

# A review of recent developments in, and the practical use of, ecological footprinting methodologies

A research report completed for the Department for Environment, Food and Rural Affairs by Risk & Policy Analysts Ltd.

***RPA***



# **A review of recent developments in, and the practical use of, ecological footprinting methodologies**

## **Final Report to the Department for Environment, Food and Rural Affairs**

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Risk & Policy Analysts Ltd, Farthing Green House,  
1 Beccles Road, Loddon, Norfolk, NR14 6LT, UK  
Tel/fax: +44 (0)1508 528465/520758  
Email: Carolyn@rpaltd.co.uk  
www.rpaltd.co.uk

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# Executive Summary

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## 1. Introduction

Sustainable consumption and production (SCP) is a priority for the Department for Environment, Food and Rural Affairs (Defra). Ecological footprinting<sup>1</sup> methods have been developed by a number of different organisations and have been used to assess the impact of consumption at the local, regional and national scale, both within the United Kingdom (UK) and in other countries.

Defra has commissioned this study to assess recent developments in ecological footprinting methodologies and to provide a focus on the practical use of ecological footprinting. This is the Final Report of the study.

The study objectives are:

- to identify, discuss and analyse key developments in ecological footprinting methodologies since November 2004;
- to consider international ecological footprinting studies, where these can inform UK policy-makers on developments in ecological footprinting methodologies and their use in practice;
- to understand how and why ecological footprinting methods have been used in practice (by governmental, non-governmental organisations and companies), with a particular focus on their relevance for UK policy-making; and
- to identify how recent and ongoing methodological developments may affect the use of ecological footprinting for UK policy-making in the future.

## 2. Background to ecological footprint analysis

Over the last 15 years or more, debate on the extent to which human development can be maintained in the light of environmental constraints has led to the development of the ecological footprint as a means of measuring the impact of human consumption and production.

The ecological footprint provides a measure of the extent to which human activities exceed two specific environmental limits; the availability of bioproductive land and the availability of forest areas to sequester carbon dioxide emissions. Recent calculations suggest that, in theory, the UK's current consumption of goods would result in these limits being exceeded by a factor of three, if everyone in the world lived the way that we do in the UK.

The UK Government's stated principle of '*living within environmental limits*', and its focus on sustainable consumption and production, has led some stakeholders to

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<sup>1</sup> The term 'ecological footprint' is abbreviated to 'the footprint', 'eco-footprinting' and 'EF' in the relevant literature. In this Report we follow the lead of the Global Footprint Network and abbreviate the term to 'the footprint'.

suggest that the ecological footprint should be adopted as an indicator by the UK Government. Furthermore, the ongoing development of ecological footprinting tools, their promotion by the Global Footprint Network and their increasing adoption by organisations has generated considerable interest in the methodologies and how they can be used to support policy-making and decision-making within local government, businesses and other organisations. The main body of this Report consider the methodologies, applications and associated issues of the ecological footprint at different levels.

### **3. National calculations and applications of ecological footprinting**

The National Footprint Accounts are prepared annually for 150 countries and they undergo continual methodological development as better data become available and understanding of issues improves. However, data and methodological issues associated with the calculation of national footprints remain.

Identified data issues include:

- concerns regarding the quality of source data; and
- the fact that there no indication is given of the levels of uncertainty associated with data.

The data used by the National Footprint Accounts are obtained from international datasets and, therefore, similar issues would arise for any measure based on these data. To some extent, improvement of data depends on the actions of third parties (i.e. the agencies collecting the international datasets). However, potential solutions identified by partners of the Global Footprint Network include:

- independent reviews of national footprints (as have been undertaken in Switzerland, Finland, Ireland, Germany and Japan), resulting in star-rated accounts; and
- undertaking sensitivity analysis using multiple data sources and a range of key constants.

Research suggests that continual methodological refinements result in an annual variation in national footprints of +/- 3-4% regardless of changes in consumption. The Global Footprint Network provides an updated time series from 1961 to account for these changes.

Key issues associated with the methodology, which are being researched by the Global Footprint Network and are likely to be addressed in the short term (next five years) include:

- new techniques for calculating the embodied footprint of traded goods and services;
- alternate methods for calculating equivalence factors; and
- a shift in the basis for calculating the carbon footprint (including a change in the calculation of nuclear energy land).

There are ongoing debates regarding the potential for inclusion of other environmental impacts (such as water use, other greenhouse gases, persistent pollutants, etc.). It appears unlikely that these will be included in the main ecological footprint, although satellite accounts may be developed.

The most significant methodological improvement (at this level) which has been adopted by the Global Footprint network since 2004 is the adjustment of a price-capping algorithm associated with trade data. Research indicates that adjusting this algorithm increased the Swiss footprint by 9%, and the Irish footprint by 28%. The effect of this on the UK footprint was minimal; however, national studies have highlighted the potential for issues to be identified which can vary the ecological footprint by -12% to +28%. Other national studies may identify further issues.

Continuing research on the application of an input-output framework for calculating the embodied footprint of traded goods and services, and/or a hybrid approach combining this with existing material balance approach, promise improvements in the methodology but have yet to be agreed upon or adopted within the National Footprint Accounts methodology. However, identifying the impacts of imports by country of origin is data and labour intensive and may take considerable time to implement.

Furthermore, the recent publication of a dynamic approach for ecological footprinting, which accounts for carbon dioxide emissions in terms of climate change impacts and its future influence on bioproductivity (as opposed to an area of forest for sequestering emissions) also provides a development of the methodology, although it is designed to be complementary to the existing static approach. This development continues to raise questions regarding the method of accounting for carbon emissions.

The ecological footprint has been adopted as a sustainability indicator by the Finnish and Swiss governments, albeit within a long list of indicators, and is included as a potential indicator within the Convention on Biological Diversity. Wales and Northern Ireland have also adopted it an indicator. Beyond these examples, the adoption of the ecological footprint as an indicator at an international and national level is rare. However, further research on its potential as an indicator is underway by the European Commission. Other research at national and international levels has expressed doubt regarding its suitability as an indicator, due to the data and methodological issues outlined above.

The key area which the current UK SCP indicators do not address is the extent to which the UK shifts the burden of consumption to other countries, through imports. The footprint could potentially help to address this gap. However, a critical and unresolved issue regarding the current methodology is that imported goods are assumed to have world average energy intensities. This is unlikely to accurately reflect the embodied energy of UK imports; in addition, any shift to importing goods produced in an energy efficient manner, which may be adopted under the UK SCP strategy, would not be reflected (at least in the short-term) in the national footprint.

#### **4. Sub-national calculations and applications of ecological footprinting**

Sub-national ecological footprints primarily relate to geographical regions (within a nation) and cities, but they can also be calculated for individuals/households, industry sectors and individual businesses, products and organisations. Consultation has identified a considerable increase in the awareness and use of ecological footprints by local and regional authorities since 2004, and an increasing awareness by companies. However, carbon footprinting, which measures greenhouse gas emissions in tonnes of carbon equivalent, is being increasingly adopted by companies and this may be at the expense of ecological footprinting.

In the past, sub-national footprints have been calculated through process-based approaches, using LCA data to provide conversion factors for locally collected (or approximated) consumption data. Inconsistent methodologies and variations in data availability resulted in difficulties in comparing the outputs of these studies. The general consensus amongst practitioners, which has been formalised in the published Ecological Footprint Standards, is that the national footprint should be taken as a starting point for sub-national footprints. The Ecological Footprint Standards may result in improvements in comparability; however, due to the relatively recent publication of the Standards, few studies have yet been prepared within their framework.

A key issue associated with sub-national footprints is the lack of availability of specific data and thus the need to use approximated or average data. Some research suggests that using approximated data (i.e. based on national data) at a local level may result in significant errors when prioritising activities to reduce impacts. However, specific research on this issue has not been undertaken in relation to sub-national ecological footprints, and is likely to require the type of sensitivity analysis identified as being needed at the national level. Stakeholders have expressed an interest in such work being undertaken and it would potentially assist local authorities and organisations to assess the need to undertake specific (and potentially costly) data collection.

The most significant development in sub-national footprints methodologies in the UK has been the application of input-output analysis, which has been used to allocate the national footprint to industry sectors, consumption categories, local areas and socio-economic groups. This has the benefits of providing comparable footprints (e.g. for industry sectors or local authority areas) and addressing issues associated with the inclusion of services, indirect impacts and other data gaps. However, using financial input-output tables (which is the dominant approach at present) critically assumes that expenditure is an accurate measure of resource consumption, which is unlikely to be the case.

The comparative strengths and weaknesses of using input-output analysis or process-based data (such as LCA data) to calculate ecological footprints is probably the most discussed area of the footprint methodology, according to the Global Footprint Network. In theory, both approaches should produce similar answers; the reason that they do not yet do so is because the categories used in input-output analysis are large and heterogeneous, causing difficulties with matching process-based data. It has been suggested by stakeholders that the most powerful approach would be a hybrid method: using input-output analysis for a larger picture of the sector, and using LCA to provide more detail on the products within that sector.

Ecological footprint tools based on an input-output approach have been developed for local authorities and companies since 2004. These allow specific data to be used where available and fill gaps with approximated data. The suitability of this approach depends upon the expected use of the results and the level of accuracy which is required. These approaches adopt the implicit assumption that imported goods are produced with world average energy intensity, therefore any changes, particularly in the supply chain of companies, will not be reflected.

There is, therefore, a trade-off between producing standardised, comparable footprints and ones which accurately reflect the local situation. A number of local authorities are concerned about the lack of local data used in calculating the sub-national footprint, which can give rise to distrust from policy-makers. It is interesting to note that over half of the local authorities who responded to consultation for this

study considered the use of local data to be very important (and 25% considered it quite important), whilst 25% considered comparability with other local authorities to be very important (and 53% considered it quite important). Stakeholders using ecological footprints have expressed uncertainty about the range of methods available to them (including uncertainty about the differences between ecological and carbon footprinting) and the appropriateness of their use in different situations.

Ecological footprint analysis of products is at a similar stage to that of geographical sub-national ecological footprinting around two years ago. Whilst methods for sub-national areas diverged in the past but are now converging (assisted by the implementation of the Ecological Footprint Standards), methods for analysing products are currently divergent. This is illustrated by the current lack of agreement on standards for organisational and product footprinting studies.

Finally, despite almost universal acceptance of the ecological footprint as an awareness raising tool, there is little empirical evidence of its effectiveness in changing behaviour. Simpson *et al.* (2000) suggest that the consumer culture is deeply embedded in society, and the shift to more equitable and environmentally responsible consumption patterns will be difficult. It is therefore perhaps unfair to expect that the results of the ecological footprint would be able to bring about such a shift in behaviour on its own. Indeed, any study on the effectiveness of the ecological footprint would find it hard to control for other positive (or negative) messages received via different channels. However, given that the ecological footprint is widely used as an awareness-raising tool, further work in this area, particularly longitudinal studies, are recommended.

## **5. Wider use of the ecological footprint**

The Global Footprint Network also highlights the use of the ecological footprint for campaigning, and this has been done, in some cases with considerable media coverage. Whilst not all campaigns can be easily monitored for effectiveness, there appears to have been little monitoring of the impacts of campaigns involving the ecological footprint. The monitoring which has been undertaken indicates some success, and further monitoring should be undertaken to increase the evidence base.

Furthermore, from the outset of this study, Defra has indicated that this Report is not intended to compare the ecological footprint with other indicators; other studies exist which have done this. In addition, work currently underway for the European Commission has a specific objective to “*assess how other assessment tools can complement the footprint, to fulfil EU policy requirements*”. This is due to be published in September 2007 and is likely to provide a more comprehensive assessment than is possible within the constraints of this study. Those with further interest in this area are suggested to refer to the Commission’s study.

## **6. Use of the ecological footprint in policy or decision-making**

Local authorities and regional organisations are currently trying to understand the issues raised by ecological footprint results, with the majority being in the early stages of using the ecological footprint for policy-making. For this reason there are few, if any, examples of the ecological footprint being used consistently throughout the stages of policy-making.

Many respondents acknowledge the level of resource use that is identified by the footprint, but require better local data to further their understanding of the key issues, as well as to improve their confidence in the results. A number of authorities have 'updated' their terminology, moving from objectives related to managing their use of natural resources to objectives of managing their ecological footprint. However, many of the actions and measures to achieve the objectives remain similar to those that existed prior to footprint studies, particularly those focusing on energy efficiency. It is likely that a considerable number of local authority strategies will contain reference to the ecological footprint in the future, although many respondents are uncertain how to use it at this stage.

A minority of authorities and organisations have adopted specific targets of reducing their ecological footprint over a specified (long) timescale. This has also resulted in the adoption of the footprint as an indicator in some strategies. A significant barrier to the adoption of the footprint as an indicator by other authorities is the cost associated with updating it on a regular basis.

Where local authorities have used the footprint within local strategies as objectives or targets, most have to yet to develop the actions required to achieve the objectives/targets. For example, one respondent stated that "*we have succeeded in writing ecological footprinting into a community strategy, but it needs a delivery mechanism which is not there at the moment*". However, uncertainty over the results of the footprint suggests that local authorities should be careful when developing objectives and targets which include the footprint.

Some local authorities have found that the footprint provides a useful concept for discussing resource use, providing a descriptive alternative to more 'wordy' explanations of the issue. It has also served to highlight the environmental impacts of food consumption for some local authorities.

However, local authorities should take care to ensure that other components of resource use (such as water consumption) and environmental impacts (e.g. water quality) are also considered. The majority of local authority respondents to consultation (91%) agreed that the footprint should be used together with other indicators/tools, to provide a fuller picture of the impacts.

There is concern that some of the objectives set by local authorities do not meet the widely accepted SMART (specific, measurable, accepted, realistic, and time-dependent) criteria, particularly where the objective is to achieve a high percentage reduction in the ecological footprint. This is a weakness of local authority policy making rather than of the ecological footprint. However, it does suggest that local authorities may lack a basic understanding of the issues involved in reducing the footprint.

This is not to suggest that local authorities should not aim to reduce their footprint. However, this may be done more robustly by using scenario analysis to assess the impacts on the footprint of a range of options to achieve broad policy objectives. Other factors can also be taken into account in the scenario analysis, providing a more sustainable approach.

## 7. Conclusions and recommendations

This Report has identified key developments in the ecological footprint methodologies at national and sub-national levels since 2004. These are summarised in Table 1.

**Table 1: Advantages and disadvantages of recent methodological developments**

| Development                                       | Advantages   | Disadvantages  |
|---|--|--|
| Removal of price capping algorithm for trade data | Results in a more accurate ecological footprint  | Highlights potential for uncertainty within the results and requirement for further data reviews   |
| Dynamic approach for ecological footprint         | Aims to provide an 'early warning' indicator which can be acted upon, rather than a 'current state' indicator  | A reduced footprint below the level of available biocapacity highlights the sensitivity of current methodology to approach taken to account for carbon emissions |
| Use of I-O analysis at national level             | Ongoing debate with GFN regarding suitability of this approach compared to material flow approaches, no change in methodology at present. Hybrid approach yet to be developed but suggested to be ideal solution |  |
| Use of (financial) I-O at sub-national level      | Comprehensive, comparable footprints with minimum data requirements for users  | Assumes expenditure reflects consumption<br>Lacks relevance at local level unless specific data are collected and integrated                                     |

The removal of the price-capping algorithm has been implemented and the use of financial input-output analysis at a sub-national level is being widely used, resulting in some improvements to the methodologies. However, the use of input-output analysis at a sub-national level relies on a number of assumptions and therefore has its disadvantages, which should also be taken into account when using the results of these footprints. Additional developments, such as a dynamic approach for ecological footprinting or the use of input-output analysis at a national level are relatively new and/or are the subject of ongoing debate. Numerous other methodology and data issues are also under discussion but have yet to be implemented.

There has been limited adoption of the ecological footprint at national and international levels. Independent reviews of the ecological footprint in Switzerland, Finland, Ireland and Germany have highlighted data and methodology issues which have varied the national footprint by -12% to +28%. Other national reviews have the potential to highlight further issues and this suggests that the UK national footprint should be used with caution, particularly in relation to target setting by local and regional organisations, until an independent review of the data and methodology for the UK national footprint is undertaken. Furthermore, the identified need for sensitivity analysis of the national results should also be acted upon by the Global Footprint Network.

Ecological footprint methods have been applied to regional and local government areas, industry sectors and businesses, households and individuals. Predominantly they have been used to communicate the impacts of consumption, identify key areas for action and, in some cases, to set targets for reducing these impacts. The ease of communicating the ecological footprint has facilitated its use with policy-makers as

well as the general public. Stakeholders have identified the role of ecological footprinting in promoting the issue of sustainable consumption, highlighting the role of food in consumption impacts and creating greater joined-up thinking in policy-making. This demonstrates the communication benefits of the ecological footprint, and its use for this purpose should not be discouraged.

However, users of the ecological footprint should be made more aware of the uncertainty within the results of the footprint, which is currently presented as a single figure. On a small scale, any actions taken to reduce the ecological footprint are likely to be beneficial for the environment; however, stakeholder trust (if the baseline figure and target should change), the relative importance of actions and the impact on wider sustainability issues may be affected by changes to the national footprint and derived sub-national footprints. Furthermore, users have expressed a need for greater guidance (from footprint practitioners) as to the methods available to them and the appropriateness of these for different levels of analysis.

At a national level, the ecological footprint is an aggregated indicator, identifying environmental limits for the availability of bioproductive land and the availability of forest area to sequester carbon dioxide emissions. Carbon dioxide emissions, particularly those embodied in traded goods, account for 58% of the UK's ecological footprint, and therefore the majority of its exceedence of the defined limits.

The need to reduce carbon emissions caused by UK consumption is accepted. On the one hand, the recent and ongoing methodological developments highlight the sensitivity of the ecological footprint to variations in the method for accounting for carbon emissions. On the other hand, they highlight the insensitivity of the current methodology to changes in the embodied energy of traded goods for a specific country.

The UK's sustainable development indicators and the SCP indicators address a range of issues, and an identified shortcoming is the lack of accounting for the effects of UK consumption on other countries through imported goods. Whilst it is acknowledged that it is difficult to obtain accurate data on the embodied energy of goods and services, the current footprint methodology would not reflect any actions taken by the UK to reduce this impact. The ecological footprint would, therefore, not address this shortcoming of the set of indicators and may be inconsistent with any alternative indicator adopted to assess the impact of imported goods and services. Therefore, it is recommended that the UK Government does not adopt the ecological footprint as a sustainability indicator at this stage. Instead, the Government should pursue other research regarding the development of a robust indicator for embedded emissions and impacts of traded goods and services.

## TABLE OF CONTENTS

|          |   |            |
|----------|---|------------|
| <b>1</b> | <b>Introduction .....</b>   | <b>1</b>   |
| 1.1      | Background to study.....  | 1          |
| 1.2      | Study objectives .....  | 1          |
| 1.3      | Structure of this report.....   | 2          |
| <b>2</b> | <b>Background to ecological footprint analysis.....</b>   | <b>3</b>   |
| 2.1      | Introduction.....   | 3          |
| 2.2      | Sustainable development and sustainable consumption and production in the UK .....                          | 3          |
| 2.3      | Environmental limits .....  | 6          |
| 2.4      | The ecological footprint concept .....  | 7          |
| 2.5      | The development of ecological footprint methodologies .....   | 9          |
| 2.6      | Summary .....   | 14         |
| <b>3</b> | <b>National calculations and applications of ecological footprinting .....</b>                              | <b>15</b>  |
| 3.1      | Introduction.....   | 15         |
| 3.2      | Calculation of national footprints .....  | 15         |
| 3.3      | Assessments and use of the ecological footprint at international and national levels .....                  | 30         |
| 3.4      | Conclusions .....   | 35         |
| <b>4</b> | <b>Sub-national calculations and applications of ecological footprinting.....</b>                           | <b>39</b>  |
| 4.1      | Introduction.....   | 39         |
| 4.2      | Calculation of sub-national footprints .....  | 39         |
| 4.3      | Use of the ecological footprint at sub-national levels.....   | 48         |
| 4.4      | Conclusions .....   | 61         |
| <b>5</b> | <b>Wider use of the ecological footprint .....</b>  | <b>65</b>  |
| 5.1      | Introduction.....   | 65         |
| 5.2      | Use of the ecological footprint in campaigns.....   | 65         |
| 5.3      | Alternative and complementary indicators .....  | 66         |
| <b>6</b> | <b>Use of the ecological footprint in policy or decision-making .....</b>                                   | <b>69</b>  |
| 6.1      | The policy (or decision) making framework.....  | 69         |
| 6.2      | Using the ecological footprint to identify the issue .....  | 70         |
| 6.3      | Using the ecological footprint as an objective .....  | 72         |
| 6.4      | Using the ecological footprint to assess options .....  | 73         |
| 6.5      | Using the ecological footprint to monitor progress .....  | 76         |
| 6.6      | Conclusions.....  | 77         |
| <b>7</b> | <b>Conclusions and recommendations.....</b>   | <b>79</b>  |
| 7.1      | Key developments in ecological footprinting .....   | 79         |
| 7.2      | International examples of ecological footprinting studies.....  | 79         |
| 7.3      | The application of ecological footprinting methodologies .....  | 80         |
| 7.4      | The effects of methodological developments on the use of ecological footprinting for UK policy-making ..... | 80         |
|          | <b>Annex 1: Study methodology.....</b>  | <b>83</b>  |
|          | <b>Annex 2: Results of local authority consultation .....</b>   | <b>101</b> |
|          | <b>References .....</b>   | <b>125</b> |

## Glossary

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|                 |  |
|-----------------|--|
| BFF             | Best Foot Forward  |
| BNESC           | Bath and North East Somerset Council   |
| BRASS           | Centre for Business Relationships Accountability, Sustainability and Society |
| CO <sub>2</sub> | Carbon dioxide   |
| CURE            | Centre for Urban and Regional Economy  |
| DCLG            | Department for Communities and Local Government                              |
| Defra           | Department for Environment, Food and Rural Affairs                           |
| DfT             | Department for Transport   |
| DTI             | Department for Trade and Industry  |
| EA              | Environment Agency   |
| ECIP            | European Common Indicators Project   |
| EF              | Ecological footprint   |
| ESI             | Environmental Sustainability Index   |
| ESRC            | Economic and Social Research Council   |
| EU              | European Union   |
| FAO             | Food and Agriculture Organisation  |
| FLAT            | Footprinting Local Authorities Tool  |
| GAEZ            | Global Agro-Ecological Zones   |
| GDP             | Gross Domestic Product   |
| gha/cap         | Global hectares per capita   |
| GFN             | Global Footprint Network   |
| HDI             | Human Development Index  |
| HPI             | Happy Planet Index   |
| IEA             | International Energy Agency  |
| I-O             | Input-Output   |
| IPCC            | Intergovernmental Panel on Climate Change                                    |
| LA              | Local Authorities  |
| LCA             | Life-cycle analysis  |
| MFA             | Material Flow Analysis   |
| NFA             | National Footprint Accounts  |
| NPP             | Net Primary Production   |
| ODPM            | Office of the Deputy Prime Minister  |
| REAP            | Resource and Energy Analysis Programme                                       |

|        |   |
|--------|---|
| RPA    | Risk & Policy Analysts Ltd                      |
| SCP    | Sustainable Consumption and Production          |
| SCPNet | Sustainable Consumption and Production Network  |
| SGA    | Sub-national Geographical Area                  |
| SE     | Scottish Executive                              |
| SEEDA  | South East England Development Agency           |
| SEERA  | South East England Regional Assembly            |
| SEI    | Stockholm Environment Institute                 |
| SYKE   | Finnish Environmental Institute                 |
| UK     | United Kingdom                                  |
| UN     | United Nations                                  |
| WCED   | World Commission on Environment and Development |



# 1 Introduction

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## 1.1 Background to study

Sustainable consumption and production (SCP) is a priority for the Department for Environment, Food and Rural Affairs (Defra). Ecological footprinting<sup>2</sup> methods have been developed by a number of different organisations and have been used to assess the impact of consumption at the local, regional and national scale, both within the United Kingdom (UK) and in other countries.

In November 2004, Defra commissioned Risk & Policy Analysts Ltd (RPA) to undertake a two-month study to produce a review of existing UK ecological footprinting studies. The Final Report (RPA, 2005), dated June 2005, was published in 2006 following a period of peer review.

The aim of the 2004/5 study was to provide an evidence base, which would inform policy-makers on the potential uses of results from the ecological footprint methods. Seventeen completed UK ecological footprint studies were reviewed for the original report, together with a range of theoretical literature. The analysis indicated that the differences in per capita ecological footprints between the studies were linked to methodological issues, as well as real differences between the areas covered. Whilst the study noted the strengths of the ecological footprint as a communication tool, it concluded that the results of ecological footprint studies could not yet be recommended as a basis for policy-making. The key issues, related to both methodology and data, were either being addressed by new research and/or had yet to be resolved. The Peer Review Report (Moffatt, 2005) supported the conclusions of the study.

Defra has commissioned a follow-up study to take into account more recent developments in the ecological footprinting methodologies and to provide a greater focus on the practical use of ecological footprinting. This is the Final Report of the study.

## 1.2 Study objectives

The study objectives are:

- to identify, discuss and analyse key developments in ecological footprinting methodologies since November 2004;

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<sup>2</sup> The term 'ecological footprint' is abbreviated to 'the footprint', 'eco-footprinting' and 'EF' in the relevant literature. In this Report we follow the lead of the Global Footprint Network and abbreviate the term to 'the footprint'.

- to consider international ecological footprinting studies, where these can inform UK policy-makers on developments in ecological footprinting methodologies and their use in practice;
- to understand how and why ecological footprinting methods have been used in practice (by governmental, non-governmental organisations and companies), with a particular focus on their relevance for UK policy-making; and
- to identify how recent and ongoing methodological developments may affect the use of ecological footprinting for UK policy-making in the future.

### **1.3 Structure of this report**

The methodology for the Study is set out in Annex 1 to this Report.

The information presented in this Report is based on a review of relevant literature and consultation with key footprint practitioners, including the Global Footprint Network, and users of the results of ecological footprints. With respect to the users of ecological footprints, RPA contacted 160 local authorities across England, Wales and Scotland by email, requesting them to complete a web-based questionnaire. 73 responses were received, giving a good response rate of 46%. The results of this consultation are set out in full in Annex 2, and key findings are discussed as appropriate throughout this Report. Other users, such as regional and other organisations, were contacted with more specific questions by email or telephone.

Section 2 of this Report sets the context for consideration of sustainable consumption and production in the UK and considers the concept of environmental limits. It discusses the reasons for the focus on ecological Footprinting and provides an overview of the development of ecological footprinting methodologies.

Section 3 discusses national level calculations and applications of the ecological footprint, while Section 4 explores sub-national calculations and applications. Section 5 provides an overview of the use of ecological footprinting for campaigning as well as work on alternative and complementary indicators.

Section 6 focuses on the use of ecological footprint analysis for policy and decision-making, specifically by public sector organisations, and considers the implications of outstanding methodological issues for further use of the footprint in UK policy-making.

Finally, Section 7 concludes the Report regarding the recent developments in, and the practical use of, ecological footprinting methodologies.

## 2 Background to ecological footprint analysis

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### 2.1 Introduction

This Section sets out the context for considering sustainable consumption and production in the UK, discusses the idea of environmental limits, explains the focus of this Report on the ecological footprint and sets out the background to the ecological footprint and its development.

Whilst this Section (and subsequent ones) discusses the methodologies for calculating the ecological footprint and associated issues, the reader is directed to previous work by RPA (2005), the Global Footprint Network, Wackernagel and Rees (1996), the Stockholm Environment Institute - York (SEI) and Best Foot Forward (BFF) for more detailed descriptions of the footprint methodologies.

### 2.2 Sustainable development and sustainable consumption and production in the UK

A widely-used definition of sustainable development is “*development which meets the needs of the present without compromising the ability of future generations to meet their own needs*” (WCED, 1987). This definition is supported by the UK Government which notes that, over the past 20 years, there has been a growing realisation that the current model of development is unsustainable<sup>3</sup>.

The UK Government, Scottish Executive, Welsh Assembly Government and the Northern Ireland Administration have agreed a set of principles, which provide the basis for sustainable development policy in the UK. For a policy to be sustainable, it must respect all five principles:

- living within environmental limits;
- ensuring a strong, healthy and just society;
- achieving a sustainable economy;
- using sound science responsibly; and
- promoting good governance.

In 2005, a new UK sustainable development strategy was published: *Securing the Future* (Defra, 2005). This was developed within a common framework for the UK, as agreed with the Devolved Administrations, and provides 20 framework indicators which monitor the key issues on a UK basis. The UK strategy provides a further 48 indicators for monitoring progress and

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<sup>3</sup> See [www.sustainable-development.gov.uk](http://www.sustainable-development.gov.uk).

each Devolved Administration has also developed its own strategy. The 20 framework indicators are set out in Table 2.1.

**Table 2.1: Indicators within the UK's shared framework for sustainable development**

|   |   |
|---|---|
| <b>Greenhouse gas emissions:</b> Kyoto target and CO <sub>2</sub> emissions   | <b>Employment:</b> people of working age in employment  |
| <b>Resource use:</b> domestic material consumption and GDP  | <b>Workless households:</b> population living in workless households (a) children (b) working age                         |
| <b>Waste:</b> arisings by (a) sector (b) method of disposal   | <b>Childhood poverty:</b> children in relatively low-income households (a) before housing costs (b) after housing costs   |
| <b>Bird populations:</b> bird population indices (a) farmland birds (b) woodland birds (c) birds of coasts and estuaries                    | <b>Pensioner poverty:</b> pensioners in relatively low-income households (a) before housing costs (b) after housing costs |
| <b>Fish stocks:</b> fish stocks around the UK within sustainable limits   | <b>Education:</b> 19 year-olds with level 2 qualifications and above  |
| <b>Ecological impacts of air pollution:</b> area of UK habitat sensitive to acidification and eutrophication with critical load exceedances | <b>Health inequality:</b> (a) infant mortality (by socio-economic group) (b) life expectancy (by area) for men and women  |
| <b>River quality:</b> rivers of good (a) biological (b) chemical quality  | <b>Mobility:</b> (a) number of trips per person by mode (b) distance traveled per person per year by broad trip purpose   |
| <b>Economic output:</b> Gross Domestic Product  | <b>Social justice:</b> ( <i>social measures to be developed</i> )   |
| <b>Active community participation:</b> informal and formal volunteering at least once a month   | <b>Environmental quality:</b> ( <i>environmental measure to be developed</i> )  |
| <b>Crime:</b> crime survey and recorded crime for (a) vehicles (b) domestic burglary (c) violence   | <b>Wellbeing:</b> ( <i>wellbeing measures to be developed</i> )   |

Source: Defra (2005)

As a result of the consultation on the UK sustainable development strategy, four priority areas for immediate action across the UK were identified:

- sustainable consumption and production;
- natural resource protection and environmental enhancement;
- sustainable communities; and
- climate change and energy.

Within the area of sustainable consumption and production (SCP), the UK sustainable development strategy builds on *Changing Patterns* (Defra, 2003), which provided a framework for SCP, and refers to 'the vision and challenge of a one planet economy'. This is associated with the idea that "if everyone in the world were to consume natural resources and generate carbon dioxide at the rate we do in the UK, we'd need three planets to support us"<sup>4</sup>, which is based on the concept of ecological footprinting.

<sup>4</sup> See [www.wwf.org.uk/oneplanetliving/index.asp](http://www.wwf.org.uk/oneplanetliving/index.asp)

The strategy for achieving SCP includes:

- better products and services, which reduce the environmental impacts from the use of energy, resources, or hazardous substances;
- cleaner, more efficient production processes, which strengthen competitiveness; and
- shifts in consumption towards goods and services with lower impacts<sup>5</sup>.

A specific set of indicators for SCP has been developed within the UK. This includes some of the framework indicators (e.g. greenhouse gas emissions, fish stocks, resource use, waste and river quality) as well as disaggregated CO<sub>2</sub> emissions by sector, water use, land recycling and more detailed waste statistics.

In developing the SCP indicators, one criticism raised by consultees was that none of the indicators are able to address the issue of the UK shifting environmental pressure onto developing countries (Barrett *et al.*, 2004). At present, only the resource use indicator (materials used by the UK economy) will reflect changes in the level of imports, and this does not directly cover the environmental impacts of production (Defra, 2004). Suggestions (by consultees) for addressing this issue included:

- adopting some form of ecological footprinting;
- estimating the global warming potential of CO<sub>2</sub> emissions related to imported goods (by estimating the energy used in their production);
- an indicator based on the information in company reports on environmental impacts; and
- the proportion of fair trade products sold in the UK as percentage of product sales.

As yet, none of the above suggestions have been adopted. However, the Government has commissioned further work on the ecological footprint (including this Report) and on the potential for estimating indirect carbon emissions, including those embodied in imports. For example, SEI and the Policy Studies Institute undertook an initial study which, *inter alia*, considered the development of an indicator for emissions and impacts associated with the consumption of imported goods and services (Wiedmann *et al.*, 2006). SEI is now undertaking follow-up work on constructing databases which are expected to provide the basis for a number of analyses of the environmental impacts associated with UK trade flows, including the provision of a robust indicator for embedded emissions.

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<sup>5</sup> See [www.defra.gov.uk/environment/business/scp](http://www.defra.gov.uk/environment/business/scp).

## 2.3 Environmental limits

A key principle within the UK's sustainable development strategy is 'living within environmental limits', which is defined as "respecting the limits of the planet's environment, resources and biodiversity – to improve our environment and ensure that the natural resources needed for life are unimpaired and remain so for future generations" (Defra, 2005).

Haines-Young *et al.* (2006) review current scientific thinking on environmental limits and thresholds and this work is part of the broader debate regarding the extent to which human development can be maintained in the light of environmental constraints. Concerns regarding environmental limits have been reflected in work under the EU's 6<sup>th</sup> Framework Programme, the Convention on Biological Diversity and, as indicated, the UK's Sustainable Development Strategy. Haines-Young *et al.* (2006) suggest that there is broad consensus that the goals of sustainable development will not be achieved unless we are better able to identify and define what environmental limits are.

Haines-Young *et al.* (2006) consider existing literature on environmental limits and thresholds across Defra's key thematic areas<sup>6</sup> and suggest the following definitions:

- "the term **limit** is used to refer to the level of some environmental pressure, indicator of environmental state or benefit derived from the natural resource system, beyond which conditions which are deemed to be unacceptable in some way, either because the system is judged to be damaged or because its integrity is at risk"; and
- "the term **threshold** is reserved to describe situations in which a distinct regime shift between alternative equilibrium states exists, which may or may not be reversible".

Haines-Young *et al.* (2006) note that, whilst defining an environmental limit is important, it is also necessary to understand the consequences of exceeding the limit, as this will determine the type of management or policy actions that are appropriate and the priority that should be attached to them. The identification of a limit, and its significance, therefore depends on:

- what types of relationship exist between environmental pressure, system state and the level of benefits that we derive from the natural resource system; and

<sup>6</sup>

Biodiversity; water quality, supply and demand; the marine environment; the soil environment; land use and landscape; atmosphere (including air quality, greenhouse gas emissions and rates of climate change); emissions and ozone depleting substances; recreation and access to the natural environment; and levels of dispersal of toxic substances and the disposal of solid waste.

- the implications that exceeding a limit has for ecosystem integrity or human wellbeing, and an understanding of what aspect of a natural resource system we are seeking to protect by defining a particular limit.

The study concludes that:

- limits are most usefully defined in terms of the point or range of conditions beyond which the benefits derived from a natural resource system are judged unacceptable or insufficient;
- given natural variability and the uncertainties that exist in our understanding of the behaviour of natural resource systems, it is wise to adopt a precautionary approach to the definition of environmental limits;
- whilst identification of an environmental limit can be useful in helping to justify where management targets should be set, discussions about environmental limits are part of the wider debate about environmental targets; and
- while the definition of an environmental limit may be based on the biophysical properties of a natural resource system, its identification also depends on the way people value the outputs from it.

Research on environmental limits highlights that different environmental limits are relevant to different media, and consultation with stakeholders emphasises sustainable development as a multi-faceted problem. Furthermore, Lenzen *et al.* (2007) highlight that the impacts associated with exceeding environmental limits can have significantly different lifetimes, and while land and ecosystems may recover or be restored over decades after an initial disturbance, greenhouse gas emissions will have an effect for centuries.

Ecological footprinting is essentially a means of identifying the extent to which human activities exceed two types of environmental limits, the availability of bioproductive land and the availability of forests to sequester carbon dioxide emissions. The concept of ecological footprinting is discussed in more detail below.

## **2.4 The ecological footprint concept**

Since the concept of sustainable development entered the political agenda, there has been an ongoing search for methods to support decision-making for this purpose (van Vuuren & Smeets, 2000). Unsustainable consumption (and production) patterns have been identified as the major cause of the continued deterioration of the global environment (Simpson *et al.*, 2000) and, therefore, to change the current trend in the consumption of natural resources and the production of waste represents a considerable challenge (Barrett & Scott, 2001).

The ecological footprint was developed in the early 1990s by the academics Mathis Wackernagel and William Rees as a means of measuring and

monitoring the rate of consumption and its relationship with nature's ability to provide resources and assimilate wastes.

*“The ecological footprint of a designated population is the area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces, wherever on Earth the land and water is located” (Rees, 2000).*

Essentially, the ecological footprint addresses the question: how much of the regenerative capacity of the biosphere is appropriated by human activities? Thus, the ecological footprint is an aggregated indicator of the population's consumption of (some<sup>7</sup>) renewable resources.

There is wide recognition that the ecological footprint has been growing in popularity, as noted by Hammond (2006) amongst others. For example, in June 2004 the Global Footprint Network reported that an internet search for the term 'ecological footprint' yielded over 50,000 web pages. In March 2007, the number of results was over 900,000. There may be many reasons for this considerable increase in popularity. For example, the apparent ease with which people understand the message of the footprint means that it is widely used as a communication tool. In addition, and specifically in the UK, the release of *Counting Consumption* (Barrett *et al.*, 2006) and the development of a footprint for every local authority area in Great Britain (which are freely available on the Internet, through the *Resource and Energy Analysis Programme* (REAP)<sup>8</sup>) may explain the growth in its popularity for governmental organisations. RPA's 2005 Report found 17 examples of sub-national studies in the UK (commissioned by local or regional organisations); this compares to at least 40 local authorities (from a sample of 30% of all local authorities in Great Britain) which are aware of their area's footprint in 2007.

In 2006, the Global Footprint Network published the first set of standards for ecological footprints (these are discussed in detail in Section 4 of this Report). These Standards state that:

*“the Footprint is an ecological accounting tool, and as such, may inform choices but does not by itself advocate nor promote any particular strategy, policy or solution. It is not predictive but can be used to assess certain pre-determined scenarios” (GFN, 2006).*

The Standards require that any statement of the ecological footprint result and the subsequent recommendations for action are clearly distinguished. This recognises that it is common practice, once the ecological footprint of an individual, activity or area has been calculated, for suggestions to be made as to how the ecological footprint can be reduced. Such suggestions may either be made by the organisation which has calculated the footprint or be based on the interpretation of the ecological footprint analysis by the 'client'.

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<sup>7</sup> It is of note that the consumption of water, for example, is not directly included.

<sup>8</sup> See [www.sei.se/reap](http://www.sei.se/reap).

Where ecological footprint analyses are presented for the individual, these provide an educational message as to the impacts of a person's lifestyle. An individual may then take action based on the information provided. Similarly, ecological footprint analysis for an area or an activity may lead to decisions being made, based on the footprint results, by an organisation. It is important to ensure that such decisions are based on robust analyses. For this reason, the ecological footprint concept, methodologies and data are continually being scrutinised and, where necessary or possible, improved.

The footprint is not without its critics; there are a number of critiques of the footprint (see, for example, van Kooten & Bulte (1999); van den Bergh & Verbruggen (2000); Moffatt (2000); and Ecotec (2001)) as well as responses to these by footprint proponents. Such critiques (and their responses) are considered in this Report, where relevant.

## 2.5 The development of ecological footprint methodologies

The approach to ecological footprinting developed by Wackernagel and Rees in the 1990s is a top-down approach and is described in more detail in *Our Ecological Footprint: Reducing Human Impact on the Earth* (Wackernagel & Rees, 1996).

The premise of the ecological footprint is that each of us requires areas of the Earth's surface to provide food and wood products; for buildings, roads, solid waste disposal, etc.; and for forests to absorb the excess carbon dioxide produced by the burning of fossil fuels (Palmer, 1998). Ecological footprinting was originally conceived as a simple method for comparing resource use among different populations, with the consumption of these populations converted into a single index – the land area needed to sustain a given population (Lenzen & Murray, 2003). It also provides a measure of a population's use of natural resources compared to the Earth's supply.

Box 2.1 sets out the key assumptions underlying the footprint.

### **Box 2.1: Assumptions underlying the concept of ecological footprinting**

1. The majority of the resources people consume and the wastes they generate can be tracked.
2. Most of these resources and waste flows can be measured in terms of the biologically productive area necessary to maintain these flows. Resource and waste flows that cannot be measured are excluded from the assessment, leading to a systematic underestimate of the true ecological footprint.
3. By weighting each area in proportion to its bioproductivity (i.e. its potential production of biomass that is of economic interest to people), different types of areas can be converted into the common unit of global hectares (gha), hectares with world average bioproductivity.
4. Because a single global hectare represents a single use, and all global hectares in any single year represent that same amount of bioproductivity, they can be added up to obtain an aggregate indicator of ecological footprint or biocapacity.
5. Human demand, expressed as the ecological footprint, can be directly compared to

**Box 2.1: Assumptions underlying the concept of ecological footprinting**

nature's supply, biocapacity, when both are expressed in global hectares.

6. Area demanded can exceed area supplied if demand on an ecosystem exceeds that ecosystem's regenerative capacity (e.g., humans can temporarily demand more biocapacity from forests, or fisheries, than those ecosystems have available). This situation, where ecological footprint exceeds available biocapacity, is known as overshoot.

Source: GFN (2006a)

This top-down approach is typically used to compare the ecological footprints of different countries. The first publication of the *Footprint of Nations*, in 1997 (Wackernagel *et al.*, 1997) measured the ecological footprint of 52 nations and now, most prominently, the *National Footprint Accounts* (NFA) (see Section 3.2) provide the average ecological footprint and the average biocapacity available per person for 150 countries. The NFA are managed by the Global Footprint Network (GFN).

Since the introduction of the ecological footprint concept, a wide range of studies across the world have attempted to calculate the ecological footprint at different levels, for example sub-national geographical areas, households, etc. In 1996, the UK-based consultancy Best Foot Forward (BFF) developed the EcoCal™, a household ecological footprint calculator. At this time, there was little guidance as to how the ecological footprint of transport, primary energy use, waste etc. may be calculated at a domestic level (Simmons *et al.*, 2000). A set of algorithms for converting activity data into land area 'footprint' equivalents was developed from a variety of (local) sources. The EcoIndex™ methodology is described in more detail in *Sharing Nature's Interest: Ecological Footprints as an Indicator of Sustainability* (Chambers *et al.*, 2000).

This bottom-up approach has been used widely in the UK and elsewhere, as discussed in RPA (2005), and a number of studies have been completed, based on local sources of data and varying methodologies. In 2001, Barrett & Scott commented that "*each year the ecological footprint has become more refined, portraying a more and more accurate figure of the land appropriated by humans*".

Lewis *et al.* (2004) reported that ecological footprinting studies from across Europe demonstrated broad differences in the application of the methodologies and the wide variation in data sources used made comparisons difficult. As interest in ecological footprinting has grown, the need to standardise the methodology has been recognised.

The European Common Indicators Project (ECIP), as discussed by Tarzia (2003), initiated the development of a standardised methodology. European practitioners recommended that a standard methodology be developed according to the following basic criteria:

- it should be compatible with the National Footprint Accounts;

- the ecological footprint should be disaggregated into policy-relevant components;
- the datasets should be those readily available Europe-wide; and
- the model should be interactive to facilitate scenario development.

Subsequently, Simmons developed a sub-national geographical area (SGA) Ecological Footprint Tool for the EU, which was trialled in five cities. However, European funding was discontinued before the results could be fully documented and integrated back into the methodology (Barrett *et al.*, 2004).

Further work continued in the UK with the development of FLAT (Footprinting Local Authorities Tool – funded by DfT and ODPM) which allowed local authorities in England to calculate a 'snap shot' ecological footprint of their area for 2000 and enabled users to compare their ecological footprint directly with that of the UK as a whole, thus making the task of undertaking an ecological footprint less arduous (Barrett & Simmons, 2003). The FLAT tool has since been withdrawn from SEI's website, due to the development of the REAP tool (see below).

In Australia, Wood & Lenzen (2003) noted that the ecological footprint concept as originally proposed had been criticised by a number of researchers and, as a result, significant modifications have been suggested. These included the use of input-output analysis by Bicknell *et al.* (1998) in New Zealand and the incorporation of a regional, disturbance-based approach by Lenzen & Murray (2001). The first (published) UK study to incorporate input-output analysis (discussed in detail in Section 4) in ecological footprint analysis was Barrett *et al.* (2005) *Reducing Wales' Ecological Footprint*.

In 2004, the Ecological Budget UK project began to undertake a detailed resource flow analysis and ecological footprint analysis to provide comparable ecological footprint data at the UK, devolved administration and regional level. This involved applying input-output analysis to the national UK ecological footprint (as calculated by the National Footprint Accounts) (as discussed in Section 4), and the project produced its major output, the *Counting Consumption* report (Barrett *et al.*, 2006) in March 2006. This report noted that:

- the average ecological footprint per person in the UK is 5.4 global hectares;
- the highest footprint of all devolved administrations and English regions is found in south east England (6.3 global hectares per person); and
- the lowest footprint of all devolved administrations and English regions is found in Wales at 5.2 global hectares per person.

The Ecological Budget UK project also developed the software tool *Resource and Energy Analysis Programme* (REAP). REAP is a scenario-based, integrated resource-environment modelling tool to help local authorities make decisions, based on policy scenarios, about how to reduce their footprint. The project is run by WWF, in partnership with SEI and the Centre for Urban and

Regional Economy (CURE) and has been developed to quantify the entire global environmental impacts of consumption in the UK. The ecological footprint analysis projects undertaken so far in the UK have had to spend a considerable amount of time collating and generating local data, as well as developing policy scenarios. The Ecological Budget UK project now makes footprint data, derived from the national footprint using expenditure data, available to all local authorities. This reduces the data requirements for local authorities (depending on the needs of the authority).

The most recent guidance to local authorities in the UK is given by WWF-UK (2006), which sets out two ways of undertaking an ecological footprint analysis:

- the 'top-down' approach using aggregated economic input-output and household expenditure data to derive footprints for large-scale areas, such as the UK as a whole. It uses widely available national statistics and calculates accurate (albeit averaged) footprints for the areas or activities in question. One disadvantage is that it can overlook particular issues or variations around the average consumption pattern in a local area; and
- the 'bottom-up' approach, which uses locally specific consumption data in order to generate a picture of consumption within a smaller area. The bottom up approach can provide some useful localised information, but one significant drawback is that, in many instances, data on local consumption patterns can be difficult to find. In addition, using local data does not take account of the resource requirements of the economy as a whole or of the indirect resource flows associated with consumption.

Thus, WWF-UK (2006) suggests that the most effective approach to preparing an ecological footprint at a local authority area level is to combine both top-down national data and bottom-up local data: this combines the strengths of each approach and minimises the drawbacks.

The input-output approach has also been extended to industry, through WWF's One Planet Business programme. This programme held its first stakeholder meeting in March 2007 and is in the early stages of operation. However, the methodology for determining sectoral ecological footprints has been developed by Best Foot Forward and is documented in Simmons *et al.* (2006). One Planet Business is an international programme and it disaggregates national footprints, for 31 countries and for 48 sectors, using input-output analysis. It is of note that, prior to Simmons *et al.* (2006), there has been little work on the ecological footprints of industrial or business activities. However, applications developed by Best Foot Forward (Corporate Stepwise™, Footprinter™) and the Centre for Integrated Sustainability Analysis at the University of Sydney (*bottomline3*) are available to calculate the ecological footprint of companies, amongst other indicators.

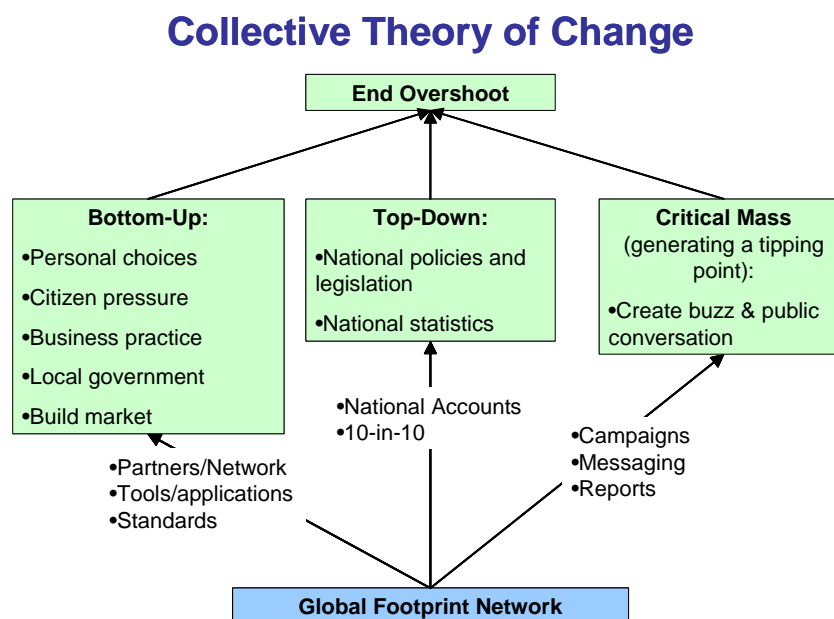
Nijkamp *et al.* (2004) note that the ecological footprint, like any other aggregate indicator, is constructed using a large amount of detailed information and its appeal lies in its synthesis. To avoid misleading interpretations from an aggregate environmental indicator, and to use it

profitably in the decision-making process, one must be informed about the data source, the aggregation and the (implicit) weights used.

To this end, the Global Footprint Network has developed standards and guidelines to assist the use of consistent, comparable approaches and the transparent presentation of results from ecological footprint analysis. In addition, further methodological work continues, from refinements to the existing methodology to the introduction of new approaches, such as the dynamic approach developed by Lenzen *et al.* (2007). This is discussed further in Section 3.

Figure 2.1 (provided by the Global Footprint Network) indicates how the ecological footprint, and its development and promotion by the Global Footprint Network, may lead to changes in behaviour that reduce the consumption of natural resources. These three areas of activity provide a useful structure for the subsequent sections of this Report, which consider the data, methodologies and application of the ecological footprint at national (top-down) and sub-national (bottom-up) levels, as well as its use as a campaigning tool.

**Figure 2.1: The ecological footprint and the collective theory of change**  
(source: Global Footprint Network)



## 2.6 Summary

Over the last 15 years or more, debate on the extent to which human development can be maintained in the light of environmental constraints has led to the development of the ecological footprint as a means of measuring the impact of human consumption and production.

The ecological footprint provides a measure of the extent to which human activities exceed two specific environmental limits; the availability of bioproductive land and the availability of forest areas to sequester carbon dioxide emissions. Recent calculations suggest that, in theory, the UK's current consumption of goods would result in these limits being exceeded by a factor of three, if everyone in the world lived the way that we do in the UK.

The UK Government's stated principle of '*living within environmental limits*', and its focus on sustainable consumption and production, has led some stakeholders to suggest that the ecological footprint should be adopted as an indicator by the UK Government. Furthermore, the ongoing development of ecological footprinting tools, their promotion by the Global Footprint Network and their increasing adoption by organisations has generated considerable interest in the methodologies and how they can be used to support policy-making and decision-making within local government, businesses and other organisations. The subsequent sections of this Report consider the methodologies, applications and associated issues of the ecological footprint at different levels.

## 3 National calculations and applications of ecological footprinting

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### 3.1 Introduction

The ecological footprint concept is based on the idea that sustainability has specific, definable requirements, including the need to avoid ecological overshoot. Wackernagel *et al.* (2004) suggest that this specific requirement allows a move away from vague notions of sustainable development and sustainable resource management. In order to move out of ecological deficit, governments can develop ecological accounts to track overshoot.

The Global Footprint Network measures the biocapacity and per capita ecological footprint of 150 countries through the use of the National Footprint Accounts. Both the data and the methodology used to develop these national ecological footprints have been scrutinised by a number of researchers, both in general and in relation to studies of specific countries (commissioned by national governments). This Section identifies key issues associated with the calculation of the national ecological footprints. The discussion is divided into data and methodological issues. In practice, however, there is considerable overlap between these issues. For example, particular methodological approaches may have been adopted because of the lack of relevant data and/or potentially more robust methodologies cannot be introduced because the necessary data are not yet available.

This Section then reviews how the ecological footprint has been assessed and used at the international and national level.

### 3.2 Calculation of national footprints

#### **Overview**

The National Footprint Accounts calculate the ecological footprint and biocapacity of the world and for 150 countries from 1961 to the present. The Accounts are updated annually by the Global Footprint Network, based on the latest complete datasets available, which usually results in a time lag of about three years<sup>9</sup>. WWF's Living Planet Reports<sup>10</sup> publish a summary of the National Footprint Accounts bi-annually (most recently, Hails (2006)).

The outputs of the National Footprint Accounts present a country's footprint in terms of its use of eight different land types (cropland; grazing land; forest:

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<sup>9</sup> [www.footprintnetwork.org](http://www.footprintnetwork.org)

<sup>10</sup> [www.panda.org/news\\_facts/publications/living\\_planet\\_report/index.cfm](http://www.panda.org/news_facts/publications/living_planet_report/index.cfm)

timber, pulp and paper; forest: fuelwood; fishing ground; land required to absorb CO<sub>2</sub> from fossil fuels, nuclear energy; built-up land). The area required to absorb CO<sub>2</sub> emissions is the dominant land use requirement in developed countries (Loh & Wackernagel, 2004; Wackernagel *et al.*, 1999).

The methodology for the National Footprint Accounts is set out by the Global Footprint Network (2005 and 2006a). The National Footprint Accounts measure the biologically productive space occupied exclusively to provide all of the resources that a nation's population consumes, and to absorb all of the wastes it generates, using prevailing technology and resource management (GFN, 2005). Through calculating biological productivity and consumption, an ecological footprint account makes ecological trade imbalances visible and, thus, shows the extent to which nations depend on net imports of ecological services (Wackernagel *et al.*, 2004)<sup>11</sup>.

In summary, the National Footprint Account method includes the following steps for each country:

1. collation of production and international trade data from official databases;
2. adjustment of data to account for consumption of goods and services (i.e. consumption = production + imports – exports);
3. biological productivity data is collated and used to convert consumption data into land and water areas; and
4. the land and water areas are adjusted for comparability and aggregated to form the ecological footprints.

The National Footprint Accounts have been constructed to err on the side of over-reporting biocapacity and under-reporting ecological footprints. The footprint approach aims to provide robust underestimates of human demand on nature to avoid exaggerating the severity of present ecological conditions (Wackernagel *et al.*, 2004). It is believed to be unlikely that accounting errors will reverse the conservative bias of the accounts. Box 3.1 summarises the six potential types of errors identified by the Global Footprint Network (2005). Data and methodological issues are discussed in more detail below, in general and specifically by land type. This Section draws largely on the work of Kitzes *et al.* (2007) and Simmons *et al.* (2007) and the issues outlined are, therefore, recognised within the Global Footprint Network.

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<sup>11</sup>

A number of authors criticise the ecological footprint for being anti-trade (e.g. see van den Bergh & Verbruggen (1999) and van Kooten & Bulte (2000)), due to comparisons between a population's ecological footprint and its own available biocapacity. It is argued that this ignores the environmental benefits of a concentration of the population (reduced habitat fragmentation, shorter transport lines and scale effects for waste processing, water and electricity supply) (VROM, 1999). Lewan & Simmons (2001) note that ecological footprints are not biased against trade, but simply demonstrate that it is not possible for all countries to be net importers of ecological capacity.

### **Box 3.1: Types of potential errors in the National Footprint Accounts identified by the Global Footprint Network**

1. *Conceptual and methodological errors:*
  - a) *systematic errors in assessing the overall demand on nature.* Some demands, such as freshwater consumption, soil erosion and toxic release are excluded or incompletely covered in the calculations. This typically leads to underestimates of ecological deficit<sup>12</sup>.
  - b) *allocation errors.* Incomplete or inaccurate trade and tourism data may distort the distribution of the global ecological footprint among producing and consuming nations. However, this does not affect the estimate of humanity's overall demand on nature.
2. *Structural and data entry errors in the calculation sheets.* Error detecting algorithms, the modular architecture of the calculation sheets, automatic cross-checks or tests for outliers in data time series and other techniques are used to identify and correct these potential errors. Minor errors are more difficult to detect, but also have minimal impact on the reliability of the accounts.
3. *Erroneous assumptions for estimating missing data.* Estimating data gaps is limited to only a proportion of the embodied energy in trade. National estimates are based on global values, with any error only affecting the ecological footprint allocation among countries. GFN expect the maximum distortion – the case of a small trade-intensive country – to be less than 5% of its total footprint. Further research is needed to analyse this potential misallocation among countries.
4. *Data errors in statistical sources for one particular year.* Errors in printed or electronically published data can be identified by comparison with similar data reported for other years. With improved ability to automate comparison across time and across nations, significant errors in this category are largely eliminated. Smaller errors of this kind may still exist in calculations, but they do not affect overall results
5. *Systematic misrepresentation of reported data in UN statistics.* Distortions in data arise for a number of reasons, such as poorly funded statistical offices and subsistence, black market and non-market activities, etc. Since most consumption occurs in the affluent regions of the world, it is considered that these data weaknesses may not distort the global picture significantly. However, cases have been found where national agency data do not match UN data - GFN have used the UN data due to its international comparability.
6. *Systematic omissions of data in UN statistics.* There are demands on nature that are significant but are not, or are inadequately, documented in UN statistics. Examples include data on the biological impact of water scarcity or pollution, and the impact of waste on bioproductivity. Including these aspects would increase the size of the ecological footprint.

Source: GFN (2005)

### **General data issues**

Wackernagel *et al.* (2004) note that data on the resources consumed and wastes generated annually by countries are drawn from international statistical and scientific organisations, which compile national statistics in a

<sup>12</sup>

There is considerable debate about the accounting procedure for nuclear power (which is based on the equivalent CO<sub>2</sub> emissions, in the absence of a better method). This may be considered a systematic error, which could have a considerable influence on the end result.

consistent format. These include, for example, United Nations agencies such as the Food and Agriculture Organisation (FAO), the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC). Other data sources include studies in peer-reviewed science journals or thematic collections (Loh, 2002). This approach enables comparisons to be made between countries, as the underlying data are readily available for all countries and conform to agreed definitions.

With the help of the European Environment Agency, the Global Footprint Network completed a major update of the National Footprint Accounts for the 2005 edition. New datasets were added, including a new database tracking imports and exports of over 600 categories of products (GFN, 2005). However, the Global Footprint Network (2005) recognises that there are still shortcomings, in particular a lack of data for some ecological demands, leading to results that underestimate humanity's full demand on nature.

### Quality of source data

Kitzes *et al.* (2007) and Simmons *et al.* (2007) note that both researchers and national governments have expressed concern regarding the quality of data sets used to calculate the National Footprint Accounts. For example:

- some government agencies are concerned that the national results are significantly biased by the frequency of data reporting, methods for measuring the population and the lack of reporting for certain commodities (EAD, 2006, cited in Kitzes *et al.* (2007)). For example, physical export data recorded in litres (as opposed to tonnes) is omitted from the (physical) COMTRADE data (but is included in value terms) received from the UN, and these are not included in the National Footprint Accounts (Simmons *et al.*, 2007);
- allocation errors occur when mapping the national data – in SITC Rev. 1 – to the classification system used by COMTRADE (SITC Rev. 3) (Simmons *et al.*, 2007);
- systematic distortions in the marine fish catch for China may be large enough to affect the estimates of the fishing grounds footprint of the entire world (Watson and Pauly, 2001, cited in Kitzes *et al.* (2007));
- informal economies are not recorded in official statistics and therefore these may underestimate consumption; and
- isolated errors in the FAO data result in discrepancies between nationally and internationally reported data. Simmons *et al.* (2007) note that Best Foot Forward has been in discussions with the FAO over the reporting of cattle stocks in the UK.

Kitzes *et al.* (2007) suggest that improvements should address both biased and mis-reported datasets, as well as possible errors and systematic

distortions resulting from the translation of national data into standardised international classification systems. One method of evaluating the extent of these inaccuracies is through the independent, scientific reviews of the underlying data sets used to calculate each nation's footprint. Full or partial reviews have already been undertaken in Switzerland, Finland, Ireland, Germany and Japan.

Simmons *et al.* (2007) propose that the National Accounts should be individually audited by a partnership of national organisations, working together with the Global Footprint Network (as in the reviews already undertaken), to check for errors in the source data and to refine the data and assumptions used where more accurate national data are available. This quality control system could result in star-rated accounts whose results would be more robust.

In addition to these general data issues, there are issues specific to particular aspects of the footprint methodology. These are discussed in the section on methodological issues below, as the potential for methodology development is critically linked to the availability of data.

#### Uncertainty levels

It is noted by Kitzes *et al.* (2007) that many researchers consider the standard error of national footprint accounting to be fairly high. However, no major systematic analyses have yet been published to examine and test confidence levels of source data in the National Footprint Accounts. Kitzes *et al.* (2007) agree that the accounting methods and assumptions should be subject to additional formal analysis and reality checks, using a range of published data sources. These could address issues such as:

- *multiple data sources* - Simmons *et al.* (2007) note that, for example, total carbon dioxide emissions for a country vary by source. In Germany, figures are variously quoted as 798 Mt/yr (source: CDIAC) and 854 Mt/yr (source: IEA), and the IEA 'sector approach' figures, which are 7% higher are used<sup>13</sup>. Whilst multiple data sources may assist with sensitivity analysis, Kitzes *et al.* (2007) suggest that caution should be exercised when comparing data or results, as regional data that are not included in international databases may affect comparisons; and
- *improvement of key constants* - Kitzes *et al.* (2007) suggest that key constants that are known to have a large influence on the overall footprint calculations should be subject to specific additional scientific analysis. It is suggested that likely ranges for these constants should be applied to generate a range or set of standard error estimates for footprint results sets.

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<sup>13</sup>

It is not clear to the authors whether a similar situation arises for the UK data.

## ***General methodological issues***

The National Footprint Accounts undergo constant refinement as better data become available and methodological issues are resolved. Therefore, it is possible that a nation's footprint can increase or decrease according to changes in the methodology, separately from actual changes in consumption. Curry *et al.* (2006) apply the National Footprint Account methodology for 1999, 2001 and 2002 to data for Northern Ireland in 2001, to calculate the change in the footprint which can be attributed to methodological developments alone. This suggests a decrease in the footprint of 4% between the 1999 methodology and that used in 2001, and a subsequent increase of 3% when using the 2002 methodology.

In addition to sensitivity analysis of data within the existing calculation framework, Kitzes *et al.* (2007) suggest that a broader definition of sensitivity analysis would include investigations of alternative methods that may affect final footprint results. For example, these might include:

- new techniques for calculating the footprint embodied in traded goods;
- alternate methods for calculating equivalence factors; and/or
- a shift in the basis for calculating the carbon footprint.

These are key issues within the ecological footprint methodology, which the Global Footprint Network identify as potential areas for development in the short term (i.e. one to five years). These are discussed in more detail below. A shift in the basis for calculating the carbon footprint is discussed in relation to the specific land types.

### Trade

A large proportion of the ecological footprint of developed countries is made up of the energy embodied within imported goods. The current method for calculating embodied energy is a *material balance* approach, which multiplies the reported weights of product flows between nations by ecological footprint intensities in hectares, or global hectares, per tonne. These intensities are derived from ecosystem yields combined with embodied material and energy values usually drawn from life cycle analysis (LCA) (Kitzes *et al.*, 2007). This assumes global average world figures for the embodied energy of imported goods and therefore no specific adjustments are made for the carbon intensity of the energy used in the country of origin or the distance travelled.

Kitzes *et al.* (2007) recognise that, in developing the current methodology, the most important priority is to use more robust country-specific embodied energy data to capture the carbon embodied in traded goods more accurately. Although these data have historically been lacking, Kitzes *et al.* (2007) suggest that the increasing global focus on carbon and climate change could potentially lead to better data in this area and therefore allow for their use in the national footprint. This could have a significant impact on the footprint.

For example, Table 3.1 provides a very basic analysis of imports to the UK, and the associated greenhouse gas intensity of each economy, based on the Climate Analysis Indicators Tool (CAIT) developed by the World Resources Institute. By assessing the volume of embodied greenhouse gases by country of origin, rather than world average (as is the case of the NFA), the emissions for the UK are reduced by 32%.

**Table 3.1: Embodied greenhouse gas emissions for UK imports, based on national and world average figures**

| Country  | Imports 2003   |                 | GHG Intensity of Economy 2003   | Total MtCO <sub>2</sub> |
|--|----------------|-----------------|---------------------------------|-------------------------|
|  | £ million      | Intl \$ million | tCO <sub>2</sub> /Mill. Intl \$ |                         |
| Germany  | 32,913         | 23,039          | 409                             | 9.41                    |
| USA  | 23,691         | 16,584          | 562                             | 9.32                    |
| France   | 19,783         | 13,848          | 248                             | 3.43                    |
| Netherlands  | 15,672         | 10,970          | 396                             | 4.35                    |
| Belgium  | 12,189         | 8,532           | 429                             | 3.66                    |
| Italy  | 11,720         | 8,204           | 317                             | 2.60                    |
| Irish Republic                                       | 10,031         | 7,022           | 310                             | 2.17                    |
| China  | 8,554          | 5,988           | 703                             | 4.21                    |
| Spain  | 8,445          | 5,912           | 350                             | 2.07                    |
| Japan  | 8,247          | 5,773           | 375                             | 2.17                    |
| Norway   | 6,591          | 4,614           | 182                             | 0.84                    |
| Sweden   | 4,593          | 3,215           | 232                             | 0.75                    |
| Switzerland  | 3,924          | 2,747           | 202                             | 0.55                    |
| Canada   | 3,796          | 2,657           | 606                             | 1.61                    |
| Denmark  | 3,008          | 2,106           | 370                             | 0.78                    |
| Singapore  | 2,738          | 1,917           | 452                             | 0.87                    |
| Austria  | 2,707          | 1,895           | 322                             | 0.61                    |
| Finland  | 2,649          | 1,854           | 531                             | 0.98                    |
| South Korea  | 2,616          | 1,831           | 565                             | 1.03                    |
| Portugal   | 1,939          | 1,357           | 343                             | 0.47                    |
| Poland   | 1,568          | 1,098           | 722                             | 0.79                    |
| Czech Republic                                       | 1,434          | 1,004           | 713                             | 0.72                    |
| Hungary  | 1,137          | 796             | 407                             | 0.32                    |
| Greece   | 626            | 438             | 450                             | 0.20                    |
| Luxembourg   | 618            | 433             | 370                             | 0.16                    |
| Latvia   | 508            | 356             | 305                             | 0.11                    |
| Lithuania  | 290            | 203             | 323                             | 0.07                    |
| Estonia  | 268            | 188             | 1,056                           | 0.20                    |
| Slovakia   | 262            | 183             | 599                             | 0.11                    |
| Cyprus   | 256            | 179             | 465                             | 0.08                    |
| Malta  | 187            | 131             | 368                             | 0.05                    |
| Slovenia   | 172            | 120             | 435                             | 0.05                    |
| <b>Total based on national figures</b>               |                |                 | <b>441</b>                      | <b>54.74</b>            |
| <b>Total based on World average figures</b>          | <b>193,132</b> | <b>135,192</b>  | <b>533</b>                      | <b>72.00</b>            |
| <b>Difference between World and national figures</b> |                |                 |                                 | <b>32%</b>              |

Source: based on data from <http://cait.wri.org>

In addition, Simmons *et al.* (2007) note that the trade method used in the National Footprint Accounts does not include the international trade in services and suggest that efforts should be made to quantify this for each

country. Kitzes *et al.* (2007) suggest that the current omission of trade in services has the potential to overestimate the ecological footprint of service exporting nations, such as those with large telecommunications sectors, research and development, or knowledge-based industries.

An alternative *input-output* framework for assessing trade has been proposed (e.g. see, *inter alia*, Bicknell (1998) and Wiedmann *et al.* (2006a)). Such an approach offers a more comprehensive assessment of national economies, and thus trade in goods and services. However, a number of uncertainties remain in an input-output approach, and these are discussed in more detail in Section 4 in relation to sub-national ecological footprints. Briefly, Kitzes *et al.* (2007) acknowledge that input-output methods suffer from a number of uncertainties, including low product resolution (i.e. data for different product types are aggregated) and, often, the use of monetary data to proxy for physical flows. Although in the past input-output tables have been available only for a subset of nations, newer multi-sector, multi-region input-output analyses could be applied to Ecological Footprint analysis. However, these require considerable investment both financially and in terms of labour. Kitzes *et al.* (2007) note that some authors have argued that the best approach for environmentally-related input-output analysis would be the use of hybrid input-output tables, comprising both physical and monetary data.

It is noted that many newer LCA databases derive their estimates using input-output frameworks, which may lead to convergence between these two methods (Kitzes *et al.*, 2007).

### Equivalence factors

Equivalence factors are used to convert world-average land of a specific type, such as cropland or forest, to global hectares. Kitzes *et al.* (2007) indicate that current equivalence factors in the National Footprint Accounts are based on estimates of achievable crop yields as compared to maximum potential crop yields from the Global Agro-Ecological Zones (GAEZ) assessment. Alternative approaches suggested in Kitzes *et al.* (2007) include basing equivalence factors on total Net Primary Production (NPP) or on usable NPP, as defined by the NPP embodied in extractable products from a given land type. Kitzes *et al.* (2007) summarises the advantages and disadvantages of all three approaches and indicates that there may be scope to use different values in the sensitivity analysis, rather than an overwhelming argument to move from the current approach to a new approach.

### Other methodological issues

Additional methodological issues are discussed in Kitzes *et al.* (2007) in more detail. In summary, these consider:

- impacts or resources which are currently excluded from (or inadequately addressed in) the National Footprint Accounts, such as:

- % tourism;
- % greenhouse gases other than carbon dioxide;
- % emissions from land use change;
- % additional land types;
- % water use;
- % persistent pollutants;
- % biodiversity;
- % multiple land uses; and
- % future footprints and biocapacity loss;

- alternative methods of normalising or allocating the results, for example;

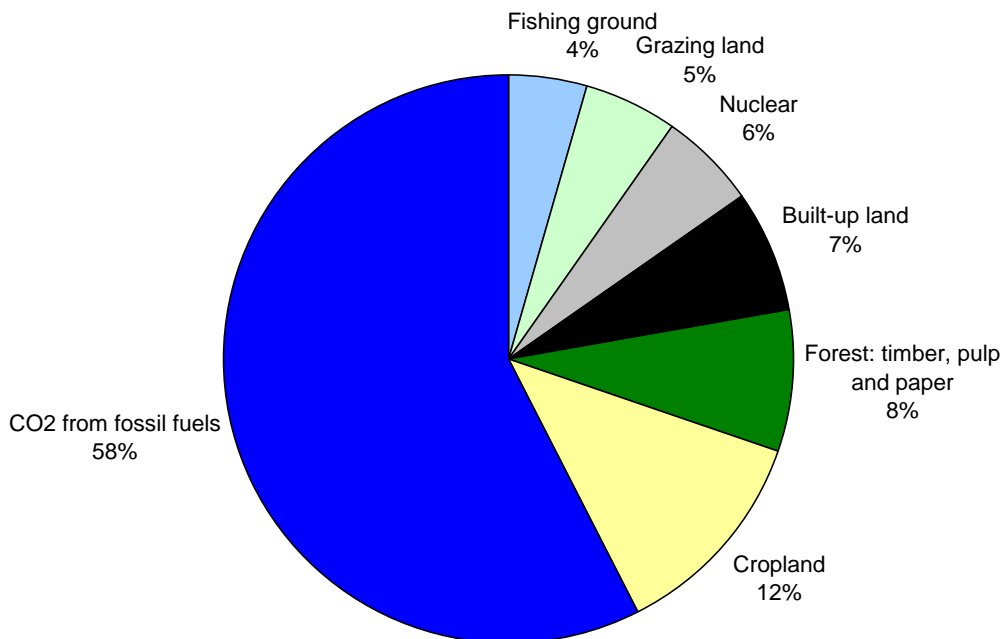
- % measured vs. calculated land use;
- % local vs. global hectares;
- % constant yield calculations; and
- % producer and consumer responsibility.

These issues are more likely to be addressed in the medium to long-term (i.e. more than five years). Kitzes *et al.* (2007) suggest that satellite accounts may be developed for some of the excluded impacts, and it is therefore unlikely that these will be included in the main ecological footprint.

### ***Methodological and data issues related to specific land types***

In the Living Planet Report 2006 (Hails, 2006), the UK's ecological footprint was reported to be 5.6 gha per capita. Figure 3.1 illustrates the distribution of the UK footprint by land type.

**Figure 3.1: The UK's ecological footprint by land type**  
(Source data: Hails, 2006)



This Section discusses the issues associated with the methodology and associated data for each land type, drawing again on the work of Kitzes *et al.* (2007) and Simmons *et al.* (2007). Methodological and data issues are discussed together, as they are closely linked for the particular land type.

### Fishing grounds

The global fishing ground is the area required to produce the fish and seafood products that populations consume (IVM, 2003); fishing grounds account for the smallest proportion of the UK's ecological footprint, at 0.25 gha or 4% of the total.

Kitzes *et al.* (2007) explain that the ecological footprint of fisheries is calculated by dividing the amount of primary production consumed by an aquatic species over its lifetime by an estimate of the harvestable primary production per hectare of marine area. This harvestable primary production estimate is based on a global estimate (by FAO in 1971) of sustainable aquatic species production, converted into primary production equivalents (i.e., the amount of land required to provide the same amount of food energy) and divided by the total available marine area.

The following methodology issues have been identified for the calculation of the fishing ground footprint:

- coastal estuaries and wetlands are not currently included in either the ecological footprint or biocapacity accounts (Simmons *et al.*, 2007); and
- the current method for calculating the footprint and biocapacity of fisheries is insensitive to the quality of the fish stocks (e.g. number of reproductive individuals) and the actual regenerative capacity in a given year. This is because the accounts are based on total available Net Primary Productivity (NPP) estimates for the world and the availability of NPP does not always act as the limiting factor on fisheries<sup>14</sup> (Kitzes *et al.*, 2007; Simmons *et al.*, 2007).

Whilst Kitzes *et al.* (2007) suggest that calculating the yields for fisheries based on stock quality information for all, or at minimum the most significant, fish species would be an improvement, data on the quality and reproduction rates of specific fisheries may be extremely difficult to locate and to compile. However, it is considered by Kitzes *et al.* (2007) that even simple models may represent a theoretical and practical improvement over current methods.

Calculation of demand on fishing grounds is based on catch data from the UN Food and Agriculture Organisation and current accounts track both fish catch for direct consumption and for fishmeal (GFN, 2006a). The following issues with the underlying data have been identified as significant for the calculation of the fishing ground footprint:

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<sup>14</sup> Kitzes *et al.* (2007) state that “*treating the availability of primary production as the only determinant of marine fisheries production might be compared to considering the availability of atmospheric carbon dioxide to be the only determinant of timber growth in forests*”.

- estimates of actual landings in a given year may be subject to reporting bias. For example, systematic distortions in the marine fish catch for China may be large enough to affect the estimates of the fishing grounds footprint of the entire world (Watson and Pauly, 2001, cited in Kitzes *et al.* (2007));
- Kitzes *et al.* (2007) notes that estimates of sustainable aquatic harvest suffer from a number of data limitations and errors in estimation, causing Simmons *et al.* (2007) to suggest that the factors used for sustainable fish yields should be validated for each country;
- an adjustment for bycatch is added to each country's reported catch, however methods for including bycatch are based on single year estimates rather than on time series observations (Kitzes *et al.*, 2007);
- there is a known problem which relates to the calculation of fishmeal for feed, therefore Simmons *et al.* (2007) suggest that the global assumption used should be validated for each set of National Accounts; and
- Simmons *et al.* (2007) have identified an error in the source data for Germany, where the continental shelf allocated to Germany is larger than the size of the Exclusive Economic Zone. Although this appears to have no impact on the footprint calculation, Simmons *et al.* (2007) suggest this should be verified it for all National Footprint Accounts;

### Grazing land

Grazing land accounts for 5% (0.30 gha) of the UK's per capita ecological footprint. GFN (2006a) explain that the grazing land ecological footprint of a livestock product is calculated by creating diet profiles to determine the mix of crop-based food, fishmeal, animal-based food, cropped grasses, and grazed grasses consumed by that type of livestock. The amount of grazing land demanded by a livestock product is calculated using the amount of pasture grass that is required to meet the total feed requirements of that product, after subtracting the other sources of feed used.

There is no discussion in the recent literature regarding methodological issues for this component. However, Simmons *et al.* (2007) identify the following issues associated with data underlying the calculation of the impact of animal products and subsequent consumption of grazing land:

- grazing land calculations make extensive use of national FAO data and are therefore particularly sensitive to errors in national production tonnages and feed tonnages;
- some data are considered 'not applicable' and Simmons *et al.* (2007) suggest that this should be verified;

- there is a known problem in the calculation of the footprint of milk products, which does not adjust the various milk products for their relative calorific value;
- the accounts make average assumptions about the volume of feed, and its energy content, to apportion the footprint to animal products. Simmons *et al.* (2007) note that, in the case of Germany, these average assumptions could be improved as the feed demand appears to be *greater* than the estimated available feed;
- embodied energy estimates for the crops used for feed are calculated based on the kcal/cap/day figures for each product provided by FAO. It is assumed that the calorific value of food when digested by humans is the same as that for animals. Simmons *et al.* (2007) note that this assumption is untested and suggests that these calculations would benefit from comparisons with existing national data on the calorific values of different types of animal feed;
- problems with calculating the footprint of fish oil has resulted in it being removed from the footprint accounts; and
- a 'capping factor' is applied when estimating the productivity of pasture land. Simmons *et al.* (2007) suggest that this assumption should be tested for each country.

### Nuclear Energy

The most recent version of the National Footprint Accounts (documented in Hails (2006)) separates the nuclear energy ecological footprint from the total energy footprint. For the UK, nuclear energy accounts for 6% (0.31 gha per capita) of the total ecological footprint. The nuclear land footprint is calculated as the amount of land that would be required to sequester the emissions of carbon dioxide if the same amount of electricity were generated using fossil fuel energy sources (Kitzes *et al.*, 2007).

This represents a significant methodological issue for the National Footprint Accounts, and Kitzes *et al.* (2007) notes that a series of research projects, focused on both the theoretical and practical basis of this nuclear footprint calculation, have been undertaken. Many researchers now believe that the footprint of nuclear land should not be calculated in this way, as it does not reflect the actual demand on the biosphere.

One suggestion discussed by Kitzes *et al.* (2007) is that the nuclear footprint should be defined as a type of consumption activity, where the footprint of nuclear electricity would be related to the consumption of those products necessary to produce nuclear electricity, such as forest land for creating infrastructure, built land for physical space, carbon sequestration land for carbon dioxide emissions (ISA, 2006) and, perhaps, productive land already rendered unproductive by contamination. Other impacts, such as the potential risk of a future nuclear accident or the footprint required for future

waste disposal, would be reflected in biocapacity and footprint accounts only when they occurred, consistent with the existing accounting framework

However, Kitzes *et al.* (2007) note this method could lead people to conclude that activities such as nuclear power, that place small current demands but high expected future demands, are better for the biosphere. Therefore Kitzes *et al.* (2007) suggest that the use of extended accounts, in parallel with the National Footprint Accounts may be the most appropriate means of addressing this misinterpretation, and that this message should be communicated to the appropriate policy makers.

It is our understanding, although this has not yet been documented, that the Global Footprint Network has recently decided to remove nuclear energy from the footprint accounts until such time that an alternative methodology is agreed upon.

### Built-up land

Built-up land accounts for 7% (0.38 gha per capita) of the UK ecological footprint. The ecological footprint of built-up land accounts for the area occupied by all buildings and other infrastructure relating to housing, transportation and industrial production (including energy production). The global information in this category is based on low resolution satellite images, which are unable to capture dispersed infrastructure, and is therefore the least well documented.

It is assumed that built land replaces arable land, since human settlements are mainly located in the most fertile areas of a country (IVM, 2003). This key assumption is the main issue regarding the calculation of the built-up land ecological footprint, and is essentially related to data availability. While the assumption was developed for use in temperate countries, it is not the case elsewhere. Kitzes *et al.* (2007) note that “*in tropical countries, for example, infrastructure often occupies previously forested areas, and in the Middle East and Central Asia, built infrastructure almost certainly occupies formerly arid non-productive land and hence should have no associated biocapacity*”. These calculations can be made more accurate by estimating more precisely what land type was replaced by built infrastructure, and Simmons *et al.* (2007) suggest that this assumption should be tested for each country.

In the UK, the assumption is likely to be reasonably true. Kitzes *et al.* (2007) note, however, that even in temperate countries, the cropland replaced by built-up land was likely to have been forested, and thus the appropriate land type to use involves a selection of a baseline year for comparison.

Some researchers have suggested that built-up land should be removed entirely from biocapacity and footprint estimates, given that the ecological footprint measures demand on and supply of bioproductive land and built land is no longer biologically productive (Kitzes *et al.*, 2007). However, built infrastructure is treated as an appropriation of bioproductive land rather than a change in the land type itself. This results in the aggregated accounts

showing no change in biocapacity where previously harvested cropland is built upon.

### Forest products

Forest products, such as timber, pulp and paper, account for 8% (0.46 gha per capita) of the UK's ecological footprint. Issues relating to forest products are primarily data-driven. Simmons *et al.* (2007) note that discrepancies between nationally-derived and international data for forestry yields have been discovered in both the Finnish and French National Accounts.

For example, Finland holds considerable statistical data at a national level regarding forestry which is not collated internationally. Therefore the consumption of forestry products included in the National Footprint Accounts is estimated, based on a number of sources. Using national data, it was found that the National Footprint Accounts may over-estimate Finland's forestry footprint by one-third, reducing the 2001 national footprint by 12%. The key source of error was found to be in the export data for timber for the production of paper, cardboard and pulp and that the utilization of chips in pulp production was not taken into account<sup>15</sup>. The National Footprint Accounts addressed those issues raised by the Finnish study which provided better data.

Simmons *et al.* (2007) also suggest that the loss factors (which reflect the amount of timber that is lost from disease, windfall, fires etc. and that is felled but not used) should be reviewed, as these can substantially alter the effective yield (the usable yield from a forest).

### Cropland

Cropland accounts for 12% (0.68 gha per capita) of the UK's ecological footprint. Kitzes *et al.* (2007) explain that, for all major land types other than cropland, the yield (product per area) used to calculate the ecological footprint is the amount of material produced by that given land type per year, rather than the amount harvested. When a harvest yield exceeds a growth yield, a specific area enters overshoot. However, the yield of cropland is equal to the amount harvested and, as such, the current methodology does not show overshoot for cropland. Whilst the energy-intensive inputs required to maintain current yields (e.g. fossil fuels needed for tractors, fertilisers, or pesticides) are considered in the aggregate footprint accounts, this (often large) carbon footprint does not contribute to overshoot in cropland itself.

Kitzes *et al.* (2007) note that this lack of overshoot can be interpreted as sustainable use of cropland, as other environmental impacts (such as nutrient leaching, contamination of groundwater and other resources) and soil erosion are not accounted for within the current methodology. Kitzes *et al.* (2007) suggest that these additional impacts could be incorporated into extended or

<sup>15</sup>

"New estimate gives smaller ecological footprint to the Finnish forest sector"  
[www.environment.fi/default.asp?contentid=204740&lan=en](http://www.environment.fi/default.asp?contentid=204740&lan=en)

satellite accounts to be used alongside core footprint accounts for multi-criteria decision-making.

Simmons *et al.* (2007) note that the cropland footprint relies heavily on FAO data to estimate the food consumption of residents and it is therefore particularly sensitive to errors in national production (tonnages), harvest area (by crop) and yields (t/ha). The following specific data issues are highlighted by Simmons *et al.* (2007):

- information on some crops is excluded due to 'duplication or insufficient data'. These include the categories of honey; hops, peppermint, and other misc. crops; and hard fibres (other); and
- there are global assumptions made about the type of crops grown on primary and marginal cropland. Simmons *et al.* (2007) suggest that these should be validated for each individual country.

### Carbon sequestration land

The ecological footprint of fossil fuel combustion is calculated as the area of world-average forest required to sequester carbon dioxide emissions, excluding the proportion absorbed by the oceans. This accounts for the largest proportion of the UK's ecological footprint at 58% (3.21 gha per capita).

Kitzes *et al.* (2007) notes that ecological footprint estimates are extremely sensitive to methodological decisions about how to calculate the energy footprint. A number of alternative methodologies have been suggested over time (see Kitzes *et al.*, 2007) and, most recently, Lenzen *et al.* (2007) have developed a framework for a dynamic approach to ecological footprinting. Lenzen *et al.* (2007) explain the basis of the dynamic approach:

*"in this view, human consumption exerts the pressure, acting via land use and greenhouse gas emissions to biodiversity and ecosystem functioning, with bioproductivity being the end-point of impacts, or state. To close the loop, available bioproductivity (biocapacity) will in turn limit what humans can consume."*

This dynamic approach allocates the impact of carbon dioxide emissions to future changes in bioproductivity under climate change rather than requiring current emissions to be sequestered. As such, the ecological footprint can only occupy available land (rather than, for example, three planets' worth), and, at present, the ecological footprint is less than the available biocapacity.

Lenzen *et al.* (2007) explain the approach/results in relation to carbon dioxide emissions as follows:

*"in a dynamic view, the appropriation of bioproductivity due to greenhouse gas emissions has to occur at the time of climate change, and not at the time of*

*emission, because at the time of emission, the bioproductivity is yet unaffected. This is a key difference to the static approach... which adds the area needed to sequester global emissions on top of the actual appropriated land area, and thus creates overshoot, no matter that emissions are actually not sequestered... This overshoot does hence not refer to the current world (as this world is functioning), but refers to a condition for emissions compensation that is not met in reality... In a temporally explicit, dynamic method there cannot be at any time more land used than is available, but instead overshoot manifests itself in converging biocapacity-Ecological-Footprint curves, which is a vivid indicator for the fact that today's greenhouse gas emissions will have a delayed effect on future bioproductivity."*

However, discussions with key stakeholders suggest that the sequestration approach will be maintained, at least in the short term. Possible methodological changes may include:

- reductions in the proportion of carbon dioxide emissions accounted for by ocean sequestration, potentially increasing the area of forest required for sequestration and thus increasing the ecological footprint;
- introducing root uptake of carbon in sequestration rates, potentially increasing the absorption rate per hectare and decreasing the ecological footprint; and
- including sequestration rates of other types of vegetation. However, Kitzes *et al.* (2007) indicate that mature ecosystems may have little to no sequestration potential and that any land set aside for sequestration must be permanently reserved, with no option for future extraction of the fixed carbon.

### **3.3 Assessments and use of the ecological footprint at international and national levels**

#### ***International examples***

Despite the increasing popularity of the ecological footprint, Munday and Roberts (2006) note that it does not yet feature prominently as an indicator within government, nor international, frameworks. Simmons *et al.* (2007) also note that examples of the ecological footprint being applied at a national level are rare.

Neither the European Commission (2006) nor the European Environment Agency (2005) uses the ecological footprint as an indicator, although the latter gives significant attention to the footprint.

However, it should be noted that a study is underway for the European Commission which aims to<sup>16</sup>:

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<sup>16</sup>

See [www.seri.at](http://www.seri.at).

- assess the potential of the ecological footprint as an aggregated indicator to measure resource-specific impacts;
- assess how other assessment tools can complement the footprint, to fulfil EU policy requirements in combination; and
- identify essential improvements needed in the footprint methodology in the next 1 to 5 years.

Furthermore, the ecological footprint has been selected by the Convention on Biological Diversity's scientific advisory group as a potential indicator for measuring progress towards the 2010 biodiversity targets (backed by WWF International and a number of nations, including Russia, Columbia, and Brazil) (GFN, 2006b). Parties to the Convention on Biological Diversity (signed in 1992) aim "*to achieve, by 2010, a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth*"<sup>17</sup>. In order to assess progress towards this 2010 target, a flexible framework has been set within which national and regional targets may be set and indicators identified. Around thirteen indicators have been identified for immediate testing, with a further eight identified as possible indicators for development. The ecological footprint has been identified as one of the latter.

In contrast, a recent study by Schaefer *et al.* (2006) (for Eurostat) concluded that the footprint was a strong communication tool but has a number of weaknesses, including that it did not give a robust policy measure. The study considered that "*the use of other data sources, modifications in the choice of input variables, and/or in the weighting system can change the message significantly*". Similar views led the Finnish Environmental Institute (SYKE) to conclude that further development of the methodology was needed before the footprint could be used as one of the indicators of sustainable development.

### **National examples**

In 2006, the Global Footprint Network (2006b) launched its 'Ten-in-Ten Campaign' to institutionalise the ecological footprint in at least ten countries by 2015. This requires an acceptance of both the methodology and the data by the statistical offices of national governments. The Global Footprint Network is therefore encouraging the review of National Accounts in a process initiated by national governments and conducted by independent third parties. A number of countries are reviewing their national footprint, as calculated by the National Footprint Accounts. This review process is being actively promoted by the Global Footprint Network and to date:

- Switzerland has completed a review of its national footprint (see von Stokar *et al.*, 2006 and 2006a);

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<sup>17</sup>

See [www.biodiv.org](http://www.biodiv.org)

- Ireland has commissioned a review which is not yet published (see Curry *et al.*, 2006) ;
- Finland is reviewing its national footprint in stages (see [www.environment.fi](http://www.environment.fi));
- Japan is undertaking a formal review (working with the Global Footprint Network);
- Germany has commissioned a third-party review; and
- the United Arab Emirates and Belgium are considering undertaking similar reviews.

Consideration is given here to the Swiss, Irish and Finnish studies for which information is available; the Finnish study completed to date addresses the forestry sector only.

All three studies compared national data with that provided by international agencies. In general, there was good correlation between national and international data sets (which would be expected where the latter are based on the former). However, all three studies identified issues with trade data that affected their footprints:

- both the Swiss and the Irish footprints were affected by a process of ‘price-capping’ in the National Footprint Accounts, which altered the quantities of imported or exported goods according to price. Essentially, a data-cleaning algorithm was used to identify poor data from the UN trade accounts (e.g. where quantities were reported in kg rather than tonnes), and any product that appeared to be valued at more or less than five times the world average price was altered so that the quantities corresponded with the world average price. This could result in significant distortions in the embodied footprint of imports and exports. This has now been addressed by the National Footprint Accounts, which has adjusted the price cap to 900 times the world average price for the 2006 accounts. This has increased the Swiss footprint by 9% (von Stokar *et al.*, 2006) and the Irish footprint by 28% (Curry *et al.*, 2006), before any changes in actual consumption levels are accounted for. Curry *et al.* (2006) also calculated the impact of this change on the UK national footprint; the associated increase was only 0.2%;
- the Irish study (Curry *et al.*, 2006) also identified that products traded in metrics other than weight, such as litres, e.g. beer, are not accounted for in any of the national footprints. Curry *et al.* (2006) calculated that, if such products were accounted for in the 2004 NFA, the Irish footprint would have decreased by 0.9%. This issue has not yet been addressed by the National Footprint Accounts; and
- the Finnish study focused on forestry, as this was a key area of its national footprint. Using national data, it was found that the National Footprint Accounts may over-estimate Finland’s forestry footprint by one-third, reducing the 2001 national footprint by 12%. The key source of error was found to be in the export data for timber for the production of paper, cardboard and pulp and that the utilization of chips in pulp production was

not taken into account<sup>18</sup>. The National Footprint Accounts addressed those issues raised by the Finnish study which provided better data. While the forestry data issue may be less significant in the UK, it highlights the fact that country-specific differences in trade may not be reflected accurately in the international data on which the National Footprint Accounts rely.

These points highlight the potential for significant changes in national footprints, due to both the type and quality of data that are available from international sources and the treatment of those data by the National Footprint Accounts. While some of these issues have now been addressed, further national studies have the potential to raise new issues.

Having undertaken national reviews of the footprint, and contrary to the opinion of Finnish Environmental Institute (SYKE), both Finland and Switzerland have, or plan to, adopt the footprint as one of their (many) sustainable development indicators.

### ***England***

In recent years, the UK Government has increased its awareness of ecological footprinting. Barrett *et al.* (2004) note that prominent concerns have been raised in the past by Defra, the Department of Trade and Industry (DTI) and the Office of the Deputy Prime Minister (ODPM – now the Department for Communities and Local Government (DCLG)), relating to the robustness of the methodology and subsequent results. However, both Defra and DfT/OPDM have since funded research on the ecological footprint to further understanding of the methodology (RPA, 2005) and to provide a tool for local authorities (FLAT – Footprinting for Local Authorities (Barrett & Simmons, 2003).

The Audit Commission has identified the ecological footprint as an aggregate indicator in which there is growing interest but, at present, has not included it as part of the local quality of life indicator set (Audit Commission, 2005). The local quality of life indicators are used by local authorities, amongst other information, to produce local Area Profiles. These Area Profiles provide a comprehensive picture of the quality of life and services in a local area and reflect the emphasis on local communities provided by the Local Government White Paper (DCLG, 2006).

Discussions with the Audit Commission indicate that the ecological footprint is seen as a useful environmental indicator, which brings together a number of impacts; however, it is also noted that additional indicators are required to provide a fuller, more detailed picture. The Audit Commission is investigating how the ecological footprint may be used in Area Profiles and has used the results of REAP to provide comparisons amongst local authority areas by footprint. This is intended to illustrate which areas have the largest footprints (in aggregate and per capita) and if particular components, such as food or

<sup>18</sup>

*“New estimate gives smaller ecological footprint to the Finnish forest sector”*  
[www.environment.fi/default.asp?contentid=204740&lan=en](http://www.environment.fi/default.asp?contentid=204740&lan=en)

transport, are unusual for that type of area. This work has not yet been published (although it is likely to be in the future) as the Audit Commission is concerned to ensure that the ecological footprint is provided as a contextual indicator, rather than a performance indicator. In other words, an area's ecological footprint is not seen as the sole responsibility (and therefore a measure) of the local authority; rather, it is the cumulative impact of a number of factors driven by different actors and conditions.

The Audit Commission has not explored the data and methodology underpinning the ecological footprint in detail and it acknowledges that, in order to provide a high level indicator, a number of assumptions are required. However, this is not unique to the footprint, but is a feature of most aggregated indicators. The Audit Commission has also indicated that it is most interested in the components where there are large differences between areas, such as housing and transport. Thus, smaller (and potentially less robust) differences are less important.

### **Wales**

Ross (2006) identifies the Welsh Assembly Government as the only government in the world to have adopted the ecological footprint (in 2002) as a headline indicator of sustainable resource use.

In March 2006, the update of sustainable development indicators for Wales, identified an ecological footprint of 5.25 gha per capita, based on 2001 data (NAW, 2006). The results of the Welsh study are based mainly on specific data for Wales, apart from resource productivity and energy efficiency of producing sectors, which used the UK average and imports/exports of materials where UK ratios were assumed.

Within Wales' Environment Strategy (NAW, 2006), the ecological footprint is identified as an indicator (amongst others) for demonstrating contribution to global sustainable development and environmental improvement minimising greenhouse gas emissions.

The Welsh Assembly is now involved in the substantial project entitled *Reducing Wales' Footprint*, which has extended further to Cardiff and Gwynedd local authorities.

### **Scotland**

The Scottish Executive launched its Sustainable Development Strategy in 2005 (SE, 2005). This identifies that a key objective of the Strategy is to reduce the size of Scotland's global footprint and states that:

*"[The Scottish Executive] need to assess not just performance against objectives but also real world outcomes including Scotland's global ecological impact. The Executive will therefore commission an independent study of Scotland's footprint in 2008."*

As such, the ecological footprint is not yet included as an indicator in Scotland. The Strategy (SE, 2005) notes that the actions and commitments

set out in the Strategy will help to reduce the size of Scotland's footprint. It also acknowledges the strengths of ecological footprinting as a tool for increasing understanding of unsustainable consumption and learning how to make more sustainable choices.

The Scottish Executive therefore supports the work of the WWF and partner organisations to roll out the footprint approach to local authorities and schools across Scotland. The three-year WWF pilot project on Scotland's Global Footprint ended in May 2007 and a follow-up project (Local Footprints) to support all councils in adopting the footprinting approach has been commissioned. In addition, SDRC (2006) reports on the ecological footprint of a conference in the Scottish Parliament.

### ***Northern Ireland***

The Northern Ireland Sustainable Development Strategy (OFMDFMNI, 2006) has a vision of Northern Ireland as a one planet economy. Northern Ireland's ecological footprint was measured by Curry *et al.* (2004) (for 2001 data) and was found to be 5.63 gha. More recently, Northern Ireland has been working with the Republic of Ireland's Environmental Protection Agency to develop an All-Island ecological footprint, and the *Island Limits* Report (using 2003 data) has identified an ecological footprint for Northern Ireland of 5.58 gha (OFMDFMNI, 2006a) (the *Island Limits* Report is not yet published).

A strategic objective of Northern Ireland's Sustainable Development Strategy is to become more resource efficient, with a key target to stabilise the Northern Ireland ecological footprint by 2015 and reduce it thereafter, using the *Island Limits* Report as a baseline. Key actions to achieve this objective include funding a project to pilot the use of ecological footprints to determine the sustainability of district council areas in NI and two pilot community projects to demonstrate how key issues can be addressed.

## **3.4 Conclusions**

The National Footprint Accounts are prepared annually for 150 countries and they undergo continual methodological development as better data become available and understanding of issues improves. However, data and methodological issues associated with the calculation of national footprints remain.

Identified data issues include:

- concerns regarding the quality of source data; and
- the fact that there no indication is given of the levels of uncertainty associated with data.

The data used by the National Footprint Accounts are obtained from international datasets and, therefore, similar issues would arise for any measure based on these data. To some extent, improvement of data depends on the actions of third parties (i.e. the agencies collecting the

international datasets). However, potential solutions identified by partners of the Global Footprint Network include:

- independent reviews of national footprints (as have been undertaken in Switzerland, Finland, Ireland, Germany and Japan), resulting in star-rated accounts; and
- undertaking sensitivity analysis using multiple data sources and a range of key constants.

Research suggests that continual methodological refinements result in an annual variation in national footprints of +/- 3-4% regardless of changes in consumption. The Global Footprint Network provides an updated time series from 1961 to account for these changes.

Key issues associated with the methodology, which are being researched by the Global Footprint Network and are likely to be addressed in the short term (next five years), include:

- new techniques for calculating the embodied footprint of traded goods and services;
- alternate methods for calculating equivalence factors; and
- a shift in the basis for calculating the carbon footprint (including a change in the calculation of nuclear energy land).

There are ongoing debates regarding the potential for inclusion of other environmental impacts (such as water use, other greenhouse gases, persistent pollutants, etc.). It appears unlikely that these will be included in the main ecological footprint, although satellite accounts may be developed.

The most significant methodological improvement (at this level) which has been adopted by the Global Footprint network since 2004 is the adjustment of a price-capping algorithm associated with trade data. Research indicates that adjusting this algorithm increased the Swiss footprint by 9%, and the Irish footprint by 28%. The effect of this on the UK footprint was minimal; however, national studies have highlighted the potential for issues to be identified which can vary the ecological footprint by -12% to +28%. Other national studies may identify further issues.

Continuing research on the application of an input-output framework for calculating the embodied footprint of traded goods and services, and/or a hybrid approach combining this with the existing material balance approach, promise improvements in the methodology, but have yet to be agreed upon or adopted within the National Footprint Accounts methodology. However, identifying the impacts of imports by country of origin is data and labour intensive and may take considerable time to implement.

Furthermore, the recent publication of a dynamic approach for ecological footprinting, which accounts for carbon dioxide emissions in terms of climate change impacts and its future influence on bioproductivity (as opposed to an area of forest for sequestering emissions) also provides a development of the

methodology, although it is designed to be complementary to the existing static approach. This development continues to raise questions regarding the method of accounting for carbon emissions.

The ecological footprint has been adopted as a sustainability indicator by the Finnish and Swiss governments, albeit within a long list of indicators, and is included as a potential indicator within the Convention on Biological Diversity. Wales and Northern Ireland have also adopted it an indicator. Beyond these examples, the adoption of the ecological footprint as an indicator at an international and national level is rare. However, further research on its potential as an indicator is underway by the European Commission. Other research at national and international levels has expressed doubt regarding its suitability as an indicator, due to the data and methodological issues outlined above.

The key area which the current UK SCP indicators do not address is the extent to which the UK shifts the burden of consumption to other countries, through imports. The footprint could potentially help to address this gap. However, a critical and unresolved issue regarding the current methodology is that imported goods are assumed to have world average energy intensities. This is unlikely to accurately reflect the embodied energy of UK imports; in addition, any shift to importing goods produced in an energy efficient manner, which may be adopted under the UK SCP strategy, would not be reflected (at least in the short-term) in the national footprint.



## 4 Sub-national calculations and applications of ecological footprinting

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### 4.1 Introduction

Sub-national ecological footprints are those which are prepared at any level which is not the national or international level. Sub-national ecological footprints primarily relate to geographical regions (within a nation) and cities, but they can also be calculated for individuals/households, industry sectors and individual businesses, products and organisations.

This Section discusses the work that has been undertaken by practitioners in relation to data and methodological issues at a sub-national level. As with the national level analysis in Section 3, the discussion is divided into data and methodological issues but, in practice, there is considerable overlap between these issues.

The use of sub-national ecological footprints by regional and local government, businesses/products and individuals/households is then discussed.

### 4.2 Calculation of sub-national footprints

#### *Overview*

The methodology for calculating sub-national ecological footprints has developed continuously over time and a key issue in using the ecological footprint at a sub-national level has been the availability of data and the consistency of the methodologies used. RPA (2005) found that, in an analysis of 17 sub-national UK studies (for geographical areas), the differences in per capita ecological footprints amongst the different studies were linked to methodological issues as well as real differences between the areas covered. However, RPA (2005) observed a general move towards approaches which use the national ecological footprint as a starting point, which now tends to be standard practice (at least in the UK). The issues associated with data availability and the development of these methodologies are discussed below. Specific attention is given to the use of input-output analysis in ecological footprinting as this was not fully covered by RPA (2005).

#### *Data issues*

The availability of data is a key issue for calculating sub-national footprints, as they require data which accurately represent the impact of the population, organisation, etc. as far as possible, whilst recognising that limited resources are available to collect such data. In previous studies for cities and other

geographical areas, variations in the availability of locally-collected data have led to differences in the scope of studies, which has reduced their comparability and completeness (RPA, 2005). However, the use of locally-collected data can increase the relevance of the results to that area.

There are two main types of data:

- *specific data* – these may be available for some consumption categories and availability will vary according to the scope of the ecological footprint being calculated. For example, at a local authority level, energy consumption, transport, waste arisings and food consumption (through health surveys) data may be available. However, consumption data for non-food goods and services may be more difficult to gather; and
- *approximated or average data*, based on higher level data (e.g. national or sector level).

Allsopp (2003, cited in Turner (2006)), identifies a trade-off between the costs and benefits of collecting and reporting specific, sub-national data. This issue is also raised by Aall & Norland (nd), who query how well proxy data can reflect genuine local variations.

Turner (2006) identifies three arguments in favour of sub-national specific data:

- if regional/local governments have operational responsibility for the environment, policy-makers need accurate local information;
- if regional/local performance is going to be evaluated by central government, specific information is required; and
- if policy-makers are to be sensitive to local needs, there must be flexibility in how local data are collected. That is, there may be a need to tailor regional/local data collection and reporting to address local problems. One issue may be that variation in the level of disaggregation of activities identified is desirable. For example, in the case of Jersey, specific attention has been given to developing a tourist survey that elicits information on polluting activities such as fuel use.

Turner (2006) uses the Jersey economy as a case study to assess the added precision from using good-quality sub-national data compared with adjusted national UK data. The study concludes that there are significant differences in the use of technology between Jersey and the UK, so that estimates based on national emissions intensities produce results that are misleading in terms of both absolute pollution levels and the relative contribution of different activities to the total emissions in the economy, leading to errors in estimating total pollution in the local economy. This will, in turn, lead to errors in determining the direct (and indirect) contributions of different production sectors and consumption activities, and thus errors in terms of prioritising activities to reduce pollution. Turner (2006) concludes that the observed differences in

fuel intensities across the sectors in Jersey, from what would be expected in their UK counterparts, are sufficient to render use of pollution coefficients based on UK technical relationships inappropriate. However, the study cautions against applying this result to other regions, given that Jersey is a very small and idiosyncratic economy.

More crucially, Turner (2006) identifies that, where responsibility for sustainability has been devolved to a sub-national level, this aims to rely on local decision-makers' knowledge of specific economic conditions and environmental preferences. Therefore, the use of averages rather than specific data is likely to be less acceptable.

### ***Methodological issues***

In response to concerns about data availability and consistency, newer methodologies for sub-national areas, and specifically for geographical areas, have taken the national footprint (as calculated by the National Footprint Accounts) as their starting points, then disaggregated it to the sub-national level. These approaches incorporate both the strengths and weaknesses inherent in the national calculations that have been discussed in Section 3. In addition, specific methodological issues are associated with sub-national footprints and industry sector footprints.

The key methodologies can be described as:

- *process-based approaches*, which use specific consumption data to the extent possible and LCA conversion factors, and address data gaps by adopting UK default values; and
- *(financial) input-output based approaches*, which use expenditure data to disaggregate the national footprint<sup>19</sup>.

#### Process-based approaches

Process-based approaches have been used in the UK over a longer period of time than input-out based approaches, and their use is addressed in RPA (2005). In summary, these approaches apply pre-calculated conversion values for a wide range of materials and activities based on LCA data, which can be adjusted where specific data are available. Examples of tools which use process-based approaches are Regional Stepwise™ and Corporate Stepwise™, which have been developed by Best Foot Forward in the UK.

Chambers *et al.* (2004) explain that the Stepwise™ methodology involves disaggregating the national footprint account for the UK by applying conversion factors used in the National Footprint Accounts, supplemented by LCA data when required, to consumption data to derive ecological footprint results for each component. The consumption data for the study area is

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<sup>19</sup> Physical input-output approaches and hybrid (combining physical and financial) input-output approaches are also discussed by practitioners (see Section 3) but such approaches have not yet been consistently applied at the sub-national level.

collated and used to sub-divide and apportion the UK footprint to smaller areas. The availability and reliability of data is the key limiting factor in determining the number and coverage of components.

The benefits of process-based approaches are that they are based on the specific data available, which increases the relevance of the results for decision-makers. The results can also be presented by activity, which can identify areas for future action. Whilst each tool developed for this purpose will provide a standardised methodology, there is likely to be variation amongst them. Using a process-based approach to disaggregate the national footprint ensures a relatively consistent scope for comparisons between areas where the same tool is used, but lack of data may still mean that differences in consumption (between areas, businesses, etc.) are not fully represented.

A key concern regarding process-based approaches relates to the quality of the available LCA data used to calculate the embodied energy of goods, which can mask developments in the energy efficiency of production processes over time and between countries. Wackernagel *et al.* (2004) suggest that the accuracy of the overall result depends upon the reliability of the LCA data, and this can be uncertain. The energy intensities used for calculating embodied energy are derived from a variety of sources, and may be based on averages for the 1990s (Loh & Wackernagel, 2004). In RPA (2005), practitioners reported the use of a large database with over 15,000 data points for 4,800 categories of goods. It is believed that this provides a reliable measure of embodied energy, with associated uncertainty of +/- 5%. However, Barrett *et al.* (2004) suggests that other studies of embodied energy could increase current ecological footprints by 30%.

An additional concern regarding process-based approaches is that they do not fully address the impacts of services (as discussed in Section 3 for the national footprints), for which data can be more difficult to collect.

#### Input-output (I-O) based approaches

*“Input-output analysis is a method of systematically quantifying the mutual interrelationships among the various sectors of a complex economic system. In practical terms, the economic system to which it is applied may be as large as a nation or even the entire world economy, or as small as the economy of a metropolitan area or even a single enterprise”* (Leontief, 1986).

Financial input-output analysis orders a vast number of individual transactions by classifying and aggregating them into groups, such as categories of production, distribution, transportation and consumption. These groups are set up on a matrix of horizontal rows and vertical columns, incorporating the monetary value of the aggregated transactions. The horizontal rows of figures show how the output of each sector of the economy is distributed among the others. Conversely, the vertical columns show how each sector obtains its inputs of goods and services from the other sectors. Since each figure in any horizontal row is also a figure in a vertical column, the output of each sector is shown to be an input in some other (Leontief, 1986).

There is a fundamental relationship between the volume of the output of an industry and the size of the inputs going into it. This relationship can be expressed as the ratio or coefficient of each input to the total output of which it becomes a part. In manufacturing industries, these ratios are largely fixed by technology. Ratios in the complete matrix of the economy, especially in the trade, services and household sectors, are established by custom and other institutional factors. However, Leontief (1986) notes that all ratios are subject to modification by forces such as progress in technology and changes in public taste.

The ratios between environmental impacts (such as carbon dioxide emissions and land use) and the volume of output of an industry can also be established. Wood & Lenzen's (2003) approach to input-output analysis uses emissions multipliers, derived from the National Greenhouse Gas Inventory, and/or land use and disturbance multipliers based on land use and condition data from various sources. Some ecological footprint methods which follow the more conventional process-based approaches have used input-output based intensities only for CO<sub>2</sub> emissions (e.g. Simpson *et al.*, 2000).

However, a different approach to input-output analysis is employed by SEI within the Ecological Budget UK project and REAP software which, amongst other uses, provides an ecological footprint for local authority areas. This takes the national ecological footprint, as defined by the National Footprint Accounts, and uses supply and use<sup>20</sup> tables (similar to I-O tables) to allocate the national footprint to each sector. This addresses the problems of lack of data at the local level and the need to generate comparable results across sub-national geographical areas (Wiedmann *et al.*, 2006a). Furthermore, Wiedmann *et al.* (2006a) suggest that this approach enables:

- the allocation of existing and commonly accepted national footprint estimates to detailed consumption categories, based on expenditure data, allowing the clustering of detailed consumption categories to policy areas such as food, energy, housing, transport, household consumption, services, etc. (which is also possible (depending on data availability) through process-based approaches);
- the calculation of ecological footprints of socio-economic groups; and
- the incorporation of ecological footprint analysis into the scope of ecological-economic modelling frameworks and scenario analysis.

The approach adopted by SEI uses household expenditure data to disaggregate the national ecological footprint to the regional level and socio-economic group data (based on the ACORN classification) to obtain local authority level data. Using the REAP software tool, local authorities are able to input locally collected data where this is available (as suggested by Turner (2006)), to improve the validity of the local ecological footprint.

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Whilst there is a difference between supply and use tables and input-output tables, for the purpose of this discussion, which aims to be a broad overview, they are considered to be broadly the same. For further information on the use of supply and use tables, see Wiedmann *et al.* (2006a).

The Global Footprint Network (2005) suggests that the use of input-output models for allocating ecological footprint areas to final consumption more accurately is considered to be a promising development. The benefits using input-output analysis to allocate national footprints are (based on Wiedmann *et al.* (2006a); Market Economics (2006) and Wood & Lenzen (2003)):

- it uses an existing and (generally) accepted national footprint;
- it is a comprehensive method, which does not exclude services (as some process-based footprints may);
- it traces how changes in one sector affect other sectors and it is internally consistent;
- it guarantees the complete coverage of upstream land and emissions requirements up to an infinite order;
- it provides a systematic disaggregation of the national footprint and avoids double-counting;
- ecological footprints are assigned to consumer activities that are relevant for sustainable consumption policies, as well as clustering data to policy areas such as food, energy, housing, transport, etc.;
- it generates comparable sub-national accounts; and
- it can be used to calculate the footprints of socio-economic groups.

However, there are a number of issues of which users of these footprints should be aware:

- use of financial input-output tables assumes that expenditure data accurately reflects consumption, which may not be the case;
- there is some discussion regarding the use of physical versus monetary input-output tables; however Wiedmann *et al.* (2006a) notes that physical input-output tables do not exist for the majority of countries. Consultation suggests that comparisons between resource allocations using monetary input-output tables and physical input-output tables, for example in Germany and Chile, have produced very different results;
- the categories used for input-output analysis are very broad and heterogeneous, which can lead to inaccurate results. For example, Market Economics (2006) note that the type of food consumed by a person affects the size of an individual's ecological footprint. However, typically, there may be only one input-output category representing food, which does not distinguish between meat and vegetable consumption, for example;
- input-output analysis and supply and use tables are based on the value of products. One key issue with using supply and use tables rather than input-output tables is that the supply matrix is valued at producer prices whilst the use matrix is valued at purchaser prices. Therefore sectors which have higher added value, such as services, will account for a greater proportion of the footprint than lower added value sectors such as manufacturing;

- imports are allocated to the sector which produces that product as an output, which is unlikely to be the case in practice;
- imports are treated as having the same value as domestically produced goods, which is unlikely to be the case since goods are normally imported where this is more efficient. Wiedmann *et al.* (2006a) notes that this is due to a lack of data (and the use of supply and use tables, as input-output tables usually provide information on imports); and
- by adopting the national footprint, Wiedmann *et al.* (2006a) notes that all imported goods are assumed to be produced with world average CO<sub>2</sub> intensity. To address this issue would require the construction of multi-regional or international input-output tables, which have a number of methodological problems and are extremely labour intensive.

Use of input-output approaches has been successful in producing footprints for local authorities and industry sectors (see Simmons *et al.* (2006) and Wiedmann *et al.* (2007)), which may not otherwise have considered using ecological footprint analysis. The key question for such organisations now is how they use the results.

### ***Ecological Footprint Standards***

The Global Footprint Network (2007) notes that, as the number of ecological footprint practitioners around the world increases, different approaches to conducting footprint studies could lead to fragmentation and divergence of the methodology, reducing the ability to produce consistent and comparable results. As reported by RPA (2005), this has already happened in the UK studies.

The Global Footprint Network (2007) therefore suggested that the value of the ecological footprint as a sustainability metric depends not only on its scientific integrity, but also on the consistent application of the methodology across analyses.

In 2004, the Global Footprint Network initiated a committee-based consensus process to achieve two key objectives:

- to establish a scientific review process for the footprint methodology; and
- to develop application and communication standards.

Three committees, composed of members from the Global Footprint Network's partner organisations, representing academia, government, non-governmental organisations (NGOs) and consulting firms, began work in 2005:

- the National Accounts Committee, which supports continued improvement of the scientific basis of the National Footprint Accounts;

- the Application Standards Committee, which develops standards and recommends strategies to ensure that the ecological footprint is applied in a consistent and appropriate manner in all key domains, at a variety of scales, and over time; and
- the Communications Standards Committee, which develops standards to ensure that the results of ecological footprint analyses are presented accurately, with assumptions clearly specified and factual findings kept distinct from advocated solutions.

In December 2005, a draft of the proposed Ecological Footprint Standards was placed on the web for public comment. The first version of the standards was launched in June 2006 (GFN, 2006); it contains both compulsory Standards and voluntary guidelines (guidelines are recommended practices which are not required for study certification). Box 4.1 sets out the topics covered by the Standards document (GFN, 2006).

**Box 4.1: Contents of the Ecological Footprint Standards 2006**

Application Standards:

- Consistency with National Footprint Accounts
- Definition of study boundaries
- Sub-national population calculations
- *Organisational and product studies – NOT RELEASED*
- Derivative conversion factors
- Consistency of components
- Use of non-standard elements in footprint studies
- *Calculation methods – NOT RELEASED*
- Error estimates (Guideline)

Communication Standards:

- Traceability to National Footprint Accounts
- Glossary, definition and versions
- Separation of analytical footprint results from normative or values-based interpretations
- Footprint scenarios
- Footprint study limitations
- Explanation of link between sustainability and footprint
- Citation of sources and description of methodologies
- Reference to standards and certifying bodies
- Communication style (Guideline)

Source: GFN (2006)

As Box 4.1 shows, there are two parts of the standards:

- *application standards*: defining the requirements for **calculating** footprint results in a consistent manner, and ensuring that results are comparable with other studies employing footprint assessments; and
- *communication standards*: defining the requirements for **reporting** footprint results, and ensuring that results are not distorted or misrepresented.

Essentially, the Standards require consistency with the National Footprint Accounts. As a starting point, each assessment must be consistent by either

using conversion factors identical to those used by the NFA or by breaking down national totals from the NFA using appropriate techniques. However, whilst variations to the methodology are allowed, at all stages the Standards require that the analysis and results are presented as they would be if the 'standard' approach was followed, as well as with the variation. In this way, it is hoped that comparable results will be obtained in a transparent manner, whilst allowing room for adaptation to meet the user's needs.

The Standards Committees decided to focus on (geographical) sub-national population studies and, as a result, some of the requirements of the Standards are not applicable in the case of organisations. This will be addressed in the second version of the standards, to be released in 2007. It is understood that issues remain on defining standards for calculation methods and for organisational and product studies. Any restriction to a single calculation method (i.e. to input-output or to process-based) would exclude the organisations of the Global Footprint Network that do not currently follow that approach, whilst organisational and product studies are seen by some as a commercial venture where standards restricting the approach used are not appropriate.

The introduction of the Standards has happened too recently for any studies to have been prepared following the Standards (at least as far as RPA is aware), and formal audit and certification procedures have not yet been finalised by the Standards Committees. Thus, there is no basis to assess how the standards, and the certification procedure, will work in practice. However, Curry *et al.* (2006) have undertaken an assessment of the *Northern Limits II* report to highlight its likely status and suggest that it meets all the applicable standards. Discussions with the Global Footprint Network also indicate that the work undertaken by SEI and Best Foot Forward generally meets the standards (however, this is not to imply that other work undertaken in the UK does not meet the Standards).

### **Carbon footprinting**

In the last few years, there has been a considerable increase in the use (and discussion) of carbon footprints. Cranston *et al.* (2007) notes that the media (amongst others) are prone to referring to carbon footprints in terms of the mass of carbon emissions in kilograms or tonnes per person, rather than global hectares. In other words, the term carbon footprint is now popularly used to refer to a measure of carbon emissions, rather than the carbon component of the ecological footprint. In addition, some carbon footprints may include the carbon equivalent of other greenhouse gases. One such recent example is provided by Tesco in the UK<sup>21</sup>.

Carbon footprinting has been applied mainly by companies, either to the company as a whole or to specific products, and research undertaken by the Carbon Trust indicates that 66% of consumers say they want to know the

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<sup>21</sup> See [www.tesco.com/climatechange/carbonFootprint.asp](http://www.tesco.com/climatechange/carbonFootprint.asp)

carbon footprint of the products they buy<sup>22</sup>. Local authorities have also undertaken carbon footprinting.

Carbon footprinting is seen as both an opportunity and a threat for the further development and application of ecological footprinting. Footprint practitioners believe that it will either encourage organisations to build on their carbon footprint and to calculate their ecological footprint, or it will be seen as a substitute for ecological footprinting. Discussions at the International Ecological Footprint Conference in 2007 suggested that footprint practitioners are concerned that the issue of climate change is seen as so significant that the other issues resulting from excessive resource consumption are in danger of being ignored.

An example of concern is associated with the issue of biofuels, which are marketed as an alternative to fossil fuels due to their reduced carbon emissions. However, these fuels require considerable areas of land for their production and there is concern that this is taking land out of food crop production (Rees, 2007). Such impacts would not be highlighted by carbon Footprinting.

Some practitioners therefore suggest that carbon footprinting should be seen as a separate tool addressing different matters to the ecological footprint, such as including other greenhouse gases. Footprint practitioners believe that a clearly articulated strategy should be developed in order to address the issues of carbon footprinting versus ecological footprinting, particularly in the UK.

### **4.3 Use of the ecological footprint at sub-national levels**

#### ***Use by regional and local government in the UK***

A range of local authorities and regional organisations have been consulted about their use of the ecological footprint. Both regional assemblies and development agencies were contacted; many of these organisations are members of the Sustainable Consumption and Production Network (SCPNet), which is funded by a partnership of the regional development agencies, the regional assemblies, the Environment Agency and WWF, and links to the Ecological Budget UK project. Examples of how ecological footprints are used at the regional level, based on consultation responses, include:

- Advantage West Midlands believes that the ecological footprint is useful as a communication tool but has not used the footprint further in policy-making;
- the East of England Development Agency is using the work undertaken by the Ecological Budget UK project and the ecological footprint results to

<sup>22</sup>

See 'Carbon footprints of products to be displayed on label package', The Independent, 16 March 2007, [http://news.independent.co.uk/environment/climate\\_change/article2362754.ece](http://news.independent.co.uk/environment/climate_change/article2362754.ece)

inform the development of the next regional economic strategy and its associated strategic environmental assessment and sustainable development appraisal;

- the Yorkshire and Humber Assembly has recently undertaken work on the contribution of regional strategies to climate change targets, using REAP, and will be preparing ecological budgets of the main regional strategies in the coming year;
- Yorkshire Forward is interested in both carbon and ecological footprinting and is considering how best to apply footprinting within the context of the regional economic strategy;
- in the South West, the Regional Economic Strategy (SWRDA, 2006) notes that facilitating growth to achieve regional objectives must recognise the need to reduce the region's ecological footprint, whilst the draft Regional Spatial Strategy (RSS) (SWRA, 2006a) notes that the region's ecological footprint is unsustainable, and a shift is needed towards 'one planet'. The Draft RSS sets out four high-level sustainable development policies, including that the region's Ecological Footprint will be stabilised and then reduced; and
- in the South East, both the South East Regional Assembly (SEERA) and the South East England Development Agency (SEEDA) have commitments to reduce the region's ecological footprint. SEERA's South East Plan has a target to "*promote measures that seek to stabilise the South East's ecological footprint by 2016 and to reduce the ecological footprint during the second half of the Plan period*" (SEERA, 2006) and SEEDA's Regional Economy Strategy (RES) includes a headline target to "*reduce the rate of increase in the region's ecological footprint (from 6.3 global hectares per capita in 2003, currently increasing at 1.1% per capita per annum), stabilise it and seek to reduce it by 2016*".

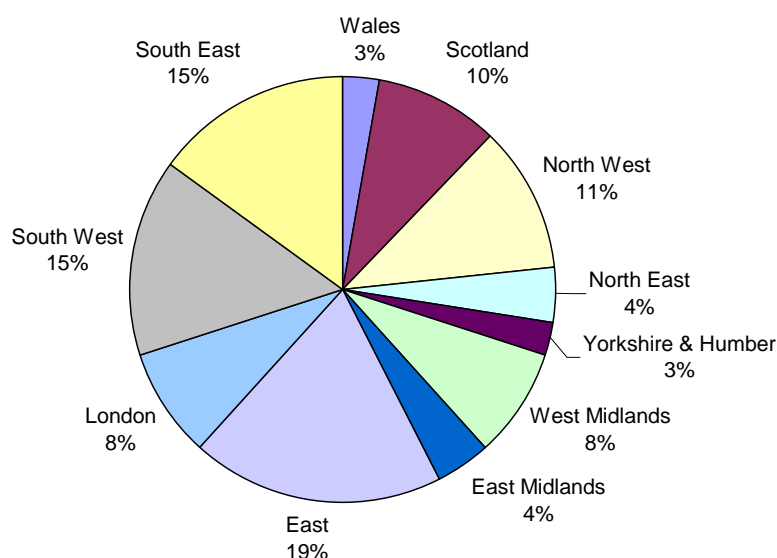
In addition, 160 local authorities were contacted across England, Wales and Scotland<sup>23</sup>. The sample was not selected on a statistical basis, it focused on authorities known to have an interest in footprinting together with additional authorities selected at random. Responses are likely to be skewed towards the authorities most familiar with ecological footprinting. Nevertheless, the results provide a useful qualitative snapshot of the awareness of, and use by, local authorities of the footprint.

Responses were received from 73 local authorities, including county and district councils and unitary authorities, giving a high response rate of 46%. The largest number of responses was received from East Anglia (19% of responses); responses from the South East and South West England each accounted for 15% of the total. Wales and Scotland provided 3% and 10% of the responses respectively, as shown in Figure 4.1.

<sup>23</sup>

See Annex 1 for details of the study methodology and Annex 2 for the full results of the local authority consultation.

**Figure 4.1: Location of Local Authority Respondents**



The majority of respondents were familiar with the concept of ecological footprinting, with only 5% having little or no knowledge and over a quarter of respondents (27%) indicating that they had detailed or expert knowledge of ecological footprinting. This result is to be expected, based on the sample selected and the higher likelihood of those working with ecological footprinting to respond to such consultation (compared to those who are not).

However, nearly a third of the respondents (32%) had not used the ecological footprint within their local authority work. When asked the reasons for this (more than one reason was allowed), the majority of these respondents (38%) had not considered it as an option. 29% were considering using the footprint, but had not yet made a decision, and a similar proportion indicated that they were constrained by time and the availability of resources. Two respondents (10%) considered that it would not be useful to use or that the methodology was not robust. Pressure to use carbon footprinting (and to avoid confusion from using two types of footprint) also overshadowed the ecological footprint in some local authorities, particularly in light of the significant contribution of CO<sub>2</sub> emissions to the ecological footprint and the current interest in climate change. One respondent considered it to be “*of limited use as it does not reflect true sustainable development*”.

Of the 73 respondents, 16 (22%) had commissioned a local ecological footprint study, generally between 2003 and 2006. However, a larger number (44%) had accessed their ecological footprint through the REAP website, whilst 11% had purchased a license for the REAP software and had used locally collected data to supplement this.

Respondents were asked to identify the main reasons for using the ecological footprint (more than one answer was allowed). Out of the 50 respondents using the ecological footprint, the majority (58%) indicated that it was ‘to

*inform the development of sustainable development or environmental strategy formation*'; whilst 48% indicated that one of the main reasons for using the ecological footprint was *'to raise public awareness'*. Other key reasons included:

- *'to be used as a key indicator'* (40%);
- *'to inform Local Agenda 21 or community strategy formation'* (36%);
- *'to produce educational material'* (36%);
- *'to provide baseline data'* (36%); and
- *'to analyse potential scenarios'* (36%).

However, at present, the identified reasons for using the ecological footprint are not quite reflected in the responses relating to current practice. This is probably because local authorities are at different stages in the process of obtaining, understanding and using the ecological footprint. In addition, it may be easier for local authorities to instigate educational or awareness-raising activities than to incorporate the ecological footprint within the policy-making process. This is supported by a larger number of responding local authorities (~40%) having implemented educational activities, compared to approximately 18% which have used the ecological footprint within current local authority strategies.

Whilst the results of ecological footprinting have been successfully communicated to authority policy-makers, few local authorities have yet used the ecological footprint in their strategies (although more are understood to be doing so). A number of respondents felt that the lack of local data (when using the basic REAP ecological footprint available on the internet) limited the relevance and accuracy of the ecological footprint and the potential for the results to be accepted by local policy-makers. Others found it difficult to identify how to link the ecological footprint results to policy decisions and therefore could not justify the resources needed to obtain local data, which could increase the relevance of the footprint to the area.

The use of the ecological footprint is therefore still in the early stages in many local authorities, but respondents were positive about their expected future use. Over the next three years, the use of ecological footprints across all types of local authority strategies is expected to increase, although a number of respondents are not yet sure how this will be done. Further use of the ecological footprint for awareness-raising or educational purposes is also expected.

A number of issues have been raised by local authorities regarding future use of the ecological footprint, not least the issue of continuity of data. The ability to use locally collected data in calculating the ecological footprint is of key importance to local authorities (identified by 53% of respondents). This is a feature of both REAP and the Regional Stepwise™ tools, but additional resources are needed to obtain such data, which may be a constraint for local authorities. The majority of respondents do not plan to update the ecological footprint, largely due to resource constraints.

However, respondents acknowledged that it is not necessary to recalculate the ecological footprint each year, with 34% considering that updating it every three to five years would be sufficient. Respondents familiar with the footprint suggest that it is not worth measuring the footprint annually, as it requires a significant change to alter the footprint size.

Local authorities would also like their ecological footprint results to be comparable, particularly with other local authorities (identified as '*very important*' by 25% of respondents).

Another issue identified by respondents was that the results of the ecological footprint derived from REAP did not identify waste as a separate issue (as this would be double-counting). As waste management is a key area of responsibility for local authorities, respondents would like to see better compatibility with their organisational structure in order to facilitate the use of ecological footprinting. The Regional Stepwise™ approach does identify waste as a separate issue. Therefore, it is important that local authorities are aware of the strengths and weaknesses of different methodologies and tools and when such approaches may be most appropriately used.

However, respondents identified the existence of different methodologies, both for the ecological footprint and for calculating carbon dioxide emissions, as well as the development (and therefore change) of methodologies over time, as issues affecting their further use of the ecological footprint. Respondents require stability and consistency of results, particularly where these are being used to communicate current impacts and future targets.

Issues of transparency and political acceptability were also raised, with respondents unsure, in some cases, how the results for their area had been derived and their significance. Where respondents had greater knowledge of the ecological footprint, and therefore of the assumptions implicit within the methodology, they considered that these could be more clearly communicated.

In summary, there is a strong argument for local authorities to use local data wherever these are available. In order to justify the cost of collecting such data, the results of the footprint need to be useful to the local authority. At this stage, many local authorities are in the initial stages of using the footprint and have yet to assess its usefulness in policy-making. However, two local authorities have identified issues associated with how waste is accounted for, given that this is a major policy area for local authorities. One local authority notes that the percentage of waste recycled by the authority is not directly acknowledged in the footprint, as this is accounted for instead by the impact of materials consumption (i.e. consumption of recycled goods reduces the production of primary materials). Another local authority would like to see waste addressed as a separate category in the footprint, in line with the services provided by the local authority and its structure. More detailed consideration of the use of ecological footprinting in policy-making is given in Section 6.

## ***Use by industry sectors, businesses and products***

### Assessments of industry sectors

WWF (2007) suggests that industry can make a significant contribution to creating sustainable solutions. Niccolucci *et al.* (2007) suggest that analysis of the environmental pressure of production processes is of fundamental importance if producers are to integrate sustainability issues into their decision-making processes. To date, the majority of the work on applying ecological footprinting to industry sectors has been academic, and does not appear to have resulted in actions being taken in practice. Such work includes:

- calls for ecological footprint analysis to become widely adopted as a key environmental indicator of sustainable tourism (Hunter & Shaw, 2007);
- the application of ecological footprinting to Italian wine production (Niccolucci *et al.*, 2007);
- Schwarz (2004) provides a very brief consideration of the role of nanotechnology in achieving sustainability, suggesting that representing the environmental benefits of nanotechnology in terms of the ecological footprint would contribute to a shift of social consciousness and the development of suitable policy responses in relation to nanotechnology, because of the method's ability to communicate that humanity is materially dependent on nature, and that nature's productive capacity is limited;
- research on the development of environmental indicators for dairy farming, which evaluated the effectiveness of input-output accounting, ecological footprint analysis and life cycle assessment, based on their relevance, quality and availability of data. Thomassen & de Boer (2005) conclude that ecological footprint has limited relevance to the issues concerned and is barely understandable to the main stakeholders. Furthermore, it is suggested that it is of low quality because of its limited sensitivity over space. Instead, Thomassen & de Boer (2005) suggest that input-output accounting indicators and LCA indicators are required to give a good insight into the environmental impact of a dairy production system; and
- Herva *et al.* (2007) consider the potential of ecological footprinting as an environmental indicator for the textile sector. The study takes a process-based approach to footprinting and Herva *et al.* (2007) suggest that it can be used as an indicator for industrial processes. However, it notes that the footprint does not include all of the environmental impacts that can be found in the textile sector and as such it suggests that the complementary use of footprints and LCA should be considered in the future.

A key area where footprinting has been applied is the construction market. Theoretical studies indicate that:

- the indirect land requirement for construction (needed to provide all the raw materials and to absorb the CO<sub>2</sub> emissions) is between 39 to 59 times larger than the actual building itself (Bastianoni *et al.*, 2006); and
- footprints are influenced more by how occupants use their home (i.e. consumption) than by how it is designed and constructed (Nye & Rydin (2006) and Moos *et al.* (2006)). Therefore, Moos *et al.* (2006) suggest that the link between design and behaviour is of critical importance; however, there is limited evidence available on this relationship at present.

Furthermore, the Centre for Business Relationships Accountability, Sustainability and Society (BRASS) has conducted a number of studies on the ecological footprints of sporting events (see Collins *et al.* (2007); Collins *et al.* (2007a)). This work is reflected in the London 2012 Olympic bid, which aims to provide a 'One Planet Olympics', throughout the construction, operation and legacy phases. However, whilst the Sustainability Policy (LOCOGPG, 2006) aims to respect the planet's ecological limits, there is considerable emphasis on greenhouse gas emissions rather than the ecological footprint as a whole. Furthermore, recent tender documents issued by the Organising Committee specify a requirement for carbon footprinting<sup>24</sup>. However, it is possible that ecological footprinting will follow at a later date.

In April 2007, ecological footprint evidence was submitted to a public enquiry in Cornwall, UK, regarding the conversion of farm buildings to residential use. This demonstrated that the impact of an individual living at the farm (which was owned by a housing co-operative aiming to create a more sustainable way of living) was 38% of the average impact of a UK individual. It was considered by the Inspector that permitting the dwelling "*would contribute to reducing travel and would support sustainable objectives*" and planning permission was granted<sup>25</sup>.

The input-output approach to ecological footprint analysis has been extended to industry sectors, through the One Planet Business programme, a joint initiative of WWF and BioRegional. Based on the belief that business and its stakeholders must share the responsibility for operating within the ecological limits of the planet, the One Planet Business programme aims to bring together a cross-section of stakeholder groups. The programme held its first stakeholder meeting in March 2007 and is in the early stages of operation. One Planet Business is an international programme and it disaggregates National Footprint Accounts, for 31 countries and for 48 sectors, using input-output analysis. The methodology for determining sectoral ecological footprints has been developed by Best Foot Forward and is documented in Simmons *et al.* (2006). Simmons *et al.* (2006) note that, prior to this work, there has been little consideration of the ecological footprints of industrial or business activities.

<sup>24</sup> See <http://main.london2012.com/en/gettinginvolved/Business/Carbon+Footprint+Consultancy.htm>

<sup>25</sup> See [www.dhmstallard.com/site/home/publications/pressreleases/Low\\_carbon\\_footprint.html](http://www.dhmstallard.com/site/home/publications/pressreleases/Low_carbon_footprint.html)

## Use by businesses

The research of Lenzen and colleagues has identified a range of issues relating to applying ecological footprint analysis to companies and organisations. These include:

- the importance of indirect impacts in the supply chain, compared to direct impacts, as identified by the use of input-output analysis (Wood & Lenzen, 2003);
- the lack of a consistent method for assessing the impacts of businesses (Lenzen *et al.*, 2004);
- issues associated with providing a static ecological footprint which does not identify the importance of impacts over time to allow for better business planning. In other words, the effects of carbon emissions remain in the atmosphere for centuries and, if these are reduced early the cumulative impact of a business will be less than one which reduces their emissions late, although after reduction both companies will report the same footprint (Lenzen *et al.*, 2004); and
- the concept of shared responsibility within the ecological footprint framework, based on value added (Lenzen *et al.*, 2006). An interesting finding of this study is the perceived resistance by companies to adopting a modified ecological footprint methodology which would substantially reduce a company's reported impact, where the company had already taken full responsibility for upstream and/or downstream impacts. This is because the companies considered that it would be difficult to justify a change in approach to internal stakeholders, and might give rise to suspicion in external stakeholders.

One of the earliest applications of ecological footprinting to businesses in the UK is thought to be the work undertaken by Best Foot Forward in May 2000 and documented in Chambers & Lewis (2001). This provides case studies for Anglian Water Services and Best Foot Forward itself.

In Anglian Water's 2002 Sustainable Development Report, the company described how it aimed to use the ecological footprint to monitor its impact on the environment and resource use, including development of a tool that could be used at a project level (i.e. measuring the environmental impact of capital investment). This tool was applied to a project in Aldeburgh, Suffolk, to examine the potential impacts of either improving primary sewage treatment or developing new secondary treatment (under the Urban Waste Water Treatment Directive). However, in its 2003 Report, Anglian Water records that the preferred approach from an ecological footprint perspective (improving primary treatment) was not acceptable to the regulator and that primary and secondary treatment must be installed. The ecological footprint indicated that the environmental impact of this approach was three times that of the preferred approach, however, this example illustrates the, in practice, a number of factors are taken into account in the decision-making process. However, Anglian Water notes that, through this work, it was able to

demonstrate to the regulator that a more sustainable solution, using trickling filter secondary treatment with reduced energy needs, would meet the environmental requirements and minimise the overall impact whilst maintaining compliance with EU legislation. The most recent company reports do not refer to the ecological footprint and it is not clear whether Anglian Water continues to use this tool.

Hannigan-Popp *et al.* (2007) applied the ecological footprint to two industrial estates in Wales and compared the roles of the ecological footprint and environmental management systems (EMS) in identifying areas for actions to reduce environmental impacts. It was noted that EMS focuses on the performance of an individual business unit and its strengths lie in directing action, reporting on performance and aiding marketing. The ecological footprint is complementary, providing a 'bigger picture' of the individual businesses in relationship to their neighbours on a spatial basis and their partners on a sector basis. It allows targets to be set and identifies areas for improvement projects on a multi-company scale.

Chambers & Lewis (2001) consider the use of the EcoIndex™ methodology as a sustainability indicator for business and conclude that it can be applied at the corporate level as an aggregated eco-efficiency indicator, which links in with global carrying capacity. The report also identifies the need to use ecological footprinting in conjunction with other indicators, to address all aspects of sustainability; this is a recurring theme. It is understood that Best Foot Forward has undertaken a range of studies for companies, including Orangebox<sup>26</sup> where the indirect impacts (i.e. the embodied energy of components) were identified as greater than the direct (on-site) impacts.

Tools for assessing the impacts of businesses have been developed and include:

- the *Footprinter*™ software<sup>27</sup>, developed by Best Foot Forward which provides access to the EcoIndex™ database and measures both carbon and ecological footprints. This is a process-based approach; and
- Dipolar Pty Limited and the Centre for Integrated Sustainability Analysis (ISA) at the University of Sydney have developed the *Bottomline*<sup>3</sup> software package<sup>28</sup>. A version for the UK economy has been co-developed by ISA<sup>UK</sup> Research & Consulting (Wiedmann *et al.*, 2007). This is an input-output approach and the indicator set of includes a number of economic, social and environmental indicators, including the ecological footprint; carbon footprint; greenhouse gases; toxic, ozone-creating, acidifying and eutrophication air pollutants; heavy metals; energy and resource use as well as material flows.

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<sup>26</sup> See [www.orangeboxuk.com](http://www.orangeboxuk.com) and paper presented by Chambers & Roper (2007) at the International Ecological Footprint Conference.

<sup>27</sup> See [www.footprinter.com](http://www.footprinter.com)

<sup>28</sup> See [www.bottomline3.com](http://www.bottomline3.com) and [www.isa-research.co.uk](http://www.isa-research.co.uk)

An ecological footprinting software tool ('TravelCal') has been developed for company fleet managers wishing to assess the impacts of staff travel (by seven modes of transport) and different car models. TravelCal was due to be released in 2006 (Merseytravel, 2006) but does not appear to be available yet. No additional information on this subject has been identified through consultation.

International examples of applying the ecological footprinting to companies include BC Hydro, Canada, which aims to have a zero net environmental impact. In calculating the ecological footprint of BC Hydro, it was found that current methods overestimated BC Hydro's impact, as power cable corridors were counted as built land when in fact crops and other land uses may occur below them. In addition, the ecological footprint is promoted by the Environmental Protection Agency in Victoria, Australia and has been used to assess the impacts of various business activities.

### Products

The literature review of ecological footprint analysis applied to products (as opposed to production processes) has identified studies covering mobile phones, alternative fuels for transport and textiles. These studies identify that:

- key issues in applying ecological footprint analysis to products are the setting of boundaries and accounting for impacts over the lifetime of the product (Frey *et al.*, 2006). Different approaches exist for dealing with lifetime issues; Frey *et al.* (2006) allocate the resource extraction and manufacturing impacts to the first year of the product life and allocate the impact of the materials and operational energy use equally over the product's life. Alternatively, consultation suggests that the footprint of the product (from resources extraction to disposal) can be calculated and simply divided by the product's expected lifetime to obtain an annual ecological footprint;
- a process-based ecological footprint methodology is sensitive enough to reveal differences in small electronic products and can identify technologies that are resource efficient (Frey *et al.*, 2006);
- Cherrett *et al.* (2005) combines an input-output approach with mass balance data to consider the environmental burden of producing five textile-based products - cotton, organic cotton, hemp, organic hemp and polyester. The results show that transport contributes less than 1% to the total ecological footprint of textile production, thereby reducing the pressure for textile goods to be produced locally;
- however, additional environmental impacts may need to be accounted for to obtain an accurate picture of product differences. Cherrett *et al.* (2005) includes a water requirement analysis for textiles. An analysis by Holden & Høyer (2005) used ecological footprint analysis to assess 18 alternative fuels and energy chains in the development of 'the environmentally friendly car', and included the area needed for the safe deposit of nitrogen and

sulphur<sup>29</sup> and the area needed to sequester emissions of other greenhouse gases (rather than just CO<sub>2</sub>). However, CO<sub>2</sub> is still found to be the dominant greenhouse gas in terms of impact.

It is understood that Best Foot Forward has undertaken additional studies for companies/products which are not publicly available for confidentiality reasons. These studies are undertaken to assess the environmental impact of products and to identify where the greatest impacts occur so that action can be taken to reduce these. Consultation suggests that the analyses will often provide unexpected results, indicating that without footprint analysis, efforts by companies to reduce the environmental impacts of products may have been focused in the wrong place.

### ***Personal choice***

The ability of ecological footprinting to raise public awareness of the impacts of consumption is recognised throughout the footprinting community. However, there is less discussion on whether using the ecological footprint to measure an individual's impact can achieve positive changes in individuals' behaviour. This Section discusses both the relevant literature and the results of the local authority consultation on the use of ecological footprinting as an educational tool.

A key study in this area was undertaken by Hunter *et al.* (2006), which notes that the educational strength of the footprint is often highlighted, but that there is little work reported in the academic literature on the evidence for ecological footprint analysis changing behaviour. In an attempt to explore the application of ecological footprinting to households further, Hunter *et al.* (2006) applied a diary-based methodology to gather data, so as to estimate the ecological footprint of a small number of households in Aberdeen, Scotland.

Feedback from householders indicated that the diary proved useful in educating participants about their environmental impacts and made ecological footprint findings relevant and convincing to them. However, Hunter *et al.* (2006) found that the methodology was time consuming for both participants and researchers and concluded that future applications of ecological footprinting at the household level might combine a simplified diary with other forms of data gathering.

For example, in the context of the ecological footprinting standardisation process, a modified diary-based methodology using COICOP (Classification of Individual Consumption according to Purpose) consumption categories might be used in conjunction with approaches that utilise household expenditure data within an input-output framework (this is in line with work discussed by Birch *et al.* (2004)). Diary-based information could also be used

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The method of calculating the footprints of sulphur and nitrogen are based on critical loads (for acidity) for an ecosystem, which can be defined as “the highest deposition of acidifying compounds that will cause chemical changes leading to long-term harmful effects on ecosystems and function” (Posch *et al.* (2001) cited in Holden & Høyer (2005)). Holden & Høyer (2005) provide critical loads of 3kg per hectare per year for sulphur and 1.5kg of nitrogen per hectare per year, for the Nordic region.

to calibrate or refine the ecological footprint for individual households or distinctive socio-economic household groups.

However, Hunter *et al.* (2006) suggest that longitudinal studies would be necessary to estimate whether the ecological footprint is capable of instigating more environmentally conscious behaviour. The household-based study suggests that the power of ecological footprint analysis alone in the promotion of more environmentally conscious attitudes or practices may be overplayed. Although, as in many studies, the expression of environmental impact in land areas was well-received, it appeared to have little lasting impact. Hunter *et al.* (2006) suggest that “*using [ecological footprint] analysis solely to demonstrate to people how far they are from some sustainability ideal may merely serve to reinforce a sense of powerlessness and fuel the abrogation of individual responsibility*”. Thus, a key finding was that the presentation of ecological footprinting results alone is unlikely to promote more environmentally conscious attitudes amongst householders, unless specific components are identified for the householder to act upon.

An interesting development of the work undertaken by Hunter *et al.* (2006) is the funding by the Economic and Social Research Council (ESRC) with the Scottish Executive of a joint collaborative PhD studentship, at Aberdeen University entitled “*Environmental attitudes and behavioural change: A role for household environmental impact diaries*”. A key aim is to use the household diary approach to measure the ecological footprint, then to identify which components the householders are willing to take responsibility for and which they consider to be the role of Government policy. The role of ecological footprinting in policy-making is discussed in Section 6.

Brody & Ryu (2006) used ecological footprinting to assess the impact of sustainability education (rather than the footprint itself) on student behaviour. Students receiving sustainability education showed marked reductions in both mobility and goods/services components. The footprint of the control group increased over the same three-month period; Brody & Ryu (2006) note that this may either indicate the relative instability of reported ecological footprints or further support the positive influence of education in increasing sustainable patterns of behaviour. They note that the study relies on reported behavioural patterns and that data could be biased, based on individual perceptions of changed behaviour or students’ increased awareness of the correct responses to the survey. It is suggested that further research should monitor actual behavioural changes by students, in order to make more robust empirical conclusions about the impact of higher education on sustainable lifestyles.

Of the 43 respondents to the local authority survey who answered the question on the main reason for using the ecological footprint (more than one main reason was allowed)<sup>30</sup>:

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<sup>30</sup> See Annex 1 for details of the study methodology and Annex 2 for the full results of the local authority consultation.

- 56% of respondents indicated ‘to raise public awareness’,
- ‘to produce educational material’ was cited by 42% of respondents and
- ‘to inform an environmental campaign’ was cited by 30%.

Box 4.2 gives a sample of the responses regarding the educational value of the ecological footprint.

**Box 4.2: Perceived educational value of the ecological footprint – based on responses from local authorities in Great Britain**

*“Gives an understandable picture of a complex subject”*

*“We have experienced first hand the understanding and insight that the footprint metaphor of one planet versus three planet living gives to people. It has been invaluable in pressing home issues of sustainable development and climate change”*

*“Positive for the comprehension and in motivating children in the subject”*

*“The most successful outcome has been as an awareness raising tool which illustrates how far we are exceeding our share of the earth’s resources and the importance of reducing our consumption levels”*

*“Helps to explain sustainable development as the shrinking of your footprint”*

*“To develop people’s awareness of the wider impacts of their consumption, both in terms of energy use and impacts overseas”*

*“I believe the ecological footprint to be one of the best educational tools in terms of communicating the concepts of sustainability as it excels at personalizing sustainability”*

*“Easy for all ages to understand and better terminology than Local Agenda 21/ sustainable development”*

72% (of the 43 respondents who are actively using the footprint) have so far applied the results of the ecological footprint analysis to education and awareness-raising projects. The most popular approach has been to use the local authority footprint in publicly available documents (e.g. leaflets, reports, etc.). This was undertaken by 22 authorities (51%). Specific projects with individuals or organisations have been undertaken by 15 authorities (35% of respondents). However, only five authorities have monitored the effects<sup>31</sup> of the educational projects undertaken and, of these, only one provided a detailed response. This response indicated that 100 residents’ footprints were measured, and educational information and incentives were provided to encourage a reduction in the footprints. The results were varied and many of the participants did not complete the final follow-up questionnaire. However, some were successful in reducing their footprint, with an increased understanding of the issues.

Overall, the local authorities suggest that the ecological footprint and its results are received ‘quite well’ (26% of respondents) or, ‘very well’ (16%), by all age groups.

<sup>31</sup>

The majority of authorities which did not monitor the impact of their awareness-raising projects were unable to do so because of a lack of resources.

Barrett *et al.* (2004) note that numerous personal ecological footprint calculators have been developed, many of which are available free online. These calculators have proved popular and, it is suggested, the process of working through a personal calculator is an enlightening experience for those who have no knowledge of the ecological footprint. However, Barrett *et al.* (2004) note that each calculator has adopted a different method for estimating the ecological footprint, and some questions are more detailed than others, which produces very different results.

TravelCal has been trialled with individuals by Merseytravel, to provide information on the ecological footprint of different modes of transport. Barrett *et al.* (2004) indicates that a one-to-one interview was held with each individual who volunteered for the project; this involved an explanation of the theory behind ecological footprinting, a demonstration of the software, and a tailored list of alternative travel options. A follow-up interview was conducted six months later with each individual to assess whether any had changed their travel behaviour (and thus reduced their ecological footprint). This suggested that some slight changes in travel behaviour, which had brought about a small reduction in ecological footprints. Barrett *et al.* (2004) suggest that the programme received positive feedback, and the tool was considered to have contributed significantly to raising people's perception of sustainable behaviour. However, there has been no attempt to monitor the effects of the project since (Barrett *et al.*, 2004).

A two-year study<sup>32</sup> is now being undertaken by the University of Liège, Ecolife, Espace Environment and University of Leuven, which focuses on the development of ecological practices and sustainable behaviour in consumers. This will investigate, to some extent, the reliability of the ecological footprint as a measure of individual behaviour, and also the influence of the result on behaviour. It appears that this study may provide evidence to support (or otherwise) the use of ecological footprint for educational purposes.

#### 4.4 Conclusions

Sub-national ecological footprints primarily relate to geographical regions (within a nation) and cities, but they can also be calculated for individuals/households, industry sectors and individual businesses, products and organisations. Consultation has identified a considerable increase in the awareness and use of ecological footprints by local and regional authorities since 2004, and an increasing awareness by companies. However, carbon footprinting, which measures greenhouse gas emissions in tonnes of carbon equivalent, is being increasingly adopted by companies and this may be at the expense of ecological footprinting.

In the past, sub-national footprints have been calculated through process-based approaches, using LCA data to provide conversion factors for locally

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*Fostering sustainable behaviours: Community-based Social Marketing*, see [www.belspo.be/belspo/fedra/proj.asp?l=en&COD=SD/TA/11A](http://www.belspo.be/belspo/fedra/proj.asp?l=en&COD=SD/TA/11A)

collected (or approximated) consumption data. Inconsistent methodologies and variations in data availability resulted in difficulties in comparing the outputs of these studies. The general consensus amongst practitioners, which has been formalised in the published Ecological Footprint Standards, is that the national footprint should be taken as a starting point for sub-national footprints. The Ecological Footprint Standards may result in improvements in comparability; however, due to the relatively recent publication of the Standards, few studies have yet been prepared within their framework.

A key issue associated with sub-national footprints is the lack of availability of specific data and thus the need to use approximated or average data. Some research suggests that using approximated data (i.e. based on national data) at a local level may result in significant errors when prioritising activities to reduce impacts. However, specific research on this issue has not been undertaken in relation to sub-national ecological footprints, and is likely to require the type of sensitivity analysis identified as being needed at the national level. Stakeholders have expressed an interest in such work being undertaken and it would potentially assist local authorities and organisations to assess the need to undertake specific (and potentially costly) data collection.

The most significant development in sub-national footprints methodologies in the UK has been the application of input-output analysis, which has been used to allocate the national footprint to industry sectors, consumption categories, local areas and socio-economic groups. This has the benefits of providing comparable footprints (e.g. for industry sectors or local authority areas) and addressing issues associated with the inclusion of services, indirect impacts and other data gaps. However, using financial input-output tables (which is the dominant approach at present) critically assumes that expenditure is an accurate measure of resource consumption, which is unlikely to be the case.

The comparative strengths and weaknesses of using input-output analysis or process-based data (such as LCA data) to calculate ecological footprints is probably the most discussed area of the footprint methodology, according to the Global Footprint Network. In theory, both approaches should produce similar answers; the reason that they do not yet do so is because the categories used in I-O tables are large and heterogeneous, causing difficulties with matching process-based data. It has been suggested by stakeholders that the most powerful approach would be a hybrid method: using I-O for a larger picture of the sector, and using LCA to provide more detail on the products within that sector.

Ecological footprint tools based on an input-output approach have been developed for local authorities and companies since 2004. These allow specific data to be used where available and fill gaps with approximated data. The suitability of this approach depends upon the expected use of the results and the level of accuracy which is required. These approaches adopt the implicit assumption that imported goods are produced with world average

energy intensity, therefore any changes, particularly in the supply chain of companies, will not be reflected.

There is therefore a trade-off between producing standardised, comparable footprints and ones which accurately reflect the local situation. A number of local authorities are concerned about the lack of local data used in calculating the sub-national footprint, which can give rise to distrust from policy-makers. It is interesting to note that over half of the local authorities who responded to consultation for this study considered the use of local data to be very important (and 25% considered it quite important), whilst 25% considered comparability with other local authorities to be very important (and 53% considered it quite important). Stakeholders using ecological footprints have expressed uncertainty about the range of methods available to them (including uncertainty about the differences between ecological and carbon footprinting) and the appropriateness of their use in different situations.

Ecological footprint analysis of products is at a similar stage to that of geographical sub-national ecological footprinting around two years ago. Whilst methods for sub-national areas diverged in the past but are now converging (assisted by the implementation of the Ecological Footprint Standards), methods for analysing products are currently divergent. This is illustrated by the current lack of agreement on standards for organisational and product footprinting studies.

Finally, despite almost universal acceptance of the ecological footprint as an awareness raising tool, there is little empirical evidence of its effectiveness in changing behaviour. Simpson *et al.* (2000) suggest that the consumer culture is deeply embedded in society, and the shift to more equitable and environmentally responsible consumption patterns will be difficult. It is therefore perhaps unfair to expect that the results of the ecological footprint would be able to bring about such a shift in behaviour on its own. Indeed, any study on the effectiveness of the ecological footprint would find it hard to control for other positive (or negative) messages received via different channels. However, given that the ecological footprint is widely used as an awareness-raising tool, further work in this area, particularly longitudinal studies, are recommended.



## 5 Wider use of the ecological footprint

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### 5.1 Introduction

The third strand of applying ecological footprint methodologies, identified by the Global Footprint Network (see Figure 2.1), is its use for campaigning and creating a 'critical mass'. Examples of such campaigns are discussed below. An additional area of literature considers alternative indicators to the ecological footprint as well complementary indicators. Where complementary indicators are used alongside the ecological footprint these may also assist with campaigns and/or the promotion of indices highlighting environmental and development impacts.

### 5.2 Use of the ecological footprint in campaigns

A number of organisations use the ecological footprint in campaigns, including the Global Footprint Network and WWF. The background literature discussed in Section 4 in relation to individual and household footprints is also relevant here, and local authority actions to increase public awareness may be considered campaigns. However, the ecological footprint is also used more widely to raise awareness.

For example, World Overshoot Day was devised by the New Economics Foundation (a partner of the Global Footprint Network) as a means of communicating the global ecological overshoot demonstrated by the ecological footprint. This is the day in the year when humans have consumed the total amount of new resources produced by nature that year. Any resources consumed and emissions produced after that day (and until the end of the year) are greater than the Earth can support (according to the ecological footprint calculations). In 2006, World Overshoot Day was 9 October, and has occurred increasingly earlier in the year since 1987 when it was 19 December. This event was widely publicised and received media coverage<sup>33</sup>.

Ecolife (2007) provides details of a media campaign run in three Belgian newspapers. On three occasions since January 2006, a week-long campaign has been undertaken to make people aware of their ecological footprint. This consists of launching a personal calculator in the newspaper and online on day one, printing daily articles on ways to reduce the footprint and, on day seven, printing the results and analysis of entries to the online calculator. Over these three occasions, a total of 60,000 people have calculated their footprints. The results indicate actions that people intend to take to reduce their footprint but as yet there has been no monitoring of whether these

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<sup>33</sup>

See, for example, <http://news.bbc.co.uk/1/hi/sci/tech/6033407.stm>

actions have been taken in practice. Around 18% of respondents provided their email address which would allow for monitoring to be undertaken.

An additional campaign example provided by Ecolife (2007) included 100 households with 100 days to reduce their ecological footprint by 100 football pitches. Whilst it is not clear whether the desired reduction in footprints was achieved, the results show that the majority of reductions were obtained in the areas of heating, transport and food. A follow-up survey one year later indicated that 75% of participants were still continuing their actions. However, Ecolife (2007) note that many of these participants were already familiar with environmental issues and were considered to be more likely to reduce the impacts of their consumption. It should be noted though that this is one of few examples of monitoring the effects of an ecological footprint campaign.

WWF implemented a three year (pilot) Global Footprint Education Project in Scotland, which explored the ways in which schools can examine, measure and reduce their impact on the environment. The pilot involved 16 schools and produced a footprint calculator, teaching materials and training to provide an interactive method to calculate the whole-school ecological footprint and to develop strategies for reducing the school's footprint. The project has been developed in conjunction with Eco Schools Scotland, part of an international initiative designed to encourage whole school action for the environment. NLP (2006) also provides an account of this project in North Lanarkshire. It is understood that the pilot project tested the materials, but did not monitor the effect of the materials in increasing awareness or achieving environmental improvements. The materials will now be shared with schools in all Scottish local authority areas.

As discussed in Section 4, although the ecological footprint is widely identified as a good communication tool, there has been little monitoring of its effect on either raising awareness or encouraging environmental improvements. Similarly, whilst not all campaigns can be easily monitored for effectiveness, there appears to have been little monitoring of the impacts of campaigns involving the ecological footprint. The monitoring which has been undertaken indicates some success, and further monitoring should be undertaken to increase the evidence base.

### **5.3 Alternative and complementary indicators**

From the outset of this study, Defra has indicated that this Report is not intended to compare the ecological footprint with other indicators. This issue is addressed in studies by Moffatt *et al.* (2001), which compares measures of resource efficiency, and Wiedmann *et al.* (2006), which compares material flow analysis (MFA) methodologies, and their analyses will not be duplicated here. However, for completeness, their conclusions are summarised.

Moffatt *et al.* (2001) undertook a detailed assessment of seven measures:

- factor four/ten;
- environmental space;

- ecological footprint;
- human appropriated net primary production;
- assimilative capacity;
- asset balances for environmental capital; and
- y/e measure.

Each measure was assessed against twelve criteria, designed to test the measures' robustness, practicality and usefulness to policymakers. The main finding of the study is that:

*“measuring resource efficiency in a way that reflects the ultimate goal of sustainable development is complex, and that all measures are imperfect, performing better against some criteria than others. It is impossible to identify a single best performing measure, as it is clear that suitability depends on purpose”* (Moffatt *et al.*, 2001).

In relation to the ecological footprint, Moffatt *et al.* (2001) identify it as the best measure for geographical sub-national areas, due to its well documented methodology, availability of case studies and integration of different aspects of resource use. Moffatt *et al.* (2001) also identify that, as it is linked to environmental impacts, it allows a sustainability gap to be identified and targets to be set. However, the gap can only be measured with limited accuracy, due to fundamental problems with the measures. Other measures give rise to similar problems for target-setting and, therefore, no method is preferred for this purpose. Other measures (than the ecological footprint) are preferred for monitoring trends, industry sectors and individual companies.

Wiedmann *et al.* (2006) focuses on five general MFA methodologies (economy-wide material flow analysis (EMFA), bulk material flow or material systems analysis (BMFA/MSA), environmental input-output analysis (EIOA), life cycle analysis (LCA) and substance flow analysis (SFA)) and the hybrids which can be derived through methodological integration. It also briefly covers methodologies with a direct sustainability reference, such as the ecological footprint and Environmental Space and some existing UK specific MFA models.

Similarly to Moffatt *et al.* (2001), Wiedmann *et al.* (2006) note that all methodologies have their strengths and weaknesses, but they can all contribute valuable evidence to inform SCP policy in specific contexts. A comparison of the ecological footprint and environmental space measures concludes that:

*“both certainly have an immediate appeal for informing the SCP policy agenda as they bring natural limits into the scope of policy and therefore allow answering unique policy questions. At the same time both suffer from concerns about their methodological robustness and can certainly only be used with great care, for informing SCP policy embedded in larger sustainability indicator sets”* (Wiedmann *et al.*, 2006).

The study concludes that the Government should consider adopting two complementary models to support the SCP agenda – one based on an EIOA methodology with a particular strength in prioritising physical flows within the domestic supply-chain context, the other based on a hybrid LCA-EMFA methodology with a particular strength on the prioritisation of (finished) materials.

Additional sources consider the ecological footprint in combination with other indicators, and these may be used in campaigns or promoted widely to increase awareness of environmental/development issues. For example:

- the Living Planet Report (Hails, 2006) presents the global ecological footprint, the global Living Planet Index (LPI) and global water withdrawals as individual indicators. The LPI is a measure of the state of the world's biodiversity and is calculated as the average of three separate indices that measure trends in populations of 695 terrestrial species, 274 marine species, and 344 freshwater species. Furthermore, the ecological footprint by country is compared to the Human Development Index (HDI) by country as an indicator of well-being. The HDI is calculated from life expectancy, literacy and education, and per capita GDP. Only Cuba meets the "minimum criteria for sustainability", i.e. an ecological footprint of less than 1.8 gha per capita and an HDI value of more than 0.8 (considered to be high human development);
- the ecological footprint is used as one of 76 datasets within the Environmental Sustainability Index (ESI) (Esty *et al.*, 2005) which covers 146 nations. These 76 indicators are grouped into five components: environmental systems, reducing environmental stresses, reducing human vulnerability, social and institutional capacity and global stewardship; and
- the Happy Planet Index (HPI) (NEF & FoE, 2006) was developed in 2006 and it evaluates 178 countries according to the satisfaction of the population, life expectancy and the ecological footprint.

Work currently underway for the European Commission has a specific objective to "*assess how other assessment tools can complement the footprint, to fulfil EU policy requirements*". This is due to be published in September 2007 and is likely to provide a more comprehensive assessment than is possible within the constraints of this study. Those with further interest in this area are suggested to refer to the Commission's study.

## 6 Use of the ecological footprint in policy or decision-making

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### 6.1 The policy (or decision) making framework

The development of policy at the UK and European level is routinely assisted by the use of (regulatory) impact assessment. Such assessment follows detailed guidance, as set out in the *Regulatory Impact Assessment Guidance* by the Cabinet Office<sup>34</sup> in the UK and the *Impact Assessment Guidelines* (EC, 2005). Both of these documents identify similar stages in the process of policy development, which are discussed below. Other decision-making frameworks, for example UKCIP (2003), follow similar processes. Although there is general agreement as to the stages of policy development, the extent to which these are formalised (and followed) at different organisational levels may vary. Nonetheless, the official guidance, as identified above, provides a framework for assessing how the ecological footprint has been used to assist policy and decision-making.

The policy-making framework can be divided into the following stages:

- identify the issue / what is the problem?
- set the policy objectives;
- identify options for achieving the policy objectives;
- assess the likely economic, social and environmental impacts of the options;
- compare the options;
- outline implementation and delivery plans; and
- organise future monitoring and evaluation.

In order to assess how the ecological footprint has been used in policy-making in the UK, we have taken the impact assessment guidance as a framework, and have used local authority/regional strategies to demonstrate the use of footprinting in policy-making. The key difference between these two types of document is that while an impact assessment assesses and compares a range of options, the strategy identifies only those options which have been identified as the preferred options. The use (or otherwise) of the ecological footprint in the middle stages of policy development is not always well documented, but can be identified from consultation responses.

Consultation with local authorities, and a review of work by regional organisations, indicates that the ecological footprint has been used, or has been considered, across the stages of the policy-making framework and this

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<sup>34</sup> See [www.cabinetoffice.gov.uk/regulation/ria/ria\\_guidance/index.asp](http://www.cabinetoffice.gov.uk/regulation/ria/ria_guidance/index.asp)

is discussed below. However, when considering the responses of the local authorities, two points should be taken into account:

- the consultation results (in Annex 2) indicate the number of local authorities using the ecological footprint in 'current' strategies. However, the responses indicate that local authorities have interpreted 'current' to include those strategies that are under development and are not yet publicly available. Therefore, the available examples of the footprint being used in policy-making are fewer than the consultation results would suggest; and
- whilst local authority respondents have identified whether the footprint is used as a reference, objective, target or indicator, there is some variation as to the interpretation of these terms by respondents. We have therefore attempted to adopt a consistent approach to defining these terms, based on the use of the footprint in published strategies, rather than the responses of individuals. However, this does not affect a significant number of responses.

This Section provides evidence as to how the ecological footprint is (or is considered being) used in policy-making.

## **6.2 Using the ecological footprint to identify the issue**

Policies are adopted to address specific issues; EC (2005) suggests that these issues should be identified and described as concretely as possible, to understand why a decision is being made. In order to provide the necessary information, the EC (2005) and the Cabinet Office (2007) suggest that it is important to:

- present an indication of the size of the problem;
- identify the key components of the issue;
- discuss why it is an issue;
- establish the drivers (or causes) behind the issue, so that the root causes may be addressed rather than the symptoms; and
- identify whether the situation will be resolved of its own accord.

A number of local and regional authorities have used the ecological footprint to identify the level of consumption of natural resources as an issue, with a large number stating that community or environment strategy formation was a main or secondary reason for using the ecological footprint. Whilst the ecological footprint may be relevant to a broad range of policies, responses from the local authorities suggest that the ecological footprint is most often referred to in energy/climate change strategies and community strategies, followed by environment strategies and local development plans.

Examples of the references made to the ecological footprint in local authority strategies are given in Box 6.1 (overleaf).

**Box 6.1: Examples from local and regional authorities of using the footprint to identify an issue**

*Baseline: The ecological footprint of residents in the Borough is 5.36 global hectares (2004) (Bury MBC, 2005)*

*“The term ‘think global, act local’ means that Sunderland together with national government and other local authorities should look to reduce its impact on natural resources, by recycling more, by saving energy and by generating more energy from renewable sources such as wind and solar power. This is now being referred to as reducing our ‘eco-footprint’ ... [which] is almost 5 hectares per person and the City Council will be actively working to reduce this over the coming years” (Sunderland City Council, 2005)*

*“Bristol places considerable demands on the environment – it takes an area roughly 191 times as big as the city to provide its food, energy and natural resources and to absorb its waste and pollution. The Bristol Partnership is working to reduce the ecological footprint of the city, focusing effort on minimising waste and achieving a sustainable transport system” (Bristol Partnership, 2006)*

*“We need to take steps now to protect our environment for the future such as balancing the demand for additional housing to meet the needs of a growing population with the need to preserve the Green Belt countryside around us ... St Albans district had the second highest use of natural resource compared to the ten districts in Hertfordshire” (St Albans LSP, 2006)*

*“It is obvious that energy is used to provide heat, light and power in buildings and to provide the fuel for cars, buses, trains and planes. It is less obvious that how we produce and distribute food has a huge impact on energy use and carbon emissions, as does the creation of waste of any kind” (Bath and North East Somerset Council (BNESC), 2007)*

From the examples in Box 6.1, it can be seen that the ecological footprint is used to identify the size of the problem (i.e. the level of consumption of natural resources) either in actual terms (e.g. Bury, Sunderland and Bristol) or in relative terms<sup>35</sup> (e.g. St Albans).

The identification of key components is also facilitated by the ecological footprint, as illustrated by Bath and North East Somerset Council (BNESC)<sup>35</sup>. Although there are fewer examples of this use of the footprint in the published strategies, consultation responses indicate that many local authority respondents have been surprised by the contribution of food to the ecological footprint, so it is possible that discussion on the key components may develop further in the future.

Discussion of why the level of consumption of natural resources is an issue is generally limited to statements along the lines of, for example, “*if everyone lived the same way, it is estimated that three planets would be needed to sustain us*” (SE, 2005). Whilst more detailed discussion would be expected in an impact assessment, this may be sufficient for a strategy which is, *inter alia*, a communication document.

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Although not explicitly stated, it is clear from the strategies that the quotes from St Albans and BNESC are based on the ecological footprint.

The last two factors in identifying the issue, establishing the drivers and whether the situation will resolve itself, are less well addressed in local authority strategies. The ecological footprint is an accounting tool which does not aim to identify the root causes of the impacts it measures; local authority officers may lack the necessary knowledge to interpret the ecological footprint results further to identify the root causes. For example, one respondent indicated that “*without a clearer understanding of how the footprint is calculated it is unclear what measures are needed and where to focus activity*”. In fact, there is a wide range of literature on the drivers of consumption; however, this may not be easily accessible to the average policy maker.

To identify whether an issue is likely to resolve itself requires, at the very least, trend data to assess what has happened in the past. Whilst it is relatively well documented that resource consumption has increased over time, and historical ecological footprints are presented at the national level, these data are not available at the local authority level. Even where a local authority has previously commissioned an ecological footprint study, the results are not comparable with the REAP-derived footprints that are now being used by local authorities. Therefore, there are no trend data for local authorities to use in this respect.

### **6.3 Using the ecological footprint as an objective**

Objectives form the basis of policy-making, as they define what is going to be achieved and in what timescale. They also provide a measure of how successful the policy has been delivered by judging whether the objective has been met (Cabinet Office, 2007). EC (2005) notes that objectives should be directly related to the problem and its root causes, and be precise and concrete enough not to be open to varying interpretations. It is also suggested that objectives should be few in number, as too many objectives suggest that there is insufficient clarity of the issue to be addressed.

Consultation responses, shown in Table 6.1 (overleaf), suggest that local authorities and regional organisations have used the footprint both as a general objective, e.g. “to reduce the ecological footprint”, and as a more specific target, e.g. “to reduce the ecological footprint by X% by 20XX”. It is here that the distinction between objectives and targets becomes blurred and, as such, the more specific targets set out by organisations meet the definition of an objective described by the Cabinet Office (2007) and EC (2005). For this reason, objectives and targets (as identified by local authorities) are considered here together.

It is of note that, where an authority or organisation has a general objective to ‘reduce the ecological footprint’, this may be supported by more specific actions or targets in the strategy which relate to individual components. For example, whilst Essex County Council initially agreed a Public Service Agreement (PSA) target to ‘*manage Essex’s ecological footprint*’, this is measured by waste (kg/capita); waste recovery (% municipal waste

recovered); domestic energy use and car travel, rather than the ecological footprint per se<sup>36</sup>. Therefore, it is likely that, in some cases, local authorities have changed the terminology that they use to refer to the footprint, whilst maintaining actions and indicators that have been used previously.

**Table 6.1: Examples of strategy objectives/targets using the ecological footprint**

| <b>Local authority</b>                 | <b>Publication</b>                        | <b>Objective</b>  | <b>Total no. of objectives</b> |
|--|---|---|--------------------------------|
| Kent County Council                    | Community Strategy 2006                   | Long term goal: for a Kent that is reducing its ecological footprint ... to sustainable levels  | 9                              |
| Bath & North East Somerset Council     | Climate Change and Sustainable Energy     | To become an authority that is moving towards a strong and diverse low carbon economy ... bringing our environmental footprint within natural limits and delivering improvements in quality of life, health and community well-being as a result. | 1                              |
| North Lanarkshire Council              | (Draft) Sustainable Development Statement | We will maintain and seek future reductions in our ecological footprint   | ?                              |
| Glasgow City Council                   | Environmental Strategy                    | To use the ecological footprint approach to inform Council decision-making and to raise awareness of sustainability issues.   | 13                             |
| London Borough of Barking and Dagenham | Local Development Plan (Environment)      | Reducing the ecological footprint of the average Borough resident by promoting environmental sustainability as a key part of new building design, to reduce energy use, water use and waste.  | 6                              |
| York City Council                      | Community Strategy (2004)                 | A progressive reduction of York's ecological footprint to 3.5 hectares per person by 2033 and by 70% over the next 50 years   | n/a                            |
| South East England Development Agency  | Regional Economic Strategy 2006-2016      | Reduce the rate of increase in the region's ecological footprint (from 6.3 gha/capita in 2003, currently increasing at 1.1% per capita per annum) stabilize it and seek to reduce it by 2016.   | 3                              |
| Northern Ireland                       | Sustainable Development Strategy 2006     | To become more resource efficient, with a key target to stabilise the Northern Ireland ecological footprint by 2015 and reduce it thereafter  |                                |

## 6.4 Using the ecological footprint to assess options

Clearly defined objectives allow for the identification of potential policy options and delivery mechanisms to achieve those objectives. It is good practice to identify a wide range of alternative options which may be screened against a

<sup>36</sup>

We have been told that this has since been changed, and that it now includes the ecological footprint measurement, however we have not found any documented evidence of this.

set of criteria to arrive at a shortlist of the most promising options (EC, 2005). EC (2005) suggests that policy options should be screened against, at least, the following criteria:

- **effectiveness** – the extent to which the options can be expected to achieve the objectives of the proposal;
- **efficiency** - the extent to which the objectives can be achieved for a given level of resources/at least cost (cost-effectiveness); and
- **consistency** – the extent to which options are likely to limit trade-offs across the economic, social and environmental domain.

It is also possible to set primary and secondary criteria, whereby primary criteria must be met and secondary criteria are preferable to meet.

At the UK and EU levels, policy options (and their associated economic, environmental and social impacts) are generally compared in terms of cost-benefit analysis or cost-effectiveness, which is the key role of the impact assessment. In other words, economic values are placed on the costs associated with the actions that might be taken, as well as the environmental and social benefits (e.g. reduced consumption of natural resources) or dis-benefits that might arise from such actions. At the local authority level, the development of strategies does not appear to follow such a formal approach, but extensive consultation is undertaken to reach agreement on the final document and the actions set out.

Scenario analysis is one method by which the impacts of different policy options may be identified, usually in comparison to the 'do nothing' situation. Sub-national footprint reports tend to include a range of scenarios, which analysed how specific targets and policies may affect the size of the footprint in the future. For example, Barrett *et al* (2001) applies footprinting scenarios to passenger travel in Merseyside. The analysis shows that, even if the targets set in the Local Transport Plan are met, the overall footprint would not be reduced due to the underlying trend of increasing car ownership. Of course, this relates to the footprint of an activity rather than the per capita footprint, which is the basis of the targets set by local authorities and regional organisations. However, it illustrates the importance of accounting for other trends within the analysis. With the advent of REAP, local authorities are provided with a scenario analysis software tool. Many local authorities are looking at how they can make use of this facility, but none of the respondents has provided results as yet.

Planning policy is one area where there has been some detailed discussion on the use of footprinting for scenario analysis. McManus & Haughton (2006) suggest that the origins of the ecological footprint (in the School of Community and Regional Planning at the University of British Columbia) and its focus on cities and the use of land as a unit of comparison mean that it is particularly appealing to planners.

Ravetz *et al.* (2005) provide an example of using the ecological footprint to analyse scenarios for a specific strategy, the South East Plan (which is

primarily concerned with housing provision), where this was commissioned by the Regional Assembly. This is described in Box 6.2.

#### **Box 6.2: Example of using the ecological footprint for scenario analysis**

The draft South East Plan set the following objective/target (as reported in Ravetz *et al.*, 2005):

*“Over the Plan period, per capita use of natural resources will stabilize and begin to reduce, supported by increased efficiency of resource use in new development, the adaptation of existing development, the extensive use of sustainable construction techniques and corresponding changes in public attitudes and behaviour. Relevant authorities will achieve a stabilization of consumption of resources and aim for a reduction in absolute levels if consumption in the long term with an aim to stabilise the South East ecological footprint by 2010”.*

Ravetz *et al.* (2005) interpret this target in terms of three main objectives:

- to stabilize the growth in the footprint of housing (as the direct remit of the SE Plan);
- to stabilize the footprint in the built environment, including other buildings and transport (i.e. sectors where the SE Plan would have some influence); and
- to stabilize the footprint across all activities and consumption in the region as a whole (i.e. outside the scope of the SE Plan as such).

The stabilization target is set at a notional 2010; however Ravetz *et al.* (2005) notes such a target is likely to involve an ambitious programme, and the target is calculated in terms of a 5 year (2010) and 20 (2025) year policy programme.

The ecological footprint in the South East is expected to grow by an average of 1.11% per capita per annum between 2010 and 2026. This total includes urban development (energy demand and construction in housing/property; surface and air travel) and other (energy supply, food, consumables, other). The urban development footprint is nearly 40% of total footprint and is growing at approximately 1.06% per year, equal to 0.025 gha/cap per year.

Ravetz *et al.* (2005) analyse three main policy options (which may also include sub-options) for achieving the necessary reductions to stabilize the footprint:

- basic actions under the Energy Efficiency Commitment/Warm Front scheme (e.g. energy efficiency measures);
- a comprehensive ‘40% house’ programme (i.e. measures to achieve a 60% reduction in CO<sub>2</sub> emissions); and
- additional effects of lifestyle shifts and/or energy prices.

The results of the (high level) analysis suggest that, in order to meet the urban development footprint stabilization target of 0.025 gha/cap per year, the following portfolio of policy options may be necessary:

- ‘40% house’ programme for upgrading of the existing housing stock: savings of **0.007** gha/cap/yr per year;
- all new house building to be low energy at the ‘Bedzed’ standard: savings of **0.002** gha/cap/yr;
- low impact construction to be phased in for all housebuilding : savings of **0.005** gha/cap/yr;
- low impact construction to be phased in for all other property construction: savings of **0.007** gha/cap/yr; and
- low energy building design and operation to be phased in for all other property: savings of **0.004** gha/cap/yr.

Each of the above savings is calculated on an annual growth basis, so in principle they apply equally to the respective targets of 2010 and 2025. However, Ravetz *et al.* (2005) note that there is a lag effect for implementing policy, which will determine the feasibility of achieving footprint stabilisation by 2010. Essentially, the necessary measures are, individually, significant policies requiring phased implementation over the 20 year period. Presumably as a result of Ravetz *et al.* (2005), the target within the revised South East Plan is to:

### **Box 6.2: Example of using the ecological footprint for scenario analysis**

*“promote measures that seek to stabilise the South East’s ecological footprint by 2016 and to reduce the ecological footprint during the second half of the Plan period” (SEERA, 2006).*

Source: Ravetz *et al.* (2005)

The example in Box 6.2 also demonstrates that policy-making is an iterative process, whereby the scenario analysis and development of options can identify unrealistic targets and objectives.

## **6.5 Using the ecological footprint to monitor progress**

In order to verify whether a policy is meeting its objectives, it is necessary to monitor progress, using relevant indicators. If a policy is not achieving its objectives, policy makers also need to know whether this is due to flawed policy design or poor implementation (EC, 2005). EC (2005) notes that another important factor for choosing indicators is that the relevant data should be relatively easy to collect: *“collecting data on an indicator should not be more costly than the value of the information it provides”*.

The Welsh Assembly and Northern Ireland Administration have both adopted the ecological footprint as an indicator of sustainable development. In addition, within Wales’ Environment Strategy (NAW, 2006), the ecological footprint is identified as an indicator (amongst others) for demonstrating contribution to global sustainable development and environmental improvement minimising greenhouse gas emissions. Munday & Roberts (2006) note that, in terms of policy relevance for Wales, the footprint represents a largely contextual indicator. However, it is difficult to link it explicitly with the Assembly’s sustainable development objectives, although it is loosely linked to the Assembly objective of the ‘environment being cherished and protected’.

A key issue with adopting the ecological footprint as an indicator for monitoring progress is the need to update it. Where organisations have adopted an objective that sets a target for reducing their footprint, this implicitly adopts the footprint as an indicator, and thus commits them to future updates. However, other authorities, as discussed above, aim to reduce individual components, which are more easily measured. One local authority respondent stated that *“without the resources to develop our own area-specific ecofootprint data, it will remain a one-off high-level indicator for the time being”*. This links to the point made by EC (2005) above regarding the value of information.

## 6.6 Conclusions

Local authorities and regional organisations are currently trying to understand the issues raised by ecological footprint results, with the majority being in the early stages of using the ecological footprint for policy-making. For this reason there are few, if any, examples of the ecological footprint being used consistently throughout the stages of policy-making (perhaps the most advanced is the South East of England).

Many respondents acknowledge the level of resource use that is identified by the footprint, but require better local data to further their understanding of the key issues, as well as to improve their confidence in the results. A number of authorities have 'updated' their terminology, moving from objectives related to managing their use of natural resources to objectives of managing their ecological footprint. However, many of the actions and measures to achieve the objectives remain similar to those that existed prior to footprint studies, particularly those focusing on energy efficiency. It is likely that a considerable number of local authority strategies will contain reference to the ecological footprint in the future, although many respondents are uncertain how to use it at this stage.

A minority of authorities and organisations have adopted specific targets of reducing their ecological footprint over a specified (long) timescale. This has also resulted in the adoption of the footprint as an indicator in some strategies. A significant barrier to the adoption of the footprint as an indicator by other authorities is the cost associated with updating it on a regular basis.

Where local authorities have used the footprint within local strategies as objectives or targets, most have to yet to develop the actions required to achieve the objectives/targets. For example, one respondent stated that "*we have succeeded in writing ecological footprinting into a community strategy, but it needs a delivery mechanism which is not there at the moment*". However, uncertainty over the results of the footprint suggests that local authorities should be careful when developing objectives and targets which include the footprint.

Some local authorities have found that the footprint provides a useful concept for discussing resource use, providing a descriptive alternative to more 'wordy' explanations of the issue. It has also served to highlight the environmental impacts of food consumption for some local authorities.

However, local authorities should take care to ensure that other components of resource use (such as water consumption) and environmental impacts (e.g. water quality) are also considered. The majority of local authority respondents to consultation (91%) agreed that the footprint should be used together with other indicators/tools, to provide a fuller picture of the impacts.

There is concern that some of the objectives set by local authorities do not meet the widely accepted SMART (specific, measurable, accepted, realistic, and time-dependent) criteria, particularly where the objective is to achieve a

high percentage reduction in the ecological footprint. This is a weakness of local authority policy making rather than of the ecological footprint. However, it does suggest that local authorities may lack a basic understanding of the issues involved in reducing the footprint.

This is not to suggest that local authorities should not aim to reduce their footprint. However, this may be done more robustly by using scenario analysis to assess the impacts on the footprint of a range of options to achieve broad policy objectives. Other factors can also be taken into account in the scenario analysis, providing a more sustainable approach.

## 7 Conclusions and recommendations

### 7.1 Key developments in ecological footprinting

This Report has identified key developments in the ecological footprint methodologies at national and sub-national levels since 2004. These are summarised in Table 7.1.

**Table 7.1: Advantages and disadvantages of recent methodological developments**

| Development                                       | Advantages   | Disadvantages  |
|---|--|--|
| Removal of price capping algorithm for trade data | Results in a more accurate ecological footprint  | Highlights potential for uncertainty within the results and requirement for further data reviews   |
| Dynamic approach for ecological footprint         | Aims to provide an 'early warning' indicator which can be acted upon, rather than a 'current state' indicator  | A reduced footprint below the level of available biocapacity highlights the sensitivity of current methodology to approach taken to account for carbon emissions |
| Use of I-O analysis at national level             | Ongoing debate with GFN regarding suitability of this approach compared to material flow approaches, no change in methodology at present. Hybrid approach yet to be developed but suggested to be ideal solution |  |
| Use of (financial) I-O at sub-national level      | Comprehensive, comparable footprints with minimum data requirements for users  | Assumes expenditure reflects consumption<br>Lacks relevance at local level unless specific data are collected and integrated                                     |

The removal of the price-capping algorithm has been implemented and the use of financial input-output analysis at a sub-national level is being widely used, resulting in some improvements to the methodologies. However, the use of input-output analysis at a sub-national level relies on a number of assumptions and therefore has its disadvantages, which should also be taken into account when using the results of these footprints. Additional developments, such as a dynamic approach for ecological footprinting or the use of input-output analysis at a national level are relatively new and/or are the subject of ongoing debate. Numerous other methodology and data issues are also under discussion, as discussed in Section 3, but have yet to be implemented.

### 7.2 International examples of ecological footprinting studies

There has been limited adoption of the ecological footprint at national and international levels. Independent reviews of the ecological footprint in Switzerland, Finland, Ireland and Germany have highlighted data and methodology issues which have varied the national footprint by -12% to

+28%. Other national reviews have the potential to highlight further issues and this suggests that the UK national footprint should be used with caution, particularly in relation to target setting by local and regional organisations, until an independent review of the data and methodology for the UK national footprint is undertaken. Furthermore, the identified need for sensitivity analysis of the national results should also be acted upon by the Global Footprint Network.

### **7.3 The application of ecological footprinting methodologies**

Ecological footprint methods have been applied to regional and local government areas, industry sectors and businesses, households and individuals. Predominantly they have been used to communicate the impacts of consumption, identify key areas for action and, in some cases, to set targets for reducing these impacts. The ease of communicating the ecological footprint has facilitated its use with policy-makers as well as the general public. Stakeholders have identified the role of ecological footprinting in promoting the issue of sustainable consumption, highlighting the role of food in consumption impacts and creating greater joined-up thinking in policy-making. This demonstrates the communication benefits of the ecological footprint, and its use for this purpose should not be discouraged.

### **7.4 The effects of methodological developments on the use of ecological footprinting for UK policy-making**

Users of the ecological footprint should be made more aware of the uncertainty within the results of the footprint, which is currently presented as a single figure. On a small scale, any actions taken to reduce the ecological footprint are likely to be beneficial for the environment; however, stakeholder trust (if the baseline figure and target should change), the relative importance of actions and the impact on wider sustainability issues may be affected by changes to the national footprint and derived sub-national footprints. Furthermore, users have expressed a need for greater guidance (from footprint practitioners) as to the methods available to them and the appropriateness of these for different levels of analysis.

At a national level, the ecological footprint is an aggregated indicator, identifying environmental limits for the availability of bioproductive land and the availability of forest area to sequester carbon dioxide emissions. Carbon dioxide emissions, particularly those embodied in traded goods, account for 58% of the UK's ecological footprint, and therefore the majority of its exceedence of the defined limits.

The need to reduce carbon emissions caused by UK consumption is accepted. On the one hand, the recent and ongoing methodological developments highlight the sensitivity of the ecological footprint to variations in the method for accounting for carbon emissions. On the other hand, they

highlight the insensitivity of the current methodology to changes in the embodied energy of traded goods for a specific country.

The UK's sustainable development indicators and the SCP indicators address a range of issues, and an identified shortcoming is the lack of accounting for the effects of UK consumption on other countries through imported goods. Whilst it is acknowledged that it is difficult to obtain accurate data on the embodied energy of goods and services, the current footprint methodology would not reflect any actions taken by the UK to reduce this impact. The ecological footprint would, therefore, not address this shortcoming of the set of indicators and may be inconsistent with any alternative indicator adopted to more accurately assess the impact of imported goods and services. Therefore, it is recommended that the UK Government does not adopt the ecological footprint as a sustainability indicator at this stage. Instead, the Government should pursue other research regarding the development of a robust indicator for embedded emissions and impacts of traded goods and services.



# Annex 1: Study methodology

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## A1.1 Overview

RPA's approach to this study was divided into six tasks:

- Task 1: Project scoping;
- Task 2: Update of literature review;
- Task 3: Consultation with stakeholders;
- Task 4: Analysis of responses;
- Task 5: Stakeholder workshop; and
- Task 6: Reporting.

There has been some suggestion, both in the Peer Review Report (Moffatt, 2005) and from informal conversations with practitioners, that this study should assist with resolving the methodological weaknesses identified in the previous study and to explore realistic policy scenarios to contribute to sustainable consumption and production in the UK. We (and Defra) do not believe that this should be an objective of this study; rather it should provide guidance to Defra on the most recent methodological developments and current uses of ecological footprinting. Where weaknesses are identified, we have examined what is being done to address these weaknesses and the timescale over which any improvements are likely to be reflected in the method and associated results. Furthermore, it should be noted that Defra has never intended for this project to assess methodologies other than the ecological footprint. However, we have given consideration to existing comparative studies and the use of the ecological footprint in combination with other indicators/measures (see Task 2).

## A1.2 Task 1: Project scoping

The project scoping task consisted of four key elements:

- attendance at a conference and workshop held by the Global Footprint Network in June 2006;
- a project scoping meeting with Defra to discuss the approach and work programme set out in the proposal;
- distribution of a preliminary consultation note (scoping questionnaire) to key stakeholders; and

- submission of an Inception Report to reflect the discussions held and agreed approach, taking into account stakeholder responses.

The conference and workshop was attended by Carolyn George from RPA in order to gain an understanding of the most recent developments in the ecological footprinting methodology(s) and its use in practical applications. In addition, contact was made with key practitioners (e.g. the Global Footprint Network, Best Foot Forward, the Stockholm Environment Institute at York and WWF-UK). Discussions with these stakeholders, and other information gathered, provided a sound basis for developing the scope of work for this study.

A scoping meeting was held with Defra on 30 August 2006 to agree the scope, approach and timescale to be followed. The Inception Report, and the methodology set out here, reflect the discussions held at that meeting. A scoping questionnaire was developed and agreed with Defra, and is included at the end of this Annex I. It had three key aims:

- to formally introduce the study and its aims;
- to ensure that the majority of key developments and studies since the original report have been identified, as well as forthcoming (significant) publications; and
- to ensure that provision is made to address (relevant) key issues from the beginning.

The scoping questionnaire was distributed to the following stakeholders:

- Global Footprint Network (Dr Mathis Wackernagel and Justin Kitzes);
- Stockholm Environment Institute - York (John Barrett, Thomas Wiedmann, Alistair Paul);
- Best Foot Forward (Craig Simmons, Nicky Chambers, Kevin Lewis and George Vergoulas);
- WWF-UK (Stuart Bond); and
- Integrated Sustainability Analysis, University of Sydney (Dr Manfred Lenzen).

Completed questionnaires were returned by Mathis Wackernagel, Manfred Lenzen, Nicky Chambers and Stuart Bond and a partial response was provided by John Barrett with an invitation to meet and discuss it further.

The scoping questionnaire proved a useful tool for engaging with key stakeholders. A good dialogue has been established with those people who responded to the questionnaire, and all communications have been informative with regard to understanding the current situation and ongoing work.

The questionnaire responses revealed that a number of reports have been published since the original report and these are discussed below. Work on ecological footprinting continues and the key documents to be published (internationally) are the National Footprint Accounts and the Living Planet Report (Hails, 2006). These were published in October 2006 and have been incorporated within the work for this study. Other documents, finalised or published during the course of this study, include the reviews of national footprints in Switzerland, Ireland and Germany and a report by WWF on One Planet Business. These reports and others have been incorporated into this study as they became available.

However, more importantly, Best Foot Forward's response indicated that their current work would be written up for the first International Ecological Footprint Conference in the UK, which was hosted by the ESRC BRASS Research Centre at Cardiff University on May 8-10 2007. This conference was entitled *Stepping up the Pace – New Developments in Ecological Footprinting Methodology, Policy and Practice*, with key themes being ecological footprint methodologies, applications and case studies, and policy and practice. The timing of this conference meant that, as agreed with Defra, we submitted our draft Final Report in March 2007, but have waited until after the conference to revise and submit the Final Report.

### **A1.3 Task 2: Update of literature review**

#### **Overview**

There were three key aspects to the literature review:

- sources identified by peer reviewers – including non-UK studies for comparison;
- the most recent developments in ecological footprinting, both in the UK and internationally; and
- more emphasis on the practical use of ecological footprinting in the UK and abroad, including its use in combination with other indicators.

Table A1.1 provides a list of documents provided by the peer reviewers and responding stakeholders; those highlighted in grey are either key documents or new literature identified by stakeholders. It should be noted that this list does not include the more general sustainability literature identified; however, we are aware of such documents and have referred to them as necessary during the course of the study. In addition to this list, other documents have been identified during the course of this study, resulting in more than 100 documents of relevance.

**Table A1.1: Literature sources identified by peer reviewers and stakeholders**

**Ecological footprint reports – UK**

Barrett J *et al* (2006): **Counting Consumption: CO<sub>2</sub> Emissions, Material Flows and Ecological Footprint of the UK by Region and Devolved Country**, WWF-UK.

Barrett J *et al* (2005): **The Ecological Footprint of Hertfordshire: Results and Scenarios**, Stockholm Environment Institute, York

Barrett J *et al* (2005): **Reducing Wales' Ecological Footprint**, WWF Cymru, Cardiff

Birch R *et al* (2005): **The Ecological Footprint of Greater Nottingham and Nottinghamshire-Results and Scenarios**, Stockholm Environment Institute, York

Paul A *et al* (2006): **Counting Consumption: CO<sub>2</sub> Emissions, Material Flows and Ecological Footprint of the North East**, WWF-UK.

**Ecological footprint reports - international**

**Global Footprint Network *et al* (2005):** Europe and the Globe: How the Planet and the World's Largest Economy Interact, **SR8 in support of EEA's State of the Environment and Outlook Report 2005, Contract EEA/AIR/04/001.**

Lenzen M *et al* (2003): *Assessing the ecological footprint of a large metropolitan water supply – lessons for water management and planning towards sustainability*, *Journal of Environmental Planning and Management*, 46, 113-141

Lenzen M and Murray S A (2001): *A modified ecological footprint method and its application to Australia*, *Ecological Economics*, 37, 2, 262-271

WWF (2005): **Living Planet Report 2004**, Gland, Switzerland

McDonald G and Patterson M (2003): **Ecological Footprints of New Zealand and its Regions** (<http://www.mfe.govt.nz/publications/ser/eco-footprint-sep03/index.html>) Ministry for the Environment New Zealand, Wellington, New Zealand

Senbel M *et al* (2003): *The Ecological Footprint: a non-monetary metric of human consumption applied to North America*, *Global Environmental Change*, 13, pp 83-100

Simpson, R W *et al* (2000): *An ecological footprint analysis for Australia*, *Journal of Environmental Management*, 7, 11-18

Van Vuuren D P and Smeets E M (2000): *Ecological Footprints of Benin, Bhutan, Costa Rica and the Netherlands*, *Ecological Economics*, 34, 1, 115-130

**Wackernagel M *et al* (2005):** Ecological Footprint Assessment for BC Hydro, **IISD, Global Footprint Network, BC Hydro, Vancouver.**

**Wackernagel M *et al* (2005):** The Ecological Footprint of Victoria, **ISA University of Sydney, Global Footprint Network, EPA Victoria.**

**WWF and Global Footprint Network (2005):** Asia Pacific 2005: The Ecological Footprint and Ecological Wealth, **WWF, Gland, Switzerland.**

**WWF and Global Footprint Network (2005):** Europe 2005: The Ecological Footprint, **WWF, Gland, Switzerland.**

WWF Italia (2004): **Ecological Footprint of the Tuscany Region, Rome**

**Input-Output approaches**

Albino V, Izzo C and Kuthtz S (2002): *Input-output models for the analysis of a local/global supply chain*, *International Journal of Production Economics*, 78, 119-131

Baglani M, Ferlano F and Procopia S (2002): **Ecological Footprint and input-output methodology: the analysis of the environmental sustainability of the economic sectors of the Piedmont region (Italy).** In the 14<sup>th</sup> International Conference on input-output techniques.

Bicknell KB *et al* (1998): *New methodology for the ecological footprint with an application to the New Zealand Economy*, *Ecological Economics*, 27, 149-160

Hubacek K and Giljum S (2003): *Applying physical input output analysis to estimate land appropriation (ecological footprints) of international trade activities*, *Ecological Economics*, 44, 137-15

Hubacek K and Sun L (2001): *Scenario analysis of China's land use and land cover change: incorporating biophysical information into input-output modelling*, *Structural Change*

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**Table A1.1: Literature sources identified by peer reviewers and stakeholders**

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and *Economic Dynamics*, 12, 367-255

Leontieff W (1966): **Input-Output Economics**, Oxford University Press, Oxford

Leontieff W (1970): *Environmental repercussions and the economic structure: An input output approach*, *Review of Economic Statistics*, 52, 262-277

Moffatt I *et al* (2005): **The impact of Scotland's economy on the environment: a note on input-output and Ecological Footprint analysis**, Quarterly Economic Commentary, Fraser of Allende Institute University of Strathclyde

**Wiedmann T *et al* (2006): *Allocating Ecological Footprints to Final Consumption Categories with Input-Output Analysis*, *Ecological Economics*, 56(1), pp 28-48**

Wiedmann T and Barrett J (2005): **The use of input-output analysis in REAP to allocate ecological footprints and material flows to final consumption categories**, REAP Report Number 2, Stockholm Environment Institute, York.

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**Other ecological footprint methodological references**

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Costanza R (2000): *The dynamics of the ecological footprint concept*, *Ecological Economics*, 32, 341-345

Ferng J J (2001): *Using composition of land multiplier to estimate ecological footprints associated with production activity*, *Ecological Economics*, 37, 159-172

Ferng, JJ (2003): *Allocating the responsibility of CO2 over-emissions from the perspective of benefit principle and ecological deficit*, *Ecological Economics*, 37, 159-172

Lenzen M *et al* (2004): *Historical accountability and cumulative impacts: the treatment of time in corporate sustainability reporting*, *Ecological Economics*, 51, 237-250

Linstead C and Ekins P (2001): **Mass Balance UK - Mapping UK Resource and Material Flows**, Forum for the Future, London

Linstead C *et al* (2004): **Mass Balance - An essential tool for understanding resource flows**, The Royal Society for the Conservation of Nature, London

Rees WE (1992): *Ecological Footprint and appropriate carrying capacity: what urban economics leaves out*, *Environment and Urbanisation*, 4, 121-130

Scott Wilson *et al* (2006): **International Impacts of UK and EU Consumption (Biodiversity)**, report prepared for Defra, dated May 2006.

Van Vuuren D P and Bouwman L F (2005): *Exploring past and future changes in the Ecological Footprint of world regions*, *Ecological Economics*, 52, 1, 43-62

Wackernagel M *et al* (2006): *Does a Nation's Ecological Performance Affect its Economic Stability? The potential for enhancing sovereign credit risk assessments with ecological resource accounts*, in Schaltegger S and Wagner M (eds.): **Managing the Business Case for Sustainability: The Integration of Social Environmental and Economic Performance**, Greenleaf Publishing.

Wackernagel M *et al* (2006): *The Ecological Footprint of Cities and Regions: Comparing Resource Availability with Resource Demand*, *Environment and Urbanization*, Vol 18, No1 p 103-112.

Wackernagel M *et al* (2006): *Ecological Footprint Accounting: Comparing Earth's Biological Capacity with an Economy's Resource Demand*, in Keiner M(ed) **The Future of Sustainability**, Springer Verlag.

Wackernagel M *et al* (2005): **National Footprint and Biocapacity Accounts 2005: The Underlying Calculation Method**, Global Footprint Network, Oakland.

Wackernagel, M *et al* (2004): *Using Ecological Footprint Accounts: From Analysis to Applications*, *Int. J. Environment and Sustainable Development*, Vol. 3, Nos. 3/4, pp293-315.

Wackernagel M *et al* (2004): *Ecological footprint time series of Austria, the Philippines, and South Korea for 1961-1999: comparing the conventional approach to an "actual land" approach*, *Land Use Policy*, 21, 261-269

Wackernagel M *et al* (1999): *Evaluating the Use of Natural Capital with the Ecological Footprint*, *Ambio*, 28,7, pp.604-612

Wackernagel M and Rees W (1997): *Perceptual and structural barriers to investing in natural capital: economics from an ecological footprint perspective*, *Ecological Economics*,

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**Table A1.1: Literature sources identified by peer reviewers and stakeholders**

20, 1, 3-24

Wood R and Lenzen M (2003): *An application of an improved ecological footprint method and structural path analysis in a comparative institutional setting*, *Local Environment*, 8, 365-384

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***Environmental/sustainability indicators***

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Ebert U and Welsh H (2004): *Meaningful environmental indices: a social choice approach*, *Journal of Environmental Economics and Management* 47, 270-283

Eurostat (2001): **Economy wide material flow accounts and derived indicators**, Eurostat, Luxembourg Haberl H *et al* (2004): *Land Use and Sustainability Indicators*, *Land Use and Policy* 21, 3, 194-320

Kratena K (2004): *Ecological value added in an integrated ecosystem-economy model an indicator of sustainability*, *Ecological Economics* 28, 189-200.

Opschoor J B and Weterings R (1994): **Towards environmental performance indicators based on the notion of Environmental space**, Rijswijk, Advisory Council for Research on Nature and Environment (RMNO) Netherlands

Wackernagel M *et al* (2006): *Ecological Footprint Accounts for Advancing Sustainability: Measuring Human Demand on Nature*, in Lawn P (ed.) (2006): **Sustainable Development Indicators in Ecological Economics** Edward Elgar.

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Sources identified by peer reviewers and stakeholders

The literature review builds on comments from the Peer Review Report (Moffatt, 2005), which noted that the Original Report (RPA, 2005) was lacking in its consideration of internationally based research. A six-page bibliography was provided, with around 60 references which had not been reviewed for the original report. These include literature which specifically covers ecological footprinting as well as more general sustainability sources. In the scoping questionnaire, stakeholders were asked to identify the key documents in order to focus the literature review. Furthermore, stakeholders were asked to identify any other literature (published since the original report) which they considered important (highlighted in grey in Table A1.1).

***Most recent developments in ecological footprinting and international examples***

The literature in Table A1.1 has been divided into five categories based on the document titles. The first category includes key UK studies published since November 2004; including *Reducing Wales' Ecological Footprint* (Barrett *et al*, 2005) and *Counting Consumption* (Barrett *et al*, 2006).

The second category includes international examples of ecological footprints studies, published by a range of sources. Such documents have been reviewed to identify issues that are relevant either to the interpretation of UK ecological footprinting studies or to policy development more generally.

It is noted by one stakeholder that reports focus on applying the same method to various circumstances, and may have more value in understanding the applicability of the ecological footprint than academic articles. The value of academic articles, it is suggested, comes from assessing potentially new

methodological twists and additions. The literature review has considered both sources of information.

The third and fourth categories include mostly journal articles on methodologies and approaches. The third category of literature focuses solely on input-output analysis. This approach was not covered in detail in the Original Report and, given that recent UK studies use this approach, a review of this literature has been required to provide an assessment of the most recent developments and issues in UK ecological footprinting. In addition, a key development at the international level is the publication of the Ecological Footprint Standards, by the Global Footprint Network, in June 2006. The content and impact of these standards are discussed in the literature review.

The final category identifies documents relevant to environmental and sustainability indicators. These provide important background information for considering the practical use of ecological footprinting further, both in the literature review and the consultation task, as ecological footprinting has been used as an indicator on its own, and in conjunction with a range of other indicators.

#### Practical use of ecological footprinting in the UK and internationally

There are many examples of the application of ecological footprint analysis to topics which could lead to more practical use of the method, both in the UK and abroad. This is an important aspect of the literature review as it builds on the review of the methodologies to understand how the ecological footprint is being used and what implications this may have for policy-making. This part of the literature review (and subsequent analysis) consider:

- the existing use of ecological footprinting at different levels (e.g. national, local, organisation, etc.); and
- complementary and alternative indicators.

Given Defra's interest in ecological footprinting, it has been useful to consider reports from those governments which have already examined the use of ecological footprinting at a national (or regional) level.

In addition to the regional and county studies undertaken in the UK (which will be followed up during the consultation task), local authorities outside of the UK have adopted the ecological footprint as a tool or indicator for improving the sustainability performance of the local community.

Furthermore, work on ecological footprinting for companies has been undertaken both in the UK and internationally, which has been reviewed. However, it should be noted that the results of ecological footprinting for specific products and companies may be limited due to confidentiality issues.

It is understood that, in some cases, the ecological footprint is being used in combination with other indicators, including as a measure of wellbeing (for example, within the Genuine Progress Index for Atlantic Canada). Therefore,

consideration has been given to the use of ecological footprinting in combination with other measures.

Consideration has been given to alternative measures, however, it should be recognised that these have not been examined in the same level of detail as the ecological footprint.

Identifying examples of practical use also enabled a list of consultees for Task 3 to be developed.

An Interim Report was submitted to Defra at the beginning of December 2006, detailing the results of the literature review at that stage, and a meeting was held with Defra to discuss that report.

#### **A1.4 Task 3: Consultation with stakeholders**

There were two parts to the consultation task:

- face-to-face or telephone discussions with key stakeholders, which have included:
  - the Global Footprint Network;
  - the Stockholm Environment Institute - York;
  - Best Foot Forward;
  - WWF-UK;
  - Audit Commission;
  - Dr Colin Hunter at the University of Aberdeen; and
- consultation with users of the ecological footprint via email or, in the case of local authorities, via a web-based questionnaire. The consultation list included those organisations which have commissioned ecological footprinting studies in the past (including those studies reviewed in the Original Report as well as the most recent) and those who have a licence to use the newest software available from SEI. With respect to local authorities, RPA contacted 160 local authorities across England, Wales and Scotland by email, requesting them to complete a web-based questionnaire. These authorities were identified from (a small number of) contacts kindly provided by the Stockholm Environment Institute at York, from a search of authorities referencing the ecological footprint on their websites, and a random selection of additional authorities in order to obtain approximately a 30% sample of local authorities in Wales, Scotland and each English region<sup>37</sup>.

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<sup>37</sup> Yorkshire and Humber, North East, North West, East Midlands, West Midlands, East Anglia, South East, South West and London.

The consultation with practitioners focused on methodological issues as well as practical uses. RPA (2005) and Moffatt (2005) suggested that there are unresolved methodological issues, including energy (and the use of nuclear power) and trade, and we aimed to identify current thinking in these areas and potential solutions (as identified by practitioners). Furthermore, greater use of the input-output approach has also required more detailed discussion to fully understand how this approach may address some of the previous weaknesses and associated and/or outstanding issues.

Consultation with the users of ecological footprints was focused on the practical use of the ecological footprint, its application within organisations and its uptake by higher level policy and decision-makers. The web-based consultation of local authorities is written up in full in Annex 2, and its development was assisted by the kind provision of a similar questionnaire by SEI. Where necessary, responses to the web-based questionnaire were followed up by further contact with the consultees.

#### **A1.5 Task 4: Analysis of responses**

This Task essentially formed the write-up of the consultation task and provides links with the findings of the literature review. We have evaluated both the methodological issues arising and the use of the ecological footprint, focussing on whether it has informed policy decisions and what other benefits may have arisen from use of the technique. A key aspect has been in making the links between the outstanding methodological issues and how these may affect the decisions taken with regard to policies and target setting.

#### **A1.6 Task 5: Stakeholder workshop**

A stakeholder workshop was held at Defra's offices in London on 26 April 2007. The workshop was a half-day session consisting of two presentations by RPA; one covering methodological issues and one detailing the practical use of ecological footprinting. After each presentation, workshop participants were given the opportunity to identify any errors or omissions from the analyses and to discuss key issues. The workshop was attended by 18 people including footprint practitioners and users of the footprint at both high and low levels. A list of attendees and notes from the workshop are included at the end of this Annex.

#### **A1.7 Task 6: Reporting**

The Inception Report (October 2006) was the first output from the study, followed by the Interim Report (December 2006) and the Draft Final Report (March 2007). Each of these reports has been peer reviewed and comments provide to RPA which have been addressed in the subsequent report to the extent possible.

Following submission of the Draft Final Report, Carolyn George of RPA presented a paper detailing a summary of results of the study at the International Ecological Footprint Conference in the UK in May 2007, which is available on the BRASS website.

This Report represents the final output of the study, which will also be peer reviewed.

## **A REVIEW OF RECENT DEVELOPMENTS IN, AND THE PRACTICAL USE OF, ECOLOGICAL FOOTPRINTING METHODOLOGIES**

### **Scoping Questionnaire – September 2006**

In November 2004, the UK Department for Environment, Food and Rural Affairs (Defra) commissioned Risk & Policy Analysts Ltd (RPA) to undertake a comprehensive review of UK ecological footprinting studies. The Final Report, dated June 2005, was published earlier this year, together with a Peer Review Report. These are available at: <http://www.defra.gov.uk/ENVIRONMENT/business/scp/methodology.htm>.

RPA has now been commissioned to undertake a follow-up study, which will take into account recent developments in the ecological footprinting methodologies and will provide a greater focus on the practical use of ecological footprinting by government and non-government organisations. Please note that we use the term methodologies to encompass the National Footprint Accounts, sub-national approaches and methodologies used for calculating the ecological footprints of organisations and products.

The objectives of this new study are:

1. to identify, discuss and analyse key developments in ecological footprinting methodologies since November 2004;
2. to consider international ecological footprinting studies, where these can inform UK policy-makers on developments in ecological footprinting methodologies and their use in practice;
3. to understand how and why ecological footprinting methods have been used in practice (by government and non-governmental organisations and companies), with a particular focus on their relevance for UK policy-making; and
4. to identify how recent and ongoing methodological developments may affect the use of ecological footprinting for UK policy-making in the future.

The key tasks in this study, which will run from September 2006 to April 2007, are to update the original literature review, consult with stakeholders (which may include a workshop) and to analyse the responses. We intend to produce a new report, with a greater focus on the practical use of ecological footprinting, which builds on the original rather than producing a revised version.

We would like to request your help to ensure that the key literature and issues are addressed; your responses to the following questions will help to form the structure of these key tasks. We look forward to your assistance and hope that you will be able to work with us throughout this study.

**Please return your completed questionnaire by 22 September 2006**

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## **A. Update of the Literature Review**

There will be three key aspects to the literature review, which will cover:

- sources identified by the peer reviewers - including non-UK studies for comparison;
- the most recent developments in ecological footprinting, both in the UK and internationally; and
- greater emphasis on the practical use of ecological footprinting in the UK and abroad, including its use in combination with other indicators.

The peer reviewers provided around 70 additional references which they considered to be lacking from the June 2005 Report. These include literature which specifically covers ecological footprinting as well as more general sustainable development sources. The bibliography is attached to this questionnaire as Annex I and is numbered for ease of reference.

1. In order to focus the literature review, do you consider any of these references to be of particular significance relative to the others, and if so, which ones?

2. Are there additional literature sources that you are aware of, which have been published since November 2004 and which address methodological developments, either in the UK or elsewhere? If yes, please provide details below.

3. Are there additional literature sources that you are aware of, which address the practical use of ecological footprinting, either in the UK or elsewhere. This may include websites. If yes, please provide details below.

4. The Draft Final Report for this study is currently scheduled for submission in mid-March 2007. Are you currently undertaking any work which will be completed within the timescale of this study (or soon afterwards), which you believe we should be aware of?

|                          |                |
|--------------------------|----------------|
| <input type="checkbox"/> | Yes            |
| <input type="checkbox"/> | No             |
| <input type="checkbox"/> | I do not know  |
| <input type="checkbox"/> | Not applicable |

If yes, we would be grateful for any information that you are able to provide at this stage, regarding content, expected publication date and its potential significance for this study.

5. Do you have any further comments on updating the literature review?

## **B. Consultation with Stakeholders**

We propose holding a series of face-to-face or telephone interviews with people involved in developing ecological footprinting methodologies, either in the UK or elsewhere.

6. What do you consider to be the key issues in relation to current ecological footprinting methodologies (where this includes the National Footprint Accounts, sub-national approaches and methodologies for organisations and products)? These may include issues relating to recent developments or outstanding issues.

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7. Would you be willing to participate in such an interview? These are likely to be held during December 2006 to the end of January 2007.

|                          |   |
|--------------------------|---|
| <input type="checkbox"/> | Yes, and I would prefer a face-to-face interview    |
| <input type="checkbox"/> | Yes, and I would prefer a telephone interview       |
| <input type="checkbox"/> | Yes, but I have no preference for type of interview |
| <input type="checkbox"/> | Maybe   |
| <input type="checkbox"/> | No  |

We intend to develop a questionnaire for organisations who have commissioned and/or used ecological footprinting studies and software. This will focus on the practical use of ecological footprinting by decision-makers, and may cover local authorities and other government agencies, non-governmental organisations and companies (including use for products). Whilst the questionnaire will be aimed at UK-based organisations, it may also be sent to non-UK organisations for comparative purposes.

8. Are you able to provide us with contact details for organisations which have commissioned reports or purchased/licensed software for ecological footprinting? We understand that there may be issues of confidentiality and we would be happy to discuss how we may address these. We would also be grateful if you could provide an indication of the number and type of contacts (e.g. government, NGO, companies) and any associated confidentiality issues below.

9. You will note that we referred earlier to the possibility of holding a workshop. If a workshop is held it is likely to be during February 2007. The structure and content of any workshop held will depend on the findings of the updated literature review and consultation task, and will therefore be developed as the study progresses. However, you are welcome to comment on the idea of a workshop if you wish.

10. Please provide any further comments you may have on consulting with stakeholders.

**Thank you for completing this questionnaire.** If you have any further comments on this study please provide them here.

We would be grateful if you could provide the following information:

|                 |  |
|-----------------|--|
| Name:           | <div style="border: 1px solid black; height: 25px;"></div> |
| Organisation:   | <div style="border: 1px solid black; height: 25px;"></div> |
| E-mail Address: | <div style="border: 1px solid black; height: 25px;"></div> |
| Telephone No:   | <div style="border: 1px solid black; height: 25px;"></div> |

We may wish to provide Defra with a copy of responses to this questionnaire as part of our project scoping. Please indicate whether you would prefer us to keep your response anonymous or whether we may link your name with your response.

|                          |  |
|--------------------------|--|
| <input type="checkbox"/> | Please keep my response anonymous  |
| <input type="checkbox"/> | You may link my name to my response in internal reports to Defra only  |
| <input type="checkbox"/> | Other (please specify) <div style="border: 1px solid black; width: 350px; height: 20px; display: inline-block;"></div> |

**Please return your completed questionnaire to:**

**Carolyn George  
Risk & Policy Analysts Ltd  
Farthing Green House, 1 Beccles Road  
Loddon  
Norfolk, NR14 6LT  
UK**

**Tel: +44 (0) 1508 528465  
Fax: +44 (0) 1508 520758  
E-mail: carolyn@rpaltd.co.uk**

**Annex I: Ecological Footprinting Bibliography**

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# A review of recent developments in, and the practical use of, ecological footprint methodologies

## Notes of Stakeholder Workshop

Ashdown House, 26 April 2007

### Attendees

|                    |                            |                  |                              |
|--------------------|----------------------------|------------------|------------------------------|
| John Barret        | SEI                        | Charles Jackson- | Wolverhampton City           |
| Philippa Beardmore | City of York Council       | Houlston         | Council                      |
| Simon Bilsborough  | Welsh Assembly             | Kevin Lewis      | Best Foot Forward            |
| Abigail BurrIDGE   | London Borough of Havering | Jonathan Loh     | WWF-UK                       |
| Nicky Chambers     | Best Foot Forward          | Matthew Marsh    | Hertfordshire County Council |
| Ruth Coward        | Defra                      | Ian Moffatt      | University of Stirling       |
| Robin Curry        | EnviroCentre               | Paul Mosley      | WWF-UK                       |
| David Davies       | Audit Commission           | Dave Tuffey      | Bristol City Council         |
| Carolyn George     | RPA                        | Jan Vernon       | RPA                          |
| Rocky Harris       | Defra                      | Carol Wilson     | SCPnet/EA                    |
| Sarah Hawkes       | Defra                      |                  |                              |

### Introduction – Rocky Harris (Defra)

RH set out the background to the current study being undertaken by RPA; it is an extension of the previous research in order to identify more recent developments and overseas experience, with a stronger focus on policy application.

The objective of the workshop was to get perspectives from different stakeholders and feedback on the research to date.

### Discussion on methodological issues (following presentation by Carolyn George, RPA)

#### *Discussion on errors and omissions*

It was noted that input-output analysis does not have to be monetary, it can also be physical. Recently, there has been development of a hybrid approach (monetary, energy, physical) and SEI are working on which is the most appropriate approach for each sector. The UK I-O approach to ecological footprinting is sensitive to changes in behaviour (at a regional level), through the household expenditure survey, but it is not so sensitive at the local level.

It was also noted that REAP does not include waste (as this would be double counting).

At the UK level, do we want an indicator of whether we are living within the limits of the biosphere over time? If so, we can either use an aggregate approach or separate indicators. If not, there is no point in continuing to investigate footprinting.

CG asked whether it would be necessary to analyse the UK ecological footprint in a similar manner to the studies undertaken elsewhere (e.g. Switzerland, Finland, Ireland, etc.) but no specific answer was obtained.

### ***Comments on the use of input-output analysis***

The key point with I-O is that it traces how changes in one sector affect other sectors; it is internally consistent (whether you use monetary or physical measures). I-O has generally been static (done for a single year); however there is work underway to link it to a dynamic model.

Different tools are needed for different purposes. I-O may be useful at the national level but not at the local level. RPA's report should identify this.

A time series of I-O tables for the UK will be available soon. It will be consistent with the EU I-O tables, but there is a problem with ONS not updating the UK data. Other EU countries may also be lax in updating, but 2000 tables are available for 18 of the 25 countries, and some have 2003 tables.

### ***Comments on methodology development and changes***

A proposal for 'star rating' for national footprint accounts, depending on whether they have been through rigorous review etc, is being discussed by the GFN.

The significant funding recently received by the GFN may lead to 'major leaps' in the methodology, e.g. on the nuclear issue (see Justin Kitzes conference paper with 'wish list' of developments).

CG asked whether changes to the NFA methodology would require sub-national footprints to be re-calculated and this would depend on what has changed.

Local authority stakeholders noted that having to re-calculate previous results would be very difficult to explain to stakeholders and it would raise doubts about the validity of the methodology.

This difficulty has been discussed within the GFN; and practitioners have suggested an indexing process which can be back-cast. It was agreed that a sensible way forward is needed until the methodology becomes stable.

The idea of an index was supported by a regional stakeholder, which is grappling with the issue. Its footprint was 6.9 in 2003 but 6.3 when calculated using REAP. They do not want to base policy on a baseline that proves to be wrong. For policy purposes, you need to be able to measure change, so you need a robust baseline.

However, it was pointed out that this problem applies to a wide range of indicators and it is not unique to the ecological footprint.

### ***Comments on national vs local data***

Regional Stepwise uses both national and local data and includes material via waste; this would be worth including, given the local authority focus on waste.

It would be easy to compare the results for local authorities from using national vs local data. This would show whether the difference between data sources is significant or not (BFF expressed interest in doing this). Such an analysis should cover a number of authorities, as approaches may vary by size.

One LA was very interested in this, especially because much LA policy work is at neighbourhood level, where national data are not accurate. They do not yet have data at the neighbourhood level and they want to look at how it could be obtained.

It was noted that REAP can be used bottom-up. The comment was made that this is useful when data are available, but that there are problems with consistency in collection approaches between different sources. Local data are valuable in getting buy-in to the validity of the methodology as approximated national data are not trusted.

### ***Do LAs worry about the 'black box' in the methodology?***

Participants agreed that providing detail on the methodology is a balancing act; the focus is on presenting results. LAs need some transparency to get buy-in, especially from members.

The big question LA practitioners get asked is on the difference between methods. Most users just want clear communication, but with access to expertise when necessary at a sub-national level.

As a policy maker, one needs to have confidence in the robustness of the methodology; it needs to be transparent enough to get the details if necessary (a black box is no good for confidence). Confidence about assumptions is vital, together with an indication of sensitivities.

A statement is needed on the data underlying the model; how consistent is it with other national data.

If local authority officers have confidence in the model, they can promote it. Officers need detailed information to understand and advise policy makers.

There is a need for an analysis comparing the ecological footprint to other methodologies in terms of robustness. But what would be the equivalent at LA level? All other methods use data collected by LAs.

Regional Stepwise uses existing data sets. It should be remembered that methodologies, tools and data sets are three separate factors affecting overall robustness – these should be separated out in the report in commenting on robustness.

The report should separate out data issues, issues applying to any indicator and issues that are specific to ecological footprints (with comments separated out by the tools used).

Defra was asked what its conclusions were on the use of the footprint, and it was indicated that the workshop would feed into the conclusions of the report.

## **Practice (Discussion following CG presentation)**

### ***Discussion on errors and omissions***

It was noted that the SE region has used the footprint in spatial and economic strategies. More work on scenario analysis is being done in the SE region.

The NHS footprint was mainly work by BFF, with some input from SEI.

We need to make clear in the report that information on the % of respondents using footprinting is only to provide a context; because the sample was not selected in a statistically valid way, we can only draw qualitative, not quantitative, conclusions and the numbers cannot be extrapolated.

### ***Use in practice***

Participants noted the use of the footprint for events management (e.g. FA cup final, Rugby 6 Nations, Hay on Wye literary festival). Looking at its potential for use in managing the Ryder Cup in Wales.

It is also being used at the sub-regional level (e.g. EA in NE) and for campaigning.

More businesses are going public on their use of the footprint (e.g. GSK). Organisations using the footprint include CCW, Scottish Parliament etc.

The EF was cited in a successful planning appeal in Devon (Bill Knights).

At local authority level, it is important to recognise that community strategies are not owned by the LA but by stakeholders, including PCTs, voluntary bodies etc. LA strategies also prepare the way for strategic partnerships – we should have included these in the survey.

Yorkshire & Humberside are only using the carbon bit of REAP, not EF. Aberdeen is working closely with communities, as are some other authorities. It is difficult to capture all the activity, as it is growing exponentially.

It is worth flagging up that business and RDAs are looking more at carbon footprints rather than EF.

In LA performance assessment, there is a move towards area assessment rather than sticking to LA boundaries, focusing on partnership. The question is whether the EF identifies where effort should be focused.

Discussion is ongoing about the use of EF in strategic assessment and SEA (which the EU Directive may require at LA level).

Was there any mention in the survey responses of using the EF to evaluate core strategies? One participant indicated that EF might be used on the Black Country core strategy; it is also being looked at in relation to the LDF (local development framework?) in Havering.

### ***Use as an indicator***

EF has value as a simple indicator for the public, who are put off by reams of data

It is the best sustainable development indicator

It is an aggregate indicator, which masks changes lower down which can be quite important. Experts need to drill down to identify these factors. But it is a fantastic communication tool (depending on how it is presented).

Its value as an indicator can only be judged in comparison with other indicators. Are the data/methodology problems with these better or worse? The criteria applied to the EF in the report also need to be applied to other indicators. (Ian M offered to update his comparative table on indicators; he would now put a tick for the EF against scenario analysis). Defra confirmed that comparison with other indicators is NOT INCLUDED in our study. It was noted that the German and EU reviews have compared the EF with other indicators.

Comparison with economic modelling would also be useful, covering similarities, differences and data issues.

Aggregation is what allows comparison of consumption with biocapacity in the EF. This is what makes it a measure of sustainability. You will need to disaggregate the EF to develop policy then re-aggregate to compare with biocapacity again. Human appropriation of NPP could provide a comparable indicator, but excludes energy.

Wolverhampton has used the EF as an example of global citizenship and the area's response to this.

It was noted that, as part of the Government's 'Lifting the burden' initiative, LAs would not be asked to collect any additional data.

The EF is still useful as a communication tool, even without more detailed analysis. If this is your aim, there is no need to spend further resources or money.

### ***Use in objective/target setting***

The EF helps to tell whether policies are counter-productive (e.g. building on floodplains), whether thinking is joined up or not (i.e. it helps to test objectives, rather than setting them).

Setting stabilisation of the EF as an overall target has been a sufficient driver to stimulate a change of view within the Regional Assembly. It means everyone has to take it into account in developing policy (this needs to be monitored, of course).

Backcasting from the objective of one-planet living leads to new objectives and better ones (e.g properly time-bound).

Food policy impacts would not have been picked up without the EF. The problem for action is that this cuts across departments – a difficulty which needs to be addressed.

Members are keen to use the EF for joined-up thinking across committees. It has been a catalyst to help the process, setting related targets, within constraints.

Setting a stabilisation target is one thing. You then need a roadmap of how to get there. This is also needed for other indicators, like the North Rhine-Westphalia target to be a factor 4 authority.

The EF seems to have triggered a lot of activity; we can't quantify whether other indicators would have done so, but the EF appears to have taken sustainable consumption and production to a regional level better than anything else.

EF has really flagged up embodied energy as an issue.

Aggregation has both strengths and weaknesses.

Rather than going for a percentage reduction target, the aim could be to move from three-planet living to two or one and a half planets. This would address some of the baseline issues.

### ***Use in options appraisal***

The footprint provides an indicator that you should do something, but not what you should do. However, it can be used with scenario analysis to indicate what the impacts would be of potential actions.

Guidance on where you can and can not use EF would be helpful. We have discussed its use in quite sophisticated ways (e.g. events), would it work for core strategies?

Does the fact that the EF is conservative mean that 'health warnings' are needed in some areas? Response from practitioners was that this depends on confidence limits and uncertainties and what is acceptable in different areas. Maybe there is a need for different standards for different purposes, rather than one overall EF standard (GFN is sympathetic to this).

One LA will be carrying out training on EF on integrating housing and transport. The EF integrates options appraisal and can highlight new ideas.

A recent study on housing showed that the fuel source in flats was the key issue, rather than housing type.

Another LA plans to hold training (with SEI) on the application to policy making.

### ***Implementation and review***

The fact that a decision is made that is not influenced by EF is not necessarily the fault of EF; EF can only present information, not force decision-makers to act on it.

It depends on status. The LA strategic target for recycling has more resources allocated to it, because it is a statutory requirement, so is more likely to be achieved.

EF has raised consumption as a key issue in achieving other environmental targets.

Note of caution: the lowest footprint LA is often the poorest, with greatest deprivation and health issues.

The key is targeting the message and finding the right tools.

The EF provides an evidence base for officers to put to politicians. The increase in scrutiny of LAs makes the use of the evidence base more important. Politicians pick up on the EF because it has currency, so prompts questions to officers (politicians are behind their constituents on this).

EF is not the answer to everything; it answers one question, but that isn't the whole story of sustainable production and consumption.

But it does open the door to further analysis, for example on excluded issues such as water consumption.

It is an iterative process to build understanding in the process – it is a pathway not an end point.

It is important to note that, if you are talking about EF in sustainability terms, it only relates to the environmental aspect of sustainability, not the social or economic aspects. It can provide a gateway to other analyses.



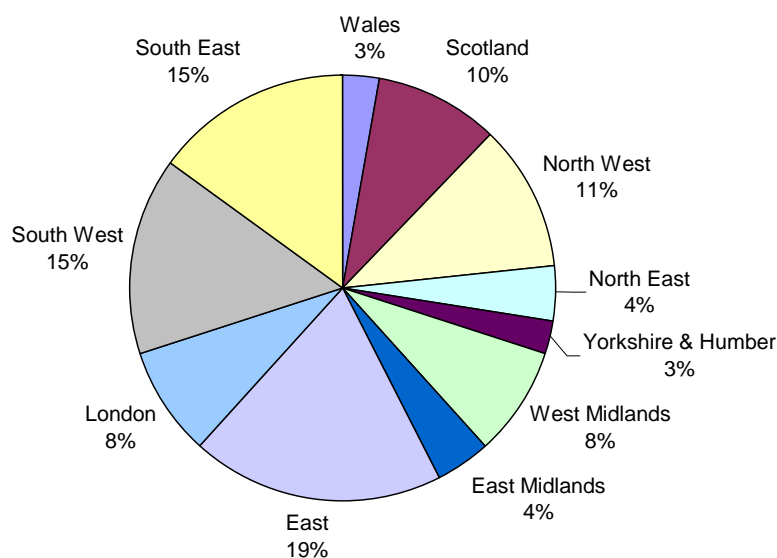
## Annex 2: Results of local authority consultation

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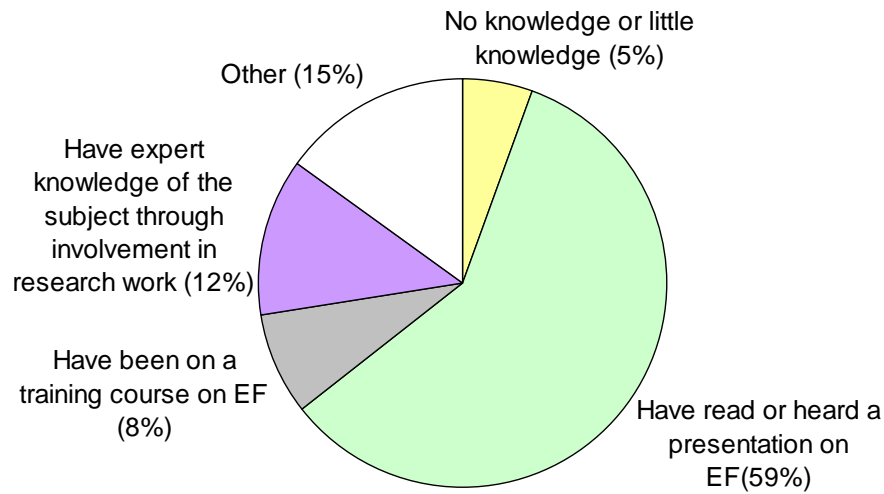
160 local authorities were contacted across England, Wales and Scotland. The sample was not selected on a statistical basis, it focused on authorities known to have an interest in footprinting together with additional authorities selected at random. Responses are likely to be skewed towards the authorities most familiar with ecological footprinting. Nevertheless, the results provide a useful qualitative snapshot of the awareness of, and use by local authorities of the footprint.

Responses were received from 73 local authorities, including county and district councils and unitary authorities, giving a high response rate of 46%. The largest number of responses was received from East Anglia (19% of responses); responses from the South East and South West England each accounted for 15% of the total. Wales and Scotland provided 3% and 10% of the responses respectively.

### Location of Local Authority Respondents



1. **How knowledgeable do you consider yourself to be on ecological footprinting?**



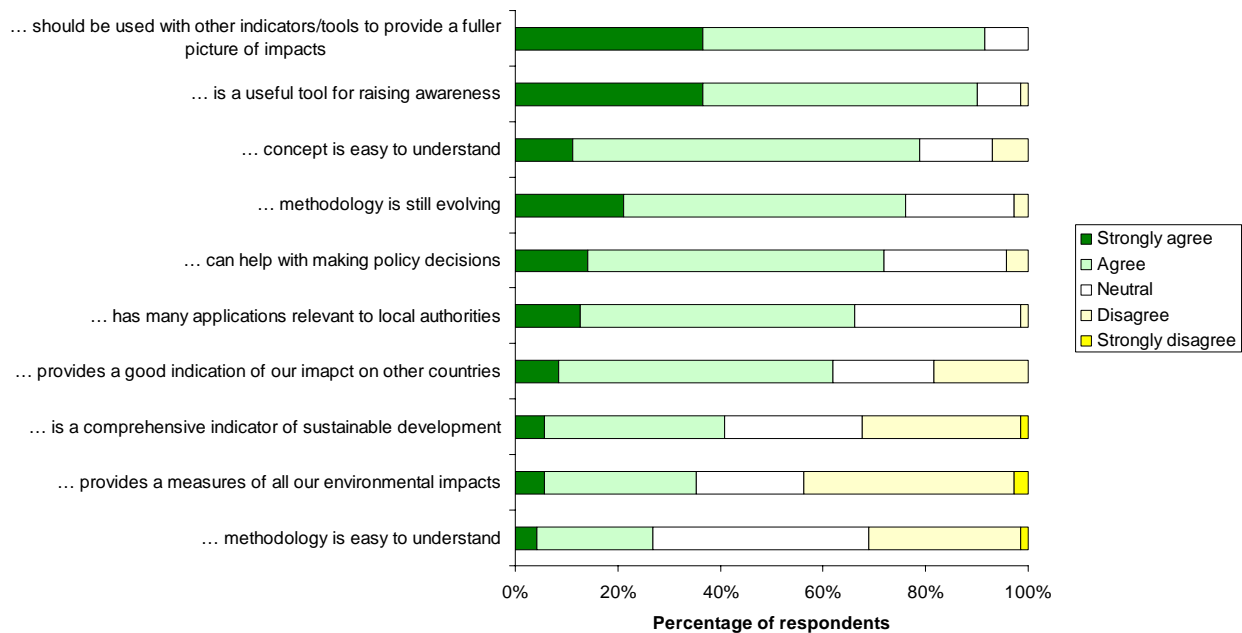
All 73 respondents answered this question. The majority (59%, or 43 respondents) had read or heard a presentation on ecological footprinting, whilst nine respondents (12%) have expert knowledge of the subject through involvement in research work.

Only 5% (4 respondents) had little or no knowledge of ecological footprinting. This result is to be expected, based on the sample selected and the higher likelihood of those working with ecological footprinting to respond to such consultation (compared to those who are not).

Eleven respondents (15%) listed *other*, which included:

- appointed/working with consultants to perform and support data provision (5);
- working with ecological footprint on a regular basis (2);
- research and comparison performed against carbon footprinting (2);
- reasonable knowledge and understanding of the ecological footprint, but not an expert as such (1); and
- knowledge gained from academic studies (1).

**2. Please indicate the extent to which you agree with the following statements: The ecological footprint ...**



This question was answered by 71 respondents. There was most agreement with the statements:

- the ecological footprint should be used with other indicators/tools to provide a fuller picture of impacts (37% strongly agreed, 55% agreed); and
- the ecological footprint is a useful tool for raising awareness (37%, 53%).

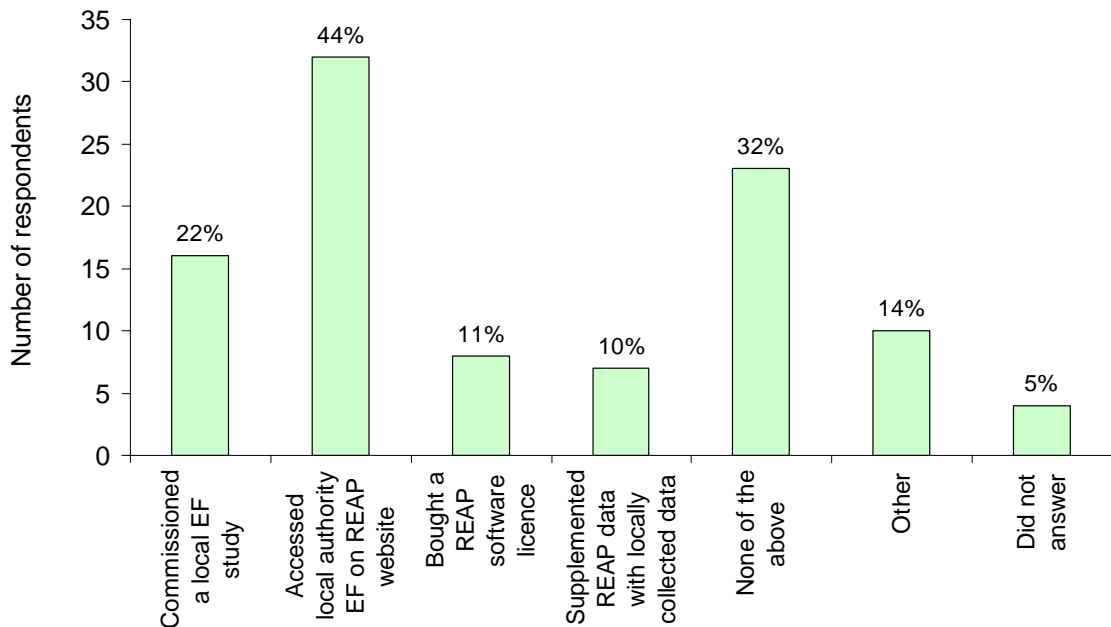
In addition, 72% of respondents either agreed or strongly agreed that the ecological footprint can help with making policy decisions.

The answers were generally consistent, with most respondents disagreeing with the statements that:

- the ecological footprint provides a measure of all our environmental impacts (3% strongly disagreed, 41% disagreed); and
- the ecological footprint is a comprehensive indicator of sustainable development (6%, 35%).

In addition, 31% of respondents disagreed that the ecological footprint methodology was easy to understand, with a further 42% remaining neutral on the subject. Only 27% agreed or strongly agreed that the methodology was easy to understand.

### 3. Has your local authority done any of the following...?



Out of the 73 respondents, 44% (32 respondents) had accessed their ecological footprint using the REAP website and 22% (16) had commissioned a local ecological footprint study. At this stage (bearing in mind that REAP is relatively new), 11% (8) had bought a licence for the REAP scenario manager software (or obtained one through commissioning a local study) and 10% (7 respondents) had used locally collected data to supplement the REAP ecological footprint data.

Twenty three respondents (32%) felt that none of the statements were directly relevant and four respondents (5%) did not answer this specific question.

Ten respondents made other statements regarding their use of the ecological footprint, which included:

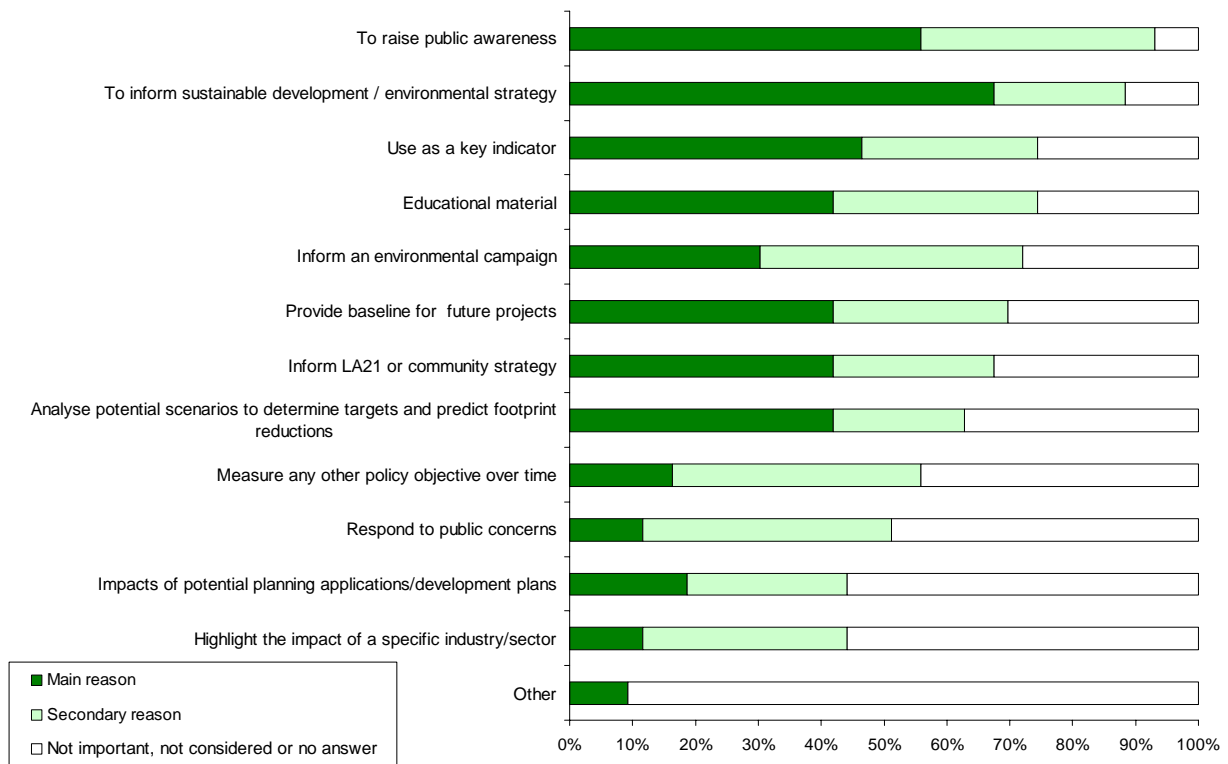
- four local authorities are still considering undertaking / commissioning the development of an ecological footprint;
- two local authorities had undertaken carbon footprinting;
- use of a Quality of Life survey, as well as use of European Common Indicators ecological footprint tool developed by Best Foot Forward;
- aggregation of district level data (from REAP) to county level; and
- a community based project involving all primary schools and the general public.

The local authorities that have supplemented REAP data with locally collected information have used:

- carbon emission data from AEA and DTi;
- transport data (passenger kms/mode) and waste data;

- air travel data from the Civil Aviation Authority;
- data from the Environment Agency and other government departments and local organisations, the NRU, Census, IMD and other data based services;
- consumption data that included energy, transport, food and drink, regional demography, services and waste production;
- quality of life indicators, sustainability indicators such as the Strategic Environmental Assessment and Sustainability Appraisal Local Agenda 21, and the Sustainable Community Strategy work;
- population and household occupancy and vehicle ownership; and
- socio-economic and residential fabric data.

#### 4. What the main reasons for using the ecological footprint in your local authority?



When asked to provide reasons for using the ecological footprint, 43 local authorities responded and 30 did not reply. The three main reasons for using the ecological footprint were to:

- inform sustainable development or environmental strategy formation (67% or 29 respondents);
- raise public awareness (56% or 24); and
- use it as a key indicator (47% or 20).

The three key secondary reasons for using the ecological footprint included:

- to inform an environmental campaign (42% or 18);
- to measure any other policy objective over time (40% or 17); and
- to respond to concerns raised by the public (40% or 17).

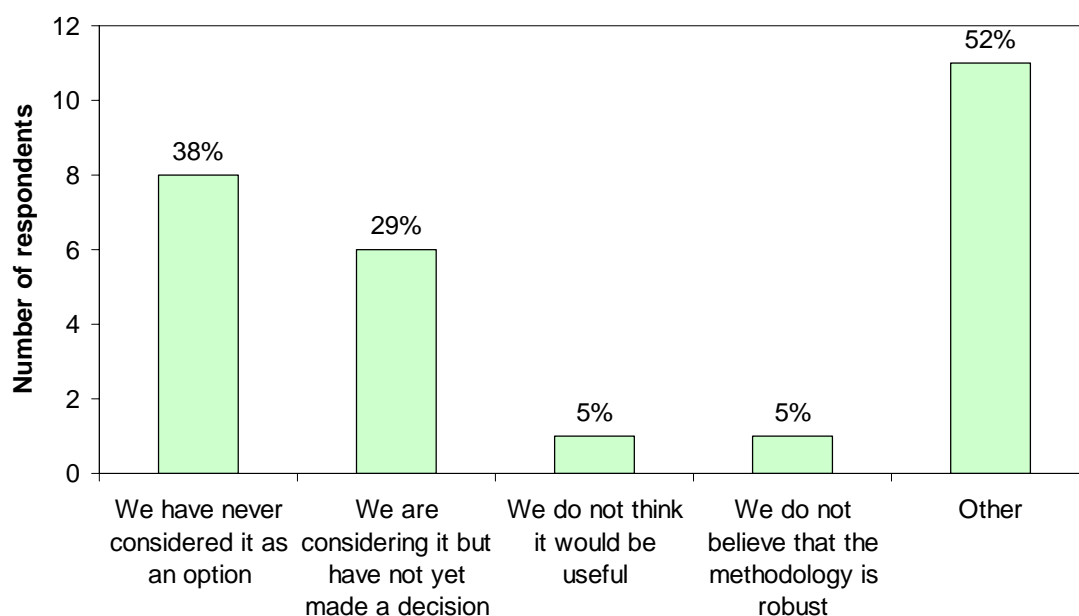
Of the reasons considered not important or not considered, the following three were the most common:

- to highlight the impact of a specific industry or sector (44% or 19);
- to rate the impacts of potential planning applications or development plans (40% or 17); and
- to respond to public concerns were the least likely main reason given by local authorities for using the ecological footprint (35% or 15).

The following are some more specific reasons given by local authorities for using the ecological footprint:

- use one tool within policy development scenarios, projecting both ecological footprints and carbon footprints;
- explore the information and methodology and determine how best to use it;
- meet government targets/indicators with a single means of assessing progress;
- in other areas such as planning and policy development; and
- in strategic environmental assessment (SEA) / sustainability assessment (SA).

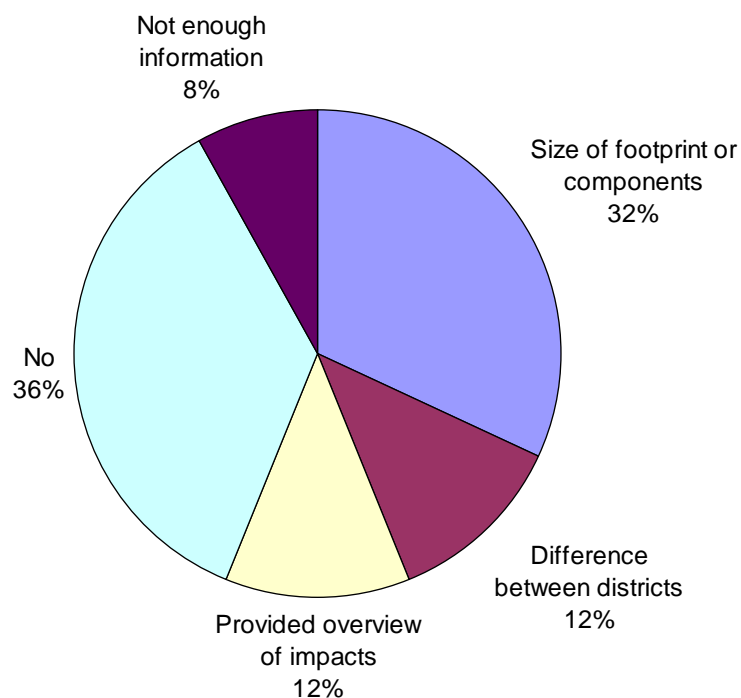
## 5. What are your reasons for not having used ecological footprinting studies?



Out of 21 who responded to this question, 38% (8 local authorities) have never considered the ecological footprint as an option; 29% (6 local authorities) are currently considering it; 1 respondent does not think it would be useful; and 1 respondent does not believe the methodology is robust. 52% (11) provided the following other reasons:

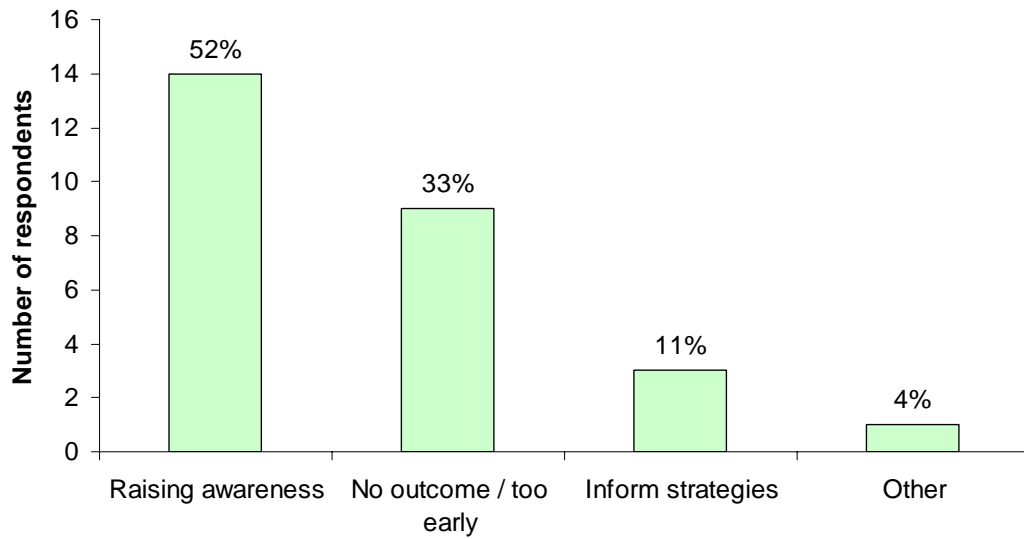
- five local authorities stated that time and resources were limited, or there are other priorities;
- it is matter of working out which service area to employ it and how useful it would be;
- ecological footprint is on the agenda, but has as yet not been addressed; and
- consider it to be important and will undertake a training course.

**6. Did any of the results from your ecological footprint surprise you or provide any new insights?**



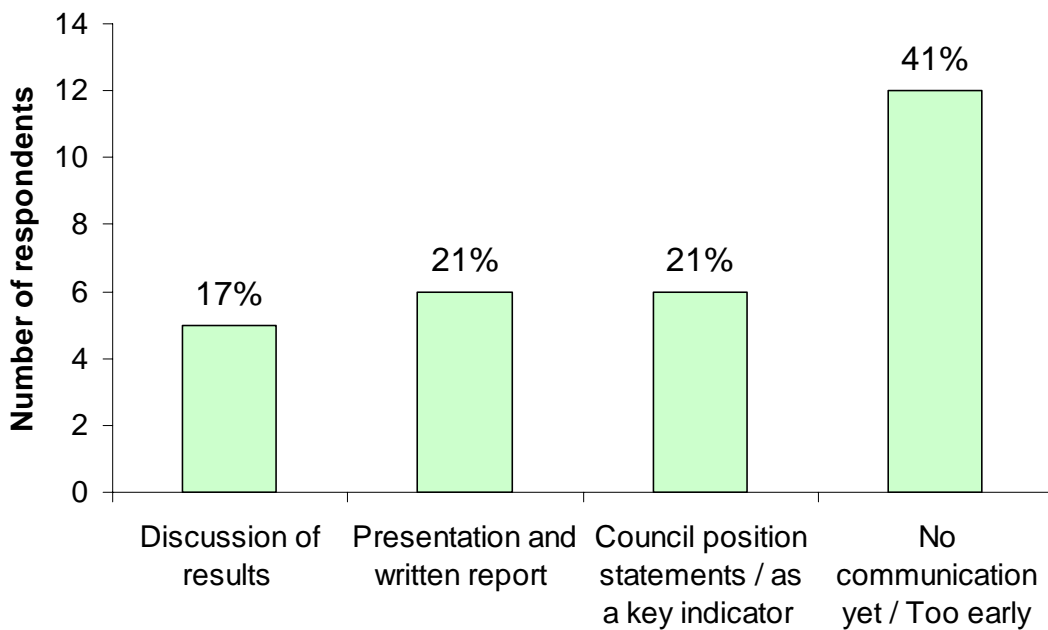
25 local authorities answered this question. Eight respondents (32%) were surprised by the size of the footprint, especially of food (high) and transport (low); 3 respondents (12%) learnt about the difference between districts (in their county); and 3 respondents (12%) considered that it provided an overview of impacts. Nine respondents (36%) were not surprised and their results were as expected and two respondents felt that it did not provide enough information.

**7. What has been the most successful outcome from using the ecological footprint?**



Twenty seven local authorities indicated which outcome was the most successful from using the ecological footprint. Fourteen (52%) believed that it helped with raising awareness amongst the public and politicians; nine (33%) have had no outcome as yet or this question was not applicable to them; three (11%) used the footprint as a comprehensive view of the regional/ local scale to inform current and future strategies.

**8. How have you communicated the results to policy makers? Which methods are most successful?**



Twenty nine out of 73 local authorities responded to this question. The following are some of the methods employed to communicate the ecological footprint results to policy makers:

- presentation and written report (6 or 21%);
- discussion of results with policy makers, sustainability teams and heads of local strategies services (5 or 17%);
- through council position statements or as a key indicator for measuring sustainability efforts (6 or 21%); and
- have not yet communicated the results or it is still too early and are awaiting for results to be disclosed (12 or 41%). One local authority further expressed that it was too early to engage policy makers, due to a lack of time and resources and a lack of definitive examples of the clear environmental benefits from using the ecological footprint. Another responded that they distrusted the approach altogether.

**9. Have the results of the ecological footprint influenced policy decisions? If yes, please provide examples.**

Twenty nine respondents answered this question; 76% of these indicated that the ecological footprint had not yet influenced a policy decision. Their responses included:

- hope to in future;
- not able due to a lack of personnel and financial constraints;
- not specifically, but it has helped raise awareness for the sustainability agenda;
- no mechanism has been established to influence policy decisions yet.

The seven local authorities (or 24%) who answered yes stated that:

- the ecological footprint is adapted as a key indicator from which further footprint targets have been integrated into the local action plan of the community strategy;
- currently receiving requests for extended studies to see how certain decisions will impact future planning;
- areas identified where the ecological footprint has or will have an impact include land use planning, transport and the sustainable development strategy;
- it is helping to investigate their future direction in terms of environmental strategy;
- allows the sustainability living objective to be integrated in the community plan;
- the footprint scenarios for a large development have helped to inform their guidance for sustainable housing; and
- the ecological footprint results and the CO<sub>2</sub> emission results are mainly used to update the transport policy on measures for congestion charging.

**10. Have you experienced problems with using the ecological footprint in your local authority? If yes, please specify.**

The following statements were made by some of the 29 local authorities that answered yes to the question whether they experienced problems with using the ecological footprint:

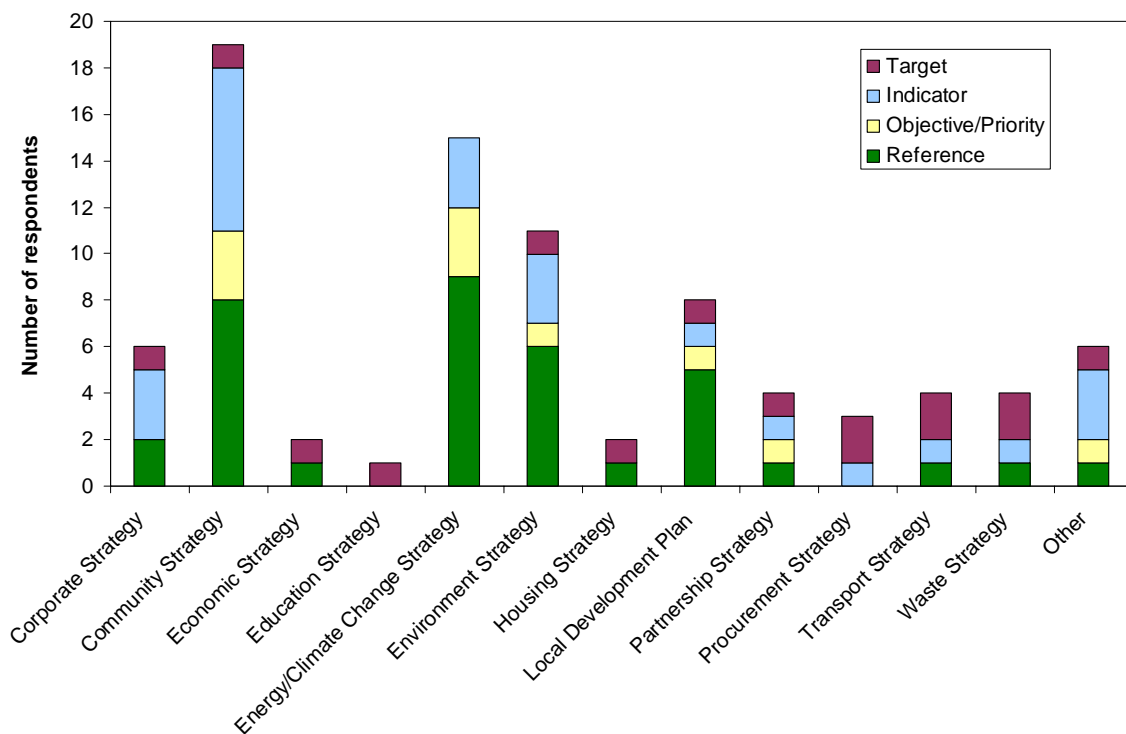
- lack of understanding of how to deliver change;
- unsure whether it truly represents the local situation;
- difficulty in getting others to take it seriously as a consideration in policy formation;
- there is no sustainability team in place to take this forward to the community strategy;
- no funding to purchase REAP software, which would be helpful to monitor how the ecological footprint is changing over time or the impact of different development scenarios;
- not able to use it as a performance indicator in LAAs or the community strategy, since data from REAP and WWF are based on regional data;
- yearly reporting of the data is not possible at present, and so it remains a one-off high level indicator at present;
- communicating the fact that the main benefits of the footprint is an 'end product' activity, and a lot of detailed data is hidden behind the various outputs;
- the ability to stress its importance in future policy making and to target the most significant impact areas;
- no resources to purchase the REAP licence and to get access to more detailed data;
- lack of robustness of the data;
- use of national averages reduces accuracy at a local level;
- not enough focus on economic or social factors;
- confusion over whether to focus on ecological footprint or carbon footprint;
- unsure as to the source of the data, results in a lack of trust of results; and
- senior managers using it as a technical tool for monitoring and appraisal rather than using it as a driver for policy at high level formulation.

**11. If you have experienced problems, how have you overcome these?**

Fifteen local authorities overcame any problems in the following way:

- working closely with SEI;
- by linking it with existing sustainability indicators and targets, which is a step towards developing a 'one size fits all' approach as not everyone fully understands the 'ecological' concept when considering services such as housing and social care; and
- to encourage more detailed REAP work.

**12. Is the Ecological Footprint referred to or used in any of the following ways in your current local authority strategies?**



Out of 73 participants, 41 local authorities responded. The majority of local authorities did not include the ecological footprint in their strategies (64%).

The strategies suggested included corporate, community, economic, education, energy / climate change, environment, housing, local development, partnership, procurement, transport and waste strategies.

In terms of the types of strategies employing the ecological footprint, the most common were:

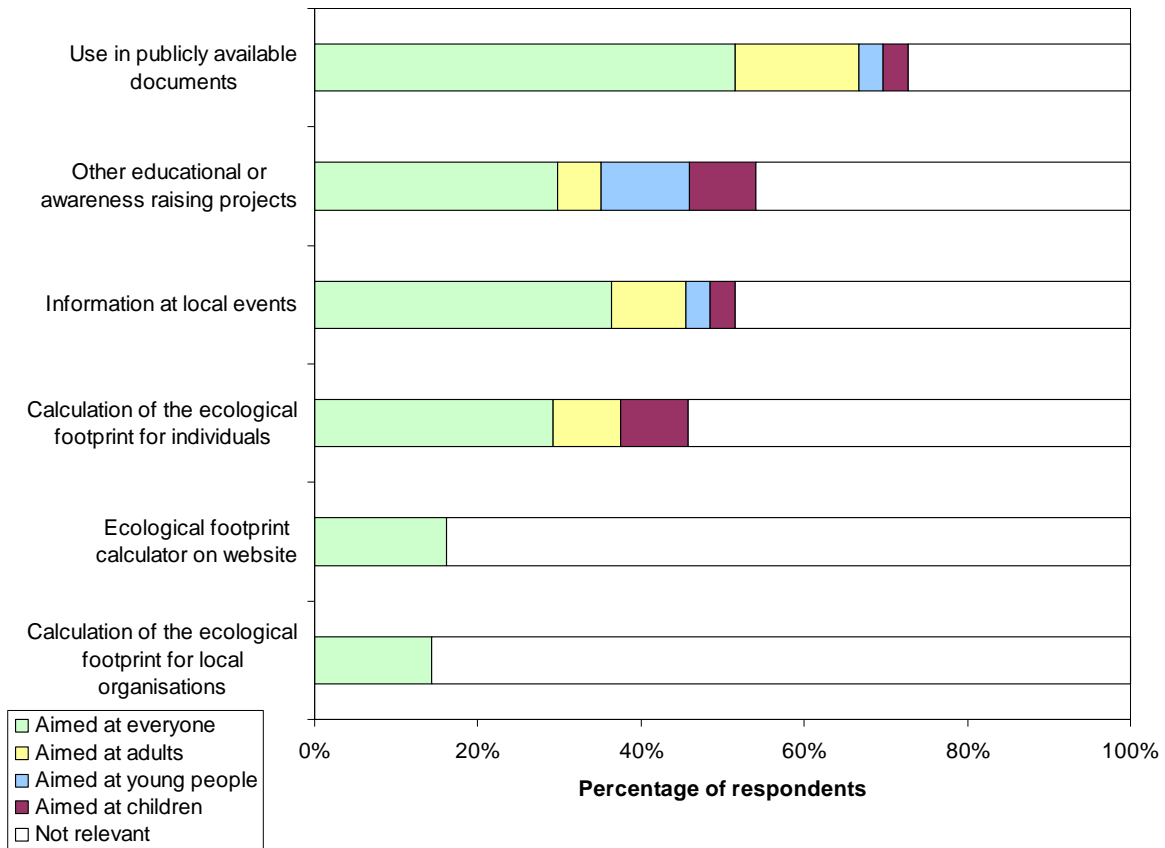
- community strategies;
- energy/climate change strategies;
- environment strategies; and
- local development plans.

Six local authorities listed *other* strategies, which included:

- local area agreement, where ecological footprinting is included as an indicator;
- strategic environmental assessment / sustainability appraisal of local development documents;
- mentioned in the local development framework annual monitoring report and sustainability appraisal/ SEA scoping report;
- annual monitoring report on quality of life; and

- the footprint is an indicator within the Council Sustainable Development Statement, for which one of the key targets is to reduce our footprint.

### 13. How has your local authority applied the ecological footprint to education and awareness-raising projects?

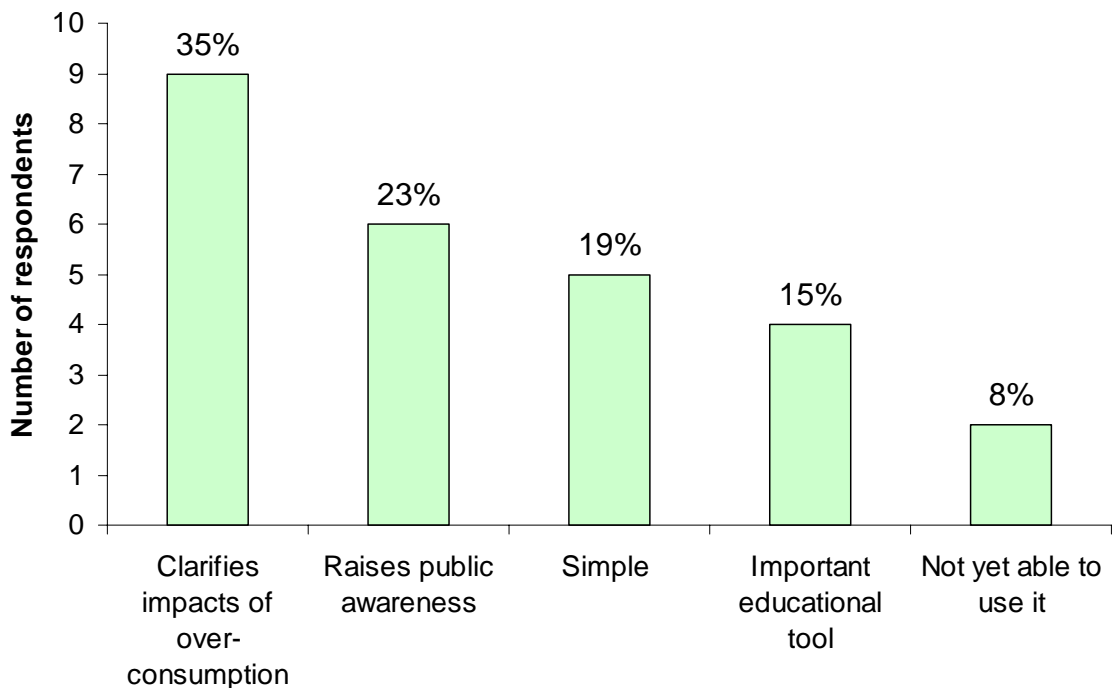


When asked to provide information on how the ecological footprint was applied to education and raising awareness projects, 30 local authorities responded. The three main ways the ecological footprint was applied and which were aimed at everyone were in:

- publicly available documents such as leaflets, reports, which were aimed at everyone (17 respondents or 60%);
- providing displays and/or information at local events (12 respondents or 48%); and
- through other educational or awareness raising projects (10 respondents or 45%).

Providing an ecological footprint calculator on their website and undertaking projects to calculate the footprint of local organisations were the predominant activities that local authorities felt were the most irrelevant (14 respondents).

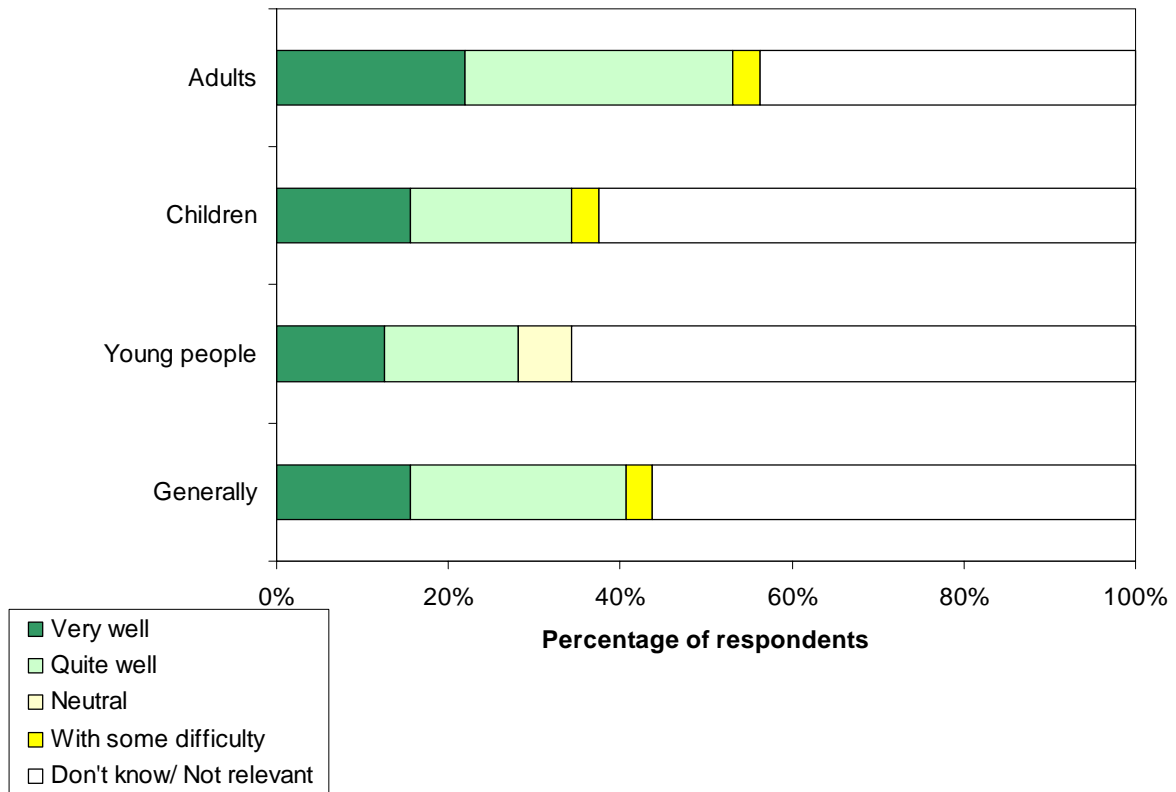
**14. What do you believe to be the educational value of the ecological footprint?**



Twenty six local authorities commented on the educational value of the ecological footprint. Two local authorities (8%) stated that they are unable to use the footprint effectively, but believed there would be significant benefits. The three main benefits it provided was its ability to:

- raise awareness of environmental impacts to the public (6 respondents or 23%);
- clarify the impacts of over-consumption and put them into a tangible, measurable context (9 respondents or 35%);
- provide a simple picture of current consumption that can be understood by a wide variety of age groups (5 respondents or 19%);
- operate as an important education tool (4 or 15%)

**15. How were the ecological footprint and its results received by your target audiences?**

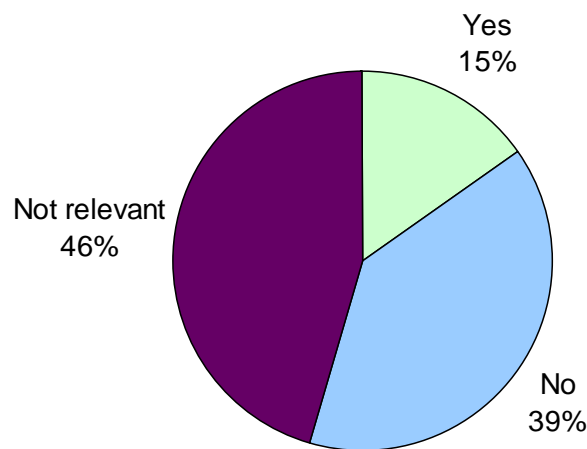


When asked how the results of the ecological footprint were received by target audiences, 31 local authorities responded. The following are some of the conclusions that can be drawn:

- adults seemed to be the most receptive target audience, as ten local authorities (33%) felt that they took to the results *quite well* and seven local authorities (23%) they took the results *very well*; only one local authority (3%) believed there was some difficulty;
- children took to the results *very well* according to 5 local authorities (17%) and *quite well* for 6 local authorities (21%); only one local authority (3%) believed there was some difficulty; and
- generally speaking, results were *very well* received from 5 local authorities (17%) and *quite well* from eight local authorities (27%); only one local authority (3%) believed there was some difficulty.

However, the vast majority of local authorities were unaware of the reception across target audiences or did not feel this to be relevant to them.

**16. Have you tried to monitor the effects of your educational projects or campaigns?**



Out of 33 local authorities, 13 (39%) stated that they did not monitor the effects of their educational projects or campaigns, only five local authorities (15%) answered yes, and 15 (46%) stated this was irrelevant to them. Forty respondents skipped this question.

**17. If yes, how did you do this and what did the results show?**

The following are statements from the five local authorities that answered yes to the previous question on monitoring the effects of the ecological footprint:

- through people completing an ecological footprint questionnaire;
- updates on reports year on year;
- feedback from teachers in terms of comprehension and motivation for children;
- performed a survey and a follow-up survey with the council's staff. The results were varied, and many of the participants did not complete a final follow-up questionnaire. However, those who stuck with the project did see successes in reducing their footprint and increased understanding of the issues; and
- Although the ecological footprint was not directly used, a project was established in a partnership with three other neighbouring local authorities that encouraged five families in each area to undertake a series of activities for a number of different sustainability issues (i.e. buying locally/fairtrade, transportation, energy use,). People's understanding and behaviours were monitored prior to and after the activities. Many of those directly involved in the project did show behavioural change towards becoming more aware of issues and taking more sustainable decisions.

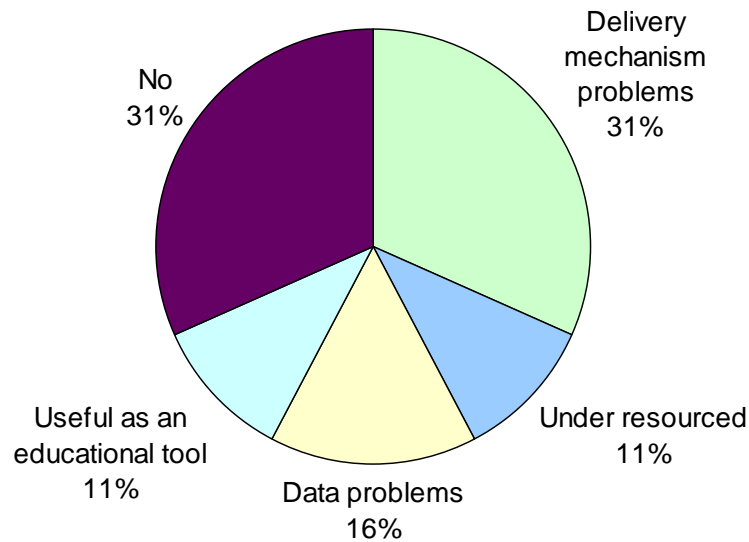
Although it has not really been possible to gage any level of change in behaviour. Though hopefully it will have raised awareness of these issues.

**18. If no, why was this?**

Nine out of 13 respondents (69%) stated that the reason they have not monitored the results of education programs was due to a lack of resources. The four other answers were:

- We are early in the process of getting the ecological footprint accepted as a concept.
- Although there was general feedback on the level of understanding and commitment, there was no monitoring of the impact on outcomes arising from the understanding, which would need to be associated with a specific campaign.
- A follow-up project did measure impacts and showed a reduction in energy use and travel and increased recycling.
- We have just finished the project and have not yet had the opportunity to monitor the results.

**19. Is there anything that you would do differently or any advice that you would offer to other local authorities using the ecological footprint?**



Out of 21 respondents, six stated that they would not do anything differently or had no advice to provide on using the ecological footprint. Six local authorities (31%) experienced problems with the delivery of ecological footprinting; two (11%) felt they were constrained by a lack of time, staff and resources; three (16%) who believe the data was not detailed or relevant for

more localised issues; and two respondents (11%) believed it was a very useful educational tool.

The following statements were from the local authorities who stated there were problems in the *delivery mechanism*:

- effective integration into decision making requires the careful assessment of assumptions and clarity of broad goals, directions and targets;
- the complexity of its use as an indicator should not be underestimated as this leads to a lot of work explaining and preparing audiences in what should and should not be done in terms of consumption habits;
- language used tends to marginalise the concept (i.e. 'ecological' rather than 'environmental' footprint), more effective to talk about in terms of 'resource efficiency' especially when integrating it into economic strategies.;
- lack of support from authorities due to it not being 'officially recognised' by Defra/SEERA/SEEDA; and
- requires capacity building, especially awareness raising. For this, local authorities should refer to WWF's publication 'EF: Taking the first step – a how to guide for Local Authorities', published in 2006.

The following statements were from the local authorities who stated there were problems from being *under resourced*:

- desirable tool but difficult to achieve through lack of time and staff resources; and
- must be government-lead, requires most senior officers and members on-board at an early stage.

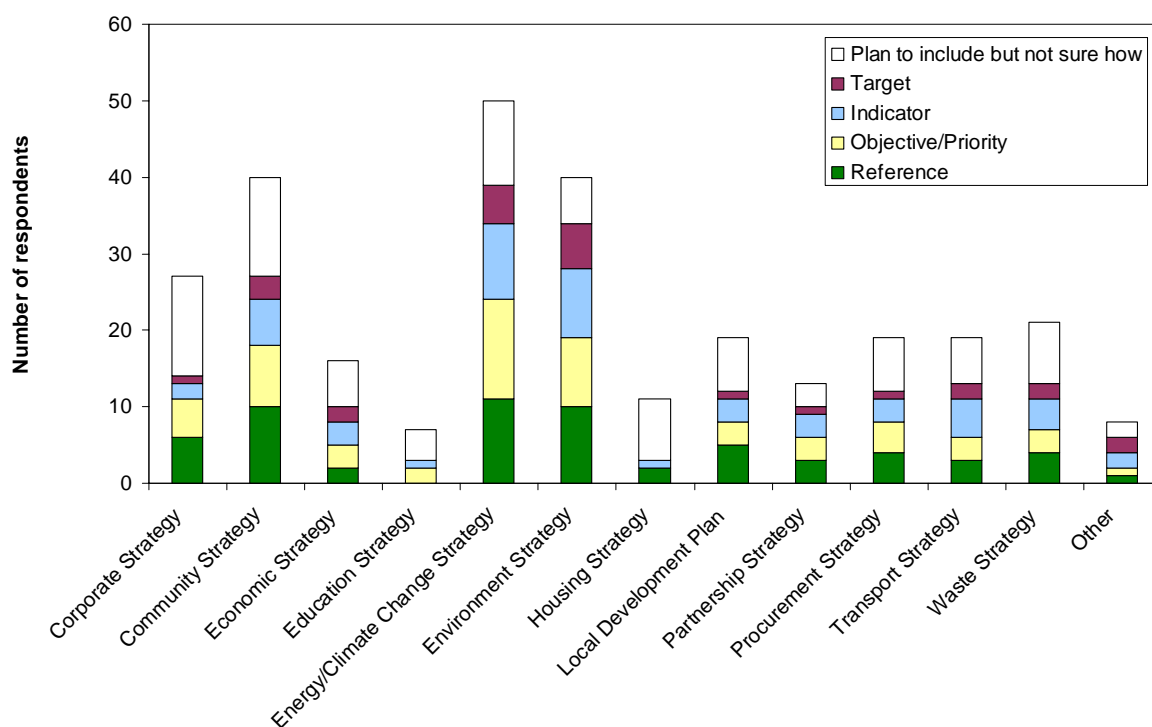
The following statements were from the local authorities who stated there were problems with the *data*:

- a particular methodology should not be blindly followed or investment into one system until there is a guarantee that it will assist all the necessary functions. Reap does not always fit appropriately and additional studies may be needed to understand the environmental impact of a service;
- lack of ability to access data at a local level (e.g. food miles and figures for import);
- data needs to be extrapolated and interpolated for certain services;
- unless the data is relevant to a local scale, the ecological footprint indicator should not be embedded in performance management. Best use of data is with organisations for whom consumption data is available and internal targets can be set; and
- data is from national data sets and reliant on central funding from Defra to continue. The ecological footprint monitors long term trends so will not immediately show the impacts of a policy decision at a strategic level. It is therefore best matched with specific neighbourhood based campaigns which provide bottom up data and more immediate indicators of change.

The following statements were from the local authorities who stated there it was useful as an *educational tool*:

- helps to get people thinking about issues; and
- promotion of the 'personal footprint calculator' as a learning tool for adults and as part of the national school curriculum.

**20. Are there plans to refer to or to use the ecological footprint in FUTURE local authority strategies?**



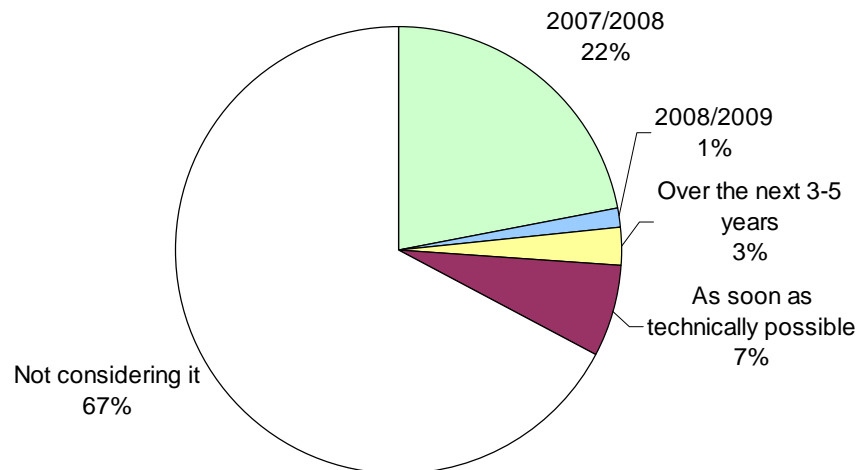
Out of 73 participants, 52 local authorities responded. Respondents may include the footprint within strategies as a reference, an objective or priority, an indicator and/or a target. Some may have plans to include the footprint but are not sure how to do so at present. Respondents could provide more than one response for each type of strategy therefore percentages are not given.

The most likely strategies to include the ecological footprint in the future are:

- energy/climate change strategy (11 will reference ecological footprinting, 13 will include it as an objective/priority, 10 as an indicator, 5 as a target and 11 plan to included it but are not sure how);
- environmental strategies (10 will reference ecological footprinting, 9 will include it as an objective/priority, 9 as an indicator, 6 as a target and 6 plan to included it but are not sure how); and

- community strategies (10 will reference ecological footprinting, 5 will include it as an objective/priority, 6 as an indicator, 3 as a target and 13 plan to included it but are not sure how).

**21. If relevant, what is the expected timescale for including the ecological footprint in the future strategies?**



Of the 73 respondents to the questionnaire, 24 (33%) gave an expected timescale for including the ecological footprint within future strategies. The majority of these (16, 22%) indicated that they would include the ecological footprint in strategies during 2007/2008, other respondents had slightly longer timescales. Five respondents (7%) stated that they would include footprinting when their strategies had been fully reviewed, or they were still waiting for the results of their research.

**22. Do you expect any barriers to including the ecological footprint in future strategies?**

From the 73 participants, 30 local authorities responded to this question. Five participants (17%) stated that there were no barriers to including ecological footprinting in future strategies. Those that believed barriers existed made the following statements:

- it does not sit neatly within the local authority strategies structure as there is insufficient level of detail in the data;
- data availability and interpretation at a project level;
- ignorance of how to use and apply it, and fear of the implications it raises;
- resources constraints;
- lack of local political awareness and support;
- training and workshops across the council and community planning partnerships required to successfully include in future strategies;
- distrust of information and process; and

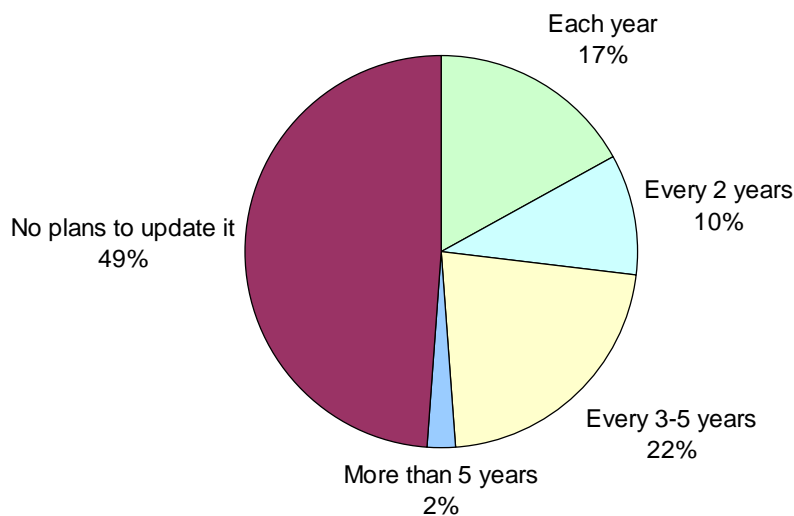
- difficulty in focusing targets.

**23. Do you have any other plans for using the ecological footprint in the future?**

Nineteen local authorities responded to this question. The following are some of the plans suggested for using the ecological footprint:

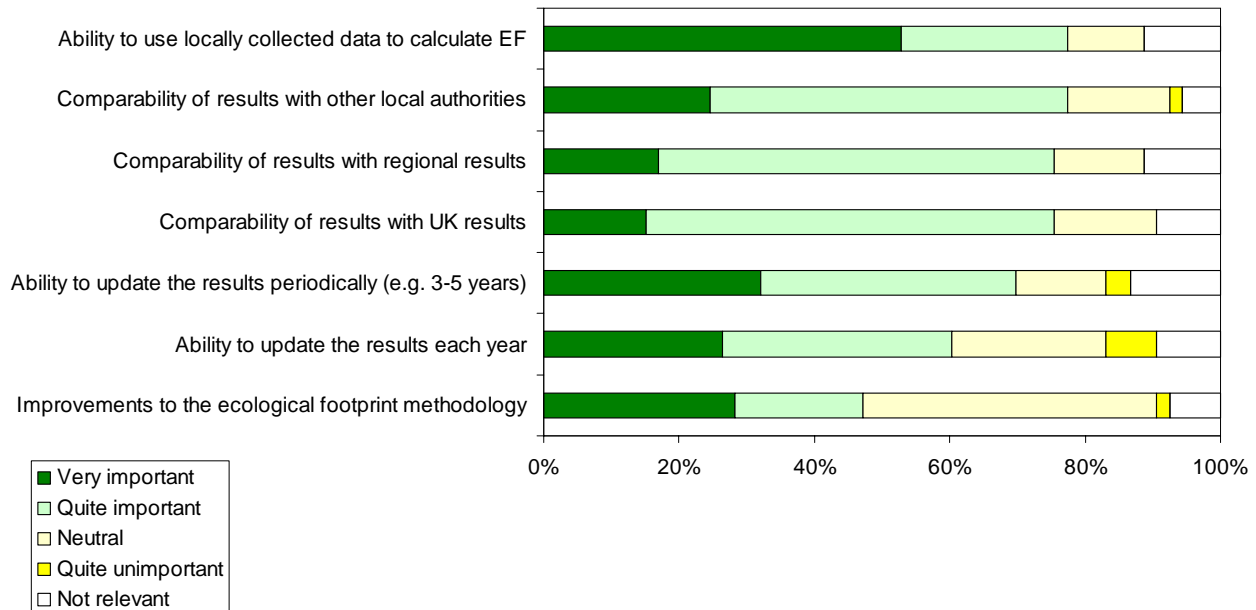
- as a policy assessment tool;
- awareness campaigns either through the local paper, in schools, directly to council staff, and within partnership groups;
- if the National Government impose it;
- as a possible tool for monitoring climate change, and corporate performance;
- trial run of the REAP software; and
- developing a permanent footprint officer position within the council.

**24. How often do you expect to update your ecological footprint?**



41 local authorities responded to this question. Nine respondents (22%) expect to update their ecological footprint every 3 to 5 years. Seven respondents (17%) said they would do this on a yearly basis; while four (10%) expect to update their results every two years. However, 20 participants (49%) do not have any plans to update their ecological footprint.

**25. Please indicate the importance of the following issues, in relation to your local authority's use of ecological footprinting**



53 responses were received to this question. The main issues of importance to local authorities included:

The two main issues of importance to local authorities are:

- the ability to use locally collected data to calculate the ecological footprint:
  - % 28 respondents (53%) considered this to be *very important*, and
  - % 13 respondents (25%) considered this to be *quite important*.
- comparability of results with other local authorities;
  - % 13 respondents (25%) considered this to be *very important*, and
  - % 28 respondents (53%) considered this to be *quite important*.

Improvements to the ecological footprint methodology were of least importance, however the largest number of respondents (23, 43%) were neutral on this issue. This suggests that respondents may not fully understand the methodology in order to identify whether improvements are important or not.

**26. If you consider improvements to the methodology to be quite or very important, please indicate what improvements you would like to see.**

17 local authorities responded to this question. Suggestions included:

- Application tailored to the structures of local authority (waste in particular), exemplars of integrated policy development (corporate strategy, community strategy, business planning targets etc.), exemplars of integration into strategic environmental activity such as sustainable

development strategies etc. (useful techniques and tips to support realistic data input and useful applied outputs). Guidance manual and 'teach yourself' REAP guide; easier application of REAP on council IT systems.

- Simpler process – invariably decisions on environment select lowest ecological footprint anyway, but lack numerical evidence to demonstrate this. Process could be two stage – first stage qualitative, second stage quantitative.
- There needs to be more transparent approaches to footprint calculations and the methodology needs to be more robust with input output criteria in the models not being moved around different categories as more information becomes available.
- Compatibility with NETCEN carbon emissions monitoring methodology.
- There still seems to be a number of methodologies out there. It would be good if it was agreed that there was one that was recognised as a national standard and guidance/training was available to local authorities on how to develop their own.
- A single process – not a huge choice of tools and less reliance on IT based methodologies. These cannot pick up on local anomalies. More access to local data without the need to extrapolate or interpolate.
- The footprint needs to capture more than CO<sub>2</sub> emissions. It doesn't consider social and economic issues more detailed and local information;
- additional funding;
- provide more on-line support, and make REAP training readily available and affordable;
- easy to update with local data without compromising the ability to easily update annually or periodically;
- continued investment in the refinement of the methodology; and
- further development of REAP in relation to policy appraisal and the application of eco-budgeting at a neighbourhood level especially in relation to regeneration.

## **27. Additional comments**

- My role is to develop ecological footprinting, in particular through the REAP tool. I am planning to focus this in the context of my second role which is developing an environmental management system within the authority. I believe that once the initial baseline review is undertaken, REAP can be used to support prioritisation, and integrated thinking for developing measurable improvement plans across the authority.
- Ecological footprint is of limited use to the area as it does not reflect sustainable development. It omits socio-economic factors.

- We chose to become a member of the Global Footprint Network in order to work collaboratively with other partners on developing the footprint and its application in the public sector in our region.
- Having district data amalgamated to give county level data would be extremely useful, and especially given our resources constraints (when we could be promoting the results). Plus county councils are more likely to do something with the footprint data, they have a more strategic role and the footprint results are probably more meaningful at the larger scale represented by the county. People often relate to their county in a way they don't to a district or region – as one of the main applications of the ecological footprint is as a communications tool, this is vital.
- As with most indicators, it is a useful means of assessing the environmental impact but for a fuller understanding it is necessary to 'look behind the figures'. As such it would help to advise decisions, along with other relevant data/factors.
- Not much point in measuring it annually, as it takes a massive change to alter the footprint size.
- An annual or at least three year update of the EF is critical.
- There would appear to be a number of approaches/initiatives looking at footprinting, which causes a degree of confusion. Without a clear understanding of how the footprint is calculated it is unclear what measures are needed and where to focus activity. Regional work, coming down to local authority area, seemed to be based largely on household expenditure. This may provide an indication of impact on the global environment but is unlikely to reflect local changes accurately.
- Removing CO<sub>2</sub> emission data from the Best Value Performance Indicator (BVPI) basket seems a retrograde step. I understand that there was wide ranging concern about the ability of local authorities to track the information required. BVPI reporting definitely drives service delivery. This doesn't bode well for the more comprehensive picture that could be presented by the ecological footprint. Perhaps a dedicated funding stream could be introduced (similar to Planning Delivery Grant) to enable authorities to appoint dedicated staff. I work in a very small authority where these difficulties are keenest, but where there is great potential for radical reductions in CO<sub>2</sub> emissions, waste and other environmental impacts.
- Too conceptual for many policy makers.
- This could be a useful tool but the present pressure on resources both time and financial means that this is not something that this authority has been able to use.
- If Government makes ecological footprinting relate to a target of local authorities it will be valued. Ecological footprinting is a good umbrella

measure of sustainable development and would help to focus long-term policies in the right direction – best value can sometimes push authorities towards short term gains which are antagonistic to sustainable development.

- This is a very specialist area at the moment with at best only 1 or 2 people in each authority having any knowledge of the topic. It is only in the last 12 months that the topic has become a more general currency (following the publication of the national and regional *Counting Consumption* reports). The Authority sees the wider Ecological Budgeting as essential to build the evidence base for addressing sustainable consumption and production (as highlighted in *Securing the Future*) and with ecological footprinting as an enormously powerful tool to influence the scope, scale and depth of change in society. Even so, the Authority recognises the limitations of using ecobudgeting/ecological footprinting as an indicator for the full sustainability agenda. It works particularly well for the environment sector, and has a substantive impact on the economy and society though yet both unrealised on any scale. However, as individual footprint calculators highlight, it makes no record of other living things (biodiversity and nature conservation) part of the wider 'natural' capital debate and very little indeed to the social capital debate. In sustainability terms, it is essential that these limitations are recognised, as at its heart sustainability is fundamentally a societal issue, not an environmental one.
- I am not convinced of its usefulness but am open to being persuaded otherwise.

## References

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Aall C & Norland IT (nd): **The Applicability of Ecological Footprint in Local Politics and Administration: A Critical Appraisal**, available from [www.prosus.uio.no](http://www.prosus.uio.no).

Allsopp C (2003): **Review of Statistics for Economic Policymaking: First Report to the Chancellor of the Exchequer, The Governor of the Bank of England and the National Statistician**, HMSO, London.

Audit Commission (2005): **Local Quality of Life Indicators – Supporting Local Communities to Become Sustainable**, available from [www.audit-commission.gov.uk](http://www.audit-commission.gov.uk)

Barrett J and Scott A (2001): **An Ecological Footprint of Liverpool: Developing Sustainable Scenarios**, Stockholm Institute, York, available from [www.regionalsustainability.org](http://www.regionalsustainability.org).

Barrett J, Scott A and Vallack H (2001): **The Ecological Footprint of Passenger Transport in Merseyside**, Stockholm Environment Institute, York, available from [www.mersyaside.org/pdf/EFofPassengerTransport.pdf](http://www.mersyaside.org/pdf/EFofPassengerTransport.pdf).

Barrett J and Simmons C (2003): **An Ecological Footprint of the UK – Providing a Tool to Measure the Sustainability of Local Authorities**, report prepared for the Department of Transport and the Office of the Deputy Prime Minister, London.

Barrett J, Cherrett N and Birch R (2004): **Step Change: An Analysis of the Policy and Educational Application of the Ecological Footprint**, Report for WWF, dated March 2004.

Barrett J, Birch R, Cherrett N and Wiedmann T (2005): **Reducing Wales' Ecological Footprint**, Stockholm Environment Institute, York, Report prepared for WWF Cymru, available from [www.walesfootprint.org](http://www.walesfootprint.org).

Barrett J, Minx J, Wiedmann T and Welch A (2006): **Counting Consumption: CO<sub>2</sub> Emissions, Material Flows and Ecological Footprint of the UK by Region and Devolved Country**, WWF-UK, Godalming

Bastianoni S, Galli A, Niccolucci V and Pulselli RM (2006): *The ecological footprint of building construction*, paper presented at International Conference on Urban Regeneration and Sustainability, Southampton.

Bicknell KB, Ball RJ, Cullen R, Bigsby H (1998): *New methodology for the ecological footprint with an application to the New Zealand economy*, Ecological Economics Vol. 27, pp 149-160.

Birch R, Barrett J and Wiedmann T (2004): *Exploring the consumption and related environmental impacts of socio-economic groups within the UK*, presented at the International Workshop on Sustainable Consumption, 5/6 March 2004, School of the Environment, University of Leeds, available from [www.env.leeds.ac.uk/~hubacek/leeds04/5.4%20leeds%20conferences%20paper.pdf](http://www.env.leeds.ac.uk/~hubacek/leeds04/5.4%20leeds%20conferences%20paper.pdf).

BNESC (2007): **Position Statement on Environmental Sustainability**, Bath & North East Somerset Council, dated February 2007.

Bristol Partnership (2006): **Bristol's Community Strategy 2006**, available from [www.bristolpartnership.org](http://www.bristolpartnership.org).

Brody SD and Ryu H-C (2006): *Measuring the Educational Impacts of a Graduate Course on Sustainable Development*, Environmental Education Research, Vol. 12, No.2, pp/179-199.

Bury MBC (2005): **Bury's Community Strategy 2005 – 2025: A Vision for Bury**, available from [www.bury.gov.uk](http://www.bury.gov.uk).

Cabinet Office (2007): **Regulatory Impact Assessment Guidance**, available from [www.cabinetoffice.gov.uk/regulation/ria](http://www.cabinetoffice.gov.uk/regulation/ria).

Chambers N, Simmons C and Wackernagel M (2000): **Sharing Nature's Interest: Ecological Footprints as an Indicator of Sustainability**, Earthscan, London.

Chambers N and Lewis K (2001): **Ecological Footprint Analysis: Towards a Sustainability Indicator for Business**, The Association of Chartered Certified Accountants, London.

Chambers N *et al.* (2004): **Scotland's Footprint - A Resource Flow and Ecologic Footprint Analysis of Scotland**, report prepared for Viridis, Best Foot Forward, Oxford, available from [www.bestfootforward.com](http://www.bestfootforward.com).

Chambers N and Roper F (2007): *Using Ecological Footprinting to Inform Product Design*, paper presented at the International Ecological Footprint Conference, 8-10 May, Cardiff.

Cherrett N, Barrett J, Clemett A, Chadwick M and Chadwick MJ (2005): **Ecological Footprint and Water Analysis of Cotton, Hemp and Polyester**, report prepared for BioRegional Development Group and World Wide Fund for Nature – Cymru, available from <http://www.york.ac.uk/inst/sei/IS/sustain.htm>

Collins A, Flunn A, Munday M and Roberts A (2007): *Assessing the Environmental Consequences of Major Sporting Events: The 2003/04 FA Cup Final*, Urban Studies, Vol. 44, No. 3, pp 457-476.

Collins A, Munday M and Roberts A (2007a): *Comparing the Economic and Environmental Impacts of Major Sporting Events: The RBS Rugby Six*

*Nations and FA Cup Final at Cardiff's Millennium Stadium*, paper presented at the International Ecological Footprint Conference, 8-10 May, Cardiff.

Cranston GR, Hammond GP and Johnson RC (2007): *Exploring the Factors that Influence National Environmental Footprints*, paper presented at the International Ecological Footprint Conference, 8-10 May 2007, Cardiff.

Curry R *et al.* (2004): **Northern Limits – A Resource Flow Analysis and Ecological Footprint for Northern Ireland**, available from [www.bestfootforward.com](http://www.bestfootforward.com).

Curry R, Maguire C, Simmons C and Lewis K (2006): **Northern Limits II**, report in review by EnviroCentre, Belfast.

DCLG (2006): **Strong and Prosperous Communities – The Local Government White Paper**, Department for Communities and Local Government, dated 26 October 2006, available from [www.communities.gov.uk](http://www.communities.gov.uk).

Defra (2003): **Changing Patterns**, Department for Environment, Food and Rural Affairs.

Defra (2004): **Consultation on decoupling indicators: summary of responses**, Department for Environment, Food and Rural Affairs.

Defra (2005): **Securing the Future: Delivering UK Sustainable Development Strategy**, TSO, Norwich.

EAD (Environment Agency Abu Dhabi) (2006): **Ecological Footprint Roundtable Discussion**, Abu Dhabi, United Arab Emirates, March 28, 2006.

Ecolife (2007): *Ecological Footprint and Behavioural Change*, workshop session at the International Ecological Footprint Conference, 8-10 May, Cardiff.

Ecotec (2001): **Ecological Footprinting**, report prepared for the STOA Panel, European Parliament, dated March 2001.

Esty DC, Levy M, Srebotnjak T and de Sherbinin A (2005): **2005 Environmental Sustainability Index: Benchmarking National Environmental Stewardship**, New Haven: Yale Center for Environmental Law & Policy.

European Commission (2006): **Review of the EU Sustainable Development Strategy (EU SDS) – Renewed Strategy**, dated 9 June 2006, available from <http://ec.europa.eu/environment/eussd>

European Commission (2005): **Impact Assessment Guidelines**, European Commission, SEC (2005) 791, dated 15 June 2005, available from [http://ec.europa.eu/governance/impact/docs/SEC2005\\_791\\_IA%20guidelines\\_annexes.pdf](http://ec.europa.eu/governance/impact/docs/SEC2005_791_IA%20guidelines_annexes.pdf)

European Environment Agency (2005): **The European Environment – State and Outlook 2005**, report available from [www.eea.europa.eu](http://www.eea.europa.eu).

Frey SD et al. (2006): *Ecological Footprint Analysis Applied to Mobile Phones*, Journal of Industrial Ecology, Vol. 10, No. 1-2, pp. 199-216.

Global Footprint Network (2005): **National Footprint and Biocapacity Accounts 2005: The Underlying Calculation Method**, available from [www.footprintnetwork.org](http://www.footprintnetwork.org).

Global Footprint Network (2007): **What We Do**, dated March 2007, available from [www.footprintnetwork.org](http://www.footprintnetwork.org).

Global Footprint Network (2006): **Ecological Footprint Standards 2006**, a project of the Global Footprint Network Standards Committee, available from [www.footprintnetwork.org](http://www.footprintnetwork.org).

Global Footprint Network (2006a): **Ecological Footprint and Biocapacity, Technical Notes: 2006 Edition**, available from [www.footprintnetwork.org](http://www.footprintnetwork.org).

Global Footprint Network (2006b): **2006 Annual Report**, available from [www.footprintnetwork.org](http://www.footprintnetwork.org)

Hails C (ed.) (2006): **Living Planet Report 2006**, WWF International, Gland: Switzerland.

Haines-Young R, Potschin M, and Cheshire D (2006): **Defining and Identifying Environmental Limits for Sustainable Development**, A Scoping Study, Final Overview Report, Defra, Project Code NR0102.

Hammond GP (2006): *'People, Planet and Prosperity': The Determinants of Humanity's Environmental Footprint*, Natural Resources Forum, Vol. 30, pp. 27-36.

Hannigan-Popp M, Harding C and Duncan K (2007): *Measuring and Managing Industrial Estate Environmental Performance: A Comparison of Case Studies*, paper presented at the International Ecological Footprint Conference, 8-10 May, 2007.

Herva M, Franco A, Ferreiro S, Álvarez A and Roca E (2007): *An Approach for the Application of the Ecological Footprint as an Environmental Indicator in the Textile Sector*, paper presented at the International Ecological Footprint Conference, 8-10 May, Cardiff.

Holden E and Høyer KG (2005): *The Ecological Footprints of Fuels, Transportation Research Part D: Transport and the Environment*, Vol. 10, Part 5, pp 395-403.

Hunter C and Shaw J (2007): *The Ecological Footprint as a Key Indicator of Sustainable Tourism*, Tourism Management, Vol. 28, pp 46-57

Hunter C, Carmichael K and Pangbourne K (2006): *Household Ecological Footprint Using a Diary-Based Data Gathering Approach*, Local Environment, Vol.11, No.3, pp.307-327.

IVM (2003): **Assessing the Ecological Footprint: A Look at the WWF's Living Planet Report 2002**, IVM, Denmark.

ISA (2006): **Life-Cycle Energy Balance and Greenhouse Gas Emissions of Nuclear Energy in Australia**, Report for the Department of Prime Minister and Cabinet of the Australian Government, dated November 2006.

Kitzes J *et al.* (2007): *A Research Agenda for Improving the National Ecological Footprint Accounts*, paper presented at the International Ecological Footprint Conference, 8-10 May, Cardiff.

Lenzen M and Murray SA (2001): *A modified ecological footprint method and its application to Australia*, Ecological Economics, Vol. 37, pp. 229–255.

Lenzen M and Murray SA (2003): **The Ecological Footprint – Issues and Trends**, University of Sydney, Australia.

Lenzen M *et al.* (2004): *Historical Accountability and Cumulative Impacts: the Treatment of Time in Corporate Sustainability Reporting*, Ecological Economics, Vol. 51, pp 237-250.

Lenzen M, Murray J, Sack F and Wiedmann T (2006): **Shared Producer and Consumer Responsibility – Theory and Practice**, ISA Research Paper 01-06, University of Sydney, Australia, available from [http://www.isa.org.usyd.edu.au/publications/documents/Lenzen,Murray,Sack&Wiedmann\\_2006-Shared\\_Responsibility.pdf](http://www.isa.org.usyd.edu.au/publications/documents/Lenzen,Murray,Sack&Wiedmann_2006-Shared_Responsibility.pdf)

Lenzen M, Wiedmann T, Foran B, Dey C, Widmer-Cooper A, Williams M, Ohlemüller R (2007): **Forecasting the Ecological Footprint of Nations: a blueprint for a dynamic approach**, ISA Research Paper 07/01.

Leontief W (1986): **Input-Output Economics**, Second Edition, New York: Oxford University Press.

Lewan L and Simmons C (2001): **The Use of Ecological Footprint and Biocapacity Analyses as Sustainability Indicators for Sub-national Geographical Areas: A Recommended Way Forward**, Final Report, prepared for Ambiente Italia (ECIP), dated 27 August 2001, available from [www.bestfootforwad.com](http://www.bestfootforwad.com).

Lewis K *et al* (2004): **Towards a Standard Methodology for Ecological Footprint Analysis of Sub-national Regions**.

LOCOPGP (2006): **Towards a Sustainable Games**, available from <http://main.london2012.com>

- Loh J (ed.) (2002): **Living Planet Report 2002**, WWF, Gland, Switzerland.
- Loh J and Wackernagel M (eds.) (2004): **Living Planet Report 2004**, WWF, Gland, Switzerland.
- Market Economics (2006): **Waikato Region Ecological Footprint 2004**, dated November 2006, available from [www.ew.govt.nz](http://www.ew.govt.nz)
- McManus P and Haughton G (2006): *Planning with ecological footprints: a sympathetic critique of theory and practice*, Environment and Urbanization, Vol. 18, No. 1, pp 135-127.
- Merseytravel (2006): **Environmental Sustainability Strategy 2006-2011**, available from [www.merseytravel.org/pdf/EnvironmentalStrategy.pdf](http://www.merseytravel.org/pdf/EnvironmentalStrategy.pdf).
- Moffatt I (2000): *Ecological Footprints and Sustainable Development*, Ecological Economics, Vol. 32, pp359-362.
- Moffatt I, Hanley N, Allen S and Fundingsland M (2001): **Sustainable Prosperity: Measuring Resource Efficiency**, report for Department for the Environment, Transport and the Regions, UK.
- Moffatt I (ed.) (2005): **An International Peer Review of a Defra Funded Report Sustainable Consumption and Production – Development of an Evidence Base Study of Ecological Footprinting**, Defra Peer Review, available from [www.defra.gov.uk](http://www.defra.gov.uk).
- Moos M, Whitfield J, Johnson LC and Andrey J (2006): *Does design matter? The ecological footprint as a planning tool at the local level*, Journal of Urban Design, Vol. 11, No. 2, pp 195-224.
- Munday M and Roberts A (2006): *Developing approaches to measuring and monitoring sustainable development in Wales: A review*, Regional Studies, Vol. 40, No. 5, pp 535-554.
- NAW (2006): **Environmental Strategy for Wales**, available from <http://new.wales.gov.uk>.
- NCSP (2003): **The Community Strategy for Norfolk 2003-2023**, available from [www.eastspace.net/norfolkambition-partnership](http://www.eastspace.net/norfolkambition-partnership)
- NEF & FoE (2006): **The Happy Planet Index: An Index of Human well-being and Environmental Impact**, available from [www.neweconomics.org](http://www.neweconomics.org).
- Nicolucci V, Galli A, Kitzes J, Puselli RM, Borsa S and Bastianoni S (2007): *The Ecological Footprint Analysis Applied to Two Different Italian Wine Productions*, paper presented at the International Ecological Footprint Conference, 8-10 May, Cardiff.
- Nijkamp P, Rossi E and Vindigni G (2004): *Ecological Footprints in Plural: A Meta-analytic Comparison of Empirical Results*, Regional Studies, Vol. 38, No.7, pp.747-765.

NLP (2006): **North Lanarkshire Partnership's Global Footprint Project: Footprint Reduction Report**, North Lanarkshire Partnership, dated September 2006, available from [www.scotlandsfingerprint.org/pdfs/NL\\_EF\\_Reduction\\_Report\\_06.pdf](http://www.scotlandsfingerprint.org/pdfs/NL_EF_Reduction_Report_06.pdf)

Nye M and Rydin Y (2006): **Evaluating sustainable housing construction standards in London: Applying ecological footprint analysis to standards in the London Plan and the GLA's draft SPG for sustainable design and construction**, SUSCON Project, Centre for Environmental Policy and Governance, available from [www.lse.ac.uk](http://www.lse.ac.uk).

OFMDFMNI (2006): **First Steps Towards Sustainability – Sustainable Development Strategy for Northern Ireland**, Office of the First Minister and Deputy First Minister, available from [www.ofmdfmini.gov.uk/economic-policy-and-effectiveness.htm](http://www.ofmdfmini.gov.uk/economic-policy-and-effectiveness.htm).

OFMDFMNI (2006a): **A Positive Step: Northern Ireland – A Sustainable Development Implementation Plan**, dated November 2006, Office of the First Minister and Deputy First Minister, available from [www.ofmdfmini.gov.uk/economic-policy-and-effectiveness.htm](http://www.ofmdfmini.gov.uk/economic-policy-and-effectiveness.htm).

Palmer AR (1998): *Evaluating Ecological Footprints*, Electronic Green Journal, December 1998, Special Issue 9.

Ravetz J, Moore A and Wiedmann T (2005): **Stabilizing the ecological footprint in the South East Plan: A Report to SEERA**, dated July 2005, available from [www.southeast-ra.gov.uk](http://www.southeast-ra.gov.uk).

Rees WE (2000): *Eco-footprint Analysis: Merits and Brickbats*, Ecological Economics, Vol. 32, pp371-374.

Rees WE (2007): *Keynote speech*, International Ecological Footprint Conference, 8-10 May, Cardiff.

Ross A (2006): **Ecological footprint: the journey so far – lesson sharing and case studies of local authorities in the UK**, WWF-UK, Godalming.

RPA (2005): **Sustainable Consumption and Production – Development of an Evidence Base: Study of Ecological Footprinting**, report prepared for Defra, dated June 2005, available from [www.defra.gov.uk](http://www.defra.gov.uk).

St Albans LSP (2006): **St Albans and District Community Strategy: Shaping Our District Together for 2020**, Draft Version 2, dated 6 December 2006, available from [www.stalbanslsp.org.uk](http://www.stalbanslsp.org.uk)

Schaefer F, Luksch U, Steinbach N, Cabeça J, Hanauet J (2006): **Ecological Footprint and Biocapacity**, report for Eurostat dated October 2006 available from <http://epp.eurostat.ec.europa.eu>.

Schwarz AE (2004): *Shrinking the Ecological Footprint with NanoTechnoScience?*, in Baird D, Nordmann, A and Schummer J (eds.) (2004): **Discovering the Nanoscale**, Amsterdam: IOS Press.

Scottish Executive (2005): **Choosing Our Future: Scotland's Sustainable Development Strategy**, dated December 2005, available from [www.scotland.gov.uk](http://www.scotland.gov.uk).

SDRC (2006): **The Ecological Footprint of a Conference in the Scottish Parliament**, report prepared for the Scottish Parliament Information Centre, available from [www.scottish.parliament.uk/business/research/factsheets/documents/EcologicalFootprint.pdf](http://www.scottish.parliament.uk/business/research/factsheets/documents/EcologicalFootprint.pdf).

SEEDA (2006): **The Regional Economic Strategy 2006-2016**, SEEDA.

SEERA (2006): **A Clear Vision for the South East**, dated March 2006, SEERA.

Simmons C, Lewis K and Barrett J (2000): *Two Feet – Two Approaches: A Component-based Model of Ecological Footprinting*, Ecological Economics, Vol. 32, pp375-380.

Simmons C, Gonzalez I and Lewis K (2006): **Methodology for determining global sectoral material consumption, carbon dioxide emissions and ecological footprints**, dated 9 June 2006, available from [www.bestfootforward.com](http://www.bestfootforward.com).

Simmons C, Lewis K, Giljum S and Best A (2007): *Assessing the Quality of the National Footprint Accounts using Germany as a Case Study*, paper presented at the International Ecological Footprint Conference, 8-10 May, Cardiff.

Simpson RW, Petroschevsky A and Lowe I (2000): *An Ecological Footprint Analysis of Australia*, Journal of Environmental Management, Vol.7, No.1, pp.11-18.

Sunderland City Council (2005): **Development and Change – Issues and Options for the City**, Core Strategy Development Plan Document, available from [www.sunderland.gov.uk](http://www.sunderland.gov.uk).

SWRDA (2006): **Regional Economic Strategy for South West England 2006-2015**, available from [www.southwestrda.org.uk/res2006](http://www.southwestrda.org.uk/res2006).

SWRA (2006a): **The Draft Regional Spatial Strategy for the South West 2006-2026**, available from [www.southwest-ra.gov.uk](http://www.southwest-ra.gov.uk).

Tarzia V (ed.) (2003): **European Common Indicators – Towards a Local Sustainability Profile**, Ambiente Italia Research Institute, Milano, Italy.

Thomassen MA and de Boer IJM (2005): *Evaluation of Indicators to Assess the Environmental Impact of Dairy Production Systems*, Agriculture, Ecosystems and Environment, Vol. 111, No. 1-4, pp185-199.

- Turner K (2006): *Additional Precision Provided by Region-specific Data: The Identification of Fuel-use and Pollution-generation Coefficients in the Jersey Economy*, Regional Studies, Vol.40, No.4, pp.347-364.
- UKCIP (2003): **Climate Adaptation: Risk, Uncertainty and Decision-making Framework**, available from [www.ukcip.org.uk](http://www.ukcip.org.uk)
- van den Bergh J and Verbruggen H (2000): **Spatial Sustainability, Trade and Indicators: An Evaluation of the Ecological Footprint**, available from [www.tinbergen.nl/discussionpapers/98105.pdf](http://www.tinbergen.nl/discussionpapers/98105.pdf).
- van Kooten GC and Bulte EH (1999): **The Ecological Footprint: Useful Science or Politics?**, Working Paper 1999-25, Sustainable Forest Management Network.
- van Vuuren DP and Smeets EMW (2000): *Ecological Footprints of Benin, Bhutan, Costa Rica and the Netherlands*, Ecological Economics, Vol.34, No.1, pp.115-130.
- von Stokar T, Steinemann M and Rüegge B (2006): **Ecological Footprint of Switzerland: Technical Report**, available from [www.bfs.admin.ch](http://www.bfs.admin.ch).
- von Stokar T, Steinemann M, Rüegge B, Schmill J (2006a): **Switzerland's Ecological Footprint : A contribution to the sustainability debate**, available from [www.bfs.admin.ch](http://www.bfs.admin.ch).
- VROM-Council (1999): **Global Sustainability and the Ecological Footprint**, VROM-Council, the Hague.
- Wackernagel M and Rees WE (1996): **Our Ecological Footprint: Reducing Human Impact on the Earth**, New Society Publishers, Gabriola Island, BC, Canada.
- Wackernagel M, White S and Moran D (2004): *Using Ecological Footprint Accounts: From Analysis to Applications*, International Journal of Environmental and Sustainable Development, Vol.3, No.3-4, pp.293-315.
- Wackernagel M, Onisto L, Callejas Linares A, López I, Garcia J, Suárez Guerro A and Suárez Guerro C (1997): **Ecological Footprints of Nations: How Much Nature Do They Use? – How Much Nature Do They Have?**, Rio+5 Forum Study, dated 10 March 1997.
- Wackernagel M (1999): *National Natural Capital Accounting with the Ecological Footprint Concept*, Ecological Economics, Vol. 29, pp375-390.
- Watson R and Pauly D (2001): *Systematic distortion in world fisheries catch trends*, Nature, Vol. 414, pp 534-536.
- WCED (World Commission on Environment and Development) (1987): **Our Common Future**, Oxford University Press, Oxford, England.

Wiedmann T and Lenzen M (2006): *On Conversion Between Local and Global Hectares in Ecological Footprint Analysis*, Ecological Economics, submitted.

Wiedmann T, Minx J, Barrett J, Vanner R and Ekins P (2006): **Sustainable Consumption and Production – Development of an Evidence Base: Resource Flows**, Report for Defra, Ref: SCP001, available from [www.defra.gov.uk](http://www.defra.gov.uk)

Wiedmann T, Minx J, Barrett J and Wackernagel M (2006a): *Allocating ecological footprints to final consumption categories with input-output analysis*, Ecological Economics, Vol. 56, pp.28-48.

Wiedmann T, Barret J and Lenzen M (2007): *Companies on the Scale: Comparing and Benchmarking the Footprints of Businesses*, paper presented at the International Ecological Footprint Conference, 8-10 May, Cardiff.

Without Walls (2004): **York City Vision and Community Strategy 2004-2024**, available from [www.yorkwow.org.uk](http://www.yorkwow.org.uk).

Wood R and Lenzen M (2003): *An Application of a Modified Ecological Footprint Method and Structural Path Analysis in a Comparative Institutional Study*, Local Environment, Vol.8, No.4, pp.365-386.

WWF-UK (2006): **Ecological Footprints: Taking the First Step – A ‘how to’ guide for Local Authorities**, WWF-UK, Godalming.

WWF-UK (2007): **One Planet Business: Creating Value within Planetary Limits**, WWF-UK, Godalming.

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17 Smith Square  
LONDON SW1P 3 JR**

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