Information Sheet:
The Value of Manure and Slurry

Introduction

NRM has conducted a review of agricultural manures and slurries going back to January 2011 to identify the mean values and variation in nutrient content. As well as looking at the variation, we have investigated the potential financial value of a typical manure/slurry within each category. This review uses standard manure analysis package results over this period. These samples were taken throughout the UK, covering many different farming practices within each category. These are a selection of those highlighted in RB209 as types of organic fertilisers:

- Cattle FYM
- Pig FYM
- Sheep FYM
- Duck FYM
- Layer manure
- Broiler/turkey litter
- Cattle slurry
- Pig slurry

The purpose of this review is to highlight the possible variation there is in nutrient value and see how this translates to the value of the material when it is spread to land. The variation in nutrients for each material can highlight the importance of getting it tested so that it can be used in the most efficient way. This saves land managers money on fertiliser application or ensures that enough additional fertiliser is applied if manure values are low.

As well as demonstrating what the variation in financial value per fresh tonne each manure can contain by using current fertiliser prices, we have used the mean values and a field spreading scenario to show what the financial savings could be for the main manure types we have investigated. This has been done with the use of the MANNER program and considers a number of factors when it comes to spreading the material. The details of each scenario are listed within this section.

Data analysis

For the data sets used in this review, samples have been selected that clearly indicate the manure type from the sample reference. From the selected samples, further statistical investigation has been undertaken to remove outliers from the data set. This highlights samples that are not a true representation of each material.

It should be noted that as we did not have control over the sampling of these materials or a clear idea of the treatment of these materials prior to sampling, the values will relate to a wide range of scenarios. This may be more relevant to the industry, as a “typical” manure type may not relate to an individual’s circumstance for the storage or treatment of their material.

For solid manures, the mean, maximum, and minimum values have been calculated and displayed in both tables and graphs to highlight the variation we have seen in the nutrient values. These values have then been used within the MANNER program to estimate the financial value of each manure type per fresh tonne of the material. We have used the set availability factors for P and K plus the derived N use efficiency values to calculate a more accurate financial value of each material. Fertiliser prices from January 2018 have been used for these calculations.

There is considerable variation in nutrient values with solid content in the slurry sample data analysis. As per RB209, the average values for set % dry solid levels have been calculated using linear correlation between nutrient concentration and % dry solids. We have plotted these values and displayed the linear correlation below. The variation around the mean nutrient value at each set percentage dry dolids contents can be visually seen through the scatter of points or the R^2 value of each correlation.

As slurries are typically assessed in terms of the % dry solids, it is harder to assign maximum and minimum values to each set dry solids content as the spread of values around these points is so wide. We have therefore not assessed the financial value per m^3 of fresh material, but instead have used the derived mean values for each set dry solids content from the linear correlation trend lines. This is within the spreading scenarios for each slurry type to produce financial values in terms of a spreading to land scenario.

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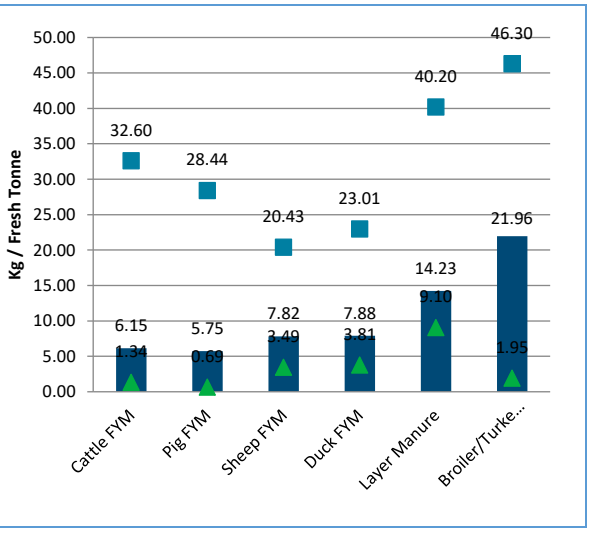
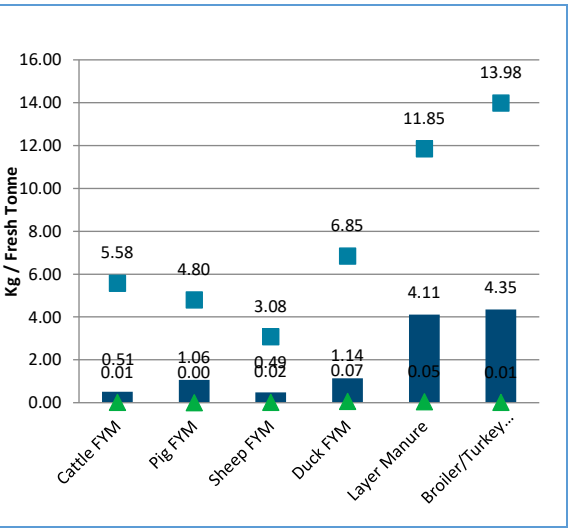
Nutrient Values of Solid Manures

Nitrogen (Kg N per fresh tonne)					
Manure Type	**NRM Minimum kg/t**	**NRM Mean kg/t**	**NRM Maximum kg/t**	**SD**	**Coefficient of Variation %**
Cattle FYM	1.34	6.15	32.60	3.42	56
Pig FYM	0.69	5.75	28.44	3.31	58
Sheep FYM	3.49	7.82	20.43	3.96	51
Duck FYM	3.81	7.88	23.01	3.73	47
Layer Manure	9.10	14.23	40.20	6.18	43
Broiler/ Turkey Litter	1.95	21.96	46.30	8.90	41



The largest variation in total nitrogen results is seen in cattle and pig FYM (56% and 58% CV). These typically have the lowest mean values for total nitrogen of all the manure types. With there being a strong correlation between dry matter and total nitrogen, the variation in dry matter for pig and cattle FYM also has the highest variation in comparison to the other manure types. This indicates that there are a wide range of management and storage practices for these manures which can have significant impacts on nutrient content. The other manures, especially poultry manures, may have more control over the management and storage of the material and there may be more consistency in the timing of sampling. Little control over the manure stack highlights the importance of getting the material tested to ensure that the correct values are used for calculating nutrient applications.

Ammoniacal N (Kg NH_4 - N per fresh tonne)					
Manure Type	**NRM Minimum kg/t**	**NRM Mean kg/t**	**NRM Maximum kg/t**	**SD**	**Coefficient of Variation %**
Cattle FYM	0.01	0.51	5.58	0.70	137
Pig FYM	0.00	1.06	4.80	1.11	104
Sheep FYM	0.02	0.49	3.08	0.76	156
Duck FYM	0.07	1.14	6.85	1.57	138
Layer Manure	0.05	4.11	11.85	2.41	59
Broiler/ Turkey Litter	0.01	4.35	13.98	2.51	58



The datasets for NH_4-N have some of the largest variations across all of the manure types, with cattle and pig FYM again having the largest variation and poultry manure having a lower variation. Even though the variation is lower for poultry manures, there is still a large variation in these materials. NH_4-N is more subject to loss (either through volatilisation or leaching) in these materials than any other nutrient, which highlights that storage and management practices can have a significant impact on the concentration of NH_4-N in the material.

Typically, poultry manure will have the highest NH_4-N values, but there are occasions where the values are very low. This could be where material has been dried, volatilising the NH_4-N, or where it may have been left for some time before sampling. Understanding how your management or storage practices influences the nutrient content of your materials is very important as they will have a significant impact on the potential financial value of your manure.

If you assume that your material has a typical concentration and do not take the above factors into account, there is a danger of over or under applying the required amount of nitrogen.

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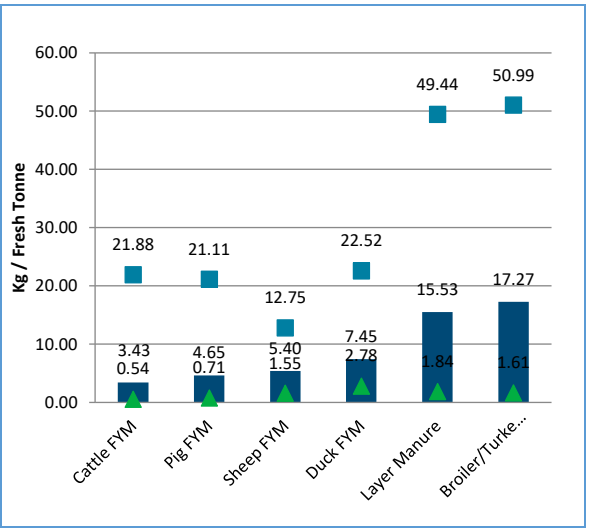
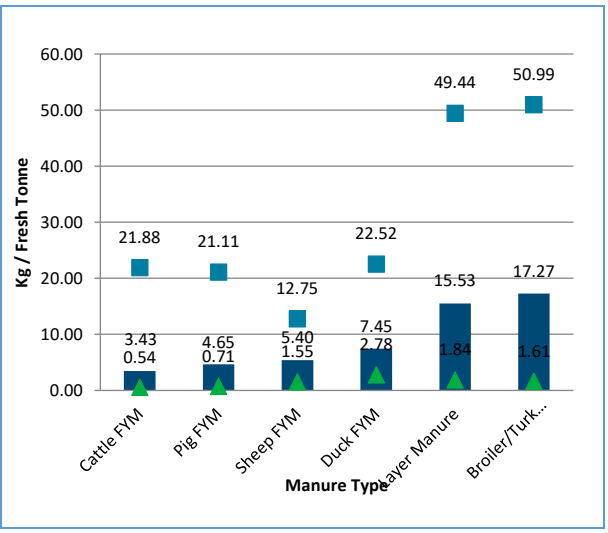
Nutrient Values of Solid Manures

Phosphate (Kg P_2O_5 per fresh tonne)					
Manure Type	**NRM Minimum kg/t**	**NRM Mean kg/t**	**NRM Maximum kg/t**	**SD**	**Coefficient of Variation %**
Cattle FYM	0.54	3.43	21.88	2.53	74
Pig FYM	0.71	4.65	21.11	3.01	65
Sheep FYM	1.55	4.65	21.11	2.86	53
Duck FYM	2.78	7.45	22.52	4.78	64
Layer Manure	1.84	15.53	49.44	8.19	53
Broiler/ Turkey Litter	1.61	17.27	50.99	7.60	44



The greatest variation in phosphate is again found in cattle and pig FYM with the lowest variation in poultry manures. The maximum results for phosphate in all manure types indicate that they could potentially provide a substantial financial benefit (in terms of the replacement of inorganic fertiliser inputs). This is shown in the financial value table later in this report.

Potash (Kg P per fresh tonne)					
Manure Type	**NRM Minimum kg/t**	**NRM Mean kg/t**	**NRM Maximum kg/t**	**SD**	**Coefficient of Variation %**
Cattle FYM	0.24	8.77	35.04	5.62	64
Pig FYM	0.41	6.64	25.50	4.45	67
Sheep FYM	4.23	14.78	35.08	7.73	52
Duck FYM	2.74	9.87	25.77	5.08	51
Layer Manure	2.04	14.35	34.26	6.79	47
Broiler/ Turkey Litter	0.41	17.47	38.78	6.67	38



There is a similar pattern in variation for potash results for all manure types, again highlighting the potential impact that storage and management can have on the nutrient content of the material. There is a smaller difference in the mean potash values between the manure types and all have relatively higher concentrations of potash than other nutrients. The current value of potash is high, so there is an opportunity for significant cost savings on fertiliser applications according to the potential maximum values.

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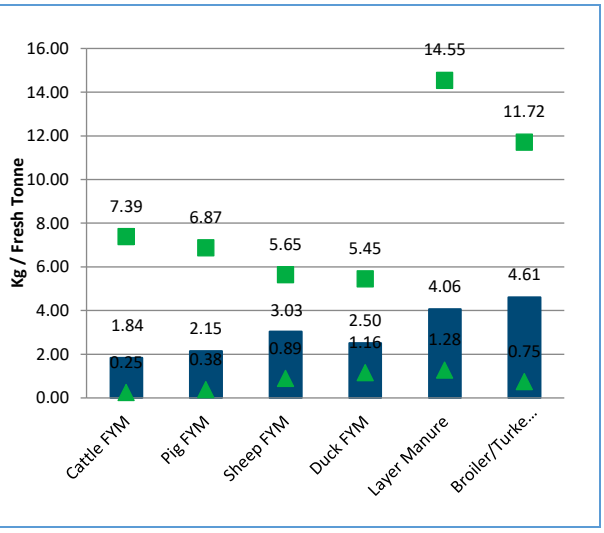
Nutrient Values of Solid Manures

Magnesium (Kg MgO per fresh tonne)					
Manure Type	**NRM Minimum kg/t**	**NRM Mean kg/t**	**NRM Maximum kg/t**	**SD**	**Coefficient of Variation %**
Cattle FYM	0.25	1.84	7.39	1.15	62
Pig FYM	0.38	2.15	6.87	1.26	59
Sheep FYM	0.89	3.03	5.65	1.27	42
Duck FYM	1.16	2.05	5.45	1.13	45
Layer Manure	1.28	4.06	14.55	2.35	58
Broiler/ Turkey Litter	0.75	4.61	11.72	1.80	39



All the manures have relatively low mean concentrations of magnesium, so there would typically be less of an offset on magnesium application from these manures. However, looking at the maximum results for each manure type, it shows that there can potentially be high concentrations. It is therefore important to get an idea of what you have before you spread to land as your material has a significant value.

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Nutrient Values of Liquid Slurries

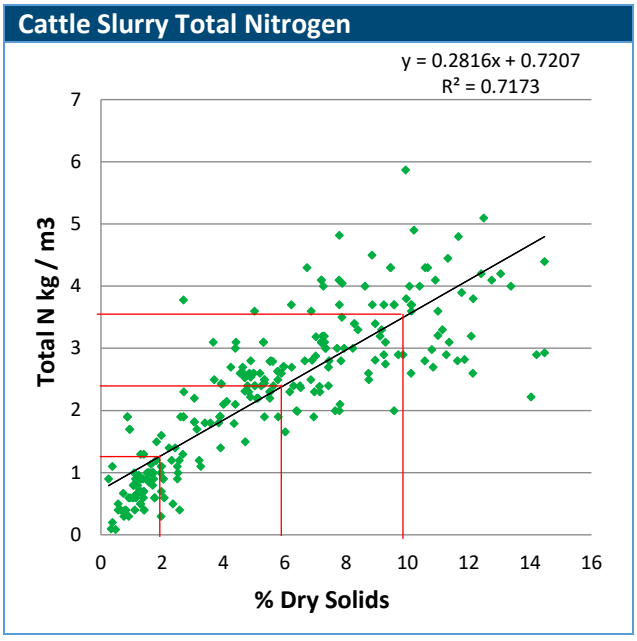
Nitrogen

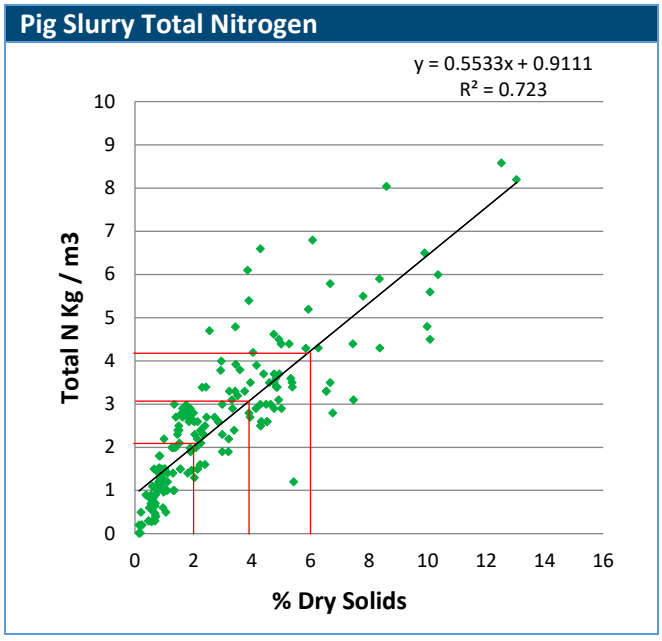
There is a relatively strong correlation between total nitrogen and dry solids for cattle slurry. This indicates that there is a relatively low variation in total nitrogen at a set dry solids point. The variation does seem to increase in samples with higher % dry solids, as you can see from the increased scatter for those with a value greater than 6%. At the 10% dry solids point, there are total nitrogen values between 2kg N/m^3 and 6kg N/m^3. This is a significant difference when using this material for nitrogen applications, highlighting the importance of having the slurry analysed.

Pig slurry typically has more total nitrogen than cattle slurry in relation to % dry solids. The mean total nitrogen value for pig slurry at 6% solids is 4.23kgN/m^3, whereas the mean total nitrogen for cattle slurry at 6% dry solids is 2.41kgN/m^3. Again, there is a strong correlation between total nitrogen and % dry solids with a similar pattern of a stronger correlation for samples with lower % dry solids as shown in the cattle slurry. The variation does increase significantly as the % dry solids level increases above 4%. Relying on a typical or book value for this type of material for offsetting fertiliser applications could potentially lead to an over estimation in the amount of nitrogen applied or excess application of nitrogen where financial savings could have been made.

Cattle Slurry Nitrogen (Kg N per fresh m3)		
	Cattle Slurry	NRM Value (Kg/m3)
Solids %	2	1.28
	6	2.41
	10	3.55

Pig Slurry Nitrogen (Kg N per fresh m3)		
	Pig Slurry	NRM Value (Kg/m3)
Solids %	2	2.02
	4	3.12
	6	4.23





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Nutrient Values of Liquid Slurries

Phosphate

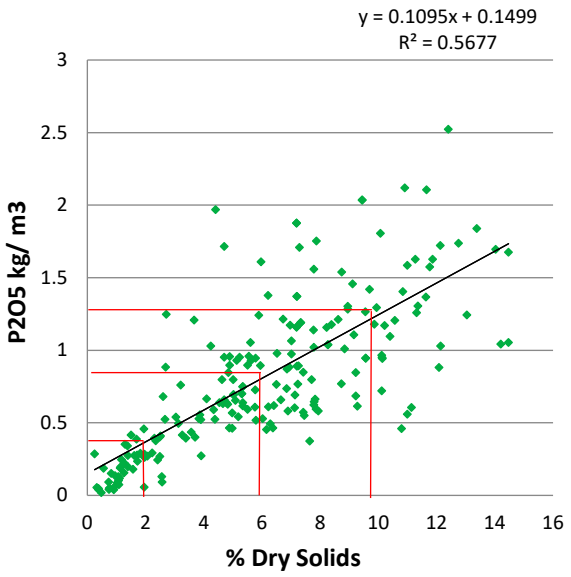
The correlation between phosphate and % dry solids for cattle slurry is not as strong as for total nitrogen. There is a stronger correlation for samples up to 4% dry solids, but as the samples increase in % dry solids over 4%, the variation in phosphate concentration increases significantly. For slurries at these higher % dry solids, there should be less reliance placed on a typical or book value of phosphate for use in nutrient management plans. As shown in the chart, your slurry could have twice as much phosphate at one of the set % dry solids levels than the typical value would suggest.

There is a stronger correlation between phosphate and % dry solids for pig slurry, but again there is an increased variation in results where samples have more than 4% dry solids. This data shows that pig slurry typically has higher concentrations of phosphate than cattle slurry and therefore can have a greater financial value if used correctly when spreading to land. Examples of this can be seen in the spreading scenarios later in the report.

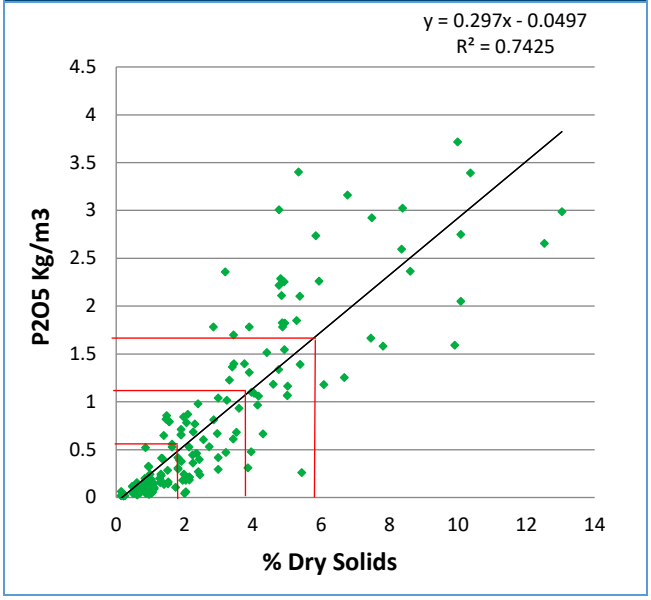
Cattle Slurry Phosphate (K g P_2O_5 per fresh m3)		
	Cattle Slurry	NRM Value (Kg/m3)
Solids %	2	0.45
	6	0.82
	10	1.19

Pig Slurry Phosphate (Kg P_2O_5 per fresh m3)		
	Pig Slurry	NRM Value (Kg/m3)
Solids %	2	0.64
	4	1.24
	6	1.83

Cattle Slurry Phosphate



Pig Slurry Phosphate



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Nutrient Values of Liquid Slurries

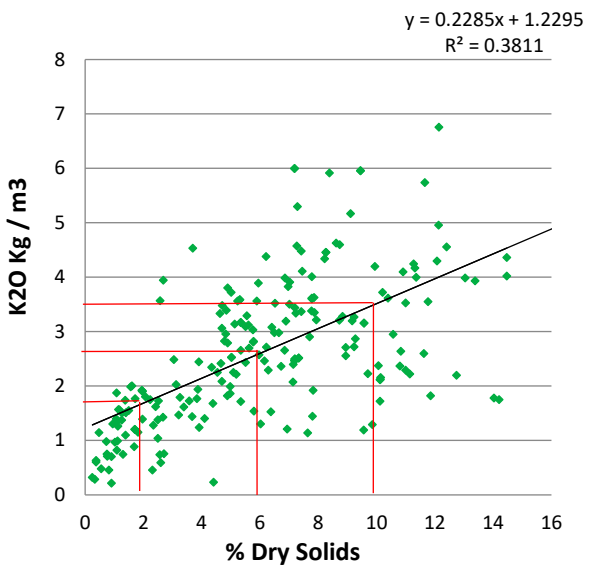
Potash

For both cattle slurry and pig slurry, there are poor correlations between the concentration of potash and % dry solids (R^2 of 0.38 and 0.35 respectively). Even at the lower % dry solids there is a poor correlation, which was not seen for the other nutrients. This highlights the importance of knowing the potash value for your slurry before planning any application, and of not relying on typical or book values if you want to ensure the most efficient use of your slurry of potash nutrient management. The concentration of potash in both cattle and pig slurry is significant and can potentially provide large financial savings against inorganic fertiliser applications. Examples of potential cost savings are shown in the slurry spreading scenarios at the end of the report.

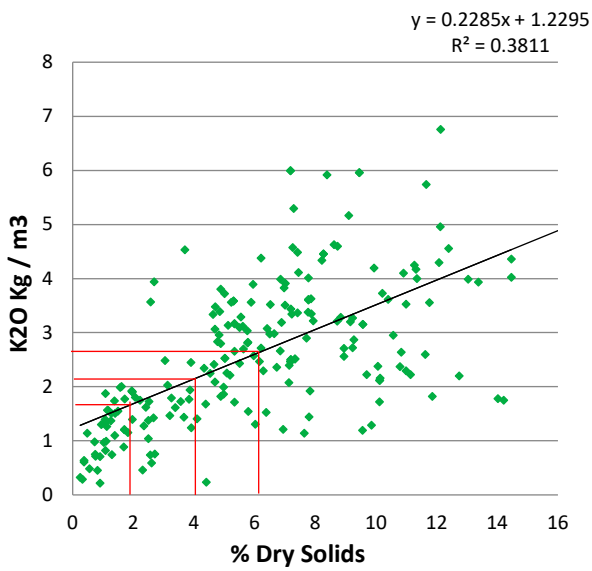
Cattle Slurry Potash (Kg K_2O per fresh m3)		
	Cattle Slurry	NRM Value (Kg/m3)
Solids %	2	1.73
	6	2.51
	10	3.28

Pig Slurry Phosphate (Kg K_2O per fresh m3)		
	Pig Slurry	NRM Value (Kg/m3)
Solids %	2	1.97
	4	2.54
	6	3.10

Cattle Slurry Potash



Pig Slurry Potash



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August 2021
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Nutrient Values of Liquid Slurries

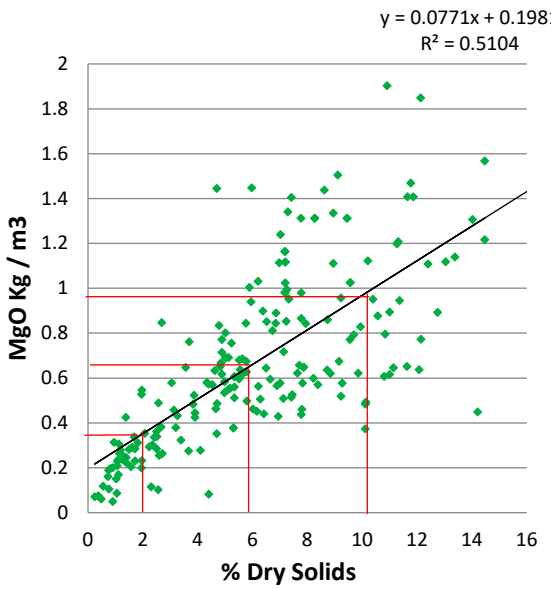
Magnesium

The relationship between magnesium concentration of % dry solids for both cattle and pig slurry is similar to what is seen for phosphate, with cattle slurry having the weaker correlation. Both datasets have a stronger correlation for samples with lower % dry solids. The concentrations of magnesium in both slurry types are typically relatively low and, as such, there may not be much reliance on the materials to fulfil magnesium requirements for a season's application. However, in some cases, especially in cattle slurry, magnesium concentrations can be significant and therefore could potentially provide noticeable financial savings. While this report does not look at the financial value in terms of magnesium for these materials, this could be worth looking in to if your slurry or manure has high concentrations.

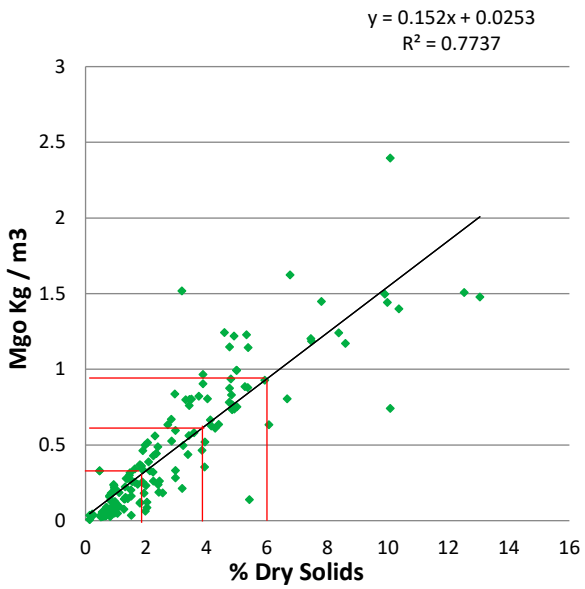
Cattle Slurry Magnesium (Kg MgO per fresh m3)		
	Cattle Slurry	**NRM Value (Kg/m3)**
Solids %	2	0.37
	6	0.64
	10	0.92

Pig Slurry Phosphate (Kg MgO per fresh m3)		
	Pig Slurry	**NRM Value (Kg/m3)**
Solids %	2	0.33
	4	0.63
	6	0.94

Cattle Slurry Magnesium



Pig Slurry Magnesium



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Nutrient Values of Liquid Slurries

Ammoniacal

There is a very poor correlation between NH_4N and % dry solids for both cattle and pig slurry. This shows that there is a very large variation in results throughout the ranges of % dry solids. This is of little surprise as NH_4-N would not be entirely associated with the solid fraction of the slurry. NH_4-N will typically increase with the amount of total nitrogen as seen in the following charts. However, the amount that will be present will vary as shown by the degree of correlation in the charts. This will depend on several factors including storage time, time of year, and type of store used. This again demonstrates that management and storage practices can have a significant impact on the financial value of the material. NH_4-N is the readily available nitrogen in the material, and so the more nitrogen you have that is in this form the greater the immediate financial value of the material. This is illustrated in our slurry spreading scenarios where the financial value of nitrogen in each material is calculated by taking the available fraction into account.

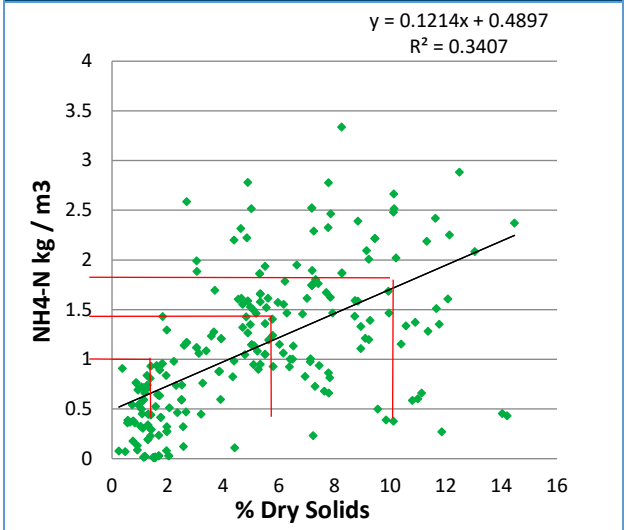
Cattle Slurry Ammoniacal N (Kg NH_4 -N per fresh m3)

	Cattle Slurry	NRM Value (Kg/m3)
Solids %	2	0.77
	6	1.17
	10	1.56

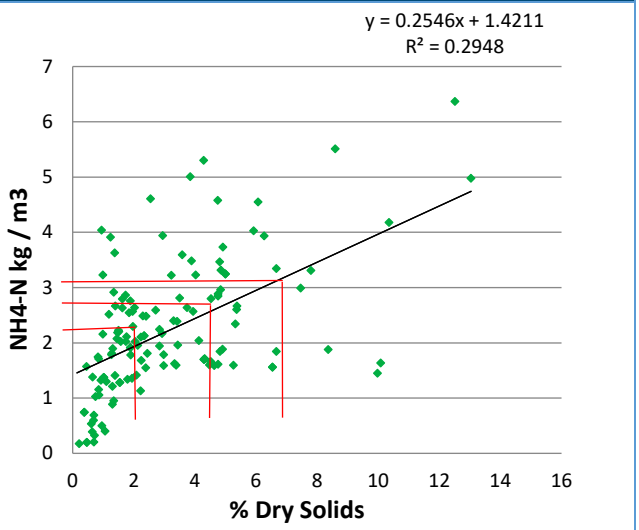
Pig Slurry Ammoniacal N (Kg NH_4 -N per fresh m3)

	Pig Slurry	NRM Value (Kg/m3)
Solids %	2	1.93
	4	2.44
	6	2.95

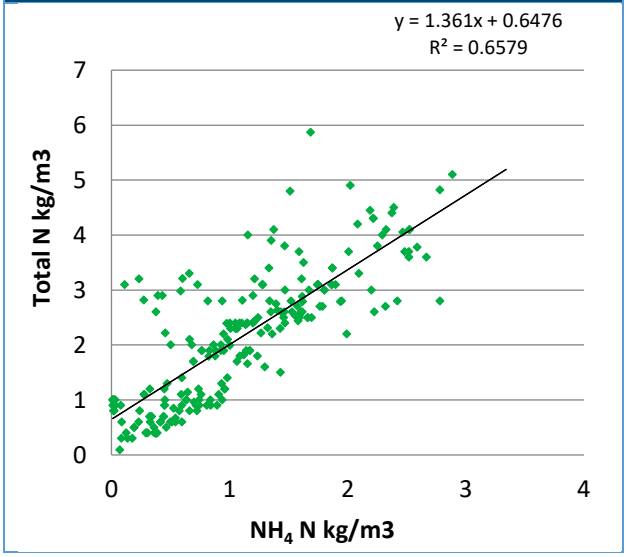
Cattle Slurry Ammoniacal N



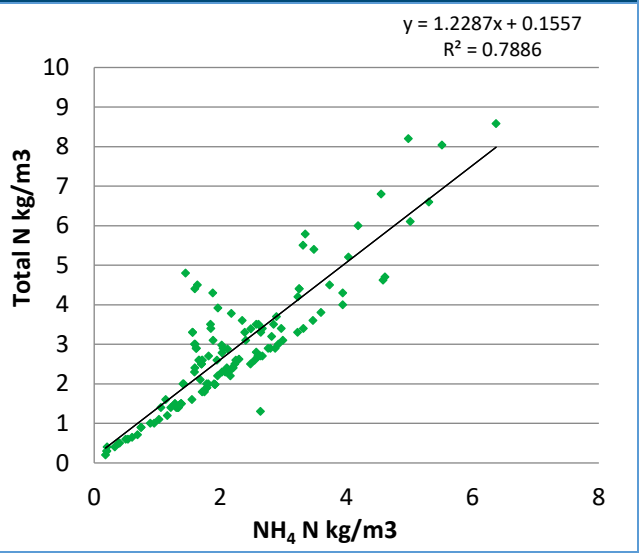
Pig Slurry Ammoniacal N



Cattle Slurry NH_4 -N VS Total N



Pig Slurry NH_4 -N VS Total N



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The Financial Value

The table below displays the mean, maximum, and minimum total N, P and K values from the NRM dataset. The crop available values have been derived from the values in the RB209 (P = 60% of total, K = 90% of total) using a spreading scenario in MANNER (see details below). This is determined alongside the NH_4 N values to calculate the nitrogen efficiency and therefore the crop available nitrogen of each material. These crop available values have then been used to calculate the financial value (£/tonne) of the material using current fertiliser prices*.

Variation in Financial Value and Nutrients of Poultry Manure											
Manure	**N**					**P**			**K**		
	Nitrogen (Kg/t)	**NH_4 N (Kg/t)**	**N Efficiency %**	**Crop Available N**	**£ / tonne**	**P_2O_5 (Kg/t)**	**Crop Available P_2O_5**	**£ / tonne**	**K_2O (Kg/t)**	**Crop Available K**	**£ / tonne**
Cattle FYM											
Mean	6.15	0.51	8	0.49	**0.34**	3.43	2.06	**2.10**	8.77	7.89	**3.73**
Max	32.60	5.58	12	3.85	**2.66**	21.88	13.13	**13.42**	35.04	31.54	**14.89**
Min	1.34	0.01	5	0.06	**0.04**	0.54	0.32	**0.33**	0.24	0.22	**0.10**
Pig FYM											
Mean	5.75	1.06	12	0.71	**0.49**	4.65	2.79	**2.85**	6.64	5.98	**2.82**
Max	28.44	4.80	12	3.33	**2.30**	21.11	12.67	**12.94**	25.50	22.95	**10.84**
Min	0.69	0.00	4	0.03	**0.02**	0.71	0.42	**0.43**	0.41	0.37	**0.17**
Sheep FYM											
Mean	7.82	0.49	7	0.56	**0.39**	5.40	3.24	**3.31**	14.78	13.30	**6.28**
Max	20.43	3.08	11	2.23	**1.54**	12.75	7.65	**7.82**	35.08	31.57	**14.91**
Min	3.49	0.02	5	0.16	**0.11**	1.55	0.93	**0.95**	4.23	3.81	**1.80**
Duck FYM											
Mean	7.88	1.14	11	0.84	**0.58**	7.45	4.47	**4.57**	9.87	8.89	**4.20**
Max	23.01	6.85	17	3.98	**2.75**	22.52	13.51	**13.81**	25.77	23.19	**10.95**
Min	3.81	0.07	5	0.20	**0.14**	2.78	1.67	**1.70**	2.74	2.46	**1.16**
Layer Manure											
Mean	14.23	4.11	50	7.17	**4.95**	15.53	9.32	**9.52**	14.35	12.92	**6.10**
Max	40.20	11.85	45	17.97	**12.40**	49.44	29.66	**30.31**	34.26	30.83	**14.56**
Min	9.10	0.05	39	3.59	**2.48**	1.84	1.11	**1.13**	2.04	1.84	**0.87**
Broiler/Turkey Litter											
Mean	21.96	4.35	41	8.99	**6.20**	17.27	10.36	**10.59**	17.47	15.73	**7.43**
Max	46.30	13.98	43	19.24	**13.27**	50.99	30.59	**31.26**	38.78	34.90	**16.48**
Min	1.95	0.01	64	1.26	**0.87**	1.61	0.97	**0.99**	0.41	0.36	**0.17**

Based on the following fertiliser prices (01/2018):

- *Ammonium Nitrate =* ***£238.00****/tonne -* ***69p****/kg N*
- *TSP =* ***£282.00****/tonne -* ***61p****/kg P_2O_5*
- *MOP =* ***£255.00****/tonne -* ***43p****/kg K_2O*

It should be noted that only a minimal amount can be applied if the materials have the maximum values listed above due to both NVZ rules (if applicable) or crop requirement. The material will have no associated value for a nutrient if the field it is being applied to is above the recommended soil indices for that nutrient.

For the financial value of crop available nitrogen, the following assumptions and scenario have been used:

Application date	15/02
Application method	Broadcast spreader
Method of incorporation	Plough
Delay to soil incorporation	12-24 hours
End of soil drainage	31/03
Rainfall post application	69mm
Soil type	Sandy clay loam
Cropping	Spring cereal

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August 2021
(updated fertiliser prices Jan 2018)

Spreading Scenarios – Financial Value

For a better idea of the true value of these materials, we have put together a number of possible spreading scenarios using the mean nutrient values for each manure/slurry. These scenarios and potential financial values have been generated using ADAS' MANNER programme.

Application 1 – Pig FYM applied before potatoes

Potential financial value of manure application

£50/ha

Pig FYM spreading scenario	
Autumn crop N uptake	N/A
Average annual rainfall	655mm
Topsoil texture	Sandy Clay Loam
Subsoil texture	Sandy Clay Loam
Field in a NVZ	Yes

Application details	
Manure type	Pig FYM fresh
Application date	15/02/2016
Application rate (t/ha or m3/ha)	8
Application method	Broadcast spreader
Method of soil incorporation	Plough
Delay to soil incorporation	12-24 hours
End of soil drainage	31/03/2016
Rainfall post application (mm)	69
Wind speed at application	Calm/gentle (0-3 Beaufort scale)
Rain within 6 hours of application (mm)	No rainfall within 6 hours of spreading
Topsoil moisture	Moist

Manure analysis (using Pig FYM mean values)								
Kg/t or kg/m3								
DM (%)	Total N	NH_4-N	Uric acid-N	Nitrate-N	Total P_2O_5	Total K_2O	Total SO_3	Total MgO
31.8	*5.75*	*1.06*	*0*	*0*	*4.65*	*6.64*	*3.4*	*2.15*

MANNER-NPK results							
		Nitrogen losses (kg/ha)			Crop available N (kg/ha)		
Total N (kg/ha)	Mineralised N (kg/ha)	Nitrate-N	Ammonia-N	Denitrified-N	Current crop	Following crop year 2	N use efficiency (%)
46	2	0	4	0	6	1	13

Total P_2O_5 (Kg/ha)	Available P_2O_5 (kg/ha)	Total K_2O (kg/ha)	Available K_2O (kg/ha)	Total SO_3 (kg/ha)	Total MgO (kg/ha)
37	22	53	48	27	17

Financial value	
Crop available N (£/ha)	£4
Total P_2O_5 (£/ha)	£23
Total K_2O (£/ha)	£23
Grand total (£/ha)	**£50**

*Based on 69 p/kg N, 61 p/kg P_2O_5 & 43 p/hg K_2O
Assumed soil index values: P ≤ 2, K ≤ 2+

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August 2021
(updated fertiliser prices Jan 2018)

Spreading Scenarios – Financial Value

For a better idea of the true value of these materials, we have put together a number of possible spreading scenarios using the mean nutrient values for each manure/slurry. These scenarios and potential financial values have been generated using ADAS' MANNER programme.

Application 2 – Cattle FYM applied to 2 cut grass

Potential financial value of Manure application **£155/ha**

Cattle FYM spreading scenario	
Autumn crop N uptake	N/A
Average annual rainfall	655mm
Topsoil texture	Sandy clay loam
Subsoil texture	Clay loam
Field in a NVZ	Yes

Application Details	
Manure type	Cattle FYM fresh
Cropping	Grass 2 cut
Application date	15/02/2016
Application rate (t/ha or m3/ha)	25
Application method	Broadcast spreader
Method of soil incorporation	Not incorporated
Delay to soil incorporation	N/A
End of soil drainage	31/03/2016
Rainfall post application (mm)	69
Wind speed at application	Calm/gentle (0-3 Beaufort scale)
Rain within 6 hours of application (mm)	No rainfall within 6 hours of spreading
Topsoil moisture	Moist

Manure analysis (using Pig FYM mean values)								
Kg/t or kg/m3								
DM (%)	Total N	NH_4-N	Uric acid-N	Nitrate-N	Total P_2O_5	Total K_2O	Total SO_3	Total MgO
23.9	6.15	0.51	0	0	3.43	8.77	2.4	1.84

	MANNER-NPK results							
		Nitrogen losses (kg/ha)				Crop available N (kg/ha)		
Total N (kg/ha)	Mineralised N (kg/ha)	Nitrate-N	Ammonia-N	Denitrified-N	Current crop	Next Grass crop cur year	Following crop year 2	N use efficiency (%)
154	1	0	9	0	4	9	5	9

Total P_2O_5 (Kg/ha)	Available P_2O_5 (kg/ha)	Total K_2O (kg/ha)	Available K_2O (kg/ha)	Total SO_3 (kg/ha)	Total MgO (kg/ha)
86	51	219	197	60	46

Financial value	
Crop available N (£/ha)	£9
Total P_2O_5 (£/ha)	£53
Total K_2O (£/ha)	£93
Grand total (£/ha)	£155

*Based on 69 p/kg N, 61 p/kg P_2O_5 & 43 p/hg K_2O
Assumed soil index values: P ≤ 2, K ≤ 2+

Spreading Scenarios – Financial Value

For a better idea of the true value of these materials, we have put together a number of possible spreading scenarios using the mean nutrient values for each manure/slurry. These scenarios and potential financial values have been generated using ADAS' MANNER programme.

Application 3 – Layer manure applied to spring cereal

Potential financial value of manure application

£165/ha

Layer Manure spreading scenario	
Autumn crop N uptake	N/A
Average annual rainfall	655mm
Topsoil texture	Sandy Clay Loam
Subsoil texture	Clay Loam
Field in a NVZ	Yes

Application details	
Manure type	Layer Manure
Cropping	Spring cereal
Application date	15/02/2016
Application rate (t/ha or m3/ha)	8
Application method	Broadcast spreader
Method of soil incorporation	Plough
Delay to soil incorporation	12-24 hours
End of soil drainage	31/03/2016
Rainfall post application (mm)	71
Wind speed at application	Calm/gentle (0-3 Beaufort scale)
Rain within 6 hours of application (mm)	No rainfall within 6 hours of spreading
Topsoil moisture	Moist

Manure analysis (using Pig FYM mean values)								
Kg/t or kg/m3								
DM (%)	Total N	NH_4-N	Uric acid-N	Nitrate-N	Total P_2O_5	Total K_2O	Total SO_3	Total MgO
41.6	14.2	4.11	4.1	0.2	15.5	14.3	4.7	4.06

MANNER-NPK results							
		Nitrogen losses (kg/ha)			Crop available N (kg/ha)		
Total N (kg/ha)	Mineralised N (kg/ha)	Nitrate-N	Ammonia-N	Denitrified-N	Current crop	Following crop year 2	N use efficiency (%)
114	11	3	14	4	57	3	51

Total P_2O_5 (Kg/ha)	Available P_2O_5 (kg/ha)	Total K_2O (kg/ha)	Available K_2O (kg/ha)	Total SO_3 (kg/ha)	Total MgO (kg/ha)
124	74	114	103	38	32

Financial value	
Crop available N (£/ha)	£40
Total P_2O_5 (£/ha)	£76
Total K_2O (£/ha)	£49
Grand total (£/ha)	£165

*Based on 69 p/kg N, 61 p/kg P_2O_5 & 43 p/hg K_2O
Assumed soil index values: P ≤ 2, K ≤ 2+

Spreading Scenarios – Financial Value

For a better idea of the true value of these materials, we have put together a number of possible spreading scenarios using the mean nutrient values for each manure/slurry. These scenarios and potential financial values have been generated using ADAS' MANNER programme.

Application 4 – Broiler/Turkey Litter applied to spring cereal

Potential financial value of manure application

£193/ha

Broiler/Turkey Litter spreading scenario	
Autumn Crop N uptake	N/A
Average Annual Rainfall	655mm
Topsoil Texture	Sandy clay loam
Subsoil Texture	Clay loam
Field in a NVZ	Yes

Application details	
Manure type	Broiler/Turkey Litter
Cropping	Spring cereal
Application date	15/02/2016
Application rate (t/ha or m3/ha)	8
Application method	Broadcast spreader
Method of soil incorporation	Plough
Delay to soil incorporation	12-24 hours
End of soil drainage	31/03/2016
Rainfall post application (mm)	71
Wind speed at application	Calm/gentle (0-3 Beaufort scale)
Rain within 6 hours of application (mm)	No rainfall within 6 hours of spreading
Topsoil moisture	Moist

Manure analysis (using Pig FYM mean values)

Kg/t or kg/m3

DM (%)	Total N	NH_4-N	Uric acid-N	Nitrate-N	Total P_2O_5	Total K_2O	Total SO_3	Total MgO
53.5	21.9	4.35	3.7	0.2	17.2	17.4	7.1	4.61

MANNER-NPK results

		Nitrogen losses (kg/ha)			Crop available N (kg/ha)		
Total N (kg/ha)	Mineralised N (kg/ha)	Nitrate-N	Ammonia-N	Denitrified-N	Current crop	Following crop year 2	N use efficiency (%)
175	27	3	14	4	72	8	41

Total P_2O_5 (Kg/ha)	Available P_2O_5 (kg/ha)	Total K_2O (kg/ha)	Available K_2O (kg/ha)	Total SO_3 (kg/ha)	Total MgO (kg/ha)
138	83	139	125	57	37

Financial value	
Crop available N (£/ha)	£50
Total P_2O_5 (£/ha)	£84
Total K_2O (£/ha)	£59
Grand total (£/ha)	**£193**

*Based on 69 p/kg N, 61 p/kg P_2O_5 & 43 p/hg K_2O
Assumed soil index values: P ≤ 2, K ≤ 2+

Spreading Scenarios – Financial Value

For a better idea of the true value of these materials, we have put together a number of possible spreading scenarios using the mean nutrient values for each manure/slurry. These scenarios and potential financial values have been generated using ADAS' MANNER programme.

Application 5 – Cattle Slurry – Autumn application to winter wheat

Potential financial value of manure application

£139/ha

*10 Dry Solids

Cattle Slurry spreading scenario	
Autumn Crop N uptake	N/A
Average annual rainfall	655mm
Topsoil texture	Sandy clay loam
Subsoil texture	Sandy clay loam
Field in a NVZ	Yes

Application Details	
Manure type	Cattle Slurry (autumn)
Cropping	Winter wheat
Application date	15/02/2016
Application rate (t/ha or m3/ha)	50
Application method	Band spreader – tailing hose
Method of soil incorporation	Not Incorporated
Delay to soil incorporation	12-24 hours
End of soil drainage	31/03/2016
Rainfall post application (mm)	379
Wind speed at application	Calm/gentle (0-3 Beaufort scale)
Rain within 6 hours of application (mm)	No rainfall within 6 hours of spreading
Topsoil moisture	Moist

Manure analysis (using Pig FYM mean values)

Kg/t or kg/m3

DM (%)	Total N	NH_4-N	Uric acid-N	Nitrate-N	Total P_2O_5	Total K_2O	Total SO_3	Total MgO
2	1.28	0.77	0	0	0.45	1.73	0.3	0.37
6	2.41	1.17	0	0	0.82	2.51	0.7	0.64
10	3.55	1.56	0	0	1.19	3.28	1.0	0.92

MANNER-NPK results

			Nitrogen losses (kg/ha)			Crop available N (kg/ha)		
% Solids	Total N (kg/ha)	Mineralised N (kg/ha)	Nitrate-N	Ammonia-N	Denitrified-N	Current crop	Following crop year 2	N use efficiency (%)
2	64	1	8	3	3	26	1	41
6	120	3	14	6	4	37	2	31
10	178	4	19	11	5	47	3	27

% Solids	Total P_2O_5 (Kg/ha)	Available P_2O_5 (kg/ha)	Total K_2O (kg/ha)	Available K_2O (kg/ha)	Total SO_3 (kg/ha)	Total MgO (kg/ha)
2	22	11	86	78	15	18
6	41	20	125	113	35	32
10	60	30	164	148	50	46

Financial value

	2% solids	6% solids	10% solids
Crop available N (£/ha)	£18	£26	£32
Total P_2O_5 (£/ha)	£14	£25	£36
Total K_2O (£/ha)	£37	£53	£70
Grand total (£/ha)	**£69**	**£104**	**£139**

*Based on 69 p/kg N, 61 p/kg P_2O_5 & 43 p/hg K_2O

Assumed soil index values: P ≤ 2, K ≤ 2+

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August 2021
(updated fertiliser prices Jan 2018)

Spreading Scenarios – Financial Value

For a better idea of the true value of these materials, we have put together a number of possible spreading scenarios using the mean nutrient values for each manure/slurry. These scenarios and potential financial values have been generated using ADAS' MANNER programme.

Application 6 – Cattle Slurry – Spring application to winter wheat

Potential financial value of manure application

£86/ha

*10% Dry Solids

Cattle Slurry spreading scenario			Application details	
Autumn crop N uptake	N/A		Manure type	Cattle Slurry (spring)
Average annual rainfall	655mm		Cropping	Winter wheat
Topsoil texture	Sandy clay loam		Application date	10/02/2016
Subsoil texture	Sandy clay loam		Application rate (t/ha or m3/ha)	30
Field in a NVZ	Yes		Application method	Band spreader – tailing hose
			Method of soil incorporation	Not Incorporated
			Delay to soil incorporation	N/A
			End of soil drainage	31/03/2016
			Rainfall post application (mm)	78
			Wind speed at application	Calm/gentle (0-3 Beaufort scale)
			Rain within 6 hours of application (mm)	No rainfall within 6 hours of spreading
			Topsoil moisture	Moist

Manure analysis (using Pig FYM mean values)								
Kg/t or kg/m3								
DM (%)	Total N	NH_4-N	Uric acid-N	Nitrate-N	Total P_2O_5	Total K_2O	Total SO_3	Total MgO
2	1.28	0.77	0	0	0.45	1.73	0.3	0.37
6	2.41	1.17	0	0	0.82	2.51	0.7	0.64
10	3.55	1.56	0	0	1.19	3.28	1.0	0.92

MANNER-NPK results								
			Nitrogen losses (kg/ha)			Crop available N (kg/ha)		
% Solids	Total N (kg/ha)	Mineralised N (kg/ha)	Nitrate-N	Ammonia-N	Denitrified-N	Current crop	Following crop year 2	N use efficiency (%)
2	38	1	3	4	3	31	1	48
6	72	2	5	5	2	25	1	34
10	106	3	6	8	3	32	2	30

% Solids	Total P_2O_5 (Kg/ha)	Available P_2O_5 (kg/ha)	Total K_2O (kg/ha)	Available K_2O (kg/ha)	Total SO_3 (kg/ha)	Total MgO (kg/ha)
2	14	7	52	47	9	11
6	25	12	75	68	21	19
10	36	18	98	89	30	28

Financial value			
	2% solids	6% solids	10% solids
Crop available N (£/ha)	£12	£17	£22
Total P_2O_5 (£/ha)	£8	£15	£22
Total K_2O (£/ha)	£22	£32	£42
Grand total (£/ha)	**£42**	**£64**	**£86**

*Based on 69 p/kg N, 61 p/kg P_2O_5 & 43 p/hg K_2O

Assumed soil index values: P ≤ 2, K ≤ 2+

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August 2021
(updated fertiliser prices Jan 2018)

Spreading Scenarios – Financial Value

For a better idea of the true value of these materials, we have put together a number of possible spreading scenarios using the mean nutrient values for each manure/slurry. These scenarios and potential financial values have been generated using ADAS' MANNER programme.

Application 7 – Pig Slurry – Autumn application to winter wheat

Potential financial value of manure application

£176/ha

*6% Dry Solids

Pig Slurry spreading scenario	
Autumn crop N uptake	N/A
Average annual rainfall	655mm
Topsoil texture	Sandy clay loam
Subsoil texture	Sandy clay loam
Field in a NVZ	Yes

Application details	
Manure type	Pig Slurry (autumn)
Cropping	Winter wheat
Application date	15/09/2016
Application rate (t/ha or m3/ha)	50
Application method	Band spreader – tailing Hose
Method of soil incorporation	Not Incorporated
Delay to soil incorporation	Not Incorporated
End of soil drainage	31/03/2016
Rainfall post application (mm)	389
Wind speed at application	Calm/gentle (0-3 Beaufort scale)
Rain within 6 hours of application (mm)	No rainfall within 6 hours of spreading
Topsoil moisture	Moist

Manure analysis (using Pig FYM mean values)

Kg/t or kg/m3

DM (%)	Total N	NH_4-N	Uric acid-N	Nitrate-N	Total P_2O_5	Total K_2O	Total SO_3	Total MgO
2	2.02	1.93	0	0	0.64	1.97	0.7	0.33
4	3.12	2.44	0	0	1.24	2.54	1.0	0.63
6	4.23	2.95	0	0	1.83	3.10	1.2	0.94

MANNER-NPK results

			Nitrogen losses (kg/ha)			Crop available N (kg/ha)		
% Solids	Total N (kg/ha)	Mineralised N (kg/ha)	Nitrate-N	Ammonia-N	Denitrified-N	Current crop	Following crop year 2	N use efficiency (%)
2	101	0	24	9	7	54	0	54
4	156	4	31	15	8	71	2	45
6	212	7	38	23	10	84	4	40

% Solids	Total P_2O_5 (Kg/ha)	Available P_2O_5 (kg/ha)	Total K_2O (kg/ha)	Available K_2O (kg/ha)	Total SO_3 (kg/ha)	Total MgO (kg/ha)
2	32	16	98	89	35	16
4	62	31	127	114	50	32
6	92	46	155	140	60	47

Financial value

	2% solids	4% solids	6% solids
Crop available N (£/ha)	£38	£46	£54
Total P_2O_5 (£/ha)	£20	£38	£56
Total K_2O (£/ha)	£42	£54	£66
Grand total (£/ha)	**£100**	**£138**	**£176**

*Based on 69 p/kg N, 61 p/kg P_2O_5 & 43 p/hg K_2O

Assumed soil index values: P ≤ 2, K ≤ 2+

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August 2021
(updated fertiliser prices Jan 2018)

Spreading Scenarios – Financial Value

For a better idea of the true value of these materials, we have put together a number of possible spreading scenarios using the mean nutrient values for each manure/slurry. These scenarios and potential financial values have been generated using ADAS' MANNER programme.

Application 8 – Pig Slurry – Spring application to winter wheat

Potential financial value of manure application

£114/ha

*6% Dry Solids

Pig Slurry spreading scenario	
Autumn crop N uptake	N/A
Average annual rainfall	655mm
Topsoil texture	Sandy Clay Loam
Subsoil texture	Sandy Clay Loam
Field in a NVZ	Yes

Application details	
Manure type	Pig Slurry (spring)
Cropping	Winter wheat
Application date	10/02/2016
Application rate (t/ha or m3/ha)	50
Application method	Band spreader – tailing Hose
Method of soil incorporation	Not Incorporated
Delay to soil incorporation	N/A
End of soil drainage	31/03/2016
Rainfall post application (mm)	78
Wind speed at application	Calm/gentle (0-3 Beaufort scale)
Rain within 6 hours of application (mm)	No rainfall within 6 hours of spreading
Topsoil moisture	Moist

Manure analysis (using Pig FYM mean values)

Kg/t or kg/m3

DM (%)	Total N	NH_4-N	Uric acid-N	Nitrate-N	Total P_2O_5	Total K_2O	Total SO_3	Total MgO
2	2.02	1.93	0	0	0.64	1.97	0.7	0.33
4	3.12	2.44	0	0	1.24	2.54	1.0	0.63
6	4.23	2.95	0	0	1.83	3.10	1.2	0.94

MANNER-NPK results

			Nitrogen losses (kg/ha)			Crop available N (kg/ha)		
% Solids	Total N (kg/ha)	Mineralised N (kg/ha)	Nitrate-N	Ammonia-N	Denitrified-N	Current crop	Following crop year 2	N use efficiency (%)
2	61	0	8	8	4	39	0	64
4	94	2	9	13	5	49	2	52
6	127	5	11	20	5	58	3	45

% Solids	Total P_2O_5 (Kg/ha)	Available P_2O_5 (kg/ha)	Total K_2O (kg/ha)	Available K_2O (kg/ha)	Total SO_3 (kg/ha)	Total MgO (kg/ha)
2	19	10	59	53	21	10
4	37	190	76	69	30	19
6	55	27	93	84	36	28

Financial value

	2% solids	4% solids	6% solids
Crop available N (£/ha)	£27	£34	£40
Total P_2O_5 (£/ha)	£12	£23	£34
Total K_2O (£/ha)	£25	£32	£40
Grand total (£/ha)	**£64**	**£89**	**£114**

*Based on 69 p/kg N, 61 p/kg P_2O_5 & 43 p/hg K_2O

Assumed soil index values: P ≤ 2, K ≤ 2+

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August 2021
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