

### EFFLUENT MANAGEMENT – Sustainable land reuse

Intensive livestock production in the Condamine region creates a large volume of high strength effluent which needs to be reused in a sustainable way. Particularly, pork production (in conventional systems) and abattoirs produce relatively large volumes of effluent.

Provided effluent is managed carefully, this by-product can be a valuable nutrient resource for irrigating onto agricultural land. Land application of effluent can allow for nutrient and water usage by crops and nutrient storage in the soil profile without environmental harm. However, poor management of effluent can result in contamination of land and water and land degradation.

To develop a sustainable land reuse system, the following factors need to be considered;

- Volume and concentration of the effluent
- Availability of good quality land for crop production
- Availability of additional clean water supplies for diluting effluent
- Irrigation infrastructure
- Management expertise to run the system

Land reuse of effluent is the most common technique for effluent management and many piggeries and abattoirs have irrigation areas established already. Provided these areas do not already show highly elevated nutrient levels, the key components for sustainable management are;

- Balancing the addition of nutrients with the off-take of nutrients in agricultural produce, the safe soil storage capacity and acceptable nutrient losses
- Manage nutrient losses to lower the risk of environmental harm
- Manage other contaminants in the water (salts) to prevent land degradation

All intensive livestock facilities in Queensland are required to identify suitable land for effluent reuse and to undertake regular monitoring to prevent environmental harm. However, within the guidelines there is still considerable room for producers to improve effluent management and ensure the longevity of their operations. This can be helped by using the best irrigation infrastructure and management practices.

#### Nutrient concentration

Significant amounts of valuable plant nutrients are present in irrigated effluent. A typical analysis for piggery effluent is shown in Table 1 below.

**Table 1. Typical nutrient composition of piggery effluent**

	Units	Concentration <sup>1</sup>	Range <sup>2</sup>
EC	dS/m	-	2-14
Total N	mg/L	854	158-1025
Ammonium N	mg/L	398	105-726
P	mg/L	109	11-123
K	mg/L	-	97-1845
Na	mg/L	623	103-2870
Ca	mg/L	-	8.6-40
Mg	mg/L	-	4-108
Cu	mg/L	-	0-8

Source: <sup>1</sup>Kruger et al. 1995 <sup>2</sup>Casey et al. 1995.

It is noted that before management decisions are made, actual analysis results should be used to accurately measure the amount of nutrient applied.

To work out the actual amount of nutrients (in kg) contained in effluent on a megalitre (ML) basis is a simple relationship; 1 mg/L = 1 kg / ML). Since 100mm of irrigation applied per ha = 1 ML/ha this makes calculating the application of nutrients relatively simple.

Once the water volume and the total nutrients are known, the application rate per ha can be determined. Ideally, effluent water would be mixed with clean irrigation water (shandied) to lower the nutrient concentration and prevent leaf burn with application. Adding clean irrigation water to effluent will maximise crop growth and nutrient uptake, improving the long term viability of the reuse area by maintaining low nutrient levels in soil. If clean water is not available, application of effluent will need to be carefully managed to avoid plant damage. This can be done by irrigating prior to crop emergence.

Because of the cost of irrigation infrastructure and limitations to suitable land area, many piggeries and abattoirs need to focus management on removing the maximum amount of nutrients each year from reuse

paddocks. Crops with maximum nutrient removal are typically high yielding fodder plants, for example maize, forage sorghum or pasture production for hay (see Table 2). When maximising nutrient off-take the key is to maximise plant yield and harvest the whole plant as hay or silage.

Grazing will not remove high quantities of nutrients (see Table 2), as a large percentage of the fodder that livestock consume will be returned to the paddock in the manure and urine. For this reason pasture for grazing is not a sustainable option for effluent reuse areas.

If effluent is being applied without additional irrigation water and rainfall is low, crop yield and nutrient uptake will also be low. This means that effluent will need to be applied to larger areas to avoid over applying nutrients.

**Table 2. Nutrient uptake for some forage crops**

Crop	Yield (t/ha)	N (kg/ha/yr)	P (kg/ha/yr)
Lucerne hay	5-15	150 – 450	15 – 45
Dry land winter cereal (grain only)	2-4	40 – 80	6 – 20
Dry land winter cereal (grain+straw)	2-4 grain (+straw)	59 – 239	9 – 20
Grain sorghum	2-8	40 – 160	6 – 24
Forage sorghum	10-20	200 – 400	30 – 60
Maize silage	10-25	200 – 500	35 – 75
Dryland pasture (cut)	1-4	20 – 80	3 – 12
Irrigated pasture (cut)	8-20	160 – 400	24 – 60
Grazing	-	7.1 - 9.5	0.9 - 1.1

<sup>4</sup> Adapted from Reuter and Robinson 1997.

Effluent does not always have a balanced nutrient content. This means some fertiliser may need to be added to maximise crop growth. One option is to apply effluent at a rate that will meet the P demands of the crop and add N fertiliser as needed. Another way of reducing the amount of nutrient applied per hectare is to rotate effluent applications to different paddocks in different years. This will reduce the overall amount of nutrients applied over time, but increases the area required for irrigation infrastructure and crop management. It must be noted that crop production must be high in years when effluent is not applied also in order to maximise nutrient uptake.

### Soil storage and acceptable losses

The soil can act as a store for nutrients, particularly phosphorus (P), which can be held strongly to soil particles. However, it should be noted that the soil has a limited capacity to store P and this should not be seen as a primary management option.

### Managing nutrient losses

The main risk of nutrient loss with effluent application comes from ammonia volatilisation. This can result in 75% of the total N being lost during application and is difficult to avoid. Nutrients are lost in other ways including; leaching to groundwater, soil erosion and overland flow. Provided nutrients are not applied at rates significantly higher than plant requirements and irrigation management is carefully scheduled, the risk of nutrient loss from an effluent irrigation area can be minimised. This assumes that fields are sited on good agricultural soils and managed from season to season to minimise nutrient build-up.

### Managing other contaminants

Effluent can contain high levels of undesirable elements and pathogens. Of particular concern is the amount of sodium (Na) and chloride (Cl) found in some effluent samples. Sodium and chloride can be toxic to plants at medium to high levels in soil or water. For further information see the fact sheet 'Effluent Management – Handling salts in effluent'.

**Hint; Avoid over application of effluent**  
*1ML ha of undiluted piggery effluent supplies about enough phosphorus for 2 consecutive forage sorghum crops that yield 15 t dry matter/ha. Shandyng effluent at a 1:10 ratio during the growing season will supply the required nutrients and meet crop demands – if you have the water!*

### References and further reading;

- <sup>1</sup> Kruger, I, Taylor, G & Ferrier, M 1995, Effluent at work, NSW Agriculture, RMB 944, Tamworth NSW.
- <sup>2</sup> Casey, KD, Gardener, EA & McGahan, EJ 1995, 'Characterisation of piggery anaerobic lagoons in southern Queensland', *Proceedings of manipulating pig production v*, Australasian Pig Science Association Conference, Canberra, ACT.
- <sup>3</sup> Queensland Department of Primary Industries 2000, *Environmental code of practice for Queensland piggeries*, DPI Publications, Brisbane, Qld.
- <sup>4</sup> Reuter, DJ & Robinson, JB (eds) 1997, 'Plant analysis – an interpretation manual', CSIRO publishing, Canberra.

### Some other fact sheets in this series:

*Effluent management – Co-composting for effluent reuse*  
*Effluent management – Handling salts in effluent*  
*Effluent management – Evaporation systems*

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