses	Trimmed mean	Percentiles				Difference*	
			Median	25th	75th	IQR	cents/doz.	%
Package: 12-egg carton	15	12.70	12.64	11.88	13.60	1.73	-0.06	-1%
Package: 18-egg carton	15	12.10	12.30	10.94	12.73	1.79	0.20	2%
Package: "5 dozen"	9	11.83	12.10	10.90	12.40	1.50	0.27	2%
Package: "filler flats"	14	3.77	3.91	3.36	4.00	0.64	0.13	4%
Case cost (30 dozen)	13	4.77	4.73	4.55	5.20	0.65	-0.03	-1%
Case cost (15 dozen)	15	4.98	4.93	4.75	5.25	0.50	-0.05	-1%
Reusable Containers	9	4.95	5.17	4.27	5.40	1.13	0.22	4%
Finishing costs:	11	1.46	1.50	1.37	1.50	0.13	0.04	3%

* Difference is the difference between the median and the trimmed mean estimates

There were 15 usable responses for the 12-egg carton cost. The median cost of the 12-egg carton was 12.64 cents/dozen and the trimmed mean was 12.70 cents/dozen. The dispersion around the median is small both in cents/dozen (1.73) and as a percentage of the median (14%).

There were 15 usable responses for the 18-egg carton cost. The median cost of the 18-egg carton was 12.30 cents/dozen and the trimmed mean was 12.10 cents/dozen. The dispersion around the median is small both in cents/dozen (1.79) and as a percentage of the median (15%).

There were 9 usable responses for the 5-dozen package cost. The median cost of the 5-dozen package was 12.10 cents/dozen and the trimmed mean was 11.83 cents/dozen. The dispersion around the median is small both in cents/dozen (1.50) and as a percentage of the median (12%).

There were 14 usable responses for the filler flats cost. The data were organized into two distinct clusters ($p<0.05$): the 1st cluster consisted of six observations with a median value of 3.31 cents/dozen, and the 2nd cluster consisted of eight observations with a median value of 3.99 cents/dozen. The overall median and trimmed mean were 3.91 and 3.77 cents/dozen, respectively (a 4% difference between these two estimates). The dispersion around the median is small both in cents/dozen (0.65) and as a percentage of the median (16%). The clustering of the data cast some uncertainty about the accuracy of these estimates.

There were 13 usable responses for the case cost for a 30-dozen case. The median case cost was 4.73 cents/dozen and the trimmed mean was 4.77 cents/dozen. The dispersion around the median is small both in cents/dozen (0.65) and as a percentage of the median (14%).

There were 15 usable responses for the case cost for a 15-dozen case. The median case cost was 4.93 cents/dozen and the trimmed mean was 4.98 cents/dozen. The dispersion around the median is small both in cents/dozen (0.50) and as a percentage of the median (10%).

There were 9 usable responses for the reusable plastic containers. The data were organized into two distinct clusters ($p<0.05$): the 1st cluster consisted of four observations with a median value of 4.20 cents/dozen, and the 2nd cluster consisted of five observations with a median value of 5.40 cents/dozen. The overall median and trimmed mean were 5.17 and 4.95 cents/dozen, respectively (a 4% difference between these two estimates). The dispersion around the median is small both in cents/dozen (1.13) and as a percentage of the median (22%). The clustering of the data cast some uncertainty about the accuracy of these estimates.

There were 11 usable responses for the finishing cost (pallets, shrink wrap, slip sheets, etc.). The data were organized into two distinct clusters ($p<0.05$): the first cluster consisted of nine observations with a median value of 1.48 cents/dozen, and the second cluster consisted of two observations with a median value of 2.74 cents/dozen, but the values on the second cluster don't affect the trimmed mean since they are part of the observations that are cut out in the calculation process. The overall median and trimmed mean were 1.50 and 1.46 cents/dozen, respectively. The dispersion around the median is small both in cents/dozen (0.13) and as a percentage of the median (9%).

Processing costs:

The processing costs are divided into two components, the cost of processing (washing, weighing, etc.) and the grade yield loss (which is the sum of the losses for eggs received that are of lower value such as smaller sizes, or undergrades, and the gain for the eggs received that are of higher value such as larger size eggs).

In 2021, there was distinct data clustering noted in responses for the processing costs of Graded Nest Run Eggs for both: sourced in-line and sourced off-line. The authors suspected this was explained by some companies not including the marketing, administration & overhead costs into their calculations. Therefore, the survey for 2022 data explicitly asked for these values separately.

Table 2 presents the results for the processing cost of Graded Nest Run Eggs – Class 1 (GNR1 eggs), sourced in-line and sourced off-line. The total number of usable responses is shown as well as the calculated median and trimmed mean costs, the dispersion, and the difference between the median and the trimmed mean expressed in both cents per dozen eggs and in percent.

Table 2. Cost of processing Gradeable Nest Run Class 1 eggs (cents/dozen)

	Usable responses	Trimmed mean	Percentiles				Difference*	
			Median	25th	75th	IQR	cents/doz.	%
Eggs sourced in-line	16	19.09	19.26	13.48	24.25	10.77	0.16	1%

There were 16 usable responses for the cost of processing GNR1 eggs sourced in-line. The median cost was 19.26 cents/dozen and the trimmed mean was 19.09 cents/dozen. The dispersion around the median is very large in cents/dozen (10.77) and large as a percentage of the median (56%).

There were 8 usable responses for the cost of processing GNR1 eggs sourced off-line. The data were organized into three distinct clusters ($p<0.05$). To illustrate the jump between clusters: the difference between the maximum value of the first cluster and the minimum value of the second cluster was 3.70, and the difference between the maximum value of the second cluster and the minimum value of the third cluster

was 3.52. The overall median and trimmed mean were 23.12 and 22.99 cents/dozen, respectively. The clustering of the data cast some uncertainty about the accuracy of these estimates.

There were only five responses for the cost of processing graded loose eggs and the responses were very different between them. Therefore, the results are not reported.

In order to estimate the grade yield loss, this survey asked for proportions of different egg sizes and classes obtained when egg farmers process both GNR1 eggs and graded loose eggs. To avoid skewing the results with outlier values, the proportions were estimated in three steps. The first step was to estimate the median value for the proportion of eggs in each size category. The second step was to calculate the sum of the median values. Finally, the share of each size category with respect to the sum of median values was defined as the estimated percentage of eggs by size so that the estimated proportions add up to 100%. The results are shown in Table 3. These proportions of eggs of different classes and sizes were then used to estimate the grade yield loss published in Table 4. There were only seven answers for the gradeable nest run eggs sourced off-line and five answers for the graded loose eggs. Therefore, those results are not reported.

Table 3. Percentage of eggs of different sizes and classes for processing Gradeable Nest Run (GNR)

	Usable responses	Percentage of eggs of different sizes and class						
		Jumbo	Extra-Large	Large	Medium	Small	Undergrades	Loss
Eggs sourced in-line	12	4.1%	27.9%	52.9%	9.2%	1.0%	4.0%	1.0%

The grade yield loss associated with processing GNR1 sourced in-line was estimated using the 2022 prices of white eggs of different sizes and classes for each region. The prices reported by USDA for eggs delivered to warehouses were used for: extra-large, large, and medium sizes (all white). USDA doesn't report warehouse prices for small or jumbo size eggs. Therefore, prices for jumbo eggs were estimated based on the price difference between jumbo and extra-large sizes of eggs as reported by Urner Barry for 2022, which ranged from 11 to 17 cents/dozen, depending on the region. Similarly, the estimated prices for small eggs were between 46 and 77 cents/dozen lower than the medium egg prices based on the prices difference between these two sizes of eggs as reported by Urner Barry for 2022. The prices used for California are "eggs delivered to 1st recipients" as published by USDA. USDA doesn't report warehouse prices for the Northwest region; as a result, this was estimated as 18 cents/dozen higher than the Midwest region prices based on the price difference between these two regions as reported by Urner Barry for 2022. The estimated grade yield loss is different between regions with the lowest estimated values in the Northeast, and the highest values are in California, as shown in Table 4. There is also a large amount of variability by company in reported proportions of classes and sizes of eggs, this variability is not reflected in Tables 3 or 4.

Table 4. Estimated grade yield loss from processing Gradeable Nest Run class 1 eggs (GNR1)

	Estimated Grade Yield Loss using USDA prices for each region (cents/dozen)					
	MW	NE	SE	SC	NW	CA
Eggs sourced in-line	10.31	9.87	10.21	11.09	13.24	16.61

A grade yield loss was estimated for each company using the company's reported proportion of eggs in different classes and sizes, and the prices of different egg types in the region where each company was operating. If a company had facilities in more than one region, a simple average of the egg prices across those regions was used. The median estimated grade yield loss from processing gradeable nest run eggs

sourced in-line was 11.87 cents/dozen and the trimmed mean was 12.46 cents/dozen (Table 5). The dispersion around the median is large in cents/dozen (5.32) and medium as a percentage of the median (45%). There were not enough answers for GNR1 eggs sourced off-line and graded loose eggs to be able to report this detailed information. There was an outbreak of avian influenza in 2022 that resulted in large shifts in egg prices and a much larger difference between the price of large size eggs and medium and small size eggs than usual. The large difference between the price of large size eggs and the prices of medium and small size eggs resulted in a much larger value for the estimated grade yield loss than in previous years.

Table 5. Estimated grade yield loss from processing Gradeable Nest Run Class-1 eggs using

	Usable responses	Trimmed mean (cents/dozen)	Percentiles (cents/dozen)				Difference*	
			Median	25th	75th	IQR	cents/doz.	%
Eggs sourced in-line	11	12.46	11.87	10.09	15.41	5.32	-0.59	-5%

* Difference is the difference between the median and the trimmed mean estimates

Transportation costs:

Table 6 presents the survey results for three types of transportation and associated costs. The total number of usable responses is shown as well as the calculated median and trimmed mean costs, the dispersion represented by the IQR (i.e., the difference between the 25th percentile and 75th percentile in the table), and the difference between the median and the trimmed mean expressed in both cents per dozen eggs and in percent.

Table 6. Transportation costs of cartoned eggs in cents per dozen (for freight within the same U.S. region):

	Usable responses	Trimmed mean	Percentiles				Difference*	
			Median	25th	75th	IQR	cents/doz.	%
Delivered - Store Door	9	10.48	9.39	8.00	14.00	6.00	-1.09	-11%
Delivered to a Warehouse	15	6.59	6.30	4.75	9.20	4.45	-0.29	-5%
Picked Up by a Warehouse	15	1.36	1.00	0.44	2.50	2.06	-0.36	-31%
Trucking 200 miles	9	4.05	4.00	2.40	5.93	3.53	-0.05	-1%
Trucking 400 miles	7	5.87	6.50				0.63	10%

* Difference is the difference between the median and the trimmed mean estimates

There were nine usable responses for the cost of delivering eggs to a store door. The median cost of delivering eggs to a store door was 9.39 cents/dozen and the trimmed mean was 10.48 cents/dozen. The dispersion around the median is large both expressed in cents/dozen (6.00) and as a percentage of the median (64%).

There were 15 usable responses for the cost of delivering eggs to a warehouse. The median cost of delivering eggs to a warehouse was 6.30 cents/dozen and the trimmed mean was 6.59 cents/dozen. The dispersion around the median is medium expressed in cents/dozen (4.45), but it is large expressed as a percentage of the median (71%). There is some indication that some of the variability could be explained by regional differences and transportation distances, but unfortunately, not enough responses were received to be able to estimate costs by region.

There were 15 usable responses for the picked-up cost. The data were found to be in two distinct clusters ($p<0.05$): the first cluster consisted of nine observations with a median value of 0.50 cents/dozen, and the second cluster consisted of six observations with a median value of 2.59 cents/dozen. The overall median

and trimmed mean were 1.00 cents/dozen and 1.36 cents/dozen, respectively. The dispersion around the median is small expressed in cents/dozen (2.06), but it is very large expressed as a percentage of the median (206%). The clustering of the data cast some uncertainty about the accuracy of these estimates.

There were nine usable responses for the cost of delivering eggs to a location 200 miles away. The median cost of delivering eggs to a location 200 miles away was 4.00 cents/dozen and the trimmed mean was 4.05 cents/dozen. The dispersion around the median is medium as expressed in cents/dozen (3.53), and it is large expressed as a percentage of the median (88%).

There were only seven usable responses for the cost of delivering eggs to a location 400 miles away. The data were organized into three distinct clusters ($p<0.05$): the first cluster consisted of three observations with a median value of 4.41 cents/dozen, the second cluster consisted of four observations with a median value of 6.71 cents/dozen, and the third cluster consisted of two observations with a median value of 11.45 cents/dozen. The overall median and trimmed mean were 6.50 and 6.87 cents/dozen, respectively. The clustering of the data cast some uncertainty about the accuracy of these estimates.

Additional costs statistics:

There were nine responses for the difference in processing costs between standard and USDA certified graded eggs, after ruling out five observations as outliers. The overall median and trimmed mean were 1.00 and 1.01 cents/dozen, respectively. The dispersion around the median is small both in cents/dozen (0.03) and as a percentage of the median (3%).

There were only four responses for the loss from store returns and the responses were very different. Therefore, the results are not reported.

Total PCT Costs (delivered to warehouses):

A total of 144 combinations are possible with the responses obtained through this survey. These include: egg types processed (two types included in the survey), packaging sizes (four types included in the survey), cases or reusable plastic containers (three options), transportation modes (three types included in the survey), and grading (USDA graded or not). These can potentially provide estimates of PCT costs for 144 combinations in each region, provided that enough responses were received. The example below (Table 7) shows the overall regions estimated PCT cost of gradeable nest run eggs sourced in-line, non-USDA certified graded eggs, packaged in 12-egg cartons in regular cases, and delivered to a warehouse.

Table 7. PCT costs for processing Gradeable Nest Run Class-1 eggs, packaged in 12-pack cartons, in regular cases, non-USDA certified, and delivered to a warehouse (loss from store returns not included)

	Trimmed mean (cents/dozen)	Percentiles (cents/dozen)				Difference*	
		Median	25th	75th	IQR	cents/doz.	%
Eggs sourced in-line	57.06	56.29	46.12	69.16	23.04	-0.78	-1%

* Difference is the difference between the median and the trimmed mean estimates

The median total PCT costs of eggs delivered to warehouses (calculated as the sum of the median cost of packaging, processing, and transportation to a warehouse within the same region) was 56.29 cents/dozen for GNR1 eggs sourced in-line (Table 7), and the trimmed mean was 57.06 cents/dozen. The difference between the trimmed mean and the median estimates was 1%. The loss from store returns wasn't included in this sum because of the concerns outlined on page 10, but they should be part of the calculation of total

PCT costs. For USDA certified graded eggs, the cost difference between standard and USDA should be added. The dispersion around the median is very large expressed in cents/dozen (23.04), but it is medium when expressed as a percentage of the median (41%).

A main factor of the PCT cost is the grade yield loss calculation. This depends on the differences between the prices of eggs of different classes and sizes with respect to the price of grade A large white eggs. The prices of different classes and sizes of eggs are different between regions and change frequently. Therefore, this estimate is constantly changing throughout the entire year and varies between regions of the country as illustrated in Table 4. The grade yield loss in 2022 was 75% higher than in 2021, driven by much larger discounts in the prices of medium-size and small-size eggs with respect to large-size egg, compared to the increases in premiums for the prices of extra large-size and jumbo-size eggs with respect to large-size eggs. For example, the six-region average:

- discount for small size eggs was180 cents/dozen vs. 57 cents/dozen in 2021
- discount for medium size eggs was 57 cents/dozen vs. 28 cents/dozen in 2021
- premium for extra-large size eggs was 4 cents/dozen vs. 1 cents/dozen in 2021
- premium for jumbo size eggs was 16 cents/dozen vs. 14 cents/dozen in 2021

Comparison with previous results

In this section, results from the 2022 data are compared with the results from the previous survey using data from 2021.

Table 8 compares median, trimmed mean, and IQR for some of the costs. The 2022 median and trimmed mean values for the costs of the 12- and 18-egg cartons, and the 30-dozen cardboard cases were above the 75th percentile of their corresponding values for 2021. The 2022 median and trimmed mean value for the cost of the 15-dozen cardboard cases were within the IQR obtained in 2021. The 2022 median and trimmed mean values for the finishing costs were within the IQR obtained in 2021.

Table 8. Comparison of costs between 2022 and 2021 survey data (cents per dozen)

	Results for 2022				Results for 2021			
	Trimmed mean	Median	25th Percentile	75th Percentile	Trimmed mean	Median	25th Percentile	75th Percentile
Package: 12-egg carton	**12.70**	**12.64**	11.88	13.60	**11.01**	**11.00**	10.45	11.58
Package: 18-egg carton	**12.10**	**12.30**	10.94	12.73	**10.35**	**10.20**	10.00	11.00
Package: Filler flats	**3.77**	**3.91**	3.36	4.00	**3.34**	**3.40**	3.01	3.60
Case cost (30 dozen)	**4.77**	**4.73**	4.55	5.20	**4.18**	**4.06**	4.00	4.60
Case cost (15 dozen)	**4.98**	**4.93**	4.75	5.25	**4.60**	**4.60**	4.14	5.00
Finishing costs:	**1.46**	**1.50**	1.37	1.50	**1.50**	**1.43**	1.20	2.00
Transportation Cost:								
Delivered to Warehouse	**6.59**	**6.30**	4.75	9.20	**6.32**	**6.59**	4.56	8.00
Picked up by Warehouse	**1.36**	**1.00**	0.44	2.50	**1.24**	**1.00**	0.61	2.00
Processing Cost for processing Gradeable Nest Run Class-1 eggs:								
Eggs Sourced In-line	**19.09**	**19.26**	13.48	24.25	**17.07**	**17.15**	11.85	24.37
Grade yield loss for processing Gradeable Nest Run Class-1 eggs:								
Eggs Sourced In-line	**12.46**	**11.87**	10.09	15.41	**7.15**	**6.80**	4.61	9.60

The 2022 median and trimmed mean values for the cost of delivering eggs to a warehouse, and the cost of pick-up by warehouse option, were within their respective IQRs of 2021. However, the ranges were wide in both surveys.

The median and trimmed mean values for the cost of processing GNR1 eggs sourced in-line were within the IQR obtained in 2021. However, the ranges were very wide in both surveys.

The largest difference between the 2021 and 2022 studies is the grade yield loss. The median and trimmed mean values for the grade yield loss of processing GNR1 eggs sourced in-line were more than 20% above the 75th percentile of their corresponding values for 2021.

Figure 1 compares the aggregate costs of packaging, processing, and transporting eggs to warehouses (excluding loss from store returns and grade yield loss) obtained in 2022 with the data from 2021, for GNR1 eggs sourced both in in-line. The median and trimmed mean values were within their respective IQRs of 2021 for both. But the ranges are very wide.

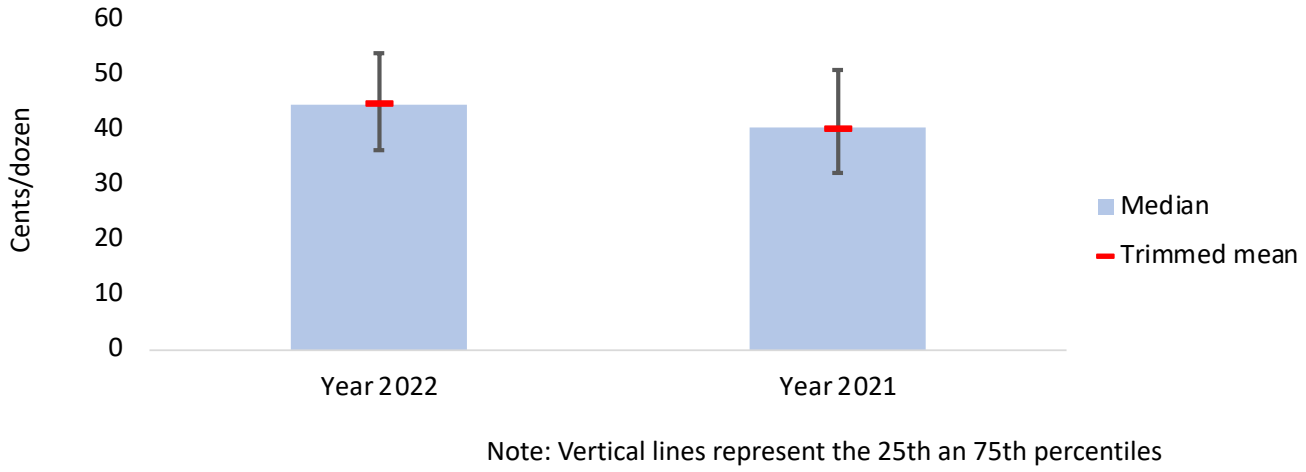


Figure 1. PCT costs of Gradeable Nest Run Class-1 eggs sourced in-line, packaged in 12-egg cartons in regular cases, non-USDA certified, and delivered to warehouses, without including the grade yield loss or loss from store returns.

Grade Yield Loss sensitivity to small changes in percentages of different sizes and classes of eggs

The estimated grade yield loss is not only sensitive to price changes but also depends on the proportions of eggs of different sizes and classes obtained. To illustrate this point, the grade yield loss for different combinations of prices was estimated (years 2020, 2021 and 2022) and proportions (using proportions of different egg types reported in each year and using the weighted average of the proportions obtained in 2020, 2021 and 2022).

The proportions of the different egg types obtained from processing GNR1 eggs sourced in-line were very similar to that obtained in 2020 and 2021 (Figure 2).

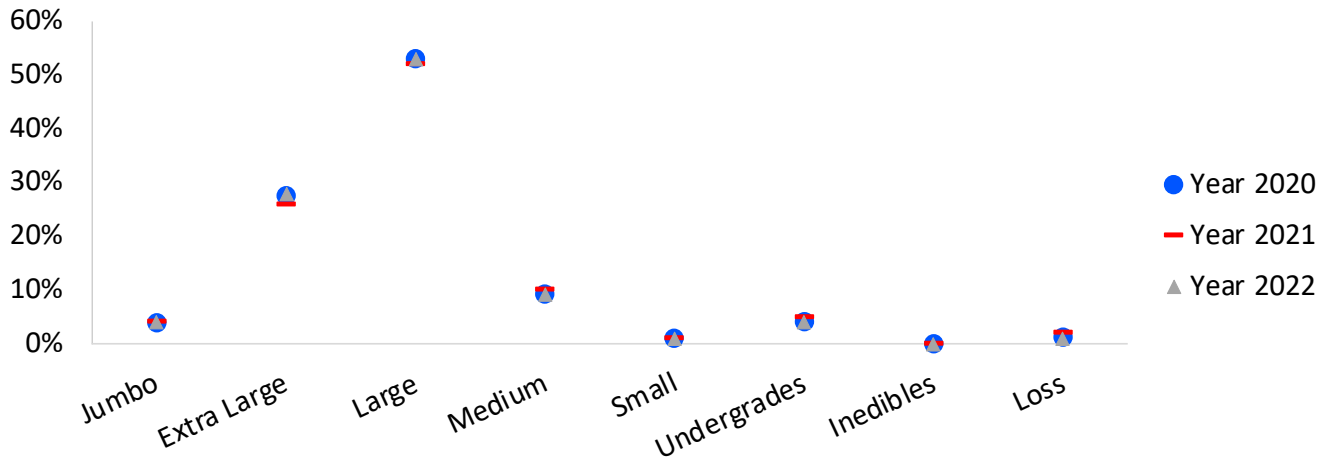


Figure 2. Comparison of proportions of the different egg types obtained from processing GNR1 eggs sourced in-line for the years 2020, 2021 & 2022.

The grade yield loss associated with processing GNR1 eggs sourced in-line were estimated using the 2020 prices of white eggs of different sizes and classes for each region under two different proportions of different egg types: 1) the proportions obtained from the 2020 survey and 2) a weighted average of the proportions obtained from the last three surveys: 2020, 2021 and 2022 (Table 9). The differences between these two estimates go from 0.46 cents/dozen in the Midwest to 0.90 cents/dozen in California. A similar comparison using 2021 prices resulted in differences between these two estimates from 0.90 cents/dozen in the Midwest to 1.63 cents/dozen in California. Further, a similar comparison using 2022 prices resulted in differences between these two estimates from 1.80 cents/dozen in the Midwest to 2.69 cents/dozen in California. But the factor with the largest impact was the prices of eggs in different years; the prices for 2022 vs. 2021 was 5.37 cents/dozen to 11.13 cents/dozen, respectively.

Table 9. Estimated grade yield loss from processing Gradeable Nest Run class 1 eggs sourced in-line

Pricing year	Proportions of types of eggs used	Estimated Grade Yield Loss using USDA prices for each region (cents/dozen)					
		MW	NE	SE	SC	NW	CA
2020	year 2020	5.63	5.97	6.60	5.40	6.42	9.80
2020	2020-2022 Wtd. Avg.	6.09	6.48	7.14	5.98	6.99	10.70
2021	year 2021	6.16	5.84	7.95	6.10	7.28	9.80
2021	2020-2022 Wtd. Avg.	5.26	4.83	6.86	4.95	6.21	8.17
2022	year 2022	10.31	9.87	10.21	11.09	13.24	16.61
2022	2020-2022 Wtd. Avg.	12.12	11.78	12.23	13.12	15.16	19.31

Transportation cost sensitivity to changes in distances

The transportation costs answers are normally very dispersed between different respondents and this variability is in part explained by the different transportation distances between farms and their customers. To illustrate how much the transportation cost depends on the distance, the values for different distances were estimated using USDA refrigerated truck rates. First, the rate per mile was plotted as a function of the distance for the shipments between 100 and 800 miles long, and a prediction curve was estimated in order to be able to estimate the expected average cost of transporting eggs over different distances (Figure 3). It is evident from the dispersion around the prediction curve that there are other factors (other than distance) affecting the rate as well.

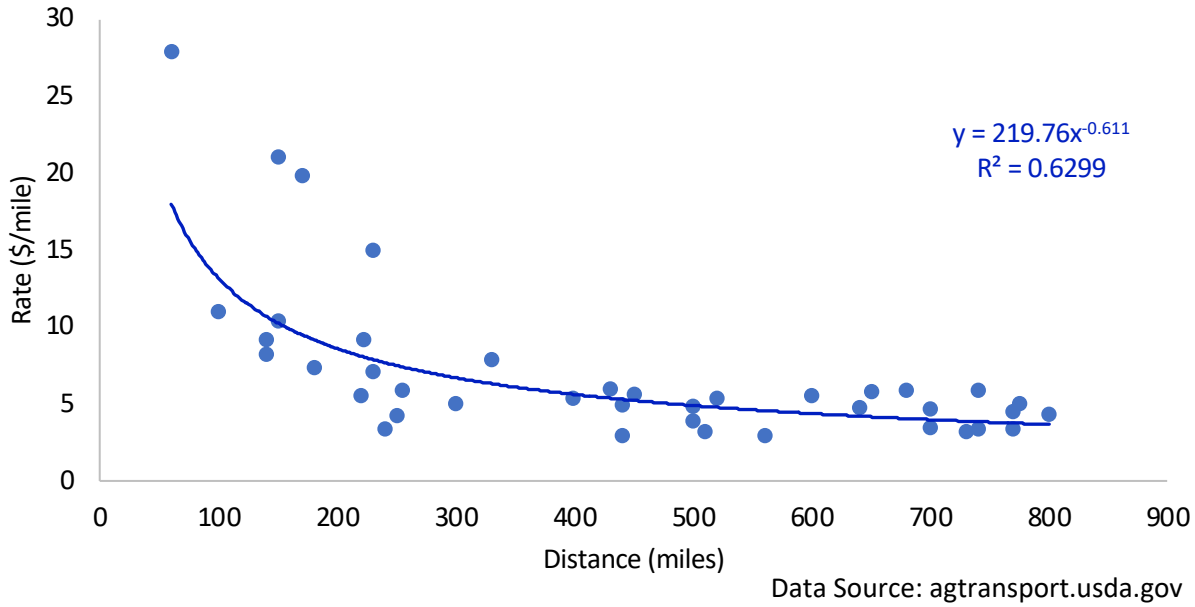


Figure 3: Estimates of refrigerated truck costs per mile for different trip distances, 2022 data.

Second, the prediction curve was used to estimate the cost of transporting eggs different distances, assuming 900 cases of eggs per truck (Table 10). Table 10 also shows the estimation for 2020 and 2021 using the same procedure to illustrate how much transportation costs changed from 2020 to 2022. Depending on the distance: the transportation cost increased between 19% and 23% from 2020 to 2021 and increased between 5% and 9% from 2021 to 2022.

Table 10. Estimated shell egg transportation cost by distance

Distance (miles)	Year 2022 average		Year 2021 average		Year 2020 average	
	Rate per mile	Cost/dozen	Rate per mile	Cost/dozen	Rate per mile	Cost/dozen
200	8.20	6.07	7.51	5.57	6.31	4.68
300	6.54	7.27	6.08	6.76	5.05	5.61
400	5.58	8.27	5.23	7.75	4.31	6.38
500	4.93	9.13	4.66	8.62	3.81	7.06
600	4.45	9.90	4.23	9.41	3.45	7.66
700	4.09	10.60	3.91	10.13	3.17	8.21

Source: EIC estimated using USDA data

Concluding Comments

This study documents 2022 processing, cartoning, and transportation cost estimates for the U.S. egg industry, with the objective to create a cost benchmarking tool. The findings presented in the previous sections are limited by the low number of responses obtained, which made regional cost estimates especially challenging.

The estimated median and trimmed mean PCT costs of processing GNR1 eggs sourced in-line and delivered to warehouses were 56.29 cents/dozen and 57.06 cents/dozen respectively, which are 20% and 21% respectively higher than the values obtained for 2021. These estimates are greatly influenced by the

large grade yield loss estimated value. The median cost without the grade yield loss was 44.42/cents per dozen which is 10% higher than the corresponding value for 2021 (40.23 cents/dozen). The trimmed mean cost excluding the grade yield loss was 44.61/cents per dozen which is 11% higher than the corresponding value for 2021 (40.08 cents/dozen).

It is evident that the price difference between different egg sizes is an important factor in the estimation of the grade yield loss. Therefore, the estimated grade yield loss should be specific to the period and region that is being represented. The grade yield loss is also very sensitive to the proportions of different egg types. Given the low number of responses obtained each year, it might be a good idea to use the weighted average of the proportions of eggs of different classes and sizes for consecutive years for estimating the grade yield loss by region. It will make the proportions more robust and the comparison between years will depend on price relationships more than on the changes in the proportions.

While some categories of reported costs are fairly concentrated around the median (e.g., 12-egg carton costs and case cost), other categories show high degrees of dispersion (e.g., processing cost and transportation). Consequently, any practical use of the estimates presented in this study must be qualified by the uncertainty surrounding the median and trimmed mean estimates.

In general, the results from this survey are indicative of mostly higher costs in 2022 than in 2021.

Acknowledgments
The authors thank Dr. Alicia Carriquiry, Iowa State University Distinguished Professor of the Department of Statistics, for her guidance about the best way to analyze this data. Also, a special thanks goes to the egg farmers/processors that collaborated with the study responding to the surveys.

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