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# Animal Waste Reuse

## – Sustainable reuse of manure and effluent for improved productivity

Queensland Dairyfarmers' Organisation

Queensland Chicken Growers' Association

mla MEAT & LIVESTOCK AUSTRALIA

DAIRYAUSTRALIA

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# *Workshop Overview*

- Manure composition
- Costs and benefits of manure usage
- Nutrient availability and application rates
- Management issues

***Your farm nutrient assessment***

- Property scale nutrient budget

***Incentive funding***

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# *Nutrient value and other benefits from using manure*

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# *What's in it?*

- Most manure and effluent sources are not balanced fertilisers
- Best used as a P fertiliser replacement
- Different treatment of manure will alter composition

N,P,K in dairy manure / chicken litter (dry basis) - mostly spread at about 30% moisture

| | N | P | K |
|---|---|---|---|
| Dairy | 3% | 0.7% | 3.6% |
| Chicken litter | 2.6% | 1.8% | 1% |

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# *Other nutrients*

- Other macro nutrients:
  - Calcium
  - Sulphur
- Valuable source of trace minerals if required, including:
  - Zinc
  - Copper

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# *Organic Matter and Soil Health - Benefits*

Improved soil structure =

- Reduced shear strength
- Better root development
- Improved infiltration

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# *Organic Matter and Soil Health - Benefits*

Soil 'health'

- Improved water holding capacity
- Improved biological activity
- Improved nutrient cycling
- Possible plant disease benefits

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# *$$$ Costs and benefits??*

## Benefits

- Nutrient value (N, P, K)
- Some benefits are hard to measure – soil health?

## Costs

- Manure value – $10-30m$^3$
- Transport? – $8-10t (5-50km)
- Application - $6-8 t contract spreading – or $80 / hr for spreader hire.

A look at your farm…

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# *How much do I produce?*

2 ways to look at it…

- Number of cows x manure excretion per year x fraction of time on feed pad (i.e. fraction of each day or fraction of the year)

Example.

100 cows x 1.3 x 75% = **98 t**

Or.

- Area of feed pad x approx. depth of manure = $m^3$ of manure

Example.

1 ha (10000$m^2$) x 4 in (100mm) = 10000 x 0.1 = **1000$m^3$**

= approx. **550 t.**

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# *Composting*

## Benefits

- Reduced volume
- Lower pathogen risk
- Weed seeds?
- Less risk of nutrient draw down
- Reduced odour

## Costs

- $$$
- Loss of Nitrogen

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# *How much to Apply? – Nutrient Availability and Plant Demand*

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# *Capital applications of manure*

- Base application on soil P levels
- If soil P is below 20 mg/kg rates may be quite high
- 25-60 t/ha dairy manure - 10-20$m^3$/ha chicken litter
- May be applied over 2 years
- Reduce application and base on soil test and crop requirement …

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# *Paddock scale nutrient budgeting*

Silage or hay paddock

- Step 1.
  - Estimate crop yield – nutrient off take
- Step 2.
  - Estimate soil reserves of P and N
- Step 3.
  - Estimate manure application for P demand
- Step 4.
  - Estimate additional inorganic fertiliser required

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# *Nutrient removal – 3 examples*

- Irrigated Corn Silage 45 t / ha (at 35% moisture)
  - 240 kg N 40 kg P 170 kg K
- Dryland grain (5 t / ha sorghum at 11% protein)
  - 80 kg N 15 kg P 20 kg K
- Grazing (10,500L milk / ha)
  - 55+ kg N 10+ kg P 15+ kg K

  (NB: Grazing will include some losses and nutrient transfer to lanes and dairy)

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# *Example 1.- Silage*

- 45 t / ha of corn silage (35% dry matter) contains:
  - 240 kg N
  - 40 kg P
  - 170 kg K

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# *Soil Reserves - Phosphorus*

- 0-30 cm is where most P is taken up from soil

Soil test Colwell P

- 70 mg / kg at the 0-10cm depth

Calculation – kg P/ha

- 70 x 0.1m (soil depth) x 1200 kg/$m^3$ (bulk density) x 0.01 = approx. 84 kg / ha in the top 10 cm of soil
- Some further P may be sourced from deeper in the root zone

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# *Soil Reserves - Nitrogen*

- Nitrate is taken up from the whole root zone – 0-10cm and 10-60cm test may be useful

Soil test shows 40mg/kg in 0-10cm, 20mg/kg in 10-60cm

**Calculate nitrate in kg N / ha**

**0-10cm**

- 40 x 0.1m (soil depth) x 1200 kg/$m^3$ (bulk density) x 0.01 = approx. 48 kg / ha in the top 10 cm of soil

**10-60cm**

- 20 x 0.5m (soil depth) x 1300 kg/$m^3$ x 0.01 = approx. 130kg / ha

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# *Manure Application*

- Crop demand for P = 40kg / ha
- Soil reserves of P = 84kg/ha in top 10cm

**Work out manure application based on P required**

- P removal is 40kg/ha, aim P application at 40kg + 30% for soil storage = approx. 60kg/ha
- Check manure analysis and estimate tonnes to meet P demand
- 12-15 t / ha of solid dairy manure or 7$m^3$ 'average' chicken litter

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# *Nutrient Availability in Manure*

- Not all nutrients present in manure are available in the first year
- Important for estimating fertiliser requirements
- Estimates – 0 – 50% N
  – 40 – 60% P
  – 70% ++ K
- Manure is a slow release fertiliser!

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# *Additional Fertiliser*

## Nitrogen

- **178kg** in soil (from soil test calculation)
- N available in 12-15t/ha manure = approx. **40*kg**
- N fertiliser required =
  **240** kg/ha (crop) – **178**kg (soil) – **40**kg(manure) = approx. **20** kg/ha

**Potassium** - Adequate K should be supplied by 12-15t/ha manure application

(NB: N availability may range from 0 – 150kg/ha with this application)

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# *Example 2. Grazing*

Pasture grazed with dairy cows; 1.5 hd/ha, 7000 L / cow / yr

- Nutrient removed in milk (0.5% N, 0.1% P, 0.15% K)
  - N = 55 kg / ha. yr
  - P = 10 kg / ha. yr
  - K = 15 kg / ha. yr
- Nutrients will also be lost in manure transfer to lanes and dairy – add 30-50% for losses
- Nitrogen is also lost to the atmosphere as nitrogen gas – up to 50%

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# *Grazing Manure Application*

- Dairy grazing removes 10 kg P/ha in milk + est. 5kg P/ha to laneways etc.
- Application rate for 1 year = approx. 15kg P/ha
- Application will depend on soil status
  - If fertility is high consider other areas for manure reuse
  - If fertility is moderate to low, apply 15-25kg P/ha/yr
  - This is approx. 3-5 t/ha dairy manure or 2-3$m^3$/ha 'average' chicken litter

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# *Over Application*

- Will result in soil nutrient build-up over time
- May lead to excessive soil nutrients
- May contribute to contamination of surface and ground water
- Management is the answer to avoiding problems!!

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Legal issues

Nutrient draw down

Nutrient losses

# *Managing manure on farm for sustainability – issues of concern*

Salt

Metals

Compaction

Incorporation

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# *Application Issues*

## Incorporation

- Benefits
  - Can reduce nutrient losses in fresh manure
  - Can reduce nutrient loss with runoff

- Other options
  - Maintain adequate pasture cover / factor in some losses
  - Higher applications when cultivating for other reasons

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# *Timing*

- 3-6 months pre crop / pasture demand
  - Helps avoid nutrient draw down
  - Incorporation will help reduce nitrogen loss and nutrient losses with erosion / overland flow
- Avoid application prior to predicted heavy storms
- Dry soil = less compaction but might not fit with other management

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# *Application rates, salt & metals*

- Regular high application rates = risk of nutrient loss
  - Reduced stream quality, groundwater quality
- Salt is not generally a problem with solid manure
  - Low amounts applied – 5 t feedlot manure = 20 kg sodium, 50kg Chloride
- Metals – not generally a problem if application rates are low, but can build up over time

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# *Legal issues*

- Chicken litter – 3 week withholding period from grazing animals – do not allow animals access to stockpiled chicken litter / manure (illegal)
- Environmental duty of care
  - Water quality
  - Soil contamination
  - Social considerations – keep distance from neighbours

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# *Best Management Practice - Key points*

- Manure may be used to build up soil nutrient levels and organic matter
- As fertility improves, apply manure to meet crop / pasture P demand
- Aim to balance nutrient additions with nutrient off take
- Reducing nutrient losses (to groundwater / surface water) saves you money and reduces environmental impacts

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# *Your farm nutrient assessment – the Big Picture*

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# Whole farm nutrient budget

## WHOLE FARM NUTRIENT BALANCE WORKSHEET (PAGE 1 OF 2)

| INPUT NUTRIENTS | | | | Nitrogen kg/yr | Phosphorus kg/yr | Potassium kg/yr |
|---|---|---|---|---|---|---|
| **GRAIN** | | | | | | |
| **Grain Component 1 brought onto the property** (sorghum) | | | | | | |
| 100 t/yr x 0.88 DM fraction | x 1.6 | % Nitrogen | x 10 | 1408 | | |
| | x 0.3 | % Phosphorus | x 10 | | 264 | |
| | x 0.5 | % Potassium | x 10 | | | 440 |
| **Grain Component 2 brought onto the property** (dairy pellets – 18%) | | | | | | |
| 100 t/yr x 0.9 DM fraction | x 2.9 | % Nitrogen | x 10 | 2610 | | |
| | x 0.6 | % Phosphorus | x 10 | | 540 | |
| | x 0.7 | % Potassium | x 10 | | | 630 |
| **Grain Component 3 brought onto the property** | | | | | | |
| _____ t/yr x ____ DM fraction | x _____ | % Nitrogen | x 10 | _____ | | |
| | x _____ | % Phosphorus | x 10 | | _____ | |
| | x _____ | % Potassium | x 10 | | | _____ |
| **Grain Component 4 brought onto the property** | | | | | | |
| _____ t/yr x ____ DM fraction | x _____ | % Nitrogen | x 10 | _____ | | |
| | x _____ | % Phosphorus | x 10 | | _____ | |
| | x _____ | % Potassium | x 10 | | | _____ |

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## HAY

### Hay / Silage component 1 brought onto the property (lucerne hay)

| | | | | | | |
|---|---|---|---|---|---|---|
| 200 t/yr x 0.83 DM fraction | x 31 | % Nitrogen | x 10 | 5146 | | |
| | x 03 | % Phosphorus | x 10 | | 498 | |
| | x 25 | % Potassium | x 10 | | | 4150 |

### Hay / Silage component 2 brought onto the property

| | | | | | | |
|---|---|---|---|---|---|---|
| _____ t/yr x ____ DM fraction | x _____ | % Nitrogen | x 10 | _____ | | |
| | x _____ | % Phosphorus | x 10 | | _____ | |
| | x _____ | % Potassium | x 10 | | | _____ |

## FERTILISER

### Fertiliser brought onto the property

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 t/yr urea | x 46 | % Nitrogen | x 10 | 4600 | | |
| 8 t/yr single super | x 8.8 | % Phosphorus | x 10 | | 704 | |
| 5 t/yr potash | x 50 | % Potassium | x 10 | | | 2500 |
| NPK fertiliser | | | | | | |
| _____ t/yr _____ | x _____ | % Nitrogen | x 10 | _____ | | |
| | x _____ | % Phosphorus | x 10 | | _____ | |
| | x _____ | % Potassium | x 10 | | | _____ |

## EXTERNAL MANURE SOURCE (Chicken litter)

**Manure brought onto the property from external source**

| | | | | | | |
|---|---|---|---|---|---|---|
| 100 t/yr x 0.7 DM fraction | x 26 | % Nitrogen | x 10 | 1820 | | |
| | x 1.8 | % Phosphorus | x 10 | | 1260 | |
| | x 1 | % Potassium | x 10 | | | 700 |

## LEGUME CROP

**Nitrogen added to the soil by a legume crop**

| | | | |
|---|---|---|---|
| **Low** | = _____ | ha of Legume **x 20** kg/ha, or | |
| **Medium** | = 20 | ha of Legume **x 80** kg/ha, or | 1600 |
| **High** | = _____ | ha of Legume **x 180** kg/ha | |

## TOTAL NUTRIENTS IMPORTED

| | | |
|---|---|---|
| 17184 | 3266 | 8420 |

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# WHOLE FARM NUTRIENT BALANCE WORKSHEET (PAGE 2 OF 2)

| OUTPUT NUTRIENTS | | | | Nitrogen kg/yr | Phosphorus kg/yr | Potassium kg/yr |
|---|---|---|---|---|---|---|
| **MILK (SOLD)** | | | | | | |
| **Milk sold** | | | | | | |
| *Annual milk yield l/yr* 1,000,000 | x 0.51 | *% Nitrogen* | */ 100* | - 5100 | | |
| | x 01 | *% Phosphorus* | */ 100* | | - 1000 | |
| | x 0.15 | *% Potassium* | */ 100* | | | - 1500 |
| **MANURE TAKEN OFFARM (SOLD)** | | | | | | |
| **Manure taken off farm** | | | | | | |
| _____ *t/yr x* ____ *DM fraction* | x _____ | *% Nitrogen* | *x 10* | - _____ | | |
| | x _____ | *% Phosphorus* | *x 10* | | - _____ | |
| | x _____ | *% Potassium* | *x 10* | | | - _____ |
| **CROPS TAKEN OFFARM (SOLD)** | | | | | | |
| **Harvested crops taken off farm** | | | | | | |
| _____ *t/yr x* ____ *DM fraction* | x _____ | *% Nitrogen* | *x 10* | - _____ | | |
| | x _____ | *% Phosphorus* | *x 10* | | - _____ | |
| | x _____ | *% Potassium* | *x 10* | | | - _____ |

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## LIVESTOCK (SOLD)

### Culled cows taken off farm

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 20 | cows/yr x | 550 | kg/cow x | 2.4 | % Nitrogen | / 100 | - 264 | | |
| | | | x | 0.7 | % Phosphorus | / 100 | | - 77 | |
| | | | x | 1.8 | % Potassium | / 100 | | | - 198 |

### Calves taken off farm

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 50 | calves/yr x | 50 | kg/calf x | 2.4 | % Nitrogen | / 100 | - 60 | | |
| | | | x | 0.7 | % Phosphorus | / 100 | | - 17.5 | |
| | | | x | 1.8 | % Potassium | / 100 | | | - 45 |

## TOTAL NUTRIENTS EXPORTED

| Nitrogen | Phosphorus | Potassium |
|---|---|---|
| 5424 | 1094.5 | 1563 |

## NET NUTRIENTS (TOTAL NUTRIENTS MPORTED - EXPORTED)

The numbers provided to the right indicate whether the property is operating under a nutrient surplus or nutrient deficit. A positive number indicates that more nutrients are being brought onto the property than leaving *(surplus)*. A negative number indicates that more nutrients are leaving the property then entering *(deficit)*.

| Nitrogen kg/yr | Phosphorus kg/yr | Potassium kg/yr |
|---|---|---|
| 11760 | 2171.5 | 6857 |

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# *What do the numbers mean - Nitrogen*

**Acceptable losses**

- Volatilisation – may be 50% of excreted N

**Harmful losses**

- Leaching – reduces water quality, causes acidification, $$
- Nitrogen may be stored in the soil with organic matter

**Target loss areas**

- Effluent reuse area?
- Manure / fertiliser usage – target application to plant requirement

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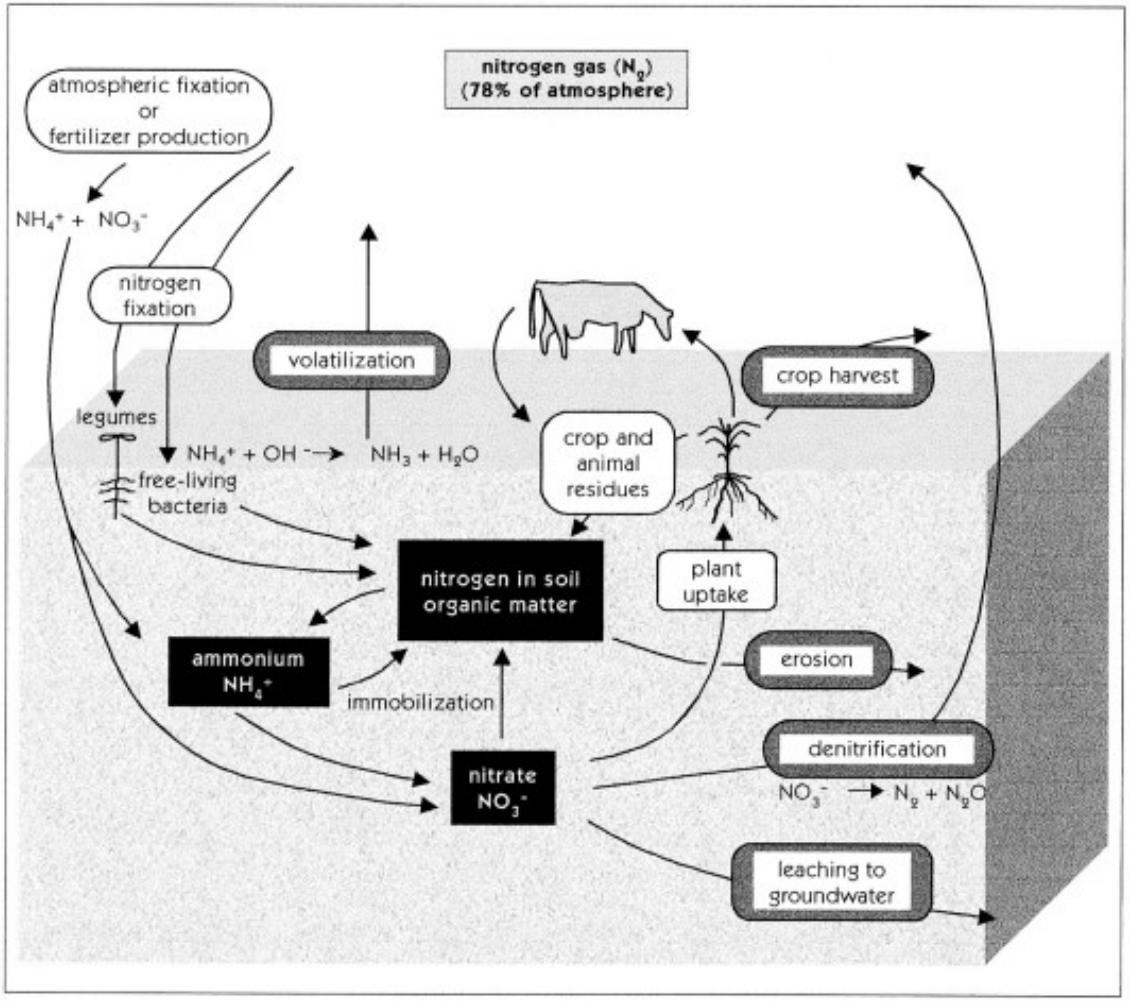
# Nitrogen cycling



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# *What do the numbers mean - Phosphorus*

**Soil storage**

- Soil may store 800 – 3000+ kg P/ha
- Indicated by Total P and Colwell P level on soil test

**Harmful losses**

- Losses in runoff to surface water
- Leaching – reduces water quality

**Target loss areas**

- Effluent reuse area?
- Manure / fertiliser usage – target application to plant requirement

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# *What do the numbers mean - Potassium*

Generally found at high levels naturally

- May be depleted on hay / silage country
- Excessive K in soil can contribute to soil structure problems
- Excessive K on grazing land can contribute to grass tetany (hypomagnesaemia)

**Target applications:**

- Apply K from manure / effluent to high K demand crops such as hay / silage

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# *What do the numbers mean?*

## Nutrient deficits

- May be sustainable for a time if land is highly fertile
- Will lead to reduced production over time
- May be addressed by purchasing manure / fertiliser

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# *Some check points*

- Is effluent being managed to apply nutrients where they are needed?
- Is there more fertiliser being used than needed?
- Is manure being managed to apply nutrients where they are needed?
- Can your farm sustain high nutrient applications?

To answer this ... Monitor soils

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# *Soil and Nutrient Monitoring*

## Soil

- Test key areas on farm – high nutrient loading / high nutrient off take
- Test at about the same point every year / second year
- Use the same laboratory
- Take multiple samples and bulk them together

## Nutrient

- Consider sampling manure / effluent

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# *Soil analysis interpretation*

**Some 'rule of thumb' numbers**

Nitrogen

- Total N
  - <0.05 % = very low
  - 0.15-0.25 % = medium
  - > 0.5 % = high

  (500 mg/kg = 0.05 %, 1000 mg/kg = 0.1 %)
- Nitrate N – depends on crop / pasture and soil / season interactions

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# *Soil analysis interpretation*

Available phosphorus (Colwell P)

- < 20 mg/kg = Low*
- > 40 mg/kg = moderate*
- > 90 mg/kg = High / very high*

- Soils may be able to safely store several hundred kg of phosphorus if there are low overall P levels

(NB: These levels depend on crop / soil type and natural P levels)

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# *Soil analysis interpretation*

Potassium

- Depends on crop and soil type

Irrigated silage

- < 90 mg / kg = low
- 100 – 200 mg/kg = adequate
- > 200 mg / kg = high

Grain

- < 30 mg / kg = low
- > 100 mg / kg = high

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# *Incentive funding*

- Applications taken until the start of July
- Up to $5000 as a 50% subsidy on work that improves nutrient management
- Contact Ruth McInnes (Queensland Dairy Organisation) – 3238 4218 or 0400 669 994

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# *Questions and Discussion*

# *- End -*

# APPENDIX B - FEEDBACK SHEET

# "Sustainable Manure Reuse" – Participating Farmer Evaluation

For reporting purposes could you please tell us the size of your farm._____ha / acres

1. What did you expect from this workshop?

_____

_____

2. To what extent were these expectations met?

**None met** **All met**

1 2 3 4 5 6 7 8 9 10

**Comment**:_____

3. Please place a tick (✔) in the appropriate square below to indicate how strongly you agree or disagree with the following statements.

| | **Strongly Agree** | **Agree** | **Neutral** | **Disagree** | **Strongly Disagree** |
|---|---|---|---|---|---|
| The field day has increased my understanding of the process and benefits of using stockpiled manure. | | | | | |
| The field day has provided me with the knowledge and skills to apply manure more effectively. | | | | | |
| As a result of this field day, I am more confident in using manure to replace synthetic fertilisers. | | | | | |
| The information presented was useful, relevant and informative. | | | | | |
| The speaker was knowledgeable and presented the information in a practical and easy to understand manner. | | | | | |

Comments:_____

_____

_____

4. Do you manage nutrient applications to meet crop / pasture needs? □ Yes □ No □ Not Really

5. Do you currently use manure or compost on your farm? □ Yes □ No □ Not Recently

6. Will you take any action on your farm as a result of this field day?

□ Yes, immediately □ Yes, I will soon □ Yes, I will eventually

□ No, I am not interested □ No, I am not in a position to □ No, I don't need to

7. Would you like to access further information on sustainable reuse of manure? □ Yes □ No

If yes, what further information would you like:_____

_____

_____

What is your preference for learning more about his topic (tick more than one if relevant)?

□ Another workshop □ Private Advisor (Agronomist) □ Landcare

□ Extension Officer □ Other:_____

□ Internet

8. Any other comments:_____

_____

# APPENDIX C – WHOLE FARM NUTRIENT BUDGET

# WHOLE FARM NUTRIENT BALANCE WORKSHEET (PAGE 1 OF 2)

## INPUT NUTRIENTS

| | Nitrogen kg/yr | Phosphorus kg/yr | Potassium kg/yr |
|---|---|---|---|

### GRAIN

**Grain Component 1 brought onto the property**

_____ *t /yr x* ____ *DM fraction* **x** _____ *% Nitrogen* *x 10* _____

**x** _____ *% Phosphorus* *x 10* _____

**x** _____ *% Potassium* *x 10* _____

**Grain Component 2 brought onto the property**

_____ *t /yr x* ____ *DM fraction* **x** _____ *% Nitrogen* *x 10* _____

**x** _____ *% Phosphorus* *x 10* _____

**x** _____ *% Potassium* *x 10* _____

**Grain Component 3 brought onto the property**

_____ *t /yr x* ____ *DM fraction* **x** _____ *% Nitrogen* *x 10* _____

**x** _____ *% Phosphorus* *x 10* _____

**x** _____ *% Potassium* *x 10* _____

**Grain Component 4 brought onto the property**

_____ *t /yr x* ____ *DM fraction* **x** _____ *% Nitrogen* *x 10* _____

**x** _____ *% Phosphorus* *x 10* _____

**x** _____ *% Potassium* *x 10* _____

### HAY

**Hay / Silage component 1 brought onto the property**

_____ *t /yr x* ____ *DM fraction* **x** _____ *% Nitrogen* *x 10* _____

**x** _____ *% Phosphorus* *x 10* _____

**x** _____ *% Potassium* *x 10* _____

**Hay / Silage component 2 brought onto the property**

_____ *t /yr x* ____ *DM fraction* **x** _____ *% Nitrogen* *x 10* _____

**x** _____ *% Phosphorus* *x 10* _____

**x** _____ *% Potassium* *x 10* _____

### FERTILISER

**Fertiliser brought onto the property**

_____ *t /yr* _____ **x** _____ *% Nitrogen* *x 10* _____

_____ *t /yr* _____ **x** _____ *% Phosphorus* *x 10* _____

_____ *t /yr* _____ **x** _____ *% Potassium* *x 10* _____

*NPK fertiliser*

_____ *t /yr* _____ **x** _____ *% Nitrogen* *x 10* _____

**x** _____ *% Phosphorus* *x 10* _____

**x** _____ *% Potassium* *x 10* _____

### EXTERNAL MANURE SOURCE

**Manure brought onto the property from external source**

_____ *t/yr x* ____ *DM fraction* **x** _____ *% Nitrogen* *x 10* _____

**x** _____ *% Phosphorus* *x 10* _____

**x** _____ *% Potassium* *x 10* _____

### LEGUME CROP

**Nitrogen added to the soil by a legume crop**

***Low*** = _____ *ha of Legume* **x 20** *kg/ha, or* _____

***Medium*** = _____ *ha of Legume* **x 80** *kg/ha, or*

***High*** = _____ *ha of Legume* **x 180** *kg/ha*

## TOTAL NUTRIENTS IMPORTED

_____ _____ _____

# WHOLE FARM NUTRIENT BALANCE WORKSHEET (PAGE 2 OF 2)

## OUTPUT NUTRIENTS

| | Nitrogen kg/yr | Phosphorus kg/yr | Potassium kg/yr |
|---|---|---|---|

### MILK (SOLD)

**Milk sold**

*Annual milk yield l/yr* _____ x _____ *% Nitrogen* */ 100* – _____

x _____ *% Phosphorus* */ 100* – _____

x _____ *% Potassium* */ 100* – _____

### MANURE TAKEN OFFARM (SOLD)

**Manure taken off farm**

_____ *t/yr x* ____ *DM fraction* x _____ *% Nitrogen* *x 10* – _____

x _____ *% Phosphorus* *x 10* – _____

x _____ *% Potassium* *x 10* – _____

### CROPS TAKEN OFFARM (SOLD)

**Harvested crops taken off farm**

_____ *t/yr x* ____ *DM fraction* x _____ *% Nitrogen* *x 10* – _____

x _____ *% Phosphorus* *x 10* – _____

x _____ *% Potassium* *x 10* – _____

### LIVESTOCK (SOLD)

**Culled cows taken off farm**

_____ *cows/yr* x _____ *kg/cow* x _____ *% Nitrogen* */ 100* – _____

x _____ *% Phosphorus* */ 100* – _____

x _____ *% Potassium* */ 100* – _____

**Calves taken off farm**

_____ *calves/yr* x _____ *kg/calf* x _____ *% Nitrogen* */ 100* – _____

x _____ *% Phosphorus* */ 100* – _____

x _____ *% Potassium* */ 100* – _____

## TOTAL NUTRIENTS EXPORTED

_____ _____ _____

## NET NUTRIENTS (TOTAL NUTRIENTS MPORTED - EXPORTED)

The numbers provided to the right indicate whether the property is operating under a nutrient surplus or nutrient deficit. A positive number indicates that more nutrients are being brought onto the property than leaving *(surplus)*. A negative number indicates that more nutrients are leaving the property then entering *(deficit)*.

| Nitrogen kg/yr | Phosphorus kg/yr | Potassium kg/yr |
|---|---|---|
| _____ | _____ | _____ |

# TYPICAL FEED CONTENTS

| | Dry Matter Fraction | Nitrogen % DM basis | Phosphorus % DM basis | Potassium % DM basis |
|---|---|---|---|---|
| **SUPPLEMENT** | | | | |
| Dairymeal/pellets 12% protein | 0.9 | 1.9% | 0.6% | 0.7% |
| Dairymeal/pellets 14% protein | 0.9 | 2.2% | 0.6% | 0.7% |
| Dairymeal/pellets 16% protein | 0.9 | 2.6% | 0.6% | 0.7% |
| Dairymeal/pellets 18% protein | 0.9 | 2.9% | 0.6% | 0.7% |
| Palm KM | 0.9 | 2.6% | 0.6% | 0.5% |
| Whole Cottonseed | 0.92 | 3.7% | 0.5% | 1.0% |
| Brewers grain dehy | 0.9 | 4.7% | 0.7% | 0.6% |
| Brewers grain wet | 0.25 | 4.0% | 0.3% | 0.06% |
| Citrus Dehyd | 0.91 | 1.1% | 0.1% | 0.8% |
| Bread | 0.31 | 2.4% | 0.3% | 0.5% |
| Pineapple pulp | 0.17 | 0.9% | 0.2% | 2.2% |
| Micellaneous protein meals | | 5.8% | 1.0% | 1.2% |
| Molasses | 0.75 | 0.7% | 0.1% | 3.2% |
| **GRAIN SUPPLEMENT** | | | | |
| Barley / Wheat (Grain Only) | 0.89 | 1.6% | 0.3% | 0.5% |
| Sorghum/Corn (Grain Only) | 0.88 | 1.4% | 0.3% | 0.4% |
| Oats for Grain only | 0.88 | 1.4% | 0.4% | 0.4% |
| **HAY** | | | | |
| Lucerne Hay | 0.83 | 3.1% | 0.3% | 2.5% |
| Grass hay -tropical | 0.89 | 1.1% | 0.3% | 1.7% |
| Grass hay-temperate | 0.85 | 2.2% | 0.3% | 2.0% |
| Sorghum Hay | 0.90 | 1.2% | 0.3% | 1.9% |
| Soybean Hay | 0.89 | 2.6% | 0.3% | 1.1% |
| Wheat Hay (cereal) | 0.89 | 1.4% | 0.02% | 1.0% |
| Barley Straw | 0.91 | 0.7% | 0.1% | 2.4% |
| Oat Straw | 0.92 | 0.7% | 0.1% | 2.5% |
| Wheat Straw | 0.91 | 0.6% | 0.05% | 1.4% |
| **SILAGE** | | | | |
| Lucerne Silage | 0.44 | 3.0% | 0.3% | 2.9% |
| Barley / Wheat Silage | 0.27 | 1.4% | 0.3% | 2.6% |
| Corn Silage | 0.24 | 1.3% | 0.2% | 1.1% |
| Pasture Silage-tropical | 0.39 | 2.2% | 0.3% | 0.6% |
| Pasture Silage-temp | 0.25 | 2.2% | 0.2% | 2.2% |
| Oats Silage | 0.3 | 2.0% | 0.2% | 2.0% |
| Soy/Lab lab | 0.43 | 2.5% | 0.08% | 0.5% |
| Sorghum silage-forage | 0.3 | 1.5% | 0.2% | 0.3% |
| Sorghum silage-crop | 0.28 | 1.2% | 0.3% | 1.0% |
| **PASTURE** | | | | |
| Pature | | 0.8% | 0.2% | 0.5% |

*Numbers provided are indicative only.*

# TYPICAL FERTILISER CONTENTS

| Fertiliser | Dry Matter Nutrient Content (%) | | | |
|---|---|---|---|---|
| | N | P | K | S |
| **Urea** | 46.0 | - | - | - |
| **MAP** | 9.2 | 21.9 | - | - |
| **DAP** | 18.5 | 20.0 | - | - |
| **Sulfate of Ammonia** | 21.0 | - | - | 24 |
| **Pivot 15** | 14.2 | 12.9 | - | - |
| **Single Super** | - | 9.0 | - | - |
| **Triple Super** | - | 20.7 | - | - |
| **Murate of Potash** | - | - | 50.0 | - |
| **Starter Z** | 10.5 | 19.5 | - | - |
| **Gran Am** | 20.2 | - | - | 24.0 |
| **CK 88** | 15.1 | 4.4 | 11.5 | 13.6 |
| **CK 55** | 13.5 | 15.0 | 12.5 | 1.2 |

# APPENDIX D – PADDOCK SCALE NUTRIENT BUDGET

# CROPPING PADDOCK NUTRIENT BALANCE WORKSHEET

## SOIL NUTRIENTS (A)

| | Nitrogen kg/ha | Phosphorus kg/ha | Potassium kg/ha |
|---|---|---|---|
| **Surface Soil** | | | |
| *Nitrate N*_____ *mg/kg N* **x** _____ *m of soil* **x 1200** *kg/m³* **x 0.01** *m²/mg/kg* | _____ | | |
| *Avail. P*_____ *mg/kg P* **x** _____ *m of soil* **x 1200** *kg/m³* **x 0.01** *m²/mg/kg* | | _____ | |
| *K* _____ *mg/kg K* **x** _____ *m of soil* **x 1200** *kg/m³* **x 0.01** *m²/mg/kg* | | | _____ |
| **Subsoil** | | | |
| *Nitrate N* _____ *mg/kg N* **x** _____ *m of soil* **x 1300** *kg/m³* **0.01** *m²/mg/kg* | _____ | | |
| **Total Soil Nutrients (A)** | | | |

## NUTRIENT OFFTAKE WITH CROP (B)

| | Nitrogen kg/ha/yr | Phosphorus kg/ha/yr | Potassium kg/ha/yr |
|---|---|---|---|
| **CUT AND CART CROPPING** | | | |
| **Summer crop harvested from the example paddock** | | | |
| _____ *t/ha harvested* **x** *DM fraction* _____ = _____ *t/ha (dry wt)* | | | |
| **x** _____ *% Nitrogen* **x 10** | _____ | | |
| **x** _____ *% Phosphorus* **x 10** | | _____ | |
| **x** _____ *% Potassium* **x 10** | | | _____ |
| **Winter crop harvested from the example paddock** | | | |
| _____ *t/ha harvested* **x** *DM fraction* _____ = _____ *t/ha (dry wt)* | | | |
| **x** _____ *% Nitrogen* **x 10** | _____ | | |
| **x** _____ *% Phosphorus* **x 10** | | _____ | |
| **x** _____ *% Potassium* **x 10** | | | _____ |
| **Total N, P, K removed ha/yr (B)** | | | |

## TARGET MANURE APPLICATION (C)

**Aim application to meet 1-2 seasons of P demand (crop off take) + 30- 40% soil storage / application efficiency factor.**

**Crop P target for 1-2 seasons kg** _____ **÷** _____ *(conversion factor = 0.6-0.7 for soil storage+ application efficiency)* = _____ **kg** *(P application target)*

**Manure application target in tonnes:** (to achieve target P application)

**Manure analysis: N** _____ **%** **P** _____ **%** **K** _____ **%** **Moisture** _____ **%**

**Calculate kg of P per wet tonne:**

*1 tonne* **x** *DM content* _____*% (100 - moisture %)* **x** *P* _____ **%** **÷ 10** = _____*kg P / wet tonne*

*Crop P target in kg* _____ **÷** _____ *kg P / wet tonne* = _____ ***t / ha (target manure application)***

## NITROGEN AND POTASSIUM APPLICATION (D)

| | Nitrogen kg/ha/yr | Phosphorus kg/ha/yr | Potassium kg/ha/yr |
|---|---|---|---|
| **Target manure application (from part C above)** | | | |
| _____ *t/ha* **x** *DM content* _____*% (100 - moisture %)* **x** *N* _____ **%** **÷ 10** | _____ | | |
| | | _____ | |
| _____ *t/ha* **x** *DM content* _____*% (100 - moisture %)* **x** *K* _____ **%** **÷ 10** | | | _____ |

## CROP AVAILABLE NUTRIENTS (E)

| | Nitrogen kg/ha/yr | Phosphorus kg/ha/yr | Potassium kg/ha/yr |
|---|---|---|---|
| **Nutrient availability in 1st yr (application in kg/ha x nutrient availability)** | | | |
| _____ *kg N/ha with manure* **x 0.85** *(15% applic. losses)* **x 0.3*** *(1st yr)* | _____ | | |
| _____ *kg P/ha with manure* **x 0.5** *(1st yr)* | | _____ | |
| _____ *kg K/ha with manure* **x 1** *(1st yr)* | | | _____ |

(Nutrient availability can vary greatly, 1st yr range for N = 0-50%, P = 10-95%, K = 70-100%)

## FERTILISER REQUIREMENT (B – A – E)

| | Nitrogen kg/ha/yr | Phosphorus kg/ha/yr | Potassium kg/ha/yr |
|---|---|---|---|
| **Nutrient off-take with Crop …….. (B)** | _____ | _____ | _____ |
| **Nutrients in soil …… (A)** | _____ | _____ | _____ |
| **Nutrient Availability from Manure …… (E)** | _____ | _____ | _____ |
| ***Inorganic Fertiliser Nutrient Required kg / ha / yr (B – A - E)*** | _____ | _____ | _____ |
| ***(positive number = required nutrient, negative number = nutrient surplus)*** | | | |

# TYPICAL CROP NUTRIENT CONTENTS

| Crop | Normal Yield Range (as harvested t/ha) | Dry Matter Fraction | Dry Matter Nutrient Content (%) | | |
|---|---|---|---|---|---|
| | | | N | P | K |
| **Hay** | | | | | |
| **Dryland Pasture Hay (cut)** | 1 - 4 | 0.89 | 2.0 | 0.3 | 1.5 |
| **Irrigated Pasture Hay (cut)** | 8 - 20 | 0.89 | 2.0 | 0.3 | 1.5 |
| **Winter Cereal Hay** | 10 - 20 | 0.89 | 2.0 | 0.3 | 1.6 |
| **Sorghum Hay** | 4 - 8 | 0.89 | 1.5 | 0.2 | 0.3 |
| **Lucerne Hay (cut)** | 5 - 15 | 0.89 | 2.9 | 0.3 | 1.8 |
| **Barley Straw (without grain)** | 4 - 8 | 0.91 | 0.7 | 0.07 | 2.3 |
| **Silage** | | | | | |
| **Maize Silage** | 30 - 70 | 0.35 | 2.2 | 0.3 | 2.0 |
| **Sorghum Silage** | 30 - 65 | 0.30 | 2.2 | 0.3 | 2.4 |
| **Lucerne Silage** | 10 - 35 | 0.44 | 3 | 0.3 | 2.8 |
| **Pasture Silage** | 10 - 50 | 0.39 | 2.2 | 0.3 | 1.5 |
| **Grain** | | | | | |
| **Grain Barley** | 2 - 5 | 0.89 | 1.9 | 0.3 | 0.4 |
| **Grain Wheat** | 2 - 5 | 0.89 | 1.9 | 0.4 | 0.5 |
| **Grain Oats** | 1 - 5 | 0.89 | 1.5 | 0.3 | 0.4 |
| **Grain Sorghum** | 2 - 8 | 0.89 | 2.0 | 0.3 | 0.3 |
| **Grain Maize** | 2 - 8 | 0.89 | 2.0 | 0.3 | 0.4 |
| **Chickpea** | 0.5 - 2 | 0.89 | 4.0 | 0.4 | 0.4 |

*Note: *Numbers provided are indicative only.*
*Source: Reuter and Robinson 1997.*

# TYPICAL FERTILISER CONTENTS

| Fertiliser | Dry Matter Nutrient Content (%) | | | |
|---|---|---|---|---|
| | N | P | K | S |
| **Urea** | 46.0 | - | - | - |
| **MAP** | 9.2 | 21.9 | - | - |
| **DAP** | 18.5 | 20.0 | - | - |
| **Sulfate of Ammonia** | 21.0 | - | - | 24 |
| **Pivot 15** | 14.2 | 12.9 | - | 24 |
| **Single Super** | - | 9.0 | - | - |
| **Triple Super** | - | 20.7 | - | - |
| **Murate of Potash** | - | - | 50.0 | - |
| **Starter Z** | 10.5 | 19.5 | - | - |
| **Gran Am** | 20.2 | - | - | 24.0 |
| **CK 88** | 15.1 | 4.4 | 11.5 | 13.6 |
| **CK 55** | 13.5 | 15.0 | 12.5 | 1.2 |