GROWING KENT & MEDWAY

Cereal Crop Waste and Valorisation

Report: The potential of cereal by-products for a biobased circular economy






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The Kent and Medway region generates substantial crop waste from various sectors, including wine, hops, fruit, cereals, and vegetables. Each type contributes specific by-products such as grape pomace, hop stems, apple pomace, and cereal straw. This report examines the potential of cereal crop waste and by-products to contribute to a biobased circular economy.

This report is an extract from a wider publication looking at the potential for agricultural and horticultural waste and crop by-products to contribute to a biobased circular economy across South East England. The full Growing Kent & Medway report explores the opportunities for fruit, vegetable, hop, cereal and mushroom waste valorisation.

Cereal crop waste applications

After harvesting cereal crops like wheat, barley, and oats, there are often residues like straw and chaff that can be considered as crop waste.
Depending on the type of crops grown and agricultural practices, there might be additional biomass residues like straw, husks, or stalks.

Cereal waste such as straw and bran can be utilised in animal feed, bioenergy, and biomaterials. The industry benefits from these by-products by reducing waste and generating alternative revenue streams.

Industrial applications and pre-treatment requirements

For effective valorisation, pre-treatment processes for all waste types include grinding, drying, acid or enzyme treatment, and innovative extraction methods like ultrasound and microwave-assisted extraction.

How much waste is produced in the region?

In South East England, cereal crop waste, particularly straw, plays a significant role in agricultural by-products. In 2024, an estimated 2.4 million tonnes of wheat straw was produced across England, including South East England, though this figure represents a 17% decrease from the previous year. Barley straw production increased, reaching around 1.7 million tonnes, largely due to increased spring barley planting. In addition, oats production in the region saw a rise in both the planted area and yield, leading to an estimated 206,000 tonnes of oat straw in 2024.

While precise data for South East England specifically isn't always detailed separately, this general estimate reflects trends in cereal production, with much of the waste being used for feed, bedding, or biomass energy. These figures underscore the importance of cereal crop by-products, which can be targeted for sustainable uses, including biorefining initiatives.

What is currently done with this waste?

- **Straw**
  - Animal feed
    - A significant portion of straw is used as bedding and feed for livestock, particularly cattle and horses.
  - Mulching
    - Straw can be used as mulch to suppress weeds, retain moisture, and improve soil health.
  - Bioenergy
    - Straw can be converted into biofuels, such as bioethanol or biogas, through various processes like anaerobic digestion.

- **Processing waste**
  - Animal feed
    - Bran, germ, and husks are commonly used as components of animal feed.
  - Food products
    - Some by-products, like wheat germ, are used in human food products due to their nutritional value.
  - Industrial applications
    - Certain components, such as cellulose fibres from straw, can be used in various industrial processes.

How easily can this waste be sorted and/or treated for transportation?

Cereal crop waste, particularly straw, is relatively easy to sort and transport. It is often baled into large, compact packages, making it convenient for handling and transportation. However, the moisture content of straw can influence its weight and transportation costs.

High-value compounds in cereal crop waste

Cereal crop waste, especially straw, is a rich source of cellulose, hemicellulose, and lignin, which can be converted into various value-added products.

- Biofuels
  - Straw can be used to produce bioethanol, biogas, or biohydrogen through processes like anaerobic digestion or thermochemical conversion.
- Biomaterials
  - Cellulose fibres from straw can be used to produce bioplastics, biocomposites, and paper products.
- Animal feed
  - Straw can be used as a feedstock for fungi to produce protein-rich feed for livestock.
- Soil amendments
  - Straw can be composted to improve soil fertility and structure.

What initial pre-treatment would be required?

Pre-treatment of cereal crop waste, particularly straw, is essential to enhance its value and facilitate its conversion into various products. Common pre-treatment methods include:

- Size reduction
  - Straw can be chopped or shredded to increase its surface area and improve its reactivity.
- Moisture adjustment
  - Adjusting the moisture content can optimise the efficiency of subsequent processes, such as enzymatic hydrolysis or fermentation.
- Chemical treatment
  - Chemical treatments, such as acid or alkali hydrolysis, can be used to break down complex polysaccharides into simpler sugars.

By exploring and implementing innovative technologies, we can maximise the value of cereal crop waste, contributing to a more sustainable and circular economy.

This table provides a summary of industrial application for cereal waste:

	Type of waste produced	High-value compounds	Industrial applications
Cereal crops	Straw	Cellulose, hemicellulose, lignin	Biofuels (bioethanol, biogas), bioplastics, compost, soil amendments, mushroom cultivation
	Bran	Fibre, proteins, vitamins (e.g., B vitamins)	Animal feed, functional foods, dietary fibre supplements
	Germ	Proteins, vitamins, oils	Nutritional supplements, animal feed, functional food ingredients
	Husks	Fibre, lignin	Bioplastics, animal feed, soil conditioners

Valuable chemicals derived from agricultural waste

Agricultural waste, often considered a mere by-product, is emerging as a treasure trove of valuable compounds with immense potential for various industries. From pharmaceuticals to food and energy, these underutilised resources hold the key to a more sustainable and circular economy. By harnessing the power of these natural resources, we can reduce our reliance on non-renewable sources and create a greener future.

Cereal crop residues

- Cellulose and hemicellulose
  - Straw waste, rich in cellulose, is processed into bioplastics, bioethanol, and biogas, supporting both energy and material sectors with biodegradable solutions.
- Bran and germ
  - Used in functional foods, animal feed, and dietary supplements, bran and germ are valued for their protein, fibre, and vitamin content.
- Husks
  - Leveraged in bioplastic production and as soil conditioners, cereal husks offer biodegradable material alternatives.

- **Fibres**
  - Residues like stalks and leaves contain cellulose, which can be transformed into bioplastics, bioethanol, and other biodegradable products.

By leveraging these high-value compounds, industries can reduce reliance on non-renewable sources and contribute to a circular economy, transforming agricultural waste into valuable, sustainable products.

High-value compounds sought by industry

In the push toward sustainable practices, several high-value compounds derived from agricultural waste are increasingly sought after by the chemical manufacturing sector and other industries.

- **Cellulose and hemicellulose (from cereal crop residues)**
  - Sectors
    - Packaging, bioplastics, and construction materials.
  - Uses
    - Cellulose derived from straw and other cereal waste is used to create biodegradable plastics, compostable packaging, and construction materials.
  - Sustainable Benefits
    - These compounds help reduce plastic waste by providing biodegradable alternatives to petroleum-based plastics, crucial in packaging and disposable products.

- **Bioethanol and biogas (from various agricultural residues)**
  - Sectors
    - Energy, transportation, and manufacturing.
  - Uses
    - Produced from grape, fruit, and cereal wastes, bioethanol and biogas are alternative fuels that reduce dependency on fossil fuels.
  - Sustainable benefits
    - These renewable energy sources lower greenhouse gas emissions, particularly when used to offset traditional fossil fuel consumption in transport and manufacturing.

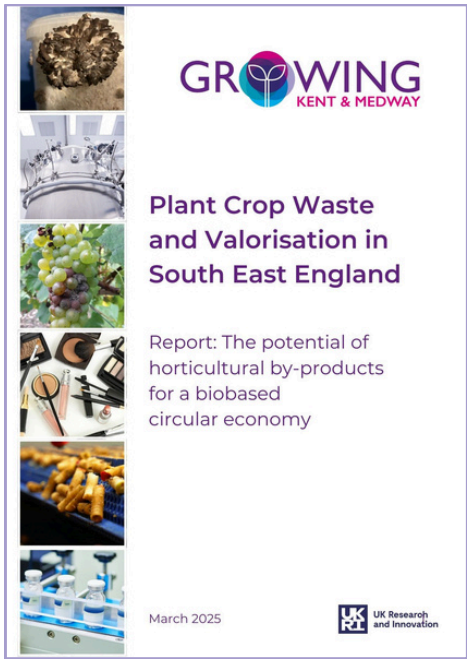
Conclusion

The agricultural waste in Kent and Medway holds immense potential for sustainable and profitable reuse. By focusing on high-value compounds and innovative industrial applications, these by-products could be transformed from environmental burdens into resources supporting diverse sectors, from pharmaceuticals to biofuels.

Sustainable practices like anaerobic digestion, composting, and nutrient recovery, coupled with advanced extraction techniques, are central to maximising the value of agricultural waste while minimising its environmental footprint. This approach aligns with a circular economy model, positioning the region as a leader in resource-efficient agricultural waste management.

The transformation of agricultural waste into high-value chemicals and materials marks a significant step towards a sustainable future. By leveraging the untapped potential of these resources, industries can reduce their environmental footprint, minimise waste, and create innovative products that benefit society.

From polyphenols with potent antioxidant properties to cellulose for biodegradable plastics, the possibilities are vast. As research and technology continue to advance, we can expect to see even more innovative applications for agricultural waste, driving a circular economy that prioritises resource efficiency and environmental responsibility.



This report is an extract from Growing Kent & Medway's report: Plant Crop Waste and Valorisation in South East England.

Read the full report at growingkentandmedway.com

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