**Under-Utilisation of Organic Wastes during Brownfield Regeneration to Community Woodland:
Tackling the Barriers**

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Abstract

The regeneration of brownfield land to greenspace is a governmental policy objective of many European countries. Healthy vegetation establishment and growth is an essential component of successful greenspace establishment, and research has shown that a planting medium of an appropriate standard for supporting vegetation can be created through amendment of soil-forming materials (typically screened construction waste residues and mineral-based soil-forming materials) with organic wastes. However, failed regeneration projects suggest that barriers may exist that prevent the use of suitable quality soil materials. The aim of this research was to identify barriers toward the use of organic wastes for improving soil materials for brownfield regeneration to community woodland. We conducted interviews with a range of professionals experienced in regeneration to greenspace, and used content analysis on interview transcripts. A diverse set of barriers were revealed, including a low technical awareness amongst some professional groups of how to improve soil quality, coupled with a low awareness of the published technical guidance. Other barriers include regulatory and project management issues, which influence the timings and economics of raising brownfield soil quality. We highlight areas in which future efforts may be focused to improve the quality of planting media used in land regeneration. Such effort will improve the sustainability of greenspaces created and complement effective management of organic waste streams.

Key words: Compost; Soil Quality; Soil-Forming Materials; Greenspace Establishment; Knowledge Transfer

Introduction

The decline of the UK's heavy industry has resulted in an abundance of vacant and derelict land that is often contaminated (Rivett *et al.*, 2002). Commonly termed 'brownfield', such land has strong links to local environmental and social degradation (Grimski & Ferber, 2001) and is an underutilisation of potentially economically productive land (CABE Space, 2003). Brownfield sites can be regenerated into greenspace, such as community woodlands and other forms of green infrastructure. Greenspace can contribute many positive local factors such as improved biodiversity and habitats, and help to alleviate local social deprivation (Westphal, 2003; Moffat & Hutchings, 2007). The provision of such benefits is influenced by the quality of the greenspaces's construction and management; a poorly managed greenspace may offer little more benefit than the unregenerated brownfield site that formerly existed (Sellers *et al.*, 2006). Among the measurements for success in turning brownfield land to greenspace, vegetation establishment and growth are key, and these are impacted by the quality of the soil used (Doick *et al.*, 2009a). However, brownfield soils are often poorly suited to vegetation growth due to physical or chemical disturbance and a suitable soil resource may not be available at all (Bending *et al.*, 1999). Where existing soil resources are unavailable, screened construction waste residues and mineral-based soil-forming materials are typically utilised.

To ensure that soil materials are of a sufficient standard, Moffat (2006) suggests that organic waste products should be considered as a primary means of raising the quality of soil-forming materials. However, such tasks are often de-prioritised in the interest of reducing the costs of a project. Doick *et al.* (2009a) suggest that despite wide knowledge of vegetation tolerances and preferences regarding soil quality, unsuitable soil media is commonly used without treatment to raise its quality. They go on to state that a number of brownfield regeneration projects have resulted in failed vegetation growth as a less than adequate planting media was used. Incorporation of organic wastes into soil materials also

complements effective management of organic waste streams. It makes ecological, social and economic sense to optimise opportunities and understanding for its use in brownfield greening projects.

Organic waste materials which have become considered for use in land regeneration in the past two decades include: liquid, cake, thermally dried and composted sewage sludges, greenwaste compost, and papermill and spent mushroom compost. More recently, by-products of anaerobic digestate processes have been considered (Forest Research, 2006; Moffat, 2006; WRAP, 2013). Moffat (2006) suggests that there are greater opportunities to employ these techniques. Yet research conducted in the same year identified barriers toward doing so. WRAP (2006) examined the concept of barriers to the use of quality-assured compost during land regeneration. Five main areas were identified as potential barriers, these were: practitioner awareness of the potential of using composts, security of supply, competition with other products, cost/price, and concerns over the quality of composted materials. No similar research has been documented since, and the work of WRAP (2006) only considered this one type of the many organic waste materials available to land regeneration professionals. They also focused solely on representatives from the private sector and the, now defunct, Regional Development Agencies. Further study is required to better understand the barriers limiting the full range organic waste materials available for use in land regeneration. Such studies should also consider the full range of practitioners involved in the delivery of projects to shed further insight into barriers and knowledge transfer mechanisms between brownfield practitioners and academia (Moncaster *et al.*, 2010). The aim of this study was to identify barriers toward the use of organic wastes for improving soil materials in brownfield regeneration to community woodland, and offer solutions to overcome these.

Material and methods

Interview schedule and sample design

This research adopted a qualitative approach toward data collection. We conducted semi-structured interviews using with a range of professionals, who represent the skills and expertise involved in a typical brownfield greening project (Doak & Karadimitriou, 2007). Interviews lasted approximately 1 hour each and were conducted during June 2011 in the South of England. We selected interview candidates against the following criteria, each must have:

1. a professional role within the process of land regeneration to greenspace,
2. an involvement or professional interest in the specification, application or selection of soil materials during regeneration projects,
3. a minimum of three years' professional experience working on regeneration.

In total, ten interviewees were chosen. Representation from each relevant profession was sought to ensure accuracy, comprehensiveness and relevance of results. The interviewees were selected to ensure both a regional and a national level perspective on regeneration projects. The selected sample represents the full range of professionals with an interest or relationship to soil quality during a typical brownfield regeneration to greenspace project and allows for an in-depth analysis of the data. Table 1 presents the range of professionals interviewed and the stages of a typical regeneration project that they are engaged with.

[Insert Table 1: Practitioners interviewed and their stages of participation]

We categorise interviewees into three groups to ensure interviewee anonymity:

- Practitioners (40% of interviewees)

- Land Managers (30% of interviewees)

- Researchers (30% of interviewees)

In defining these categories, practitioners are considered to be those who take an active role in the development of a regeneration project, such as site developers, landscape architects, and/or civil engineers; land managers were defined as those who primarily adopt an interest in the management of a regeneration project, such as foresters and project managers; and researchers are involved in regeneration schemes from a scientific research and advisory perspective.

Semi-structured interviewing allows for comparability of responses, whilst still enabling deep exploration of answers given by interviewees (Hughes, 1996; Patton, 2002). This technique is an appropriate method of primary data collection for this study. An interview schedule of 13 pre-determined questions was designed to focus on the key issues of this study and was tailored using information obtained through a review of the literature. The interview questions were supplemented during interviews with probing questions to enable deeper exploration of salient issues related to the objectives of this research. Questions were written following guidance developed by Patton (2002), and were worded to be open-ended, so that the interviewee could respond freely. Dichotomous questions which imply a 'yes or no' response were avoided, since these types of questions limit the expression of the respondent (Patton, 2002). Probes were carefully considered so as to remain open-ended and non-dichotomous. Interviewees were first asked questions to explore their understanding of the relationship between soil quality and successful brownfield regeneration to greenspace (Table 2), before moving on to focus on identifying potential barriers toward the use of organic wastes for improving soil materials for community woodland creation. Interviews were recorded using a dictaphone, then fully transcribed into Microsoft Word to be used in data analysis.

Data analysis

Inductive content analysis was used to identifying core meanings within and between interview transcripts. Through inductive analysis, an analyst discovers patterns and themes within the data, and designs a classification scheme to fit the emergent findings (Patton, 2002). This required patterns within the data to be identified, coded and then classified or categorised according to their significance. Patton (2002) explains that without statistical tests to determine significance, qualitative researchers must instead determine the 'substantive' significance of their findings. Determining substantive significance is primarily reliant upon the intelligence, judgement and experience of the analyst (Patton, 2002). As this is somewhat subjective, Patton (2002) advises that the significance of responses should be determined according to the following criteria:

- The consistency, reliability and coherence of responses in support of the findings, and with other knowledge; either supportive of other work, or innovative and uncovering new issues,
- The relevance of responses to the scope of the research, and extent to which a response increased or deepened understanding of the subject matter, and
- The number of occasions a particular response is given by an interviewee/across interviewees.

Results and discussion

Under-utilisation of organic waste materials

[Insert Tables 2 and 3]

Interviewees were asked to describe the typical quality of planting media that they had experienced being used during land regeneration to greenspace projects. Of the ten interviewees, nine described the typical quality as unfit for purpose, stating it was “low nutrient, dry, barren” and “very limited from a nutrient point of view” (Table 2). Most interviewees (n=9) were aware of the option of adding organic waste materials to raise soil quality, suggesting a high awareness amongst land regeneration professionals of the potential to use this method (Table 2). However, most interviewees reported no use of organic soil amendments in the projects that they were aware of.

“I would say if I went back 15 years, every one of my sites was using some sort of additive.

...On... sites that I’ve been doing for the last five years I’ve not used any, none at all.” –

Practitioner

Availability and awareness of guidance

Our findings suggest a lack of awareness of technical guidance by land regeneration professionals, with the majority of respondents (n=8) claiming there is a low availability of technical guidance documents to help those in industry to use organic waste materials. All four Practitioners described a low industry awareness of available guidance or poor knowledge of where to find such information, despite the existence of an available body of such literature (Atkinson, 2013). For example:

“...I’m not so sure that folk in our industry would necessarily arrive so quickly at being able to find it or knowing that it even existed.” - Practitioner

168 These findings support those of WRAP (2006), which identified a low awareness amongst developers
169 regarding the availability of information and guidance materials. Of the five interviewees aware of
170 guidance materials, three were in the Researcher category, who expressed an involvement in the
171 production of such guidance. These findings echo those of Moncaster *et al.* (2010), who identified that
172 traditional 'pipeline' knowledge transfer methods between academic researchers and practitioners are
173 unsuitable for ensuring effective knowledge acquisition by those in industry. Thus, the academic
174 outputs of research seem not to be in a format suitable for use by brownfield regeneration practitioners.
175 For example, an academic-style presentation of research can leave practitioners needing to make
176 considerable effort to translate findings into relevant on-the-ground techniques. Practitioners also
177 reported it costly and time-prohibitive to locate relevant scientific articles in journals or online. The effort
178 required, strongly reduces the likelihood of research being adopted by practitioners. This presents an
179 opportunity for a research organisation, professional body or interested society to deliver more effective
180 dissemination of existing guidance to practitioners/the industry.

181 Interviewees indicated a perception that many project managers and site developers see the addition of
182 organic wastes as unnecessary, or that there is low awareness among these individuals about the
183 benefits of their use. This reflects the previous findings of WRAP (2006), wherein respondents identified
184 there to be limited specification of use of composts in projects, and raised doubts around the
185 awareness of project managers regarding compost as a resource. It may be the case that organic
186 waste materials are not on the agenda of project managers because the use of these to improve soil-
187 forming materials is not adequately communicated by guidance for executing reclamation projects. For
188 example, technical guidance such as DoE's *The Reclamation of Mineral Workings to Agriculture* (1996)
189 and DCLG's (1996) *Minerals Planning Guidance 7: Reclamation of mineral workings* make little
190 reference to the improvement of soil quality for supporting vegetation cover, nor using amendments to
191 achieve this. There is a need to refresh existing guidance on achieving suitable soil quality in land

regeneration (such as Bending *et al.*, (1999) 'Soil-forming materials: Their use in land reclamation') to reflect changes in the waste, contaminated land, biodiversity regulations. The refreshed guidance should seek to provide specifications for a wider range of habitats, as currently only woodland is considered in detail. Our interviewees also suggested that providing stepwise instructions for regeneration managers and their machine operators would also make the guidance more user-friendly and thus more likely to be adopted.

Furthermore, in the good practice literature available, there is a lack of consideration that regeneration schemes operate in stages and involve many actors (Bending *et al.*, 1999; Nason *et al.*, 2007; SNIFFER, 2010). Literature that details land regeneration as a series of discrete stages may give the negative perception that these can be conducted in isolation of each other. Rather, the process should be thought of as a number of inter-related sub stages whereby action or inaction early in the process will affect delivery further on (Atkinson and Doick, In Press; Doick *et al.*, 2009b). If guidance were to identify the key sub-stages of the process at which to consider the use of organic wastes, and roles communicated across the actors in the process, then perhaps there would be better uptake of organic wastes in greenspace creation schemes.

Two Researchers discussed how the lack of a mechanism for reviewing regeneration schemes and sharing information has limited the communication of information about success and failures of projects involving organic wastes. For example:

“...there’s no real consolidated evidence base... so it’s difficult to say ‘well that was good and that was bad’...” - Researcher

There would also appear to be a need for project managers to release ‘lessons learnt reports’ detailing an honest assessment of failures, causes and how they were overcome, as well as detailed economic studies into the benefits of organic waste use in land regeneration. A number of online libraries include

reports 'showcasing' regeneration projects (including CIRIA, CL:AIRE and the URG - Urban Regeneration and Greenspace Partnership), and these organisations, or others, would be well placed to host the lessons-learnt reports, and discussions arising also. Such reports should consider the project cycle phase of the land regeneration, with a follow-up report covering 'aftercare'.

Regulatory and economic issues

Half of interviewees (n=5) described how the legal classification of most forms of organic waste material as 'wastes' presents barriers toward their use (Table 3). A Researcher and a Land Manager suggested that there may be avoidance of specifying the use of materials which have (potential for) liability issues, as previously reported (WRAP, 2006). For example, an avoidance of using wastes such as sewage sludge, for fear of contaminating surface water. Four interviewees felt the anti-social nature of some organic wastes (the odour of sewage sludge for example) leads to negative perceptions of the site amongst local residents. However, a Researcher explained that this may be more of a *perceived* barrier than an extant one.

The project manager and site developer interviewed felt regulatory and economic barriers prevented them from being able to raise soil quality; the high costs of purchasing quality-assured waste products, and those imposed by requiring permits to apply non-quality-assured organic wastes, for example.

Eighty percent of interviewees (n=8) described the budget of land regeneration schemes as prohibitively small (Table 3). Eight interviewees (across all three categories) discussed how the cost of importing organic wastes, coupled with a low project budget, discourages their use in projects. One Practitioner summarised as follows:

"...we've got no cash on these schemes to go out and start buying materials... there's no cash in these schemes to start buying topsoils in, nutrients in, organics in..."

This complements the findings of WRAP (2006), who identified that projects may operate a 'material neutral' approach toward minimising the importation of materials carrying a cost. However, one

Researcher notes the cost of using organic waste materials may only be a perceived cost. Many organic wastes do not require purchasing and, if locally sourced, transportation costs may not be prohibitive. Furthermore, works to rectify failed planting can be as expensive as the initial regeneration, thus the initial importation of organic wastes may be cost-effective in the long-run.

Three interviewees felt that waste licensing and the planning process acted as barriers (Table 3). Two Practitioners felt that the need for a permit to use organic waste materials is a key barrier and that the cost and timings of applying for waste permits discourages the use of organic waste materials:

“...If you want to start introducing additional planning permissions, you’re talking £70,000 to £80,000 for a planning application. You need a change of your licence for what you’re doing with the material, it suddenly just becomes cost-prohibitive to do it... A planning application, even on a short project will take you probably twelve months.” - Practitioner

This finding suggests a greater opportunity to use organic wastes by considering them earlier, at the project planning stage. Planning Authorities do not regularly apply soil fitness-for-purpose as planning conditions and may grant planning permissions with little or no information regarding the soils to be used (DoE, 1996). Clearly the planning application stage provides an opportunity to ensure the use of a suitable quality planting media by stating it as a condition of planning. Such a condition could define ‘suitable’ or ‘fit-for-purpose’ via reference to the literature, however this may require a paradigm shift in the way planning authorities view the quality of soil quality in regeneration projects.

Project timetabling and material availability

Five of the ten interviewees discussed the local availability of soil-forming materials and organic waste materials as being a barrier. Six interviewees felt that that over large distances, transport of organic wastes becomes uneconomic (Table 3). Four of these interviewees commented that low availability of organic waste materials prevents their use. Speaking as a representative of an organic waste producer,

one Practitioner described there being a perception amongst practitioners of an insecurity of supply of organic waste materials. This complements WRAP (2006), who found that professionals questioned the ability of waste producers to supply materials in sufficient time and quantities for land regeneration projects. The establishment of an online market or meeting-place for waste producers and users could address issues of insecurity of supply. Waste producers could list the products they generate, including specifications, dates of availability, quantities available and charges. Users could monitor suppliers, quality and affordability, and contact potential suppliers. Thus, the market-place would build confidence in the supply chain. A waste watch-dog or an organisation committed to promoting the reduction and reuse of wastes would be well placed to establish such a market-place. This would enable regeneration professionals to source materials despite the large quantities required in brownfield greening projects.

Half of all interviewees raised the subject of project timeframes (Table 3). A Practitioner explained that short project timeframes can force contractors and civil engineers to compromise on soil placement technique, or to work with soils in sub-optimal weather conditions, leading to soil poaching and compaction. A Land Manager spoke of how tight timeframes have caused rushed project planning and negotiations, leaving no time to consider raising soil quality. Our research highlights a need for broader acceptance of longer timeframes for regeneration projects in order to ease the development of improved soils. Such a paradigm shift would require the commitment of stakeholders throughout the regeneration process, including land owners, funders, future managers and users of the site and may require significant changes in the way projects are funded, including ring-fencing money between financial years. However, the approach would allow for greater consideration of progressive restoration, the use of soil-forming materials with organic waste amendments, and allow contractors to cease work when conditions are suboptimal (e.g. due to inclement weather). This requires the backing of all those involved in the regeneration and a project champion to drive the overarching vision to achieve sustainable results for the project. To overcome issues of fragmentation and juggling competing needs

286 in regeneration projects, project champions (or another professional with vested interests in the long
287 term success of the site) should insist on higher prioritisation of ensuring appropriate soil quality,
288 including any necessary changes in budget.

Conclusions

Prior research by WRAP (2006) has suggested a number of barriers exist toward using organic wastes in land regeneration. Investigating a broader variety of organic wastes and land regeneration professionals has confirmed many of the barriers identified by WRAP (such as the issue of low technical knowledge by professionals) and identified additional ones, including a low awareness of guidance amongst professionals, the influence of waste regulation on the economics and timings of using these materials, and a void in communication between professionals at the various stages of the brownfield greening process. This research highlights areas where efforts can be focused to ensure soil materials are fit-for-purpose, namely by placing higher priority on soil quality; through more effective dissemination of guidance and communication of roles to practitioners; through proactive consideration of greenspace soil requirements early in the project planning process; and the adoption of longer timeframes for regeneration projects.

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363 Table 1. Practitioners interviewed and their stages of participation in the regeneration process; number of
 364 practitioners interviewed was one, unless otherwise stated.

Professional category	Stage in the process of brownfield regeneration to greenspace			
	Site Identification and Reclamation	Consultation and Design	Implementation and Delivery	Management and Maintenance
Researcher				
Soil scientists and national greenspace advisers (n=3)	X			
Practitioner				
Landscape architect		X		
Civil engineer		X	X	
Organic waste producer			X	
Site developer	X	X	X	X
Land Manager				
Professional forester for regenerated greenspace		X	X	X
Project manager	X	X	X	X
Land agent	X	X	X	X

365
 366 Adapted from Atkinson & Doick (2010).
 367

368 Table 2. Summary of responses: testing practitioner understanding of the use of a planting medium of suitable
 369 quality in brownfield regeneration to community woodland.

Interview question	Interviewee response	Frequency stated	
		# of Interviewees	# of Occasions
What defines a quality planting medium for brownfield regeneration to greenspace?	Fitness for purpose	5	15
	Should mimic natural soils	3	3
	Should possess particular physical, chemical and biological aspects	3	3
How important to you is a quality planting medium?	Soil quality drives the success of a greenspace	5	6
How would you describe the final quality of planting media used in brownfield regeneration to greenspace?	Poor quality	9	22
	Poor but improving	5	8
	Acceptable quality	2	2
	Compacted	6	17
	There is a shortage of quality topsoil to import for projects	2	6
What methods are you aware of for improving the quality of brownfield soil?	Addition of organic wastes	9	11
	Screening of soil-forming materials	1	1
	Place soil materials to avoid compaction	5	11
	Mixing soil materials with organic wastes	2	2
How did you get this knowledge?	From contacts/work experiences	5	8
	Scientific literature	3	3
	From reading guidance materials	1	2
How commonly are organic soil amendments used to raise soil quality?	Commonly used	2	7
	Used in exceptions	2	4
	Not used	7	14

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371

372 Table 3. Summary of the most frequently identified barriers to the use of suitable quality planting medium in
 373 brownfield regeneration to community woodland.

		374
Main barrier category	Most frequently identified issues within category	
		375
Economic	Low project budget for materials	
	Cost/ Perceived cost	376
	Organic wastes must be locally available to be economically justifiable	
Regulatory	Classification as 'waste'	
	Planning permission and waste permits prevent use	
	Health & Safety - public perception & seen as risk to project success	
Timings	Tight project timeframes limit options	
Process	Void in communication between professionals in the process	
	End-use of site not considered early enough	
	Lack of reporting mechanism for projects	
Practitioner	Low technical awareness amongst practitioners	
	Improving soil quality is perceived as unnecessary	
	Unrealistic landscape designs	
Guidance	Low availability of guidance materials for industry	
	Low industry awareness of existing guidance	