Environmental actions to reduce household ecological footprints

Journal Item

Paper for International Journal of Environmental Education and Information. [REVISED VERSION]

Environmental Actions to reduce Household Ecological Footprints

Professor Robin Roy and Dr Sally Caird
Design Innovation Group/Centre for Technology Strategy
Faculty of Technology, The Open University.

Postal Address:
Robin Roy
Department of Design and Innovation,
Faculty of Technology,
The Open University,
Milton Keynes
MK76AA
UK.

ABSTRACT

This paper presents the ideas of UK householders on how to reduce their Ecological Footprint (EF) after applying a tool called 'EcoCal', which assesses the environmental impacts of households by measuring footprints arising from Transport, Energy, Shopping, House and Garden, Water and Waste. Analysis of the EcoCal results of nearly 700 adult Open University (OU) student households showed that transport and energy impacts are the biggest contributors to the household footprint. Reducing these impacts poses the greatest challenge to achieving a globally sustainable household EF of approximately 0.5 hectares per person. Analysis of the ideas that the OU students were prepared to consider to reduce their household EF revealed a variety of technical and behavioural changes. However, in the context of their own household, the OU students identified several constraints on the implementation of their environmental action plans. Despite such constraints, many of the students instigated changes that helped to make their households more sustainable.

INTRODUCTION

Most of us are aware that human activities have led to environmental problems that affect our own lives and threaten future generations of life on this planet. Most notably, burning fossil fuels has led to global warming due to emissions of greenhouse gases. This has been linked to the melting of the polar ice caps, rising sea levels, increased storms and flooding. There are also major problems with the availability and pollution of water supplies from industrial contamination and human pressures. Soil resources have reduced in quality as a result of agricultural intensification, leading to impacts such as soil erosion and decreased fertility. There is also increasing species extinction, with a loss of biodiversity that is not fully understood in terms of its impact, for example on food chains. Governments, particularly in rich, industrialised countries, are under increasing pressure to significantly reduce their national greenhouse gas emissions. At the same time developing countries are striving to develop economically in ways that entail an increase in greenhouse gas emissions and other negative impacts on the environment (see e.g. UNEP, 1999).

In industrialised countries, despite a growing awareness of such environmental issues, most individuals are uncertain how to respond. One response that became popular among mainly young and/or relatively affluent members of the population in the late 1980s involved purchasing 'green' products, such as phosphate free detergents and recycled paper goods. Green consumerism declined with public cynicism about the way marketers capitalised on consumers' environmental concerns to sell products, often with unsubstantiated 'green' claims, at inflated prices. Since then, despite the development of an increasing range of genuinely 'greener' products such as energy-efficient lights and appliances, the inadequacy of green consumerism alone to tackle environmental problems has become increasingly apparent (Cooper, 2000, p. 46). Attention turned to the need not just to consume products with lower environmental impacts, but to move towards more sustainable lifestyles and patterns of consumption.

Despite the decline of green consumerism, recent surveys have indicated that about a third of the UK population regularly take environmental issues into account when purchasing products (Cooper, 2000). About a quarter (probably including many of the first group) attempt to take active responsibility for the impact of their lifestyles on the environment, for example by recycling materials, reducing water consumption, and walking or cycling whenever practicable (Burgess and Harrison, 1997). The majority, however, remain unwilling to take action on the environment, either because they feel individually they cannot have a worthwhile effect or because they consider that their actions are not reinforced by action by government or industry.

Another reason for inaction is that most people lack reliable information on the extent of their environmental impacts and of the most effective ways to significantly reduce those impacts. For example, is it more worthwhile to attempt to recycle waste or save water? How does this compare to travelling by public transport or installing energy-saving lamps? Recently, however, a number of techniques have been developed which attempt to assess the capacity of the natural environment to support particular populations with given lifestyles and indicate what needs to be done to make their patterns of consumption more sustainable.

The Ecological Footprint

One such technique is the 'Ecological Footprint' (EF). The EF is a measure of the area of land (and sea), of world average bio-productivity, required to indefinitely provide the resources for, and to absorb the pollution and wastes of, a particular population with a given lifestyle and level of technology (Chambers, Simmons and Wackernagel, 2000 p. 31).

For example, it has been calculated that the area required to continuously supply the food and forest products, accommodate the buildings and roads, and absorb the CO_2 produced by the average Briton living their current lifestyle is 6.3 hectares (ha). This compares with the bio-productive capacity of the UK's land (and sea) at 1.8 ha per person. Using the latest 1996 data, an average American has the world's largest footprint at about 12.2 ha compared to 5.6 ha bio-productive capacity per person of the USA (Loh et. al., 2000, p.27).

Similar calculations indicate that the OECD industrialised countries need to halve their present average EF of 7.2 ha per person if they are to live sustainably within their countries' bio-productive capacity. This implies an approach to sustainability dependent on each national population becoming self-sufficient from its own resources. However, in a global economy it may be more relevant to consider a globally equitable footprint – a so-called 'earthshare'. This is estimated at about 2 ha per person, roughly twice the EF of the average Indian. To move towards such a globally sustainable earthshare the present EF of the average OECD inhabitant would have to be reduced by over two-thirds (Wackernagel and Rees, 1996; Loh et. al., 2000, pp. 12, 24).

Ecological footprint analysis is, of course, a great simplification of a very complex situation, but it gives some idea of the extent to which any given population can be sustained indefinitely from its own, or an equal share of the world's, resources at a given level of technology. So although the calculations are very approximate, it seems that the EF of an average person in the industrialised countries is too large to be sustainable from the earth's land (and sea) resources, especially if we allow for rising world population and living standards in the developing world. It may be argued therefore, that the populations of those industrialised countries need to reduce their footprints through a combination of technical and lifestyle changes.

Reducing household footprints

The above figures all refer to the total EF of an average member of the population, taking into account impacts due to industry, commerce and government as well as of households. Households, however, are a very important source of environmental impacts. Household heating, lighting and appliances are directly responsible for nearly a third of energy delivered in the UK and a quarter of CO_2 emissions. Also about 60% of goods and services, including food and personal transport, purchased in industrialised countries are for domestic consumption, giving rise to indirect demands for energy, water and materials (OECD, 1998). The EF associated with household consumption of energy, food, water and materials thus represents a large proportion of the total footprint of the average person in the industrialised world.

EcoCal

One approach to reducing household impacts arose from a project initiated by British environmental consultants, Best Foot Forward (BFF), and taken up by an environmental awareness campaign called 'Going For Green' aimed at the UK general public.[1] This led to the development of a method of measuring household EFs called *EcoCal: Your Environmental Health Check*[2], launched in 1998 (Open University, 2000).

EcoCal is a paper or computer-based questionnaire, which calculates the EF of a given household from data about its members' consumption in six areas – Transport, Energy, Water, Shopping, House & Garden, and Waste – plus a total 'greenscore' for

[1] For details of Going for Green's current activities see http://www.tidybritain.org.uk
[2] To find out more about measuring household ecological footprints using EcoCal, access the BFF website: http://www.bestfootforward.com

the household. In order to be useable by the general public, EcoCal does not cover all the areas of domestic consumption that result in environmental impacts, but it does include most of the important ones. Transport includes car, train, bus and air travel; Energy includes consumption of gas, electricity and other household fuels; Water includes consumption for appliances, personal hygiene, and gardening. Shopping includes purchases of food from different regions, eating out and hotel stays, plus any regular high impact purchases of newspapers and/or nappies. House and Garden is concerned with land use and any high impact purchases of hardwoods and peat, while Waste covers the amounts of normal domestic and bulk household waste produced and recycled.

All scores are expressed in 'ecocalories', where *100 ecocals = 1 hectare (ha)*. This measure, with its analogy to food calories and dieting, was thought to be more comprehensible to the public than the ecological footprint. Scores are plotted graphically in one of three distinct zones, better than average ('green'), average ('amber') or worse than average ('red'), as a result of comparisons with national consumption data for similar-size households. Ecocal also provides recommendations on environmental actions – both technical and behavioural –to encourage householders to reduce their footprint and thus achieve a more sustainable lifestyle.

RESEARCH ON HOUSEHOLD ECOLOGICAL FOOTPRINTS

Although there are now many ecological footprint studies at international, national regional and city levels (e.g. Loh et al., 2000), very few household level studies have been conducted.

One Canadian study calculated the EF of households occupying five dwelling types, which ranged from 0.9 to 1.5 ha per person (Chambers, Simmons and Wackernagel, 2000, p. 167). A study by BFF used EcoCal to calculate the footprints of 42 UK households representing a variety of socio-economic types. This produced a wide range of EcoCal scores with an average household footprint of 3.6 ha, or 1.24 ha per person (Simmons & Chambers 1998, p. 358; Chambers, Simmons and Wackernagel, 2000, p. 165).

The authors have followed the latter study with the largest survey of UK household ecological footprints so far conducted. The 692 households studied (including 2011 adults and children) all included an adult member who took an Open University introductory environment course called *Working with Our Environment* during 2000.[3] As part of this distance learning course students used EcoCal to obtain their household's EF scores in Energy, Transport, etc., together with a total household footprint score.

For example, under Transport, students entered how much vehicle fuel was typically used by all members of their household each week, and how far household members traveled by bus, train and air. Precise data was not sought, but nevertheless it was necessary to give the students detailed guidance on answering each question to get

[3] T172 *Working with Our Environment: Technology for a Sustainable Future*. For details go to http://www.open.ac.uk, select 'Courses and Qualifications', then 'Environment'.

reliable responses. Having entered the data students could compare their household's scores with those of typical UK households and obtain suggestions for reducing their footprint. For example, under Transport EcoCal provided fairly obvious suggestions such as using public transport or cycling wherever possible. In the EcoCal activity for the course these initial suggestions were used to encourage students to think creatively of further ways of reducing the environmental impact of their household. Students then had to decide which actions they, and other members of their household, were likely to implement and to submit their results as part of an assignment (Roy, 2000, pp. 22-30).

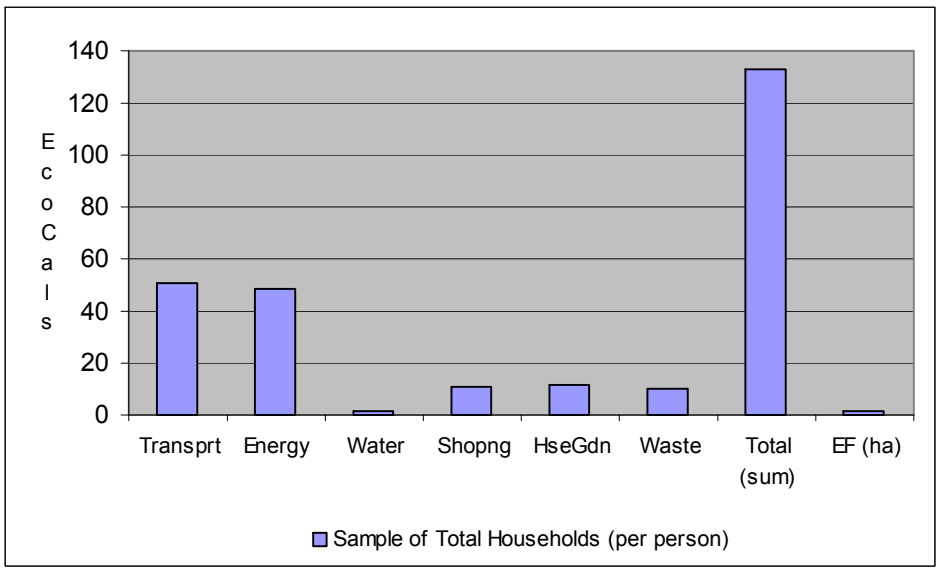
Since OU students are mature, often with experiences of employment and parenthood and their households are similar in size and composition to British averages, the results should be fairly representative of UK households.[4]

Our analysis shows that the average EF is 3.34 ha per OU household or 1.33 ha per person, including children. This is very similar to the estimates of the footprints per head of UK households obtained in the BFF study. In general our results confirm that of other studies that transport and energy are the biggest contributors to the EF of the household (Figure 1).

[DATA TABLE NOT TO BE INCLUDED]

Transprt	Energy	Water	Shopng	HseGdn	Waste	Total (sum)	EF (ha)
50.98	48.37	1.35	10.89	11.57	9.66	132.83	1.33

Figure 1 Average component and total EF scores per person of the OU sample of UK households.



100 ecocals = 1 hectare (ha).

[4] For full details see Roy and Caird, (2001a).

It is estimated that Ecocal captures roughly one third of the total UK footprint of each person, the rest being each individual's share of the footprints of industry, commerce and government (Simmons and Chambers, 1998, p. 360).

A globally equitable and sustainable footprint (or 'earthshare'), based on world average land and sea bio-productivity divided by the earth's population, is estimated at about 2.0 ha per person (Wackernagel et. al, 1997). This suggests that to be sustainable at a global level UK households should have an EF of 2.0/3 = 0.67 ha per person.[5]

EcoCal, however, uses UK data for land bio-productivity, which is higher than the world average used in most EF calculations. Taking account of this fact, a globally sustainable UK household footprint is about *0.5 ha per person*.[6] This contrasts with the average OU household EF of 1.33 ha per person.

Nevertheless, our survey of the 692 OU households showed some potentially encouraging results. About 11% of OU households had a footprint within the global sustainability target of 0.5 ha per person. The majority of OU households achieving these strict sustainability targets were urban and included children under 16 years old.

The results showed that rural households had significantly larger footprints per person than urban households, especially in terms of energy impacts and the area occupied by the house and garden. Furthermore, households without children had significantly larger footprints *per head* than households with children. In particular, households without children had almost three times higher per capita Transport footprints than the households with children. This is probably due to higher disposable incomes of households without children and a freedom from the commitments associated with younger children, allowing greater travel. Households without children also had significantly higher per capita footprints in the other key areas of energy and shopping (see Roy and Caird, 2001b). This is because children below 16 years generally consume less than adults and should not be taken as an environmental incentive to have children!

Moving towards sustainability

This raises the question of the extent to which each area of consumption (Transport, Energy, etc.) would need to be reduced to reach the total household target for a globally equitable and sustainable footprint of 0.5 ha per capita. To obtain such targets it was assumed that the distribution of component footprints for a sustainable household was the same as for an average household (Table 1). This implies that, for sustainability, each component footprint would be reduced compared to the average OU household by nearly two-thirds. Is then possible to derive a mix of consumption under each area that would achieve this level of reduction, thus giving some idea of what might need to be done in practice for a household to become sustainable. Of

[5] These figures are based on 1993 data, to be compatible with the data used during the development of Ecocal.

[6] Author's estimates based on Simmons and Chambers (1998) p. 358; Chambers, Simmons and Wackernagel (2000) p.165 and Simmons, C. (2000) *Personal Communication* (Oxford: Best Foot Forward Ltd.) August.

course, trade-offs between component footprints are possible. So, for example, a very low energy footprint might compensate for an unsustainable transport footprint.

Table 1 Target component EFs for sustainable UK households

Area of consumption	Average OU component EF (ha per person)	Target globally sustainable component EF (ha per person)
Transport	0.51	0.19
Energy	0.48	0.18
Water	0.014	0.005
Shopping	0.11	0.041
House & Garden	0.12	0.044
Waste	0.097	0.036
Total (ha)	1.33	0.50

Transport

Using the EcoCal program it is possible to model many possible patterns of transport use that would reduce the amount of motorised travel per person by nearly two-thirds and reach the target footprint for Transport sustainability of 0.19 ha per person. One such pattern, that includes lower than average car use, is given below:

Car use: 3500 km per year (Approx. 70 km per week) per adult at 35 mpg (8 l/100km);
Train travel: 1500 km per year (Approx. 30 km per week) per adult;
Bus travel: 500 km per year (Approx. 10 km per week) per adult;
Air travel: 700 km per year (e.g. one return flight London to Paris) per adult;
Walking/cycling: Unlimited amount.

Such a pattern could only be achieved by major changes to average household travel behaviour, such as low commuting distances, replacement of many journeys by cycling or walking, and local holidays.

Energy

As before, using the EcoCal program it is possible to model mixes of household fuel use to fall below the target footprint for household sustainability in Energy of 0.18 ha per person. One such mix is given below:

Gas 600 kWh per adult per quarter (2400 kWh per adult per year)
Electricity 200 kWh per adult per quarter (800 kWh per adult per year).

Such a two-thirds reduction in average per capita energy consumption could only be achieved by fairly radical measures, for example high levels of home insulation; use of energy-efficient appliances and switching to ‘green’ electricity.

Water

One possible pattern of water use to reach target footprint for household sustainability in Water of 0.005 ha per person is given below:

Showers 7 per week (daily) per adult
Dishwasher 1 use per week per adult
Washing machine 2 uses per week per adult
Gardening/car washing None.

For many households, except perhaps those with several children or elderly or sick occupants, such a sustainable pattern of water consumption should be achievable with only relatively modest changes in technology and behaviour.

Shopping

As before it is possible to derive household shopping patterns to fall below the target footprint for household sustainability in Shopping of 0.005 ha per person, for example:

Food and drink	£20 per adult per week (including £3 on meat products and £8 on food imported from outside Europe and meals out)
Newspapers	2 per adult per week (including free newspapers)
Nappies	None
Hotel stays	None.

Such a reduction is likely involve changes in purchasing habits, such as buying a daily newspaper, that many households might find difficult to implement.

House & Garden

A possible size of house and garden to fall below the target footprint for sustainability of 0.044 ha per person is given below:

Semi-detached or terraced house	40 square metres per adult
Garden	35 square metres per adult.

A dwelling with a floor area per adult of this size would be too small for a single person or one parent family, but should be suitable for two-person or larger household.

Waste

One pattern of waste and recycling to reach the target footprint for household sustainability in Waste of 0.036 ha per person is given below:

Waste	Approx. 6 kg (half a bin bag) per adult per week
Recycling	All cans, glass, plastics, paper and food waste

Except for single person households or those with several children, such a sustainable pattern of waste might be achievable with only relatively modest changes in behaviour, provided suitable recycling facilities were available.

ENVIRONMENTAL ACTIONS FOR SUSTAINABLE HOUSEHOLDS

As noted earlier, as part of the *Working with Our Environment* course, the OU students surveyed used EcoCal not only to assess the footprints of their households but also to consider how to reduce those footprints. As part of their first assignment they could submit a report that included an action plan for achieving a more sustainable household. It should be emphasised that these plans comprised ideas that the students felt were most likely to be implemented by members of their household, either in the short or longer term. The ideas themselves were chosen from a longer list, both suggested by EcoCal and generated by the students, often in discussion with other members of their household, and considering environmental benefits, financial cost, and practical, social and other constraints. In other words these were ideas which should have taken into account, at least to some extent, the personal circumstances of the students and other members of their household.

A qualitative analysis of the ideas contained in 22 randomly selected action plans submitted by the students was conducted. A selection of the most frequently mentioned ideas for reducing household footprints are presented in Tables 2-7 below, along with perceptions of their environmental advantages and of constraints upon implementation.

Particular attention should be paid to the ideas for reducing the environmental impacts of transport and energy: since transport is the biggest contributor to the EF in general and energy is the biggest contributor to the footprint of rural households and households with children. Thus, while all of the ideas for environmental actions presented are potentially beneficial, actions to reduce transport and energy impacts are particularly significant in reducing household EFs. For example, most of the OU households that achieved a 'sustainable' footprint did so by having much lower than average scores in all areas, but especially transport. It is likely that some of these sustainable households depend mainly on cycling or walking for travel.

Transport

Table 2 OU household action plan ideas for reducing Transport impacts

Environmental ideas	Advantages	Perceived disadvantages/ constraints
Set up a flexible household transport plan, i.e. using public transport or walking, cycling and using car-pools.	• Lower fuel consumption and cost • Increases local knowledge • No car parking charges • Health and fitness benefits • Can be quicker • Can be less stressful than parking • More sociable • Saves money • Reduces carbon dioxide, carbon monoxide gases and water emissions • Less road vehicles and traffic congestion • Reduces car wear and tear	• Weather dependent • Requires extra planning & time • During unusual hours it is less safe if travelling alone • Difficult to transport children walking or on bikes • Cycling can be dangerous on narrow roads • Restricts luggage, routes and timetables and doing other things en-route • Petrol is less expensive than public transport • Doesn't suit all working hours or locations • Inflexibility with tickets, times and operators • Difficult to sustain less convenient habits • Many car-related expenses remain unchanged
Drive at lower speed	• Car uses 25% less fuel driven at 50 mph (80km/h) tan at 70+ mph (110km/h) • More relaxing • Safer driving and less accidents • Wear and tear on the car is reduced	• May increase journey time, • May incite road rage
Replace car with smaller more fuel-efficient engine	• Less emissions • Fuel efficiency • Less road tax /insurance costs	• Limited choice • Higher initial expense • Less acceleration available • Less comfortable for long journeys
Travel less by air and use train and coach more for long journeys	• Less polluting as air travel contributes to excessive transport EcoCal scores • Less stressful in urban areas	• Air travel is cost- and time-effective • Necessary to visit relatives • Unreliable public transport • Less adventurous 'feel' of local holidays
Work more from home	• Less polluting • More flexible life-style and time • Reduces emissions & improves air quality	• Can hamper career opportunities • Lack of social side of work
Move house to be closer to work and shops	• Financial benefits • Less road vehicles and traffic congestion	• Requires life-style change • Stressful & costly • Less suitable for less secure employees

Energy

Table 3 OU household action plan ideas for reducing Energy impacts

Environmental Ideas	Advantages	Perceived Disadvantages/ constraints
Insulate cavity walls, loft and windows	• Lower energy consumption • Saves money	• Impact of chemicals associated with insulation, creating household pollution • Initial expense • Poor ventilation
Reduce heating by using a heating control timer and wearing extra warm clothing	• Saves money • Reduces the consumption of fossil fuels • Reduces emissions to environment • Reduce chances of cot-death syndrome • Health benefits	• If too cold then there may be health issues
Fit a condensing or combination boiler for heating	• Energy efficiency • Lower bills • Lower emissions, greenhouse gases and water vapour • Instant hot water (combi boiler)	• Higher initial expense • Significantly more expensive than other boilers • Only worth considering when replacing boiler
Replace appliances with energy-efficient models e.g. freezer, washing machine, dishwasher, boiler, light bulbs, etc.	• Saves energy • Long term financial savings compared with less efficient, lower cost models • Avoid HFC and HCFC emissions	• Too costly if replacement is not necessary • Sometimes more expensive than comparable goods in short-term
Replace electric cooker with gas	• Saves energy since electricity loses 70% of its efficiency between power station and point of use • Financial savings since these differences are reflected in cost per kWh	• Cost of purchase • Gas perceived to be dirtier in kitchen
Wind dry clothes on line rather than tumble dry	• Lower energy consumption and bills • Less static in clothes • No softener products required • Less noise • Wind-dried clothes are aerated & fresher	• Weather and season dependent • Inconvenience
Switch electrical appliances off when not in use	• Lower energy consumption • Lower bills because standby costs almost as much as when appliance is fully on • Greater safety	• Reprogramming required • Surges in current may cause damage • New habits required
Use green energy, i.e. renewable sources and/or ‘green’ electricity	• Reduces fossil fuel use • Initial expense recouped over long-term • Now more affordable • Green electricity widely available • Green electricity can be used in any house	• Most buildings are not designed to harness alternative technologies • Time consuming and expensive to set up an energy efficient house

Water

Table 4 OU household action plan ideas for reducing Water impacts

Environmental Ideas	Advantages	Perceived Disadvantages/ constraints
Mend dripping taps and turn taps off, including when you brush your teeth	• Lower water and energy consumption • Less risk of flooding house	• Remembering
Water garden at night	• Saves water lost due to evaporation	
Collect rainwater in water butts and use for garden, toilet and cleaning car or topping up swimming pools	• Lower water and energy consumption • More convenience • Prevents overloading sewage systems • Can be filtered	• Initial expense • Alterations required • Less convenient water delivery
Use less water when flushing by (a) placing a plastic bottle in toilet cistern or (b) adjusting the screw on ballcock or (c) flush less often	• Saves water, about 1.5 litres per flush • Helps prevent septic tanks (when present) from over filling • Prevents overloading sewage systems • Not expensive	• May not fully clear waste if flush is inadequate • No financial savings unless water meter is installed
Wash crockery by hand occasionally if you have a dish-washer	• Saves 30 litres approximately of water a day	• Inconvenience • Extra time required
Shower rather than bath	• Save water • More hygienic	• Expensive to install if house has no shower • Less relaxing
Wash full clothing loads on low temperatures and only use dishwasher when full	• Lower energy consumed • Less green house gas emissions	• Washing machine will scale up unless hot washes are sometimes done • Need to buy extra crockery
Replace washing machine and dishwasher with more water-efficient models	• Lower water and energy consumption • Savings will offset initial outlay • Prevents overloading sewage systems	• Higher initial expense
Re-cycle used 'grey' water for plants, garden, toilet cisterns, etc	• Save water, 30% of usual use approximately	• Requires installation of large tank • Expensive to re-route waste outlets from showers and bath and install pipe work • Grey soap smelling water in toilets • Minimal financial gains
Install alternative toilets e.g. waterless urinal, composting toilet,	• Save water • Prevents overloading sewage systems	• Expense • May be resistance in family • Maintenance required
Reduce use of detergents	• Less polluting to waterways • May reduce allergies	• Unsuitable for heavily soiled clothes

Shopping

Table 5 OU household action plan ideas for reducing Shopping impacts

Environmental Ideas	Advantages	Perceived Disadvantages/ constraints
Buy locally grown food, eat seasonal foods and reduce consumption of goods air-freighted from abroad	• Benefits local and national economy • Reduces negative impacts associated with transportation and refrigeration of food	• Limited choice • More expensive
Reduce meat consumption	• Reduce land-use impacts associated with meat production • More productive land • Safer food	• Effort in learning new food habits • Inefficient use of marginal land
Reduce fast food and take-away meals	• Less packaging and waste	• Less convenience • Sacrifice fast food fun
Grow own vegetables	• Cheaper • Available in season • Fresher, tastier and healthier • No packaging • Reduce shopping	• Limited choice • Garden or allotment required • Effort and attention
Buy less goods in plastic containers and packaging	• Reduce waste	• Less choice • Plastic more difficult to recycle
Avoid tropical hardwoods, unless from a sustainable source	• Protects a non-renewable resource	• Poorer quality alternatives
Buy fewer newspapers	• Saves paper	• Less information
Buy less disposable nappies	• Reduce waste • Nappies take too long to degrade • Reduce energy in production • Reduce transport impacts • Financial savings	• Inconvenience • Unappealing • More washing machine use
Buy 'green' goods, e.g. chlorine-free cleaning agents	• Protect water-ways	• Expensive and less effective compared with non-green products
Avoid purchasing clothes that require dry cleaning	• Less chemicals and energy used • Cheaper	Reduces choice
Buy in bulk	• Cheaper over time • Less packaging – less energy and waste • Common sense to buy in bulk once a week or less	• Difficult to transport by foot or bicycle • Storage required • May require freezing, i.e. extra packaging and energy • Initial expense
Buy re-chargeable batteries	• Saves money • Reduces impacts of heavy metals	• Initial expense
Make investments in ethical companies	• Ethical trust funds often yield similar returns to other trust funds	

House and Garden

Table 6 OU household action plan ideas for reducing House & Garden impacts

Environmental Ideas	Advantages	Perceived Disadvantages/ constraints
Grow a natural wild garden	• Encourages wild life • Includes edibles • More photosynthesis	• Upkeep • Cats may disturb wildlife • Aesthetics
Mow lawn only when necessary	• Saves energy • Reduces emissions from fuel-powered mowers • Time saving	• Aesthetics
Choose non-peat or non-SSSI composts (Site of Special Scientific Interest)	• Less impact on countryside and SSSI's	• Availability • Initial expense • Difficulty in determining origin
When decorating measure the area to avoid paint waste and donate excess paints for re-use	• Less storage required • Less expense • Reduce harmful chemical production if non-toxic water-based paints and decorating materials are used	
Consider environmental issues when moving home	• Consider energy efficiencies of new home • Lower energy consumption and bills if closer to work and shops	• Choice and availability • Many other issues to consider

Waste

Table 7 OU household action plan ideas for reducing Waste impacts

Environmental Ideas	Advantages	Perceived Disadvantages/ constraints
Use recyclable products	• Less waste and less energy consumed	• Storage • Availability • Initial expense
Compost household waste	• Reduces requirement to purchase compost and chemical feeds • Improved garden • Reduce household waste by up to 50%	• Effort • Cost of bin, time required to produce useable waste • May be resistance in family
Re-use clothes, magazines and plastic shopping bags	• Environmental savings on materials, energy and pollution • No costs • Old comics and magazines may be appreciated in waiting rooms of doctors, dentists and hairdressers	• Less convenient and takes time • Requires remembering
Recycle newspapers, plastic bottles, glass, packaging, food, goods, engine oil and paper	• Less waste means less energy consumed • Reduce tax paid for landfill • Recycling engine oil protects sewers and streams from contamination	• Easier to dispose in bin • Requires extra space to store rubbish for recycling • Aesthetics of storing rubbish • Unenthusiasm in family • Extra work to wash items and separate packaging • Impact of transportation may be worse than binning • Requires recycling facilities • Requires energy to reclaim usefulness of product
Spend more to buy longer-lasting goods	• Less material consumption and waste	• Expense • Difficulty buying replacement parts • Cheaper to replace product than repair

Constraints to implementation

Although the ideas listed above for reducing household environmental footprints were those that the OU students felt they might actually implement, they nevertheless perceived a variety of constraints (Tables 1-7) that could prevent carrying out of their environmental action plans. These included the following major types of barrier or constraint:

1) *Comfort and convenience*. Taking environmental actions, such as home food growing or recycling, may take more time or create extra work. Actions such travelling by bus or cycling instead of driving may lead to reduced levels of comfort as well as convenience. Poor weather may make such actions unacceptable.

2) *Expense*. Greener products, such as energy-efficient appliances or homes, are often more costly, at least initially.

3) *Habit*. Changing long established habits and preferences, such as diets and food buying, may be difficult. Less committed members of the household may not be willing to co-operate with environmental actions that require them to change habits, create extra work or make life less comfortable and convenient.

4) *Practical*. Environmental actions, such as wall insulation or water recycling, may not be possible due to practical constraints or lack of space in the home.

5) *Social*. The demands of caring relationships, such as looking after children or the elderly and visiting relatives, may make it difficult to take some environmental actions such as avoiding car use, lowering room temperatures or reducing air travel.

6) *Aesthetic*. Environmental actions, such as storage of materials for recycling or growing and storing food, may lead to difficulties of aesthetics and space.

7) *Lifestyle*. Some environmental actions, such as reduced air travel, would deny people more adventurous and luxurious lifestyle choices.

8) *External*. Many environmental actions, such as recycling, using public transport or working from home, depend on suitable facilities or opportunities being provided by bodies outside the household.

Such constraints highlight the fact that change towards more sustainable lifestyles is very dependent on particular circumstances of the individuals, families and households concerned. Changes that may be relatively easy to make for one household may be difficult or impossible for another. It has been pointed out that often the changes expected fall unequally on women.

But despite the existence of all these constraints, there was evidence that at least some of the students had actually implemented their ideas for reducing household footprints. This came from an environmental audit conducted at the end of the course in which a sample of 206 students completed a postal questionnaire that included questions about changes in their attitudes and behaviour as a result of taking the course.

In this survey students mentioned a wide variety of both modest and major changes in their behaviour, such as:
'*We now compost all organic waste and recycle paper, glass and cans. We have bought thirteen low energy light bulbs*';
'we changed from two cars to one, and lower engine size. I now cycle to work giving a reduction of overall fuel used of 70%';
'*we shop for food now with an awareness of 'food miles' and what's in season*';
'*we moved house to reduce travel to and from work*'.

Further examples of such behavioural changes are given in another paper by the authors (Crompton, Caird and Roy, 2001).

CONCLUSIONS

This analysis of the ecological footprints of Open University student households shows that, on average, to move towards a globally equitable household footprint they would have to reduce their consumption by about two-thirds. Although the students identified many constraints upon change, many were willing to make an action plan to reduce their own footprint, and that of other members of their household, to a more sustainable level. These actions involve both behavioural changes, such as reducing, reusing and recycling, and technical changes, such as adopting more eco-efficient housing, vehicles and appliances as well as attempting to shift, where possible, to renewable energy supplies.

The analysis shows clearly that transport and energy contribute most to the ecological footprint of households, and action to reduce these footprints to sustainable levels pose some of the greatest technical and lifestyle challenges. Reducing the impacts of shopping and the land taken by dwellings and gardens are also difficult to achieve, especially for single-person households. Actions to reduce water consumption and waste production to sustainable levels are likely to be easier to achieve, but have less overall effect on overall household footprints. This means that, while some 11% of the OU households might already be sustainable, the majority is moving towards sustainability rather than achieving it.

The OU students were generally of the opinion that the householder, either as consumer or citizen, was not able to achieve sustainable lifestyles without supporting action from government, local authorities and industry. However, some comments reflect the view that greater education among the public about environmental issues could create a groundswell for change. This view is reinforced by the changes in attitudes and behaviour that appear to have resulted from studying an Open University environment course that involved activities, like Ecocal, relevant to the students' own lives. This is illustrated by the following comment from the course environmental audit:

'*It has made me very aware of how with purchasing power we can maybe bring about change. It has made me keen to stress the importance of environmental awareness to my children .. I am also constantly assessing any new activity I engage in to see its affects on the environment.*'

REFERENCES

Burgess, J. and Harrison, C. 1997, Climate change and changing lifestyles, ESRC Global Environmental Change Programme, Special Briefing No. 1, November, p. 18.

Chambers, N., Simmons, C. and Wackernagel, M., 2000. *Sharing Nature's Interest. Ecological Footprints as an Indicator of Sustainability* (London: Earthscan).

Cooper, T. 2000. Product development implications of sustainable consumption, *The Design Journal*, 3(2), 46-57.

Crompton, C., Caird, S. and Roy, R. 2001. An environmental assessment activity to promote active distance learning and challenge of personal lifestyles and values, *Paper for 6th International auDES Conference, 'Bridging Minds and Markets. Emerging Issues in Environmental Education and Employment in Europe'*, Venice, Italy, 5-7 April. (Revised version to be published in the *International Journal for Sustainability in Higher Education* in 2002.)

Loh, J. (ed.) *et al* 2000. *Living Planet Report 2000* World Wide Fund for Nature, Gland, Switzerland, Oct. Available Internet: http://www.panda.org/living planet/

OECD 1998, *Towards Sustainable Development: Environmental Indicators* (Paris: Organisation for Economic Co-operation and Development).

Open University 2000. *Going for Green's EcoCal: Your Environmental Health Check,* Supplementary Material for T172 *Working with Our Environment* (Milton Keynes: The Open University).

Roy, R. 2000. You and the Environment, Theme 1 of T172 *Working with Our Environment: Technology for a Sustainable Future* (Milton Keynes: The Open University).

Roy, R. and Caird, S. 2001a. The statistical analysis of Ecocals, *Unpublished research report*, Design Innovation Group (Milton Keynes: The Open University), May.

Roy, R. and Caird, S. 2001b. Household ecological footprints – moving towards sustainability, *Town and Country Planning*, 70(10), pp. 277-279.

Simmons, C. and Chambers, N. 1998. Footprinting UK Households, *Local Environment* 3 (3), pp. 355-362.

UNEP. 1999. *Global Environmental Outlook. UNEP's Millennium Report on the Environment* (London: Earthscan).

Wackernagel, M and Rees, W. 1996. *Our Ecological Footprint* (British Columbia, Canada: New Society Publishers).

Wackernagel *et al* 1997. *Ecological Footprint of Nations* [on-line], Earth Council, December. Available Internet: www.ecouncil.ac.cr/rio/focus/report/english/footprint/
Loh *et al* (2000) cited above is the latest update based on 1996 rather than 1993 data.