

Egg Industry Range Regeneration Guidelines

A report for Australian Eggs Limited by M. Copley, C. de Koning, E. McGahan, S. Clarke & S. Wiedemann | May 2025





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In submitting this report, the researcher has agreed to Australian Eggs Limited publishing this material in its edited form.



Foreword

This project was conducted to integrate recent and ongoing work on range enrichment with knowledge of range management from the *Egg Industry Environmental Guidelines* and the *Practical Guide to Range Management* with new information on practical experiences obtained from industry surveys, consultation, and case studies, and package these findings in a guideline designed to promote practice change.

This project was funded from industry revenue which is matched by funds provided by the Australian Government.

This report is an addition to Australian Eggs Limited's range of peer-reviewed research publications and an output of our R&D program, which aims to support improved efficiency, sustainability, product quality, education and technology transfer in the Australian egg industry.

Most of our publications are available for viewing or downloading through our website: **www.australianeggs.org.au**

Printed copies of this report are available for a nominal postage and handling fee and can be requested by phoning **(02) 9409 6999** or emailing **research@australianeggs.org.au**.

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Free range egg producers

We thank those producers and range managers in Queensland, New South Wales, Victoria, South Australia, Western Australia, Tasmania and the Australian Capital Territory with free range systems who have so generously shared their experiences, insights, views, and expertise

to inform the development of the guideline and allowed photographs from their facilities to be used in the manual.

Australian Eggs Limited

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Overview

PURPOSE OF THE DOCUMENT

These guidelines are designed to assist in regenerating existing ranges, encouraging optimal management, and providing insight into common range management issues and how these can be mitigated when establishing new farms or ranges.

Industry can use these guidelines to ensure free range egg farms are developed, designed, and managed to minimise the risk and severity of range degradation. The guidelines also provide information that range managers can use to identify strategies to regenerate ranges when unavoidable degradation occurs. It is further envisaged that the guidelines and accompanying case studies will assist individual producers in identifying new or novel and cost-effective range management and regeneration strategies by sharing practices and learnings.

SCOPE OF THE DOCUMENT

Facilities to which this Guideline Applies

The guidelines detail design, management, and regeneration strategies to assist free range egg producers with range management.

While the document focuses on layer farms, the principles outlined equally apply to free range rearing farms.

The principles outlined in this document are equally applicable to small and large enterprises.

Content is Not Legal Advice

While the guidance in this document was developed with reference to state (all references to 'state government' contained in these guidelines include 'territory government') regulatory frameworks, it is not a guide to regulatory compliance. These guidelines do not claim that their recommendations meet regulatory requirements. They only advise on important issues to address when establishing ranges and for their ongoing management.

Guidance Does Not Preclude Alternative Practices

The information in these guidelines is based on current information, knowledge and practices that

can be used as a reference standard. Future research and innovation may identify new strategies and best practices for range management. The guidelines aim to provide industry with the necessary information to take a risk-based approach to range management. Where potential solutions and strategies have been identified, there may be alternatives not covered here which also achieve the desired outcome.

Guidance is Subject to Other Requirements

Egg industry facilities, including ranges, are subject to other requirements such as biosecurity, animal welfare and labelling standards. Any changes to these standards can have flow-on effects with respect to range design and management and must be considered.

GUIDELINE CONTENTS

Chapter 1 – “Introduction” summarises producer motivations for range management and regeneration, outlines the major challenges associated with range areas, and draws attention to biosecurity considerations.

Chapter 2 – “Groundcover” focuses on strategies to establish and maintain appropriate groundcover in the areas immediately outside fixed sheds and inner and outer range areas. The chapter also discusses appropriate groundcover types, e.g., living and artificial.

Chapter 3 – “Trees and Shrubs” covers where to plant trees and shrubs on ranges, appropriate plant choices, and how best to establish them to ensure survival. The chapter discusses how species selection should reflect geographic/climatic conditions.

Chapter 4 – “Enrichment to Encourage Dispersion” outlines how artificial shade structures and straw bales may be used to encourage dispersion in range areas. The chapter also considers the cost of selected structures.

Chapter 5 – “Rotation of Range Areas” outlines key considerations and potential benefits arising from the rotation of range areas for both fixed and mobile sheds.

Chapter 6 – “Modifying Hen Behaviour” covers how changes in management or routines might be used to benefit range conditions and avoid selected productivity losses that may arise because of ranging.

Chapter 7 – “Shed Design” outlines key considerations in shed design (fixed and mobile) to optimise bird behaviour on ranges and conditions of range areas.

Chapter 8 – “Range Design” provides diagrammatic examples of how these guidelines may be utilised to implement design and management changes to range areas.

FREE RANGE EGG PRODUCTION

Modern Australian free range layer farms vary from small-scale mobile sheds to large, fixed, environmentally controlled sheds which can house tens of thousands of birds. Several sheds may be located on the same farm. Layer hens typically remain on-farm for about 75-85 weeks, after which the birds are removed, and the sheds cleaned before a new batch of hens are placed there.

Shedding used for free range egg production is typically fixed (i.e., immobile), where the hens have access to an outside range area. The range allows hens access to vegetation and open space whilst the sheds provide feed, water, nest boxes, shelter and protection from weather and predators. Some smaller free range (or pasture) operations use mobile sheds/ caravans that are moved regularly around a paddock/ range. In some systems, larger sheds may be moved on skids between locations.



1 Introduction

1.1 WHY REGENERATE RANGES?

Many motivations and justifications exist for investment in range regeneration, varying from purely aesthetic to cost-prevention to welfare and market requirements. As part of the development process for these guidelines, interviews were conducted with producers and range managers of free range egg farms across Australia. The points below on the needs for regeneration have been taken from those interviews.

1. Effectively managed ranges minimise hen stress. Producers noted that, “Range areas can be the source of numerous stresses, including bright light, high winds, predators, and disease, as well as the behaviour of other hens.”
2. Denuded ranges have negative impacts on production and the credentials of the farm. Producers noted that, “denuded ranges are an aesthetic problem and are a poor image to present to employees or the public as they are not reflective of the high workplace standards, nor the sustainability goals of the farm. Unsightly at the best of times, denuded ranges become a quagmire of mud and manure after heavy rains. Denuded ranges also directly conflict with the idea of leaving a farm in a better condition than how it was received.”
3. “Experience has shown that auditors are particularly responsive to positive actions taken to regenerate range areas. Tangible actions may also be important for future development applications.”
4. Well-managed range areas should comply with and align with the principles of welfare standards.
5. Good range design and regular maintenance to range areas are key to avoiding or limiting degradation which must then be repaired at a significant cost to the farm. Producers noted that “range degradation can be both avoidable and unavoidable. Upfront investment on the avoidable elements maintains the range from the outset and prevents excess cost and time spent on maintenance and production loss” and that, for smaller, family-run businesses, it is a cost and staffing priority to design a system which doesn’t require fixing or minimises recurring problems.”
6. Innovation and ongoing improvement in production and land management should support range regeneration. Producers noted that “evolving range management strategies are consistent with the constant learning and thinking of new ways of operating farms.”

1.2 THE CHALLENGES OF RANGE MANAGEMENT

The interviewees identified the following as key range-related issues of free range egg production:

1. **Mortalities** – “higher mortalities in free range egg production compared with cage or cage-free (barn). There is an economic incentive to produce free range eggs (higher selling price), however, for some batches, the returns from cage-free production would be greater due to high mortality rates and issues on the range.”
2. **Digging** – “hens have a strong tendency to dig which leads to craters and puddles on the range from which hens may drink contaminated water. The presence of surface water may also reduce egg production as hens stay outside and drink, and the intake of their specially formulated diet is reduced.”
3. **Selective foraging and maintaining groundcover** – “hens prefer grass to weeds and due to a lack of competition from grass, and because options for weed management during a production cycle are limited, weeds can take over the range. As a result, ranges often oscillate between too little and too much biomass.”
4. **Budget considerations** – “due to the low profit margins of selling eggs to the major retailers, budget pressure may conflict with range management and regeneration. This keeps downward pressure on wages, potentially resulting in high staff turnover and the hiring of inexperienced staff.”
5. **Regulatory requirements** – “regulation which has range management implications, particularly in relation to biosecurity, may be challenging to apply in certain operations or at certain scales.”



6. **Runoff management** – “Catchment management authorities may require runoff to be captured in a dam, but these same dams may be a disease risk as they attract wild birds.”
7. **Vegetation** – “this can be aesthetically pleasing and may act as a source of shelter and shade; however, vegetation may also attract wild birds, increasing the risk of avian influenza.”

Proactive management and a well-designed range are key to addressing these challenges and reducing the need for major and regular regeneration activities. In short, a poorly designed and managed range will require a lot of time and money to repair. Good design and management may also reduce hen stress and mortality. Solutions must be practical and cost-effective to ensure they are applicable across different regions, farm sizes, and production systems.

1.3 BIOSECURITY CONSIDERATIONS FOR RANGE MANAGEMENT AND REGENERATION

It is important to consider all factors that may affect the biosecurity of the production area, including range design and management. The National Farm Biosecurity Technical Manual for Egg Production (Animal Health Australia & AEL, 2020) notes that while hygiene practices are more difficult to apply to range areas, the fundamental biosecurity principles of preventing disease by controlling livestock movements, equipment, and personnel still apply.

The following objectives and requirements are quoted directly from the National Farm Biosecurity Technical Manual for Egg Production. They should be considered in any range management and regeneration strategy:

Objective:

“To limit and control access to poultry production areas by vehicles and people, and prevent access

by livestock, wild birds and other animals (including rodents) as much as possible.”

Requirements of the objective:

1. “If livestock graze the property, then the production area must have a stock-proof fence.”
2. “Drainage from livestock pastures or holding areas must not enter poultry enclosures or ranges.”
3. “If dogs or alpacas are used to protect poultry in the range area, the guard animals should be tested for freedom from Salmonella prior to introduction and ideally retested annually.”
4. “Free range landscape – trees (e.g., no fruit trees), shrubs and other range amenities should be selected to minimise the risk of attracting the types of wild birds that are a high biosecurity risk.”
5. “The area around the shed must be kept free from debris and vegetation, and be mown regularly to discourage wild birds, insects and rodents which are potential disease vectors.”
6. “A range management plan should be implemented to manage potholes or water pooling after heavy rainfall.”

Objective:

“To reduce the likelihood and introduction of disease agents and contaminants into poultry sheds and enclosures and reduce the attraction of rodents and wild birds to production areas.”

Requirements of the objective:

1. “Grass on and around the production area must be kept cut – long grass attracts rodents and favours the survival of viruses and bacteria.”
2. “The free range area must be adequately drained to prevent accumulation and stagnation of water. The area must also be contoured to limit the ingress of runoff water from other parts of the property.”
3. “The use of manure or poultry litter on adjoining land to the free range areas from other parts of the poultry operation or from other poultry farms should take into account the spread of potential endemic disease agents. The use of windrow composting or off-site disposal is preferable, to remove these risks. Alternatively, manure or litter should be deposited at least 1 kilometre away from the production area.”

2 Groundcover

The following sections describe strategies for maintaining or restoring groundcover on range areas, broken down between areas immediately outside the shed, inner, and outer range areas.

Maintaining groundcover on range areas year-round is difficult, and success or failure may depend on stocking density, region, soil type, and groundcover type.

2.1 IMMEDIATELY OUTSIDE FIXED SHEDS

Maintaining any vegetative groundcover in the area immediately (e.g., <10m) outside the shed is incredibly challenging because of the high traffic and may require the use of non-vegetative groundcovers to reduce the loss of nutrients and soil from this area.

To prevent holes from being dug immediately outside the shed, mesh (metal or thick gauge plastic, $\leq 50\text{mm}$) or rock (aggregate) may be used. Metal mesh is likely the most expensive (costs may range from \$15–\$50/m² depending on quality, quantity, and source) but requires the lowest maintenance and is likely the longest-lasting (up to 10 years). Though cheaper than metal, plastic mesh (costs may range from \$2–\$5/m²) will not last as long and may be more prone to damage by vehicles and machinery. Hens may then dig and create craters in the damaged areas.



Rock aggregate outside sheds reduces soil loss and assists in cleaning hens' feet before re-entering the shed.

Rock or aggregate may be relatively more expensive, in the order of \$7–\$20/m² based on the cost of

\$35–\$100/t plus freight for materials and about 100mm depth, if not cheaply available from local quarries. This base is long-lasting, and may also have the added benefit of helping clean birds' feet before they re-enter the shed.



Rock aggregate – fist-sized rocks considered to be the 'ideal' size.

Key considerations when using rock include:

1. **Size of the rock:** should be small enough that they don't provide habitat for vermin, but not so small that hens can easily move them onto the inner range area. Fist-sized rocks are considered the 'ideal' size,
2. **End-use of recovered manure:** manure recovered from the area immediately outside the shed may be of very little value if it contains rock, and
3. **Replacement frequency (cost and availability):** additional rock may be required as frequently as every second batch.

Alternatives to mesh or rock aggregate in the area immediately outside the shed include a compacted or concrete pad/apron (Wiedemann & Zadow, 2010). These options may make collection of manure easier (e.g., by scraping) if the producer intends to stockpile manure for on-farm composting or sale off-site, however, manure removal will be required more frequently than on rock. Strategies to contain runoff should also be used if this area is compacted or concreted. Whilst a concrete pad will be long-lasting, the cost of labour and materials will be very high. For an apron along a 2m x 50m shed, the cost of reinforced concrete may range from \$75–\$100/m². Producers should source a number of local quotes.

In some cases, carbon-rich materials (such as bark chips) may be used, but many insurers may consider these a fire risk. Bark chips, for example:

- are relatively cheap (costs may range from \$17–\$22/m² based on 100mm depth),
- are widely available,
- are easily moved by farm machinery (but also by hens),
- can be driven over without being damaged, and
- may provide a cooler surface than rock or mesh during summer or in warm climates.

Mulching the inner range area may be another option. However, in high-rainfall regions or episodes, the material may become sodden and break down too quickly, meaning it must be removed and replaced mid-batch. Any mulching system must be monitored and managed to prevent the build-up of contaminants or pathogens (e.g., fungal rot). Mesh may be used to contain the chips or mulch within a certain area. Potential benefits of mulching the area immediately outside the shed include:

- all those listed for bark chips,
- the possibility of selling the mulch, if collected and replaced at the end of each batch, as a compost starter,
- the possibility of selling the mulch as a nutrient-rich compost after composting on-farm,
- limiting stagnant water or manual pools outside sheds as the mulch should allow water to soak through rather than pool,
- it makes it relatively easy to repair any holes dug, and
- reducing nutrient loss.



Pop holes present a high traffic area, meaning artificial groundcover such as rock aggregate is important.

For biosecurity reasons and to maintain access to range areas during the production period, earthworks in the area immediately outside the shed should be timed to occur between batches. If there is an excessive build-up of manure, water-logged holes, or weeds, however, repair activities may need to be undertaken during periods when birds are confined to the shed (e.g., early morning, evening). If weeds are a problem that must be addressed during a batch, slashing or chemical-free strategies should be used, as herbicides would likely require a withholding period.

2.2 INNER RANGE AREA

Although artificial groundcover is the best choice for the first 8–10m outside the shed, vegetative groundcover should be maintained on the inner range area (10–50m from the shed). This is difficult, however, as even where groundcover is well-established before the start of the batch, it may not last the length of the production cycle if there is a lot of pressure from hens or a lot of bad weather during a batch. Costs to resow groundcover can be significant, ranging from less than \$50/ha to \$200/ha, depending on whether contractors are used, ease of access to range areas, and seed selection.



Areas under shade are particularly vulnerable to being denuded.

Dustbowls or holes in inner range areas are a common issue. Repairs to the inner range areas between batches should be undertaken regularly. Routine maintenance may include re-levelling (e.g., scarifying and towing a heavy object across the inner range) to repair holes. The need for re-levelling and repair to groundcover may be greater during the hot, dry summer months and/or on sandy soils, where wind erosion may also be a greater risk. Where there is no way of preventing dust bowls during a batch, the uneven ground should be ploughed and reseeded as soon as possible after the end of the batch.



Dust bathing can create holes and craters where water can pool.

As hens often find pasture palatable and there may not be enough time between batches to engage contractors (if relevant) to re-seed and for pastures to re-establish, reseeding should be done whenever possible and necessary. To avoid delays waiting for contractors, producers should (if relevant) prioritise the purchase of their own cultivator/seeder so the farm can sow when conditions are right. Producers can then quickly re-sow if establishment is poor.



Hens restricted by fencing from accessing part of the range area to allow groundcover to become re-established.

Surface netting may be one strategy to prevent hens from digging up established grass, as it restricts access to the roots. Where groundcover on inner range areas dies off due to bird activity or bad weather, alternative, additional groundcover (e.g., hay) should be used (see Section 4.2).

In some cases, most commonly in spring, excessive groundcover can be an issue as hens may eat too much pasture/grass and not enough of their formulated feed, which may lead to crop impaction, nutrient dilution and a drop in production. Strategies to address this include mowing before the hens move into the paddock or onto the range and changing feeding and pop-hole opening times (see Section 6.2).

In mobile systems, particularly for small-scale production, it may be feasible to use sacrificial paddocks when groundcover is vulnerable, e.g., when groundcover is dormant in winter or during particularly wet periods.

2.3 OUTER RANGE AREA

Compared with inner range areas, it may be easier to maintain groundcover in the outer range, particularly on farms with low stocking densities. It is also easier to fence off parts of the outer range for short periods to allow mowing, etc. Digging and holes should be less of an issue as the outer range can be re-levelled if necessary or ploughed using an offset disc before sowing.

Good groundcover for the outer range areas includes grasses or cereal crops. If the outer range is cropped, temporary exclusion fencing (costs may range from \$6–\$10/m – source local quotes, plus

\$500–\$1000 for an energiser) may be needed as some activities can't be performed when hens are in the immediate area (e.g., some sprays may require a withholding period of several days). If these activities can take place before or after shed doors are closed, this may avoid the need for exclusion fencing. Planting seasonal cover crops (e.g., sunflowers and maize) in strips on the outer range may also encourage hens to range further as these crops are attractive, provide cover, and will be less dense than many cereals. These crops should be sown within a predator proof fence, however, as they can provide cover for predators.

If grasses are used as groundcover on the outer range area, slashing may be required as tall grass can provide cover for foxes. One advantage of grasses over crops as a groundcover is that the former can be maintained with little intervention.

2.4 GROUNDCOVER CHOICE

Choice of groundcover is key to maintaining or prolonging vegetative cover on ranges. As seed is often the most expensive input to range management, groundcover should be appropriate for:

- the stocking density,
- the site specifics (soil, slope),
- region (rainfall, temperature, e.g., drought or frost prone),
- need for and availability of water for irrigation, and
- capacity to undertake maintenance during a production cycle (e.g., mowing, slashing, reseeding).

Key considerations for common vegetative groundcover are outlined in Table 1.



A mix of ryegrass, cocksfoot, and subterranean clover provides a good groundcover.

Regardless of groundcover type, it should be given the longest possible time to get established before exposure to hens, particularly as new shoots may be highly palatable to the birds. On farms with fixed sheds and fixed range areas, there may not be enough time between batches to re-seed and re-establish cover, but temporary fencing is one strategy to give some areas longer to establish. If possible, temporary fencing could be set up outside the shed, e.g., at the edge of the rock area immediately outside the shed, so hens still have outdoor access whilst they are young and less likely to range far from the shed.

Care should be taken to ensure that groundcover doesn't become too long as long leaves can result in mass indigestion (crop impaction), which may result in poor hen health and reduced production. Note, however, that this may conflict with other objectives if the groundcover doubles as a crop for farm use (e.g., hay-making lucerne). However, long blades of grass pose the greatest risk (compared with lucerne) as hens can ingest them whole, causing digestion issues.

In mobile systems, movement frequency (see Section 5.2.1) is key to evenly spreading manure and nutrients and avoiding nitrogen burn.



Subterranean clover provides good groundcover on the outer range of a fixed shed farm (pictured 60-80m from the shed).

Table 1. Summary of key characteristics of selected vegetative groundcover types that can be used on fixed shed and mobile shed farms.

	VARIETY	DROUGHT TOLERANCE	FROST TOLERANCE	RANGE AREA BEST SUITED	*COST (\$/KG SEED)
GRASSES	Ryegrass (<i>Lolium</i> species)	L	M	Inner or outer	\$4.50–\$15.20+
	Rhodes grass (<i>Chloris gayana</i>)	M	L	Inner or outer	\$20.90–\$28.80
	Couch grass/Bluegrass (Various species)	H	M (goes dormant)	Inner or outer	Kentucky bluegrass = \$25.00 Bermuda couch = \$31.70 QLD bluegrass (<i>Dichanthium sericeum</i>) (native) = \$107.00 Bisset creeping bluegrass (<i>Bothriochloa insculpta</i>) = \$42.50
	Kikuyu (<i>Pennisetum clandestinum</i>)	H	M (goes dormant)	Inner or outer	\$65.00–\$110.00
LEGUMES	Clover (red or white) (<i>Trifolium pratense</i> & <i>T.repens</i>)	L	M	Inner or outer	Red clover \$17.00–\$29.40 White clover \$12.30–\$13.00
	Subterranean clover (<i>Trifolium subterraneum</i> , many varieties available suited to low to high rainfall areas)	M	M	Inner or outer	\$8-10
	Annual Medic (Various <i>Medicago</i> species)	M	M	Inner or outer	From \$5.50
	Lucerne (<i>Medicago sativa</i>)	H	M – H	Inner or outer	From \$12.10
CEREAL CROPS	Oats (<i>Avena sativa</i>)	L	H	Outer	\$0.60 to \$1.50/kg
<i>Helianthus</i> SPECIES	Sunflowers	M	L	Outer	From \$6.00

H= High, M = Medium, L = Low

*Cost of seed can depend on the source, variety, and the bag's weight. The heavier the bag, the cheaper per kg. Most costs shown are based on 20 kg or 25 kg bags. Cost per kg is only indicative at the time. +Cost of ryegrass seed also depends on the type of ryegrass (e.g., annual, perennial, Italian). #Consult your local agronomist for species and choices of variety for your area and the sowing rate.

Table 1. Summary of key characteristics of selected vegetative groundcover types that can be used on fixed shed and mobile shed farms. *Cont.*

VARIETY	ATTRACTIVENESS TO HENS (PECKING, EATING)	RESILIENCE	OTHER CONSIDERATIONS
Ryegrass (<i>Lolium</i> species)	H	Grasses tend to be more resilient to hen activity than legumes (Breitsameter et al., 2014).	Too much grass can reduce hen productivity. Grass may need mowing.
Rhodes grass (<i>Chloris gayana</i>)	L (when mature)	Grasses tend to be more resilient to hen activity than legumes (Breitsameter et al., 2014).	Can be killed by hens if allowed onto new growth too soon after mowing.
Couch grass/Bluegrass (Various species)	M	Grasses tend to be more resilient to hen activity than legumes (Breitsameter et al., 2014).	-
Kikuyu (<i>Pennisetum clandestinum</i>)	H	Grasses tend to be more resilient to hen activity than legumes (Breitsameter et al., 2014).	Nitrate poisoning and fungal disease in Kikuyu cause toxicity in cattle. Hens may eventually dig up Kikuyu runners.
Clover (red or white) (<i>Trifolium pratense</i> & <i>T.repens</i>)	H	-	In a mixture of grasses, hens will target red and white clover first.
Subterranean clover (<i>Trifolium subterraneum</i> , many varieties available suited to low to high rainfall areas)	M – H	Annual plants grow through autumn, winter & spring. Self-seeding is best on the outer range.	Suitable in mixtures with grasses. Mostly suited to slightly acidic to moderately acidic soils.
Annual Medic (Various <i>Medicago</i> species)	M – H	Annual plants grow through autumn, winter & spring. Self-seeding is best on the outer range.	Suited to slightly acidic to alkaline soils
Lucerne (<i>Medicago sativa</i>)	M – H	-	Lucerne needs at least 12 weeks to establish before hens can be allowed to forage on it.
Oats (<i>Avena sativa</i>)	M – H	-	Hens may scratch up cereal seeds if allowed onto crop too soon.
Sunflowers	H	Plants need to be above hen height before hens are allowed to forage.	Seeds can attract wild birds, but hens will also seek out the seeds.

H= High, M = Medium, L = Low

3 Trees and Shrubs



Trees planted at least 20m from the shed.

Although trees and shrubs on ranges may be a good source of shade, amenity, and support range regeneration, biosecurity and fire policies should be consulted before planting.

Where planting on range areas (particularly inner ranges) is prohibited, the sheds can provide good shade and protection from bad weather. Tree lines should be planted at the edges of ranges or paddocks as windbreaks, providing further protection. Tree lines can, however, provide habitat for foxes and vermin, so depth, density, and distance from sheds should be considered.

The following sections detail the potential placement of trees and shrubs on range areas, plant selection, and key issues during establishment. How region/ climate should be factored into planting and plant choice is also considered.

3.1 WHERE TO PLANT

The planting of trees and shrubs should align with biosecurity and fire management requirements, including those of insurers. Producers should review all requirements and policies before planting.

Although planting trees close to (<20m) sheds may encourage hens to enter the range and provide a source of shelter and shade, avoiding planting in that location may reduce the number of wild birds near the shed and the majority of the flock.



Example planting configuration.

Any planting configuration has advantages and disadvantages, meaning producers/range managers should evaluate the most suitable based on farm specifics and regional climate. Where possible, small-scale (e.g., one paddock or range) trials may be worth undertaking before commencing widespread plantings.

Shelterbelts or tree lines should consist of shrubs, short trees, and tall trees to act as windbreaks at multiple levels. If it is possible to plant on the range, trees and shrubs should be positioned to provide a windbreak around pop holes.



Tree lines at paddock edges on a mobile caravan farm.

Although often planted in rows along fence lines or scattered individually across the range, trees planted in groves (see Figure 6) may be more likely to withstand strong winds and easier to fence and irrigate whilst still being attractive shelter and foraging spots for hens. Hens have been observed to run from one grove to another, seeking cover and forage as the groves attract insects, adding to their appeal. Dust bathing within groves and any associated damage to roots may be less of an issue than around single trees, as hens have been observed to prefer dust bathing at the edges of the groves, where they can also sunbathe.



Inside a circular grove planted with wattles (3 years old) and slower growing eucalypt.



Hens ranging towards tree plantings.

For fixed sheds in particular, planting trees in corridors (e.g., 3 trees wide, 2.5m between trees, leaving gaps for machinery to pass through) radiating out from a shed (e.g., starting 8–10m from the shed) to the range boundary may encourage hens to leave the vicinity of the shed and range out along these corridors. Radial planting (see Figure 2) and consistent shelter such as this may also encourage more even distribution across the range, reducing the intensity of destructive behaviour beneath trees.

For shrubs, scattered plantings or rows may be appropriate. In the former case, scattered plantings may allow for greater movement (i.e., lateral and vertical) of mobile sheds than if planting is done in rows, ensuring wider distribution of nutrients across the range. For fixed sheds, shrubs (e.g., saltbush) may be planted in rows (starting 10 m from the shed), i.e., at edge of rock aggregate, running parallel to the shed to form hedgerows (see Figure 4). An additional benefit to this planting configuration may be a reduction in wind entering pop holes. Consistent planting in rows may encourage hens to range from row to row, moving further away from the shed and more evenly distributing nutrients and digging, reducing build-up in high-traffic areas.

3.2 PLANT CHOICE

It is highly recommended that a horticulturist or specialised landscape or nursery consultant is engaged to assist in a site-specific selection of appropriate plant species. A list (non-exhaustive, non-site specific) of potential plant choices is outlined in Appendix 1.

When considering plant choices, producers/range managers should:

- select several species of grasses, shrubs, or trees to reduce the risk of damage or loss if pests or diseases appear in certain species. Diversity reduces the chances of a mass dying off during different weather conditions (e.g., drought, wet soil conditions, heatwaves, frost), and
- select plants with different growth rates. Although fast-growing plants will provide quick shade, shelter and visual screening, these species are generally short-lived and need replacing sooner than slower-growing species.
- Select nutrient tolerant varieties because tree areas receive more manure deposition than other parts of the range.



Combination planting of saltbush and wattle provides a good variety of species.

3.2.1 Trees

Ideal characteristics of trees on range areas are:

- low maintenance/care and not sensitive or prone to disease and pests,
- low leaf and twig litter to reduce the risk of fire and rodents. Trees should not be prone to breaking in strong winds,
- complex leaf shapes and waxy leaves filter dust,
- stable root systems to withstand strong winds and drought stress,
- nutrient tolerance, because depending on placement, hens may congregate under trees, meaning the species must have high nutrient tolerance, and
- avoid trees that have seeds or produce fruit to minimise the attraction of wild birds.



Olive trees (pictured approx. 40m from the shed) provide a resilient tree option.

A variety of tree species should be selected to ensure that tree cover on ranges remains constant (i.e., to avoid a mass dying off). Selection should also include fast-growing trees (e.g., wattles, blackwoods) with shorter lifespans and slower-growing, longer-lived species (e.g., gums, bottle trees).

3.2.2 Vegetation

Evergreen grass or a mixture of summer- and winter-active species are recommended to provide year-round shelter and vegetation. To stimulate new growth, grasses should be regularly slashed. However, slashing should be staggered between rows/plantings to ensure that there is always mature growth on the range.



Select a mix of grass species that provides year-round cover.

Ideal characteristics of vegetation (grasses and hardy shrubs) are:

- evergreen species, or a mix of summer- and winter-active species, which provide year-round shelter and vegetation,
- tolerance to hot and dry conditions,
- tolerance to wet, dry or compacted soils,
- clump growth, i.e., plants which will not spread and become invasive,
- stable root systems and/or upright forms with stiff stems to withstand high wind speeds (if needed),
- dust filtering capability (if needed), e.g., from waxy leaves or complex leaf structures, and
- nutrient tolerance, because depending on placement, e.g., in high-traffic areas (as a major source of shelter) or at the bottom of sloping areas on ranges, plants may need to be tolerant of high levels of nitrogen, phosphorus and potassium.



Vineyard as a range area where hens range between rows and forage under the plants. No negative effects from nutrient deposition were observed in the vines or grapes at this site.

Saltbush, for example, is highly suitable in a wide range of climate and rainfall zones and is also suited to range areas (minimum 3m x 3m spacing) for the following reasons:

- the naturally high salt content of its foliage may aid in dealing with pecking behaviour,
- it may be planted in inner range areas to provide natural shade, helping cool the environment immediately around the shed, making it a more pleasant environment for hens and staff,
- it provides cover when wild birds fly overhead, and
- it has a reputation for being tolerant of both drought and high soil nitrogen concentrations, making it an ideal species for inner range areas in hot and dry environments.



On several farms, saltbush plantings have proven a good option due to their drought tolerance and ability to handle high nitrogen concentrations in the soil.

3.3 ESTABLISHMENT

For new farms or sheds, trees and shrubs should be planted (if possible) before the completion of new sheds or introducing hens to the range area so that the plants have time to become established.



Ensure trees are well established on the range before the introduction of hens.

Construction of new sheds may lead to compaction of soil or gravel and removal of topsoil, meaning that, before planting trees, vegetation or vegetative groundcover, the following may be required:

- application of additional topsoil,
- application of compost to improve soil drainage,

- deep ripping and gypsum application to uncompacted soil, and
- application of lime to correct soil pH.

Where trees and shrubs are to be introduced to an existing range area, consideration should be given to the following:

1. **What size of plant is most suitable** (e.g., tube stock vs mature)? Note: Tube stock are cheaper but mature plants have higher survival rates and may be better value in the long term.
2. **Does temporary fencing or other protection for new plants need to be installed?** Fencing may be required to prevent hens damaging young plants and to protect growing plants from rodent defoliation. As options for rodent control during the production cycle may be limited, proactive or preventative measures should be taken at the time of planting. Tree guards or improvised guards (e.g., PVC pipe) may be used to protect young plants from rodents and hens at high stocking densities. In hot weather or climates, temporary fencing may be used to protect young plants from hens during establishment. It can also be reinstalled to rest the area again if needed.
3. **What irrigation is needed** (and how this might be done, e.g., drip lines, fluted mulch pads to funnel rainwater)?
4. **What planting configuration is most suitable** (taking into consideration the fencing and irrigation requirements, e.g., staggered, or groups instead of rows)? Staggering planting may reduce the risk of widescale plant loss in bad weather. For plants with short lives, staggered plantings may avoid complete loss of vegetation.

As weeds are a major threat to plant establishment, some management activities (e.g. tilling and chemical application) should be undertaken before planting to eliminate weeds. Mulching around vegetation:

- will suppress weed growth,
- assist in moderating soil temperature and moisture retention, and
- should be performed in areas with low rainfall or scarce water for irrigation, and the chosen plants in such areas should be drought-tolerant.

Adding gypsum or compost can improve drainage when planting in heavy or sodic soils.

Established groundcover, saltbush, and tree lines on the range ensure that vegetation is abundant and that the shrubs and trees provide shade and shelter.

4 Enrichment to Encourage Dispersion



Use of straw bales as enrichment strategies encourages hen dispersion across the range.

The use of enrichment objects may encourage ranging and reduce hen activities in typical high-traffic areas, such as under shelter and in the area immediately outside the shed. Enrichment structures and objects have been found to increase the number of hens using the range (De Koning et al., 2018).

A variety and combination of enrichment structures and objects (see Figure 5) is most effective. Even distribution should be maintained, and placement should not be too close to the shed.

The cost of implementing enrichment strategies may range from less than \$50/ha up to \$200/ha.

4.1 SHADE STRUCTURES

4.1.1 Artificial

Artificial structures may form part of a strategy to encourage hens to range by providing shelter or where trees are not appropriate or permitted, e.g., in the inner range area where trees might pose a fire hazard, encouraging hens to range further, limiting congregation and destructive behaviours on the inner range.

Before artificial structures are implemented at a wide scale, they should be trialled at a small scale to determine whether hens respond positively to them and whether the cost is warranted. Shade huts with scratching pens, for example, might be most

successful at providing permanent shade and encouraging positive behaviour. Still, there are far cheaper alternatives (e.g., pallets wired together to provide shade and a climbing structure).



Makeshift structure on the range to provide enrichment and a source of shelter.

The longevity of materials should also be considered, as many materials and designs do not last when exposed to the environment or bird behaviour. Metal shade huts are the most robust; however, there should be confidence in a return on investment before installing these widely across an enterprise. It is estimated that for a 3x2m metal-framed welded structure on wheels with shade cloth, costs could range from \$500–\$1000 where the lower estimate is based on an on-farm workshop. Near blackout (up to 90% UV block out), shade cloth has been observed to be the most durable and attractive option for hens. Depending on source and quality of shade cloth, prices may range from \$5–\$12/m².

The benefits of fixed versus portable structures should also be considered. Portable structures, such as moveable shade sails, can be regularly relocated, encouraging birds to use different areas of the range and limiting destructive digging in particular areas.

Types of artificial shade structures (in increasing cost order) which could be trialled include:

- makeshift structures constructed from on-hand or cheaply available materials, e.g., old planks or offcuts, single-use pallets,
- portable shade sails,
- fixed shade sails, and
- fixed metal sheds (prices will vary depending on size, number, source)



A combination of trees and artificial shade structures (portable and fixed) encourages hens to range away from the shed



A portable self-made shade structure can be moved incrementally to encourage hens to range further over time.



Portable commercial-made shade structures offer a long-lasting, moveable, and low-maintenance option. Consider trialling before widespread adoption and investment.

4.1.2 Living

Living shade structures may be comprised of readily available or relatively inexpensive materials, e.g., 44-gallon drums (plastic drums may range in cost from \$25–\$130, used to new) filled with organic waste materials and soil, placed on top of a wooden pallet (may be available for as little as \$5/pallet from

scrap or council waste depots), tall grasses (e.g., Bana grass) planted in the drums and mulched, and mulch covered with chicken mesh.



Living shade (Bana grass in full-height drums and halved drums on a wooden pallet) provides a novel and portable source of enrichment and shade.

Placing the drum and grass on pallets will make it easier to move. These living shade structures may also provide some protection from wind and act as a preferable alternative to artificial structures, particularly if adding vegetation to the range is a priority.

Potential benefits of living shade structures include:

- improved range aesthetic, e.g., particularly where vegetative groundcover or shrubs struggle, and trees are not permitted,
- Portable shade and portable windbreaks as the structures can be moved seasonally to protect from dominant winds,
- inexpensive, sustainable,
- low maintenance (e.g., occasional watering may be needed) compared to artificial shade structures, which may be vulnerable to strong winds, storms, and UV degradation,
- may reduce pressure on high-traffic areas by encouraging hens to move out towards the shade, particularly if trees are not permitted near the shed,
- unlike trees, grasses in drums are unlikely to attract wild birds or provide cover for predators, and
- unlike fixed trees or shrubs, living shade structures can be moved if the plants require resting or maintenance.

4.2 STRAW BALES

Straw bales (~\$35/ round bale) can be placed on range areas to encourage dispersion. Hens may spread the straw (from intact bales) across the range, or the bales can be spread at placement. The straw may contain or attract insects for hens to find.



Straw bale to encourage ranging from the shed and to provide additional groundcover where vegetative groundcover is depleted.

Additional benefits are that straw:

- bales may provide supplementary groundcover when cover in range areas is depleted (particularly due to seasonal conditions),
- it may absorb excess water, reducing mud on ranges during wet weather periods, and
- it supplies extra carbon, supporting soil biota and diversifying the microorganisms (beyond bacteria from manure) that hens encounter on the range.

4.3 PECKING OBJECTS, DUST BATHS

Other objects and structures should be included on range areas to provide enrichment and encourage birds to leave high-traffic areas. Objects which encourage natural behaviours, such as pecking and dust bathing, should be selected to limit damage to the range itself from these behaviours.



Use brightly coloured, inexpensive objects to encourage pecking.

Producers should consider using the following:

- peck stones (may range in cost from \$10–\$40/ stone depending on source, brand),
- other brightly coloured available objects (such as traffic cones), and
- dust bathing boxes (e.g., roofed boxes filled with sand, old tyres filled with sand, or other homemade alternatives).

Past studies suggest that a larger variety of enrichment objects, rather than a larger quantity, encourages hens to range more.



Peck stone provides a source of interest on the range and a different option to exhibit natural behaviours than establishing vegetation.



5 Rotation of Range Areas

5.1 FIXED SHEDS

Rotating range areas on farms with fixed sheds is not a common practice. Where range areas are rotated, it must be ensured that the practice does not conflict with requirements for the frequency of doors/pop-holes. Where stocking density requirements allow, restricting access to part of a range (e.g., a third) may be useful for establishing or resting groundcover (see Figure 3). Additional welfare checks may also be required, i.e., if hens are prone to jumping interior-fencing.

5.2 MOBILE SHEDS

Fencing (permanent or temporary) may be used to facilitate range rotation. Permanent fencing around the total production area may be sufficient, and sheds can be moved within this larger area. Where only one perimeter fence is used, other strategies (e.g., Maremma dogs) may be needed to deter predators. In other cases, temporary fencing may be preferred to create a smaller range area around one or more mobile sheds, particularly where there are features (e.g., dams) from which hens should be restricted access. The temporary fencing and sheds can then be moved on a rotational basis.



Temporary fencing (electrified poultry netting) on a farm with mobile sheds.

Range rotation may be a key strategy in a broader plan for range regeneration or circular production. Circular economy refers to a model of production and consumption which involves reusing existing materials and products for as long as possible, e.g., using chicken manure as organic fertiliser for pasture or cash crops. Where manure is deposited on the

ground under the shed, the mobile shed should be moved to fresh groundcover once the manure begins to accrue. After the shed is moved or the range area rotated, the manure may be ploughed into the ground, reducing the need for soil additives (e.g., lime, nitrogen), pasture re-sown and then rested until established.

Range rotation may be planned such that hens are brought onto a paddock before planting a cash crop to provide nutrients to the soil (see Figure 7). Once the crop is established, hens may be let back on to forage and deliver more nutrients to the crop. Where limited range areas are available on a property, positioning sheds so that hens may range onto cropland at appropriate times may allow longer resting periods for ranges or facilitate regeneration activities which require manual intervention (e.g., re-sowing, re-levelling).

5.2.1 Frequency of Shed Movement

To avoid excessive nutrient build-up, sheds should be moved at a high frequency (every 2–3 days). If sheds are moved less frequently, manure should be collected from under them. If not, nutrient levels below mobile sheds will quickly exceed annual plant uptake capacity, resulting in an increased risk of environmental loss. The frequency and distance of shed movement should reflect nutrient deposition patterns.

For high-frequency shed movement (see Figure 1), manure deposition will be highest under the sheds; however, the frequent movement means that total deposition in one area is limited. This will result in nutrients being spread across the whole range area and will protect pasture cover. Birds will also range over the areas where the shed was previously, breaking up and distributing the manure.

For low-frequency (fortnightly) shed movement (Figure 1, B), manure will not be spread evenly across the range, requiring additional management to reduce the risk of nutrient loss or damage to the pasture.

At either frequency, producers should avoid returning the shed to the same location within 12 months to avoid excessive nutrient build-up.

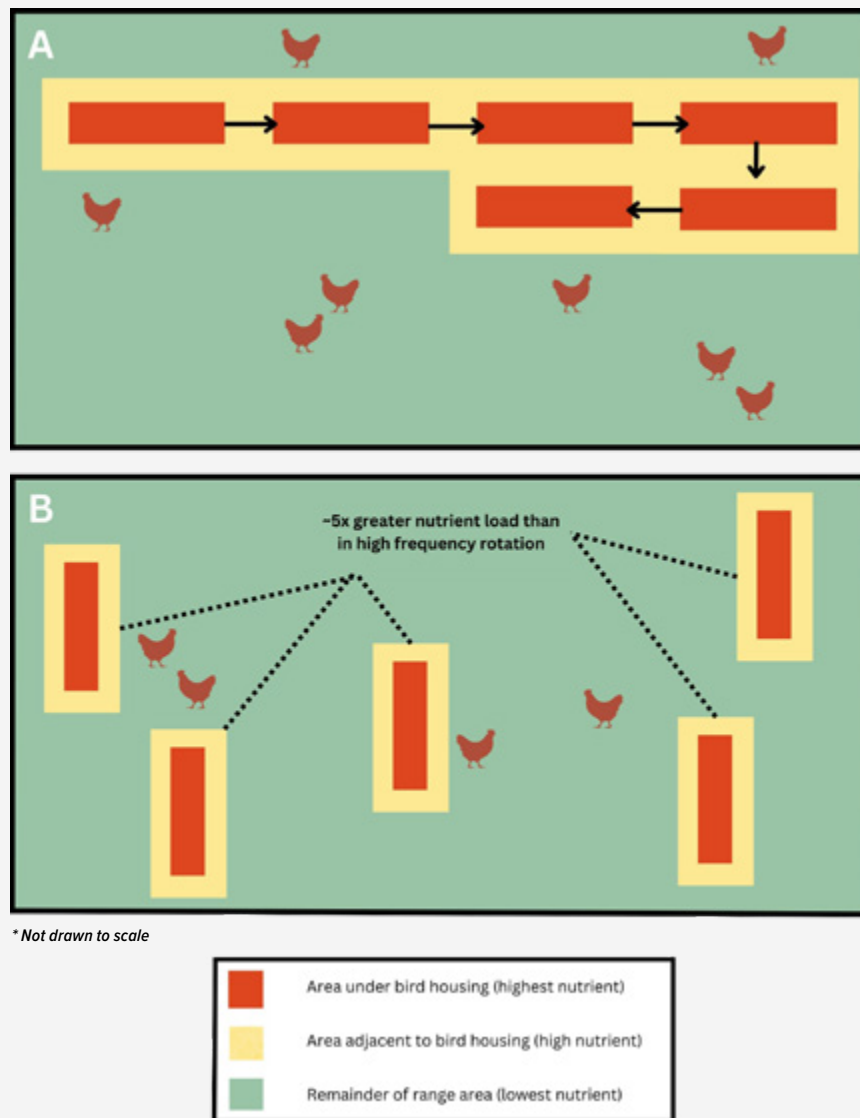


Figure 1. High (A) and low (B) frequency mobile shed movement and resulting nutrient distribution on range areas.

On farms with short return periods (<12 months) or increased risk of nutrient runoff (high slope, low groundcover, high rainfall etc.), additional management may be required, such as:

- collecting manure with scrapers once the shed has been moved and either selling off-farm or spreading the manure across other areas of the range (where the shed will not or has not been moved to recently),
- using metal sheets or tarpaulins under the shed to collect manure and then either selling off-farm or spreading evenly across the range, or
- using litter in sheds to limit deposition beneath sheds, then removing and spreading or selling the spent litter.

More frequent movement may be required at higher stocking densities to avoid nutrient build-up, range denudation or dust bowls developing. Other issues which may affect the frequency of shed movement include:

- condition of pasture around the shed,
- availability of new pasture,
- proximity to other sheds, and
- state of the ground (e.g., soft/wet from rain).

6 Optimising Hen Behaviour

6.1 TRAINING YOUNG HENS TO RANGE

Pullets are generally reared in cage or barn systems, and the lack of exposure to the outdoors may impede ranging, particularly early in the batch. Training young hens to range, however, may also be problematic. For example, if young hens are cold because the shed doors are open, there is a risk that they will pile up for warmth. There is also the risk that hens will not train successfully to use their nest boxes. Allowing access to the range early in the production cycle and closing pop holes when hens begin to lay should be avoided, as doing so may cause stress, disrupt production, and cause manure to pile up around pop holes.

The degree to which the hens' range (particularly to outer range areas) may differ between:

- breeds,
- density of the crop or pasture,
- width of the inner range area, and
- season hens were trained on the range, e.g., hens may range further if introduced to the range in cooler months where shade-seeking behaviour or the attractiveness of a climate-controlled shed is reduced. Birds may require additional incentives (e.g., enrichment) to encourage ranging in warmer climates.

Ultimately, the behaviour of one batch will not necessarily be the same as another, and range management should be adjusted as needed.

6.2 FEEDING AND POP-HOLE OPENING TIMES

Feeding times and pop-hole opening times may be useful for reducing negative impacts from hen behaviour on ranges.

Turning on shed lights at dawn (particularly in winter) while pop-holes remain closed may discourage over-indulgence on pasture, as the hens are woken with time to drink and eat the specially formulated layer mix in the shed before venturing outside. This strategy, in addition to providing consistent light hours over the year, may also reduce the drop in productivity over the cooler months.

In sheds without automatic feeders, feeding 15 minutes before opening the pop-holes may lead to less aggressive birds entering the range and less destruction. Opening pop holes later in the day (particularly in summer when days are longer) may also ensure that hens enter the range after feeding and drinking in the shed, improving control over the quality of feed and water consumed by the hens. Later pop-hole opening times may be prudent at other times of the year, e.g., when there is excessive groundcover from spring growth, and hens may consume too much pasture and too little formulated feed, resulting in a drop in production.



7 Shed Design

Certain shed design elements may sometimes mitigate range degradation and/or encourage ranging.

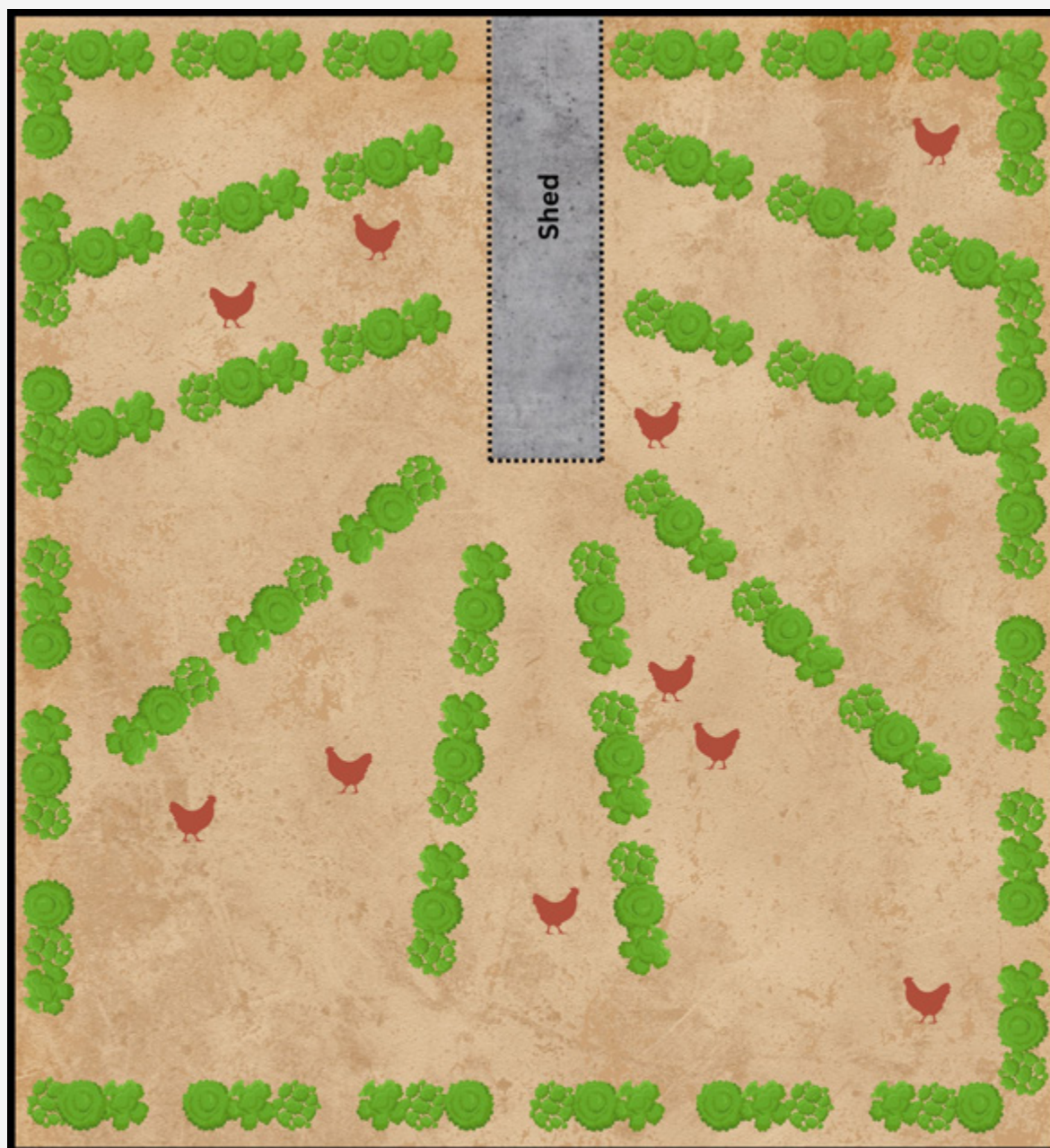
These include:

1. Eaves and gutters on sheds (to reduce mud and water immediately outside shed doors).
2. Rainwater (from gutters) is collected and stored in covered tanks to control the movement of water and nutrients on the range (e.g., runoff, pooling) and to reduce mortality.
3. Allowing access to the range on one side of the shed only and using the other side to service the shed (e.g., pop holes on one side only). This minimises the need for vehicles to enter the range area, that has both practical (avoided compacting, tyre damage) and biosecurity advantages. In some studies, however, this has been found to limit the number of hens using the range to those that typically remain in the area of the shed close to these pop holes (Pettersson et al., 2016).
4. The number of pop holes per shed. Some studies have found that percentage range use increases with the number of pop holes available per bird.
5. Height of pop holes. Elevated (>50cm high) pop holes may be difficult for hens to negotiate, and hens have been found to show aversion to spaces of certain heights (<46cm).
6. Verandas/winter gardens with awnings that run the length of the shed may encourage birds to exit the shed and provide a permanent source of shade on the range area (particularly where trees are prohibited).
7. Litter use. As pop holes are often accessed from shed floors, poor litter quality may discourage litter use and, by extension, range use (Pettersson et al., 2016).
8. For mobile sheds,
 - Narrow sheds (e.g., to fit through gates) allow for easier transportation between paddocks/ranges with permanent fencing, i.e., easier/faster rotation.
 - In high-wind areas, it may be prudent to avoid sheds with sides that open, as the large surface area (and a lightweight shed) may be a hazard.
 - Where trees are prohibited on inner range areas, and shade is a priority (particularly in warm climates), setting sheds above the ground (e.g., 50cm) may provide a source of shade outside the shed itself.
 - Floorless (no mesh) sheds allow almost all manure deposited in the shed to fall onto the range area, which, if ploughed into the soil after the shed/range area is moved, may improve soil nutrients for uptake by the range pasture/groundcover. This system will, however, require regular moving to avoid nutrient built-up.



8 Range Design

8.1 FIXED



* Not drawn to scale

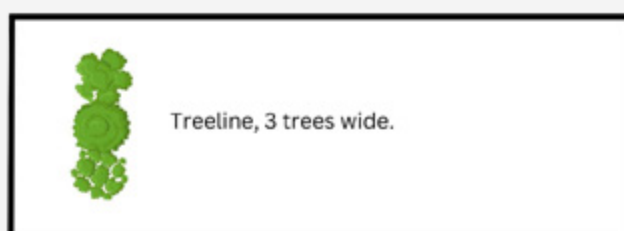


Figure 2. Diagram of radial tree plantings on a fixed shed farm.

8.1 FIXED (CONT.)



* Not drawn to scale

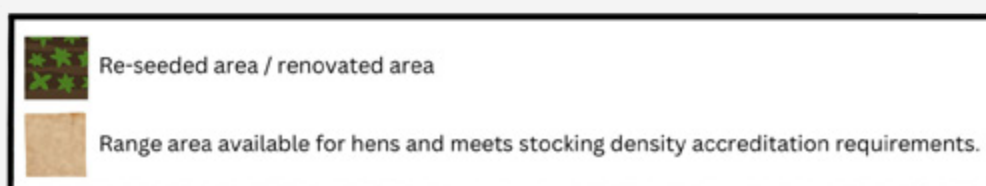
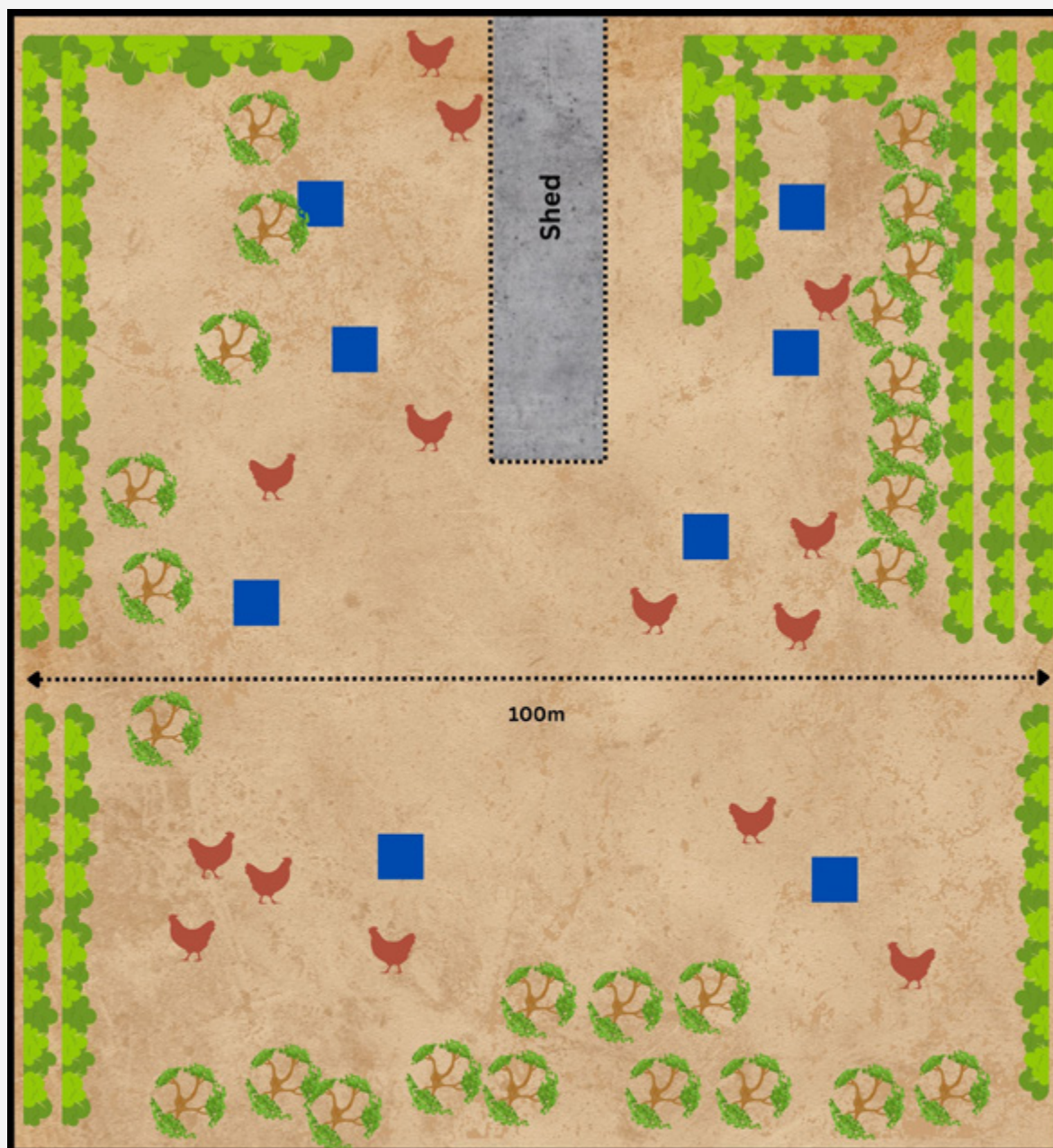


Figure 3. Diagram of temporary fencing on a range with fixed sheds to allow re-seeding and re-establishment of groundcover on part of the range.

8.1 FIXED (CONT.)



* Not drawn to scale

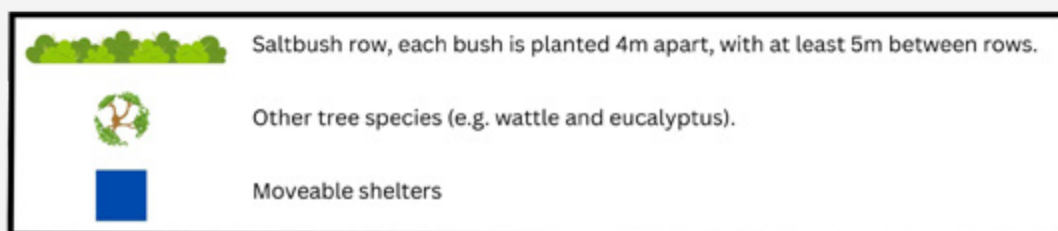
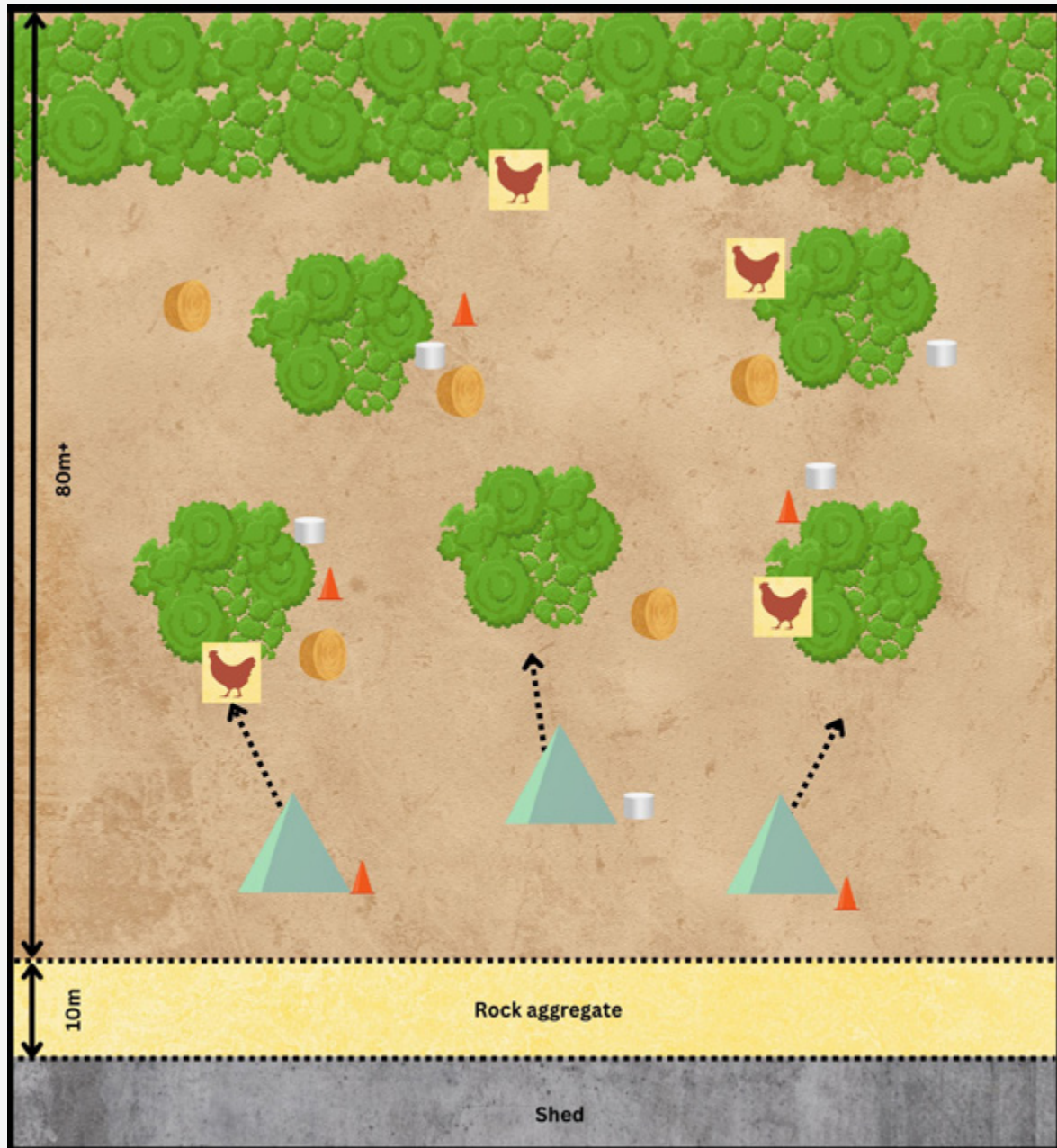


Figure 4. Diagram of saltbush and tree plantings, and placement of moveable shelters, on range areas on a fixed shed farm.

8.1 FIXED (CONT.)



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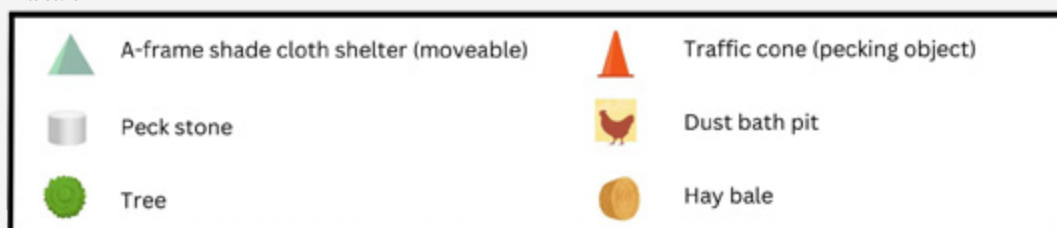
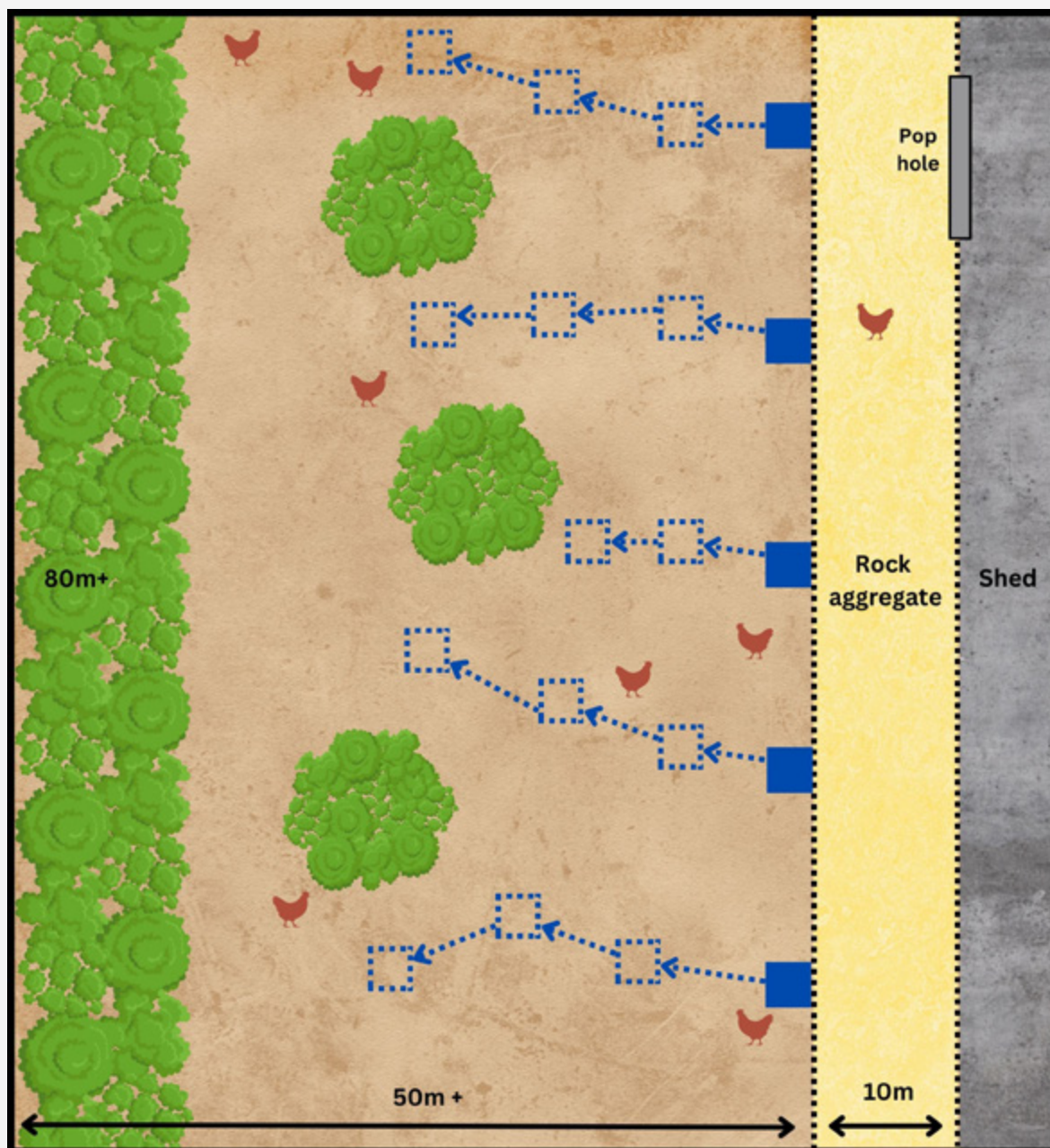


Figure 5. Diagram of placement of enrichment objects (hay bales, dust baths, pecking objects) and tree plantings on a range with fixed sheds.

8.1 FIXED (CONT.)



* Not drawn to scale

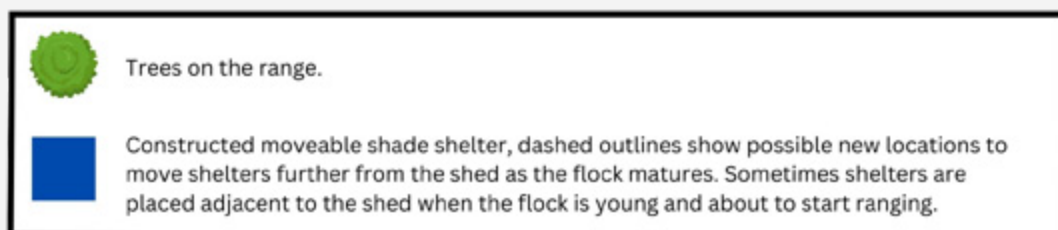
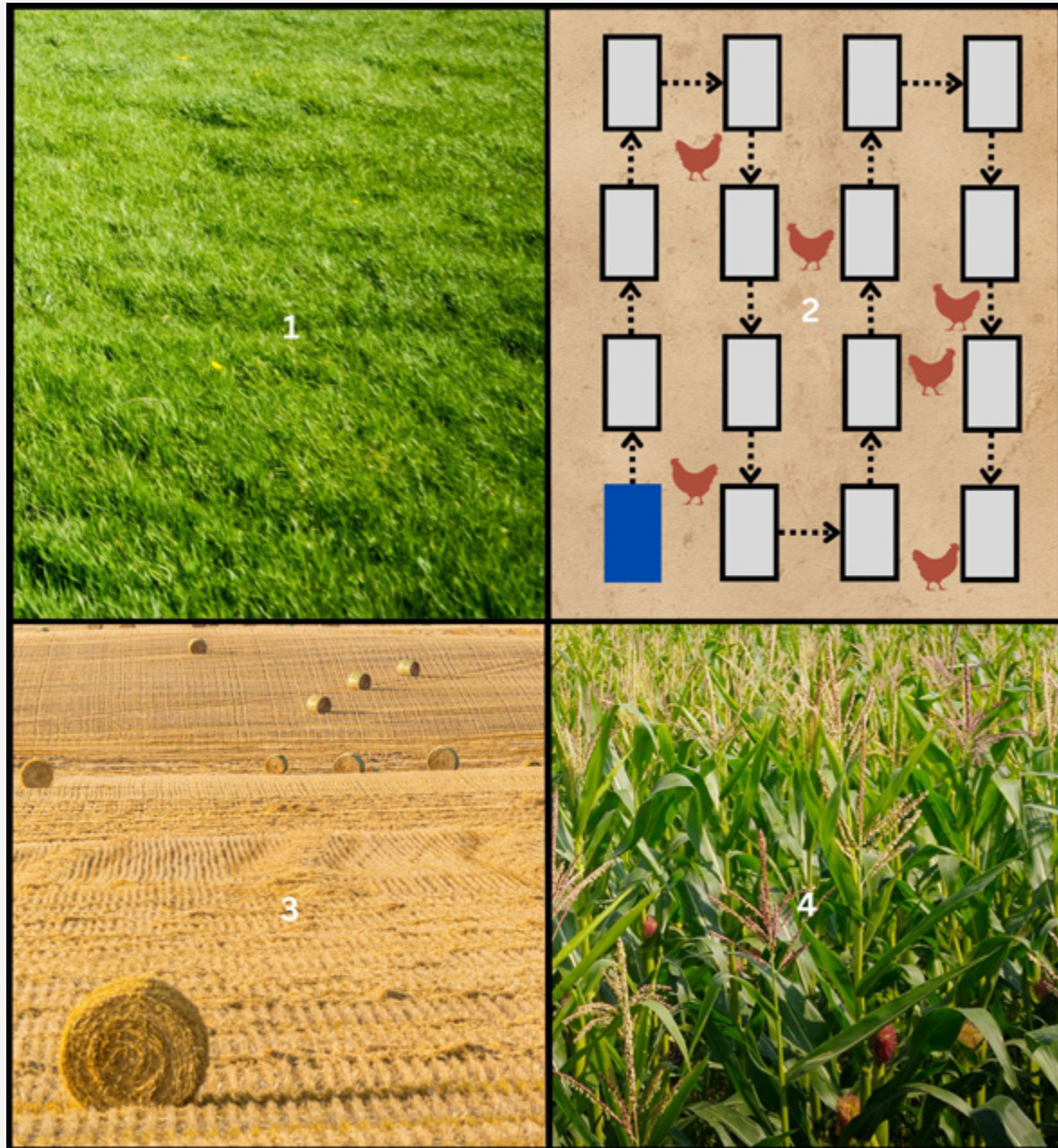


Figure 6. Diagram of tree plantings in groves and incremental movement of portable shelters on range areas to encourage dispersion.

8.2 MOBILE



* Not drawn to scale

Paddock #1: Pasture, ready for the hens next move.
 Paddock #2: Mobile shed and hens.
 Paddock #3: Hay crop, meadow or Lucerne.
 Paddock #4: Corn crop - following hens.

Figure 7. Diagram of optimal mobile rotation of mobile sheds with a rotational production system.



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Appendix

The following table provides a sample list of plant species suitable for range areas. Note that the list is not exhaustive, and an appropriate specialist should be engaged to assist with selecting site-appropriate species.

Table 2. Selected plant species (and their key characteristics) suitable for range areas.

Species	Bana grass (<i>Pennisetum purpureum</i> x <i>P. americanum</i>)	Old Man Saltbush (<i>Atriplex nummularia</i>)	Tree lucerne (tagasaste) (<i>Cytisus proliferus</i>)	Green Pillar Pittosporum (<i>Pittosporum tenuifolium</i>)	Sally Wattle (<i>Acacia salicina</i>)	Wilga (<i>Geijera parviflora</i>)	Bottle tree (<i>Brachychiton rupestris</i>)	Olive (<i>Olea europaea</i>)
Description	Tall clumps (~4m tall)	Evergreen shrub (2m x 2m)	Evergreen shrub (4m x 2m)	Evergreen shrub (3m x 2m)	Evergreen tree (8m x 3m)	Evergreen tree (8m x 5m)	Semi-evergreen	Evergreen tree (8m x 5m)
Growth rate	Fast	Medium	Fast	Fast	Medium	Slow	Slow	Slow
Suitable climate zones	Warm temperate Subtropical	Temperate Warm temperate Subtropical	Cool temperate Temperate Warm Temperate Subtropical	Temperate Warm temperate	Temperate Warm temperate Subtropical	Warm temperate Subtropical	Warm Temperate Subtropical Mediterranean	Warm Temperate Subtropical Semi-arid
Drought tolerance	High	High	High	Moderate	High	High	High	High
Frost tolerance	Low	High	Moderate (Seedlings have low tolerance)	Moderate	High	High	Moderate	High
Salt tolerant	Unknown – no literature on tolerance to high salinity	Yes	No	Yes	Yes	No	Yes	Yes
Suitable soil type	Well-drained, infertile sandy soils through to nutrient-rich loams	Well-drained clay loams through to low nutrient and low fertility soils	Well drained, moderate acidity	Well-drained, humus-rich, most soil types	Well-drained, sandy through to clay loams and poor soils	Red clays or sandy soils	Well drained, slightly acid, clay, shale basalt	Most soil types but intolerant of wet, cold soil. Best in poor-quality sandy or gravel soil.
Fire resistant	No	Yes	Yes	No	Yes	No	To some degree	No
Sun	Full sun to part shade	Full sun	Full sun	Full sun, part shade	Full sun, part shade	Full shade to full sun	Full sun/ part shade	Full sun
Care level	Low	Medium	Low	Low	Medium	Low	Low	Low

Case Studies



CASE STUDY

Challenges to production efficiency and bird health caused by digging behaviour

System: Fixed sheds **Stocking density:** 5000–10,000 hens/ha **Climate:** Subtropical

MOTIVATION:

Annual maintenance cost to repair damage caused by digging behaviour, particularly when combined with the risk to hen health and mortality rates, are a concern for this producer.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Inner range:

- Rocks around shed perimeter

Shade and shelter:

- Tree planting in the inner and outer range
- Shade cloth awnings on sheds

Weed control:

- Regular mulching of vegetation

DETAIL:

To stop hens from excavating around the shed walls, rocks were placed over the first 0.5m. The sheds are 100–150m long and, not including labour, the rocks cost close to \$7,000 per shed. Spreading rocks across more of the range area would not be economically viable. Doing so would also de-value manure collected from the inner range, as it would likely contain rock.



The rocks (fist-sized on average) were also placed to maintain drainage lines. However, this was ineffective as, shortly after the rocks were placed, the hens began moving them about, spreading the rocks throughout the range.

For hens to range more widely on the farm, continuous tree cover would be required – approximately three-quarters of the range is not used by the hens. Continuous cover (shelter) is needed because eagles are a problem. Due to selective foraging behaviour and digging, however, there would be no vegetation under the tree lines.



In an effort to provide continuous cover, tube stock were planted across the range. In the outer range area, the tree survival rate was 90%. In the inner range area, however, 80–90% of the trees died due to defoliation by rodents. Shade cloth awnings on the sides of the shed provide some shade and shelter for birds in the area immediately outside the shed.



As rodent numbers are higher when there are more weeds on the range, regularly mulching is required. Alternative rodent control options are limited during the production cycle.



Due to the lack of competition from grass, and because options for weed management during a production cycle are limited, the weeds can get out of hand. As a result, ranges often oscillate between too little and too much vegetation.

The idea of training young hens to use the range may be problematic – if young hens are cold because the shed doors are open, there is a risk they will pile up for warmth. There is also a risk that they will not successfully train to use their nest boxes. Opening shed doors early in the production cycle and then closing them when hens start to lay may stress the hens, disrupting their production, and may result in pile ups around shed doors.

PRODUCER LEARNINGS:

In the future, more established trees will be purchased.

Producer comments on free range egg production:

Free range production is highly problematic. The major disincentives to produce free range eggs are:

1. hen welfare, and
2. land management.

The mortality rate of free range production is double that of barn production systems. The mortality rate is increased by the length of the production cycle as there is a higher frequency of problems like puddles on the range from which hens drink contaminated water. For some batches, the returns from barn laid eggs would be greater than those of free range, due to production problems with the latter.

CASE STUDY

Mobile shelters and manure collection to avoid nutrient hot spots

System: Mobile sheds **Stocking density:** <1500 hens/ha **Climate:** Temperate

MOTIVATION:

A major range management focus on this farm is managing where manure is deposited to avoid nutrient hotspots on the range.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Shade and shelter on ranges:

- Mobile sheds

Groundcover:

- Natural grasses
- Mulching of pasture

DETAIL:

The sheds are designed with a mesh floor and vents in the ceiling to allow for good air circulation. Sheds are moved weekly to avoid nitrogen burn and sprinklers are run on top of the shed roofs on hot days.

If wind becomes an issue, the chickens move inside the sheds for shelter. The producers are careful to avoid sheds with sides that open, as the large surface area can make the shed a hazard in windy conditions.

The farm holds six 1000L shuttles of concentrated liquid chicken manure fertiliser. Poultry mats (\$15-\$25/mat, approx. 30x30cm) rest under the chickens' laying area and are used to collect the eggs in a conveyor-like fashion. As a result, these mats become soaked in manure and are washed at least daily. The manure from the mats is mixed with the washing water and left to ferment with biodynamic preps.

After fermentation, this concentrate is diluted and sprayed onto paddocks as a fertiliser. This process allows for manure to be spread more evenly across pastures and avoids nutrient hotspots and nitrogen burn on range areas.

Due to NSW policy, this farm was required to cut down all trees and burn all stumps within the production zone due to disease risk. Shade on the range is provided by the mobile sheds.

The removal of trees from the production zone has resulted in the absence of wild birds, minimising the risk of infectious diseases (e.g., infectious bronchitis).

The farm relies on natural grasses that cover the paddock as groundcover. Weeds are chipped out. To help manage the groundcover, the pasture is occasionally mulched, which mulches chicken manure back into the soil.

This farm does not experience drops in egg production, even when groundcover is at its fullest. The only production drops (aside from external factors, such as diseases) are observed during winter days when the daylight period is shorter.

Producer comments on range management and regeneration in free range egg production:

These producers find that the inconsistencies in the state legislation, and enforcement of this legislation, is highly problematic. According to these producers, the strictness of the policies makes it hard for smaller farms to remain competitive. Compliance is increasingly costly, especially biosecurity compliance which cost the producers \$15,000 for new fences, salmonella checks and a sign in/out system.

CASE STUDY

Addressing denuded inner range areas and providing shade and shelter on outer range areas

System: Fixed sheds **Stocking density:** 1500 & 10,000 hens/ha **Climate:** Subtropical

MOTIVATION:

Key objectives of range management are to:

1. Address denuded area close to the sheds (first 40m)
2. Address aesthetic issues, particularly due to effect on employee perceptions
3. Provide shade and shelter in appropriate range areas, and
4. Ensure welfare standards are met.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Inner range:

- Relevelling
- Re-seeding groundcover
- Soil pH monitoring

Outer range:

- Slashing
- Pallets for shade/shelter
- Tree plantings

Groundcover & trees:

- Rhodes grass
- Eucalyptus
- Bottlebrush

DETAIL:

Repairs to inner range areas (between flocks) are regularly undertaken and are becoming a formal part of company range management practice. Routine maintenance includes re-levelling by towing a heavy metal object (e.g., an old gate, railway rails) to repair holes created by digging and dust bathing. Range levelling is more common during the hot, dry summer months.



Routine maintenance, such as relevelling, is conducted regularly as a formal part of range management.

During the cooler, wetter months, opportunities to re-seed the inner range are taken. Rhodes grass (may range from \$20.90–\$28.80/kg, consult locally for costs) works well as a groundcover as it is deep-rooted, survives the hot summers, and responds to rainfall with new growth across the seasons.

Soil pH in inner range areas is also monitored to ensure conditions are suitable for the establishment and maintenance of groundcover. Groundcover is necessary to reduce the risk of wind erosion of the sandy soils.

In the outer range areas, groundcover is maintained without much intervention, especially at lower hen densities. Although slashing is sometimes required to remove cover for foxes.

In these outer range areas, the main regeneration and improvement strategies are to provide shade, shelter and encourage dispersion. Strong winds can damage canvas shade structures so one aim is to replace these with trees. Cost of canvas may range from \$5–\$12/m² and the producer observed that 90% UV blackout shade cloth, priced at the upper end of the range, was most appealing to the hens and the longest lasting.



A combination of fixed canvas shelters, portable, home-made shelters, and trees are used on range areas.

Tree planting is most effective in groups (e.g., 30m wide) as trees are easier to irrigate and fence until they can withstand the digging activities of hens. Advice was obtained on suitable species for sandy soils and these species (eucalyptus, bottlebrush) were all successful.

Drone footage has proven handy to identify the current fraction of the range covered by trees. The footage will be used to confirm that range shade cover requirements are being met, to monitor tree growth, and to inform future tree planting efforts.

Pallet structures are used to encourage hens onto ranges. Wooden pallets (may be available on-farm already or could be sourced from local scrap or council waste for as little as \$5) are wired together like a tent to provide shade and a climbing structure. The hens will use these but ultimately prefer the shade and shelter of trees.



Pallet structures providing a source of enrichment and shelter on the inner range to encourage hens to move to trees and canvas shelters further out.

LEARNINGS:

Overall, the combination of a Mediterranean climate and sandy soils influence many of this producer's range regeneration practices and it is necessary to keep ground cover to reduce the risk of wind erosion.

CASE STUDY

Controlling access to groundcover

System: Mobile sheds **Stocking density:** <1500 hens/ha **Climate:** Temperate

MOTIVATION:

The priority is to control excessive growth (and consumption of) groundcover.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Groundcover & weed control:

- Restricted ranging hours
- Fencing
- Slashing

Shade and shelter:

- Tree lines
- Mobile sheds

DETAIL:

Too much groundcover, particularly spring growth, can be an issue with hens as they fill up on too much vegetation and then do not eat enough of their formulated diet which leads to reduced production.

The producer manages this risk by not letting the hens out too early in the morning and mowing prior to hens moving into the paddock. Within each paddock the shed is moved frequently, and portable electric fencing used.

Weeds are controlled by slashing. In addition, sown crops help by competing with the weeds. If seasonal conditions allow a summer crop of millet is sown, and winter crops of ryegrass and oats.

The producer is considering sowing wildflowers and sunflowers to attract extra insects for the hens to eat.

Throughout the farm there are many established tree lines. These are used to great effect for shade and shelter; however, they do provide habitat for vermin and foxes. Young pullets at point of lay are housed in sheds next to tree lines to provide them with extra shade and shelter while they settle in.

The sheds themselves provide shade as they are set 50cm above ground level meaning that hens can seek shelter or shade underneath.

CASE STUDY

Performance of couch grass as groundcover

System: Mobile sheds **Stocking density:** <1500 hens/ha **Climate:** Temperate

MOTIVATION:

Couch grass can self-repair. It was being harvested from other areas on the farm with a second-hand turf cutter and transplanted onto the range. Kikuyu did not persist; the hens were far more destructive with the kikuyu runners.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Groundcover:

- Couch grass

DETAIL:

During the drought years (2019 was the driest on record for the region), the established groundcover (couch grass) was set back, although it did recover.

In extreme wet weather, hens are particularly destructive as the ground is soft and damp, making it easier for the hens to scratch up couch grass runners. Hence, after periods of high rainfall, the area is spelled/rested to allow it to recover. The couch grass goes dormant during the frost season, meaning that recovery at that point in the year is much slower.



Downslope area of the range with well-established couch and nearby trees.

Persistence of couch grass is partly dependent on where it is growing on the range (e.g., uphill vs downhill). On top of the hills and ridges the grass does extremely well and has formed a lawn-like groundcover. The upslope area, however, is less attractive to the hens (they are reluctant to travel

uphill and there are no trees nearby) meaning that bird density is lower than on the downslope areas.

In contrast, downslope areas with couch grass have trees close by and the area is highly utilised by hens because of the shelter provided by the trees. The downslope couch grass also has more dust baths dug into it.



Closeup of couch grass.

Even though the range is subdivided, all areas can be opened up to the hens to meet space and stocking density requirements. In future, the producer may set up an additional new area to allow for the rotation/resting of range areas. This would allow one area to be rested while the other is in use.

CASE STUDY

Strategies to mitigate manure build up and denuded range areas

System: Fixed sheds **Stocking density:** 5000–10,000 hens/ha **Climate:** Temperate-cool

MOTIVATION:

Managing manure build up and the exposure of bare rock in high traffic areas is a priority on this farm.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Groundcover & weed control:

- Deep mulch

DETAIL:

Hens exit the side of the shed onto runs that are 25–30m wide. These are known as the ‘let-out areas’ and run parallel to the shed, and then out into a small paddock. Manure build-up and denuding of the let-out area and similar high-traffic zones is a current issue for the farm. No vegetative ground cover can survive the hen pressure, so bare rock is exposed.

To improve the welfare of the hens, the producers are investigating a deep mulch system. The farm managers are in discussion with various experts about the logistics of the system.

The deep mulch system would involve spreading carbonaceous mulched material in high-traffic zones, at least 10–15 cm deep (est. \$10,000–15,000/shed). Where necessary to contain the mulch, chicken mesh could be applied around the edges of the high traffic areas.

Once the mulch is thoroughly soiled, it could be transported to a composting site on the property. It may be sold as is (as a composting starter [\$40–\$50/m³]) or sold as nutrient-rich compost after undergoing the composting process on-farm (\$80–\$100/m³). The former option is predicted to recoup the initial costs of the mulch, whereas the latter is expected to recoup costs with a possible profit margin.

The expected advantages of this method are numerous. These potential benefits include:

- Carbonaceous mulch materials should allow water to percolate through the substrate, filtering out manure. This facilitates water drainage, which should inhibit stagnant water/manure pools.
- The mulch will facilitate natural hen behaviours such as scratching and digging. It will also be easy to fill small pits dug out by the hens, either via the action of other hens scratching, or by running a small implement over the mulch.
- Carbon in the mulch is expected to absorb and lock-up faecal nutrients, potentially reducing the loss of nutrients to waterway).
- The mulch itself will provide a ground cover that will reduce erosion, dust, and soil loss.
- Mulched surfaces will mitigate extreme surface temperatures on rock or bare soil. On hot days, hens will be able to dig into a cooler/damp layer.
- Consultation with compost experts has indicated that mulch could be successfully composted and sold. Soiled mulch would be harvested from the let-out area periodically, composted, and sold; or sold as a compostable material. This facilitates the recouping of the costs of each mulch batch, with the potential for profit and income diversification.

The deep mulching system must be managed well to avoid accumulation of bio contaminants or pathogens (incl. fungal rot). Further, the mulching material would need to be free of contaminants (e.g., plastics, chemical treatments, pathogens) and producers aware of potentially hazardous leeching associated with treated timber.

If these risks are well managed, the producer believes the potential benefits could significantly improve the operational and ecological outcomes of small to medium free-range egg operations. Therefore, trialling of this method is essential. These trials should aim to determine optimum mulch depths and materials, as well as the effects of mulched vs. non-mulched outputs (via measuring nutrient flows and contaminants).

The greatest barriers to a trial are the initial capital required to purchase appropriate mulch, and the source of the mulch.



Shredded building waste.



Shredded building waste.



Let out area (after rest).



Let out area during rest period (with mulch applied).



Compost trial.

CASE STUDY

Saltbush as a hardy source of vegetation on range areas

System: Fixed sheds **Stocking density:** 5000–10,000 hens/ha **Climate:** Subtropical

MOTIVATION:

Addressing denuded ranges is a priority for the farm as:

1. they do not reflect the high workplace standards
2. they do not reflect the sustainability goals of the farm
3. they look terrible and turn to quagmire after heavy rains, and
4. they directly conflict with aim of leaving a farm in a better condition than how it was received.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Vegetation:

- Saltbush

Groundcover:

- Rhodes grass

DETAIL:

To address the problem of denuded ranges, small stands of saltbush (at 2m inter- and between-row spacings) were planted to the left and right of fixed sheds in the inner range area. A 20L bucket of manure was added to each hole, 20cm seedlings (\$4–\$14/plant, depending on source and number) planted and hand watered until established. Thereafter, the saltbush was irrigated four times only, and fenced off for six months to allow the plants to establish.

The cost of establishing the saltbush included one hour of labour per thirty bushes.



Preparation for saltbush planting in the inner range area.

Establishing saltbush was attractive as:

- The naturally high salt content of the foliage may help deal with pecking behaviour.
- It provides shade in the inner range, helping to cool the environment immediately around the shed, making it a more pleasant environment for hens and staff.
- It provides cover when wild birds fly overhead.
- It has a reputation for being tolerant of both drought and high soil nitrogen concentrations, making it an ideal species for inner range areas in hot and dry environments.

An additional benefit of the plantings is that they provide evidence that the farm is actively managing range areas and the water and nutrients that may flow from them. This may be important for future development applications. In this farm's experience, auditors are also particularly responsive to positive actions taken on range areas.



Hens foraging under established saltbush.

Between flocks, Rhodes grass was hand sown across the inner range area of a shed. Corridors were then mown through it to encourage the hens to access it. Once the hens were let out of the shed, they readily occupied both the Rhodes grass and the saltbush.



Rhodes grass was trialled and found to be effective.

LEARNINGS:

The first saltbush planting was too dense, especially for employees as they could not comfortably walk through the range. Subsequent planting density was at 3m inter- and between-row spacing.

There is no issue with hens pecking at the saltbush once they reach knee height. Once they are waist high, the temporary fencing can be removed and the saltbush continuously opened up for the hens to access.

In the past, sowing ranges with pasture and irrigating was trialled by the farm with limited success as:

- the hens found new shoots highly palatable
- even with rotations, there was not enough time to re-seed and re-establish pastures, and
- it is also possible that the species mix was not optimised

The unsuccessful experiences were additionally problematic because they discouraged investment in subsequent range regeneration practices.

Producer comments on free range egg production:

The key message coming from these experiences, both positive and negative, is that any range regeneration techniques must be practical.

CASE STUDY

Using surface netting to discourage digging on the inner range and shelter to encourage hens onto the outer range

System: Fixed sheds **Stocking density:** 1500–3500 hens/ha **Climate:** Temperate

MOTIVATION:

The farm has trialed several strategies to:

1. Prevent hens from digging in the inner range, and
2. Encourage hens into the outer range.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Inner range area:

- Metal or plastic mesh
- Shade huts

Outer range area:

- Trees (outer range)

Groundcover:

- Fencing off part of the range

DETAIL:

Surface netting on the inner range was found to stop hens digging up established grass as it prevents access to the roots. Results with both metal (\$15–\$50/m²) and thick gauge plastic mesh (\$2–\$5/m²) have been promising, though any gaps in the mesh became cratered from digging activity.

The farm has also trialed eucalypt bark chips (\$85–\$110/m³) as a surface cover for the inner range area. Though these could be driven over and were easily movable, the insurer identified them as a fire hazard.

Large stones (cost may range from \$35–\$60/t plus freight, local sourcing likely to be cheapest) were also trialed but, if their diameter was too large, they provided shelter for rodents.

The main strategy to encourage hens to disperse across the range area has been to provide semi-continuous access to shelter from the shed to outer range.

Many outer range areas have excellent tree cover encouraging some hens to roam large distances. However, due to fire risk, trees are not suitable for the inner range.

To protect young trees on the range, the farm took the European approach of using PVC pipes as tree guards. Unfortunately, a heat wave during a large trial killed the trees. If the idea is used now, it is done on a much smaller scale. Similarly, the farm has had bad experiences trying to establish trees from seeds.

The farm has found that shade huts that include scratching pens (scratch mix may range from \$1.80–\$3.00/kg) are the best means of providing shade across the inner range. However, experience has shown that material and design are key as many huts do not last. The ideal shade hut would be made of metal but there would need to be a confident return on investment before shade huts were installed across the whole farm. It is estimated that for a 3x2m metal-framed welded structure on wheels with shade cloth, costs could range from \$500–\$1000 where the lower estimate is based on an on-farm workshop.

Keeping hens out of part of the range (e.g., one third) has proven useful for establishing groundcover. Choice of groundcover is important, however, as the farm has had bad experiences with rye grass. Hens that were provided access to a well-established rye grass paddock showed an unacceptable drop in production that continued across the production cycle.

Producer comments on free range egg production:

The transfer of birds from rearing sheds to production sheds brings them into a very new environment – new lighting, new substrate underfoot, and exposure to the outdoor environment for the first time – this causes stress in addition to the stresses of coming into lay and the search for a nesting site. In the range area there are numerous stresses including bright

light, high winds, predators, and disease, as well as the behaviour of other hens.

Smothering is a problem both in- and outside the shed. Inside the shed, walls have been electrified to stop localised over-crowding. In the range, fatalities from over-crowding can occur under the edge of verandahs and are common in favoured digging and dust bathing spots, despite the absence of fixed walls.

The range needs to be part of a production system that helps minimise hen stress. The best strategies to minimise hen stress must be cost effective. Unfortunately, there is a tendency for range design and management to be overlooked during the construction of state-of-the-art sheds.

Due to the low profit margins, there is always pressure on budgets for range management and regeneration. This keeps downward pressure on wages, potentially resulting in high staff turnover and the hiring of inexperienced staff. Mistakes or oversights by untrained staff are undesirable at any time, especially in a system that presents laying hens with multiple potential stressors.

CASE STUDY

Groves and corridors to encourage ranging and round bales to provide additional groundcover

System: Fixed sheds **Stocking density:** 10,000 hens/ha **Climate:** Temperate-cool

MOTIVATION:

The whole appearance of the farm is important, and the producers are constantly learning, changing things on farm, and thinking of new ways to do things.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Trees & vegetation:

- Wattles, gums, walnuts, blackwood, tree lucerne

Groundcover:

- Mixture of ryegrass, clover and cocksfoot
- Wheat & barley straw round bales

Inner range:

- Rocks (fist-sized and smaller) in first 10m outside shed

DETAIL:

The farm has planted circular groves of trees (particularly gums) on ranges and created corridors (three trees wide, 2.5m between trees). Gaps in the corridors allow farm machinery to pass through and high tree guards (~\$2/guard) encourage the trees to grow upright and tall.

Hens range to the tree groves and will run from one grove to another to seek shelter. The groves also attract insects which adds to the appeal to the hens. The birds tend to dustbathe at the edges of the grove where they can also sunbathe.



Shredded building waste.

The corridors begin at the edge of the rocks (~\$100/m³) placed in the first ten metres outside the shed. The rocks facilitate drainage, discourage dustbathing (and creation of deep holes for puddles) immediately outside the shed, and clean the hens' feet as they return to the shed. Rocks are topped up or replaced after every second flock.



Shredded building waste.

The farm purchased a second-hand small cultivator/ seeder (\$3000) so they can sow (and re-sow) pasture on ranges as needed without needing to wait or pay for a contractor. As the pasture usually only has 3–4 months to establish before hens access the range for the first time, temporary fencing of mesh (\$1.5/m²) and star pickets (~\$10 each) is placed at the edge of the rock for the first two weeks as birds are unlikely to range far. Since using this technique, the farm has found that it takes longer for the hens to damage the pasture.



Shredded building waste.

The farm buys (up to 150 per season) wheat and barley straw round bales (~\$35/bale) which are rolled out onto the range areas where the hens soon spread the hay across the range, creating cover that lasts for a month. The straw contains and attracts insects for the hens to find and helps provide groundcover and reduce mud on the range during wet weather.



Shredded building waste.

LEARNINGS:

In future plantings, the producer may space the trees in groves an extra metre apart as that would require fewer trees per grove and make the groves larger.

Wattles were extensively planted in the beginning but the producer is now changing to gums and a variety of species (walnuts, blackwood). The gums are hardier and long-lived in comparison with the wattles. Tree lucerne will also be trialled on ranges.

As the farm is an expansion phase, trees will be planted with dripper and spray lines before new sheds are built. Shelter belts will consist of a mix of tall trees, short trees, and shrubs around boundaries of the new sheds as the site is windy.

Producer comments on range management and regeneration in free range egg production:

If hens are fed well and nutritional requirements are met, they will react well on the range or in a shed situation. The hens on the farm have good feather coverage; this could be a combination of changing genetics, good nutrition, and evidence that trees/ pastures do help the hens.

CASE STUDY

Preventing digging and providing broad access to the outer range area

System: Fixed sheds **Stocking density:** <1500 hens/ha **Climate:** Temperate

MOTIVATION:

Range management strategies are implemented on this farm to:

- Reduce digging in concentrated areas
- Encourage hens onto outer range areas

RANGE MANAGEMENT & REGENERATION PRACTICES:

Inner range:

- Mesh netting
- Straw bales
- Fixed and portable shade sails & fencing

Outer range:

- Sown with winter cereals

DETAIL:

There is a distinct difference between inner and outer range management on the farm. The first 7–15m of the inner range ground surface is covered with 50mm metal mesh. The purpose of the mesh is to prevent the hens from digging in a concentrated area. This reduces the number of places water can collect, which has multiple benefits:

- there are fewer puddles for the hens to drink from
- wild birds are less likely to be attracted close to the sheds, and
- surface water runoff is better controlled.

The producer expects that the mesh will need replacing once every ten years, at which point the surface it protects will be reshaped and the manure layer will be removed.

Other management practices applied in the inner range include the use of straw bales, and both fixed and portable shade sails and fencing. The portable shade sails are moved regularly so that digging activity is spread across the range, rather than concentrated in fixed areas. One or two straw bales (8x4x4 ft) are used per fortnight (\$120/bale). The hens make good use of these, spreading the straw across the inner range area, particularly when the weather is dry.

Fencing is used to prevent hens from entering the outer range area when specific management activities are taking place there. Pop holes could be kept closed at these times, but that comes with the unacceptable risk of over-crowding inside the shed around pop holes by hens expecting to enter the range area.

The outer range area is sown with a winter cereal, such as barley or sometimes wheat. Some cropping activities cannot take place when hens are in the outer range area (e.g., sprays may require a withholding period of several days), hence the need for the exclusion fencing.

Digging behaviour is less of a concern in the outer range as it is used less frequently and because it is ploughed using an offset disc before sowing.

PRODUCER LEARNINGS:

Several strategies are avoided because they either didn't work or pose a biosecurity risk. Strategies that didn't work include sowing ranges with kikuyu and watering with irrigation lines – the hens dug these up.

Sowing the inner range area with crops didn't work – the hens would excavate the plants, seeking out the seed.

To minimise wild birds on-site the following are avoided: shrubs, standing water (including dams on the property or neighbouring properties), and having range areas that are greener than the surrounding landscape.

Producer comments on range management and regeneration in free range egg production:

The degree to which the hens use the outer range depends on the breed, the season they were trained on the range, the density of the crop, and the width of the inner range area. ISA Browns tend to range further, and hens in general will range further if they were introduced to the range in cooler months (when shade-seeking behaviours are reduced).

Hens won't enter a crop if it is too dense but this is readily resolved by mowing corridors into the crop. Hens are more likely to range further if the inner range area provides broad access to the outer range area. Based on this last observation, the latest free range sheds on the farm open on one broad side only – the other side is used to service the sheds. This design minimises the need for vehicles to enter the range area, which is handy for practical and biosecurity reasons.

CASE STUDY

Horticultural plantations utilised as ranges

System: Fixed sheds **Stocking density:** 1,500 hens/ha **Climate:** Temperate

MOTIVATION:

Farms C and D were broiler farms before being converted to free range egg farms in 2012 and 2014, respectively. Adjacent horticultural plantations were seen as opportunities to provide free range hens with shelter and cover on the range, while still producing wine grapes (Farm C) and olives (Farm D).

RANGE MANAGEMENT & REGENERATION PRACTICES:

Farm C: The inter rows between the vines had good ground cover with a mix of annual ryegrass and perennial grasses. The main over-head cover was provided by grapevines running parallel to the shed, spaced 2.5m apart with the first row 23m from the shed.

Farm D: Groundcover is composed of naturalised annual grasses, annual Medicago species and some broadleaf weeds. Olives trees spaced at 7m intervals provided overhead cover for hens and the first row was 15m from the shed.



Farm D, olive trees and hens 40m from shed. Transition zone between 5% groundcover and 70–80% groundcover.

DETAIL:

Farm C: The vineyard occupies the upward slope (5–10%) on the north side of the shed. The vines are managed by a vineyard manager independently from the free range enterprise. A fence running parallel to the hen shed separates the inner range area (20m wide) from the vineyard. This fence line

had 8 gates evenly distributed along the length of the fence. Gates into the vineyard could be closed to exclude hens when vineyard activities need to be done such as pruning, slashing of inter rows and grape harvesting. Hens mostly ranged within the first six rows of vines.



Hens in the shade of grapevines on farm C.

Farm D: The olive tree plantation was on a flat north range. Hens had free access to the olive plantation and ventured to the extremities of the plantation. Nonetheless, hen numbers were lower on the outer edge of the plantation compared to close to the shed. Sometimes the groundcover needs to be slashed on the outer sections of the olive plantation, and this encouraged more hens to go out further.



Farm D, mown inter row further on the range (100m from the shed) to encourage hens to explore.

Soil nutrient levels on farms C & D

Soil tests and plant tissue samples were taken to see what impact if any the extra nutrients in the soil had on the vines and olive trees. Higher levels of nitrate and phosphorus were found closest to the shed on farm D, but not on farm C. Nitrate levels were higher under olive trees but not under vines when compared to open range areas. However, phosphorus levels in the soil under olive trees and vines were no different to adjacent open areas. Nitrate and especially phosphorus were concentrated in the top 10cm of soil.

The nutrient levels in the soil on farm C were very low, likely due to the high leaching properties of the deep sand. In contrast, farm D soils retained nutrients due to the high clay content. Nevertheless, plant tissue analyses for nitrate, nitrogen and phosphorus did not show differences between olives trees or vines grown closest to the shed compared with those 100m from the shed.



Closeup of olive fruit set on farm D.

Plant tissue analyses had shown nitrogen and phosphorus were within the target ranges for the productive growth of olive trees and vines. Olive fruit set was highest on trees closest to the shed on farm D.

PRODUCER LEARNINGS:

Biosecurity threats from wild birds were much reduced because the fruit (grapes and olives) from the vines and trees were harvested. Hens seem more reluctant to range the upslope on farm C, however hens can be encouraged further upslope when they followed the stock people.



Farm C vines and inter row groundcover 30m from shed during midsummer. At this stage the young flock had not ranged this far.

CASE STUDY

Tailoring range design and vegetation to local conditions

System: Fixed sheds **Stocking density:** 1500 & 10,000 hens/ha **Climate:** Temperate

MOTIVATION:

The producer operates several farms, and although they are all within the same state, the climate varies widely between them. As such, local farm climatic conditions and soil type are considered when making range design and management choices.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Groundcover:

- Natural grass and vegetation

Vegetation & trees:

- Saltbush
- Wattle
- Trees (>20m from shed)

DETAIL:

For groundcover, the farms rely on plants already naturalised on the range, however, a short-term strategy when groundcover is depleted (or during the summer months when there is no green groundcover) is to use straw bales.



Farm A, before the range was planted with trees and saltbush back in 2015.



Farm A, the same range in 2022 with straw bale in background.

Between flocks, manure is collected and removed from the area surrounding the shed. New aggregate or soil is then put back, and dust bathing holes are filled, usually with the aggregate or soil. When necessary, dust bathing holes are filled during a current flock.

Trees planted on the range are a long-term strategy, with the eventual aim of creating a forest-like environment. The farm employs an arborist to plant and look after trees and shrubs.

Intermediate strategies involve the planting of fast-growing shrubs and trees, such as saltbush and wattles. Farms in the low rainfall area have planted Oldman saltbush.



Farm D, olive trees and hens 40m from shed. Transition zone between 5% groundcover and 70–80% groundcover.

On one of the farms the saltbush has worked very well, encouraging the hens out of the shed and to move across the range. On that farm (Farm A), the saltbush was planted in rows running parallel to the shed (approx. 10m from the shed on the edge of the aggregate) and have since formed hedgerows. A potential added benefit of having saltbush at the edge of the aggregate area near the shed is to minimise wind entering pop holes. Other rows were planted in the mid-range areas and at the range boundary.



Farm D, olive trees and hens 40m from shed. Transition zone between 5% groundcover and 70–80% groundcover.

On the other farm, the first saltbush planting was at least 50m away from the shed (Farm B). Although some hens do range to the saltbush, most tend to stay within 50m of the shed where there are well-established trees.



Farm D, olive trees and hens 40m from shed. Transition zone between 5% groundcover and 70–80% groundcover.



Farm D, olive trees and hens 40m from shed. Transition zone between 5% groundcover and 70–80% groundcover.

Insurance restrictions require a firebreak, i.e., no trees can be planted within 20m of the shed. This has an added benefit of reducing the number of wild birds near the shed.



Farm D, olive trees and hens 40m from shed. Transition zone between 5% groundcover and 70–80% groundcover.



Farm D, olive trees and hens 40m from shed. Transition zone between 5% groundcover and 70–80% groundcover.

PRODUCER LEARNINGS:

The producer operates several farms, and the climate (e.g., rainfall) varies widely between them (350mm-520mm) even though they are all within the same state. As such, local farm climatic conditions and soil type are considered when making vegetation choices. Particularly for those farms located in the lower rainfall areas, it is not possible to maintain green groundcover all year round, especially in summer.

For future saltbush plantings, the producer is considering staggering planting times so not all shrubs on the range are the same age. This is to avoid the risk of losing large numbers of shrubs at the same time when they start dying off.

Soil nutrient levels on farm A

Soil closest to the shed (10m from shed) had the highest levels of nitrate and phosphorus, especially in the top 10cm. There was also more nitrate and phosphorous in soils under saltbush compared to adjacent open range areas. The saltbush on Farm A was at least 8 years old and had grown extremely well. Plant tissue analysis of saltbush leaf had shown no differences for nitrate, nitrogen and phosphorous whether saltbush had grown close to the shed or further on the range.

No soil samples were taken on Farm B. Although, plant tissue samples revealed variations were due to different native plant species. Of note, was the very high nitrate levels (2,700 mg/kg) found in vsmall leaf bluebush (*Maireana brevifolia*). Bluebush had not been planted and was naturalised on the range. Hens were not eating bluebushes and preferred to shelter and dustbathe under them.

CASE STUDY

Moveable living shade – Bana grass

System: Fixed sheds **Stocking density:** 5000–10,000 hens/ha **Climate:** Temperate-cool

MOTIVATION:

To use moveable living shade to decrease range degradation, provide shade and improve hen wellbeing.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Shade:

- Portable living shade (Bana grass)

DETAIL:

One novel range design idea from this producer is living, portable shade structures. These are inexpensive structures comprised of readily available materials. Four drums (44-gallon drums, or similar size) are cut in half, filled with organic waste materials and soil, and attached to a wooden pallet. Bana grass is planted in the drums and mulched. The mulch is covered with chicken mesh.

Alternative configurations include using just two drums on half a pallet, and/or maintaining the drum's full height by just cutting the top off. The pallets can then be easily moved around the property, providing shade (via shadow casting) and protection from wind.



Halved drums and Bana grass on pallets.



Full-height drums with Bana grass.

The Bana grass is extremely hardy, only requiring water during drought. Bana grass can thrive on just 15cm of soil over rock. It is propagated from cuttings which shoot in water. Including the barrel height, the living shade structures should reach 4–5 m in height.

Living shade structures may be an inexpensive way to improve hen wellbeing and decrease range degradation. Potential benefits include:

- portable shade
- portable windbreak; can move seasonally to protect from dominant winds
- decrease pressure on high-traffic areas by encouraging hens to move out towards the shade

- improved range aesthetic
- very low maintenance – occasional watering required
- unlike trees, does not attract predators
- rapid growth; very hardy
- inexpensive and sustainable, repurposing old materials
- structures can be moved if the plants need to be rested
- unlike conventional shade structures, living shade attracts and supports insects on the property (to a limited extent).



CASE STUDY

Circular economy and diversified revenue streams in small-scale free range egg production

System: Mobile sheds **Stocking density:** 1500–5000 hens/ha **Climate:** Temperate-cool

MOTIVATION:

This farm has a focus on environmental sustainability and incorporates circular economy principles where possible and is also mindful of how scale of production and design influence environmental performance.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Range design:

- Rotational
- Electrified poultry netting
- Multi-species paddocks

Groundcover:

- Lucerne
- Mowing to restrict growth

Trees & vegetation:

- Trees as windbreaks at paddock edges
- Shade & shelter on range provided by sheds

DETAIL:

The operation consists of mobile aluminium sheds (approximately 3x9m) that shift around vegetated land within a larger patch of land which is fenced-off with semi-permanent electrified poultry netting (may range from \$6–\$10/m² depending on supplier, height etc). After the shed has been moved three times within the fenced area, the poultry netting and the mobile shed are relocated to a new patch on a rotational basis.



The sheds have been designed for easy mobility – they are narrow enough to fit through farm gates, light weight yet durable (corrugated aluminium) and custom-built for optimised chicken wellbeing. This allows the sheds to be transported to a different property or sold to different producers.



This farm has a focus on environmental sustainability and incorporates circular economy principles where possible. The chickens deposit manure on the area under the shed. When the manure begins to accrue into a layer, the mobile shed is attached to a small tractor and moved forwards over fresh groundcover. The mobile shed is moved often enough to avoid the manure smothering the vegetation. It instead acts as a natural fertiliser which is later ploughed into the ground, thus removing the need for soil additives (e.g., lime, nitrogen).



Chickens are occasionally brought onto a paddock to provide nutrients prior to planting sweet corn or other cash crops. Once the corn is established, the chickens are let back on to forage around the corn and deliver more nutrients to the crop. The corn is then sold at the farmers markets. Likewise, lucerne is grown as the vegetative pasture for the chickens. Once this becomes long enough, it is cut and sold as lucerne hay (\$20/small square bale).



As the primary groundcover, lucerne has been particularly effective given its drought resistance (relatively deep roots) and ability to be cut and hauled for hay (nutrient removal). Mowing ensures that pasture does not become too long, as long leaves can result in mass indigestion, which in turn results in poor hen health and reduced egg production.

One way the producers discourage hens over-indulging on pasture is to turn on the shed lights at dawn (especially in winter) while the shed doors are still shut. This wakes the chickens and gives them a chance to drink and eat the layer mix in the shed before they venture outside. It also increases the hours of productivity and gives consistent light hours year-round.

Moving the mobile sheds often is key to avoiding excess manure accumulation or bad smells. Despite the pastured land, there is still an issue with small dust bowls developing. The resulting irregular land is eventually ploughed – manure and plant roots are ploughed into the soil, and the land is given time to rest before it is reseeded. This tillage is sub-optimal, and a preventative solution to the dust bowl issue has not yet been found.

The farm has been careful to avoid scaling up production too much, even if the space allows it. This gives pastures enough time to rest before being used again. Instead of increasing egg production, the producers have opted for diversification. Cash crops (and other benefits of the circular economy) provide multiple income streams, as do other on-farm projects, such as a planned sheep milk operation. Production at the current scale also means that the producers do not need to hire non-family staff.

The sheds provide a good level of protection from the sun/adverse weather, reducing the need for trees or shrubs within the paddocks. However, tree lines are planted around paddocks as wind breaks. They also encourage an abundance of wild birds. Food and water are kept within the sheds and are only accessible to the chickens, thereby minimising the risk of disease transmission from wild birds. Cooperative interactions between chickens and wild birds are frequently observed (i.e., warning of incoming predatory birds).



This results in a turnover of under-performing chickens that are bought by egg producers. Ways to combat this include a system-wide program to ensure that hens are raised to be fit for their purpose, clearer guidelines and expectations for hatcheries and/or more on-farm hatcheries.

PRODUCER LEARNINGS:

The mobile shed range design has many benefits, especially the separate cohorts of hens. In the event that one hen becomes diseased or sick, the spread of illness is contained to one shed and does not threaten the viability of the entire operation. The same is true for in-shed issues, such as a burst water pipe – the impact is always contained. The multitude of smaller sheds and fenced-off areas also reduce over-crowding. As a result, the farm can achieve a higher stocking rate while maintaining ample space for each hen.

Producer comments on range management and regeneration in free range egg production:

More research into quantifying the impacts of chicken manure on soil health would be beneficial. Additionally, research into the relationship between (the volume of) chicken manure, soil health and soil type, with the aim of reducing the required frequency of soil tests, would be well received.

Additionally, there appears to be a disconnect between breeders and egg producers.

More specifically, some batches of chickens have not had the appropriate upbringing for egg production, especially free range egg production (e.g., too little human interaction, lack of roost training, lack of outdoor exposure etc.).

CASE STUDY

Circular economy and long-term management

System: Mobile sheds **Stocking density:** <1500 hens/ha **Climate:** Temperate

MOTIVATION:

The farm takes a long-term view of how range management and rotation can improve the state of the land whilst contending with a labour-intensive production system.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Range rotation:

- Circular economy

Trees & vegetation:

- Lucerne and other trees
- Shrubs

DETAIL:

The mobile sheds are moved by tractor and relocated at least once every few months.

The decision to move a shed is based on the availability of new pasture and the current state of the pasture around the shed. Sheds are moved more frequently if they are located close together, or if the ground is soft due to wet weather.

The relatively low frequency of relocation leads to denuded areas, especially in high traffic areas, however, this is not a long-term problem but the first part of a cyclical management regime that has been in place for a number of years. Bare patches are usually re-planted with a crop. If they are left un-planted, pasture will typically re-establish. Unharvested crops and stubble are made available for hens to graze. This cycle takes advantage of the manure left behind by the hens.

At a whole-farm scale, sheds are kept away from sensitive areas, such as establishing (<3 years old) lucerne trees (*tagasaste*, *Cytisus proliferus*). Once established, lucerne trees (\$3–\$10/plant depending on source and size) provide shade.

PRODUCER LEARNINGS:

One factor that other producers must consider if trying to run a similar operation is the provision of shade on the range. During summer on this farm, shade is essential for hen welfare. For this reason, mobile sheds are always situated close to trees, shrubs or lucerne trees.

The labour-intensive nature of the mobile sheds presented a problem when initially trying to scale up the enterprise from its origin as a family-run business. The labour-intensive system continues to be a major challenge –sheds must be attended to daily to check on welfare, feed, and water, and to collect eggs. The need to move sheds by tractor adds to the labour requirements. A relatively simple system of farm management is used to ensure tasks are not forgotten.

Producer comments on range management and regeneration in free range egg production:

Economically, the labour-intensive system is viable due to the greater returns achieved for producing eggs from this sort of system. This equates to a couple of extra dollars at the point of sale relative to larger scale free-range egg production.

CASE STUDY

Low-density, small-scale system design to maintain environmental performance

System: Mobile sheds **Stocking density:** <1500 hens/ha **Climate:** Temperate

MOTIVATION:

The priority on this farm is to maintain profitable small-scale production to preserve the environmental sustainability of the enterprise.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Range areas:

- Weekly relocation of sheds
- Floorless sheds to promote spreading of manure

DETAIL:

The farm is a family-run, multi-species farm running sheep, cattle and free range hens. Only one-fifth of the farm is used to run the mobile sheds. The sheds are moved once a week, and the hens are protected by Maremma dogs. In conjunction with the low hen density, moving the sheds regularly avoids range denudation.



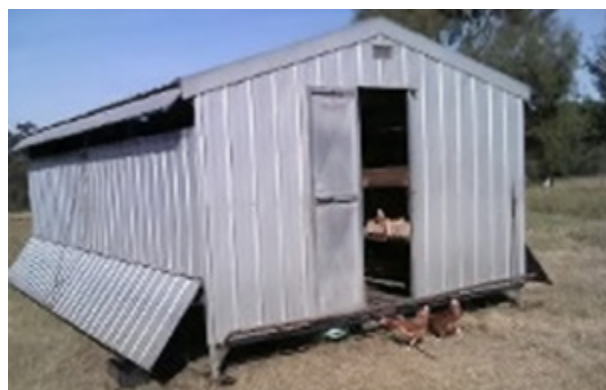
The sheds are simple (no automation of feed, water, or egg collection) which makes them inexpensive (bought off-farm for \$500 each). The lack of automation increases contact with people, which makes the hens easier to handle. This has benefits when hens are sold to the public – customer satisfaction is increased as the hens are docile.

The hens are ISA Browns, which are favoured because they aren't flighty, which makes them adaptable for mobile shed systems, as well as being very good layers.

The sheds are floorless (no mesh) and continually open (hens can come and go 24 hours a day). Floorless sheds save on cleaning and promote the spreading of manure across the range. The sheds have skids rather than wheels – skids are less manoeuvrable than wheels, but they eliminate the problem of flat tyres.



Sheds are inspected daily, and the water supply is topped up every few days via a tank mounted on a ute or tractor. The sheds and tractor are deliberately inexpensive as economic viability is closely tied to the environmental sustainability of the business.



PRODUCER LEARNINGS:

Increasing the number of sheds is of no interest – it would require paying staff, which would in-turn increase the need for more sheds and simultaneously undermine the autonomy and risk the quality control of the production system.

Producer comments on range management and regeneration in free range egg production:

As well as environmental and economic benefits, the production system has social benefits in the form of:

1. very high job satisfaction (although collecting eggs in miserable weather is trying), and
2. the opportunity to host other producers and interest groups (e.g., Landcare) interested in sustainable land management.

From the outset, a low hen density was an integral attribute of the production system. First-hand observations of other free range production systems showed how difficult, if not impossible, it is to maintain groundcover at a density of 10,000 hens per hectare.



By minimising range denudation, less mud and dust are tracked into the shed, so the eggs rarely require cleaning. The low density also minimises feather and vent pecking. The chosen density reflects both economic and environmental concerns – running enough sheep or cattle to make a living would not have been environmentally sustainable, whereas a low-density egg production system was estimated to be (and has proven to be) viable economically in terms of land management.

CASE STUDY

Functional and visually appealing solutions to mud and dirt on range areas

System: Fixed sheds **Stocking density:** 1500 hens/ha **Climate:** Temperate

MOTIVATION:

To identify and implement functional and visually appealing solutions to excessive mud and dirt on ranges.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Inner range:

- Concrete strips and rock along sides of sheds

DETAIL:

The inner range areas were improved by adding 2m wide concrete strips along both sides of a shed, with an additional 2m wide strip of heavy rocks. These interventions helped minimise areas of mud and excess digging in the inner range whilst also reducing the volumes of dirt and mud that enter the shed. Associated costs were high – for both sides of a 130m long shed, concrete strips cost \$35,000 and the rocks cost \$5,000.

In the inner range area pastures of different seed mixes are sown using a disc seeder to maintain year-round cover on a seed bank.

V-drains are used to capture runoff in the inner range area. Due to hen digging behaviour and sedimentation the drains continually need reshaping – this can take up to 8 hours per shed and requires favourable weather conditions.

LEARNINGS:

Resowing was not very successful as hens destroyed the pasture within a day or two. There was additional difficulty in finding a long enough gap between flocks with favourable soil moisture and rainfall to allow the pasture to establish.

The farm has tried locking the hens away from certain areas but found this to be a labour-intensive process with little reward for the effort involved.

Low rainfall can pose an added challenge to maintaining groundcover. The farm has also trialed round straw bales and lucerne in the ranges but saw few benefits from these actions. These interventions were expensive as 10 bales can cost between \$350 and \$1000.

CASE STUDY

Range design to avoid degradation in high-density areas

System: Fixed sheds **Stocking density:** 1500 hens/ha **Climate:** Temperate

MOTIVATION:

As a smaller, family-run business, the priority on this farm is range design to avoid or minimise potential for range degradation, particularly in high-density areas outside pop holes. Spending money up-front on degradation avoidance measures maintains the range and prevents production loss and excess cost and time required for repair.

RANGE MANAGEMENT & REGENERATION PRACTICES:

Inner range:

- Wintergarden concrete slab
- Heavy rock and fill covered by netting (8m out from shed)
- Guttering on sheds

Outer range:

- Topsoil banks (1.5m high)
- Pasture buffer (50m)

Trees & vegetation:

- Small number of trees scattered on range

DETAIL:

The farm uses an aviary system which allows for ranging on one-side of the sheds via a 1.2m high, shed-long pop hole. There is a wintergarden (veranda) over a concrete slab with a 4.5m wide awning which runs the length of the shed. The awning provides 90% of the shade on the range.

The veranda with the concrete slab prevents excessive degeneration in a high-density area. The slab was more expensive than the veranda. The cost of the overall shed was almost twice that of a conventional shed.

For the first 8m outside the shed, the ground is heavy rock with fill, covered by netting. This prevents excessive digging and damage to the range in the

second most dense area. Birds are still able to display digging behaviours without causing excessive damage.

At the end of the rock segment/underlay, the range is unmodified. Topsoil banks, approximately 1.5m high, are built to direct and drain water away. The friable soil in the bank provides hens with an area to concentrate digging behaviour, and the small number of shallow holes are easily repaired in between production cycles.

Beyond this, there is a 50m pasture buffer. At times, a nutrient-hungry crop (e.g., canola) is planted (during the night) to minimise nutrient build-up. As the sheds are located on a hilltop, cropping is part of a strategy to limit nutrient build-up resulting from runoff.

With this combination of inner and outer range design elements, only a fraction (one-tenth) of hens dig.

Guttering to direct water to tanks plays a major part in controlling the movement of water and nutrients on the range and reduces mortality.

Ramps are not used due to concern that they would provide an impediment to hens ranging.

PRODUCER LEARNINGS:

These range design ideas would be applicable at 10,000 hens/ha. Of a 18,000-hen shed, 8,000–9,000 never go outside, and only 3,000–4,000 of those that exit the shed would venture beyond the veranda. Frustratingly, this means the outer range area is generally a huge waste.

The Hyline bird was observed to range 'aggressively'. It is difficult to get back inside, grazes and drinks more on the range, and is likely to smother – all of which can affect hen well-being and productivity. The farm now uses Lohmann hens.

Feeding times and pop-hole opening times are useful tools for modifying range behaviour. Feeding 15 minutes prior to opening the pop hole was found to lead to less aggressive birds entering the range and causing less destruction.

Opening pop holes later in the day is also useful for ensuring hens enter the range after feeding and drinking in the shed – particularly in summer, the long days still provide plenty of time for pop holes to be open and for hens to have access to sunlight. In summer, the hens can still be out at 9 PM, and with the lights on under the veranda, the range provides a nice climate at this hour. These two strategies increase control over the quality of feed and water consumed by the hens.

Producer comments on range management and regeneration in free range egg production:

Range managers should have more say in shed and range design and operation. A shed built solely to maximise economic returns is not likely to have many of the design elements of this farm as they come at a higher cost. They can, however, make a big difference to welfare and productivity of hens and the staff who manage them.

Similarly, industry standards must give range managers options on how to achieve desirable outcomes. They must not be overly prescriptive. What doesn't work in agriculture is being regulated to a point where there's no flexibility to do what does work.



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