ADDED VALUE FROM PIG MANURES AND SLURRIES

Details correct at April 2010

Pig manures and slurries contain useful quantities of essential and minor plant nutrients providing a greater mix of nutrients than many manufactured fertilisers. The benefits to crop yield and soil quality from using organic manures under rotational systems are supported by the experience of many farmers.

Farmyard manure (FYM) in particular contains a large proportion of organic matter, which improves soil texture, workability and quantity of water available for uptake by plant roots whilst improving drainage characteristics, a feature particularly important under low rainfall. Organic manures also enhance soil bio-diversity encouraging a wider range of species (e.g. insects and birds) to our countryside. Despite much research and anecdotal evidence, some of these additional benefits are difficult to quantify, especially in terms of economic value. Some of the key benefits and limitations are summarised below.

Benefits		Limitations	
Major plant nutrients – N, P, K		Bulky to handle, transport and store	
Minor plant nutrients – Mg, S, etc		Storage facilities required	
Organic matter -	Soil workability, reduced power input and fuel consumption	Specialist equipment –	Are contractors readily available?
	Improved soil structure, better rooting, improved soil drainage	Spreading costs	
	Improved permeability, better utilisation of rainfall and irrigation	Soil compaction -	Avoidable
	Improved retention of plant available water	Can increase pressure on management and resources at times of peak work load	
	Encourages soil micro-flora and biodiversity		
Reduces purchased fertiliser –	Financial saving		
	Price stability issues avoided		
	Cash flow		
	Less dependence on external sources		

Fertiliser Value

The fertiliser value of manures and slurries may be determined by analysis, either in a laboratory or using portable testing kits, or from authorative published sources. Defra publish a comprehensive reference book on the use of organic manures and inorganic fertilisers, Fertiliser Recommendations for Agricultural and Horticultural Crops (Defra RB209) available either from The Stationery Office or at; http://www.defra.gov.uk/foodfarm/landmanage/land-soil/nutrient/fert/rb209/index.htm RB209 contains tables of nutrient contents for a range of manures and slurries, these

are often used as industry standards, but at individual farm level should be backed up by analysis.

The composition of samples may be analysed by a laboratory or using small portable devices on farm (slurries only). These devices are quick and capable of reliable estimates; they offer the ability to assess slurries from different sources at the time of spreading.

Table 1: Typical total nutrient content of pig manures kg/t or kg/m^3 (fresh weight basis)

Manure Type	Dry Matter (%)	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)	Sulphur (SO_3)	Magnesium (MgO)
FYM		7.0	7.0	5.0	1.8	0.7
Slurry	2	3.0	1.0	2.0	0.5	0.3
	4	4.0	2.0	2.5	0.7	0.4
	6	5.0	3.0	3.0	0.9	0.5

Source RB209

Only a proportion of the total nitrogen and phosphorous within organic manures becomes available in the season following application.

Nitrogen

When assessing the value, the total and available nitrogen (N) needs to be considered. Limits for organic nitrogen applications per field should not exceed 250 kg/ha in any 12-month period; this is a recommendation within '*Protecting our Water, Soil and Air: A Code of Good Agricultural Practice for farmers, growers and land managers* (the 'CoGAP')', Defra, 2009 (http://www.defra.gov.uk/foodfarm/landmanage/cogap/index.htm) and a legal requirement within Nitrate Vulnerable Zones (http://www.defra.gov.uk/environment/quality/water/waterquality/diffuse/nitrate/index.htm) making it a Cross Compliance issue within the Single Payment Scheme for land within the designated zones.

Table 2: Typical application rates of pig manures to supply 250 kg/ha of total nitrogen.

Manure type	Dry Matter (%)	Application rate (tonnes or m^3/ha fresh weight)
Pig FYM	25	36
Pig slurry	2	83
	4	63
	6	50

Source RB209

The proportion of this nitrogen available to the following crop is dependent on a number of factors: time of application, soil type, rainfall and if incorporated into the soil, how long after application this takes place.

Table 3: Percentage of total nitrogen available to the next crop following application of pig manure (percent of total N)

Timing							
	DM (%)	Autumn (Aug – Oct)		Winter (Nov – Jan)		Spring (Feb – Apr)	Summer (May - July
		Sandy/ shallow	Medium/ heavy	Sandy/ shallow	Medium/ heavy	All soils	All soils
Surface Application							
Pig FYM - fresh	25	5	10	10	15	20	NA
Pig FYM - old	25	5	10	10	10	15	NA
Pig slurry	2	5	25	30	50	60	40
	4	5	20	25	40	50	30
	6	5	15	20	30	40	25
Soil incorporation (within 48 hours)							
Pig FYM - fresh	25	5	10	10	15	20	NA
Pig FYM - old	25	5	10	10	10	15	NA
Pig slurry	2	5	25	25	55	65	NA
	4	5	20	20	45	55	NA
	6	5	20	20	40	50	NA

Source RB209

A number of tools eg MANNER and PLANET developed with Defra funding and verified by field trials and farmer experience can predict crop-available nitrogen. These tools are available free of charge from Defra on-line (www.adas.co.uk/manner or www.planet4farmers.co.uk/welcome/index.html). Alternatively you can consult your local Fertiliser Advisers Certification and Training Scheme (FACTS) qualified adviser for advice (for more information about FACTS contact BASIS Registration: 01335 343945 or visit www.basis-reg.com).

When assessing the fertiliser substitution value of nitrogen, only use the *available* nitrogen figure.

Phosphate and Potash

As with nitrogen, only a proportion of the total phosphate (P) and potash (K) is actually available for the following crop, however total P and K must be considered over the whole rotation in the same way that manufactured fertiliser can be.

Table 4: Percentage availability of phosphate and potash contained within pig manures

Manure type	Phosphate (P_2O_5)	Potash (K_2O)
Pig FYM	60	90
Pig slurry	50	90

Source RB209

Sulphur and Magnesium

Sulphur (S) deficiency is being reported in areas of low sulphur deposition. Generally sandy and shallow soils are more susceptible and respond better to S applications. However there is only limited data on the availability of S following application, a proportion will be released in the first season with the remaining organically-bound S released slowly over subsequent years.

Magnesium will contribute to the maintenance of soil reserves.

Heavy Metals

Pig manures have a reputation of contributing significant levels of heavy metals, in particular copper and zinc, to the soil. This is no longer the case in modern production; the dietary content of these metals has been reduced, especially in finishing diets. Useful quantities are contained and copper-deficient soils will benefit.

So what is it worth?

With PLANET or MANNER (N only), it is possible to predict the contribution made by applying manures and slurries, and use current fertiliser prices to assign an equivalent value.

Alternatively use the following steps, two worked examples are provided at the end.

Step 1: Determine total N, P and K.
If spreading rate is known then determine total N, P and K to be applied either;

i) using results from rapid on farm testers (slurry only)
ii) using results from laboratory analysis
iii) using Table 1

Step 2: Determine available N
Estimate available N either by

i) using results from rapid on farm testers (slurry only)
ii) using results from laboratory analysis
iii) using Table 3

Step 3: Determine available P and K
Estimate available P and K using Table 4

Step 4: Calculate fertiliser replacement value.
Using current fertiliser prices, calculate fertiliser replacement value to determine the financial benefit available. Recently fertiliser price have shown considerable volatility.

	July 2008		April 2010	
	p/kg	Compound price	p/kg	Compound price
N	100	ammonium nitrate = £340/t	58	ammonium nitrate = £200/t
P	138	Triple Super Phosphate = £650/t	54	Triple Super Phosphate = £250/t
K	75	Muriate of Potash =£450/t	58	Muriate of Potash =£350/t

The value can be calculated on the basis of £/ha for the following crop, £/ha over the rotation or £/time period.

Worksheet:

You can use the following worksheet;

Step 1 – from Table 1

	N	**P_2O_5**	**K_2O**
(1) Total content kg/t or kg/m^3			
(2) Multiply by application rate to give total nutrients applied			
(3)Total nutrients per ha kg/ha = (1) x (2)	*n*	*p*	*k*

Step 2 - from Table 3
Available N kg/ha = *n x* (percent available/100) = *pn* kg/ha

Step 3 – from Table 4
Available P_2O_5 kg/ha = *p x* (percent available/100) = *pp* kg/ha
Available K_2O kg/ha = *k x* (percent available/100) = *pk* kg/ha

Step 4
Decide fertiliser component price, use current market prices or typical recent prices.

	kg/ha		Price (£/kg)	Value to next crop (£)
N	*pn*	x		
P_2O_5	*pp*	x		
K_2O	*pk*	x		
Total				

To determine the value over the rotation, follow step 4, but use the total quantity of P_2O_5 and K_2O.

Worked Example 1

To calculate the value of pig slurry (4 %DM) applied at the rate of 50 m^3/ha (4500 gallons/acre) during February, incorporated (disced) within 48 hours, medium soil type.

Step 1

	N	**P_2O_5**	**K_2O**
(1) Total content kg/t or kg/m^3	*4*	*2*	*2.5*
(2) Multiply by application rate to give total nutrients applied = 50 m^3/ha			
(3)Total nutrients per ha kg/ha = (1) x (2)	*200*	*100*	*125*

Step 2

Available N kg/ha = *200 x* (50/100) = *100* kg/ha

Step 3

Available P_2O_5 kg/ha = *100 x* (50/100) = *50* kg/ha

Available K_2O kg/ha = *125 x* (90available/100) = *112.5* kg/ha

Step 4

	kg/ha		Price (£/kg)	Value to next crop (£)
N	*100*	x	0.58	58.00
P_2O_5	*50*	x	0.54	27.00
K_2O	*112.5*	x	0.58	65.25
Total				**150.25**

Note: this is the theoretical maximum value, depending on soil nutrient status and crop. Phosphate and potash may have been applied in excess of crop requirement in which case the surplus will remain available for following crops.

To determine the value over the rotation:

	kg/ha		Price (£/kg)	Value to next crop (£)
N	*100*	x	0.58	58.00
P_2O_5	*100*	x	0.54	54.00
K_2O	*125*	x	0.58	72.50
Total				**184.50**

Using this calculation, the value of slurry produced by 1000 finishing pigs over a 4-month period (550m^3) is £2030.

Sensitivity:

Manufactured fertiliser market volatility can have a significant impact on the value of slurry as a fertiliser. In 2006 the fertiliser value over the rotation in the above example was £85.00 and produced by 1000 finishing pigs over a 4-month period £935, in 2008 the equivalent value was £3650.

Worked Example 2

To calculate the value of fresh pig manure (FYM) applied at the rate of 35 t/ha (14.5 t/acre) during February, surface spread, medium soil type.

Step 1

	N	**P_2O_5**	**K_2O**
(1) Total content kg/t or kg/m^3	*7*	*7*	*5*
(2) Multiply by application rate to give total nutrients applied =35 t/ha			
(3)Total nutrients per ha kg/ha = (1) x (2)	*245*	*245*	*175*

Step 2

Available N kg/ha = *245 x* (20/100) = *49* kg/ha

Step 3

Available P_2O_5 kg/ha = *245 x* (60/100) = *147* kg/ha
Available K_2O kg/ha = *175 x* (90available/100) = *157.5* kg/ha

Step 4

	kg/ha		Price (£/kg)	Value to next crop (£)
N	*49*	x	0.58	28.42
P_2O_5	*147*	x	0.54	79.38
K_2O	*157.5*	x	0.58	91.35
Total				**199.15**

Note: this is the theoretical maximum value, depending on soil nutrient status and crop. Phosphate and potash may have been applied in excess of crop requirement in which case, the surplus will remain available for following crops.

To determine the value over the rotation:

	kg/ha		Price (£/kg)	Value to next crop (£)
N	*49*	x	0.58	28.42
P_2O_5	*245*	x	0.54	132.30
K_2O	*175*	x	0.58	101.50
Total				**262.22**

Using this calculation, the value of FYM produced by 560 finishing pigs over a 6-month period (310 tonnes) is £2,322 (£7.491/t).

Sensitivity:

Manufactured fertiliser market volatility can have a significant impact on the value of slurry as a fertiliser. When the price of ammonium nitrate fertiliser was £350/t, the component cost of nitrogen was 100 p/kg, the fertiliser equivalent value of the FYM over a rotation was £14.80/t.

Test kit in use

For further information or advice please contact your local Fertiliser Advisers Certification and Training Scheme (FACTS) qualified adviser (for more information about FACTS contact BASIS Registration call 01335 343945 or visit www.basis-reg.com), alternatively contact Nigel Penlington at BPEX: nigel.penlington@bpex.org.uk or 0247 647 8797.