

## ADDED VALUE FROM PIG MANURES AND SLURRIES

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 authoritative 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 free of charge on-line at [www.planet4farmers.co.uk/welcome/index.html](http://www.planet4farmers.co.uk/welcome/index.html). 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.

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

Manure Type	Dry Matter (%)	Nitrogen (N)	Phosphate (P <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)	Sulphur (SO <sub>3</sub> )	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 of the Defra Water Code and a legal requirement within Nitrate Vulnerable Zones, 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 <sup>3</sup> /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)**

	DM (%)	Timing					
		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 e.g. 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](http://www.adas.co.uk/manner) or [www.planet4farmers.co.uk/welcome/index.html](http://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](http://www.basis-reg.com)).

When assessing the 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 <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)
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 determine the contribution made by applying manures, 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 using Table 1

### **Step 2: Determine available N**

Estimate available N 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. Typical fertiliser prices in 2008 are: N = 81 p/kg (ammonium nitrate = £280/t); P<sub>2</sub>O<sub>5</sub> = 96 p/kg (Triple Super Phosphate = £450/t); K<sub>2</sub>O = 53p/kg (Muriate of Potash =£320/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

	<b>N</b>	<b>P<sub>2</sub>O<sub>5</sub></b>	<b>K<sub>2</sub>O</b>
(1) Total content kg/t or kg/m <sup>3</sup>			
(2) Multiply by application rate to give total nutrients applied			
(3) Total nutrients per ha kg/ha = (1) x (2)	<i>n</i>	<i>p</i>	<i>k</i>

**Step 2** - from Table 3

Available N kg/ha =  $n \times (\text{percent available}/100) = pn$  kg/ha

**Step 3** – from Table 4

Available P<sub>2</sub>O<sub>5</sub> kg/ha =  $p \times (\text{percent available}/100) = pp$  kg/ha

Available K<sub>2</sub>O kg/ha =  $k \times (\text{percent available}/100) = pk$  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	<i>pn</i>	x		
P <sub>2</sub> O <sub>5</sub>	<i>pp</i>	x		
K <sub>2</sub> O	<i>pk</i>	x		
<b>Total</b>				

To determine the value over the rotation, follow step 4, but use the total quantity of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O.

### Worked Example 1

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

#### Step 1

	<b>N</b>	<b>P<sub>2</sub>O<sub>5</sub></b>	<b>K<sub>2</sub>O</b>
(1) Total content kg/t or kg/m <sup>3</sup>	4	2	2.5
(2) Multiply by application rate to give total nutrients applied = 50 m <sup>3</sup> /ha			
(3) Total nutrients per ha kg/ha = (1) x (2)	200	100	125

#### Step 2

$$\text{Available N kg/ha} = 200 \times (50/100) = 100 \text{ kg/ha}$$

#### Step 3

$$\begin{aligned} \text{Available P}_2\text{O}_5 \text{ kg/ha} &= 100 \times (50/100) = 50 \text{ kg/ha} \\ \text{Available K}_2\text{O kg/ha} &= 125 \times (90\text{available}/100) = 112.5 \text{ kg/ha} \end{aligned}$$

#### Step 4

	kg/ha		Price (£/kg)	Value to next crop (£)
N	100	x	0.81	81.00
P <sub>2</sub> O <sub>5</sub>	50	x	0.96	48.00
K <sub>2</sub> O	112.5	x	0.53	59.63
<b>Total</b>				<b>188.63</b>

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	0.81	81.00
P <sub>2</sub> O <sub>5</sub>	100	x	0.96	96.00
K <sub>2</sub> O	125	x	0.53	66.25
<b>Total</b>				<b>243.25</b>

Using this calculation, the value of slurry produced by 1000 finishing pigs over a 4-month period (550 m<sup>3</sup>) is £2675.75.

**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. This is nearly a three fold increase.

**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**

	<b>N</b>	<b>P<sub>2</sub>O<sub>5</sub></b>	<b>K<sub>2</sub>O</b>
(1) Total content kg/t or kg/m <sup>3</sup>	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<sub>2</sub>O<sub>5</sub> kg/ha = 245 x (60/100) = 147 kg/ha  
 Available K<sub>2</sub>O kg/ha = 175 x (90available/100) = 157.5 kg/ha

**Step 4**

	kg/ha		Price (£/kg)	Value to next crop (£)
N	49	x	0.81	39.69
P <sub>2</sub> O <sub>5</sub>	147	x	0.96	141.12
K <sub>2</sub> O	157.5	x	0.53	83.48
<b>Total</b>				<b>264.29</b>

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	0.81	39.69
P <sub>2</sub> O <sub>5</sub>	245	x	0.96	235.20
K <sub>2</sub> O	175	x	0.53	92.75
<b>Total</b>				<b>367.64</b>

Using this calculation, the value of slurry produced by 560 finishing pigs over a 6-month period (310 tonnes) is £3,256.24 (£10.50/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 £103/t, the component cost of nitrogen was 30 p/kg, the fertiliser equivalent value of the FYM over a rotation was £3.52.

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](http://www.basis-reg.com)), alternatively contact Nigel Penlington, BPEX, (01908 844734).