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DRIVING THE WASTE PREVENTION AGENDA: AN EVALUATION OF WEIGHING KERBSIDE HOUSEHOLD WASTE ARISINGS METHODOLOGY, IN DORSET, UK.

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ABSTRACT

Household waste prevention in England has been recognised in national strategy as a key component for future sustainable practice. To support the policy agenda, the Department of Environment, Food and Rural Affairs (Defra) in England has funded an extensive programme of fundamental research in the area. Previous attempts to assess the impacts of waste prevention initiatives have faced a number of problems. These have generally centred on difficulty in separating the effects of initiatives from external factors and inadequate sample sizes or methodology. The specific research aim reported on here, in this Defra funded project, was to trial and assess methods for monitoring and evaluating approaches detailed in the National Resource and Waste Forum (NRWF)'s Household Waste Prevention Toolkit. The primary objective of this research was to quantify the direct waste tonnage impacts of implementing a targeted household waste campaign in Dorset. The key performance indicator chosen for this assessment was the weight of waste collected at the kerbside from households. The results are informative and will help future teams design campaigns on the basis of rigorous methodology. It was found that there are a wide range of factors that need to be taken into account and that had hitherto been given little prominence, such as careful matching of pilot and control areas. Analysis of the results leads to the conclusion that waste arisings for residual waste has decreased in the pilot area ($\approx 10.5\%$) more than the controls (e.g. $\approx 5.5\%$). This method for monitoring can be used, in the hands of an expert project team, to communicate to the public the direct benefits of waste prevention.

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INTRODUCTION

Waste Strategy 2007 for England (Defra 2007a) reports that since the publication of the waste strategy in 2000 (DETR, 2000), England has made significant progress in the adoption of sustainable practice for Municipal Solid Waste (MSW). On the whole, in England, household waste is a high percentage of MSW (>94%). Recycling and composting of waste has nearly quadrupled since 1996-97, achieving 27% in 2005-06. Less waste is being landfilled, with a 9% fall between 2000-01 and 2004-05. Waste growth is also being reduced with MSW growing much less quickly than the economy at 0.5% per year (Defra 2007a).

This progress has been driven by significant changes in policy. The landfill tax escalator and the introduction of the Landfill Allowance Trading Scheme (LATS) have created sharp incentives to divert waste from landfill. New delivery arrangements have helped to drive the strategy, including the Waste Implementation Programme (WIP), the Waste and Resources Action Programme (WRAP) and the Business Resource Efficiency and Waste (BREW) programme (Defra 2007a).

Despite major progress since 2000, England's performance on waste still lags behind many European countries. All parts of society will have to share responsibility not just for recycling but also waste prevention. Some key actors are:
• retailers will have to reduce packaging, source and market products that are less wasteful,
and help their consumers to be less wasteful;
• consumers – both business and individual households – will have the opportunity to reduce
their own waste, purchase products and services that generate less waste and reduce
environmental impacts.

The Government's future key objectives include the decoupling of waste growth (in all sectors) from economic growth and putting more emphasis on waste prevention and re-use. A greater focus on waste prevention will be recognized through a new target to reduce the amount of household waste (not MSW) not re-used, recycled or composted from over 22.2 million tones in 2000 by 29% to 15.8 million tones in 2010 with an aspiration to reduce it to 12.2 million tones in 2020 – a reduction of 45%. This is equivalent to a fall of 50% per person (from 450 kg per person in 2000 to 225 kg in 2020).

There is no centrally adopted definition of waste prevention / minimisation in England. WRAP (2008) suggests that:

"Waste prevention aims to reduce the amount, hazardousness or the energy content of products before they enter the waste stream. At the same time, prevention differs from minimisation in that it occurs before things become waste. Minimisation includes re-use."

On a more pragmatic level for a Local Authority, they also suggest:

"Waste prevention is limiting the quantities of waste requiring collection and management at the local level."

Academic research on waste prevention has been much less reported than recycling. Recent research has emphasised the major differences between prevention / minimisation and recycling and that in the future campaigns to drive prevention need to be markedly different to those for recycling. Key research papers include Tonglet, et al., 2004; they point out the differences between minimisation and recycling. Their findings also provide support for the proposition that recycling and waste minimisation through point of purchase and waste minimisation through repair or re-use represent different dimensions of waste management behaviour, and thus will require different strategies and messages. They suggest that waste minimisation behaviour is likely to be influenced by a concern for the environment and the community, and is likely to be inhibited by perceptions of inconvenience and lack of time and knowledge.

Drawing upon psychology, Barr (2007) points out again the differences between minimisation and recycling. Barr shows that the predictors of reduction, reuse, and recycling behaviour differed significantly, with reduction and reuse being predicted by underlying environmental values, knowledge, and concern-based variables. Recycling behaviour was, in contrast, characterized as highly normative behaviour.

Other research has looked at developing conceptual frameworks to understand public attitudes (Barr et al., 2001). Tucker and Speirs consider the behavioural changes required to drive prevention (Tucker and Speirs, 2003). Prevention is linked to the need for a clear consumption led approach (Copper, 2005). For the limitations to waste prevention potential within a given locality, Salhofer et al, suggest that the prevention potential can reach an order of magnitude of some 10% of the relevant waste stream (e.g., advertising material, beverage packaging), or rather 1–3% of MSW. The prevention potential appear to be relatively small in relation to the total municipal waste quantities (Salhofer, et al., 2008). Others (e.g. Maycox, 2003) have reported on small scale minimisation projects limited to say 50 homes, with varying cost effectiveness.

Following a damming report on the progress in waste management (Strategy Unit, 2002) and to accelerate the adoption of waste prevention practice, for MSW in England , in 2003 the Department of Environment, Food and Rural Affairs (Defra) initiated a major funded research programme through their Waste and Resources Evidence Programme (Defra, 2003a). By 2007 there had been over 66 active and completed projects. The projects are mainly multi-disciplinary in nature and several have a clear emphasis upon Household Waste prevention (Table 1).

Table 1 here

To move the agenda forward on prevention, Defra has produced a range of guides for policy makers and practitioners that are based on current research with particular emphasis on behavioural change. In "Tackling the Waste Challenge" (2006), Defra make clear that:

- Behaviours are complex and non-linear. Each behaviour is determined by various (often interrelated) factors, many of which need addressing simultaneously to facilitate change;
- Different audiences, different segments of society in relation to environmental issues behave differently, and require targeted and/or tailored interventions;
- The audience for a change intervention should not be regarded as a passive target. Policy-makers need to view target audiences and other key stakeholders as 'actors' at the heart of the change process;
- Feedback is vital to driving and sustaining change. Instead of understanding changing behaviour as a single event, it should be viewed as an ongoing process;
- Government policy needs to convey a consistent message and visibly pull in one direction. The suite of policies emerging from government needs to avoid contradictions in order to convey clear messages to target audiences. Which is the main message prevention or recycling?

At the present (March 2008), the Defra research agenda containing household waste prevention is included in their Waste and Resources Evidence Strategy 2007-2011 (Defra, 2007b). The emphasis is upon research informing policy. Some key research questions that are emerging from present policy engagement includes (Defra, 2007a):
- Is further work required to understand the impact of community sector contributions to waste minimisation and prevention and to facilitate their efforts?
- Is it feasible to incorporate recycling and waste prevention into a carbon calculator and what evidence would be needed to achieve this? What impact does public concern have on waste arisings, recycling levels etc.?
- Are the drivers for waste growth sufficiently understood, including identification of the impacts of technology and lifestyle trends on waste arisings? What does current research on the barriers to household waste prevention and recovery tell us and what are the evidence gaps in this work?
- Is there a realistic sense of how much householders can do to prevent waste and how much influence they have on retailers and manufacturers? If so, are we engaging with them in the right way?
- How is household waste management behaviour related to income, age and other social factors? What are the most effective financial incentives in the UK context?

Overall, there are clearly still many gaps in the understanding of waste prevention in England, with quite a small scientific literature addressing waste prevention. The need for further quantitative based research is crucial in order to expand the available evidence base, and to find any corroborating evidence that could increase confidence in interpretations and recommendations.

This paper reports on one of these projects – Household Waste Prevention in Dorset (Table 1) and in particular the use of a major tool in the UK for designing and planning waste prevention strategies and campaigns, the National Resource and Waste Forum (NRWF) Toolkit (WRAP, 2007). The research was funded by Defra between 2005 and 2008 with around £240 000.

METHODS

Project location: Dorset County

The project occurred within the County of Dorset in South West England (Figure 1) between 2005 and 2008. Within an English County there are two tiers for the management of MSW. The County Council is the Waste Disposal Authority (WDA) and it is responsible for disposing of MSW. The County Council will have a Waste Management Strategy (Dorset County Council, 2003) and will also have in most cases, a waste minimisation strategy as part of the overall waste management strategy (Dorset County Council, 2005). The Borough and Distinct Councils are Waste Collection Authorites (WCAs) and collect household waste as well as the other components of MSW, such as some commercial waste. Data for the County of Dorset is found in Table 2.

Table 2 here

Municipal Solid Waste has been increasing markedly in Dorset and records show an increase of over 150% since 1979 . Dorset household waste arisings in 2006/2007 were 214 318 tonnes and MSW arisings were 231 791 tonnes. Some 56% of MSW in Dorset went to landfill in 2006/2007 and the cost of disposal was £52.18 per tonne. Except for North Dorset (82%), 90% or more of homes capture 2 or more different recyclates in household kerbside (Shaw, 2008) collection. Across England, there are a wide variety of kerbside schemes but in essence many will collect separately at least 2 recyclates, residual and green waste (Defra, 2003b).

Objectives

Previous attempts to assess the impacts of waste prevention initiatives have faced a number of problems. These have generally centred on:
(a) difficulty in separating the effects of initiatives from external factors;
(b) inadequate sample sizes or methodology; and
(c) lack of applicability outside the area concerned.

The specific research aim reported on here is to trial and assess methods for monitoring and evaluating approaches detailed in Section 4 'Measurement of Waste Prevention Impacts' of the National Resource and Waste Forum (NRWF)'s Household Waste Prevention Toolkit (WRAP, 2007). This paper considers research investigating the use of `Tracking Waste Arisings` in the context of Trial and Control Ares(s). These are:

1. NRWF Approach 1. 'Weighing Kerbside Household Waste Arisings'. To analyse location-specific, and district-specific historic waste arisings, and relevant location-specific external factors. To establish robust baselines and pre-existing trends to guide choices of control areas, and against which to measure the effectiveness of the different household waste prevention initiatives.

2. NRWF Approach 2. 'Using a Control Area'. To analyse demographic, economic and waste collection data to guide selection of a matrix of correction-matched pair areas. These to guide selection of the individual and combinations of waste prevention initiatives.

Methods Used: Weighing Kerbside Household Waste Arisings

 The primary objective of this research was to quantify the direct waste tonnage impacts of implementing a targeted household waste campaign in Dorset. The key performance indicator chosen for this assessment was the weight of waste collected at the kerbside from households. This necessitated robust baseline weight data and ongoing monitoring (for both the target area that was subjected to the campaign and its control areas) in order to be able to identify any reductions in waste arisings.

The ideal choice of areas to be monitored was determined to be specific residual waste collection rounds - where the data recorded related directly to around 1 700 households in a local area. The requirement for a baseline and ongoing measurement of specific collection round data on a weekly basis effectively narrowed the choice down to areas within the East Dorset District Council area (WCA) , where data had been accurately recorded in this way since July 2002. In combination with a detailed assessment of other socio- and geo-demographic factors, the final choice of monitoring areas (Figure 1) was:

- Pilot: Corfe Mullen, Residual Waste Round 3 - Friday (covering 1 682 properties);
- Control 1: St. Leonards-St. Ives, Residual Waste Round 4 – Wednesday (covering 1 745 properties);
- Control 2: Verwood, Residual Waste Round 8 – Tuesday (covering 1 749 properties).

Recognising that a waste prevention campaign might also affect householder recycling and composting behaviour (and therefore the quantity of those materials being collected at the kerbside), monitoring of waste arisings was extended to include dry recyclables and organic waste (brown bin) collections. This was also necessary due to the need to take account of the extended waste collection service for both of the control areas, where a brown bin was introduced for organic waste, initially in March 2004 in Verwood and in November 2004 in St. Leonards-St. Ives. No organic waste is currently collected at the kerbside in Corfe Mullen.

There is a difference in the size and coverage of recycling, organic waste and residual collection rounds. Additional monitoring was therefore chosen to encompass recycling rounds that were within the selected residual waste collection areas and representative organic waste collection rounds covering the two control areas. In Verwood, for example, three separate organic collection rounds overlaid the chosen recycling and residual collection round area so all three were monitored so that the average arisings could be calculated. The final chosen rounds were:

- Pilot: Corfe Mullen, Recycling Round 4 - Tuesday (covering 675 properties);
- Control 1: St. Leonards-St. Ives, Recycling Round 37 – Monday (covering 656 properties);
- Control 1: St. Leonards-St. Ives, Brown Bin 2 – Wednesday (covering 1 454 properties);
- Control 2: Verwood, Recycling Round 48 – Thursday (covering 605 properties);
- Control 2: Verwood, Brown Bin 1 – Wednesday & Thursday; Brown Bin 2 – Friday (covering 4 705 properties).

Methods Used: Using a Control Area Approach

The project team carried out selection of 'matched twins' of pilot and control areas, based on a carefully developed set of criteria. Close consideration was given, based on local knowledge, to the factors that might impinge differentially on `matched` pilot and control areas, and these were taken into account in order to ensure maximum credibility and accuracy of the final results.

In order to credibly assess the impact of any waste prevention initiative it is vital to know what would have happened in the absence of the initiative. This requires there to be one or more control populations that, to all intents and purposes, are identical to the study populations but where the initiative in question is absent.

Should a control population be different in some material way from the study population then it may well become impossible to distinguish whether observed changes in the study population that do not occur in the control are attributable to a waste prevention initiative, rather than potentially dozens of other factors.

No two populations are 100% identical. However in this context, where relatively small changes are expected amidst much 'background noise', a very high degree of similarity is vital. Where differences between study and control populations become apparent, to avoid having to discard the data it is important to investigate the possible reasons for these differences, and to explore whether 'weighting' or 'normalising' factors may be used.

It is interesting to note that, since the development of this research, WRAP (2006) now "does not recommend using control for monitoring" even for monitoring something as relatively simple as set-out rates and participation in kerbside recycling. Yet at the same time WRAP does not explain how to establish credibly whether any observed changes are attributable to a waste campaign. This research appears to have been unique in attempting to rigorously apply the control population technique for waste prevention.

The key factors used in the selection process for pilot and control areas were:

- close similarity of socio-demographic profile as indicated by ACORN (ACORN, 2008) categories. This is a means of classification of residential neighbourhoods, based upon a wide range of factors. Data is found in Table 3;
- close similarity of waste management provision (e.g. recycling facilities and their proximity) over at least two years prior to the commencement of the study;
- confidence in the continued close similarity of waste management provision over the lifetime of the study;
- similarity in proximity of supermarkets, schools, etc. that might influence waste prevention behaviour; and
- where possible, existence of very accurate waste arisings data for at least two years prior to the commencement of the study.

For the research on household waste arisings the pilot area was Corfe Mullen and the control areas were St. Leonards-St Ives, Verwood.

Table 3 here

Activities in Corfe Mullen

There were a range of activities undertaken in the pilot area (Table 4). In Corfe Mullen, the area of greatest waste prevention activity, this included promotion of the waste reduction packs (leading with the junk mail message), smart shopping, and an intensive doorstepping campaign that included signing up to the Mail Preference Service registrations.

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Table 4 here

RESULTS

Weighing Kerbside Household Waste Arisings

Using weekly weighbridge ticket data for specific collection rounds, time series graphs were produced that show the monthly average of weekly (kerbside collected) arisings of residual waste and recyclables (and organic waste for the control areas) per household in the pilot area and two control areas for the months May to November from 2005 to 2007.

Typical weekly data for a the Corfe Mullen (pilot Area) Collection Round (1 682 properties) is given in Figure 1. As is typical in UK there are large variations in arisings due to major holiday periods, e.g. April (Easter) and December (Christmas).

Figure 1 here.

Historic data is given in Figure 2 for kg arisings per household in Corfe Mullen (Pilot Area) from 2002/2003 until 2007/2008 for the months May to November. This is in line with the overall trend in Dorset.There was an increase in arisings from 2002/ 2003 until 2005/2006 (start of project) and then a decrease since after the impact of the waste prevention campaigns.

Figure 2 here

Figure 3 contains data for Corfe Mullen for household arisings (kg/ household) for residual and recyclate wastes 2005- 2008. There is a clear drop in residuals and an increase in recyclates. It could be argued that the impact of the waste prevention campaigns leads to a decrease in recyclates as the population adopt prevention measures and in addition it stimulates increased recycling of the waste stream components.

Figure 3 here

Figure 4 contains data on residuals for Corfe Mullen, St Leonards-St Ives and Verwood from May 2006 until November 2007. The decrease in Corfe Mullen ($\approx$ 10.5%) is greater than St Leonards-St Ives ($\approx$ 6.9%) and Verwood ($\approx$ 5.5%). It can be seen that the variation in residuals between the 3 areas is large with Corfe Mullen starting from a much higher base than St Leonards-St Ives .

Figure 4 here

Figure 5 contains data on the total collection of residual , recyclates and green waste (brown bin) for St Leonard-St Ives and Verwood, and the residual and recyclates for Corfe Mullen. This shows the need to take into account all components of waste collected in such a project remembering that Corfe Mullen does not have a green waste collection event though it is in the same WCA.

Figure 5 here

This aspect of the research attempted to quantify the level of impact a concentrated waste prevention campaign has upon levels of kerbside household waste arisings. The results obtained have illustrated that it is extremely difficult to accurately identify short term effects within the monthly fluctuations of waste arisings due to such factors as missed collections, Christmas and Easter holidays, DIY activity, use of local household waste recycling centres & bring banks, and bins not being put out. Furthermore, linear trend analysis of levels of arisings over more than one year is also highly problematic due to the influence of significant peaks and troughs observed around traditional holiday periods (in particular Christmas and to a lesser extent at Easter). Our analysis has identified that an interpretation of the year-on-year data between the months of May and November from 2005 to 2007 greatly reduces the influence of seasonal and 'one-off' effects, and reveals underlying trends most clearly.

The results obtained in Dorset demonstrate the importance of recording not only levels of residual waste collected but also recycling round data and organic waste collections if they are offered to residents. If there is an increase in recycling activity in an area then there is likely to be a corresponding decrease in levels of residual waste, whilst overall arisings would remain fairly constant. The detailed results for Corfe Mullen illustrate a more significant fall in residual waste than the increase in recycling and therefore a fall in overall arisings. However, in the control areas of Verwood and St. Leonards-St Ives we observe a smaller fall in residual waste and slightly higher increases in recycling, resulting in gradual waste growth. This growth is further exacerbated in the control areas by increased collection of organic waste at the kerbside over the three year monitoring period despite there being no change in the service delivery.

It is important to note that certain waste reduction activities, such as reducing junk mail (paper) and home composting, are likely to result in reduced levels of collection of recyclable and compostable materials at the kerbside as opposed to simply reducing residual waste quantities therefore monitoring of all three metrics is necessary to evaluate potential campaign impacts.

Overall, the results for Corfe Mullen showed an increase of 3.5% for all waste recorded in year 1 of project (2005/ 2006) and a 2.5% decrease for years 2 and 3 (2006/2007 and 2007/2008). For St Leonards-St Ives there was a 6.5% increase in year one (2005/2006) and this continued for years 2 and 3. For Verwood the data is a 2.5% rise in year 1 and a 3% rise for years 2 and 3.

Impact of campaigns

Some data from an evaluation of campaigns in Corfe Mullen and St Leonards-St Ives (Table 4) is contained in Table 5. It can be seen that there is some progress in topics such as `using reusable shopping bags` but in other topics such as `avoiding buying over packaged goods`, levels can quickly revert. Also the variation between pilot and control can be marked as in case of `home composting of cardboard` where control area practice is much higher than pilot.

Table 5 here

DISCUSSION

Weighing Kerbside Household Waste Arisings

The project monitored the most significant disposal route of household waste arisings by examining what was put out for collection at the kerbside.

Other outlets for household waste include household waste recycling centres, bring sites (e.g. bottle banks) and home composting. As it is not credible for any local authority to cost-effectively monitor individual household use of every potential outlet this research has focused upon tracking kerbside arisings, for which specific collection round data can be interrogated from weighbridge ticket statistics. However, efforts were made to investigate any observable differences in the use of bring site facilities in the pilot area of Corfe Mullen as compared to its control of Verwood and data were sourced from WRAP to assess levels of compost bin sales to households across Dorset over the three year monitoring period. The evidence is anecdotal but does show that there was less growth in paper material arisings at Corfe Mullen bring banks than in Verwood - supporting a hypothesis that waste reduction campaigns have made an impact on household arisings at the kerbside and also governed the need for residents to use additional bring site recycling facilities. Examination of the home composting bin sales data showed some success in targeted promotional activity to encourage households to compost more of their biodegradable waste at home.

Early graphical interpretation of the kerbside household waste arisings data suggested that in order to identify clearly a waste reduction campaign impact upon residual waste arisings (with an initial level of around 12kg per household per week in Corfe Mullen) necessitated a sustained reduction of around 10% (1.2kg/household/week). This would imply a reduction of 10% by all of the 1 682 households in the Corfe Mullen area. Monitoring populations on this scale means there would be some inevitable dilution of waste impacts recorded due to non-participating households. If, for example, the campaign only achieved a 25% take-up at the 1.2kg reduction level and say 25% at 0.8kg level, with the remaining 50% not changing their behaviour at all, the impact would be significantly diluted to 0.5kg/household/wk. Any impact on this scale, of just over 4%, was around the typical level of monthly variation in average arisings and therefore unlikely to be discernable, particularly when displacement effects resulting from increased recycling activity were taken into consideration. Therefore an extended time series of data (over 3 years) incorporating all kerbside household waste arisings (residual, recyclables and organic) was deemed necessary to reveal and determine any long-term data trends.

Despite the potential for dilution of impacts from a proportion of non-participating households, the measurement of data for a collection round of greater than 1 500 households provides a more realistic overall impact assessment of a waste reduction campaign than much smaller waste prevention pilot studies that have been reported in the past where extrapolation of results from a dedicated pilot to a much broader population can often be overstated.

As noted earlier, measurement of recycling (and organic) collection round data, in combination with records of residual waste arisings, is vitally important to be able to take account of the displacement effects of increased recycling and composting trends upon residual waste levels. For example in Verwood and St. Leonards-St Ives increases in the brown bin collection for organic wastes would imply displacement of some materials (e.g. food waste) from the residual stream. As this impact is not discernable in the residual waste trend we can infer that a degree of overall waste growth per household has occurred in the control areas whilst there has been an overall reduction in arisings the pilot area of Corfe Mullen.

If a local authority is tracking waste arisings in an attempt to monitor household waste reduction it is important that the collection round data being used does not include any other municipal solid waste (for example local authority collected trade waste, arisings from schools, parks and gardens or street sweepings) that might create uncertainty in interpretation of the results.

Using a Control Area Approach

Pilot and control areas have been used in this research as a means of comparing the relative effect of waste reduction impacts in one area with another similar area where no intervention has been directly applied. The main uses of this approach have been in comparing the waste arisings data for a pilot area (Corfe Mullen) with two control areas (Verwood and St. Leonards-St Ives) and in evaluating responses to the three annual waste reduction surveys for all twelve pilot / control areas.

The original selection of similar pairs of pilot and control areas was determined by a number of criteria but from a socio-demographic perspective the process was largely guided by an assessment of ACORN profile for an area. The broadest segmentation using just 5 'Categories' was used (Wealthy Achievers, Urban Prosperity, Comfortably Off, Moderate Means and

Hard Pressed). Subsequent analysis showed that using the next levels of detail (18 'Groups' or 57 'Types') would have significantly lowered correlations between selected areas. This is inevitable – the finer the grain of detail, the less alike any two populations become. However, recent research (Darnton, 2006) suggests that ACORN may not necessarily be a reliable indicator of receptivity to waste prevention practices and thus reinforces the need for careful consideration of the other factors in selecting similar pilot and control areas.

Considerable effort was expended in the initial phases of the research in order to determine the choice of pilot and control areas in Dorset for this study. Factors considered can be broadly classified under the three headings of: socio/geo-demographic factors; waste management service delivery infrastructure; and other factors, and are detailed in Table 6. Future campaigns that use waste arisings must take account of these.

Table 6 here

Value of tracking waste arisings compared to other monitoring techniques.

A set of criteria was established by which to assess and score the various monitoring techniques being used. These were divided into input and output criteria as in Table 7, with weighting factors decided on to account for the relative importance of these criteria. Input criteria consider the relative difficulty of obtaining the necessary resources, and output criteria consider various aspects of the value of the data obtained. These criteria were established as part of the project as, surprisingly, no comparable set of parameters by which to judge the success of similar research projects appear to exist. At the end of the project a detailed evaluation occurred of a wide range of techniques used, but not reported in this paper, by the extensive, expert project team who independently assessed the methods against the criteria. The collated scores are shown in Table 7.

Table 7 here

As can be seen from Table 7, no clear preference was revealed. None of the techniques was judged very poor, nor very good. These judgments are inevitably coloured to some extent by local experience during the research and may not necessarily be universally valid.

Tracking waste arisings directly, and focus groups emerge as the best methods. Focus groups are assessed the easiest/best technique in terms of 'input criteria' i.e. how much effort they require. Tracking waste arisings directly is assessed to be the best technique in terms of 'output criteria' i.e. how useful the outputs. It is suggested that the two techniques can be adopted in future campaigns with a degree of certainty as to their value. However, future research needs to build upon this project and further confirm the value of tracking waste arisings.

Costs and benefits

Dorset County Council performed a cost benefit analysis for their Waste Reduction and Reuse Strategy (Dorset County Council, 2005). In it (Table 8), they calculated that the cost of all the planned campaigns up until 2009/2010 would be £704 860 for a tonnage reduction of 31 547 tonnes. The benefits in terms of reduced landfill cost, etc, were £922 824 with an overall balance of £217 964. At present (2008) rates of UK landfill tax, (increasing at £8 per tonne per annum) the balance would be in region of £320 000.

Table 8 here

What are the costs of a `Weighing Kerbside Household Waste Arisings` programme? How can it be used? The costs of monitoring waste arisings will vary depending upon relationship between all involved. If the WCA has an `in-house` service they can direct their staff to adopt practice that enables accurate data to be collected, validated and inputted into a suitable software package. The costs of this will be overwhelmingly `in kind`, with an additional cost in the region of £2 000 per annum to the WCA. If the collection service is contracted out to an external company then cost will rise markedly depending upon the contractual position. It is estimated that the costs to the WCA could lie within the region of £5 000 to £10 000 per annum.

The value of a `Weighing Kerbside Household Waste Arisings` approach, is dependant upon the quality of the waste prevention campaign that it is incorporated into. Well designed communication campaigns (Mee et al., 2004) will maximise the impact on the general public (Tucker and Speirs, 2003) and will increase the take up of pro-environmental behaviour (Defra, 2006; Tonglet et al., 2004)), they will be designed on the basis of a proven conceptual framework (Barr et al., 2001) and will lead to a Local Authority reaching its maximum potential in waste prevention (Solhofer et al., 2008). The campaigns must also link household waste prevention to developments with a wide range of commercial and industrial producers; to link MSW and these waste streams in a holistic community programme (Ackroyd et al., 2003).   In the case of an `in-house` Local Authority, waste arisings will be cost effective, in the other case the economics will need careful consideration in light of possible elevated costs and above all taking consideration of the quality assurance issues that underpin accurate data to feed to the campaign.

CONCLUSIONS

The project monitored the most significant disposal route of household waste arisings by examining what was put out for collection at the kerbside. Early graphical interpretation of the kerbside household waste arisings data suggested that in order to

identify clearly a waste reduction campaign impact upon residual waste arisings (with an initial level of around 12kg per household per week in Corfe Mullen) necessitated a sustained reduction of around 10% (1.2kg/household/week). This would imply a reduction of 10% by all of the 1 682 households in the Corfe Mullen area. Therefore an extended time series of data (over 3 years) incorporating all kerbside household waste arisings (residual, recyclables and organic) was deemed necessary to reveal and determine any long-term data trends. Overall, the results for Corfe Mullen showed an increase of 3.5% for all waste recorded in year 1 of project (2005/ 2006) and a 2.5% decrease for years 2 and 3 (2006/2007 and 2007/2008). For St Leonards-St Ives there was a 6.5% increase in year one (2005/2006) and this continued for years 2 and 3. For Verwood the data is a 2.5% rise in year 1 and a 3% rise for years 2 and 3. What is the value of tracking waste arisings compared to other monitoring techniques? As can be seen from Table 7, no clear preference was revealed by the project team. None of the techniques was judged very poor, nor very good. The project team considered waste arisings to be an acceptable approach. However, the value of a `Weighing Kerbside Household Waste Arisings` approach is dependant upon the quality of the waste prevention programme campaign that it is incorporated. Only well designed communication campaigns will lead to a Local Authority reaching its maximum potential in waste prevention.

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TABLE 1.

Defra projects on Household Waste Prevention from Waste and Resources Evidence Programme

Code	Project	Start Date	Completion Date
WR0103	Household waste Prevention Policy Side Research Programme	2005	2007
WR0105	Project REDUCE Monitoring and Evaluation – Developing tools to measure Waste Prevention	2005	2007
WR0106	Achieving Household waste Prevention and Promoting Sustainable Resource Use through Product Services Systems	2005	2008
WR0107	Modeling the Impact of Lifestyle Changes on Household Waste Arisings	2005	2007
WR0112	Understanding Household Waste Prevention Behaviour	2005	2007
WR0113	Refillable Packaging Systems	2006	2007
WR0116	Household Waste Prevention in Dorset	2005	2008
WR0209	Enhancing participation in Kitchen Waste Collection	2006	2008
WR0211	Unlocking the Potential for Community Composting	2006	2008

TABLE 2

Data (2007) for Local Authorites responsible for waste management in Dorset

Local Authority	Population	Household residual waste per head (kg)	Household waste recycling and composting rate	Cost (£) of waste collection per head of population
Waste Collection Authority				
Christchurch Borough Council	45 100	305	22.79	34.23
East Dorset District Council	85 200	269	31.58	45.23
North Dorset District Council	65 400	245	31.65	46.29
Purbeck District Council	45 100	210	30.45	46.5
West Dorset District Council	95 800	290	27.34	48.18
Weymouth and Portland Borough Council	64 600	199	35.89	47.95
Waste Disposal Authority				
Dorset County Council	401 200	307	42.43	NA

Source: Defra, Municipal Waste Statistics 2008

TABLE 3
Percentages of Households in Acorn Categories in Pilot and Control Areas

Area	ACORN Category				
	Wealthy Achievers	Urban Prosperity	Comfortably Off	Moderate Means	Hard Pressed
Corfe Mullen Population = 9 910	59	0	35	6	0
St Leonards-St Ives Population = 7 340	97	0	3	0	0
Verwood Population = 13 590	41	0	49	0	10

TABLE 4
Campaign activities undertaken in Corfe Mullen pilot area.

2006		
February	Launch presentation to on campaign activities	Corfe Mullen Parish Council
April	Washable nappies seminar -	Village Hall
May	Reduce, Reuse, Recycle assembly and class visits	Rushcombe First and Lockyers Middle School
	Home composting and waste prevention awareness	Co-Op
	Reuse Directory and Waste Reduction packs	Corfe Mullen Parish Office and Library
June	Kids Recycling Fun Day (plus information about waste prevention and home composting). Included making various items from recycled materials e.g. windmills from plastic bottles, musical instruments from "junk" and grass heads using yoghurt pots	Village Hall
	Waste prevention/recycling stand	Corfe Mullen carnival
June to July	Secret Agents competition. Children collected 15 "secrets" about waste reduction	Promotion at Henbury View First School and Posters at participating shops in village
	Doorstepping campaign - information waste prevention, sign a pledge, register for MPS, reusable jute bags provided to participating residents	Selected areas in Corfe Mullen
	Waste prevention display	Library
July	Home composting and waste prevention awareness	Co-Op
	Secret Agents competition	Henbury View First School
2007		
February	Reduce, Reuse, Recycle assembly and class visits	Rushcombe First and Henbury View First Schools
March	SMART Shopping stand	Co-Op
	Doorstepping campaign - information waste prevention, sign a pledge, register for MPS, reusable jute bags provided to participating residents	Selected areas in Corfe Mullen
April	Easter Craft Day - children's recycling and reuse activities	Village Hall
	Assembly for prize giving	Henbury View First School
May	Doorstepping campaign - information waste prevention, sign a pledge, register for MPS, reusable jute bags provided to participating residents	Selected areas in Corfe Mullen
June	Waste reduction/recycling stand	Corfe Mullen Carnival
	Class visits	Lockyers Middle School (Year 5)
August	Doorstepping campaign - information waste prevention, sign a pledge, register for MPS, reusable jute bags provided to participating residents	Selected areas in Corfe Mullen

TABLE 5.
Some data on response in Corfe Mullen and St Leonards-St Ives to campaigns

Recycling Participation	Participation rates improved over the three years with more respondent's behaviour changing to from "sometimes" to "often". 2007 rates similar to control areas.
Home Composting	Slight increase in participation but just under 50% over the 3 years in line with the Dorset average.
Home Composting – kitchen waste (reduced number of respondents)	Dropped in 2007 from a high point of 85% in 2006. General rate high in line with the Dorset average.
Home Composting – cardboard (reduced number of respondents)	Rise in 2006 to 40% but back to 2005 levels in 2007. Huge rise(60%) in St Leonards-St Ives in 2007.
Avoided buying over packaged goods	Rise in 2006 to 78%, falling back to the 2005 levels in 2007. Significant increase each year in St Leonards-St Ives .
Used reusable shopping bags	Increase each year to over 80% slightly better than the Dorset average.
Reuse Directory useful	Significant rise in interest in 2006 towards 90%.
Action on Junk Mail	A 14% rise in action taken during 2006, a level maintained in 2007. Around 15% more action than the Dorset average. This is confirmed with reported MPS data.

TABLE 6
Factors that might impinge differentially on 'matched' pilot and control areas

Socio / geo - demographic Factors These are typically static over the short-term and non-controllable	• Average household size. • Average garden size. • Degree of daily occupancy, e.g. holiday homes, retirement homes, proportion of people 'working from home', number of 'housewives', etc. • Demographics of occupants (age and gender), e.g. families with children; students; retired pensioners, etc. • Type of home ownership, e.g. owned, rented, council housing. • Type of property, e.g. detached house, flat, bungalow, etc. • Local affluence / level of household deprivation. • Number of residents in full-time employment.
Waste Management Service Delivery Infrastructure These are typically static over the short-term and controllable	• Residual waste bin size. • Availability of kerbside recycling and / or green waste collection. • Regularity of collection services. • Proximity to Civic Amenity Site. • Proximity to Bring Sites. • Home composting bin distribution.
Other Factors These are typically highly variable over the short-term, with some being controllable, others not so	• Exposure to sustainable waste management communications, for example: • localised incentive schemes, e.g. free compost bin distribution, • door-knocking campaigns, e.g. to promote the Mailing Preference Service (MPS), • schools activities, e.g. households with children attending schools with waste related curricula activities, • supermarket activities, e.g. re-useable bag promotions, take back schemes, etc., and • local community / voluntary group activity, e.g. 'give and take' days. • Proximity to local charity shops, e.g. collecting unwanted clothes, toys, etc. • Localised free newspaper (and flyers) distribution.

TABLE 7
Collated Technique Assessment Scores

Criteria	Tracking Waste Arisings Directly	Selecting & Using Control Areas	Measuring Specific Activities	Questionnaire	Focus Groups
	(A) Input criteria				
	Pre-existing data, Cost, Staff time, Skills, Duration				
% of maximum possible input criteria score	45	46	58	39	67
	(B) Output criteria				
	Accuracy, Specificity, Influence, Comparability, Extendibility, Adaptability, Reliability, Assessibility, Relevance Comprehensivity				
% of maximum possible output criteria score	68	54	54	59	60
% of maximum possible overall score (A+B)	61	51	55	53	62

TABLE 8
Proposed Campaign Cost (£), predicted tonnage reduction, Benefit (£) and Balance (£) for Dorset County (Dorset County Council, 2005)

Campaign Title	Year 1– 2005/06 (£)	Year2 – 2006/07 (£)	Year 3 – 2007/08 (£)	Year 4 – 2008/09£	Year 5 – 2009/10 (£)	Total (£)
Reduction Pack	6 500	1 500	0	0	0	8 000
Home Composters	102 000	71 000	61 200	6 000	6 000	246 200
Community Champions Scheme	41 500	36 500	36 500	1 500	1 500	117 500
Community Composting Sites	21 280	6 460	6 640	6 820	7 000	48 200
Grass Cycling Trials	4 000	0	0	0	0	4 000
Green Shredding Service Trials	4 500	4 500	0	0	0	9 000
Food Digesters	47 000	48 500	48 500	48 500	48 500	241 000
Communication inc leaflet.	18 960	3 000	3 000	3 000	3 000	30 960
Total cost	245 740	171 460	155 840	65 820	66 000	704 860
Benefit	75 981	137 669	196 100	235 344	277 730	922 824
Balance	-169 759	-33 791	40 260	169 524	211 730	217 964
Tonnage (tonnes)	1 767	5 574	7 926	8 072	8 209	31 547