Final report

Open Innovation Pipeline rubber flooring trials - Indonesia

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Abstract

This project evaluated the use of non-slip rubber matting to improve cattle handling in the Indonesian supply chain, with installations at three high-risk locations: port discharge ramps, feedlot unloading ramps, and general cargo trucks. Observations were conducted before and after installation to assess changes in cattle movement, slips, and falls. Results showed complete elimination of falls and marked reductions in slips across all sites, with additional benefits noted in cattle behaviour and handler safety.

The matting performed particularly well in high-traffic areas and transition points where loose bedding materials typically fail to remain effective, such as on truck tailgates. While consumable materials remain suitable for static, low-pressure zones, this trial reinforced the value of integrating durable matting in targeted applications. Cost–benefit analysis indicated that, despite higher upfront investment, rubber matting can deliver competitive long-term value through reduced injuries, fewer disruptions, and improved handling efficiency. Further development of adaptable, commercially viable solutions especially for transport applications is recommended to support broader industry adoption.

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1. Background

Slips and falls are a recognised animal welfare consideration during cattle handling and transport, particularly in overseas supply chains where animals may encounter unfamiliar environments and infrastructure (Grandin, 1997; Fisher et al., 2009). Facility design and flooring characteristics can influence the likelihood of these events (Fisher et al., 2009). Cattle are known to respond to visual and surface cues such as shadows, puddles, and changes in flooring, which may lead to hesitation or altered movement patterns (Grandin, 1997).

This issue has direct relevance to Australia's Exporter Supply Chain Assurance System (ESCAS), which requires exporters to demonstrate compliance with animal welfare standards based on World Organisation for Animal Health (WOAH) recommendations. ESCAS standards include measurable performance indicators for handling, such as maintaining slips below 3% and falls below 1% (Department of Agriculture, Fisheries and Forestry [DAFF], 2018). To meet these standards, non-slip surfaces are already widely used throughout the supply chain, typically through slats, battens, abrasive finishes, or patterned concrete, particularly in ramps and raceways. However, non-slip rubber solutions are not in common use.

Evidence from previous studies highlights the potential of rubber matting to mitigate such risks. Research in dairy and beef production systems has shown that rubber flooring improves animal comfort and welfare outcomes (Brscic et al., 2015; Amstel et al., 2016). Similarly, Dean et al. (2025) found that installing rubber mats in abattoir holding areas enhanced cattle mobility and altered behaviour during lairage, suggesting reduced stress and greater comfort, while also improving operational efficiency. Consistent with these findings, the Indonesia Supply Chain Logistics Study (KPMG, 2018) observed that smooth metal truck doors were associated with a higher likelihood of slips and recommended the use of permanent non-slip flooring, such as rubber mats, to reduce injuries and improve loading efficiency. The present trial builds on this evidence by examining where slips are most likely to occur under operational conditions, with the truck tailgate identified as a key risk point, highlighting the value of targeted flooring interventions in transport settings.

This project was delivered as part of the Livestock Export Program's (LEP) Open Innovation Pipeline, which supports short-duration, small-scale technology trials aimed at solving industry problems through agile proof-of-concept approaches. The Pipeline is designed to rapidly assess the practical applicability of both new and existing technologies drawn from other sectors. This matting trial represents one such proof-of-concept, targeting the reduction of animal slips and falls through adaptive use of rubber matting solutions already proven in dairy, beef, and equine industries. Alongside welfare outcomes, the trial also incorporated a cost–benefit analysis to assess the commercial viability of wider adoption across Indonesian supply chains.

2. Methodology

The trial was delivered jointly by Numat Agri, the LEP, and Cooleco, with Cooleco responsible for overall trial coordination and delivery, ensuring consistency across stakeholder engagement, installation, and data reporting. A structured before-and-after observational design was applied across three points in the Indonesian cattle supply chain: the discharge platform at a major port, a commercial feedlot ramp, and transport trucks operating between these locations.

Definitions

For consistency, slips and falls were defined in accordance with international livestock handling guidelines (Grandin, 2021):

- **Slip** – any loss of footing where the animal's limbs slide unexpectedly but the body remains upright.
- **Fall** – when an animal loses its upright position suddenly and a part of the body other than the limbs touches the ground.

These definitions were applied consistently across all sites during both pre- and post-installation observations.

Product

The rubber matting used in the trial was the *YoungStar™ 32mm Mat* supplied by Numat Agri. According to the manufacturer, the product is specifically designed to provide extreme grip for hooved animals, with added durability and stability suitable for high-traffic environments. Each mat measured 900 mm wide by 2100 mm long, with a thickness of 32 mm and an approximate weight of 50 kg.

Image: YoungStar™ 32mm Mat

Sites

- **Port discharge platform – Indonesian port facility:** A major Indonesian port that receives Australian feeder cattle. It was undertaken in collaboration with local stevedoring and transport service providers who assisted with operations and data collection.

- **Feedlot unloading ramp – Indonesian cattle feedlot:** A large, commercially operated feedlot that regularly receives Australian cattle. Support was provided by feedlot management and facility staff involved in cattle import and handling operations.
- **Indonesian cattle trucks:** Cattle were transported between the port and the feedlot using multi-purpose cargo trucks commonly used for various commodities including livestock. Truck operators were coordinated by the trucking company involved in the trial.

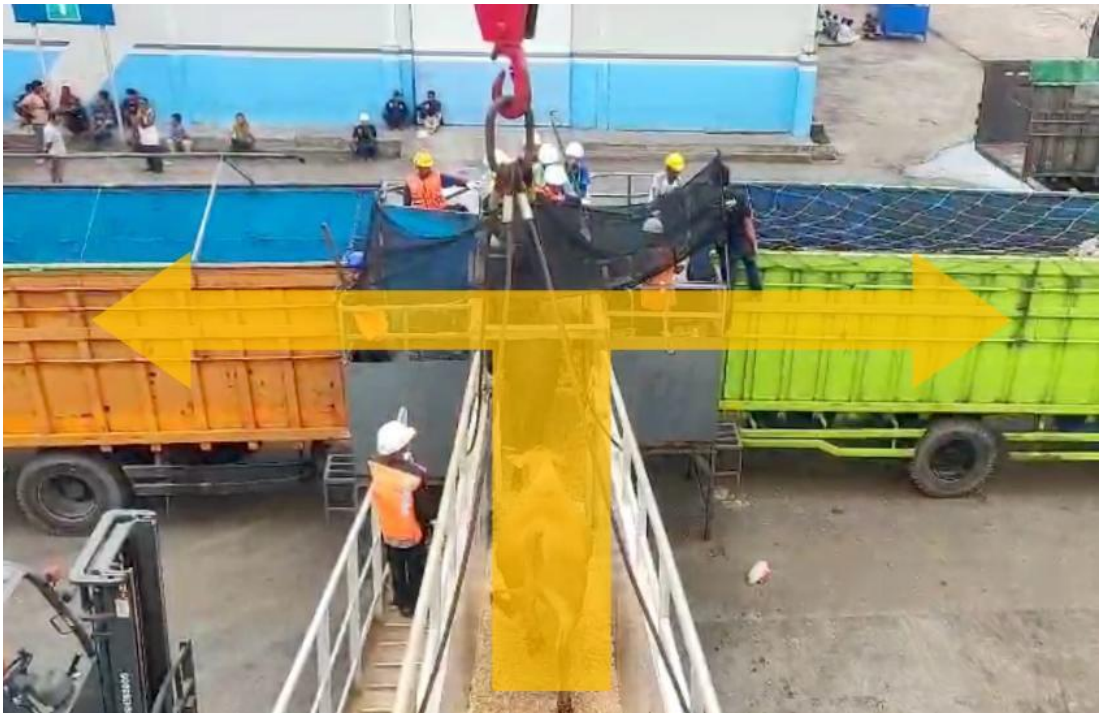


Image: Illustration of cattle flow through discharge platform on to trucks

Data recording

Baseline observations

Cattle handling was monitored prior to mat installation at three locations. At the port discharge ramp, 18 truck movements were observed. At the feedlot, 15 truck deliveries were recorded. For the transport component, three truck journeys were monitored, focused on unloading events. Slips and falls were recorded through direct observation, supported by video footage where feasible.

Installation

Numat Agri matting was installed at the designated locations. YoungStar mats were fitted on the discharge ramp, inside the trucks, and on the tailgate of a truck. Installation was coordinated by Cooleco's in-market team in consultation with site operators. Given that the trucks in use were general cargo vehicles, operators required the rubber matting to be non-permanent. For the purposes of the trial, mats were laid directly onto the flat steel floor of the truck body, where they remained stable under their own weight. The tailgate, however, posed a greater challenge due to the need for frequent raising and lowering during loading and unloading which would dislodge unsecured materials.

To address this, a temporary system was devised whereby flat steel hooks were bolted to the matting and secured over the tailgate edges. This solution provided sufficient stability during use while allowing the mats to be removed when necessary. The hooks were fabricated from flat steel bar and designed to sit flush with the mat surface when the tailgate was lowered.

Post-installation observations

Observations were repeated using the same sampling framework as the baseline observations and equivalent numbers of cattle movements. Installation cost and operational data were also recorded to support the cost–benefit analysis.

Stakeholder feedback

Stakeholder consultation was conducted through unstructured interviews with feedlot staff, stevedores, truck operators, and cattle handlers to gather feedback on livestock behaviour, ease of installation, cleaning, operational performance, and perceived value relative to cost.

3. Results

The results demonstrated clear improvements in both animal welfare and handling efficiency following mat installation. Slips and falls reduced sharply in every environment tested, and handlers reported that cattle moved with greater confidence, with a noticeable reduction in hesitation.

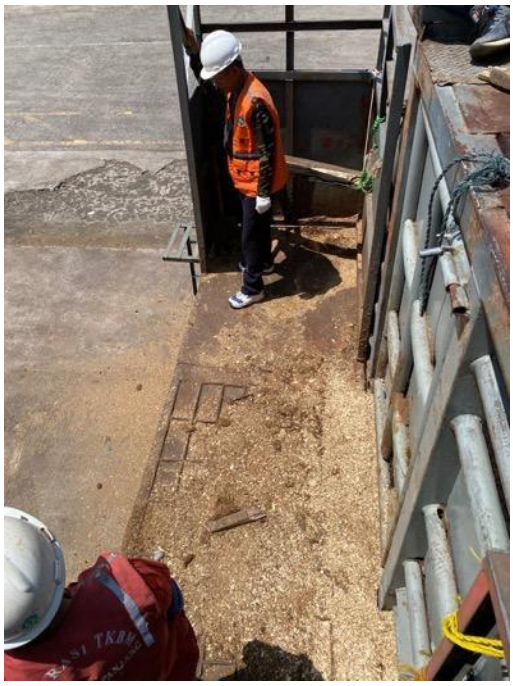
TABLE 1 Summary of trial results by site

Site	No. of trucks (before installation)	Slips (before installation)	Falls (before installation)	No. of trucks (after installation)	Slips (after installation)	Falls (after installation
Port discharge ramp	18	12	0	18	4	0
Feedlot unloading ramp	15	6	8	15	1	0
Truck - tailgate unloading	3	7	2	3	0	0

3.1. Site findings

3.1.1. Port discharge platform

Following installation of the rubber matting system, slips decreased by 67%, dropping from 12 recorded instances to 4. No falls were observed during either the pre-installation or post-installation periods. Additionally, handlers reported that cattle exhibited calmer movement across the discharge ramp after installation, indicating improved animal handling conditions.



Images: Discharge platform prior to rubber mat installation.

Images: Discharge platform following YoungStar rubber mat installation.

3.1.2. Feedlot unloading ramp

Implementation of the rubber matting system resulted in a complete elimination of falls, reducing the previous count of eight instances to zero. Slips were reduced by 83%, decreasing from six recorded cases to one. These improvements significantly enhanced safety outcomes within the feedlot environment. Staff feedback indicated measurable operational benefits, including improved surface traction, smoother and more controlled unloading procedures, and a noticeable reduction in noise during cattle movement.

Image: Feedlot unloading ramp prior to mat installation, with thick non-slip bedding applied.

Image: Feedlot unloading ramp with rubber matting installed at the key transition point where cattle step off the truck tailgate onto the ramp.

3.1.3. 4.1.3 General cargo truck tailgate unloading

Installation of YoungStar mats on truck floors and tailgates resulted in the complete elimination of all recorded slips (previously 7 instances) and falls (previously 2 instances). Observational feedback indicated that cattle entered and exited vehicles with greater confidence and exhibited reduced hesitation, suggesting improved footing and overall handling conditions.

Images: Truck tailgate (left) and floor (right) prior to mat installation, showing use of coconut husk for bedding and traction.

Images: Rubber matting temporarily installed on truck tailgate (left) and floor (right).

3.2. Qualitative findings

Across all sites, handlers consistently reported calmer animal behaviour, reduced agitation, and improved safety for stockpersons. Noise levels associated with hooves striking hard surfaces were significantly reduced, resulting in quieter handling environments. Additionally, feedback confirmed that mat cleaning and maintenance requirements were manageable and could be integrated into existing operational routines without disruption. These observations underscore the broader benefits of matting systems in enhancing animal welfare, workplace safety, and operational efficiency.

To support wider industry engagement, a truck fitted with the trial matting was displayed at the LEP Expo in Jakarta in May 2025. This provided stakeholders an opportunity to inspect the matting in person and discuss its application in commercial settings. A representative from the matting supplier was present to respond to enquiries, with most questions focused on cost, installation practicality, and long-term durability.

3.3 Cost–benefit analysis

The Indonesia flooring trial incorporated a cost–benefit analysis to evaluate the commercial viability of adopting non-slip rubber matting in Indonesian livestock handling environments. Data collected during pre- and post-installation observations were supplemented with operational information and handler feedback.

Costs considered

- **Matting purchase and delivery:** Supplied and shipped from Australia to Tanjung Priok, Jakarta.
- **Installation labour and tools:** Minimal requirements; installation was completed using standard tools and local labour.
- **Maintenance and cleaning:** Mats are durable and require only routine washing, representing negligible ongoing cost.
- **Adaptation for trucks:** Current solutions for tailgate coverage are improvised; a commercial product will be required for long-term adoption.

Benefits considered

- **Reduced injuries and losses:** Avoidance of animal injuries or mortalities associated with slips and falls.
- **Improved efficiency:** Faster loading and unloading times due to calmer cattle and reduced baulking.
- **Lower consumable costs:** Reduced reliance on bedding materials such as sawdust or husks to improve traction.
- **Enhanced handler safety:** Fewer instances translate to a safer working environment and lower risk of workplace injuries.
- **Regulatory compliance:** Supports ESCAS performance benchmarks for slips and falls, reducing risks to compliance and reputation.
- **Animal welfare outcomes:** Lower stress levels, with potential for improvements in meat quality and reduced shrinkage.

3.2.1. Indicative cost comparison of flooring solutions in truck crates

Although the trial did not formally assess slips and falls inside the truck during transit, due to the practical limitations of observing all animals' feet and legs for the duration of each journey, an indicative cost comparison of bedding materials that might be used in the truck bed has been included. This comparison is intended solely to examine the relative costs of non-slip rubber matting versus traditional bedding materials used to improve traction during transport. The cost of conventional bedding materials such as wood shavings and coconut husks is highly variable across regions of Indonesia, as feedlots and transporters frequently rely on locally available by-products from nearby industries. Consequently, the figures presented in Table 2 are provided for illustrative purposes only and should not be interpreted as representative of costs across all supply chain contexts. The rubber matting was significantly cheaper than the bedding alternatives on an annualised basis on an 8 year depreciation schedule.

TABLE 2. Illustrative comparative annual operating costs to outfit a truck with non-slip matting versus traditional consumable bedding materials (assume 180 trips with consumables replaced each trip)

Product	Annual cost (AUD)
Rubber mat (annualised over 8 years)	**$799**
Wood shavings	**$2,041**
Coconut husk	**$1,837**
Sand	**$1,224**

3.2.2. Estimated economic impact of falls – per 1,000 head

The example below estimates the potential financial losses associated with falls per 1,000 cattle discharged. It assumes that each fall results in a 10-day recovery period, during which average daily gain (ADG) is reduced by 500 grams per day, with a liveweight value of AUD $4.50 per kilogram. The analysis focuses solely on falls, as the impact of minor slips on feed performance is too uncertain. Material costs are presented exclusive of labour, as installation was completed by on-site staff during the trial. Notably, falls were completely eliminated at all sites following the installation of rubber matting. As such, Table 3 presents only pre-installation losses, with the implied assumption that these losses would be fully avoided where matting is applied. Although the port discharge platform recorded no falls before or after installation, it has been included to illustrate the minimal capital expenditure required for matting at that site.

TABLE 3. **Estimated savings from fall reduction - per 1,000 head discharged from vessel to feedlot**

Site	Estimated productivity losses avoided due to falls (AUD per 1,000 head)	Once-off Material cost	Unit
Port discharge platform	NIL	$2,536	Entire platform floor – 8 square meters
Feedlot unloading ramp	$2,362	$3,750	10 square meters
General cargo truck tailgate - Unloading	$7,875	$30,300	60 trucks @ 2.1 square meters each ($505 per truck)

3.2.3. Conclusion of the cost-benefit analysis

The cost–benefit analysis supports the targeted use of rubber matting as a commercially viable and operationally effective solution in livestock handling environments. For the feedlot unloading ramp and the truck tailgate, where falls were observed prior to installation and eliminated thereafter, the investment is clearly justified on both economic and welfare grounds. While the upfront cost of rubber matting exceeds that of consumable bedding materials, the annualised cost is favourable in these applications, delivering value through reduced productivity losses, improved animal welfare, enhanced handler safety, and more efficient livestock movement.

For the port discharge platform, no falls were recorded during the pre-installation period. However, given the small surface area requiring coverage and the relatively modest capital investment involved, installation of rubber matting represents a cost-effective precautionary measure that strengthens handling conditions with minimal financial exposure.

The cost–benefit analysis presented is rudimentary and intentionally conservative, only on avoided losses associated with falls. It does not account for other potential benefits of rubber matting, such as the provision of a cushioned surface that may reduce hoof injuries, joint strain, or bruising. While these outcomes are plausible, they are difficult to quantify under commercial conditions and were therefore excluded from the analysis.

Overall, rubber matting offers a strong value proposition when applied selectively at high traffic areas where traditional bedding materials are less effective or cannot be reliably retained.

4. Discussion

Observations from the trial aligned with previous research demonstrating that rubber flooring enhances animal welfare, mobility, and behaviour in commercial livestock settings (Brscic et al., 2015; Amstel et al., 2016; Dean et al., 2025). In line with ESCAS requirements, most fixed cattle handling infrastructure within Indonesian supply chains incorporates non-slip surfaces such as abrasive concrete, slatted concrete, or timber battens. While these features improve traction in general, they are not without limitations. Slatted and batten-style surfaces typically include flat sections between the raised elements, which can still become slippery particularly when wet or soiled with faeces and urine. These smooth zones are a common point of instability, especially during turning or when animals transfer weight laterally.

To supplement fixed infrastructure, consumable bedding materials such as coconut husk, wood shavings, and sand are often applied. These materials are cost-effective and perform well in static, low-pressure areas where they assist with moisture absorption and cushioning. However, their ability to provide reliable traction, especially under shearing force is poorly understood. In high-risk transition points such as truck tailgates or metal ramps, they are often ineffective as they cannot be securely retained and are quickly dislodged. By contrast, the rubber matting trialled included integrated rubber lugs with minimal spacing between them, offering consistent contact and grip across the entire surface. This design provided secure footing even under lateral load and in contaminated conditions, addressing a known gap in current flooring practices. As highlighted in the KPMG Indonesia Supply Chain Logistics Study (2018), inadequate traction at these critical points can compromise animal welfare and disrupt handling efficiency.

In this trial, a temporary rubber matting solution was deployed on the tailgate using an improvised hook-mounted system. This setup provided sufficient stability for trial conditions but was not intended for long-term use. The trial findings reinforced that consumable bedding materials do not adhere to tailgate surfaces when raised into the closed position, rendering them functionally ineffective during loading and unloading.

The trial also explored the feasibility of using rubber matting inside the crate of general cargo trucks. Although this was not a formally assessed site and slips and falls were not observed due to practical constraints, temporary installation was undertaken to test fit, function and cost. The crate's rectangular shape allowed mats to be laid without trimming, and their weight and surface area ensured they remained in place during transit without the need for fixing. However, installation required four people, and handling was noted as a constraint due to the mats' size and flexibility. Regular removal would also be required to maintain hygiene and biosecurity standards, as trucks are typically used to transport other goods. Permanent fixing is not viable in this context, as waste material can accumulate underneath and obstruct thorough cleaning.

Stakeholder feedback consistently identified the initial capital outlay as the primary barrier to adoption. Outfitting a truck with rubber matting entails a fixed investment of several thousand dollars, in contrast to the low variable cost per journey associated with bedding. While rubber matting is cost-competitive on an annualised basis, and may exceed the conservative eight-year lifespan used in this report, the upfront cost remains significant. Compounding this issue is the misalignment between cost and benefit: feedlot operators, who stand to gain from improved handling and animal outcomes, do not typically own or control the trucks. This disconnect will need to be addressed to support broader uptake across the supply chain.

To fully realise the benefits of flooring interventions such as rubber matting, it is essential that feedlot operators actively monitor and measure relevant animal welfare indicators. Without capturing data on changes in behaviour, injury rates, or handling efficiency, it becomes difficult to quantify the impact of infrastructure improvements and build a business case for further investment.

In the absence of measurable outcomes, internal justification for capital expenditure remains challenging—particularly in operational environments where margins are tight and expenditure scrutiny is high.

Overall, the findings support the role of rubber matting as a targeted intervention rather than a blanket replacement for all flooring types. Its highest value application lies in permanently or semi-permanently covering high-slip transition points where consumable materials cannot be effectively retained.

5. Conclusions

The Indonesia cattle supply chain flooring trial confirmed that non-slip rubber matting is a practical and effective intervention for improving livestock handling in port, feedlot, and transport environments. Across all trial locations, the matting improved surface conditions, leading to better cattle movement and enhanced safety for handlers. These outcomes were achieved under typical commercial operating conditions, demonstrating the suitability of the solution for real-world application.

The findings have direct relevance for animal welfare and workplace safety. The reductions observed in this trial demonstrate that performance can be strengthened through targeted flooring interventions. In addition, handlers reported smoother cattle flow, calmer behaviour, and reduced noise, highlighting operational as well as welfare benefits.

The trial also reinforced the importance of addressing transport environments, where truck tailgates were identified as the most slip-prone point. The success of matting in eliminating instances of slips and falls in trucks provides a strong basis for further development of temporary installation solutions that can be used flexibly in general cargo vehicles. Continued innovation in this area will support broader adoption and ensure benefits are realised at scale across the livestock export supply chain.

6. Future research and recommendations

Development of practical tailgate matting mount designs for industry use

The trial highlighted the need for a practical method to install rubber matting on truck tailgates in a way that allows it to be easily applied and removed as needed. While the simple hook system used during the trial was functional and easy to construct, it was not designed for long-term or commercial use. Given the low-tech nature of the solution, it is unlikely that a commercial supplier would develop and market such a product. A more realistic pathway is for trucking companies, feedlots, or exporters to refine the design and arrange for fabrication either in-house or through local workshops. This approach, common in the supply chain, would keep costs low and allow operators to customise the solution to suit their specific equipment. To support this, a refined prototype and basic technical drawings should be developed and made available to industry.

Investigate the Non-Slip Performance of Common Bedding Materials

It is recommended that further research be undertaken to assess the actual traction performance of common bedding materials used in livestock supply chains, such as sawdust, coco-peat, and coconut husk. While these materials are widely applied to improve surface comfort and reduce bruising, their effectiveness in preventing slips is often assumed but not well-quantified. A structured study should be designed to simulate the shearing forces generated by a bovine hoof during turning and weight transfer, including both downward pressure and lateral movement. The study should test each bedding material across a range of common flooring types such as abrasive concrete, smooth steel, and patterned surfaces under variable conditions including wetness (e.g. urine, faeces, and rain exposure). Additionally, the retention of bedding in high-traffic areas should be measured to understand how long it remains in place under typical operational loads. The results would help determine whether current bedding practices provide meaningful traction benefits and guide more effective flooring strategies in the future.

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