



## FACT SHEET

### DEVELOPING A NUTRIENT MANAGEMENT PLAN FOR A ROTATIONAL OUTDOOR PIGGERY

Outdoor Piggery Fact Sheet Series  
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Nutrients can accumulate quickly in rotational outdoor piggeries. Without active management, manure nutrients are not evenly spread over the paddocks, which can quickly result in unsustainable levels over the areas between the shelters and the feeding, watering and wallowing areas. This poses an increased risk of soil degradation and nutrient transfer to any nearby surface waters and groundwater. It also provides a challenge for future crop production on that land.

A nutrient management plan (NMP) can assist operators of rotational outdoor piggeries to:

- document the existing operation
- develop a nutrient budget for the farm including nutrient application rates during the pig phase and nutrient removal rates during the crop / pasture / forage phase
- evaluate how evenly manure nutrients are spread
- identify potential nutrient loss pathways
- develop and implement an action plan for managing the risk.

#### Documenting Existing Operation

It is useful to include a description of the size, type and history of the operation.

*The piggery operated from 2000-2005 as a 500 sow breeder unit. Since 2006 it has operated as a 1000 sow breeder unit. It is a rotational outdoor system with a rotation including two years of pigs followed by one year of pasture (baled, 2 t DM/ha) and three years of barley (grain only, 3 t DM/ha). Dry sows are kept in paddocks set out in a radial with bedded group shelters. The average stocking density is 15 sows/ha (667 m<sup>2</sup>/sow). Farrowing sows are kept in rectangular paddocks with individual bedded shelters. The average stocking density of these paddocks is 10 sows/ha (1000 m<sup>2</sup>/sow). Piglets are weaned at 28 days and leave the site for rearing in deep litter shelters. The typical herd composition is: 830 dry sows, 170 farrowing sows, 50 boars, 55 gilts, 1725 suckers. The paddocks are largely denuded of vegetation within about six months of the start of the pig phase.*

Also describe the land, soil, groundwater and surface water resources.

*The site has a gentle slope of about 2% to the north. The soil across the site is a clay loam suitable for crop production. Groundwater, which provides the water source for the piggery, is approximately 30 m below ground level. A creek forms the northern boundary of the property. The boundaries of the pig paddocks are always at least 50 m from the creek. This buffer zone is kept well vegetated with permanent pastures. There are no other significant drainage lines on the farm.*



## Preparing a Nutrient Budget

Rotational outdoor piggeries are net accumulators of nutrients since nutrients brought in as pigs, feed and bedding are not matched by removals through pigs and gaseous losses. The balance remains as manure and spent bedding (unless this is removed from the paddocks). Surplus nutrients can be removed by growing and harvesting crops, forage or pastures after the pig phase.

The nutrient budget must cover the pig phase and the crop / forage / pasture harvesting phase. The nutrients added during the pig phase can be estimated using PigBal 4 model or from data provided in the National Environmental Guidelines for Rotational Outdoor Piggeries (revised 2013), bearing in mind that the data provided are derived from intensive conventional piggeries and may under-estimate nutrients added to outdoor rotational piggery systems. The steps in preparing a nutrient budget using this data are provided overleaf. However, APL has also developed a Nutrient Balance Calculator for Rotational Outdoor Piggeries that estimates nutrients added by the pigs and nutrient removal by crop production. The calculator is available on the APL website: [www.australianpork.com.au](http://www.australianpork.com.au)

*The nutrient budget (overleaf) identified that the mass of nutrients added by the pig phase is not being matched by the crop / forage / pasture phase. For example, there is an average nitrogen surplus in the dry sow area of 175 kg/ha at the end of the rotation. For the farrowing area there is an average nitrogen surplus of 637 kg/ha.*

*The producer needs to reconsider his rotation to achieve a balance between nutrients added and nutrients removed.*

## Evaluating How Evenly Manure Nutrients are Spread

It is important to recognise that while the nutrient budget provides a guide to the total amount of nutrients added to the system as pig manure, it does not tell the whole story. Most of the manure from pigs kept outdoors is concentrated in the area between the shelter and the feeding area and other facilities. Active site management is needed to promote more even manure distribution over the whole paddock area in order to reduce environmental risk. This involves regularly relocating moveable facilities around the paddock (e.g. shelters and feeding points). If this does not occur, the nutrient-rich hot-spots that result pose an increased risk of soil structure damage, nutrient build up and nitrate-nitrogen leaching during both the pig phase and the cropping phase that follows. There is also an increased risk of nutrient removal in runoff or as eroded soil. Increased harvests from the hot spot areas will also be needed to remove the nutrients from these areas.

*Paddock installations are not regularly moved in the dry sow paddocks. Wallows are replaced if they become too deep. Spent bedding is spread evenly over the paddocks.*

*Manure nutrients would be concentrating in the areas between the shelters and the feeding area and other facilities.*

*In the farrowing paddocks shelters are relocated after each litter is weaned. The spent bedding is spread in the paddock or removed. Wallows are replaced if they become too deep.*

Providing shelters are regularly moved over the majority of the paddock, better manure nutrient dispersal might be expected in the farrowing paddocks. However, regular movement of the feeding area and possibly other installations would enhance this dispersal.



## Potential Nutrient Loss Pathways

This section should evaluate the detail contained in the previous sections, along with any soil analysis results, and identify areas where there is a significant risk of nutrient losses.

*In both the dry sow and the farrowing paddocks there is a significant surplus of nutrients, with the farrowing paddocks being of particular concern. It is also likely that nutrients are concentrating on parts of the paddocks, particularly in the dry sow paddocks. Although there is no shallow groundwater, there is a significant risk of nitrate leaching during both the pig and pasture / cropping phases due to the level of nitrogen surplus. This may eventually contaminate the groundwater.*

*The stocking rate is such that the paddocks are denuded about six months into the pig phase. This increases the erosion risk. Because the soils have high nutrient levels a significant nutrient load will be carried in the eroded soil. The vegetated filter strip between the paddocks and the creek offers some protection but is only a secondary measure.*

### Mortalities Management

Good mortalities management is needed to prevent nutrient movement to groundwater and surface waters; odour nuisance; spread of diseases; and vermin breeding.

Rendering and composting pose a lower environmental risk than burial or incineration. This section should describe the routine mortalities management and the plan for managing a mass mortalities event.

To prevent water impacts, carcass composting should be undertaken within a bunded area with a compacted base that sits at least 2 m above the water table.

Each carcass should be surrounded with at least 300 mm of sawdust, spent litter or similar to promote low odour aerobic composting. Keeping carcasses well covered reduces the interest from vermin and the disease transfer risk. The finished compost is suitable for spreading on land at sustainable rates. Grazing stock should be excluded from land for three weeks after the compost is spread to minimise disease transfer risks.

Burial may be an option if composting and rendering are not feasible. To prevent water impacts, burial pits should be situated on low permeability soils and / or low risk sites. The base of the pits should sit at least 2 m above the highest water table. Carcasses need to be kept well-covered with soil or other suitable material to avoid scavenging and to prevent odour.

An effective response to a mass mortalities event requires planning. It is important to identify a suitable disposal site and have a contingency plan in place. State government veterinary officers have the main responsibility and resources to combat an exotic disease outbreak and should be contacted regarding the selection of a site and disposal method but also in the event of a suspected disease outbreak. AUSVETPLAN (2015) provides useful information for managing a mass mortalities event.



## Regular Soil Monitoring

Regular soil monitoring can confirm that nutrients are maintained at levels that do not pose an environmental risk. This should occur before a pig phase commences to provide baseline data and confirm that the soil is suitable to run pigs. Thereafter soil monitoring should be undertaken at least every two years during the pig phase. For more heavily stocked paddocks, annual soil monitoring is recommended. Samples should be collected from areas that are expected to be nutrient-rich (i.e. between the areas that have been sites for shelters feeding, waterers and wallows).

If interpretation of the results confirms that soil nutrients are at suitable levels the area can be used for ongoing or subsequent pig phases.

If the results show high or unsuitable levels, the area should be destocked and action taken to reduce soil nutrients to acceptable levels through crop or forage production and harvest, and address any degradation concerns.

## Action Plan for Managing the Risk

This section needs to provide targeted action to reduce the likelihood of nutrients losses. When planning rotations, it is important to aim for a balanced nutrient budget.

In the example provided in this Fact Sheet, there is a need to reduce nutrient inputs (e.g. by reducing the stocking density or shortening the length of the pig phase) and / or increase nutrient removals (e.g. by growing crops that remove more nutrients like hay or silage crops; or by lengthening the cropping phase). Where a significant nutrient surplus exists, the planned length of the pig phase should not exceed two years. Reducing the stocking density

and / or shortening the length of the pig phase will also help to retain groundcover which is the primary protection against soil erosion. The action plan would specify how the pig phase will be managed (length, stocking densities of paddocks) and a crop / forage / pasture phase that achieves satisfactory nutrient removal.

There is also a need to promote more even nutrient distribution over the paddocks to minimise the risk of nutrient hot-spots. An action plan would identify the actions needed to achieve a better outcome.

Good mortalities management is important to prevent transfer of nutrients to groundwater or surface waters. If changes to mortalities management are warranted, the action plan would describe how these would be enacted.

If soil monitoring is not a part of the piggeries management, an action plan for implementing this should be developed.

*An action plan for the example used in this Fact Sheet follows:*

*From 1 July 2017 Promote more even nutrient distribution over the paddocks by moving shelters and self-feeders around the paddocks at least quarterly.*

*By 1 Jan 2018 Design a pig and crop / forage / pasture rotations that will achieve a balanced nutrient budget. This must involve a 50% reduction in stocking density and / or shortening of the pig phase to retain groundcover for longer. It may also involve extending the length of the crop / forage / pasture phase and / or growing different crops.*

*By 1 Mar 2018 Implement regular two-yearly soil monitoring across the farm. Undertake baseline soil monitoring for new areas before the pigs arrive. For paddocks under pigs, sample the areas that are likely to be nutrient-rich ie areas where shelters, waterers, wallows and feeders have been located.*



## Other Fact Sheets in this Series

- Land and Water Protection Measures for Rotational Outdoor Piggeries
- Promoting More Even Distribution of Manure Nutrients in Rotational Outdoor Piggeries
- Soil Monitoring for Rotational Outdoor Piggeries

## References and Further Reading

Australian Pork Ltd, ND, Nutrient Balance Calculator for Rotational Outdoor Piggeries,  
<http://australianpork.com.au/industry-focus/environment/outdoor-production/>

Australian Pork Ltd 2013 (revised) National Environmental Guidelines for Rotational Outdoor Piggeries, Australian Pork Ltd, Deakin.

AUSVETPLAN 2015, Operational Procedures Manual: Disposal – Version 3.q, Animal Health Australia, Canberra.

Department of Agriculture and Fisheries, 2013, PigBal 4: A Nutrient Mass Balance Model for Intensive Piggeries, Department of Agriculture and Fisheries, Brisbane.

## Preparing a Nutrient Budget

The nutrient budget for the pig phase involves the following steps:

- I. Estimate nutrient inputs to paddocks:  
*Example calculations for a 100-sow breeder unit are provided below. It is assumed that the herd consists of 83 dry sows running on 6.24 ha at any one time, and 17 farrowing sows and piglets running on 1.7 ha at any one time. The calculations are for nitrogen only and would need to be repeated for phosphorus and potassium.*
  - Calculate manure nutrients. Table 10.1 of the National Environmental Guidelines for Rotational Outdoor Piggeries (2013) (revised) (NEGROP) provides generic nutrient outputs for different classes of pigs. These can be used to estimate the manure nutrient output for the entire dry sow area and for the entire farrowing area. e.g.

### Dry sow area:

*Nitrogen added:*

83 dry sows X 13.9 kg N/hd/yr = 1154 kg N/yr

5 boars X 15 kg N/hd/yr = 75 kg N/yr

5 gilts X 12 kg N/hd/yr = 60 kg N/yr

Total nitrogen added as manure = 1289 kg/yr

### Farrowing area:

*Nitrogen added:*

17 lactating sows X 27.1 kg N/hd/yr = 461 kg N/yr

173 suckers X 2.3 kg/hd/yr = 398 kg N/yr

Total nitrogen added as manure = 859 kg N/yr



- Nutrients also enter the paddocks as bedding. Table 10.2 of NEGROP provides typical total solids and nutrient content data for clean bedding materials.

Assuming each adult pig uses 400 kg/yr of barley straw for bedding, the nitrogen added as bedding is:

Dry sow area:

Nitrogen added:

83 pigs X 400 kg straw X (91/100) (total solids content of straw) X (0.69/100) (N content of dry matter in straw) = 209 kg N/yr

Farrowing area:

Nitrogen added:

17 sows X 400 kg straw X (91/100) (total solids content of straw) X (0.69/100) (N content of dry matter in straw) = 43 kg N/yr

- The nutrients in the manure and bedding are then summed to get an estimate of the total nutrients added to the soil. e.g.

Dry sow area:

Nitrogen added:

Manure N (1289 kg N/yr) + bedding N (208 kg N/yr) = 1497 kg N/yr

Farrowing area:

Nitrogen added:

Manure N (859 kg N/yr) + bedding N (43 kg N/yr) = 902 kg N/yr

- For nitrogen only, some volatilisation losses (~20%) would be expected. These

need to be subtracted from the mass of nutrients added to the soil

Dry sow area:

Nitrogen remaining after volatilisation losses = 1497 kg N/yr X (1-0.2) = 1198 kg N/yr

Farrowing area:

Nitrogen remaining after volatilisation losses = 902 kg N/yr X (1-0.2) = 722 kg N/yr

- These total nutrient quantities then need to be converted to application rates (kg/ha) by dividing the mass by the total area of land e.g.

Dry sow area:

1198 kg N/yr / 6.24 ha = 192 kg N/ha/yr.

The length of the pig phase is 2 years so the net application rate needs to be multiplied by 2. Hence, the nitrogen application rate for the pig phase is 384 kg N/ha.

Farrowing area:

722 kg N/yr / 1.7 ha = 425 kg N/ha/yr.

The length of the pig phase is 2 years. Hence, the net nitrogen application rate for the pig phase is 850 kg N/ha.

- Estimate nutrient removals from paddocks as plant harvest. Table 14.4 of NEGROP provides nutrient removal rates for a range



of crops, forages and pastures. Example calculations for nitrogen only are provided below. The calculations would need to be repeated for phosphorus and potassium.

- Following the pig phase, pasture yielding 2 t DM/ha) is grown on the area for one year followed by three years of barley (3 t DM/ha).

#### Pasture

The harvested yield is 2 t DM/ha so the nutrient removal rate is:

$$2 \text{ t DM/ha} \times 20 \text{ kg/t} = 40 \text{ kg/ha}$$

#### Barley

The harvested yield is 3 t DM/ha so the nutrient removal rate is:

$$3 \text{ t DM/ha} \times 19 \text{ kg/t} = 57 \text{ kg/ha}$$

#### Total Nutrient Removal

One year of pasture and three years of barley are grown and harvested.

$$40 \text{ kg/ha} = (3 \times 57 \text{ kg/ha}) = 211 \text{ kg/ha}$$

Note: This assumes no fertiliser is applied to the pasture or barley. If fertiliser is applied this needs to be subtracted from the total nutrient removal rate. E.g. if 20 kg N/ha were applied each year, a total of 80 kg N/ha would need to be subtracted leaving a net nitrogen removal rate of 131 kg N/ha.

- Determine Nutrient Budget. The nutrient budget is the nutrient application rate less the nutrient removal rate. *Example calculations for nitrogen only are provided below.*

*The calculations would need to be repeated for phosphorus and potassium.*

E.g.

#### Dry sow area:

$$384 \text{ kg N/ha} - 211 \text{ kg N/ha} = 173 \text{ kg N/ha}$$

N/ha

#### Farrowing area:

$$850 \text{ kg N/ha} - 211 \text{ kg N/ha} = 639 \text{ kg N/ha}$$

In both cases, there is a significant surplus of nitrogen, with the surplus for the farrowing area being of particular concern.

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