

Digestate and compost use in agriculture

February 2016

wrap



Good practice guidance

Good practice guidance

Anaerobic digestate and compost can be considered renewable fertilisers, much like livestock slurry and farmyard manure.

This guide provides an introduction to compost and anaerobic digestate, how they should be integrated into farm nutrient planning, and how they should be applied to the field.

The guide is intended to complement rather than replace other statutory or good practice guidance for handling these materials.

This document provides a full description of good practice guidance, but two separate guides are available for (a) farmers and their advisers; and (b) agricultural contractors (covering haulage and application). These guides are available at www.wrap.org.uk/using-renewable-fertilisers

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Summary

1 What are compost and digestate?

Anaerobic digestate and compost can be considered renewable fertilisers, together with livestock slurry, farmyard manure and other materials sourced from on and off farm. This guidance covers just anaerobic digestate and compost.

Digestate is an effective biofertiliser supplying readily available nitrogen that reduces the requirement for inputs of conventional fertiliser (such as ammonium nitrate). It is one of the



Whole digestate

products of anaerobic digestion (AD), which is the controlled biological decomposition (without oxygen) of biodegradable materials such as food wastes and animal manures. Whole digestate is most commonly available (with a dry matter content of around 3-10%), but this can be separated by the producer into liquor (typically 1-6% dry matter) and fibre fractions (typically 20-40% dry matter).

Compost is an excellent soil conditioner and a good source of major plant nutrients, including readily available potash. It is made from the controlled biological decomposition (with oxygen) of either solely green waste (e.g. lawn clippings, prunings, woody material) or from a mix of green waste and food waste. Repeated use over time can improve the workability and water retention properties of soil.



Compost (image courtesy of Audrey Litterick)

2 Are renewable fertilisers safe to use?

The evidence shows that compost and digestate can be used safely in agriculture and field horticulture, including grassland (as well as other markets). There are regulatory controls in place for composts and digestates derived from food wastes and other animal by-products (ABP) to

ensure their safety. A '**Renewable Fertiliser Matrix**' has been developed in conjunction with farm assurance and other food-chain stakeholders to standardize the safe use of renewable fertilisers.

3 Do renewable fertilisers meet specific quality criteria?

Composts certified to the BSI PAS100 specification under the Compost Certification Scheme (CCS), and digestates certified to the BSI PAS110 specification under the Biofertiliser Certification Scheme (BCS) will all meet pre-defined quality criteria. Both certification schemes allow farmers and growers to improve or add to these specifications if needed. Specific Environment Agency/SEPA/NRW authorisations are generally not required when certified material is used – although legal restrictions still apply where renewable fertilisers are derived from food waste and other animal by-products.

Summary

4 Are there any special considerations when using renewable fertilisers made from food waste?

When using renewable fertilisers derived from inputs that include food waste (or other allowed animal by-products), statutory requirements must always be complied with.

These include:

- Preventing stock access to composts and digestates that are stored on farm before application to land;
- Adhering to the specified minimum grazing and harvest intervals following application of composts and digestates;
- Keeping records to demonstrate that the grazing and harvest intervals have been observed.



Image courtesy of SRUC

5 How should I plan applications or apply renewable fertilisers to the field?

Renewable fertilisers should be accounted for in manure and/or nutrient management planning to achieve good crop performance and to avoid environmental harm. The Fertiliser Manual (RB209) and SRUC Technical Note TN650 provide detailed information.

Compost and fibre digestate can be spread with most conventional muck spreaders, while whole and liquor digestates are best applied with precision application equipment such as a bandspreader, either trailing hose or trailing shoe, or shallow injector, to minimise ammonia emissions and maximise crop available nitrogen.



Image courtesy of ADAS

Summary

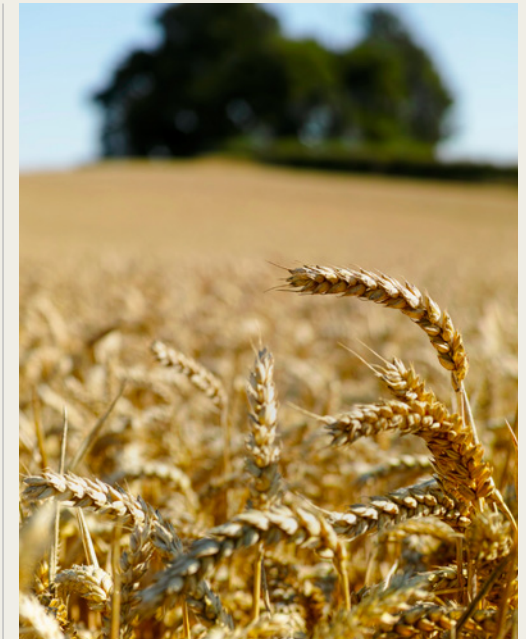
6 What if I have doubts about the quality of the material supplied?

It is recommended that farmers and growers obtain written confirmation from suppliers that the compost or digestate to be supplied meets requirements. If quality does not meet quality requirements, users can and should reject the material before it is applied to land.

Details on how to submit a formal complaint can be found on the BCS and CCS websites. Contractors can refuse to haul or apply the material if they believe it to be of inadequate quality.

✓ General good practice

- Get to know suppliers and their product; e.g. visit sites to see the process.
 - Speak to other farmers and growers about their experience of using these products, and if you don't know anyone who has used the products, ask your supplier to put you in touch with other customers.
 - Ask for an up to date analysis of the material. Ideally this should be an analysis of the consignment that will be supplied for your use.
- Useful agronomic analyses include pH, dry matter, total nitrogen, readily available nitrogen, phosphate, potash, magnesium, sulphur and liming value. Useful quality analyses include physical contaminants and potentially toxic elements (PTEs).
- Try to be in the field when the first loads arrive to ensure that you are happy with the quality as supplied. If you believe that it does not meet your requirements, you should refuse to take it.



1.0 Renewable fertilisers



1.0 Renewable fertilisers

A wide range of materials can be considered renewable fertilisers – including those that are produced on and off-farm.

This guide focusses on compost and anaerobic digestate, produced off the farm (or separately from the main farming business), although the principles applied are also relevant to compost and digestate produced on the farm.

1.1 Introducing anaerobic digestate and compost

Anaerobic digestate (sometimes known as biofertiliser, or simply ‘digestate’) is a useful fertiliser because of its readily available nitrogen content. It also contains useful amounts of phosphate, potash, sulphur, magnesium and trace elements.

Most digestate is ‘whole’, although it can be separated into liquor and fibre fractions. Whole and separated liquor digestates typically have a dry matter content of 1-10%, while the fibre fraction typically has a dry matter content of 20-40%, although these proportions will vary depending upon the separation process or processes employed. Fibre fractions can, therefore, be used as a soil conditioner, although whole and liquor digestate will have little or no benefit for soil quality.

Compost is an excellent source of crop nutrients (particularly potash), and is a

useful soil conditioner, comprising a significant proportion of stabilised organic matter. Some composts also have significant liming potential.

1.1.1 Anaerobic digestion (AD) and composting

Anaerobic digestion systems vary widely in terms of their design. They can be either wet or dry systems, and have operating temperatures that are either mesophilic (30-40°C) or thermophilic (50-60°C). Typical AD input materials include domestic and commercial food wastes, livestock slurries and purpose-grown crops.

Composting systems are (relatively) simpler than AD systems. They can be based on an open area (the composting ‘pad’) with or without covers and forced aeration, or they can take place in buildings. All composting processes follow the same stages, with temperatures rapidly rising through the mesophilic to the thermophilic range as microbial activity increases. This self-heating

sanitises the material, after which activity and temperatures decrease during stabilisation and maturation. Compost is most commonly made from biodegradable garden wastes, such as lawn clippings and shrub prunings. Food waste can be composted too, which will increase the nutrient value of the resulting product.

If food wastes or other permitted animal by-products are processed through composting or AD systems, pasteurisation or sanitisation phases are **required by law**¹. Further information on this is provided in **Section 1.3**. Even if animal by-products are not processed, pasteurisation remains a requirement of the Biofertiliser Certification Scheme, because pasteurisation effectively controls animal, plant and human pathogens, as well as weed seeds. A similar approach is adopted by the Compost Certification Scheme, where sanitisation of all materials at 65°C for seven days is recommended. More information on both Schemes can be found in **Section 1.2**.

1.0 Renewable fertilisers

1.1.2 What are the benefits of AD and composting?

AD is one of the best ways to recover value from biodegradable materials because energy, in the form of biogas, is naturally produced as part of the digestion process.

Biogas can be used as a substitute for natural gas to produce electricity or heat, or compressed for use as a transport fuel. AD is an important part of the UK's strategy to increase the production of renewable energy, combat climate change and meet recycling targets.

Composting is a robust natural method for stabilising organic matter before its addition to soil. Composting is key to recycling in the UK, while compost may have a role to play in combating the impacts of climate change on UK soils.

1.2 What are the Biofertiliser and Compost Certification Schemes?

The **Biofertiliser Certification Scheme (BCS)**² and **Compost Certification Scheme (CCS)**³ are independent quality assurance schemes that provide confidence to the market that anaerobic digestate and compost are safe, consistent and fit for purpose. To be eligible for certification by each scheme, digestate and compost manufacturers must comply with process and product specifications which:

- clarify what inputs can be used in digestate and compost production⁴;
- impose strict controls to ensure that inputs are processed safely; and
- specify minimum quality standards for digestate and compost sold to farmers (and other markets).

Both schemes are designed to meet the needs of UK-based AD and compost operators accepting inputs that are classified as wastes, since certification of the resulting digestates and composts means that they are no longer considered wastes by the environmental regulators.

Certified composts also benefit from some advantages under the NVZ regulations, allowing them to be spread at higher rates in specified circumstances ([see Section 5.2](#)).



AD operators accepting only manures, slurries and crops grown for digestion (as well as some vegetable processing by-products) will produce digestate that is not normally regulated as waste, diminishing their interest in the Certification Scheme.

It is not compulsory for anaerobic digestates and composts derived from waste inputs to be certified under the BCS or CCS, but spreading uncertified material would require an environmental permit or waste management license exemption.

Further information on the environmental regulation of digestate and compost can be obtained by contacting the local Environment Agency (England), Natural Resources Wales (NRW) or Scottish Environment Protection Agency (SEPA) officer.

1.0 Renewable fertilisers

1.2.1 What are PAS110 and PAS100?

The British Standards Institution's **Publicly Available Specification 110**⁵ (BSI PAS 110 or PAS110) provides a baseline quality specification for anaerobic digestate, ensuring that it is consistent, safe and reliable to use. The British Standards Institution's **Publicly Available Specification 100**⁶ (BSI PAS 100 or PAS100) provides a similar baseline quality specification for compost.

Each PAS specifies minimum quality criteria. They also allow customers to specify higher quality thresholds, which is particularly useful for compost and digestate producers wishing to supply into niche markets with specific requirements.

1.2.2 What are the ADQP and CQP?

The **Anaerobic Digestate Quality Protocol**⁷ (ADQP) applies in England, Wales and Northern Ireland, and clarifies which input materials can be used in digestate production, as well as identifying specific markets for digestate, including agriculture.

Compliance with the ADQP is essential if digestates derived from waste inputs are to be spread to land as products without environmental regulatory control. The ADQP also requires that digestate meets a recognised standard – the only one recognised at the time of writing being PAS110.

The **Compost Quality Protocol**⁸ (CQP) applies in England, Wales and Northern Ireland, and clarifies which input materials can be used in compost production as well as identifying specific markets for compost, including agriculture. Compliance with the CQP is essential if composts derived from waste inputs

are to be spread to land as products without environmental regulatory control. The CQP also requires that compost meets a recognised standard – the only one recognised at the time of writing being PAS100.

Note: The Quality Protocols do not apply in Scotland.

Instead, compliance with SEPA's position statement on the **'Classification of outputs from anaerobic digestion processes'**⁹ is required if digestates derived from waste inputs are to be spread to land as products without environmental regulatory control. This requires certification to PAS110.

The situation is very similar for compost, as explained in SEPA's **'Composting Position'**¹⁰. In this case, certification to PAS100 is obligatory.

For simplicity, the Biofertiliser and Compost Certification Schemes encompass all the requirements of the relevant PAS and QP or SEPA's position statements.

Irrespective of whether they are classified as products or wastes under environmental regulation, digestate and compost derived from animal by-products such as food waste are subject to statutory requirements covering testing, storage, transport and use under the animal by-product regulations (ABPR). Further information on these is provided in the next section.

1.0 Renewable fertilisers

1.3 Animal By-Product (ABP) Regulations

Animal By-Products (ABP) are categorised according to their level of risk, from Category one (highest risk) to Category three (lowest risk). Compost and digestate cannot be made from Category one ABP.

Some Category two ABP can be applied to land directly, without prior treatment. These include manure, digestive tract content separated from the digestive tract, milk, milk-based products and colostrum. Because they can be applied to land directly, these ABP can be used in compost or digestate processes without inclusion of specific sanitisation and pasteurisation approaches. All other types of Category two ABP must be first pressure-rendered before they can be used as feedstocks for composting or AD processes.

Digestate or compost that is derived from animal by-products which is destined for use in agriculture must be clearly labelled as such during transport, and prior to land spreading.

Digestate and compost stores must be registered with the **Animal and Plant Health Agency**¹¹ unless the store is at the same place where the material will be used. However, when stored on farm, digestate and compost must be stored in such a way that livestock cannot access them before they are applied to land. The regulations impose strict 'lay off' periods, whereby pasture land cannot be used for livestock grazing, or harvested for forage, within three weeks (or two months for pigs) of applying digestate or compost that is derived from animal by-products. The regulations require compliance with these restrictions to be demonstrated through record keeping.

Further information can be found on the gov.uk¹² website. Grazing and harvest bans apply regardless of whether digestate or compost are certified as products (see **Section 1.2.2**) or classified as wastes.

When Category three ABP are composted or digested, the processes must include a defined sanitisation and pasteurisation step – usually 70°C for one hour.

1.4 Use of digestate and compost on organic holdings

The governing EU regulation for **organic farming**¹³ lists the types of compost and digestate that are considered acceptable for use by organic farmers and growers.

Questions about material selection should be directed to the farmer's organic certifying body.

2.0 Safety and acceptability of digestate and compost



2.0 Safety and acceptability of digestate and compost

2.1 Health and Safety

- As with all biological materials, users should wear gloves when handling digestate and compost.
- Avoid eating any of the material, or inhaling any airborne dust, water vapour or microscopic particles that may arise when handling.
- If digestate or compost come into direct contact with the skin, wash the affected area thoroughly.

2.2 The Renewable Fertiliser Matrix

The Renewable Fertiliser Matrix details when renewable fertilisers can be used to grow different crops.

The Matrix is based on a thorough scientific research programme which evaluated the risks to human and animal health, and the environment, from recycling digestate and compost to land. It is also based on discussions with key industry representatives and crop assurance schemes. This research shows that compost and digestate can be applied safely to arable, grass and forage land.

Although the Matrix builds on the baseline regulatory requirements for applying renewable fertilisers to agricultural land, it does not replace them. Following the Matrix does not exempt users of digestate or compost from compliance with regulatory requirements or good agricultural practice, which are outlined in [Section 5](#).

2.3 Being confident in quality

It is recommended that users request written confirmation from their supplier that the compost or digestate to be supplied meets their requirements. If the quality does not meet requirements, users can and should reject the material before it is applied to land. Compost can be checked visually for physical quality, while a sample of digestate can be decanted into a bucket and 'scooped' with a kitchen-type sieve to inspect for plastic or other undesirable material.

Details on how to submit a formal complaint about certified compost or digestate can be found on the [BCS](#)¹⁴ and [CCS](#)¹⁵ websites. If a pollution incident has taken place, alert the [EA](#)¹⁶, [NRW](#)¹⁷ or [SEPA](#)¹⁸.

- Farmers and growers should always check with their buyers to ensure that applications of compost or digestate are acceptable
- The **Renewable Fertiliser Matrix** is based on digestate and compost that are certified by the Biofertiliser and Compost Certification schemes. This means that they must comply with the PAS110 and PAS100 quality specifications. Users should check with their buyers to determine whether they have additional quality requirements
- The Biofertiliser and Compost Certification schemes allow digestate and compost users to specify higher thresholds. Compliance with these additional criteria becomes part of the Biofertiliser and Compost Certification process for participating sites

2.0 Safety and acceptability of digestate and compost

2.3.1 The Renewable Fertiliser Matrix

Cropping category		BSI PAS 110 digestate				BSI PAS 100 compost			
		Pasteurised ¹		Non-pasteurised		Green		Green/food	
Fresh produce	Group one	✓	Before drilling or planting ²	✗	NOT within 12 months of harvest and also at least six months before drilling or planting ²	✓	Before drilling or planting ²	✓	Before drilling or planting ²
	Group two	✓	Before drilling or planting ²	✗	NOT within 12 months of harvest and also at least six months before drilling or planting ²	✓	Before drilling or planting ^{2,3}	✓	Before drilling or planting ^{2,3}
	Group three	✓	Before drilling or planting ²	✓	Before drilling or planting ²	✓	Before drilling or planting ^{2,3}	✓	Before drilling or planting ²
Combinable and animal feed crops		✓	May be applied before and after drilling or planting ⁵	✓	May be applied before and after drilling or planting ⁵	✓	May be applied before and after drilling or planting ⁵	✓	May be applied before and after drilling or planting ⁵
Grassland and forage – grazed		✓	Statutory no-graze intervals apply ⁴	✓	Three week no grazing period applies	✓	Three week no grazing period applies	✓	Statutory no-graze intervals apply ⁴
Grassland and forage – harvested		✓	Statutory no-harvest intervals apply ⁴	✓	Three week no harvest period applies	✓	Three week no grazing period applies	✓	Statutory no-graze intervals apply ⁴

Notes

1. Derived from feedstocks that include Animal By-Products (ABPs), according to the requirements of the European Animal By-Products Regulations (Regulation (EC) No. 1069/2009 and Commission Regulation (EU) No. 142/2011, as implemented by the nations of the UK and Northern Ireland). Pasteurised digestates also include those derived from inputs that have undergone prior processes equivalent to pasteurisation.

2. Target of zero and absolute limit of <0.1% (m/m dry weight) glass must be achieved.

3. May be applied as mulch.

4. In accordance with the Animal By-Products Regulations (see above). These currently stipulate intervals of two months for pigs and three weeks for other livestock.

5. No specific additional risk-management approaches are required for this cropping category, as regulatory and good practice requirements apply to this (and all other) categories.

2.0 Safety and acceptability of digestate and compost

2.3.2 Cropping categories

*Note that this group also includes non-edible ornamental crops

Fresh produce	Group one	Crops that the customer can eat raw and which do not have a protective skin that is removed before eating; they may also have a significant risk or history of pathogen contamination:	Whole head Lettuce, Leafy Salads (including any vegetable leaf you can eat raw), Celery, Salad Onions, Radish, Fresh and Frozen Herbs, etc.
	Group two	Crops that the customer can eat raw and which either have a protective skin or grow clear of the ground, or that have no history of pathogen contamination:	Apple, Beetroot, Blackcurrant, Blueberry, Broad Bean, Broccoli, Cabbage, Carrot, Capsicum, Cauliflower, Celeriac, Cherry, Courgette, Cucumber, Garlic, Green Beans (other than runner beans), Melon, Mushroom, Onion (red and white), Pea, Pear, Peach, Plum, Raspberry, Strawberry, Sugar Snap Peas, Sweet Corn, Tomato and Tree Nuts, etc.
	Group three*	Crops that the customer always cooks:	Artichoke, Runner Bean, Leek, Marrow, Parsnip, Potato, Pumpkin, Squash, Swede, Turnip, etc.
Combinable and animal feed crops		Wheat, Barley, Oats, Rye, Triticale, Field peas, Field beans, Linseed/flax, Oilseed rape, Sugar beet, Sunflower, Borage.	
Grassland and forage – grazed		Grass, Forage swedes and turnips, Fodder mangolds, Fodder beet, Fodder kale, Forage rye and triticale, Turf.	
Grassland and forage – harvested		Grass silage, Forage maize, Haylage, Hay, Herbage seeds.	

3.0 Properties of anaerobic digestate and compost



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3.1 Digestate

3.1.1 Typical nutrient contents of digestate

Digestates are not all the same, as dry matter and nutrient contents will vary depending on the input materials used and the nature of the AD process. For these reasons it is difficult to define the nutrient characteristics of a 'typical' digestate. However, data from multiple analyses of food-based digestate have been collated to produce the indicative figures listed in Table 3-1. This shows that nitrogen is the most agronomically valuable nutrient in digestate.

For comparison, the 'typical' nitrogen, phosphate and potash contents of food-based digestate are also illustrated alongside livestock slurries in Figure 3-1. AD does not significantly alter the total nutrient contents of the input materials. Therefore digestate derived from pig slurry or cattle slurry would have total nutrient characteristics similar to those shown for untreated pig and cattle slurry, as shown in Figure 3-1.

Table 3-1 Indicative nutrient contents for food-based digestate (kilograms/tonne fresh weight)

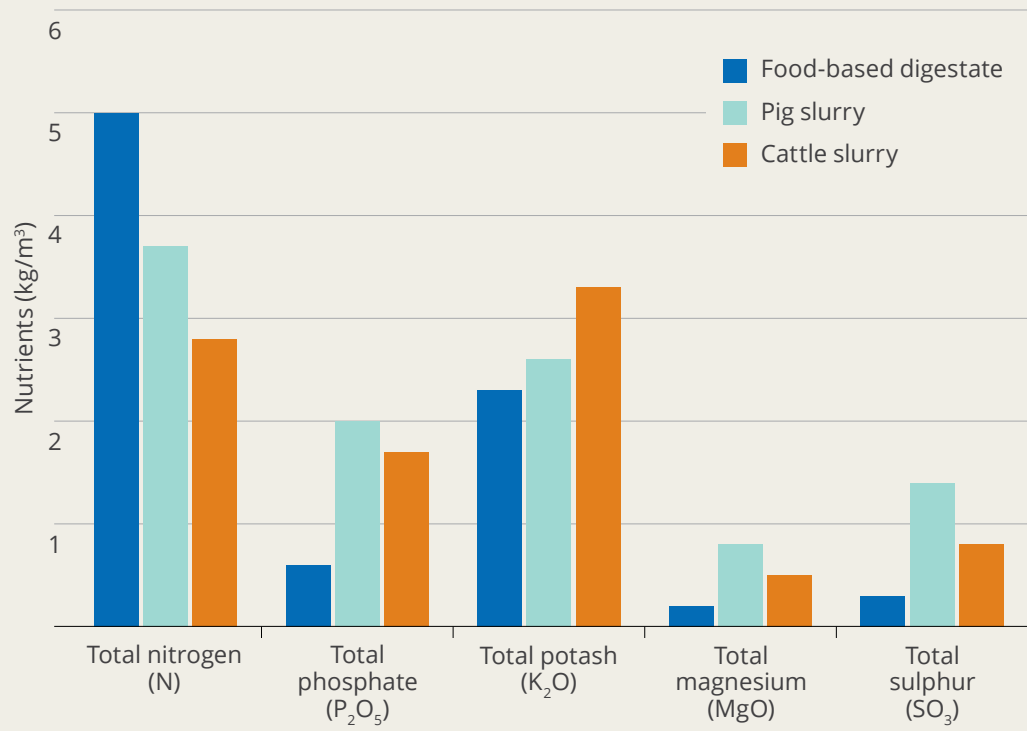
	Unit	Food-based digestate
Dry matter content	%	4
Total nutrients		
Nitrogen (N)	kg/t	5
Phosphate (as P ₂ O ₅)	"	0.5
Potash (as K ₂ O)	"	2.0
Magnesium (as MgO)	"	0.1
Sulphur (as SO ₃)	"	0.4
Readily available nitrogen		
Nitrogen (N)	kg/t	4

The nutrient content of digestate will vary between AD plants and can change during the post-digestion storage period. To maximise the fertiliser benefits, it is recommended that an up to date analysis is obtained for the consignments of digestate to be used before it is applied. This can be done by:

- Asking for a copy of a recent laboratory analysis from the digestate supplier;
- Sending a sample for analysis at an accredited laboratory e.g. a member of the **Professional Agricultural Analysis User Group**¹⁹; or
- Undertaking on-site 'rapid' analysis to quantify the readily available nitrogen content, using a nitrogen meter e.g. Agros, Quantofix.

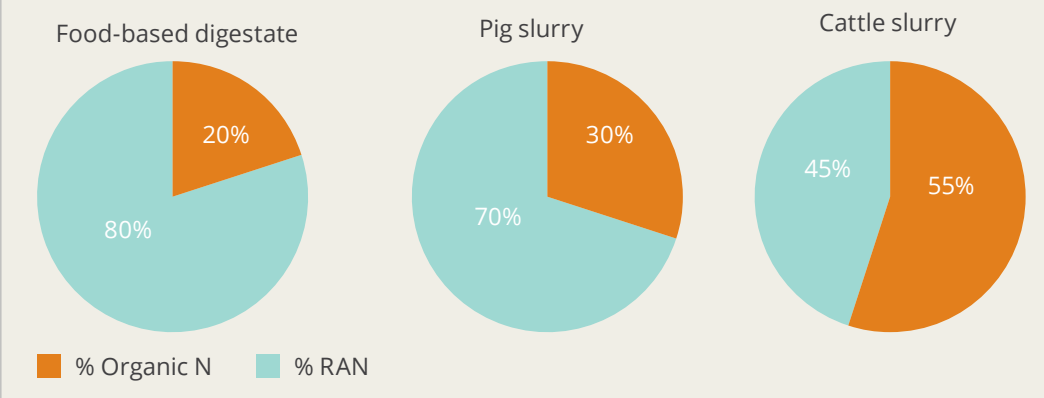
3.0 Properties of anaerobic digestate and compost

Figure 3-1 'Typical' nutrient content of food-based digestate and livestock slurries (fresh weight basis)



Source: Defra Fertiliser Manual (RB209) and SRUC Technical Note 650.

Figure 3-2 Readily available nitrogen (RAN) content of food-based digestate in comparison with 'typical' values for pig and cattle slurry



3.1.2 Nitrogen availability in digestate

As shown in Table 3-1, digestate is a good source of readily available nitrogen (RAN) i.e. ammonium-N, which is potentially available for immediate crop uptake. Food-based digestate typically contains around 80% of its total N content as RAN, compared with around 70% for pig slurry and 45% for cattle slurry (Figure 3-2).

Most of the nitrogen in digestate will become available to the crop in the

year of application, as it is mainly present as RAN. However, it is important not to confuse RAN with crop available nitrogen. Whilst digestate is rich in RAN, just like livestock slurries, this can decrease during storage and be lost to the wider environment following land spreading by two main routes: (a) ammonia emissions to air; and (b) nitrate leaching to surface and ground waters. The proportion of RAN which can be used by the crop, taking into account these losses, is called *crop available nitrogen*.

3.0 Properties of anaerobic digestate and compost

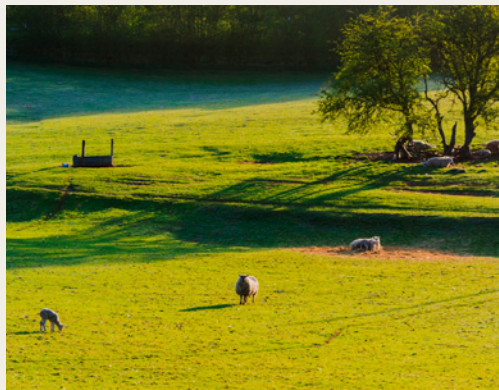
Freely available software can be used to calculate the amount of crop available nitrogen that can be expected from digestate, and to help integrate its use into farm nutrient management plans (see **Section 3.3.1**). For liquid digestates it is typically assumed that 60% of the total nitrogen will be crop available, and this figure has been used to estimate the value of digestate in **Table 4-1**.

3.1.3 Maximising crop available nitrogen from digestate

Managing digestate to maximise the amount of crop available nitrogen supplied will increase the fertiliser replacement value of the digestate and the financial value to farmers, and reduce emissions to the environment.

There are two key steps that can be taken to reduce emissions and maximise the amount of crop available nitrogen:

- Use precision application equipment such as band spreaders or shallow injectors or (where appropriate) rapid soil incorporation to reduce the amount of nitrogen lost as ammonia. Broadcasting digestate with a splash-plate or similar will result in higher ammonia losses and greater amounts of crop contamination.
- Apply digestate only when there is a crop nitrogen requirement. For most crops this would mean early spring or summer.



Users should aim for digestate to supply no more than 50-60% of the total N requirement of the crop, and use manufactured fertiliser N to supply the remainder. Relying on digestate to supply the entire crop nitrogen requirement may compromise crop yields and quality – and is not good practice.

Food-based digestate is an effective renewable fertiliser supplying crop available nitrogen, of which a high proportion is ammonium. It is known that livestock slurries that contain a high proportion of ammonium-N may sometimes have a negative impact on earthworms, and this effect may also be seen sometimes following applications of food-based digestate.

It is recommended that ammonium-N loading rates are controlled by following normal good practice, as outlined in this guidance document, and that users adjust application rates using up-to-date digestate nutrient analysis data in order to reduce the possibility of any negative impacts. Rapid on-farm nitrogen meters (e.g. Agros and Quantofix) meters can be used to provide on-site measurements of digestate ammonium-N contents.

3.0 Properties of anaerobic digestate and compost

3.1.4 Availability of phosphate, potash and other major nutrients in digestate

As a general rule, around 50% of the phosphate and around 80% of potash in digestate will be available to the crop in the year of application. These values should be used in calculating crop nutrient requirements where a response to phosphate/potash is expected (e.g. ADAS soil P/K Index 0/1; SRUC very low/low status, as set out in the Fertiliser Manual, RB209, and the SRUC Technical Notes) or where responsive crops (e.g. maize, potatoes and other field vegetables) are grown.

Where the soil is at or above the target soil P/K status and a crop response to phosphate and potash additions is not expected (i.e. ADAS Index 2 or above; SRUC moderate status or above), the total phosphate and potash content of the digestate should be used in nutrient planning to avoid over-application of these nutrients and loss to the environment.

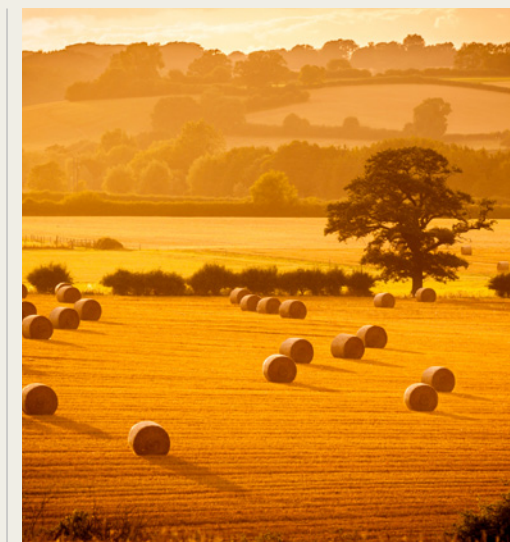
Digestate also supplies useful quantities of sulphur and magnesium. As there are no data on availability to the next crop grown, sulphur and magnesium inputs should largely be regarded as contributing to the maintenance of soil reserves.

3.1.5 Organic matter content of digestate

Based on an application rate of 250 kg total N/ha, which is the maximum field N rate permitted in Nitrate Vulnerable Zones (NVZs), the organic matter loading from a typical whole food-based digestate can be around 1 t/ha on a fresh weight basis.

3.1.6 Other benefits of digestate use

Using digestate can help reduce a farm's carbon footprint by replacing the need to apply manufactured fertilisers. Replacing manufactured fertiliser with food-based digestate could reduce a farm's carbon footprint by around 20 kg CO₂e/tonne of digestate applied, or around 1 tonne CO₂e/hectare (if applied at the **maximum permitted field limit in NVZs of 250 kg total N/ha**)²⁰. This figure is provided for indicative purposes only; it is not good practice to supply the whole crop nitrogen demand from just digestate or other organic manures (see [Section 3.3](#)).



3.0 Properties of anaerobic digestate and compost

3.2 Compost

3.2.1 Typical nutrient contents of compost

Compost contains valuable quantities of major plant nutrients, most notably phosphate and potash, plus nitrogen, sulphur and magnesium, as shown in Table 3-2. Compost can also have a liming value.

Table 3-2 Typical compost total and readily available nutrient contents (kilograms/tonne fresh weight)

	Unit	Green compost	Green/food compost
Dry matter content	%	60	60
Total nutrients			
Nitrogen (N)	kg/t	7.5	11
Phosphate (as P ₂ O ₅)	"	3.0	3.8
Potash (as K ₂ O)	"	5.5	8.0
Magnesium (as MgO)	"	3.4	3.4
Sulphur (as SO ₃)	"	2.6	3.4
Readily available nitrogen			
Nitrogen (N)	kg/t	<0.2	0.6

Source: Defra Fertiliser Manual (RB209) and SRUC Technical Note 650

The typical values in Table 3-2 can be used as a guide for nutrient planning, however, the nutrient content and liming value of compost will vary between suppliers. To maximise the fertilising benefits of compost it is recommended that users get an up to date analysis for the consignments of material that will be used. This can be obtained by:

- Asking for a copy of a recent laboratory analysis from the compost supplier; or
- Sending a sample of compost to be analysed at an accredited laboratory e.g. a member of the **Professional Agricultural Analysis User Group**²¹.

3.0 Properties of anaerobic digestate and compost

3.2.2 Nitrogen availability from compost

Field experimental data have indicated that green compost supplies only very small amounts of crop available nitrogen, and that green/food compost supplies around 5% of its total nitrogen to the next crop grown (irrespective of application timing). However, soil nitrogen supply can be increased over the long term following the repeated use of green and green/food compost.

3.2.3 Availability of phosphate, potash and other major nutrients in compost

As a general rule, around 50% of the phosphate and around 80% of the potash in compost will be available to the crop in the year of application.

Compost also supplies useful quantities of sulphur and magnesium. As there are no data on availability to

the next crop grown, sulphur and magnesium inputs should largely be regarded as contributing to the maintenance of soil reserves.

3.2.4 Liming value of compost

Compost also has a liming value that can balance the acidifying effects of fertiliser nitrogen additions to soils. It is recommended that users ask their supplier to determine the neutralising value of their product as in some composts this can exceed 15% of the liming value of ground limestone.

3.2.5 Improving soil organic matter with compost

Increasing soil organic matter levels has many benefits, including:

- improved soil structure and workability;
- increased soil biological activity and nutrient retention; and
- increased water holding capacity.

Organic matter is a vital component of fertile soils. Compost is a valuable source of stable organic matter that can form part of a long-term strategy to maintain and enhance soil quality, and thereby help to maintain soils in good agricultural and environmental condition (GAEC).

Notably, organic matter can hold up to 20 times its weight in water and can directly improve the ability of soils to retain water for longer.



3.0 Properties of anaerobic digestate and compost

3.3 Integrating renewable fertilisers into nutrient planning

Integrating digestate and compost into a farm's nutrient management plan should aim to maximise the use of nutrients supplied. Adequately allowing for the nutrients supplied by renewable fertilisers will help farmers achieve good crop performance and avoid wasting money, as well as avoiding environmental harm. The key steps are:

- 1 Identify the fields and crops that are available and will benefit most from renewable fertiliser application. Digestate is best suited to crops with a high nitrogen demand, and compost is best suited to soils requiring organic matter and/or phosphate and potash.

Take into account accessibility and likely soil conditions at the time of application, and the application equipment available.

- 2 Aim for digestate to supply no more than 50-60% of the total N requirement of the crop, and use manufactured fertiliser N to supply the remainder. Relying on digestate to supply the entire crop nitrogen requirement may compromise crop yields and quality – and is not good practice.

- 3 Where possible, apply digestate when there is a crop nitrogen requirement (often in early spring to summer), as this will make best use of the readily available nitrogen.

- 4 Use a nutrient management recommendation system (e.g. **The Fertiliser Manual (RB209)**²², **SRUC Technical Note 650**²³ or the **MANNER-NPK/PLANET**²⁴ software) to calculate the amount of crop available nitrogen, phosphate, potash and other nutrients supplied from each application in each field. Digestate does not yet feature in

RB209, and whilst the digestate data from the **DC-Agri programme of field experiments**²⁵ will be integrated into the 2016 update to RB209, the advice is to use pig slurry as a proxy.

- 5 Calculate the nutrients supplied by the renewable fertiliser and deduct these from the requirement of the crop. This will give the balance (if any) that needs to be supplied by manufactured fertiliser; see examples in Table 4-1 and Table 4-2.

- 6 Make sure that application equipment is well maintained and suitable for applying digestate or compost evenly and at the target rate. All equipment should be calibrated for the type of material being applied (please refer to the manufacturer's guidance). For liquid digestate, use precision application equipment (e.g. trailing hose, trailing shoe or shallow injector).

3.3.1 Tools to help

The free software packages **MANNER-NPK**²⁶ and **PLANET/PLANET Scotland**²⁷ predict the fertiliser N replacement value of field-applied organic materials, and simplify their integration into farm nutrient management plans.

MANNER
-NPK

PLANET
NUTRIENT MANAGEMENT

The **Tried and Tested**²⁸ nutrient management toolkit is also a useful resource for planning and recording nutrient use.

4.0 Value and costs of digestate and compost



4.0 Value and costs of digestate and compost

4.1 Nutrient content: value

Digestate and compost are sources of crop nutrients that can be used to reduce manufactured fertiliser additions. At the time of writing, a typical food-based digestate applied at a rate of 30 m³/ha has a value of around £100/hectare (Table 4-1), and green compost application at a rate of 30 t/ha has an approximate value of £130/hectare (Table 4-2).

Table 4-1 Food-based digestate

	Nitrogen (N)	Phosphate (P ₂ O ₅)	Potash (K ₂ O)
1st cut grass silage requirement (kg/ha) ^a	120	40	80
Total nutrients supplied by 30 m ³ /ha food-based digestate application (kg/ha)	150	15	60
Crop available nitrogen (kg/ha)	90	~	~
Manufactured fertiliser required	30	25	20
Digestate value in year 1 ^b	£68	£5	£20
Digestate value to next crop ^b	-	£5	£5
Total digestate value (per hectare)			£103

^a Based on first cut grass silage grown in P Index 2 and K Index 2- soils / SRUC moderate status

^b Assuming N = 75p/kg, P₂O₅ = 64p/kg, K₂O = 43p/kg (based on 2015 average fertiliser prices)



4.0 Value and costs of digestate and compost

Table 4-2 Green compost

	Nitrogen (N)	Phosphate (P ₂ O ₅)	Potash (K ₂ O)
Winter wheat requirement (kg/ha) ^a	190	65	85
Total nutrients supplied by 30t/ha green compost application (kg/ha)	225	90	165
Crop available nitrogen	0	~	~
Manufactured fertiliser required	190	nil	nil
Total compost value in year 1 ^b	-	£29	£56
Compost value to next crop ^b	-	£29	£14
Total compost value (per hectare)			£128

a Based on winter wheat sown in autumn on medium soil with a soil nitrogen supply of Index of 2, P Index 2, K Index 2- (SRUC moderate status) and straw removed.

b Assuming N = 75p/kg, P₂O₅ = 64p/kg, K₂O = 43p/kg (based on 2015 average fertiliser prices).



The financial values calculated above are based on the crop available nitrogen and total phosphate and potash supplied by the renewable fertiliser. Additionally, other major nutrients (e.g. sulphur and magnesium) and trace elements (e.g. copper) are applied, along with stable organic matter.

4.2 Haulage and spreading: costs

The costs of transporting and applying digestate and compost will be an important consideration to decide whether or not their use will be worthwhile on individual farms.

These costs can be high, due to the high water content of digestate and the bulky nature of compost (and fibre digestate). Typical transport costs are listed in Table 4-3 while typical spreading costs are listed in Table 4-4.

Some operators may be willing to share the costs of transporting digestate and compost, particularly if it is possible to develop a longer-term working relationship; it is recommended that farmers discuss with their supplier the logistics and costs of using renewable fertilisers.

4.0 Value and costs of digestate and compost

Table 4-3 Approximate transport costs for organic materials²⁹

Organic material type	Cost (£/hr if paying for a hauled load)	Cost for 10 mile delivery (£ per tonne or m ³) if paying by volume*
Liquid organic materials (e.g. whole digestate or separated liquor digestate)	£60 – 80	£3 – 4
Solid organic materials (e.g. compost, separated fibre digestate)	£40 – 60	£2 – 3

*Costs adapted from Nix (2012)³⁰, taking into account typical haulage rates.

Table 4-4 Approximate spreading costs for applying different organic materials¹²

Vehicle type (load size)	£ per tonne or per m ³ *
Bandspread (whole digestate)	£3 – 4
Shallow-injected (whole digestate)	£3.50 – 4.50
Broadcast (fibre digestate or compost)	£2 – 4

*Costs adapted from Nix (2012).³¹



Contractors already certified under the NAAC Assured Land-Based Contractor (Generic) Standard and the Agricultural Operations Standard may choose to be certified against the recently-introduced **Spreading**

Materials to Agricultural Land Standard³². This requires that spreading contractors and their customers co-operate to ensure safe, traceable spreading of compost and digestate.

5.0 Managing renewable fertilisers in the field



5.0 Managing renewable fertilisers in the field

5.1 Good practice for the application of renewable fertilisers

Established good practice for the application of livestock manures and slurries should be followed when applying compost and digestate. Detailed information can be found in:

- the **Code of Good Agricultural Practice**³³ in England;
- **The Code of Good Agricultural Practice for Wales**³⁴; and
- the **Prevention of Environmental Pollution from Agricultural Activity**³⁵ in Scotland – whilst a summary is included below.

The conventional approach should be used for developing a manure management plan to create a risk map showing where renewable fertiliser applications should not be made or spread under certain conditions.

Renewable fertilisers should not be applied when:

- the soil is waterlogged; or
- the soil is frozen hard; or
- the field is snow covered; or
- the soil is cracked down to field drains or backfill; or
- the field has been pipe or mole drained or subsoiled over drains in the last 12 months; or
- heavy rain is forecast within the next 48 hours.

5.1.1 Additional considerations for digestate

Liquid digestates (ie whole and liquor digestates) typically have biochemical oxygen demand (BOD) levels of around 9,000 mg/l, which is similar to livestock slurries (10,000-30,000 mg/l) and dirty water (1,000-5,000 mg/l). This means that application of digestates to land should be carefully managed to minimise risks of water pollution.

As a minimum, applications should not be made:

- within 10 metres of any ditch, pond or surface water (or within six meters if digestate is applied using precision application equipment e.g. a bandspreader or shallow injector);
- within 50 metres of any spring, well, borehole or reservoir that supplies water for human consumption or for farm dairies; or
- on very steep slopes where run-off is a high risk throughout the year.

To make the best use of the readily available nitrogen in digestate, it is recommended that precision application equipment is used (bandspreader – trailing hose/trailing shoe, or shallow injector) to minimise ammonia emissions (and odour nuisance) and maximise crop available N supply.

Bandspreading and shallow injection application techniques spread digestate evenly across their boom widths, increase the number of spreading days and cause less sward contamination than surface broadcast application. Bandspreading equipment is also available that enables accurate topdressing of arable crops across full tramline widths, without causing crop damage and contamination.

As digestates are bulky, there are considerable logistical advantages in having an available agricultural market close to the AD plant. In the case of liquid digestates, access to this agricultural land using umbilical (i.e. no tanker) spreading equipment can increase spreading opportunities and reduce soil compaction risks.

5.0 Managing renewable fertilisers in the field

5.2 Considerations relevant to Nitrate Vulnerable Zones (NVZs)

5.2.1 Field N limit

In NVZs in Britain, the amount of N applied to a field in 'organic manures', including digestate and compost, must not exceed 250 kg N/ha in any 12 month period. This is the field N limit, and it is based on the total N content of the compost and digestate applied – not the *crop available or readily available* N content.

However, certified compost (either green or green/food which does not include livestock manure as an input) can be applied at up to 500 kg total N/ha, provided no other organic manure applications are made to the same land in any two year period. Where certified compost is used as a mulch in an orchard, up to 1,000 kg total N/ha can be applied provided no other organic manure applications are made to the same land in any four year period.

5.2.2 N max

The N max limit means that the average amount of crop available N supplied to specified crop types must not exceed the specified limit value. Changes to the regulations mean that from 1 January 2014 all organic manures including digestate and compost, must be included in the N max calculations.

5.2.3 Soil incorporation

Rapidly incorporating digestate into the soil maximises crop available N supply, while reducing ammonia emissions (and possible odour nuisance). Unless applied to un-cropped land in NVZs with a bandspreader or shallow injector, digestate (where >30% of the total N content is present as RAN) must be incorporated into the soil within 24 hours.

5.2.4 Temporary field heaps

The location of solid 'organic manure' field heaps (including compost and fibre digestate) should be carefully

managed to minimise the risks of water pollution. Like livestock manure field heaps, their position should be marked on the farm risk map and the date of use recorded.

Temporary field heaps must:

- be made from compost and fibre digestate solid enough to be stacked in a freestanding heap;
- not give rise to free drainage from within the stacked material; and
- should occupy as small a surface area as is needed to support the weight of the heap without it collapsing.

Field heaps must not be located:

- within 10m of a surface water or (effective) land drain;
- within 30m of a surface water if the slope is >12°;
- within 50m of a spring, well or borehole;

- on land likely to become waterlogged;
- on land likely to flood; or
- in any single position for more than 12 successive months (and there must be a two year gap before returning to the same site).

5.2.5 Closed spreading periods for digestate

- As the RAN content of liquid digestate (and some fibre digestates) exceeds 30% of its total N content, applications are subject to mandatory closed spreading periods in NVZs during autumn and winter.
- To ensure that digestates are not applied in closed spreading periods, digestate suppliers need to ensure that they have adequate storage available.

Stores must be constructed to meet the requirements of **SSAFO Regulations**³⁶. Guidance on tank construction requirements can be found on the **gov.uk** website³⁷.

Checklist for sourcing and using digestate and compost

1	<p>Do you know what the material is (compost or digestate) and what facility it will come from?</p> <p>The supplier should be able to provide this information – including contact details for the production facility.</p>	Y / N	5	<p>Do you have an up-to-date analysis of the material?</p> <p>To ensure that the right amount of material is applied, include compost and digestate applications in nutrient planning, using up-to-date information on the characteristics of the material intended for use. If you are in any doubt about how to do this, consult an agronomist with specific expertise in handling organic materials.</p>	Y / N
2	<p>Do your buyers or farm assurance schemes have a position on the use of these products?</p> <p>Some buyers and assurance schemes may not allow their use or have specific restrictions in place, so this should be checked before entering into discussions with suppliers.</p>	Y / N	6	<p>Do you want to request higher quality requirements?</p> <p>Products certified under the Biofertiliser and Compost Certification Schemes are required to meet appropriate quality specifications. However, it is important that you are happy with the quality that will be supplied, and you can insist that it meets higher specifications and that the supplier provides analytical evidence to demonstrate that it meets your requirements.</p>	Y / N
3	<p>Do you know what the material is made from?</p> <p>The supplier should be able to provide a list of input materials. If the material is made from inputs that include Animal By-Products (ABP), it is safe to use them, but the statutory requirements must be followed, preventing stock access to the material before and after it is spread on the field. The supplier should provide guidance on these requirements.</p>	Y / N	7	<p>Are you happy with the compost or digestate that has been delivered?</p> <p>It is important that you are happy with the material that has been supplied. You should be satisfied that you know enough about the material and that any questions you may have about it have been answered satisfactorily. If you do not believe that it is of the quality specified, you should refuse to accept it.</p>	Y / N
4	<p>Is the material certified under the Biofertiliser Certification Scheme or Compost Certification Scheme?</p> <p>The supplier should be able to provide a copy of the certification document(s). Be sure that they are in date.</p>	Y / N			

Notes and references

1 https://www.gov.uk/guidance/using-animal-by-products-at-compost-and-biogas-sites	9 https://www.sepa.org.uk/media/156496/wst_ps_classification_of_outputs_from_anaerobic_digestion_processes.pdf	20 Assuming crop available N = 60% of total N applied, and using data for inorganic fertilisers listed in Brentrup F and Palliere C (2008): GHG emissions and energy efficiency in European nitrogen fertiliser production and use. Proceedings of the International Fertiliser Society, December 11, York, UK.	31 Nix, J. (2012). John Nix Farm Management Pocketbook 43 Edition. Impress, Corby, UK. ISBN 978-0-951488-9-1
2 http://www.biofertiliser.org.uk/	10 http://www.sepa.org.uk/media/153947/composting_position_statement.pdf	21 http://www.nutrientmanagement.org/library/soil-testing-find-a-laboratory/	32 http://www.naac.co.uk/SpreadingtoLand/
3 http://www.qualitycompost.org.uk/	11 https://www.gov.uk/guidance/using-animal-by-products-at-compost-and-biogas-sites	22 http://www.ahdb.org.uk/projects/CropNutrition.aspx	33 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69344/pb13558-cogap-090202.pdf
4 All inputs to certified anaerobic digestion and composting plants must be source-separated, biodegradable materials. Food wastes from households (but not black-bag mixed waste), food processers and caterers are treated by many facilities. Sewage sludge and its derivatives are not allowed. Any feedstocks that have, or might have been in contact with meat and other permitted but low risk animal by-products, are controlled by regulations which require a pasteurisation or sanitisation step, e.g. 1 hour at 70°C, with a particle size no greater than 12mm.	12 https://www.gov.uk/government/publications/controls-on-animal-by-products	23 http://www.sruc.ac.uk/downloads/download/560/tn650_optimising_the_application_of_bulky_organic_fertilisers	34 http://wales.gov.uk/docs/drah/publications/110420cogapwales2011introen.pdf
5 http://www.wrap.org.uk/content/bsi-pas-110-specification-digestate	13 See Annex I of Commission Regulation (EC) No 889/2008 http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:250:0001:0084:EN:PDF	24 http://www.planet4farmers.co.uk/	35 http://www.scotland.gov.uk/Resource/Doc/37428/0014235.pdf
6 http://www.wrap.org.uk/content/bsi-pas-100-compost-specification-1	14 http://www.biofertiliser.org.uk/contact	25 http://www.wrap.org.uk/content/digestate-compost-agriculture	36 http://www.legislation.gov.uk/ukxi/2010/639/pdfs/ukxi_20100639_en.pdf
7 https://www.gov.uk/government/publications/quality-protocol-anaerobic-digestate	15 http://www.qualitycompost.org.uk/product-complaints	26 http://www.planet4farmers.co.uk/Manner	37 https://www.gov.uk/government/collections/water-resources-control-of-pollution-silage-slurry-and-agriculturalfuel-oil-england-regulations-2010-and-as-amended-2013-ssafo
8 https://www.gov.uk/government/publications/quality-protocol-for-the-production-and-use-of-compost-from-waste	16 https://www.gov.uk/report-an-environmental-incident	27 http://www.planet4farmers.co.uk/Content.aspx?name=PLANET	
	17 http://naturalresourceswales.gov.uk/about-us/how-to-contact-us/228102/?lang=en	28 http://www.nutrientmanagement.org/home/	
	18 http://www.sepa.org.uk/about_us/dealing_with_us/contacting_us.aspx	29 http://www.wrap.org.uk/sites/files/wrap/Digestate%20distribution%20models%20report.pdf	
	19 http://www.nutrientmanagement.org/library/soil-testing-find-a-laboratory/	30 Nix, J. (2012). John Nix Farm Management Pocketbook 43 Edition. Impress, Corby, UK. ISBN 978-0-951488-9-1	

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www.wrap.org.uk/using-renewable-fertilisers

Document reference: Digestate and compost use in agriculture: Good Practice Guidance

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