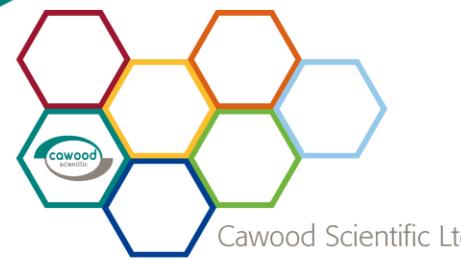




# ITLUS Conference – Optimising Organic Manures in Tillage Systems

6<sup>th</sup> December 2018



# Operational Divisions



## Business focus:

- Independence
- Quality assurance
- Fast service
- Experience
- Technical competence
- Confidentiality

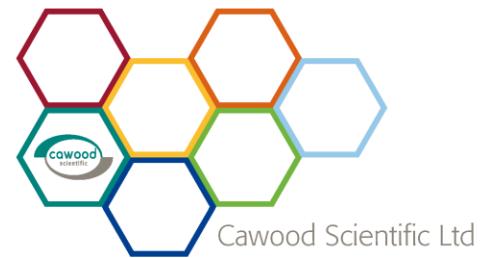


# Group Locations





# Variability of nutrient content in organic manures



# Outline

- Introduction to the Value of Manure and Slurry Report
- Variation of nutrient values in typical Manures
- Variation in nutrient values in typical Slurries
- Financial Values
- Spreading Scenarios

# Value of Manure & Slurry Report

Review of Agricultural manures and slurries since 2011

## Investigate:

- Variation in nutrient content
- Potential financial values

Samples from throughout the UK and Ireland

- Only samples with clear and specific reference to manure type

**Cattle FYM**

**Sheep FYM**

**Cattle Slurry**

**Pig FYM**

**Duck FYM**

**Pig Slurry**

**Layer Manure**

**Broiler Manure**

**Purpose - Importance of getting material tested when applying to land**

- Good Agricultural Practice for nutrient management on farm
- Cost Saving – Use of Spreading Scenarios



# Nutrient Variation in Manures

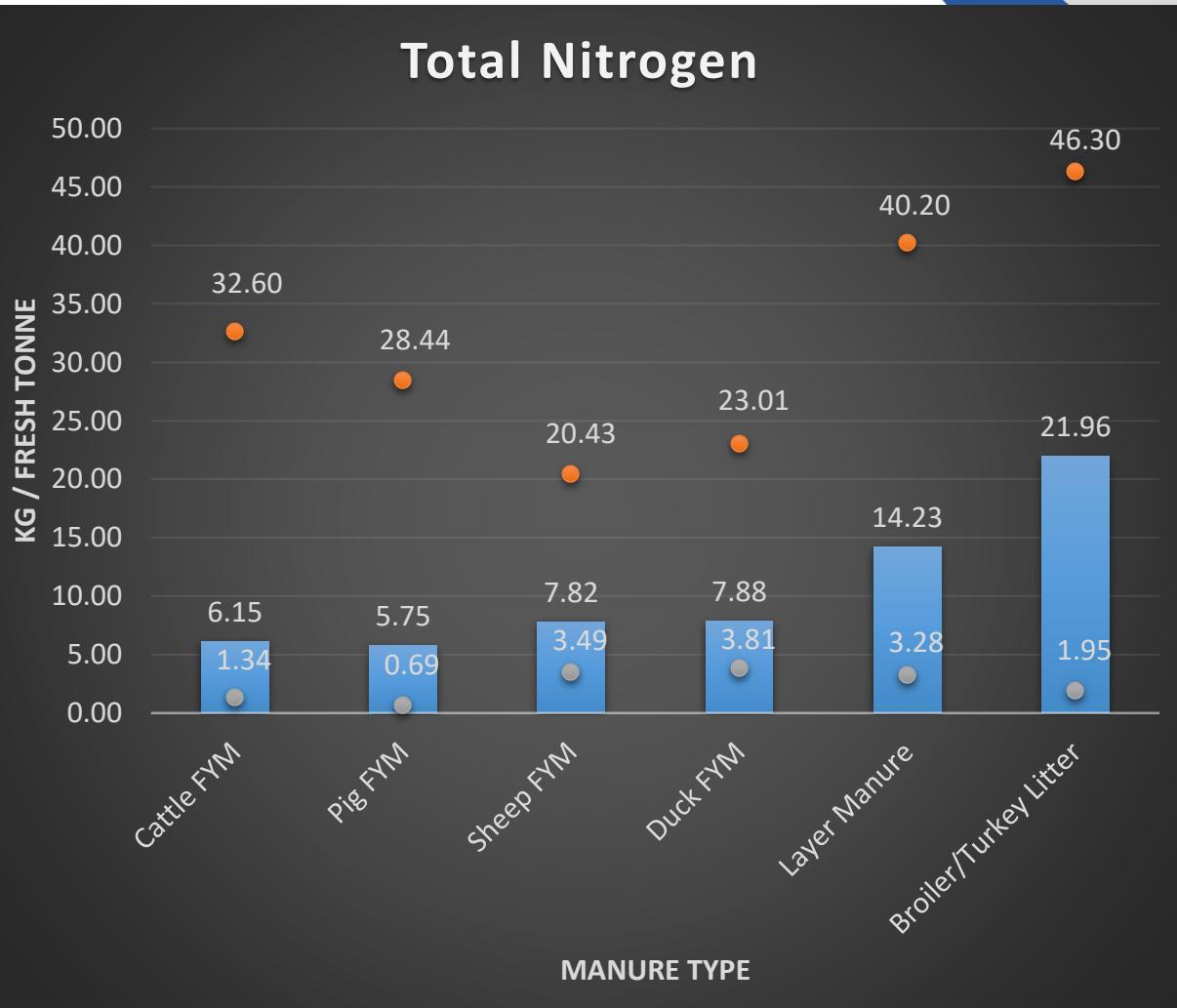
# Nitrogen in Manures

## Nitrogen (Kg N per fresh tonne)

Manure Type	NRM Minimum	NRM Mean	NRM Maximum	SD	Coefficient of Variation (CV)
Kg/t					
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

Largest variation in total Nitrogen - Cattle and Pig FYM

Typically lowest mean values for total Nitrogen of all the manure types.



# Nitrogen in Manures

## Total Nitrogen

Strong correlation between dry matter and total nitrogen in manure. Pig and Cattle FYM also have the highest variation in Dry Matter - Indicates:

- Wide range of management and storage practices
- Significant impacts on nutrient content

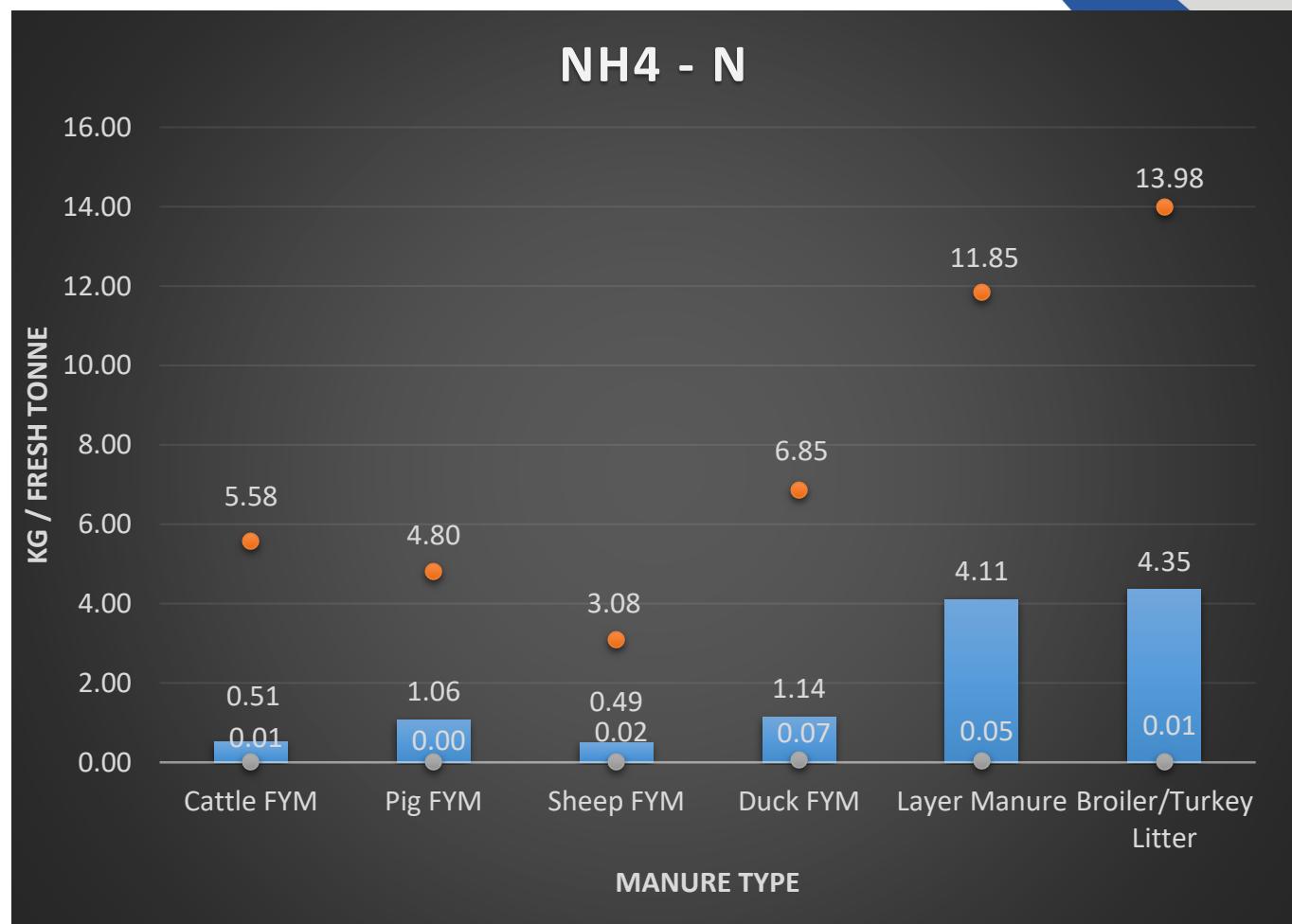
Poultry manures may have more control over the management and storage of the material and there may be more consistency in the timing of sampling.

**The less control over the management of manure stack - Greater importance of getting the material tested!**

# Nitrogen in Manures

## Ammoniacal N (Kg NH<sub>4</sub>-N) per fresh tonne )

Manure Type	NRM Minimum	NRM Mean	NRM Maximum	SD	Coefficient of Variation (CV)
Kg/t					%
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



**Manure NH<sub>4</sub>-N levels - largest variations across all of the manure types.**

**Cattle and Pig FYM again having the largest variation and poultry manure having a lower variation.**

# Nitrogen in Manures

## Ammoniacal Nitrogen

Highest variation due to NH<sub>4</sub>-N being more subject to loss from **volatilisation or leaching**

Storage and management practices - Significant impact on NH<sub>4</sub>-N Concentrations

Poultry manure typically highest NH<sub>4</sub>-N values. However - Occasions where the values are very low. Drying of material volatilising the NH<sub>4</sub>-N

**Important** - Understand how management or storage practice influences the nutrient content - significant impact on the potential financial value of your manure.

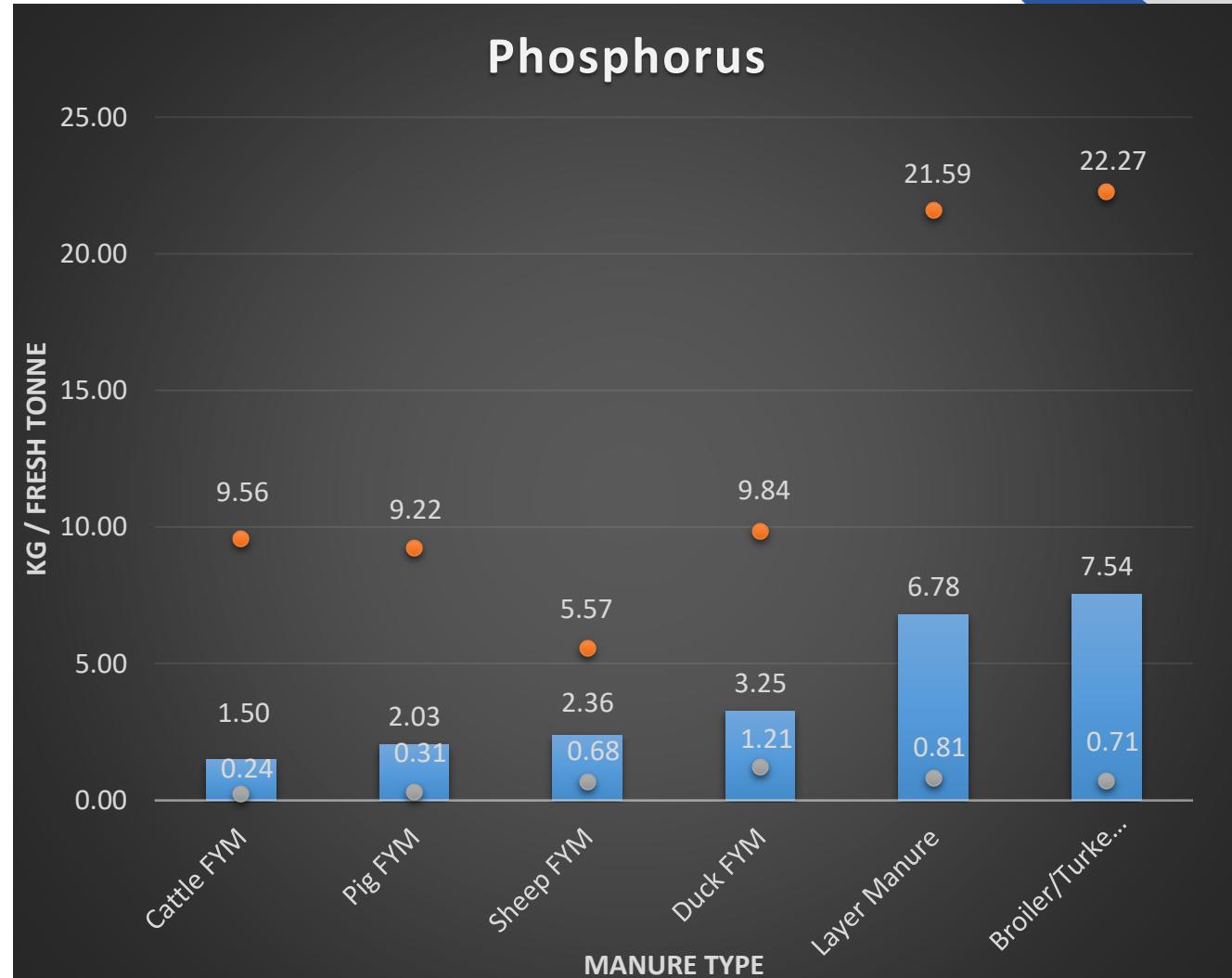
# Phosphorus in Manures

## Phosphorus (Kg P per fresh tonne)

Manure Type	NRM Minimum	NRM Mean	NRM Maximum	SD	Coefficient of Variation (CV)
Kg/t					%
Cattle FYM	0.24	1.50	9.56	1.10	74
Pig FYM	0.31	2.03	9.22	1.31	65
Sheep FYM	0.68	2.03	9.22	1.25	53
Duck FYM	1.21	3.25	9.84	2.09	64
Layer Manure	0.81	6.78	21.59	3.58	53
Broiler / Turkey Litter	0.71	7.54	22.27	3.32	44

Similar Pattern again – Pig and Cattle FYM highest Variation

High maximum P Concentration in all manure types – Potential significant and valuable source of P



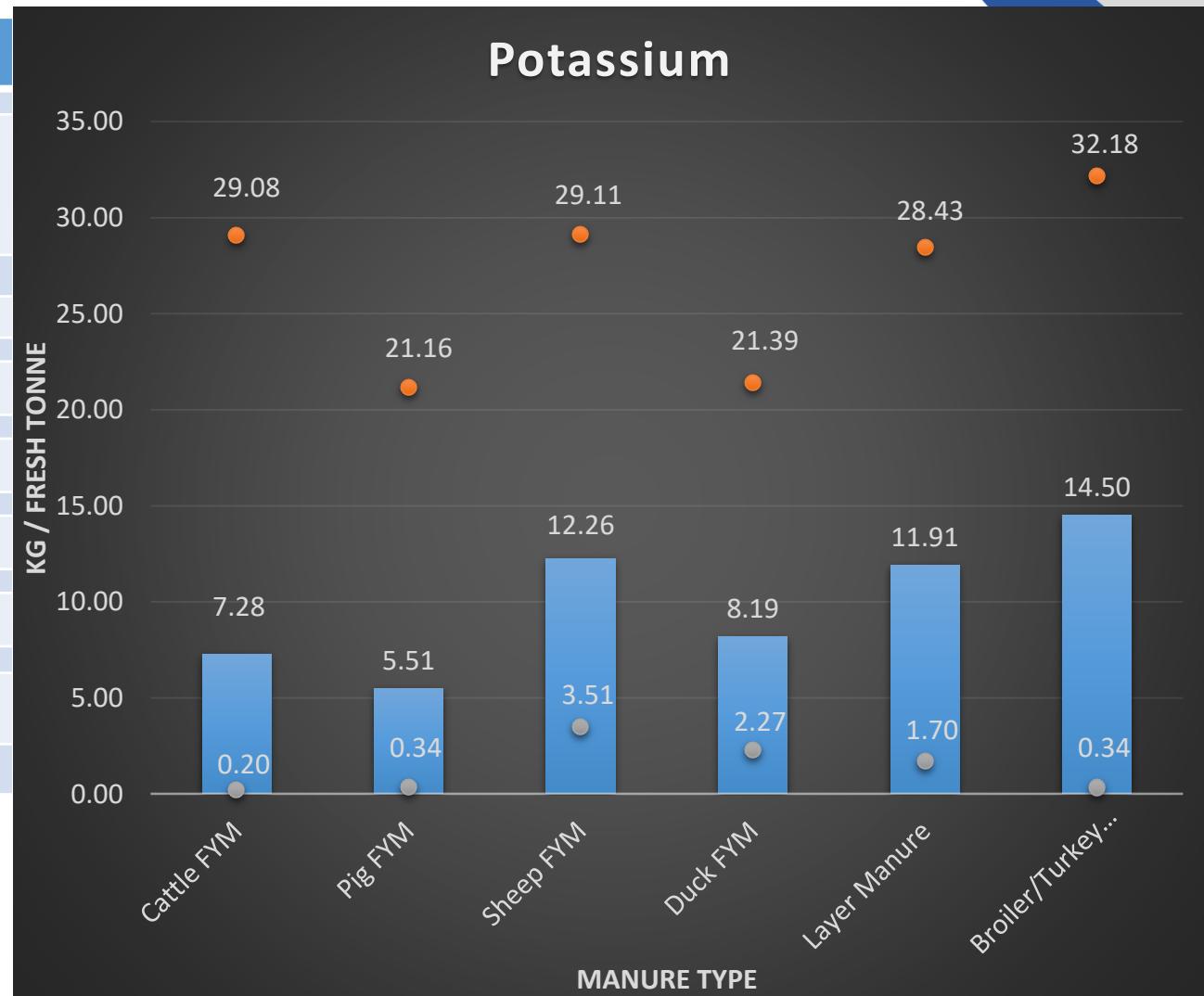
# Potassium in Manures

## Potassium (Kg K per fresh tonne)

Manure Type	NRM Minimum	NRM Mean	NRM Maximum	SD	Coefficient of Variation (CV)
Kg/t					%
Cattle FYM	0.20	7.28	29.08	4.67	64
Pig FYM	0.34	5.51	21.16	3.69	67
Sheep FYM	3.51	12.26	29.11	6.41	52
Duck FYM	2.27	8.19	21.39	4.22	51
Layer Manure	1.70	11.91	28.43	5.64	47
Broiler / Turkey Litter	0.34	14.50	32.18	5.53	38

Pig and Cattle FYM highest Variation

Similar K concentrations across all manure types



# Potassium in Manures

High variation in Potassium values – very mobile nutrient – easily leached

Important to analyse close to application – take account of K concentrations

Similar to Phosphorus – high maximum concentrations and mean values

- potential significant source of nutrients
- high financial value - Will be demonstrated later

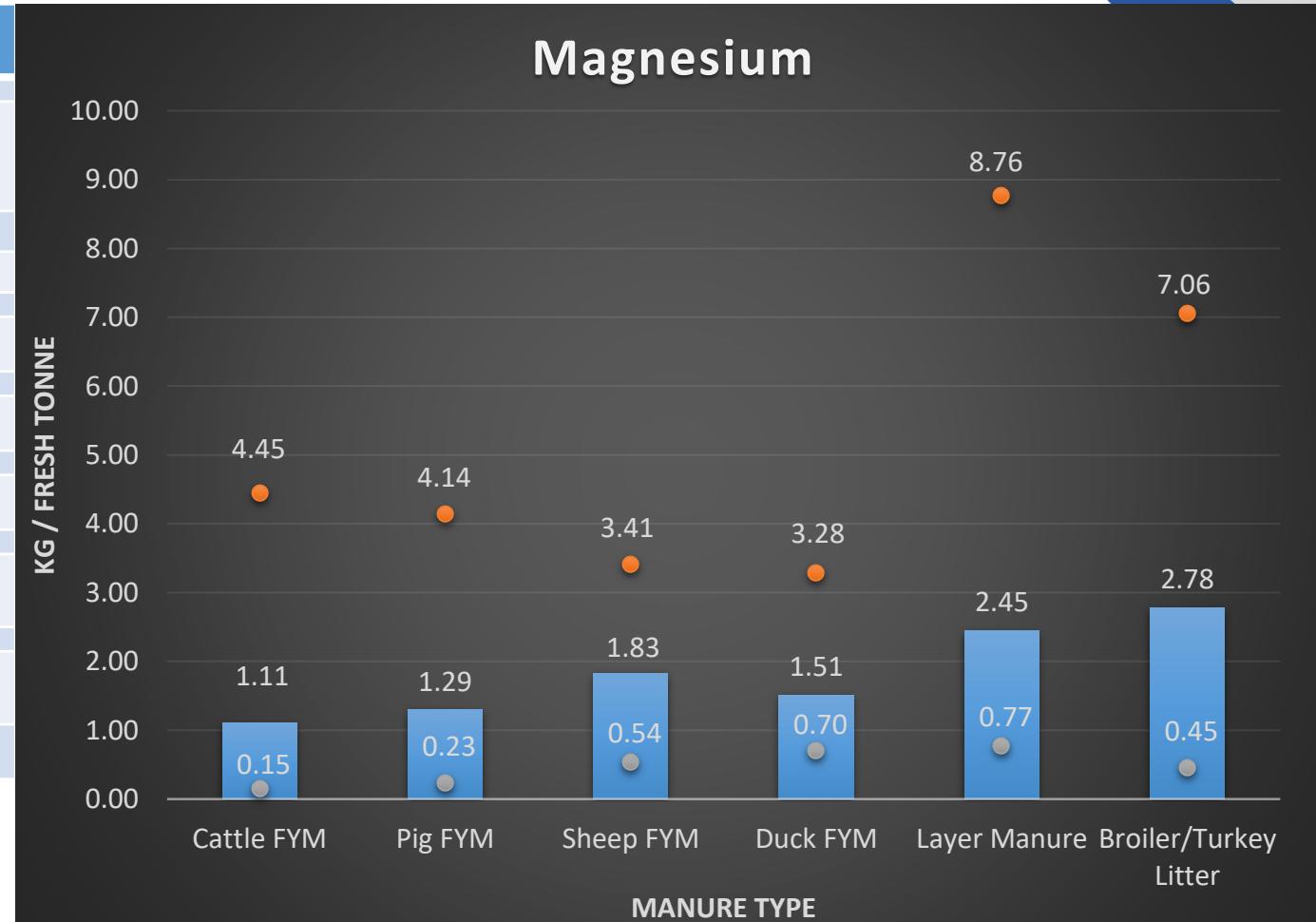
# Magnesium in Manures

## Magnesium (Kg Mg per fresh tonne)

Manure Type	NRM Minimum	NRM Mean	NRM Maximum	SD	Coefficient of Variation (CV)
Kg/t					%
Cattle FYM	0.15	1.11	4.45	0.69	62
Pig FYM	0.23	1.29	4.14	0.76	59
Sheep FYM	0.54	1.83	3.41	0.76	42
Duck FYM	0.70	1.51	3.28	0.68	45
Layer Manure	0.77	2.45	8.76	1.41	58
Broiler / Turkey Litter	0.45	2.78	7.06	1.08	39

All Manures – relatively low concentrations

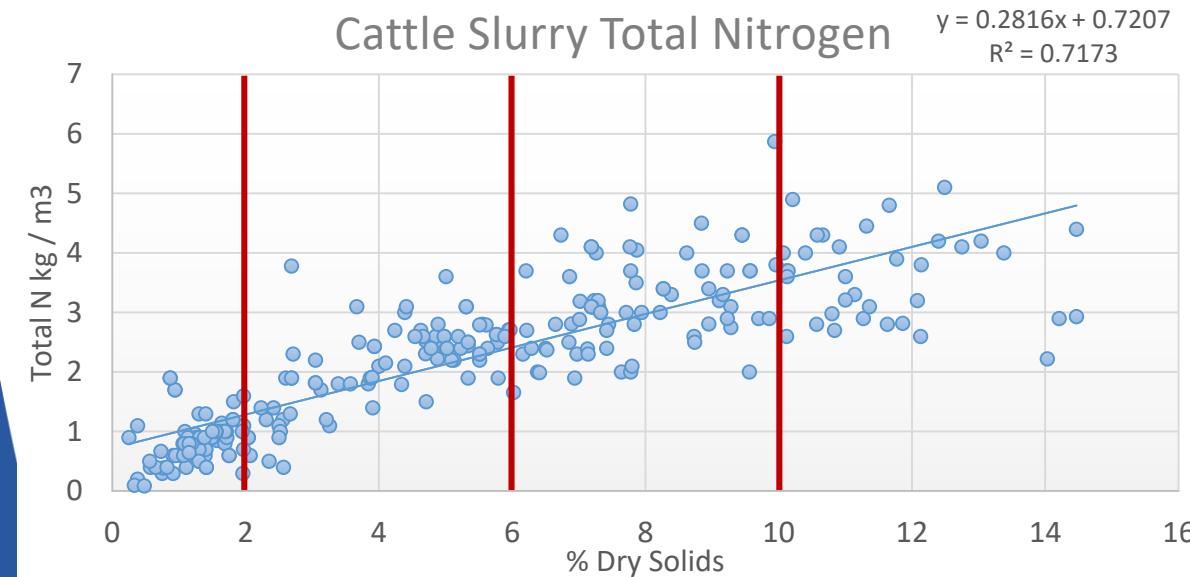
Less focus when assessing nutrient and financial value



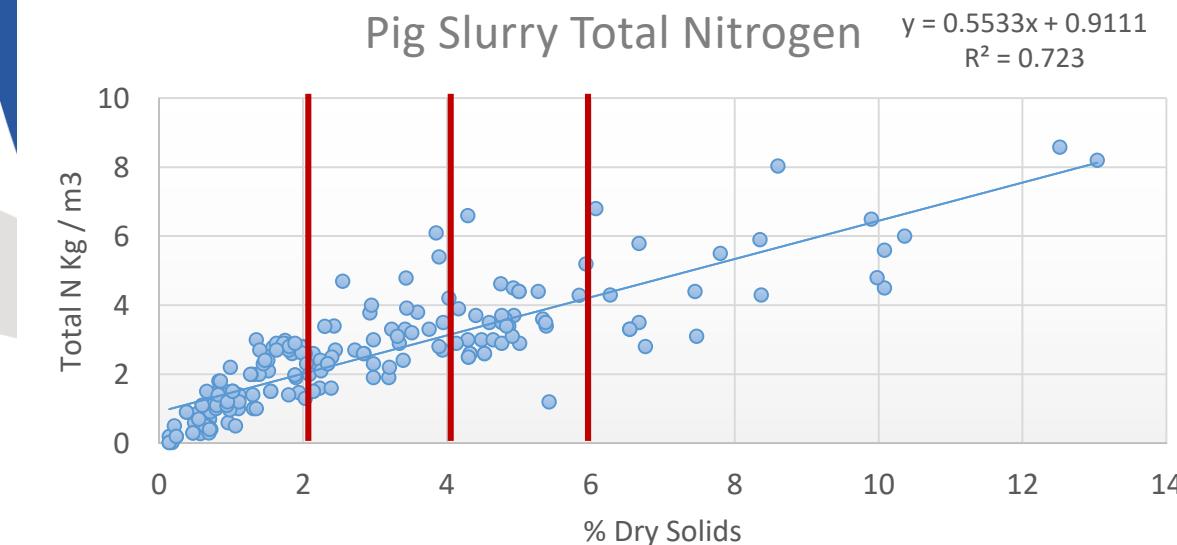
# Nutrient Variation in Slurries

# Nitrogen in Slurry

Cattle Slurry Total Nitrogen



Pig Slurry Total Nitrogen



## Cattle Slurry

Strong correlation Total Nitrogen vs Dry solids for cattle slurry - low variation in Total Nitrogen at a set dry solids point

Variation increases with Solids content  
Greater scatter above 6%

10% solids – Values 2-6KgN/m<sup>3</sup> –  
significant variation – care required when calculating application

% Solids	Kg/m <sup>3</sup>
2	1.28
6	2.41
10	3.55

## Pig Slurry

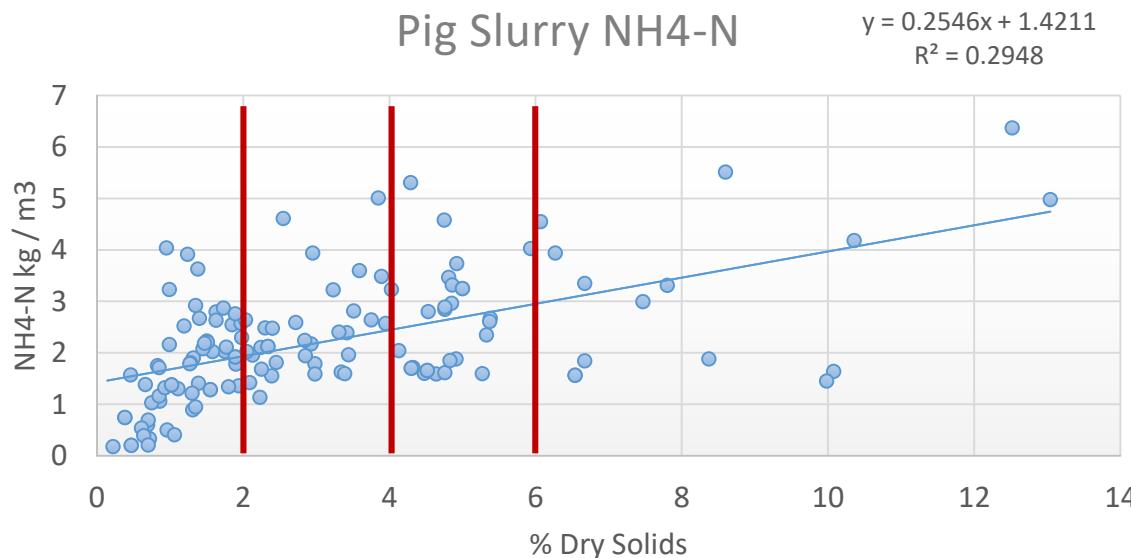
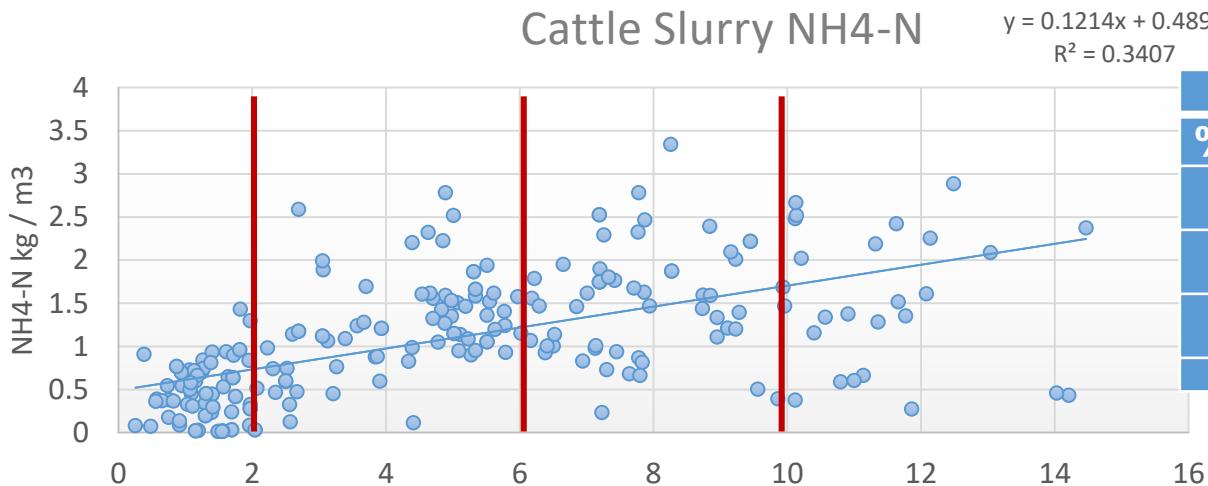
Typically more Nitrogen

Same trend – less variation at lower solids

Significant variation above 4% solids –  
book values could be very misleading

% Solids	Kg/m <sup>3</sup>
2	2.02
4	3.12
6	4.23

# Nitrogen in Slurry



## Cattle & Pig Slurry

Very poor correlation in NH4-N to Solids  
NH4-N associated with the liquid fraction

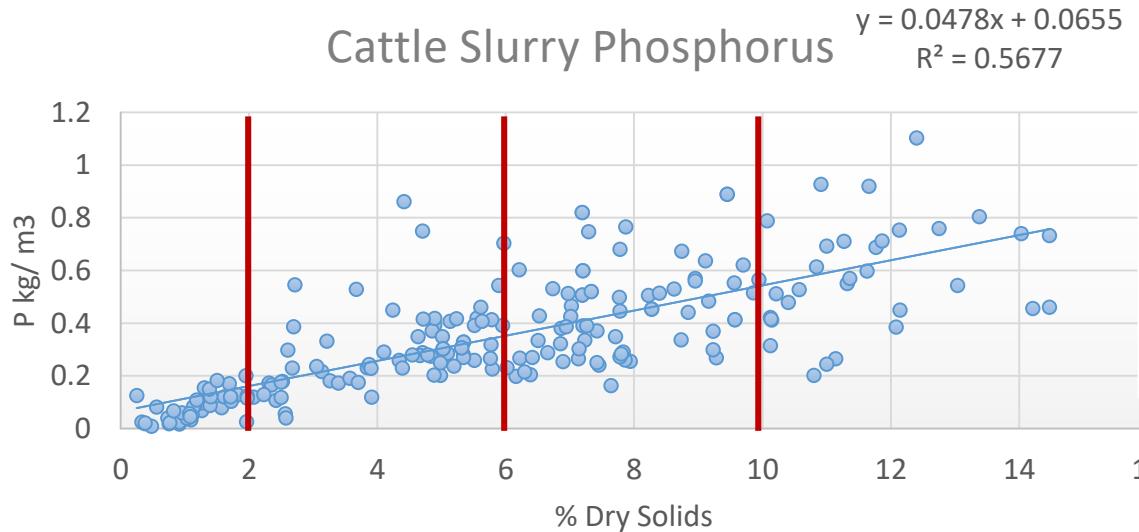
Will have a strong correlation with Total N

Variation in the proportion of NH4-N of the Total N due to storage & management practice – loss from volatilisation

Nitrogen value of slurry determined by the NH4-N concentration (readily available fraction)

Very difficult to predict based on % solids content – essential to get it analysed

# Phosphorus in Slurry

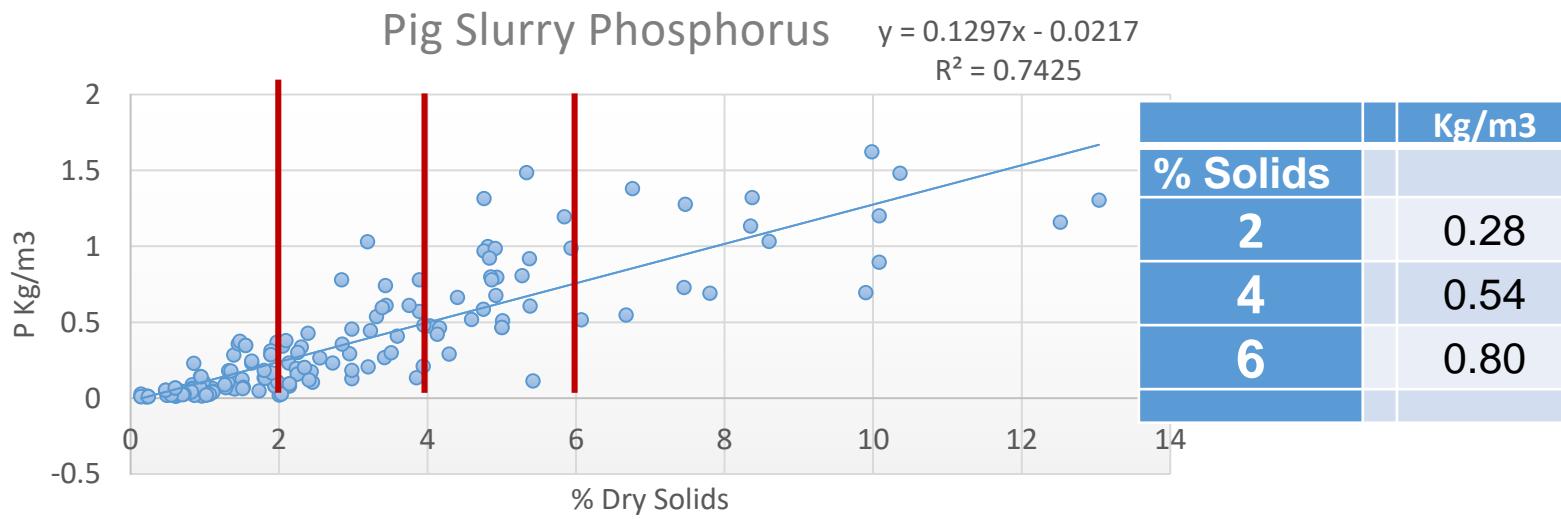


## Cattle Slurry

Weaker correlation between Phosphorus and Dry Solids

Higher variation above 4% solids – caution on using book values

At 10% solids you may have twice as much P – compared to book values



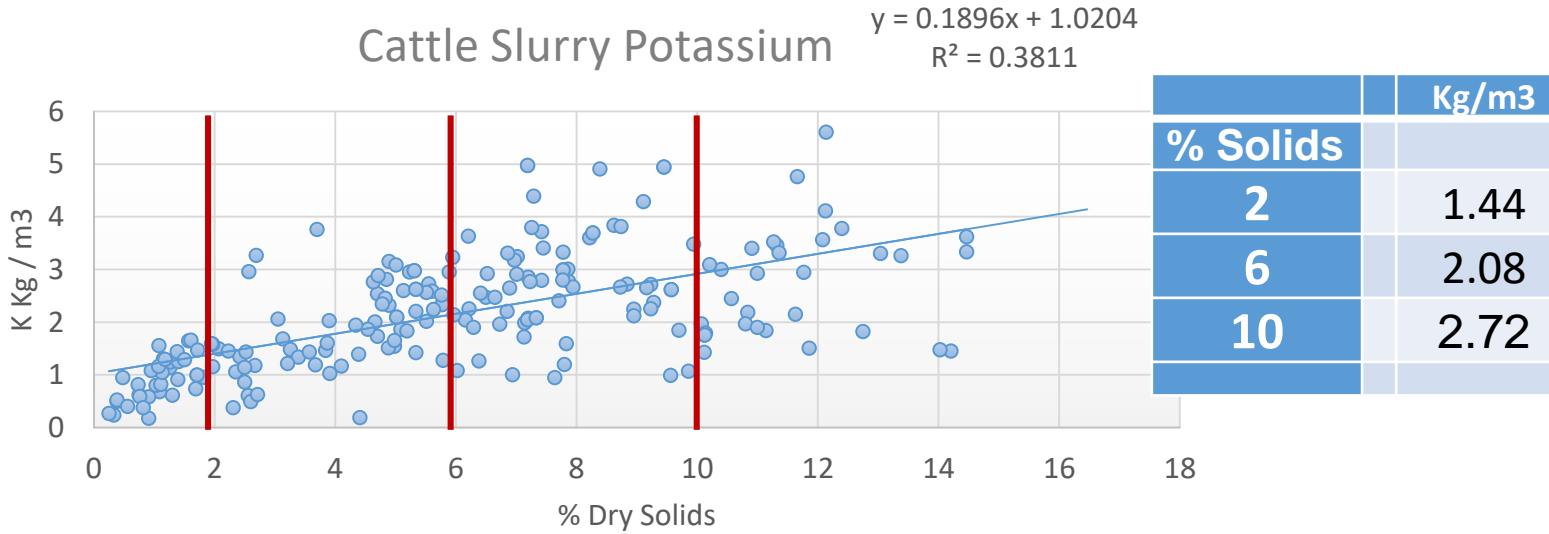
## Pig Slurry

Relatively good correlation up to 4% solids

Again, becomes more variable above 4%

# Potassium in Slurry

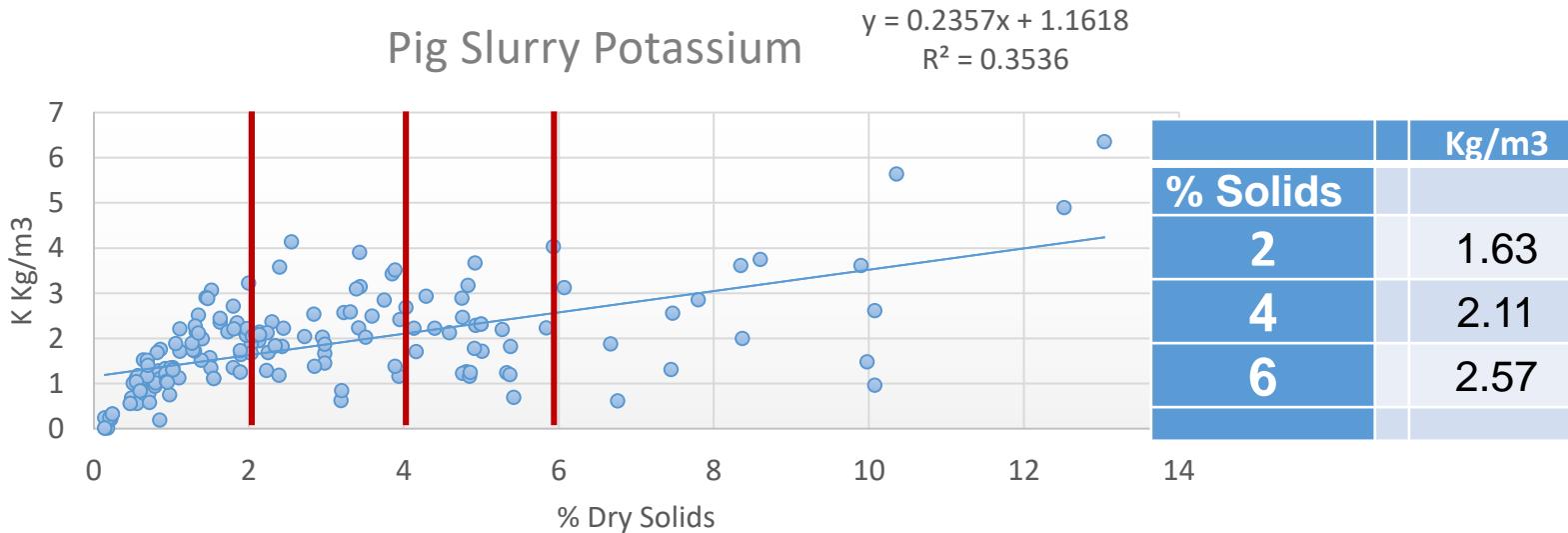
## Cattle & Pig Slurry



Very poor correlations between Potassium and Dry Solids – weaker than any other nutrient

Potassium is very soluble and more associated with the liquid than solid fraction in slurry

Book values determined by dry solids content should not be used



# Financial Values

# Financial Values & Spreading Scenarios

Fertiliser Values taken from AHDB Fertiliser Price Review November 2018 – uses October 2018 Prices – converted to € using current exchange rate

Crop available values have been derived from the values in the RB209 (P = 60% of total, K = 90% of total)

The N use efficiency for crop available N has been calculated using the MANNER NPK software

Spreading Scenarios – Range of soil types, manures and application techniques used to calculate financial value of the material using MANNER NPK



# Financial Values

Manure				N						P					K	
				Nitrogen (Kg/t)	NH <sub>4</sub> N (Kg/t)	N Efficiency %				Crop Available N	€ / tonne	P (Kg/ t)	Crop Available P	€ / tonne	K (Kg/t)	Crop Available K
Cattle FYM																
	Mean	6.15	0.51	8	0.49	0.55		1.50	0.90	2.84		7.28	6.55	4.48		
	Max	32.60	5.58	12	3.85	3.55		9.56	5.73	18.15		29.08	26.17	17.91		
	Min	1.34	0.01	5	0.06	0.07		0.24	0.14	0.45		0.20	0.18	0.12		
Pig FYM																
	Mean	5.75	1.06	12	0.71	0.55		2.03	1.22	3.85		5.51	4.96	3.39		
	Max	28.44	4.80	12	3.33	2.58		9.22	5.53	17.51		21.16	19.04	13.03		
	Min	0.69	0.00	4	0.03	0.02		0.31	0.19	0.58		0.34	0.31	0.21		
Layer Manure																
	Mean	14.23	4.11	50	7.17	5.56		6.78	4.07	12.88		11.91	10.72	7.34		
	Max	40.20	11.85	45	17.97	13.93		21.59	12.95	41.00		28.43	25.59	17.52		
	Min	9.10	0.05	39	3.59	2.79		0.81	0.48	1.53		1.70	1.53	1.04		
Broiler/Turkey Litter																
	Mean	21.96	4.35	41	8.99	6.97		7.54	4.52	14.31		14.50	13.05	8.93		
	Max	46.30	13.98	43	19.24	14.91		22.27	13.36	42.28		32.18	28.96	19.82		
	Min	1.95	0.01	64	1.26	0.98		0.71	0.42	1.34		0.34	0.30	0.20		

# Financial Values

<u>Manure</u>		N	P	K
		€ / tonne	€ / tonne	€ / tonne
Cattle FYM				
	Mean	<b>0.55</b>	<b>2.84</b>	<b>4.48</b>
	Max	<b>3.55</b>	<b>18.15</b>	<b>17.91</b>
	Min	<b>0.07</b>	<b>0.45</b>	<b>0.12</b>
Pig FYM				
	Mean	<b>0.55</b>	<b>3.85</b>	<b>3.39</b>
	Max	<b>2.58</b>	<b>17.51</b>	<b>13.03</b>
	Min	<b>0.02</b>	<b>0.58</b>	<b>0.21</b>
Layer Manure				
	Mean	<b>5.56</b>	<b>12.88</b>	<b>7.34</b>
	Max	<b>13.93</b>	<b>41.00</b>	<b>17.52</b>
	Min	<b>2.79</b>	<b>1.53</b>	<b>1.04</b>
Broiler/Turkey Litter				
	Mean	<b>6.97</b>	<b>14.31</b>	<b>8.93</b>
	Max	<b>14.91</b>	<b>42.28</b>	<b>19.82</b>
	Min	<b>0.98</b>	<b>1.34</b>	<b>0.20</b>

**Inorganic Fertiliser Prices  
October 2018**

**AN - €318/tonne  
TSP - €380/tonne  
MOP - €307/tonne**

# Spreading Scenarios

## Application 1 – Pig FYM Applied before Potatoes

Scenario	Pig FYM
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 m <sup>3</sup> /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 Results – (Pig FYM Mean values)

DM (%)	Total N	NH <sub>4</sub> -N	Uric acid-N	Nitrate-N	Total P	Total K
kg/t or kg/m <sup>3</sup>						
31.8	5.75	1.06	0	0	2.03	5.51

# Spreading Scenarios

## Application 1 – Pig FYM Applied before Potatoes

### 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 (Kg/ha)	Available P (kg/ha)	Total K (kg/ha)	Available K (kg/ha)	Total SO <sub>3</sub> (kg/ha)	Total MgO (kg/ha)
16	7	44	40	27	10

	€/ha
Crop available N	€6
Total P	€30
Total K	€27
Grand total	€63

Potential Financial Value of  
Application **€63 / ha**

# Spreading Scenarios

## Application 2 – Cattle FYM applied to 2 cut Grass

Scenario	Cattle FYM
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 m <sup>3</sup> /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 Results – (Pig FYM Mean values)

DM (%)	Total N	NH <sub>4</sub> -N	Uric acid-N	Nitrate -N	Total P	Total K
kg/t or kg/m <sup>3</sup>						
23.9	6.15	0.51	0	0	1.50	7.28

# Spreading Scenarios

## Application 2 – Cattle FYM applied to 2 cut Grass

### 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 Current year	Following crop year 2	N use efficiency (%)
154	1	0	9	0	4	9	5	9

Total P (Kg/ha)	Available P (kg/ha)	Total K (kg/ha)	Available K (kg/ha)	Total SO3 (kg/ha)	Total Mg (kg/ha)
38	22	182	163	60	28

	€/ha
Crop available N	€12
Total P	€72
Total K	€113
Grand total	€197

Potential Financial Value of  
Application **€197 / ha**

# Spreading Scenarios

## Application 3 – Pig Slurry – spring application to Winter Wheat

Scenario	Pig Slurry (spring)
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
Cropping	Winter Wheat
Application date	10/02/2016
Application rate (t/ha or m <sup>3</sup> /ha)	30
Application method	Band Spreader – Trailing 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 Results – (Pig Slurry Mean Results)

DM (%)	Total N	NH <sub>4</sub> -N	Uric acid-N	Nitrate-N	Total P	Total K
kg/t or kg/m <sup>3</sup>						
2	2.02	1.93	0	0	0.28	1.63
4	3.12	2.44	0	0	0.54	2.11
6	4.23	2.95	0	0	0.80	2.57

# Spreading Scenarios

## Application 3 – Pig Slurry – spring application to Winter Wheat

### MANNER NPK Results

% Solids	Nitrogen losses (kg/ha)			Crop available N (kg/ha)		Current crop	Following crop year 2	N use efficiency (%)
	Total N (kg/ha)	Mineralised N (kg/ha)	Nitrate-N	Ammonia -N	Denitrified -N			
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 (Kg/ha)	Available P (kg/ha)	Total K (kg/ha)	Available K (kg/ha)	Total SO <sub>3</sub> (kg/ha)	Total Mg (kg/ha)
2	8	4	49	44	21	6
4	16	83	63	57	30	11
6	24	12	77	70	36	17

### Potential Financial Values of Application

	€/ha		
	2% Solids	4% Solids	6% Solids
Crop available N	€36	€45	€53
Total P	€15	€30	€46
Total K	€30	€39	€48
Grand total	€81	€114	€147

# Conclusions

- Manures & Slurries can have significant variation in nutrient content influenced mainly by the management and storage of the material.
- Using book values may lead to significant over or under application of nutrients – miss out on potential financial savings or have potential yield penalty
- Getting materials analysed close to time of application will give you most accurate data for nutrient management – especially for more mobile nutrients
- Manures and slurries have significant financial value if used and managed correctly



# Thank You



Cawood Scientific Ltd

