NSW GOVERNMENT Food Authority

Baseline evaluation of the NSW Egg Food Safety Scheme

Results summary report

January 2013

NSW/FA/CP068/1301

About this document

This document reports the findings of the *Baseline Evaluation of the NSW Egg Food Safety Scheme* conducted by the NSW Food Authority in 2010–11.

This document is a high-level interpretative summary of the evaluation findings. It is one of three evaluation reports. The other reports describe the findings of the two surveys conducted as part of the evaluation:

- Survey results of industry profile and observed practices are reported in the *Baseline evaluation of the NSW Egg Food Safety Scheme*: *Survey of NSW egg businesses – industry profile and observed practices* (2012)
- Baseline microbiological survey results of egg businesses in NSW are reported in the *Baseline evaluation of the NSW Egg Food Safety Scheme: Microbiological survey of egg farms in NSW* (2012)

If you have any questions about this document, please contact the NSW Food Authority helpline on 1300 552 406 or contact@foodauthority.nsw.gov.au.

Acknowledgements

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Laboratory analysis was conducted by NSW Forensic and Analytical Science Services, Lidcombe, Institute for Clinical Pathology and Medical Research, Westmead, and IMVS Pathology, Adelaide.

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Executive summary

Background

The Egg Food Safety Scheme (Egg Regulation[1]) was introduced in NSW in June 2010. The Regulation covers businesses producing, grading or processing eggs but also includes egg products for sale. Under the Regulation, egg businesses[2] are required to obtain a licence with the Authority and introduce certain food safety management practices that are then inspected and audited by the Authority's Authorised Officers.

The Authority undertook a number of activities supporting the implementation of the Regulation. This included preparing industry-specific assistance materials and conducting specialist training for Authority Officers engaged in the audit and inspection program. When regulatory visits commenced in October 2010, all licensed egg businesses received one-on-one information assistance from Authority Officers on the new Egg Regulation requirements.

The Egg Regulation's ultimate purpose is to reduce the incidence and potential for foodborne illness from eggs and egg products produced in NSW. By introducing inspected/audited food safety management requirements for egg businesses in NSW, an expected outcome is improved egg handling and processing practices resulting in the production of safer and cleaner eggs by egg businesses in NSW.

Evaluation objectives and design

In 2011–12, the Authority undertook a baseline evaluation of the NSW Egg Food Safety Scheme. The overall aim of the evaluation was to assess the Authority's implementation of the Regulation and to establish industry benchmarks for assessing impact of the Regulation in the future. In addition, the evaluation sought to identify ways where the Regulation can be fine-tuned.

In accordance with the Authority's overarching evaluation framework, future evaluation objectives will seek to determine whether the Egg Regulation is working as intended and is ultimately reducing the incidence and potential for foodborne illness from eggs and egg products.

The baseline evaluation therefore focused on answering (or collecting data and establishing comparative benchmarks for answering) the following key questions:

- To what extent has the Egg Regulation been implemented as planned?
- To what extent have the Egg Regulation's intended outcomes been achieved?
- In what ways can the Egg Regulation be fine-tuned?

Data collection

The Authority adopted a multi-method data collection approach for the evaluation allowing for future confirmation of findings through comparison. Over a twelve-month period in 2010–11, four projects were undertaken aimed at collecting new and reviewing existing data. Projects included collecting industry profile and compliance data from about 140 egg businesses, collecting environmental samples for microbiological analysis from 49 farms, analysing initial inspection and compliance data and reviewing the Authority's foodborne illness data.

[1] A Food Safety Scheme under the NSW Food Regulation 2010

[2] Businesses producing or grading less than 20 dozen eggs for sale in any week are exempt from licensing requirements

Results summary

The evaluation concluded that the Authority had successfully implemented the Egg Regulation. Furthermore, evaluation findings were used to construct an industry and environmental microbiological profile of egg businesses in NSW. Compliance ratings and food safety management practices were also benchmarked at the initial regulatory visit and areas were identified where further assistance was needed or where requirements needed fine-tuning.

The Authority adopted best practice implementation practices when introducing the egg scheme. The evaluation concluded that egg businesses were appropriately licensed, were well informed about the new requirement and Authority Officers were trained in consistent egg related inspection/audit practices. As a result, most egg businesses had introduced food safety requirements by the initial regulatory visit.

A comprehensive profile of the NSW egg industry was also established, informing the Authority's approach to regulatory compliance. Profile data was collected on location, production volume and production systems. Of the egg businesses in the study, the evaluation found that:

- over half the egg producers/graders were located in the Greater Sydney and Hunter regions of NSW,
- egg businesses produced on average 2.5 million eggs per day,
- about two-thirds of egg farms were free-range operators producing about half the total volume of eggs recorded,
- one-quarter were cage-based producing just under half the total volume of eggs, and a
- small proportion of businesses were barn-based (5%), producing less than 4% of the total amount of eggs.

High levels of regulatory compliance are important measures indicating that egg businesses are handling eggs safely and properly. Industry compliance and performance scores on key food safety measures are therefore useful comparative benchmarks for assessing the impact of the Regulation in the future. Initial compliance rates for key food safety practices were well within expected ranges and further improvement is likely as industry's food safety management proficiencies are expected to increase with time.

Overall, 84% of egg businesses scored an 'A' audit/inspection rating while 10% scored a 'B' rating. However, due to the emphasis on education and the provision of advisory findings at the initial visit, it is likely that compliance rates will decrease in the near future before businesses record longer-term improvements.

Large variations in overall industry performance scores were recorded for 'construction/maintenance', 'product identification/traceability' and 'pre-requisite programs for egg producers/graders'.

For system inputs (stock feed and hen drinking water) and biosecurity practices, evaluation findings highlight opportunities exist for improvement.

As cracked eggs carry an increased risk of contamination by harmful bacteria compared with intact whole eggs, effective cracked egg detection and handling practices are an important hazard control step. At the initial audit, the evaluation found that improved crack detection practices were required in 15% of the businesses in the study. Improvements against this benchmark are also expected over time.

Egg cleaning is a key food safety management step for removing faecal material. Eggs that contact faecal material are a particular concern as studies have found that faecal material facilitates the penetration of bacteria into eggs more rapidly and in greater numbers. The most common method used by the producer/graders in the evaluation survey was abrasive removal[3] (two-thirds) followed by 'wet-washing'. Washing eggs in water or 'wet-washing' is a higher risk process compared with other cleaning methods and requires businesses to implement additional food safety procedures. At the first

[3] Damp cloth, paper towel, sandpaper

audit, Authority Officers found that businesses needed to make changes to improve wash water hygiene and monitoring practices. These findings highlighted the fact that additional industry assistance information from the Authority on acceptable egg cleaning practices is needed.

Accurately labelled egg cartons and containers facilitate rapid identification of producers involved in possible foodborne illness outbreaks. At the initial regulatory visit, over 85% of egg businesses were correctly labelling eggs for wholesale. Increased levels of compliance are expected in future.

Serving as a point of comparison for assessing the impact of the Regulation in the future, the evaluation findings were used to establish a baseline microbiological profile of egg farms in NSW at the initial regulatory visit. No *Salmonella* was detected on over half of the egg farms in the study, 20% of farms were positive for *S.* Typhimurium and no farm tested positive for *S.*Enteriditis. As expected, *Salmonella* prevalence was higher in the egg laying environment (boot/cage swab and faecal material) than in samples of system inputs (stock feed and drinking water).

A microbiological profile of *Salmonella* types was established from the baseline data, providing a risk-based snapshot of the NSW egg industry in 2011. Findings include the following:

- 17 serovars were identified on farms in NSW. *S.* Typhimurium and *S.* Infantis were the two most dominant serovars (both have caused illness in humans).
- A *S.* Typhimurium phage-type profile comparison found that egg farms in the study and human salmonellosis cases for the same period in NSW shared four out of five of the most common phage types.
- A review of the Authority's foodborne illness data found that eggs were implicated or were considered the likely source of half the confirmed foodborne illness outbreaks in 2012 in NSW. This has decreased slightly compared with previous years.

However, it is important to note that as eggs undergo a long process of grading, cleaning and packaging before reaching the supermarket shelves, the likelihood of whole shell eggs being contaminated with *Salmonella* is relatively low[4]. Even so, the evaluation findings demonstrate that egg farms are an important part of the food safety picture, highlighting the importance of on-farm food safety practices as well as risk management practices throughout the egg supply chain.

The Egg Regulation has been successfully implemented but there is more work to be done

The evaluation results serve as a solid reference point against which to compare the impact of the Regulation in the future.

The evaluation findings also provide insight into the appropriateness of Egg Regulation requirements by highlighting areas of potential concern at the initial regulatory visit. In future, the Authority plans on working with industry to ensure that risk management approaches remain targeted and effective.

Four recommendations have been put forward for consideration where the Authority:

1. focuses on audit and reporting consistency,
2. continues building its knowledge of the egg industry in NSW,
3. reviews industry assistance materials, and
4. communicates a through-chain *Salmonella* risk management strategy for eggs.

[4] A statistical model estimated *Salmonella* prevalence on the surface of shells eggs at one in 25,000 (Daughtry et al, 2005). For NSW, this translates to estimates of less than 100 eggs with *Salmonella* being produced every day out of a possible 2.5 million (NSW Food Authority, *Baseline evaluation of the NSW Egg Food Safety Scheme, Survey of NSW egg businesses industry profile and observed practices,* 2012).

Background

In June 2010, the Egg Food Safety Scheme (Egg Regulation[5]) was introduced in NSW. The NSW Food Authority (the Authority) commenced initial regulatory visits of egg businesses four months later in October 2010.

The Egg Regulation's ultimate purpose is to reduce the incidence and potential for foodborne illness from eggs and egg products produced in NSW. By introducing inspected/audited food safety management requirements for egg businesses in NSW, an expected outcome is improved egg handling and production practices resulting in the production of safer and cleaner eggs by egg businesses in NSW.

Specifically, the Regulation's key food safety objectives include:

1. reducing the prevalence and concentration of *Salmonella* on-farm by managing the risks associated with cross contamination of *Salmonella* from the environment to whole eggs,
2. restricting the movement and implementing practices that manage dirty, cracked and broken eggs (which have an increased risk of contamination) through the supply chain, and
3. ensuring that eggs for sale are accurately labelled allowing for rapid identification of producers and graders potentially involved in foodborne illness outbreaks.

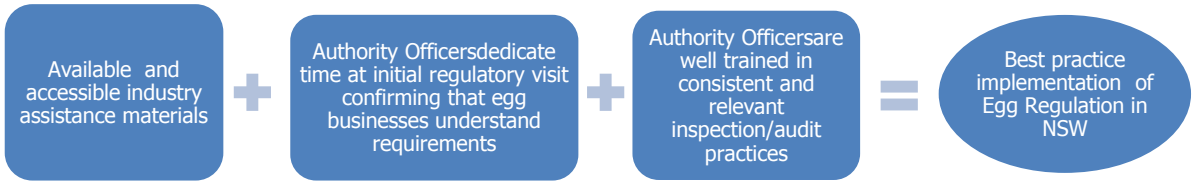
The Egg Regulation covers businesses producing, grading or processing eggs but also includes egg products for sale. Under the Regulation, egg businesses required licensing with the Authority if they produce or grade more than twenty dozen eggs for sale in any week.

By 30 November 2011, there were 199 licensed egg businesses comprising:

- 74 licensed egg primary production businesses (egg producers), and
- 125 licensed egg primary production businesses with additional activities such as grading and washing (egg producers/graders).

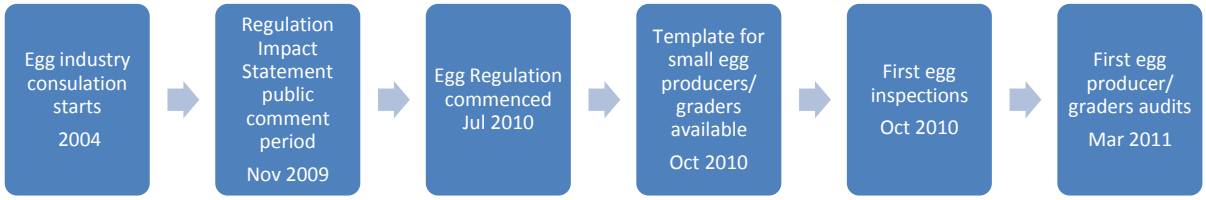
Figure 1 outlines key steps needed to achieve best practice implementation of the new requirements in egg businesses in NSW.

Figure 1. Key assumptions for best practice implementation of the Egg Regulation



Consistent with key steps illustrated above, the Authority undertook a number of activities supporting the implementation of the Egg Regulation. This included preparing industry-specific assistance materials and conducting training for Authority Officers engaged in the audit and inspection program. When regulatory visits commenced in October 2010, all licensed egg businesses received training from Authority Officers on the new requirements. An implementation timeline is shown in Figure 2.

Figure 2. Implementation timeline for the Egg Food Safety Scheme



[5] A Food Safety Scheme under the NSW Food Regulation 2010

Evaluation objectives and design

The Egg Regulation's ultimate purpose is to reduce the incidence and potential for foodborne illness from eggs and egg products produced in NSW. By introducing inspected/audited food safety management requirements for egg businesses in NSW, it is expected that improved egg handling and production practices results in the production of safer and cleaner eggs by egg businesses in NSW.

It has been almost two years since the Authority implemented the Egg Regulation in NSW. In accordance with the Authority's overarching evaluation framework, future evaluation objectives will seek to determine whether the Egg Regulation is working as intended, including reducing the incidence and potential for foodborne illness from eggs and egg products.

The evaluation focused on answering (or collecting data and establishing comparative benchmarks for answering) the following key questions:

- To what extent has the Egg Regulation been implemented as planned?
- To what extent have the Egg Regulation's intended outcomes been achieved?
- In what ways can the Egg Regulation be fine-tuned?

Understandably, prior to the initial round of regulatory visits, the Authority's 'on the ground' information about the egg industry was limited to targeted site visits and findings from its online survey of potential licence holders in 2010.

Evaluation objectives were therefore to:

- assess how effectively the Authority introduced the new requirements in demonstrating best practice implementation,
- gather information on common practices and collect NSW egg industry details in order to help the Authority further develop industry assistance and regulatory (audit/inspection) services that are most useful for businesses,
- establish first audit/inspection food safety performance, compliance and microbiological benchmarks against which the impacts of the Regulation can be assessed over time. This included estimating *Salmonella* prevalence on egg farms, establishing a microbiological profile of *Salmonella* serovars and microbiological benchmarks for *Salmonella* and *E. coli* (water only) in the egg laying environment and in farm/shed inputs, and
- identify areas (if any) where industry may need further assistance in complying with the new Egg Regulation and confirm the appropriateness of the requirements by identifying areas of potential concern.

Data collection

A multi-method data collection approach was chosen for the evaluation, allowing for confirmation of findings in the future using multiple lines of evidence.

For a twelve-month period (1 December 2010 to 30 November 2011) Authority Officers collected industry profile data (eg production system, flock size, egg volume) and environmental samples in addition to performing routine food safety compliance duties at the initial regulatory visit.

Standard checklist data was collected from approximately 140 of the 165 egg businesses that were inspected/audited during the sampling period. Overall, data from approximately 70% of total number of licensed egg businesses at the time[6] was analysed as part of the evaluation.

Concurrently, officers collected environmental samples from 49 egg farms. About one-quarter of the egg businesses[6] participated in the voluntary microbiology survey. Overall, these businesses produced approximately half the total volume of eggs produced by the industry at the time[7].

Over 380 egg farm samples were collected. From a maximum of four sheds per farm, a set of four samples from each shed was collected comprising boot/cage swab, faecal material, feed at point of consumption and hen drinking water. All samples were analysed for serovars of *Salmonella* and when *S.* Typhimurium was detected, isolates were further typed. Some drinking water samples were also tested for *E. coli*.

Overall, *Salmonella* prevalence was calculated for farm/shed inputs (stock feed and water) and egg laying environment (boot/cage swab and faecal material). A farm, shed or flock was categorised as 'positive' if at least one sample was positive for *Salmonella* and negative if all samples for the farm, shed or flock were negative.

[6] Businesses licensed by 30 November 2011 = 199

[7] In total, 139 egg businesses were surveyed as part of the evaluation. Findings indicate that these businesses produced approximately 2.5 million eggs per day. The amount of eggs produced by the farms that participated in the micro component was approximately half that (1.3 million eggs per day).

Results summary

Overall, the evaluation findings show that the Authority effectively implemented the Egg Regulation as planned.

Baseline evaluation findings also provide a solid point of reference against which to assess the impact of the Regulation over time and a way to identify potential areas of high food safety risk. Indicator measures signaling the achievement of medium- and long-term outcomes of the Egg Regulation were benchmarked for future reference at the initial regulatory visit. A summary of results includes:

- a comprehensive industry profile of egg businesses and practices in NSW,
- overall audit/inspection compliance rates for licensed egg businesses and selected high risk food safety practices,
- microbiological profile of egg farms in NSW including system inputs, egg laying environments, *S.* Typhimurium types, and
- egg-related foodborne illness outbreaks in NSW.

Findings are further described in the two survey reports: *Survey of NSW egg businesses – industry profile and observed practices* (2012), and *Microbiological survey of egg farms in NSW* (2012).

The Authority implemented the Regulation as planned

Table 1 presents an implementation scorecard for the Regulation that summarises benchmark measures for outcome indicators at the initial regulatory visit.

As informed by the Authority's assumptions for best practice implementation (Figure 1) the evaluation concluded that egg businesses were appropriately licensed, were well informed about the new requirements and Authority Officers were trained in consistent practices. Overall, this resulted in a high proportion of businesses introducing the new requirements as required.

Regarding implementation of the Egg Regulation, overall, key indicator measures were on target. The evaluation found that Authority Officers were well trained in consistent and relevant compliance and enforcement practices as standardised checklists were used for all inspections/audits, officers received specialist training for the Egg Regulation. To further standardise inspection/audit practices, senior auditing staff accompanied all officers at their initial regulatory visits. The egg industry was well informed about the new requirements as 90% of businesses received one-on-one information sessions at initial visit. The Authority also supplied all egg businesses with assistance materials ahead of their first regulatory visit, finding that 90% of egg producers/graders had used the provided template tool. Resolution of identified but unlicensed egg businesses is an ongoing process. The Authority continues working on resolving the status of a number of identified but unlicensed businesses.

Table 1. Egg Regulation implementation scorecard

Egg businesses are appropriately licensed	
↑	Numbers of egg businesses identified and licensed was up by 61% within six months of the Regulation commencing
↑	Two in three identified and unlicensed egg businesses were resolved by June 2011
Authority Officers were well trained in consistent compliance and enforcement practices	
✓	All Authority Officers were trained in consistent compliance practices for egg businesses
✓	Standardised checklists were used for all inspections/audits
✓	Initially, all Authority Officers were accompanied by senior auditing staff at regulatory visits to encourage standardisation between inspections/audits
Egg businesses were well informed and implemented the new requirements	
✓	All licensed egg businesses were mailed the Authority's assistance materials ahead of the initial regulatory inspection/audit visit
✓	Approximately 90% of licensed egg businesses provided with one-on-one information session by Officers at first inspection/audit with 89% of those indicating that they do not require any additional information
✓	After the one-on-one information session, over 95% of egg businesses reported confidence in their businesses ability to comply with the requirements
✓	At initial audit, 92% of egg producers/graders had implemented food safety program as required
✓	90% of egg businesses made use of the Authority's industry assistance tool (food safety template)

✓ On target ↑ Expected future trend

A comprehensive profile NSW egg industry informs the Authority's approach to regulatory compliance

Location, size and production systems

- Greater Sydney (about one-third) followed by the Hunter (20%) were two regions with the highest number of egg businesses.
- In total, egg businesses in the study produced an average of over 2.5 million eggs per day.
- Just over three-quarters (77%) of the businesses in the study were categorised as 'small' by the licensing system[8] but production volumes of eggs produced by the businesses in the 'small' licence category ranged from 180 to 250,000 eggs/day.
- About two-thirds of egg farms in the study were free-range operators producing about half (49%) the total volume of eggs of businesses in the study. Overall, free-range businesses typically produced smaller volumes compared with cage and barn-based businesses.

[8] Based on full-time equivalents (FTE) egg handling employees

- Authority Officers observed two distinct types of free-range systems in operation in NSW — paddock-based with moveable laying sheds and barn-based with access to an outdoor range.
- One-quarter of businesses in the study were cage-based operators producing about half (47%) the total volume of eggs. Compared to other production systems (barn and free-range), fewer businesses were cage-based (25%), but on average produced approximately the same amount of eggs as the free-range system (49% of the overall egg production in this study).
- Differences in cage systems were mainly limited to the number of cage tiers (single tier up to a maximum of eight tiers was observed). Authority Officers observed higher levels of automation for multi-tier sheds compared with single-tier cage systems.
- A limited number of businesses were barn-based egg producers (representing only 5% of those in the study). Egg production volumes for barn-based producers were less than 4% of the total amount of the eggs produced by the businesses in the study. Authority Officers noted that barn production systems were often very similar to free-range (barn-based) systems but without access to an outdoor range.

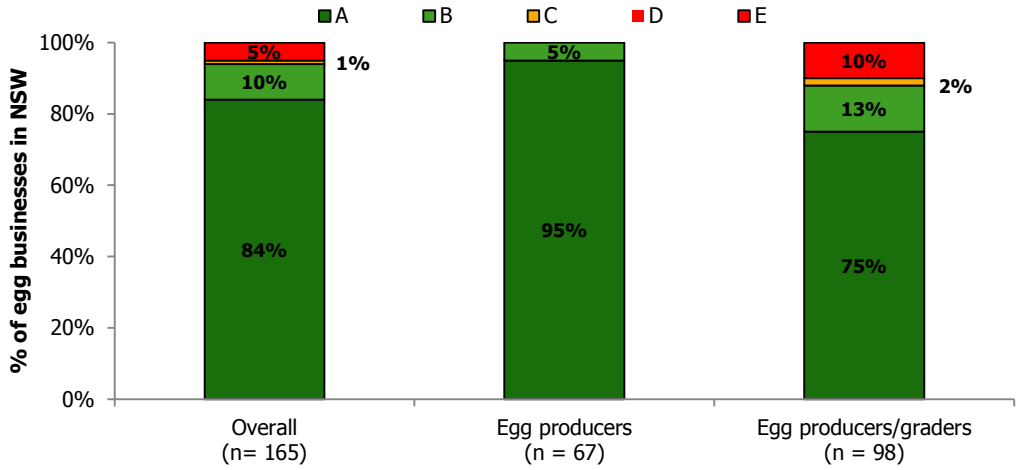
Outcome measures benchmarked for assessing the impact of the Egg Regulation in the future

Baseline compliance rates established for egg business at first regulatory visit

Levels of regulatory compliance are important measures indicating whether egg businesses are handling eggs safely and properly. Overall, the evaluation found high levels of regulatory compliance at initial inspection/audit.

- At initial inspection/audit, overall performance scores for egg businesses were 93%.
- Overall, 84% of egg businesses scored an 'A' audit/inspection rating while 10% scored a 'B' rating. However, due to the emphasis on education and the provision of advisory findings at the initial visit, it is likely that future compliance rates will decrease before longer term improvements are recorded.
- As expected, compliance rates at the initial visit were slightly lower for egg producers/graders than for egg producers, reflecting the increased number of food safety requirements for managing higher risk processes (eg crack detection, egg cleaning).
- One in ten egg producers/graders failed their first audit but all passed at their follow-up visit.
- On average, facility and equipment hygiene and sanitation were the highest performing components of the audits and inspections.
- Large variations in overall industry performance scores were recorded for 'construction/maintenance', 'product identification/traceability' and 'pre-requisite programs for egg producers/graders'.
- For egg producers/graders, almost one-quarter of all defects raised at the first audit were for noncompliant food safety programs (the new requirement).

Figure 3. Initial inspection and audit compliance ratings for egg businesses in NSW



Industry benchmarks were established for selected industry food safety practices

Industry performance on key food safety measures are useful comparative benchmarks for assessing the impact of the Regulation in the future.

As part of the initial regulatory visit, Authority Officers examined the management of system inputs (stock feed and water) and other egg business operating practices.

Food safety management objectives of the Egg Regulation include restricting the movement and implementing practices that manage dirty, cracked and broken eggs through the supply chain and improving the traceability of eggs back to farm in order to rapidly identify and respond when producers are involved in possible foodborne illness outbreaks.

A risk-based industry profile was established on first regulatory visit findings. Figure 4 below illustrates initial benchmark results for selected findings. It is expected that as egg businesses become experienced food safety managers under the Regulation, improvements will be observed.

Managing system inputs (stock feed, hen drinking water) and biosecurity – findings highlight opportunities for improved biosecurity practices

- Almost 90% of businesses were found to be adequately covering their stock feed, preventing contamination from rodents and birds with about 80% of egg businesses purchasing stock feed from external sources.
- For half of the egg producers in the study, hen drinking water was from a non-reticulated source, with one-third of these businesses testing the bore/dam water for indicators of faecal hygiene[9].
- About three-quarters of egg businesses were observed with at least minimum-level biosecurity arrangements in place. At first visit, biosecurity management usually consisted of restricting visitor and staff access to farms. Opportunities exist for improving biosecurity management.

Cracked egg handling – effective systems and practices needed in some businesses

Cracked eggs carry an increased risk of contamination by harmful bacteria compared with intact whole eggs. Informing the Authority's approach regarding cracked egg compliance, the evaluation found that:

- more effective crack detection systems (eg hairline crack detection with a backlight) were needed for 15% of egg producers/graders in the study, and

[9] A recommended practice but not a requirement under the Egg Regulation

- less than one-fifth of egg businesses in the study handled cracked eggs or pulp for further processing requiring additional food safety controls.

Egg cleaning – removing faecal material is a key food safety management step

- Eggs which come into contact with faecal material are of particular concern as chicken faeces has been shown to facilitate the penetration of bacteria into eggs more rapidly and in greater numbers. Therefore, in accordance with the Egg Regulation, only visibly clean shell eggs can be sold in NSW. Dirty eggs must therefore be either cleaned or discarded. At the initial regulatory visit Authority Officers observed variable egg cleaning practices across egg businesses in NSW.
- Egg businesses most commonly used abrasive removal (eg kitchen wipes) methods for cleaning eggs. Approximately two-thirds of the businesses in the study used this method.
- Almost one-third of businesses in the study were wet washing dirty eggs[10] but only two-thirds of these businesses were adding sanitiser to the wash water, a required practice.
- Almost half of the businesses who were wet washing dirty eggs were using non-reticulated water. Audit findings revealed that about 85% of these businesses at the first audit had not yet implemented wash water testing as required. In response, Authority Officers issued corrective action requests to businesses[11].
- A small number of businesses were soaking eggs in the wash water. This was assessed as an unacceptable practice and was immediately rectified. Authority Officers then also provided appropriate information on acceptable egg washing procedures.

Egg labelling – traceability back to farm is important when investigating foodborne illness outbreaks

The third key objective of the Regulation is to ensure that whole eggs are accurately labelled, facilitating rapid identification of producers involved in possible foodborne illness outbreaks. Traceability findings are summarised as follows:

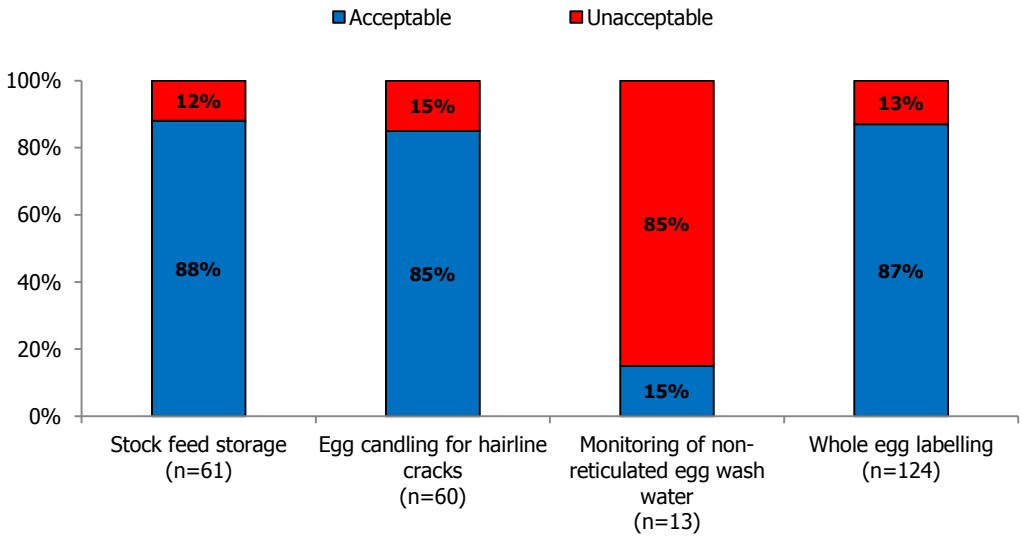
- At the initial regulatory visit, just over 85% of egg businesses were correctly labelling eggs for wholesale.
- From 2009–11, the Authority was only able to trace-back to farm two-thirds of egg related or implicated foodborne illness outbreaks due to incorrect industry labelling practices[12]. As egg businesses introduce the Egg Regulation requirements, egg traceability is expected to improve over time.

[10] Relates to about 12% of the total number of eggs produced by the businesses in this study

[11] Under the Regulation, egg businesses must test non-treated, non-reticulated wash water for *E. coli* every month, or every six months if treated. If water is treated, businesses must also monitor daily residual chlorine levels and maintain appropriate records.

[12] From 2009–11, 12/18 egg related outbreaks were traced back. During this time, a further nine confirmed outbreaks where eggs were implicated but were not able to be traced back due to absent packaging materials. These outbreaks were not included in the calculation.

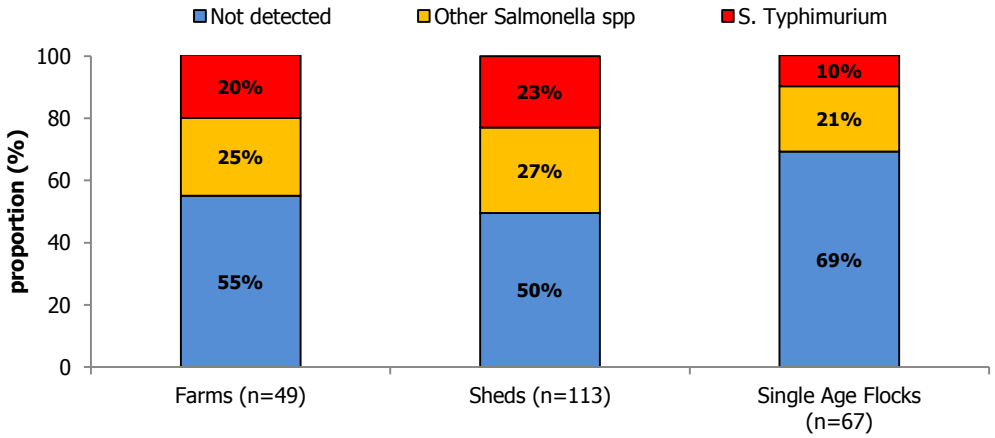
Figure 4. Benchmark findings for key food safety practices



A baseline microbiological profile of egg farms, system inputs and egg laying environment was established – a future reference point

As shown in Figure 5, overall *Salmonella* prevalence on egg farms was benchmarked at the initial regulatory visit. *Salmonella* was detected on 22 of the 49 farms. Ten (20%) farms were positive for *S.* Typhimurium and no farms in the NSW survey were positive for *S.* Enteritidis. *Salmonella* was detected in half of the sheds surveyed but only in one-third of the sheds housing single-aged flocks.

Figure 5. Prevalence of *Salmonella* on farms, sheds and single age flocks



As seen in Figure 6, overall *Salmonella* prevalence was higher for egg laying environment samples (boot/cage swabs and faecal material) than samples of farm/shed inputs (stock feed and drinking water).

Farm level inputs:

- *S.* Typhimurium was not detected in any bulk stored feed sample. For bulk stored feed, *Salmonella* prevalence of self-produced feed (14%) was similar to purchased feed (10%) but the sample size is not statistically significant. Sample numbers of both feed types were too small to allow a statistical comparison of *Salmonella* prevalence of feed types.
- None of the drinking water source samples (reticulated and non-reticulated) were positive for *Salmonella,* but half of the samples that underwent additional analysis contained detectable levels of *E. coli* indicating faecal contamination (all non-reticulated).

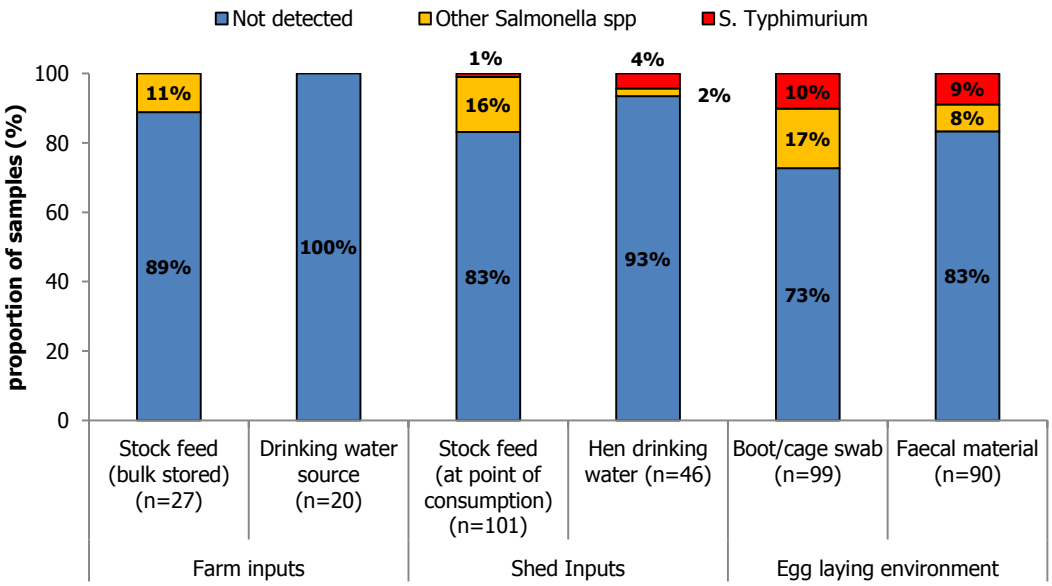
Shed level inputs:

- Due to increased risk of cross contamination from the shed environment, higher *Salmonella* prevalence was found in feed at point of consumption and hen drinking water than for bulk stored feed and water source samples.

Egg laying environment:

- In the egg laying environment, sample analysis found that just over one-quarter of boot/cage swabs were positive for *Salmonella* and prevalence of *S.* Typhimurium was 10%. *Salmonella* prevalence for faecal material was lower compared with boot/cage swabs.

Figure 6. *Salmonella* prevalence in egg laying environment and farm inputs



Microbiological profiles of *Salmonella* types on egg farms and human cases is a point of comparison for future evaluations of the Egg Regulation

Out of the 17 serovars identified, *S.* Typhimurium was the most frequently isolated serovar on the surveyed egg farms in NSW.

Of the five most frequently isolated serovars, two common serovars were isolated from both egg farms in the survey and from human cases of salmonellosis in NSW in 2011: *S.* Typhimurium and *S.* Infantis.

Human cases and egg farms shared similar *S.* Typhimurium phage type profiles, four of the five most prevalent phage types are common to both.

S. Typhimurium MLVA analysis of egg farm samples identified seven MLVA types. Two types were common to notified human cases in NSW during that time.

Egg-related foodborne illness outbreaks in NSW – one of a number of benchmark measures for assessing the long term impact of the Regulation

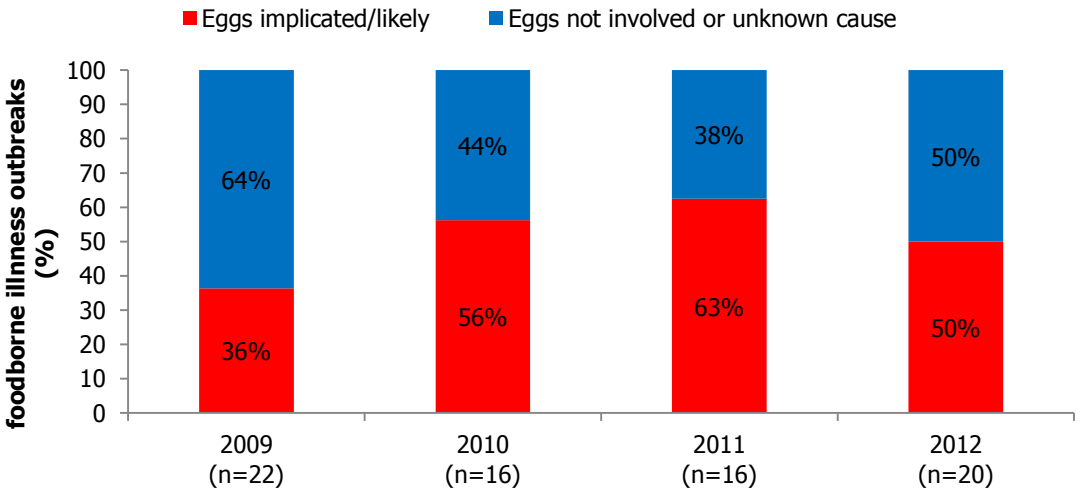
As seen in Figure 7, Authority records indicate that from 2009 to 2011 egg-related outbreaks expressed as a proportion of all confirmed foodborne illness outbreaks, has almost doubled.

In 2011, eggs were implicated or were considered a likely vehicle for almost two-thirds of all confirmed outbreaks. However, in 2012, a downward trend was observed and outbreaks linked to eggs accounted for just over half of all confirmed foodborne illness outbreaks.

As always, foodborne illness data requires careful interpretation. Issues for consideration relate mainly to underreporting. Outbreak figures are just the tip of the iceberg. Cases linked to outbreaks represent a small fraction of the total *Salmonella* notifications reported to health departments. For every foodborne illness case of *Salmonella* that is reported, there are an estimated seven more unreported cases in the community. Other issues include the fact that at times, 'true' outbreaks cannot be classified as such due to lack of physical evidence.

There are also additional issues for consideration when trying to make meaningful causal assertions about the Egg Regulation and its impacts. More broadly, any apparent reduction in foodborne illness outbreaks relating to eggs cannot be viewed as solely due to the impact of the Regulation. Food safety interventions in other parts of the egg supply chain have also been implemented in the same period and the effect may be the result of multiple causes.

Figure 7. Confirmed foodborne illness outbreaks for NSW



The Egg Regulation has been successfully implemented but there is more work to be done

The ultimate aim of the Egg Regulation is to reduce the incidence and potential for foodborne illness from eggs and egg products. The evaluation findings confirm the importance of the regulatory food safety measures for the egg industry in NSW as *Salmonella* was detected on close to half the farms surveyed. Many of the *Salmonella* types that predominated on farms also predominate among isolates from humans. While there is sufficient evidence in the scientific literature to show that the presence of *Salmonella* in the egg laying environment does not automatically infer a high prevalence on whole eggs offered for sale, it does highlight increased risk associated with cross contamination of *Salmonella* from the environment to whole eggs.

Effective implementation is an important first step in order to achieve high-levels of regulatory compliance. The evaluation findings indicated that the Authority successfully implemented the Regulation as planned. Overall, egg businesses were appropriately licensed, well informed about the new requirements and Authority Officers were trained in consistent practices. Consequently, a high proportion of egg businesses introduced the new requirements as required.

Prior to the introduction of the Egg Regulation, the Authority's 'on the ground' knowledge of the egg industry in NSW was limited to an online industry survey (NSW Food Authority, 2010) and targeted site visits. A baseline profile of egg industry practices, activities and a microbiological profile of egg farms was established.

Food safety practices and environmental indicators (*Salmonella* prevalence in egg laying environments and farm inputs) at initial regulatory visits were also benchmarked. As noted earlier, evaluation data provides a reference point of comparison for assessing future impacts of the Egg Regulation and for monitoring any changes to composition and activities of the NSW egg industry.

Continuous improvement is an important part of the Authority's regulatory approach. Evaluation findings have highlighted areas of potential concern and identified where improvements and further industry assistance is needed. In future, the Authority plans to work with industry to ensure that risk management approaches remain targeted and effective.

Informed by the evaluation findings, four recommendations have been put forward for consideration where the Authority:

1. focuses on audit and reporting consistency,
2. continues building its knowledge of the egg industry in NSW,
3. reviews industry assistance materials, and
4. communicates a through chain *Salmonella* risk management strategy for eggs.

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