

Appendix 4.

Manure valuation pro forma

Introduction

The nutrients in aged feedlot manure and compost have significant value in cropping or pasture systems and need to be valued appropriately. This appendix provides a method using fertiliser price and manure nutrient content to place a value on manure.

Quantify the nutrient content of the aged manure or compost

Table A4.1 shows the typical composition of aged beef feedlot manure and compost.

Table A4.1 Typical composition of aged beef feedlot manure and compost

Parameter	Aged manure	Compost
Dry matter (%)	63.2	74.0
Volatile solids (% db)	67.5	43.7
Total nitrogen (% db)	2.18	2.11
Total phosphorus (% db)	0.80	1.31
Potassium (% db)	1.86	2.49
Sodium (% db)	0.30	0.43
Sulfur (% db)	0.45	0.52
Calcium (% db)	2.22	1.91
Magnesium (% db)	0.86	0.93
EC1:5 (dS/m)	8.3	16.1
pH	7.2	7.3
Ammonia-N (mg/kg db)	1,431	1,016
Nitrate-N (mg/kg db)	307	714
Boron (mg/kg db)	22	23
Cobalt (mg/kg db)	7	-
Copper (mg/kg db)	35	37
Iron (mg/kg db)	11,700	5,300
Manganese (mg/kg db)	387	351
Molybdenum (mg/kg db)	4.3	5.7
Ortho-phosphate (mg/kg db)	944	3,100
Zinc (mg/kg db)	221	254

A significant proportion of the nitrogen in aged manure and compost is lost to the atmosphere through release as ammonia following spreading, especially if the manure is not incorporated into the soil. If nitrogen losses are expected to be 40% for aged manure and 25% for compost, the net amount of nitrogen remaining after spreading would be 1.31% and 1.58% respectively.

Value the nutrients in inorganic fertilisers

It is possible to value the nitrogen (N), phosphorus (P) and potassium (K) in aged manure or compost using the value of these nutrients in inorganic fertilisers. Table A4.2 shows the typical composition of a range of common fertiliser products.

Commercial, bulk-delivered fertiliser prices (ex GST) were obtained for common nitrogen, phosphorus and potassium fertilisers (see Table A4.3). These were \$550/t for urea, \$800/t for DAP and \$800/t for muriate of potash (Nov 2012). These were used to calculate values for N, P and K.

Table A4.2 Typical composition of common N, P and K fertilisers

Fertiliser	Macro-nutrient content (%)		
	N	P	K
Anhydrous ammonia	82.3	-	-
Urea	46	-	-
UAN (urea-ammonium nitrate)	42	-	-
MAP	10	22.6	-
DAP	17.5	20.0	-
Superphosphate	-	9.1	-
Double superphosphate	-	17.5	-
Triple superphosphate	-	20	-
Ammonium sulfate	21	-	-
Muriate of potash	-	-	50
Potassium sulfate	-	-	41
Potassium magnesium sulfate	-	-	18
Potassium nitrate	13	-	38

Table A4.3 Value of macronutrients in inorganic fertilisers (November 2014)

Fertiliser	Total delivered price (ex GST) \$/tonne	Value of target nutrient \$/tonne	Target nutrient content (%)	Nutrient value (\$/kg)
Urea (value of N)	\$550	\$550	46% N	N = \$1.20/kg
DAP (value of P)	\$800	\$590	20% P	P = \$2.95/kg
Muriate of potash (value of K)	\$800	\$800	50% K	K = \$1.60/kg

Since urea is 46% nitrogen and costs \$550/t, nitrogen can be valued at \$1.20/kg (i.e. $(\$550/0.46)/1,000$). Where a fertiliser product contains multiple nutrients their value should be separated out. For instance, DAP contains 17.5% nitrogen and 20% phosphorus and costs \$800/t. For the purpose of this exercise we are interested in the value of the phosphorus. The nitrogen in DAP is worth about \$210/t (i.e. $175 \text{ kg/t} \times \1.20). Subtracting this from the total fertiliser cost gives a phosphorus value of about \$590/t or \$2.95/kg. The potassium in muriate of potash is worth \$1.60/kg (i.e. $(\$800/0.5)/1,000$). Thus in this case, nitrogen is valued at \$1.20/kg, phosphorus at \$2.95/kg and potassium at \$1.60/kg (see Table A4.3).

Applying the fertiliser nutrient values to the nutrients in aged manure or compost

The gross nutrient values (\$/kg) for N, P and K calculated in the previous step can be applied to nutrients in the manure or compost to obtain a macronutrient value for the product. Table A4.4 and Table A4.5 provide a summary for aged manure and compost respectively.

The composition of aged feedlot manure and compost can vary widely. To achieve greater accuracy, use site-specific data for the composition of aged manure or compost and up to date fertiliser prices.

Care must be taken when comparing the values in these tables with costs for inorganic fertilisers. Remember that

- Nutrients are only of value if they are needed in the cropping system. For example, if the soil is deficient in N but has adequate P and K, the latter provide no additional value. Hence, the N value is also the manure value. However if multiple nutrients are needed, the value of these can be summed up to estimate the real value of the manure or compost to the recipient.

- N losses after spreading must be considered. If the manure is not incorporated into the soil immediately, losses could be significant with a corresponding reduction in the N value of the manure. The aged manure and compost N values in Tables A4.4 and A4.5 take into account suggested ammonia losses.
- The rates of availability of nutrients vary in manure and compost. For example, only one third of the N in the manure may be available in year one and depending on release rate in that year, 20–30% could be available in year two.
- P availability also varies widely. Where soils are P deficient, about 70% of the P in the manure is probably available in the first year, but this could be much lower. The value of the manure or compost nutrients should be spread over 2–3 years as they become available to plants. The value of the nutrient contribution in any given year can be calculated by multiplying the percentage of the nutrient expected to be available in that year by the monetary contribution for that nutrient.
- Aged beef feedlot manure and compost do not supply nutrients in the ideal ratios for plant needs. They are often best used in conjunction with an inorganic fertiliser program designed to meet plant requirements. One option is to apply the manure or compost at a rate that meets P requirements and then supplement the N to meet crop needs. An alternative is to apply the manure or compost at a rate that meets crop N requirements if the soil is able to store the surplus P. If this option is chosen, N availability in the first year needs to be considered. Storage of P in the soil should be regarded as a temporary measure. The P concentration should be reduced to a sustainable level before additional manure or compost is applied.

- The valuation above does not consider the contribution of other elements such as sulfur, zinc, calcium, magnesium, boron, copper and other trace elements that may be valuable to the cropping system depending on the soil nutrient status. If these are deficient, their value can be added to the macronutrient value. For example, sulfur and zinc are likely to be deficient on the black cracking clays of the Darling Downs and the value of these two nutrients could add \$3-6/t to the value of feedlot manure.

Manure and compost also add carbon as organic matter to the soil. This helps to improve the soil's structure and water-holding capacity and reduce its erosivity. It is difficult to put a dollar value on these benefits.

Table A4.4 Value of nutrients in aged feedlot manure

Parameter	Manure analysis (% dry basis)	Manure analysis (as spread)	Mass of nutrient per wet tonne (kg/t)	Value from inorganic fertiliser rate (\$/kg)
Dry matter	63	–	–	–
Total nitrogen	2.18	1.37	13.7	–
Nitrogen (after ammonia losses)	1.31	0.84	8.4	\$10.08
Phosphorus	0.80	0.50	5.0	\$14.75
Potassium	1.86	1.17	11.7	\$18.72

Table A4.5 Value of nutrients in feedlot compost

Parameter	Compost analysis (% dry basis)	Compost analysis (as spread)	Mass of nutrient per wet tonne (kg/t)	Value from inorganic fertiliser rate (\$/kg)
Dry matter	74	–	–	–
Total nitrogen	2.11	1.58	15.8	–
Nitrogen (after ammonia losses)	1.58	1.11	11.1	\$13.32
Phosphorus	1.31	0.96	9.6	\$28.32
Potassium	2.49	1.84	18.4	\$29.44

Example

Is it more cost effective to spread aged manure or spread DAP on paddocks with soils that are deficient in nitrogen and phosphorus but have adequate potassium?

Details:

- planned application rate 4 t/ha
- cost of aged manure (ex-feedlot) \$8/t
- cost of cartage and spreading \$15/t
- DAP costs \$800/t delivered and could be spread in conjunction with other activities (i.e. at no extra cost) at seeding time.

On a dry matter basis, the aged manure contains 2.18% nitrogen (1.31% after accounting for ammonia losses) and 0.80% phosphorus. With a moisture content of 37%, the manure as spread contains 0.83% nitrogen (after accounting for gaseous losses) (i.e. 1.31×0.63) and 0.50% phosphorus (i.e. $0.80\% \times 0.63$).

Based on the cost and nutrient content of inorganic fertilisers, N in the manure is valued at \$1.20/kg, P at \$2.95 and K at \$1.60, but extra K has no value on this soil.

Details of the nutrient content of the manure, the application rate, the nutrients applied and the value of these are tabulated below.

Nutrient	Nutrient content (% as spread)	Nutrients applied (kg/t)	Nutrients applied @ 4 t/ha (kg/ha)	Value of nutrients applied (\$/ha)
N (after gaseous losses)	0.83	8.3	33.2	\$40
P	0.50	5.0	20.0	\$59
Total value				\$99

The cost to purchase, cart and spread this manure at 4 t/ha must be compared with the cost for applying the DAP.

An analysis of the net value of nutrients in the manure, after accounting for all costs, is tabulated below.

Item	Cost (\$/t)	Cost (\$@4 t/ha)
Manure	8	\$32
Freight and spreading	15	\$60
Total cost	23	\$92
Nutrient value (based on cost of inorganic fertiliser)		\$99
Economic advantage of aged feedlot manure		\$7

In this example, there is an economic advantage of \$7/ha to using aged feedlot manure rather than DAP and urea.

Any economic advantage to using feedlot manure is strongly influenced by the cost of cartage and spreading (which includes cartage distances and contractors rates) and the current cost of artificial fertilisers.

Use site-specific data for the composition of aged manure or compost, up to date fertiliser prices and relevant cartage distances and spreading costs.