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CASE STUDIES USING THE OUTDOOR PIG MODEL IN OVERSEER®

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Abstract

Regional Councils have signalled that the primary method of recording nitrogen leaching rates will be through the use of OVERSEER® Nutrient Budget (OVERSEER). While indoor pig farms in New Zealand can be modelled using OVERSEER®, outdoor bred pigs which comprise 40% of New Zealand production, until recently could not be modelled in OVERSEER. An NZPork and Sustainable Farming Fund funded project set out to integrate outdoor pigs into OVERSEER®. Outdoor pig farms require low rainfall and free draining soil and as such are situated in Canterbury. Outdoor pig farms are different for a variety of reasons; including soil type, rainfall, farm and land area under pigs, stocking rate, ground cover, productivity and feed type. Development of the outdoor pig module required inputs limited to the key parameters that were easy to obtain, and where possible assumptions and default figures were used. Case studies were undertaken on two farms using a development version of OVERSEER (Version 13).

Farm 1 had a total area of 196 ha, of which 65 ha was running 900 sows. The remaining 106 ha was pastoral with sheep and dairy grazers, 15 ha forestry and the balance being housing and sheds. The soil type was a Lismore silt loam, annual rainfall of 717 mm and sow feed intake of 1.53 tonne/sow/year. OVERSEER determined a nitrogen (N) leaching rate of 14 kg N/ha over the whole farm and 33 kg N/ha under pigs.

Farm 2 had a total area of 118 ha, of which 13 ha was running 390 sows. The remaining 73.8 ha had cattle grazing, fodder beet and green oats on 23.2 ha and lucerne on 6.5 ha. The soil type was Timaru and Rakaia, with an average rainfall of 554 mm and sow feed intake of 1.45 tonne/sow/year. The predicted whole farm N leaching rate was 25 kg N/ha and under the pigs 71 kg N/ha.

For the case study farms the inputs were varied to highlight the key influencers on N leaching. The inputs varied were ground cover, stocking rate and rainfall, followed by feed make up and usage, with productivity factors such as weaning weight, sow performance, replacement rates having less effect.

Introduction

Across New Zealand (NZ), farmers as well as Regional Councils are asking for increasing levels of information about nutrient losses from primary production activities. Regional Councils, through their regional plans, are signifying that their preferred (and in some cases required) method of analysing and reporting this information is through OVERSEER® Nutrient Budget (OVERSEER). Environment Canterbury (ECan) regional plan requires all farms to be able to produce OVERSEER nutrient budgets. Canterbury is NZ's largest pig production area and is home to the majority of NZ's outdoor breeding operations. When this was proposed, outdoor pig production techniques could not be modelled using OVERSEER.

In response, NZPork, to maintain its proactive status and being environmentally responsible, started a number of projects to fill in the research gaps during the gradual integration of outdoor sow production into OVERSEER. Outdoor pig farmers require knowledge of their nutrient leaching profile underneath outdoor piggeries in order to understand their impact and if required, to develop mitigation solutions. An NZPork and Sustainable Farming Fund project titled: *PigSeer-Integrating Outdoor Pigs into OVERSEER* was undertaken to allow this to happen and two case studies undertaken as part of this project are described here.

The majority of outdoor farms consist of breeding herds producing weaners that are either transferred to other parts of the farm or sold off farm. Only a small numbers of growing pigs are finished outdoors. The sows are maintained on paddocks within a block for all stages of their reproductive cycle (Figure 1). This block may be part of an arable cropping rotation on the farm. Stock numbers remain reasonably constant with sows moving to different parts of the farm depending on the stage of reproductive cycle.

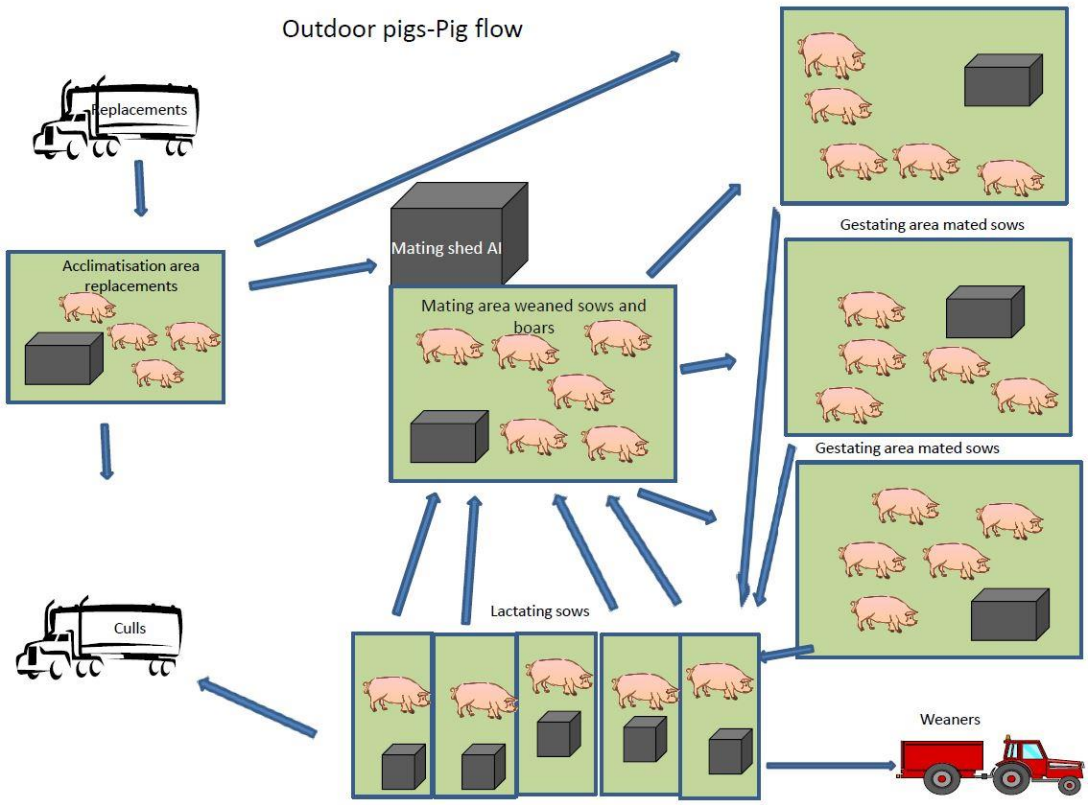

Figure 1: Conceptual layout of an outdoor breeding pig farm

The majority of the sows feed requirement is brought in, with little reliance on grass as a feed source. The nutritive feed make-up is known and sows are fed known levels of feed on a daily basis.

Material and Methods

The project was undertaken in a number of stages. The first stage was designed to get an understanding of the range of management and farming practices that occur on outdoor pig farms. This involved an extensive survey of outdoor pig farms to obtain what was considered 'normal' practice and to determine realistic performance boundaries. An 'outdoor pig farming working group' was then established to determine good management practice for outdoor pig farms. This was used as a baseline for nutrient modelling by OVERSEER.

OVERSEER is a computerised nutrient budget model that:

- Tracks nutrient flows into, out of, and within the farm system
- Estimates off-farm losses e.g. N leaching
- Calculates maintenance fertiliser and lime requirements
- Can identify nutrient hotspots i.e. high loss blocks
- Can run "what if" scenarios to assist with mitigation strategies

Nutrient Budget

In calculating the nutrient flows for outdoor pig farms it is important to understand that each farm will be different for a variety of reasons.

These include:

- Soil type
- Rainfall
- Total farm area and area under pigs
- Farming systems on the rest of the farm
- The percentage of ground cover
- Productivity levels
- Feed type and make up
- Feeding levels
- How these factors interact with each other

The inputs required for the test OVERSEER Outdoor Pig Model are limited to the important and key factors associated with nutrient flows from outdoor pig farming. The information required is easy to obtain. Assumptions and calculations are used where hard to obtain input data are required. An example of this is the use of chopper dead weights to calculate the live weight of cull stock leaving the farm. Being monogastric, pigs cannot rely on grass as a source of nutrition so the supplementary feed component is important. Pigs are fed well formulated and balanced diets that supply their required amino acid and energy levels. Assumptions have been made for feed losses from different feed methods (feeding in a trough v on the ground) as well as the form the feed is supplied e.g. pellets or meal. Further to this, standard default figures are available to be used for the nutritive make up of feed and feeding levels for various classes of stock and stage of production.

Data Input parameters

The data collected on the two case study farms to develop nutrient budgets using a test version of OVERSEER for outdoor pigs were:

- Soil and climate data.
- Sow herd size – this is the number of mated gilts and sows
- Number of boars
- Replacement rates for boars and sows. This determines the nutrients brought on the farm when they arrive and exported off when they are culled.
- Mortality rates
- Weight of weaned pigs
- Numbers of weaners/sow/year

- The percentage ground cover on the farrowing paddocks, dry sow paddocks and mating paddocks. These areas have different 'wear' patterns along fence lines, around huts, troughs and wallows.
- Daily feed levels in kg/animal/day.
- Feed makeup - amino acid, energy and mineral levels
- Straw usage and how the straw is managed on farm.

Photo 1: Lactating sow paddock with good ground cover

Results and discussion

Case study farms: brief descriptions

Case Study Farm 1

This farm had a total area of 196 ha, made up of 65 ha under pigs, 106 ha pastoral, 15 ha of forestry, with the balance being housing and sheds. On the pig block the farm was running 900 sows (14 sows/ha), with an annual per sow feed dry matter intake of 1.53 tonnes/sow.
The area had a rainfall average of 717 mm per year. The farm has a soil type of Lismore silt loam (Brown soil). The pastoral part of the farm ran sheep and dairy grazers.

Case Study Farm 2

This farm had a total area of 118 ha, made up of 13 ha under pigs, 73.8 ha pastoral, 23.2 ha of crops, 6.5 ha crops with the balance being housing and sheds. On the pig block, the farm was running 390 sows (30 sows/ha) in a cropping rotation, with an annual per sow feed dry matter intake of 1.45 tonnes/sow. The area had a rainfall average of 554 mm per year. The farm has two soil types consisting of Timaru (Pallic soil) and Rakaia (Recent soil). The pastoral part of the farm ran beef and the crops were fodder beet and oats.

Table 1: Input figures used for case study farm 1

Input parameter	Figures used
Sows herd (sows and mated gilts)	900
Cull dead weight (kg)	150
Replacement rate % (sow herd)	35
Litters/sow/year	2.2
Piglets weaned/litter	10
Weaning age (days)	28
Weaning weight (kg)	7.5
No. boars on hand	16
Boar replacement rate %	50
Time replacements on hand before entry to herd (days)	70
Feed levels	default
Feed composition	default
Lactating sows feeding method	Ad lib feeder
Dry, mating and replacement sow feeding method	On the ground
Lactating sow ground cover %	90
Dry sow ground cover %	28

Whole farm nutrient budget calculated nitrogen leaching at 14 kg N/ha and under the pig block it calculated nitrogen leaching at 33 kg N/ha

Table 2: Input figures used for case study farm 2

Input parameter	Figures used
Sows herd (sows and mated gilts)	390
Cull dead weight (kg)	140
Replacement rate % (sow herd)	50
Litters/sow/year	2.3
Piglets weaned/litter	10.3
Weaning age (days)	28
Weaning weight (kg)	8.6
No. boars on hand	16
Boar replacement rate %	50
Time replacements on hand before entry to herd (days)	63
Feed levels	default
Feed composition	default
Lactating sows feeding method	Ad lib feeder
Dry, mating and replacement sow feeding method	Into a trough
Lactating sow ground cover %	42.5
Dry sow ground cover %	37

Whole farm nutrient budget calculated nitrogen leaching at 25 kg N/ha and under the pig block it calculated nitrogen leaching at 71 kg N/ha

Considering ‘what if” scenarios, there are a number of options that can be explored. Shifts in the input parameters were investigated to demonstrate the influence each input had on calculated nitrogen leaching In addition to this, more capital intense factors such as housing sows for a proportion of the time can be used as a mitigation practice to reduce nutrient loading. An example of this would be to house sows at farrowing which would reduce direct loading to soil as well as increasing the weaner output.

Table 3: Summary of factors that affect the scale of N leaching for outdoor pigs.

Larger	Medium	Smaller
Ground cover Stocking rate Rainfall Soil type	Feed make up Feed usage	Replacement rate Chopper weight Weaning weight Pigs weaned/litter Litters/sow/year.

Given the fact that ground cover can have such a large effect on nitrogen leaching, maintaining ground cover becomes very important. The amount of ground cover is linked to stocking rate- obviously more sows/ha there will be more activity which will reduce ground cover. Paddocks where mating occurs will be high activity areas and as such will have less ground cover. They may require ‘spelling’ or those paddocks could be larger to allow for lower stocking density. In addition, with a higher stocking rate, more feed inputs will be required which will lead to more nutrients being excreted. An important management factor that affects ground cover is ‘ringing’ of the sows’ nose to prevent ‘rooting’ of the ground cover. A regular maintenance programme of ‘over-sowing’ with rye grass at an appropriate time of the year and spelling of paddocks if the system allows it, will assist to maintain good ground cover.

None of these parameters can be considered in isolation. For example if the level of feed is reduced or the protein specifications are lowered, it will reduce the calculated amount of N leaching, but will have negative effects on sow productivity. The effect may be smaller litters or lower weaning weight, both of which will increase the level of N leaching. With feed level waste minimisation is critical, the use of feeders reduce feed loss to soil when compared to feeding on the ground.

In looking at mitigation strategies it will be combinations of these parameters that will determine the calculated N leaching level. Farmers will need to evaluate the effectiveness and cost of mitigation options, which will depend on soil type and management systems. They need to identify and implement cost effective strategies such as reducing feed wastage and maintain ground cover before moving on to removing sows off paddocks into sheds where the nutrients produced can be contained.

Conclusion

The test OVERSEER model for outdoor pig farms used in these examples gives a calculated nitrogen leaching level and allows outdoor pig farmers to meet the regulatory requirements of supplying a farm environment plan with an OVERSEER nutrient budget. The test model also allows ‘what if’ scenarios to be developed and explore possible mitigation options

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