ENVIRO FACT SHEET

Free Range Production: Management of range areas

Managing range areas for good environmental outcomes is an important aspect of managing a free range farm.

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Improperly managed range areas result in increased environmental risks from nutrient losses. Nutrients lost in surface water runoff from free range areas may cause eutrophication in water bodies (e.g. creeks, rivers, dams, lakes), promoting the growth of algae. High nitrate levels in water are also toxic to fish, birds, wildlife, stock and humans. Elevated organic matter levels in water reduce oxygenation, affecting fish and other aquatic life. Hence, practices that elevate the nutrient content of runoff should be avoided or the runoff to waterways avoided.

Nutrients can also leach through the soil and contaminate groundwater. Contamination of groundwater can lead to health problems for humans, animals and ecosystems. Once groundwater contamination has occurred, remediation is difficult and expensive. The risk to groundwater is influenced by a range of features of the site, including the depth to groundwater, soil type and the existing quality of the ground water.

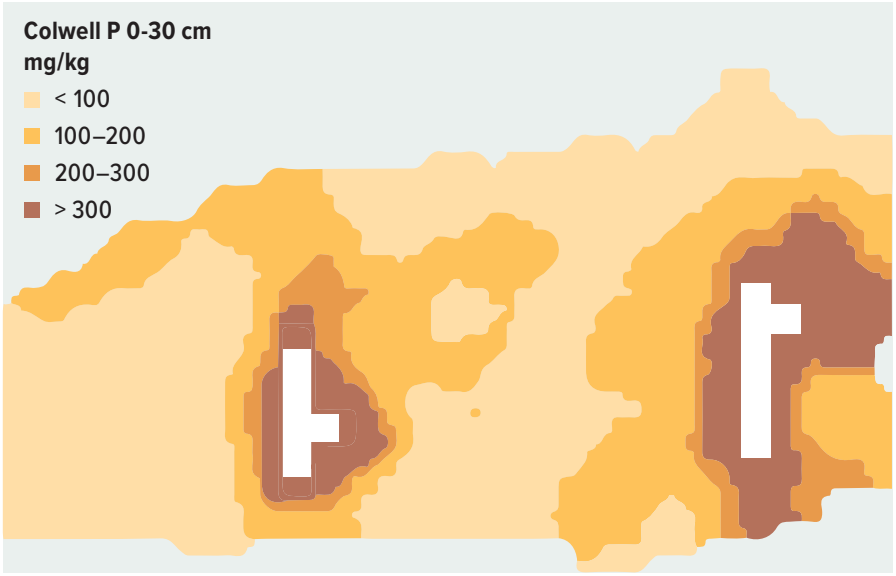

Figure 1. Phosphorus concentration in range areas associated with fixed sheds (Wiedemann and Zadow, 2010)

Nutrients in ground water can also influence surface water, where shallow aquifers are linked to the surface water system.

Other impacts to range areas include the denuding of groundcover, resulting in potential erosion and loss of soil structure, however the high organic content of manure can help to maintain and even improve soil structure.

Nutrient sources such as range areas should be assessed for environmental risk, then designed and managed to control these risks.

Nutrient deposition for fixed sheds

Most free range farms have fixed sheds and a range area around the shed. In these systems, nutrients are deposited in a predictable pattern.

Figure 1 shows that the soil available phosphorus concentration in free range areas is much higher in the areas closest to the shed and this pattern is the same for other nutrients. *Figure 2* shows that soil nitrate levels decrease significantly with distance from sheds, while *Figure 3*

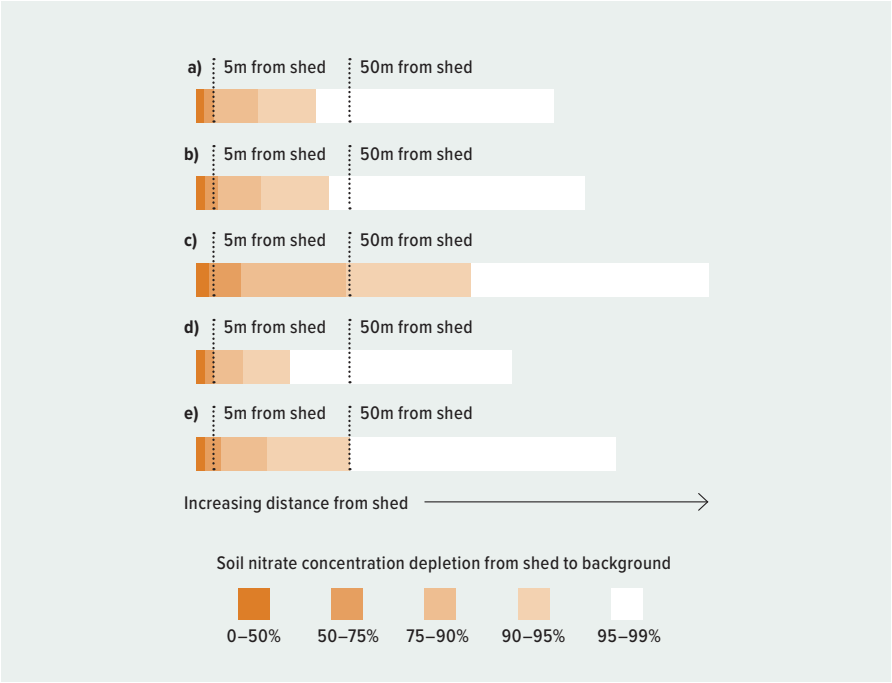

Figure 2. Soil Nitrate concentration and distance from sheds (Wiedemann et. al., 2018)

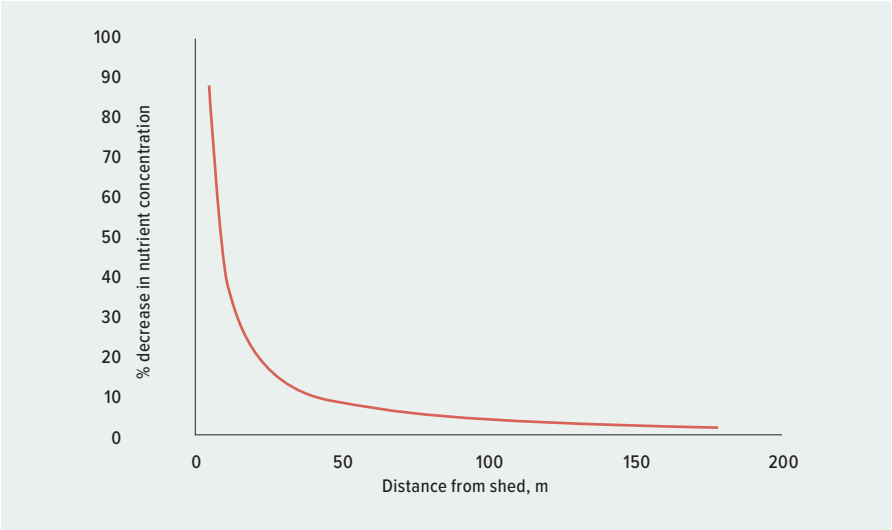

Figure 3. Combined soil nutrient (nitrate-N and available-P) levels and distance from shed (Wiedemann et. al., 2018

shows the trend for both nitrate and phosphorus, indicating that nutrient concentrations at 25m are less than 20% of the levels closest to the shed.

Based on recent research (Wiedemann et. al., 2018, Larsen et al., 2017) it is estimated that around 86% of manure deposition occurs within the shed and the remainder in the range area, with decreasing amounts deposited as you move away from the shed. This reduction in nutrient deposition can be divided into zones as described in *Table 1*. It is important to note that due to the size of Zone 3 (the remainder of the range), the nutrient concentration in this zone is much lower than in other zones and represents a lower environmental risk.

Table 1. Estimated manure deposition in each zone.

Area of Range	Distance From Shed	Estimated Manure Deposition
Zone 1	0–10m	10.5%
Zone 2	10–25m	1.5%
Zone 3	> 25m	2.0%

Effect of Fenced Areas

Fenced areas within the inner range are likely to restrict bird movement and result in higher nutrient deposition rates in the zone closest to the shed.

Management measures for fixed sheds

The Egg Industry Environmental Guidelines (Edition II – McGahan et al., 2018) provide a risk tool for evaluating nutrient loss potential from range areas. Please refer to the guidelines for a more thorough discussion of the risks associated with range areas, how these risks are calculated and subsequent management recommendations.

For 'high risk' sites the following management strategies are recommended in each zone.

Zone 1

The installation of roofed verandas with impermeable flooring and bunding to control manure nutrient loss immediately outside the exit point of each shed (i.e. 2–3m) is recommended to restrict nutrient loss.

Verandas of 2–3m are expected to restrict 50% of nutrient losses. Diversion of rainwater from these verandas and the shed roof is also recommended, to reduce water movement and subsequent nutrient loss. Verandas will require cleaning (as manure builds up in these areas), and removal of this manure/litter. Manure should only be spread in the outer range area (zone 3) after assessing the nutrient status via soil testing.

In the area between the veranda edge and 10m, drainage may be controlled by constructing an impermeable pad, or by using coarse rock or aggregate underlain with an impermeable base, to avoid problems with birds scratching through the pad.

Bunding should be provided to exclude stormwater from running onto these areas. Runoff from these areas may be managed using vegetative filter strips (VFS). More detail on VFSs can be found below.

Zone 2

Monitoring of soil nutrient levels is warranted to ensure unacceptable levels of nutrient accumulation do not occur. Where nutrient accumulation is observed, management strategies applied in other intensive livestock systems such as long-cycle rotations of range areas and nutrient removal via crop production could be used where site conditions allow. Rotation can also be achieved by using movable shelters. Alternatively, compacted pads, bunding and runoff control could be employed as in Zone 1.

Zone 3

The lower nutrient concentration, and higher groundcover in this area poses a reduced environmental risk, even on high risk sites. Wiedemann et al. (2018) showed nutrient levels in this zone, considering differences in background soil fertility, were typically within acceptable agronomic ranges for crop and pasture production and management.

Nutrient levels in this zone should be periodically monitored to check that levels do not increase substantially beyond pasture or crop requirements. If nutrient levels increase substantially, practices adopted in other intensive livestock systems would be suitable in these zones. These include: paddock rotation or periodic crop removal; together with ongoing monitoring to ensure soil nutrient levels do not pose unacceptable risk.

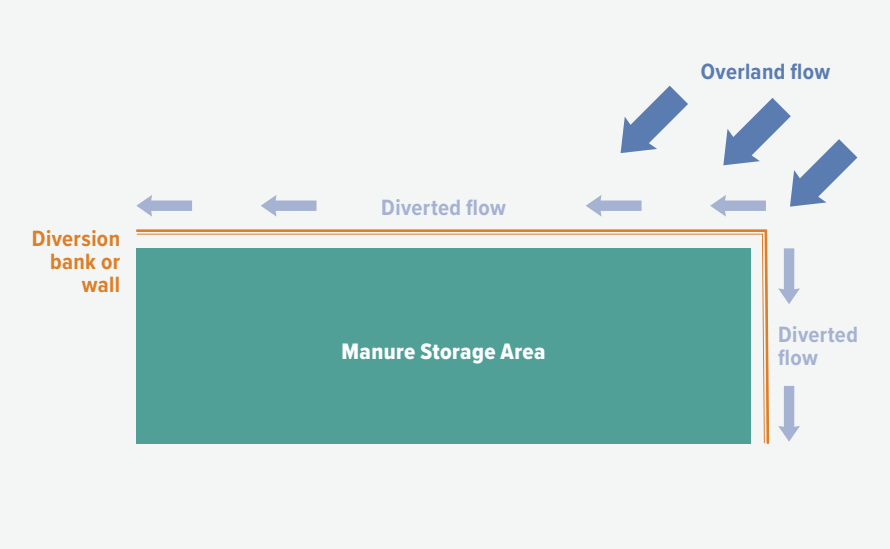

Figure 4. Diversion of overland flow

Refer to the *Egg Industry Environmental Guidelines* (Edition II – McGahan et al., 2018) for more information on monitoring testing and sampling information and suggestions. More detail on VFSs can be found below.

For 'low risk' sites, the following management strategies are recommended:

- Place compacted gravel from 0 to 6m from sheds.
- Divert water from roofs away from range areas.

Excluding overland flow

On high risk sites it is recommended to divert stormwater away from zones which contain the highest nutrient deposition. This prevents the overland flow of stormwater from being able to transport the nutrients (dissolved and in sediment). As shown in *Figure 4*, it is important to consider the site topography and direction of runoff, as any protective measures must redirect water away from the range area.

The measures used to redirect flow could include bunding, diversion banks, or appropriately sized and maintained drainage ditches. Any such measures are likely to cause diverted flows to become concentrated, increasing flow rate and erosive potential. This can be managed by maintaining groundcover along drainage lines, or installing measures which slow flow rates.

Maintaining Groundcover

Maintaining groundcover in free range areas can be difficult, particularly in high traffic areas near the sheds. Similar strategies to those used for nutrient management are appropriate:

- Rotate range areas to allow denuded areas to recover.
- If moveable shade structures are used, ensure they are regularly shifted to allow pasture to recover.
- Spread straw/hay in denuded areas to increase groundcover.

Where groundcover is particularly difficult to maintain, erosion controls are recommended. These include:

- Installing contour banks and associated drainage works.

- Constructing drains that minimise flow convergence and slow/spread flow where possible.
- Repairing rills before gullies form.
- Maintaining groundcover in drain areas, and fencing these areas off where necessary.
- Reducing the flow rate of runoff with control measures (e.g. swales, contour banks, VFSs).
- Using rock/gravel groundcover in high traffic areas such as Zone 1 and 2.
- Directing runoff to a VFS. More detail on VFSs can be found below

Effect of bird numbers

The number of birds present on the range will have a significant impact on the total amount of nutrient deposited in each zone.

Where the number of birds is doubled this is expected to result in double the total nutrient being applied to the range area. As a result, this will increase the total amount of nutrient available for loss, and the potential impacts.

Effect of Shed shape

Nutrient deposition is expected to occur within the same distance of the shed, regardless of shed size or shape. As such, the total area of Zone 1 is dependent on the length of the shed, as shown in *Figure 5*.

For any given number of birds, a smaller Zone 1 area results in higher nutrient deposition rates per m^2. This is associated with higher soil nutrient concentrations, and a higher risk of nutrient loss to the environment.

The manure removal frequency from Zone 1 areas should be determined from both the risk of nutrient loss from the site and the deposition rate of manure per m^2.

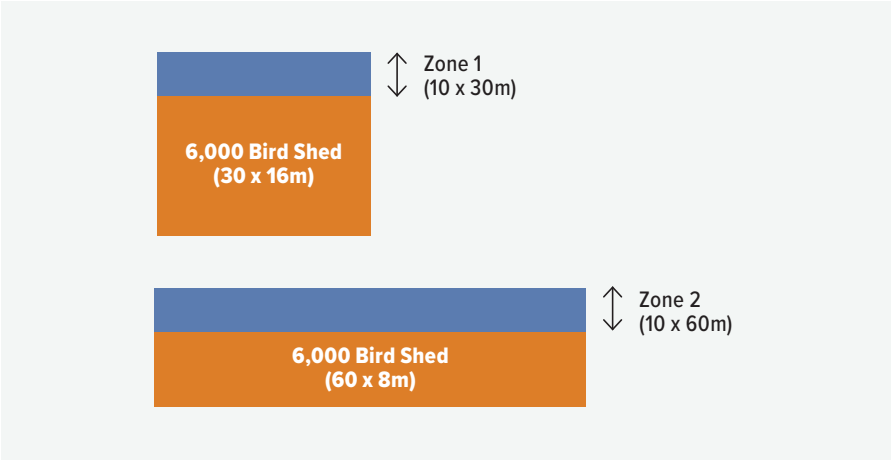

Figure 5. Effect of shed geometry on zone size

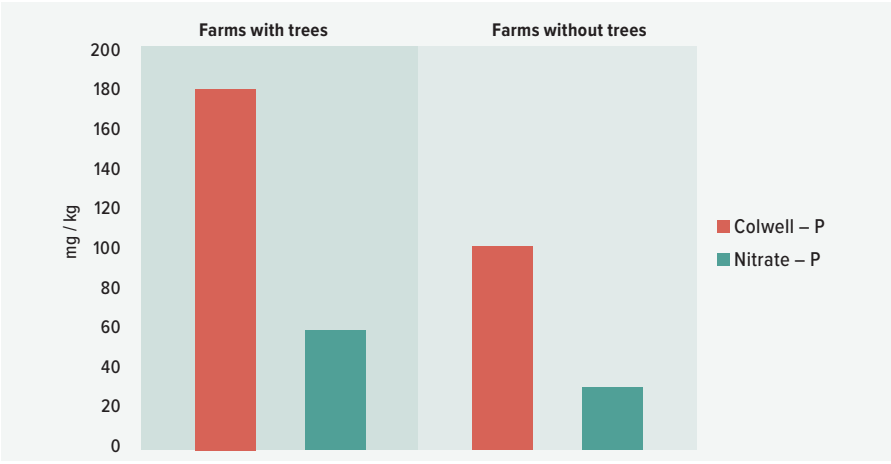

Figure 6. Average soil nutrient concentration on treed and non-treed range areas (Wiedemann et al. 2018).

Impact of Range Enrichment

The presence of trees on the range area has been shown to encourage ranging behaviour, and subsequently increase nutrient distribution further into the range, as shown in *Figure 6*.

Managing Impacts of Range Enrichment

Due to the high nutrient deposition associated with treed areas, a suitable management strategy needs to be developed for treed areas which allows for the regular collection and removal of manure from beneath trees and avenues.

Other forms of range enrichment using artificial structures have been shown to have a similar effect on the ranging behaviour of birds and subsequent nutrient deposition. Artificially enriched areas are also expected to be associated with reduced levels of ground cover.

Due to the difficulty of collecting manure from treed and other artifically enriched areas, artificial shade structures could be used. These structures could be placed on compacted pads to make manure collection easier. Arificial shade structures should also use impermeable roofing materials to exclude rainfall from the high nutrient areas under the shade structure.

An alternative approach is to regularly move shade and enrichment structures, allowing less manure to accumulate in each location and helping to maintain ground cover.

Where fixed structures are used, these areas could be fenced and access to birds allowed only on a rotational basis.

Impacts of Open Floored Housing

In open floored or slatted housing (such as some mobile bird housing) manure deposited within the shed is deposited directly onto the ground. If this manure is not collected, the total nutrient deposition on the range may be 7 times higher than an equivalent sized fixed shed (where only around 14% of nutrients may be deposited on the range area).

Managing Impacts of Open Floored Housing

Regularly moving open floored housing results in less manure deposition in each location. Housing movements should aim to provide fresh ranging areas for birds, ensuring that the majority of nutrient deposition (associated with the housing and immediate area) does not occur in recently used areas.

Regular rotation of range areas also allows for re-establishment of groundcover. Increased groundcover will also utilise nutrients in the manure, lowering the risk of nutrient loss. Groundcover also decreases the risk of erosion, and contributes to healthy soil structure.

Collecting manure from beneath bird housing significantly reduces the total amount of nutrients deposited onto the range. This can be achieved by laying plastic sheeting or similar under the housing unit and collecting the deposited manure for use off-site or spreading in areas of low nutrient deposition. This could be done when housing is moved. Alternatively, hard compacted areas could be provided for shed locations, allowing manure to be easily collected when the shed is moved.

Vegetative Filter Strips (VFS)

VFS are small areas of well maintained groundcover, which are used to reduce the nutrient levels in overland flow/surface runoff. They are designed and located so that runoff must flow across the VFS at a minimum water depth. This reduces runoff volume (though increased infiltration) and allows greater deposition of eroded soil and nutrients, as well as providing opportunity for nutrients to be adsorbed to soils.

The appropriate width of the VFS depends on the slope of the land, the type of vegetative cover within the buffer area and whether there are other stormwater control devices, such as diversion banks. Ideal grasses for a VFS are runner-developing, non-clump forming grasses that can effectively reduce nutrient and sediment concentrations in the runoff.

Generally, wider VFSs reduce the soil loss rate from erosion. However, for the same soil loss rate, areas with higher slopes need a wider VFS than areas with lower slope due to the higher speed of runoff. To be most effective a VFS needs to be located as close as possible to the nutrient source to minimise additional runoff. It is also critical to locate the VFS before any convergence of runoff (i.e. drainage lines).

More detail on how VFSs operate, their effectiveness and how they should be designed can be found in *Egg Industry Environmental Guidelines* (Edition II – McGahan et al., 2018).

Managing Vegetative Filter Strips
To maintain effective operation of a VFS:

- Remove sediment build up at the higher end of the drain or VFS to avoid any ponding.
- If the VFS becomes denuded, consider treatments to maintain high rates of groundcover, or reseed the VFS with runner type grasses. Seek guidance on appropriate species.
- Water during dry periods to maintain effective grass coverage over the VFS. Where appropriate (depending on environmental regulations), alternative water sources should be used to avoid use of potable water.
- Maintain sediment and erosion control measures upslope of the drain or VFS to reduce the sediment load.
- Ensure livestock do not damage the VFS.
- Avoid using VFSs for traffic.
- Avoid leaving tyre or tillage marks in VFSs when maintenance is required.
- Remove any woody stem plants before they exceed 50 mm in diameter from VFSs.
- Avoid damaging VFSs with herbicides and use mowing and slashing to control weeds.
- Consider a cut and cart operation from the VFS to remove mature plant material and promote new growth.

Summary of Recommendations

Range areas should be designed and managed based on the risk rating of the site and the likely nutrient deposition rates in the various zones (associated with distances from the sheds).

Additional management options to minimise environmental impacts from range areas include:

- Use of rotation and spelling to allow denuded areas to recover, which ideally includes hay production or cropping during the rotation phase, as this allows nutrients to be removed from the site. Grazing livestock on the area is significantly less effective than a cropping/pasture production for hay, as most of the nutrients are recycled back onto the site.
- If moveable shade structures are used, ensure they are regularly shifted to allow pasture to recover or use permanent structures that control nutrient loss by having an impermeable roof and a pad.
- If moveable sheds/caravans are used, ensure they are regularly shifted to allow pasture to recover and to reduce nutrient build-up. These operations can also consider a cropping/pasture harvest rotation or manure capture and removal if conducted on a high risk site.
- Monitor soil nutrients to ensure nutrient application and removal rates are sustainable.

References and Further Reading

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