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Green Waste and Archaeological Geophysics

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Green Waste and Archaeological Geophysics

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Abstract

Environmental concerns, supported by regulatory frameworks, have encouraged the conversion of organic and biological waste into fertilizers and soil conditioners (so-called green waste) that are being increasingly used on arable fields. Recent work has shown that the level of ferrous contaminants within this waste can have a detrimental impact on shallow geophysical prospection methods that use the principles of magnetism. This paper highlights the negative impact of this new agricultural practice on the historic environment and calls for tighter regulation of green waste.

Keywords

Green waste; archaeology, magnetometry; metal-detecting; regulation, Anthropocene

Green waste and archaeological geophysics

James Gerrard, Liz Caldwell and Alisa Kennedy

Introduction

This paper aims to raise awareness of a significant and developing challenge for archaeological geophysics. The widespread use of fertilizers and soil conditioners derived from so-called 'green waste' (biodegradable and organic materials) is becoming commonplace and the diversion of this waste from landfill is widely perceived as having numerous environmental benefits (EC 2010). Unfortunately these macro-scale environmental benefits come at a cost to the historic environment on a micro-scale.

A virtuous circle?

The Landfill Directive (EU, 1999) stipulates that EU member states had to agree a series of binding reductions in the quantity of biodegradable waste being landfilled. Taking 1995 levels as a base line, obligatory reductions of 25% over five years, 50% over eight years and 65% over fifteen years (EU, 1999: 5.2) were imposed. The UK government had already developed a policy to tackle this issue by introducing a landfill tax in 1996, which established a charge for every tonne of waste sent to landfill (UK, 1996).

The environmental justifications for these policy changes are well known and reducing the quantity of biodegradable and organic waste was (and remains) a priority (EC, 2010). Some 90% of municipal solid waste (MSW) could be formed of these biodegradable materials (Slater and Frederickson, 2001: 368-69) and reducing this quantity minimizes emissions from the decomposition of organic waste and saves space in landfill sites (Lou and Nair, 2009). To achieve this goal MSW is now separated into different waste streams with animal by-products subjected to anaerobic digestion, which produces energy (Slater and Frederickson, 2001: 25). The residues from this process can be incorporated into composted garden rubbish or 'green waste', which can be marketed as a fertilizer providing the product conforms to BSI PAS100 and BSI PAS110.

The production of these composts offers a seemingly virtuous circle (EU, 2010). Councils can use composting to escape punitive landfill taxes and for the recycling industry composting and

anaerobic digestion offers a means of creating saleable products (energy and fertilizer). Farmers benefit by gaining access to compost that can be used to fertilize their fields at a time when agricultural fertilizers are increasing in price (WRAP, 2013: 9-10). For environmentalists the ecological benefits in terms of reductions in greenhouse gases and other forms of pollution are clear. There appear to be no downsides. However, the impact of green waste deposition on the historic environment has received scant attention.

Geophysics and green waste

Between 2009 and 2014 the immediate hinterland of a Roman villa in Somerset was surveyed using magnetometry (Caldwell, 2009). The surveys identified an extensive but hitherto unknown settlement around the Roman villa. As work progressed to define the extent of this settlement it became apparent that these fields offered an exemplary case study for the investigation of the impact of green waste on archaeological prospection using magnetometers.

Just prior to the geophysical survey being undertaken in 2011 the landowner spread one of the fields (Danscombe) with 30t of green waste a hectare (Figs 1 and 2). The field is small (3ha) but it was apparent that the green waste contained a significant quantity of inorganic contaminants, including batteries, pieces of metal cans and other items. Clearly these objects would have an impact on the survey results. Nevertheless the survey went ahead using a Bartington Grad 601-2 fluxgate gradiometer. Readings were logged every 0.25m along north-south traverses set 1m apart in a zig-zag fashion and the data was processed in *Geoplot* 3.00v.

Comparison of the resulting geophysical plot with the surveys in the surrounding fields highlights the poor quality of the data collected from Danscombe. Interference is generally in the range of 5-15nT, with a scatter of anomalies in the >30nT range. Archaeological anomalies are visible but comparison with the fields to the north and east demonstrates that subtler geophysical anomalies have probably been masked by the green waste.

To test the longer term impact of green waste the field was resurveyed in 2013 using the same methodology. It was hoped that the data might be of a higher quality than the original survey. Some new archaeological anomalies (in the range of 2-4nT) were identified but the interference was still clearly visible, with little diminution over the intervening period.

The cause of the interference would appear to be mainly the product of metal contaminants, which are typified by 'iron spikes'. The BSI PAS 100 specification requires waste destined for composting to be screened to remove physical contaminants such as 'glass, metal, plastic and other non-stone fragments' but such contaminants are not completely excluded. Up to 0.25% of a composted product may be formed from such materials (BSI PAS 100). This seems like a small quantity but assuming the compost spread on Danscombe was within the specification, then the 90t of green waste would have included 225kgs of contaminants. These contaminants (including non-magnetic materials) will cumulatively increase with successive applications of green waste to fields.

The survey of Danscombe presents an alarming scenario: over time large swathes of arable land may be blanketed with green waste with a significant impact on our most commonly used method of geophysical prospection. In regions such as southern Somerset, where magnetometry is an essential means of archaeological prospection, the implications of this scenario are catastrophic.

The scale of green waste usage on arable land

In 2009 the EU composted 45Mt of waste and much of this waste ends up on arable land. Definite statistics are difficult to reconstruct but Germany spreads perhaps 2.5Mt annually on arable land (Eurostat, 2014, Table 1; ECN, 2014). Statistical data for England indicates that composting rates leapt from just over 0.25Mt in 1996/7 to over 3.5Mt in 2009/10 (ENV18, 2013). If half of the latter figure was spread on arable land at the rates used in Somerset then 66,000ha would be impacted annually.

Anecdotal evidence also allows an idea of the scale of green waste production in the UK. In 2007 'The Land Network' supplied sixteen farms with 0.1Mt tonnes of green waste (Butterworth, 2007). In 2009 over three hundred facilities were thought to be involved in the composting of waste (Song et al., 2009: 2130) and Veolia produces over 0.2Mt of green waste compost annually (Veolia, 2014). However, perhaps the best evidence for the widespread use of green waste comes from the metal detecting community.

Online forums dedicated to metal detecting abound with discussions and images of metal contaminants recovered by metal detectorists (MDF, 2014). This has caused such problems that detectorists have only called for green waste to be banned and lobbied the UK parliament (Wells, 2012). These widespread difficulties demonstrate the challenges that will increasingly

confront archaeologists carrying out geophysical surveys and controlled metal-detector surveys on land treated with green waste.

Green waste and its implications for policy and practice

In 2010 the European Commission (2010: 7.2.5) suggested that:

Member States should promote the production and use of compost from "clean" bio-waste. They should pro-actively support the wide up-take of this material by end-users. This would improve resource efficiency by partially replacing non-renewable mineral fertilizer as well as by maintaining the quality of EU soils. Member States should proactively participate in the definition of quality criteria... and support their application to accelerate market growth.

Green waste is here to stay. The macro-scale environmental and economic benefits of processing waste into a product that can be beneficially spread on the land will outweigh many other considerations. This scenario, in which mechanized industrial farming spreads waste and its contaminants across arable land in large and seasonally cumulative quantities, is already here and represents another manifestation of what is increasingly being termed the Anthropocene (Steffen et al., 2011).

How should archaeologists in the UK, EU and further afield respond to the challenge that this phenomenon will increasingly pose to archaeological prospection techniques based on the principles of magnetism? Banning green waste would be one solution (Wells, 2012) but is unrealistic. Nation states and communities need to process and reuse waste and this imperative is unlikely to be derailed by small pressure groups.

A more constructive stance would be for those concerned by the spread of green waste and its contaminants to push at national and supra-national levels for more stringent regulation of green waste and its physical contaminants coupled with the robust enforcement of these regulations. Additional clauses could be drafted into existing regulatory frameworks that take into account the impact of green waste on the historic environment. In the UK fields treated with green waste could be recorded on the local Historic Environment Records.

Changing how green waste is regulated would not be easy or straightforward. Further research on the spread and impact of green waste, and further geophysical work to assess its impact, would be necessary. Nevertheless, this is work that should be considered before one of the most important archaeological prospection techniques is emasculated.

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Figure Captions

Fig 1 The geophysical survey at Lufton.

Fig 2 The interference caused by the green waste in Danscombe (left) can be clearly contrasted with the untreated field to the right.

Fig 2 The interference caused by the green waste in Danscombe (left) can be clearly contrasted with the untreated field to the right.