AUSTRALIAN Pork

Fact Sheet

FACT SHEET

Outdoor Piggery Fact Sheet Series
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DEVELOPING A NUTRIENT MANAGEMENT PLAN FOR A ROTATIONAL OUTDOOR PIGGERY

Nutrients can accumulate quickly in rotational outdoor piggeries. Without active management, manure nutrients are not evenly spread over the paddocks, which can 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 accommodated in paddocks set out in a radial with bedded group shelters. The average stocking density is 15 sows/ha (667 m^2/sow). Farrowing sows are accommodated in rectangular paddocks with individual bedded shelters. The average stocking density of these paddocks is 10 sows/ha (1000 m^2/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 about six months after the commencement 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 is approximately 30 m below ground level. It is the water source for the piggery. 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. There are no other significant waterways or dams on the farm.

Preparing a Nutrient Budget

Rotational outdoor piggeries are net accumulators of nutrients since nutrients imported 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.

A nutrient budget is needed for the pig phase and for the entire rotation. The PIGBAL model (DPI 2006) is a very useful tool to use for the pig phase. However, data provided in the National Environmental Guidelines for Piggeries (2010) can be used to prepare an approximate budget, 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 are provided overleaf.

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 181 kg/ha at the end of the rotation. For the farrowing area there is an average nitrogen surplus of 637 kg/ha.

Evaluating How Evenly Manure Nutrients are Spread

Research has confirmed that manure nutrients are not evenly distributed across the paddocks of outdoor rotational piggeries.

Rather they are concentrated in the area between the shelter and the feeding area and other installations.

Active site management is needed to promote even manure excretion. This involves regularly relocating moveable installations 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 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.

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.
It is likely that manure nutrients are concentrating in the areas between the shelters and the feeding area and other installations.
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 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 not being distributed evenly in 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 well-covered with soil or other suitable material each day 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 (2007) provides useful information for managing a mass mortalities event.

Regular Soil Monitoring

Regular soil monitoring can confirm that nutrients are maintained at levels that pose an acceptable ecological risk. Ideally this should occur before a pig phase commences to ensure that the soil has suitable properties for use by pigs. This will also provide benchmark data for comparison with future analysis results. Thereafter soil monitoring should usually be undertaken at the end of any two year period that includes a 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 shelters and the feeding area).
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 they do not, action must be taken to reduce soil nutrients to acceptable levels.

This will generally involve destocking the land and growing and harvesting plant material from the area.

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 when harvested like hay or silage crops; or by lengthening the cropping phase). Where a significant nutrient surplus exists, the length of the pig phase should not exceed two years. There is also a need to promote even nutrient distribution over the paddocks to minimise the risk of nutrient hot-spots.

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.

Good mortalities management is important to prevent transfer of nutrients to groundwater or surface waters.

Regular soil monitoring can confirm that nutrients are maintained at suitable levels or identify risks.

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

From 1 July 2012 Promote more heterogeneous nutrient distribution over the paddocks by moving shelters and self-feeders around the paddocks at least quarterly.

By 1 Jan 2013 Design future 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 2013 Implement regular two-yearly soil monitoring across the farm. Undertake baseline soil monitoring for new area and sampling of the nutrient-rich areas of the existing pig paddocks.

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 2010 National Environmental Guidelines for Piggeries 2nd Edition (revised), Australian Pork Ltd, Deakin.

AUSVETPLAN 2007, Operational Procedures Manual: Disposal – Version 3, Animal Health Australia, Canberra.

Casey, K, McGahan, E, Atzeni, M, Gardner, E and Frizzo, R 1996, PIGBAL: A Nutrient Mass Balance Model for Intensive Piggeries, Department of Primary Industries, Brisbane.

Preparing a Nutrient Budget

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

1. Estimate nutrient inputs to paddocks:
   Example calculations for nitrogen only are provided below. The calculations would need to be repeated for phosphorus and potassium.

   - Table 9.1 of the National Environmental Guidelines for Piggeries (2010) (revised) (NEGP) 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.

     <u>Dry sow area:</u>
     Nitrogen added:
     830 dry sows X 13.9 kg N/hd/yr = 11,537 kg N/yr
     50 boars X 15 kg N/hd/yr = 750 kg N/yr
     55 gilts X 12 kg N/hd/yr = 660 kg N/yr

     Total nitrogen added as manure = 12,950 kg/yr

     <u>Farrowing area:</u>
     Nitrogen added:
     170 lactating sows X 27.1 kg N/hd/yr = 4607 kg N/yr
     1725 suckers X 2.3 kg/hd/yr = 3968 kg N/yr

     Total nitrogen added as manure = 8575 kg N/yr
   - Nutrients also enter the paddocks as bedding. Table 9.2 of NEGP 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:
935 pigs X 400 kg straw X (91/100) (total solids content of straw) X (0.69/100) (N content of dry matter in straw) = 2350 kg N/yr

Farrowing area:
Nitrogen added:
170 sows X 400 kg straw X (91/100) (total solids content of straw) X (0.69/100) (N content of dry matter in straw) = 430 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 (12,950 kg N/yr) + bedding N (2350 kg N/yr) = 15,300 kg N/yr

  Farrowing area:
  Nitrogen added:
  Manure N (8575 kg N/yr) + bedding N (430 kg N/yr) = 9005 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:
  15,300 kg N/yr / 62.4 ha = 245 kg N/ha/yr.

  In the case of nitrogen only, some volatilisation losses will occur. Assuming these are 20%, the net nitrogen application rate is:

  245 kg N/ha/yr X (1-(20/100) = 196 kg/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 392 kg N/ha.

  Farrowing area:
  The land area is calculated by multiplying the total number of pigs by the area per pig (ha). E.g.
  170 sows x (1/10 ha/sow) = 17 ha.

  Then the mass of nutrient is divided by the area e.g.

  9005 kg N/yr / 17 ha = 530 kg N/ha/yr.

  In the case of nitrogen only, some volatilisation losses will occur. Assuming these are 20%, the net nitrogen application rate is:

  530 kg N/ha/yr X (1-(20/100) = 424 kg/ha/yr.

  The length of the pig phase is 2 years. Hence, the net nitrogen application rate for the pig phase is 848 kg N/ha.

2. Estimate nutrient removals from paddocks as plant harvest. Table 14.4 of NEGP 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 t DM/ha X 20 kg/t = 40 kg/ha

     Barley
     The harvested yield is 3 t DM/ha so the nutrient removal rate is:
     3 t DM/ha X 19 kg/t = 57 kg/ha

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

     40 kg/ha = (3 X 57 kg/ha) = 211 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.

3. 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:
392 kg N/ha - 211 kg N/ha = 181 kg N/ha

Farrowing area:
848 kg N/ha – 211 kg N/ha = 637 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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