1. INTRODUCTION

Home composting (HC) is identified by the UK Government as a potentially significant mechanism for diverting biodegradable household waste from landfill disposal and many Local Authorities have promoted HC schemes by, for example, the distribution of free or subsidized bins to the community. However, because the activity is undertaken at the individual household level, and only a proportion of householders within a community participate, it is difficult to quantify the overall impact of HC on waste diversion rates. Consequently, there is little reliable, quantitative information available to inform Government and Local Authorities on the role of HC in household waste management. Therefore, Government has been reluctant to reward those Local Authorities supporting HC activities, within the recycling credit scheme or the current Landfill Allowance Trading Scheme (LATS). Despite the recognised potential benefits of HC at waste reduction, Local Government has no direct financial incentive to promote this and in some cases it has possibly lessened the enthusiasm for supporting homeowners to compost their waste.

There are a variety of factors that influence the extent and potential impact of HC on waste diversion, such as public attitude and willingness to compost waste, and the size and availability of garden space, both to produce and utilize the composted end-product. Jasim and Smith (2003) and Jasim (2003) approached the problem of quantifying waste diversion by engaging a cohort of 64 homeowners in the Borough of Runnymede, Surrey, to compost garden and kitchen food waste at home and measure the quantities of these residuals deposited in a standard 290 l compost bin for a period of two years. This indicated that households composted approximately 375 kg of waste per year on average, thus implying a significant reduction in the amount of waste disposed by those households actively engaged in HC. However, whilst providing a first approximation of the reduction in the quantity of waste deposited in the residual waste stream for collection and disposal by landfill, this value was an indirect measure. The amount of kitchen waste recycled by composting (mean = 108 kg y^{-1}) could be directly equated to a reduction in the amount of this type of biodegradable waste disposed for collection, however, the effect of HC on the patterns of garden waste disposal were much more complex. The data of Jasim and Smith (2003) suggested that homeowners deposited more garden waste in home compost bins (mean = 260 kg y^{-1}) than would typically be collected in the residual waste. Composting homeowners indicated, for example, that they made less frequent journeys to the local civic amenity (CA) site to dispose of garden waste, therefore, it appeared that a proportion of the waste that was disposed at CA facilities was accounted for by HC.

The research conducted by Jasim and Smith (2003), funded by The Norlands Foundation and in collaboration with Runnymede Borough Council (RBC), provided a clear indication of the potential for waste reduction and diversion of biodegradable waste from landfill disposal achieved by HC. However, it was possible to argue that the indirect methodology applied, although a reasonable quantitative approach, did not measure the actual impact of HC on the residual waste stream. It emerged from this work that direct measurements of the effects of HC on the quantity and composition of the residual waste stream were necessary to critically assess the level of diversion achieved and to examine the potentially subtle influence of changing the biodegradable waste disposal behaviour of homeowners on the characteristics of the residual waste collected from households.

Therefore, a second phase of research was developed to respond to this identified need. This involved a significantly more complex and demanding experimental methodology than that adopted by Jasim and Smith (2003). Direct weight measurements of the collected residual waste were obtained using an automated weighing system fitted to a refuse collection vehicle (RCV) and radio identification chips attached to the wheeled bins of participating households. Detailed waste composition analysis was also performed to

quantify the impact of HC on the balance of different types of biodegradable and other waste disposed in the residual waste stream. During the period of the second phase of work (2004 – 2006) RBC introduced a kerbside collection (KC) scheme for dry recyclable materials. Therefore, the study also examined the impact of the scheme on waste generation and composition in factorial combination with HC.

The data reported here, and previously by Jasim and Smith (2003), provide a comprehensive and quantitative assessment of the role of HC, and kerbside collection, in household waste management. This information can inform Government and Local Authorities of the potential impacts and consequences of these techniques on the production and composition of the residual waste collected from households. It also provides an independent data set that can be used to assist in the validation and calibration of numerical models to predict the impacts of waste management strategies and HC on diversion from landfill (Parfitt, 2006). In summary, this information is necessary to:

1. Determine the effectiveness of waste minimisation/recycling measures in reducing the amounts of landfilled waste;

2. Assess whether removing material from the wheeled bin by these measures encourages household waste disposal – there is anecdotal evidence to suggest that this may be the case. For example, homeowners may be less willing to take waste to a CA site for disposal if space is created in the wheeled bin due to kerbside recycling/home composting;

3. Provide management optimisation information for Local Authorities in terms of the required frequency of waste collections from households and waste bin size. For example, where recycling/minimisation measures are effective in reducing the amount of waste placed in the wheeled bin for disposal, the frequency of collection could be reduced;

4. Provide a technical evaluation of the role of HC in waste diversion from landfill to assist Defra in the development of a methodology that can be used to account for the contribution of HC to Best Value Performance Indicator figures for Local Authorities.

A number of subsidiary issues were also identified for further investigation in the Phase II programme. Homeowners were responsible for managing and weighing there own waste inputs into the bins in the Phase I project (Jasim and Smith, 2003) and, as would be expected, there was wide variation in behaviour in terms of the timing, amounts and types of biodegradable wastes deposited. Two key questions to be addressed, therefore, were: (1) what was the maximum potential waste throughput capability of small-scale composters, and (2) what were the effects of the balance of garden, paper and kitchen waste inputs on degradation and waste treatment capacity. Therefore, a controlled field experiment was established with managed inputs and quantities of these three waste types to determine the effects on the biodegradable waste treatment potential of small-scale home compost bins. The potential for anaerobic conditions in home compost bins to liberate methane (CH_4), a potent greenhouse gas, has been suggested as a possible environmental concern associated with HC waste (Gronow, 2006). Jasim and Smith (2003) showed that gaseous emissions of CH_4 were negligible from compost bins managed by homeowners. However, further information on the potential environmental emissions from HC, including gaseous and leaching losses, was required and these were monitored as part of the controlled field experiment. Biodegradable packaging wastes may be diverted from landfill disposal by composting treatment, but there is uncertainty about the suitability of different packaging types for HC. Therefore, an additional trial was performed using the established experimental bins to evaluate the biodegradability of card and biodegradable polymer based packaging.

Therefore, the key objectives of the project can be summarized as follows:

- To identify the relative importance and quantitatively evaluate the effects of HC and kerbside recyclate collection on residual waste generation and composition;

- To quantify the effects of HC and KC on the diversion of household waste from landfill disposal;

- To determine the maximum waste treatment potential of small-scale home compost bins and to optimise the management factors governing biodegradation rates;

- To assess the gaseous (CO_2, CH_4) emissions to the environment from home compost bins; and

- To examine the biodegradability of packaging materials used as bulking agents and determine their suitability for HC.