Measuring your 'Garden Footprint'
Initial Report

Introduction

It is becoming increasingly clear that the Earths eco-systems upon which all human activity depend are not inexhaustible. Ever since the Brandt (ref 1) and Brundtland (ref 2) reports on sustainability which lead to the UN Rio summit on Agenda 21 (ref 3), it has become clearer that our ecosystems, and therefore our food production systems, are being squeezed in the pincers of a rapidly growing population and vastly increased economic activity, manifested and demonised as 'consumerism' and 'globalisation'.

One way to measure the impact of our activities is to calculate the 'environmental footprint' that we each leave as we live day-to-day and create with our lifestyle choices. An environmental footprint is usually expressed as the land area necessary to support either a specific activity or, more commonly, a person's consumption and is usually given in hectares (or acres). It represents the area necessary to produce the resources and/or food required by that particular activity or person. In the latter case when multiplied by the number of people on the planet it gives an estimate of how much area would be necessary to support a population with that lifestyle. In the case of people living in the most developed economies (like the UK) this normally works out in the region of 3 planets!

Another measure of our impact on the environment is our 'carbon footprint'. Carbon dioxide (CO_2) is important in itself as it is a 'greenhouse' gas with the ability to trap heat close to the surface of the earth and thus warm it up. It is also a good proxy measure of the amount of resources we consume, as the amount of CO_2 we produce is closely linked to the amount of energy that we use, either directly (e.g. for transport) or indirectly (e.g. in manufacturing the material goods we use). It is therefore also closely linked to our environmental footprint as described above. Carbon footprinting becoming a favourite way of reporting about our potential impact on climate change in the UK and can either be reported as the quantity of CO_2 we produce each year or, more rarely, the amount that we produce each year per hectare, or even the amount of CO_2 equivalent gases (e.g. methane) we produce per hectare per year.

Whilst the problems created by our consumption are all to evident- the solutions are also becoming clearer. Central to most visions for a sustainable society are a relocalisation of economic activity within regions, countries and communities (ref 4). And integral to this vision is the production and distribution of food at a local level. Activities around food acquisition, consumption and waste disposal account for around 25-33% of an average persons ecological footprint in the UK (ref 5) which, alongside housing which also accounts for around a third (33%) of the average footprint, comprises well over half our resource needs. It seems to follow that if we could collectively reduce our needs and consumption in these two areas we would be at least making a significant step towards reducing our ecological footprint.

In order to make informed choices and help people to reduce their footprints we need to understand how peoples behaviours affect their footprint. At Garden Organic we are interested in finding out how our gardening habits contribute to our ecological footprints. We have been asking ourselves what resources are need to produce fruit and vegetables at home? Is it realistic to expect people to produce a significant proportion of their own food, and if they do, what resources do they need to do this? And how does this resource use impact on the size of their ecological footprint? Answers to questions like these will become increasingly important as global warming begins to be felt at the same time as competition for primary resources becomes more intense.

Aims

In this initial survey we aimed to open a dialogue with our members on the resources and motivation needed to encourage people to produce at least some of their own food. Our motive for doing this was to stimulate a debate about the ecological impact of home food production, and more crucially, to generate information that would allow people to evaluate their impact on the planet when producing their own vegetables and food, and, even more crucially, to take practical steps to minimise this impact whilst still producing a worthwhile quantity of produce.

Methods

Background

The initial part of the members experiment, took the form of a survey. This was based on our experience with evaluation of the ecological footprint of commercial organic farms adapted to a garden or allotment situation. The survey was intended to provide a baseline survey that would allow us to estimate the resource use necessary to produce fruit and vegetables at home or on an allotment and compare this to the resource use for getting that food through a more complex supply chain (inputs → farms → wholesalers and/or processors → shops → homes → waste chain). We wanted to get a real idea of the types of inputs that organic gardeners used and what their environmental impact might be and to work out at least what proportion of their food they could realistically supply. To mirror this in our work with commercial organic farmers we have a good idea of the kinds of impacts the more conventional food production chains have. We also know that many of the 'alternate' food chains (especially box schemes) are also working on evaluating their ecological footprints.

A second, and perhaps more important part of the experiment/survey, was to provoke a debate on the issue by returning a sheet to members with their footprint and an idea of where they are on a benchmark from best to worst. The idea of this was also to continue collection ideas for improving (that is reducing) the ecological footprint of gardening and home food production.

Ultimately all the information collected will be used to create a discussion area on our website together with information and/or a model which would allow members to calculate their own ecological and/or carbon footprint and to evaluate the contribution growing your own vegetables makes. More pertinently the idea is to set up a source of ideas for helping people to creatively reduce the impact of their production methods at the same time as enjoying and healthy and organic supply of fresh fruit and vegetables.

In some cases we have used a carbon footprint as a proxy for the ecological footprint although, in some ways, the two are quite different. We also recognise that many of these terms are often used loosely and often used interchangeably. In our work we regard an ecological footprint as the area from which you would need to sustainably[1] draw on resources in order to carry out an activity (i.e. it is a measure of the ecosystems regenerative capacity) whereas a carbon footprint is the amount of CO_2 or CO_2 equivalent gases that an activity generates. The two are often closely related as, at heart, most activities require an input of energy that depends heavily on the amount of resources used. In fact many models standardise resource use by calculating a carbon footprint and then converting this back to an ecological footprint in (global) hectares.

Survey

The experiment was carried out by means of a survey broken into four sections:

In the first section of the survey members were asked to calculate a rough carbon footprint by providing the type of information necessary to fill in a typical on-line footprint calculator. We choose the Best Foot Forward calculator (http://www.ecologicalfootprint.com/) as this provides an estimate of carbon footprint and ecological footprint. Members were encouraged to go on-line and calculate this themselves but we also did it with the information provided to standardise the calculation across survey forms. Members were asked to make comments about the calculator and the process of calculation.

In the second section members were asked questions about the scale and commitment to their gardens and/or allotments. It was intended as an 'estimate' to get an overview of the carbon footprint attributable to gardening and home production. As we develop our ideas we may well in future members' experiments ask for more detailed information. Questions were asked about area of gardens, scale of activites, length of time spent on activities and whether these activities were regarded as 'leisure' or 'work time'. The reason for asking these questions was to try and gauge attitudes to gardening and/or growing your own food, and how likely it is that they displace or 'offset' to some extent other CO_2 generating activities.

The third section was devoted to questions about the inputs and resources used in gardening activities. Inputs include seeds, fertilizers and pest management products, all of which have an inbuilt 'energy' or resource cost which will obviously impact on carbon footprint. Even tools, which although they may last many years, have an inbuilt cost in this sense. Protective cropping methods also have an inbuilt energy cost and we asked what form of protected cropping people employed. Although some materials are recycled, for instance cloches made from plastic bottles, many protective structures, like glasshouses, have an inbuilt energy cost and also take energy to heat. Composting is a good way to recycle nutrients and helps to build soil structure. It is also a biological process that can release CO_2 and other greenhouse gases, and in this sub-section we asked about what and how much people composted. We also tried to gauge how efficiently people used or recycled water and how members tended to store their surplus produce (if at all) as both these can have a large impact on ecological footprint.

The forth and final section looked at outputs or production by asking about what vegetables and fruit were produced, the amount produced, and where it was producted. These questions allow us to estimate the proportion of home grown fruit and vegetables as compared to the total amount that consumed during the course of the year. There was also a box to allow members to say where you obtain any fruit or vegetables necessary to fill in any shortfalls in

[1] Here sustainable has a specific ecological meaning; a pattern of resource use that will allow future generations to access and use the same resource if they need to

their own production. All these questions were aimed to help us to compute the carbon cost of home grown food production and, ultimately to compare it with the carbon cost of food that you buy. A final sub-section was also included for comments about footprinting with an open question as to any areas of your activities that we hadn't been mentioned and things that might need to be included, or perhaps even excluded?

Analysis

The questionnaire was analysed by entering the data into a Microsoft Access database and running queries on it based on accepted analysis practice for this type of work. Theories about behaviour and the results were allowed to emerge from the data as we analysed it and it is intended to pass this back to participants for further comment.

Results and Commentary

This section of the report presents the results and analysis of the replies to the survey, section by section. For each section commentary is provided as additional analysis. A more general discussion of the results and their implications is presented in the following discussion section.

Returns

136 forms were sent out and there have been 116 returns (to date). This represents a return rate of 85%.

Section 1: General Ecological Footprint

Results

In the first part of this survey we asked people to make a rough estimate of their carbon footprint based on a freely available on-line footprint calculator (ref 6). We asked people to provide information that we could put into the calculator in order to standardise the results. We also asked people to estimate their own ecological footprint in they had access to the internet. Generally the estimate we made and their estimates were identical or very close.

The average calculated carbon footprint was **7.4 tonnes CO_2** per person with a range from **4.4** to **12.6**. This is considerably below (about 66%) the national average of 10.92 tonnes per person (ref 5) and represents what is achievable with a raised awareness of the issues.

In terms of an ecological footprint this works out at **3.84 global hectares** (gha) per person on average and compares with a UK average 5.45 gha per person. Obviously the same range applies from the smallest at **2.3** to the largest at **6.6** gha. Garden Organic members would therefore, on average, need **2.5 planets** to live sustainably as opposed to 3.4 planets for the UK population as a whole. This compares to the 1.9 gha that would be available if we shared out all resources on an equal basis to each person currently on the planet.

The general picture from the survey is of a (admittedly self selected) group of environmentally conscious people. For instance respondents:

- were conscious of energy use where heating bills are low for 47 (41%), moderate for 58 (50%) and high for only 11 (9%). Similarly 112 (97%) conserved energy and 36 (31%) used renewable energy suppliers.
- tended to take holidays close to home. The majority, 71 people (61%), indicating that they took holidays close to home while 31 (27%) holidayed a short flight away and 12 (10 %) a long flight away.
- generally produced a small amount of waste. In fact 99 (85 %) reckoned on producing a small amount as compared to 17 (15%) who judged themselves to produce an average amount. This is probably helped by the fact that everyone (that is 116 respondents (100%)) composted biodegradable waste (including garden waste (97%), kitchen waste (99%) and other biodegradable material (84%)) and recycled in one form or another.

When it came to transport and food there were mixed messages:

- 67 (58%) still used a car as the main provider of transport compared to 29 (25%) for bike/foot, 17 (15%) for the train or bus and 2 (2%) on motorbikes. On the other hand car use was generally classified as moderate (36 (31%)), light (66 (57%)), minimal (2 (2%)) as compared to heavy (2 (2%)). 9 people didn't use cars at all (8%).
- whilst 3 (3%) were vegan and a further 29 (25%) vegetarian, both good options for reducing ecological footprints, 51 (44%) were light meat eaters and 33 (28%) regular meat eaters. On the positive side a whooping 96 (83%) reckoned on eating fresh vegetables and fruit while the rest (20 or 17%) also used a significant proportion of processed food.

Commentary

Many people commented that the on-line ecological footprint calculator was a very crude measure and to, this generally aware audience, often slightly unsatisfactory. The calculator requires that generalisations are made about complex behaviour and it is not always possible to reflect this in the choices available on the website. Many people found many of the choices given to be subjective and found it difficult to judge whether, for example, their heating bills were low, medium or high for the size of their house. Some calculators take this into account by asking for specific consumption figures of gas or electricity but whilst this is more accurate it makes the calculator more difficult to use without having a lot more information to hand. In the end these judgements probably make less difference than people might think because, on the whole, average consumption baselines used in these types of models are high and because the 'embedded footprint' of our way of life is already high (see below).

This leads to a more seriously challenge to such calculators, in that they don't usually allow for alternative lifestyle choices, so that, for example, generating your own solar hot water or electricity are difficult to factor in apart from indicating low heating bills. Travel and holiday arrangements were also difficult to factor in as most people use of mix of travel methods and also may vary holidays and destinations from year to year. In other words inflexible models often find real life situations difficult to cope with. This however does not necessarily invalidate the models as they are still useful for asking the broader questions, e.g. what happens if I reduce my car use to zero? That is they are good for indicating what the likely effects of any gross changes are as long as the model assumptions are broadly realistic or representative. For instance, looking at the results of this survey, it is apparent that any long haul flights at all will tend to increase the size of a footprint irrespective of any other measures taken to reduce it (i.e. it is difficult to 'offset' the effects of flying with purely lifestyle choices). It is also apparent that the more people in a household (to a point!) sharing resources can reduce the footprint per person even though the household footprint may be larger.

One of the reasons we choose the Best Foot Forward calculator is that it makes it explicit that a portion of our footprint is to do with the way we live, the so called institutional or embedded footprint. This is the footprint associated with things like delivery of goods, services, education, health and government. As part of society we all need to take into account this portion of our footprint. Some people correctly pointed out that this implies that although personally we can take responsibility for reducing our own footprint there is also a more collective and political responsibility for reducing our collective environmental footprint. In other words it is not entirely down to how good we are individually that counts but also how good we are collectively. We all need to work on reducing the impact of our society on the environment in general (and this is where the disagreements begin!).

The other reason for picking this calculator is that it makes the link between our carbon footprint and our ecological footprint. One is an output in amount of CO_2 and the other an area (in ha) from which we need to draw the resources to live sustainably. The two measures are both important. The amount of CO_2 (or CO_2 equivalents produced) is a major driver in climate change- the more we produce the hotter the earth will ultimately become. The other is an indication of the area we need to live sustainably in a manner that does not over exploit resources and diminish them for future generations. Obviously in this case the total area cannot add up to more than one planet's worth without seriously damaging the environment. Currently the UK population is using up 3.4 planets worth of resources, Garden Organic members 2.5, and it is estimated that the human population as a whole is currently living as if we had 1.5 planets to spare.

Given the carbon and environmental footprint of our members the aim of this study was to begin to tease out the effects of gardening, and more specifically, producing your own food on a persons environmental footprint. Does the gardening and home production impact to any significant effect on the environmental footprint of an individual, as compared to say simply buying in those products. To begin to examine these effects section 2 looked at production aims and methods, section 3 the types of inputs used and section 4 any outputs produced and what contribution these made to the household food.

Section 2: Production aims, area and method

Results

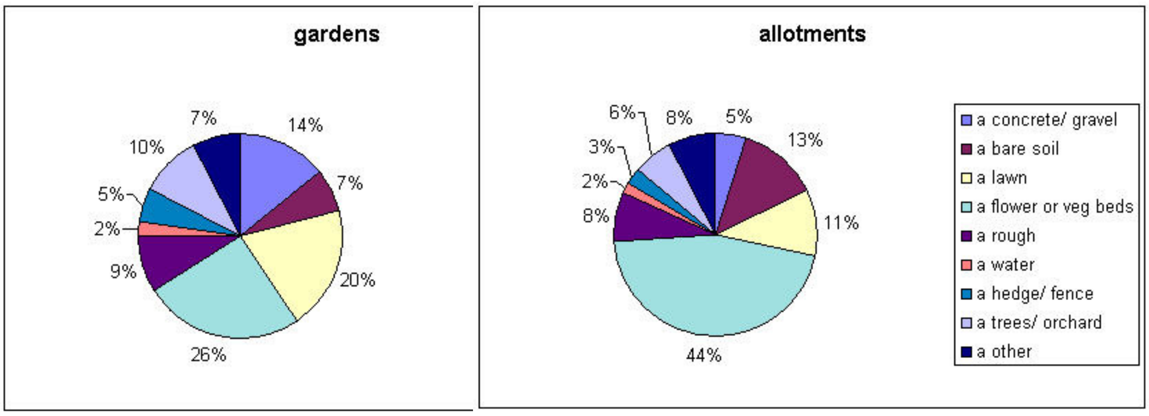
114 members gave us an estimate of the area of their gardens and/or allotments. The majority of members produced fruit and vegetables in their gardens (58%) or in their garden and on an allotment (36%). Only a few (4%) produced exclusively in an allotment. The average total land area reported was **1954.6 m^2** with a min 25 m^2 to a max 25000 m^2 (see table 1). However, the average is distorted upwards by a relatively few number of large gardens so that the geometric mean is a better reflection of the average garden size at **733 m^2**.

Table 1: Area of gardens and/or allotments reported by members

Location	No replies	Area m^2 (*geometric mean*)	Min area	Max area
Garden only	67	2859 (*1013*)	25	25000
Garden and Allotment	42	562 (*425*)	78	2003
Allotment only	5	1531 (*935*)	248	3556
Total	114	1955 (*733*)	25	25000

However, we also asked members to estimate the proportion of their areas devoted to different uses, and these are summarised in Figure 1. Looking at the percentage areas devoted to vegetables, as might be expected, almost twice as much land on allotments is devoted to vegetable production. Looked at another way gardens have almost three times as much unproductive concrete or gravel and twice as much lawn as allotments. Using these proportions it is possible to estimate the average production area for gardens at 1229 m^2 (geometric mean 436m^2), for allotments 964 m^2 (589 m^2) and for gardens and allotments combined 298 m^2 (226 m^2). This gives an overall average of **1036 m^2** (**389 m^2**) **productive area per garden and/or allotment** on average.

Figure 1: Areas devoted to different uses in member's gardens and allotments.



112 members reported that they spent an average of **10.4 hours per week** in their garden and/or allotment averaged over the whole year. Most understandably spent more time in spring, summer and autumn in the garden than in the winter. There is also a relationship between the area worked and the hours worked; those with more land tend to work for longer; this is an exponential relationship so that people with larger areas tend to work proportionally less time! (see figure 2).

Most respondents found it difficult to differentiate between leisure and work when it came to producing food. Even those who choose work (17%) or leisure (47%) often qualified this by saying there were elements of the other in their activities. 27% considered it to be both. 9% considered their production part of a lifestyle choice and thus presumably an integral part of their life-work activities. (see also figure 3).

Figure 2: Relationship between garden/allotment area and time worked.

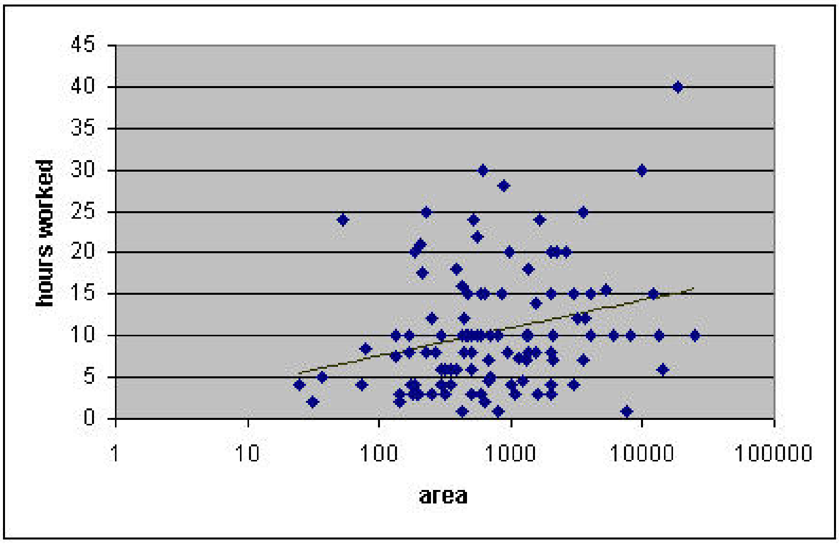
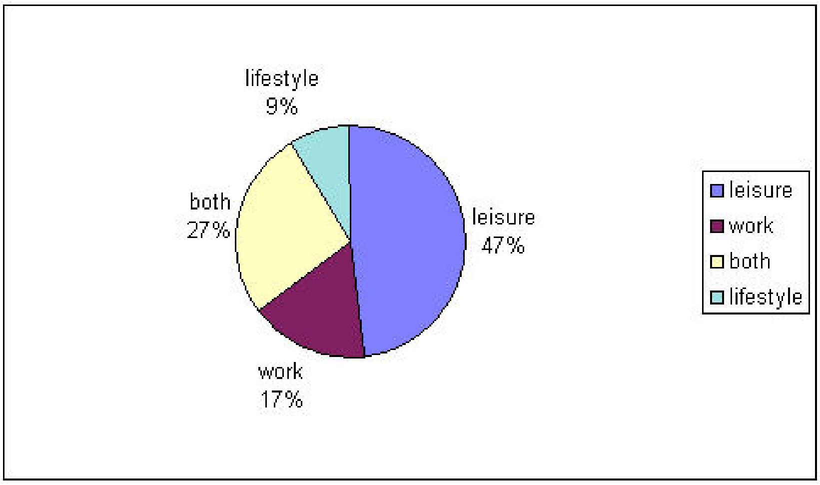


Figure 3: Attitude to gardening and production



Commentary

The average garden or allotment area per person was about 1955 m^2 ($733m^2$) as reported by participants in this survey. However, the proportion likely to be devoted to vegetables and fruit was considerably less than this at $1036m^2$ ($389m^2$). This is about $1/10^{th}$ of a hectare which is generally regarded as too small an area in which to be entirely self-sufficient in food (at least on a long-term sustainable basis) although it is surprisingly difficult to find any information on the amount of land necessary to support a person sustainably producing food. This is complicated by the fact that, strictly speaking, any calculation should also include the area necessary to produce other resources necessary like biomass for fertility building, storage and tool production. Taking an overview these results imply that most of the respondents will have to draw on resources from a wider area than their garden for their food, or alternatively that their food production is not likely to fall within their actual garden footprint.

Interestingly it has been estimated that we have about 0.1 ha of arable farmland per person to produce food in the UK (5.3 millon ha arable land and 60 million people, ref 7), which is about the same as our members devote to vegetable production. This indicates that home food production could make a significant contribution to national self-sufficiency but still begs the question of whether we would all have enough to eat! This should be tempered with the knowledge that most low input farming families (say 2 adults and 4 children) in the tropics, using largely manual labour and locally generated fertility inputs, need at least 1.5 ha to supply their basic food needs (i.e. about 0.4 ha per adult). John Semour in his classic book on self-sufficiency (ref 8) and other authors tend towards a figure of around 2 ha (5 acres) for a family (say 2 adults and 2 kids) to be self-sufficient in temperate areas (i.e. about 0.6 ha per adult). Permaculture practioners (e.g. ref 9) would probably reckon to at least halve this area but some of their estimates are optimistic (ref 10 at 0.1ha!) and many of their practices have yet to be tested over time (at least in temperate climates).

Specific questions that arose from members on issues arising in this section included:

- What is the implication of the human work done? Does it have some cost that we need to factor in? Does home working affect the calculations? How can effects be separated out?
- Is their any value in having just rough ground- what is the comparison in carbon footprinting terms? Perhaps it could be environmentally beneficial just to buy an allotment and plant trees? Can we allow for wildlife in these calculations?
- What would people do with their time if they weren't gardening or producing food e.g. is gardening a replacement form of consumption? Do we also need to count the number of people involved in gardening and/or allotment activities?

Section 3: Inputs

Results

Obviously, apart from their labour input (see section 2), all respondents used a range of physical inputs in their gardens and allotments. The inputs are either produced within the garden system or imported into it from external sources. The majority of respondents (=110 or 95%), as expected, **grew organically**, and could be expected to follow organic principles when sourcing inputs (ref 11). Five people (4%) did not consider themselves organic, and 1 (1%) practiced organic methods only where possible. It seems that some people probably practiced organic methods for growing food but where more relaxed in other areas of the garden (e.g. weed control on paths or lawns).

Seed: seed is a primary resource for organic growers, and they should use organic seed where possible. 8 people (7%) reported that they used no home saved seed implying that all the seed used was bought. Although we did not specifically ask this question in this preliminary survey it would be reasonable to assume at least some of the seed is organic but a proportion used will be standard non-organically produced. 98 (84%) used some home saved seed indicating that the balance is bought and 9 (8%) used a lot of home saved seed. Although we did not specifically ask people to quantify the amount of seed they bought it is possible to infer this from the range of crops grown (see section 4 below) and in many cases is likely to be one of the larger outlays in terms of money. All seed production has an associated environmental footprint to do with its production and transport and this is discussed below

Products used: a wide range of products were reported as being used by members, see table 2 and annex 1. The products can be categorised according to their end use (see table 2) and the most popular were pest and disease control products, fertilisers and amendments, mulch and weed controls, and propagation materials. Table 2 shows the most popular product types in these categories. The use of the majority of the products is self-evident and their use is not described here.

Table 2: Most popular inputs used by members by catergory.

Product category	Product	No using product	Average quantity used	standard measure	no for average	Source	Comments
Pest/Disease Control	biological slug control	12	1.71	pkts	7	D	
	codling moth traps	5	2.75	items	4	D	
	derris	4	225.00	g	2	D	
	enviromesh	2				D	more people recorded this in protected croping
	fleece	3	1.73	m3		D	more people recorded in protected cropping
	insecticidal soap	9	337	ml	7	D	
	organic pest control spray	4	1250.00	ml	2	D	fatty acid spray (Chase catalogue PCRT)
	slug pellets	22	985	g	15	D	one very large quantity left out of calculation
	yellow sticky traps	3	10	traps	3	D	
Weed Control/ Mulch	weed control fabrics/membrane	3	10.00	sq m	2	D	recorded in mulch section as well
	pathclear (glyphosate)	8	2.50	l	5	D	
Mulch	black plastic mulch/ landscape fabric	6	300	sq m	1	D	see above as well
	leaf mould	34	690.30	l	27	H	
	mulch (green)	22	343	l	3	H/C	
	mulch (recycled carpet, card, newspaper)	9				H/D	recycled
	mulch (shreddings)	5	1460	l	3	H	
	mulch (bark/woodchips)	18	1399	l	13	H/C/D	
	mulch (straw/hay)	7				H/C	
	mulch (unspecified)	15	1397	l	9	H/C	
Amendments	comfrey (home made)	15				H	
	comfrey liquid	17	50.80	l	10	H/D	
	comfrey pellet	2	10.00	kg		D	
	compost (unspecified)	18	962.80	l	15	H/C/D	
	compost (commercial)	13	348.46	l		D	
	compost (green waste)	3	280.00	l	2	C	
	compost (home made)	72	1863.29	l	45	H	
	nettle liquid	6	91.67	l	3	H	

	seaweed	6	255.00	kg	2	D	
	seaweed calcified	3	5.00	kg	2	D	
	seaweed extract	19	657.81	ml	16	D	
	seaweed meal	11	3.28	kg	9	D	
	worm compost	3				H	from worm bin
	worm liquid	6	15.20	l	5	H	from worm bin
Fertiliser /fertility	blood fish bone meal	14	12.77	kg	11	D	
	bone meal	6	3.40	kg		D	
	chicken manure pellets	26	7.61	kg	24	D	
	fertiliser (general, organic)	8	15.7	kg	4	D	
	fertiliser tomato (solid)	5	35.00	g	2	D	
	fertiliser tomato (liquid)	10	1.75	l	10	D	
	lime (dolomite)	11	6.63	kg	8	D	
	manure (farm yard)	78	806.4	kg	61	H/C	
	potash	2	40.00	kg	1	D	
	rock phosphate	1				D	
	urine	3	1.00	l	1	H	
Propagation	bedding plants	1				C/D	
	potting compost	24	206.89	l	19	D	
	seedlings, tubs etc	1				C/D	
	seeds	3				H/D	
	sharp sand	3	60.00	kg		D	
	vermiculite	4	21.25	l		D	

Many of the most popular products used are sourced through long supply chains, presumably through hardware shops, local garden centres, and national (supermarket type) garden centre chains. Such products generally have a large ecological footprint as compared to home produced or locally sourced materials. Some of the more bulky amendments or fertilisers were more likely to be home produced or locally sourced and will have a lower ecological footprint. This is discussed further in the commentary and analysis below.

Tools used: members reported using a wide range of tools. The most popular are listed in table 3 and the complete range shown in annex 2. The ecological footprint of these tools will depend on how often they are replaced and, to some extent, how much they are used. Some 'tools' like wheelbarrows, buckets and watering cans are likely to have been underestimated from this survey due to the structure of the questionnaire which may not have led people to list them although we could reasonably expect them to be used.

From the survey it is gratifying to see that most members reckon to get a long life (more than 15 years) from most of their basic tools like forks, spades and hoes. Even more short-lived tools like strimmers and lawnmowers are estimated to last longer than 10 years. Most of these products will also be marketed at the end of a long supply chain (often sited predominantly outside the UK) and this needs to counted into their ecological footprint. This is discussed further in the commentary and analysis below.

Table 3: Tools used for gardening

Tool	Count Of Tools	Avg Of Replacement	Min Of Replacement	Max Of Replacement	Avg Of hours use per year	Min Of hours use per year	Max Of hours use per year
bucket(s)	6	4	2	5	60	20	100
chainsaw(s)	13	16	8	30	21	1	72
dibber	6	22	10	30	7	4	10
fork(s)	108	17	2	100	75	0	365
fork(s) (small)	6	20	20	20	137	30	300
hand fork(s)	43	18	0.5	100	53	1	300
hedge cutter	18	13	4	25	10.5	3	30
hedge cutter (electric)	5	11.5	10	15	6	1	15
hedge cutter (petrol)	2	9	8	10	17	3.5	30
hoe(s)	80	21	5	100	46	2	300
lawn rake	11	19	5	50	5	2	10
lawnmower	38	12	3	25	35	1	100
lawnmower (electric)	8	15	10	25	23	5	50
lawnmower (manual)	12	26	10	40	40	5	200
lawnmower (petrol)	14	16	6	40	34	4	80
loppers	23	12	5	20	18	2	100
mattock	5	22	12.5	30	40	40	40
pruning saw	8	15	10	25	4	2	10
rake(s)	77	20	2	100	24	1	300
rotovator	12	25	7	40	6	1	30
saw(s)	7	8	5	10	4	3	4
secateurs	58	7	0	20	46	0	300
shears	33	16	1	100	14	4	30
shredder	19	16	8	30	17	2	100
shredder (electric)	2	10	10	10	24	8	40
shredder (petrol)	1	10	10	10	30	30	30
spade(s)	106	18	3	100	65	2	520
strimmer	20	10	3	25	16	2	60
strimmer (battery)	3	2	2	2	55	50	60
strimmer (electric)	3	5	5	5	10	3	20
strimmer (petrol)	6	14	10	25	14	5	25
trowel(s)	81	13	0.5	100	44	1	200
watering can(s)	6	3	1	5	65	10	130
wheelbarrow(s)	15	12	2	20	65	5	100

Protected cropping: is popular in the UK as a way of prolonging the season at either end, or as the climate warms, it could be increasingly used for producing through the winter months. 71 people (61%) reported that they had glasshouses, the majority small or medium sized (table 4). 38 (33%) didn't have a glasshouse. Only a few people heated their glasshouses (15 out of 71 (21%)) but those that did, and gave estimates, reported that they kept them heated for about 114 days, 12 hours a day. Most however mentioned that they used thermostats and so the energy use would depend on the external ambient temperature.

Table 4: Use of glasshouses

Size	No (total)	No Heated
Large	5	2
Medium	24	6
Two Medium	2	1
Small	38	6
Two Small	2	0
None	38	

Polytunnels are becoming a more popular choice for protected cropping because they can cover larger areas relatively cheaply (in terms of cash cost!). 4 people (3%) reported that they had a large polytunnel, 10 (9%) a medium sized one and 8 (7%) a small one, one person having both a medium and large tunnel. This implies that 91 (78%) didn't have a polytunnel.

Both glasshouses and polytunnels are usually constructed from materials that have to be sourced through long supply chains and, consequently, will have a high ecological footprint associated with them. Glasshouses are likely to be more durable (as long as people don't throw stones!) being made of metal and glass. Polytunnels are likely to have a shorter lifespan, especially the plastic covering, which is likely to need redoing at least every 5 years or so. In this case the waste plastic also needs disposing of through the waste chain which once again involves transport and destruction costs.

A wide range of other protected cropping methods were mentioned; see table 5 below for the most popular and annex 3 for the complete list. Many of these structures are of more traditional design and the materials are often locally sourced or even recycled. For example many of the materials used for cloches and cold frames are recycled e.g. old window frames and pallets and plastic drink bottles. Although recycling is a positive benefit it must be borne in mind that the recycled materials themselves will have some ecological footprint associated with them and what is really being saved is the (admittedly often large) ecological footprint associated with disposal.

Table 5: Other protected cropping methods

protected cropping	CountOfprotected cropping
cloches (bell)	1
cloches (glass)	3
cloches (plastic bottles/containers)	48
cloches (polythene tunnels)	3
cold frame(s)	25
cold frame(s) (recycled materials)	4
enviromesh	17
enviromesh (tunnels)	2
fleece	51
fleece (tunnels)	2
fruit cage(s)	7
mini plastic greenhouse/ polytunnel	10
netting (over fruit and/or cabbages)	18

Compost: the survey recorded very high rates of composting, understandable as compost forms the basis of any organic soil management programme in the garden or on the allotment. 113 people (97%) recorded that they composting garden waste, 115 (99%) composted kitchen waste (including some using wormeries and bookashi methods), and 98 (84%) composted other biodegradable waste. We asked people to estimate the size of their compost heaps; the average volume of compost was 4.64 m^3 (from 107 replies), with most people having three or more compost bins on the go at any one time as well as a heap of leaf mould or two. In fact this is the equivalent of 14 large (330 l) compost bins of the type that councils usually distribute and our members must be in line for any number of champion composting awards.

The ecological footprint of composting is not well documented. On the one hand the aerobic composting process must produce CO_2, a natural by-product of all aerobic respiration, but on the other hand, it prevents the material ending up in landfill, where it would normally be degraded anaerobically to produce methane, a more potent greenhouse gas. There is also an environmental footprint associated with waste disposal, especially transport, which is (usually) negligible for home produced compost. Compost is also likely to increase soil organic matter content and promote soil biological activity when used, and this will have a further effect on soil carbon levels. There is some evidence that this might help to bolster carbon sequestration is soils but the research into this is still in its infancy and open to many contradictory interpretations (refs 12 and 13). There is also the question of what difference composting methods make; for instance is there any difference between compost and leaf mould?

Water use: most people found it difficult to answer the survey in the way it was presented. 112 people (97%) admitted to watering their vegetables, but often qualifying this by noting that they only watered seedlings or when needed (e.g. in drought conditions). Of these 42 (36%) also watered their flower beds and a further 4 (3%) their lawn as well. Encouragingly an overwheliming majority (104 people, 90%) collected and used rainwater and with only 2 (2%) stating that they didn't.

82 people (71%) used mains water; from rarely (only in drought conditions or when rain water runs out), to sparingly (mainly to water in plants or water seedlings), or regularly (to water vegetables). Most people found it hard to give a volume but we have calculated an average use of water based on reported hours use or meter readings where given. We have used figures from Ofwat that assume a hosepipe for one hour uses approximately 540 litres (costing around 70p, ref 14) of water (incidentally a conservative estimate as most sites reckon on 1000 l per hour for sprinklers and hosepipes). From 82 replies the average use was **9.8 m^3 per year** (min 0.1 to max 180) with peaks around 2 m^3 for those who just used mains water occasionally and a group regularly using more than 10 m^3.

Cleaning, distribution (and treatment) of water has an environmental footprint although it is true to say that the use in gardening is probably dwarfed by other personal and industrial (including agricultural) uses in the UK. Of the respondents 30 (26%) used grey water habitually or occasionally. Grey water is essentially a method of recycling water that is only lightly tainted (usually with soap or even just dirt from washed vegetables). It should be pointed out that it is a legal responsibility that people who use grey water ensure that it cannot backflow into the mains. From this point of view, and a hygiene point of view, it is therefore better to use grey water immediately (see ref 15 for advice from the Environmental Agency).

Food Storage: most people (93 (80%)) reported using a fridge with or without a number of freezers. One or two people reported using Savaplugs or equivalent on fridges and freezers although modern fridges should have these fitted as standard. Fridges typically consume about 3.5% of household energy in the UK (although they do also have a small heating effect!) and are getting better (ref 16). Obviously the energy to make them (the embedded energy and resources) as well as at least a portion of the energy needed to run them has an ecological footprint associated.

Table 6: Numbers of respondents using fridge and/or freezers for storage

Category	fridge	small freezer	large freezer
Appliance only	5	9	8
Fridge plus 1 small freezer	47		
Appliance plus 2 small freezers	3	1	
Fridge plus 3 small freezer	1		
Appliance plus 1 large freezer	16	2	
Fridge plus 2 large freezers	4		
Fridge plus 1 small and 1 large freezer	12		
Fridge plus 1 small and 2 large freezer	2		
Fridge plus 2 small and 1 large freezer	2		
Fridge plus 3 small and 2 large freezers	1		

In contrast many traditional methods of food storage have a low of one off environmental cost. Members reported a range of alternate food storage methods and these are listed here in Table 7. Some of the methods obviously involve an energy input and/or the use of a range of products or resources that would normally be bought in from long(ish) supply chains. For instance the energy cost of cooking and the ecological footprint of items like vinegar and sugar used for prickling and jam making need to be taken into account in any complete evaluation of storage methods.

Table 7: Reported storage methods

Storage method: produce	N^{o} reporting using method
Bottling: fruit, beetroot, tomatoes	29
Chutneys: apple, tomatoes, cucumber/squash, onions	28
Clamping: (normally in compost or sand). Products include root vegetables like carrots and beets	6
Cool dry storage: normally in shed, garage or cellar. Often in boxes, nets, sacks or bunched with string. Products include apples, potatoes, onions, squashes, carrots, garlic, beet.	78
Drying (either solar, oven, box (with 60W light bulb), electric dryer). Products include beans, herbs, spices, tomatoes, fruit, chillies, peppers.	28
Sharing: excess to neighbours	1
Fruit butter	1
Fruit draws	1
Herb oils	1
Ice cream (sorbet)	1
Immediate use	2
In ground: carrots, swedes, parsnips	8
Jam (and jellies): fruit	57

Juicing: (with or without pasteurisation). Products mainly fruit.	6
Pickling: onions, shallots, gerkhins, cabbage, other veg	27
Preserving (with or without alcohol)	3
Syrups:	1
Wine: mainly fruit	7

Commentary

The replies to this section of the survey where in many respects the most difficult to answer and quantify but will be important in the ultimate size of any footprint associated with gardening and home food production. Some of the implications for the garden footprint have been discussed under the various sections above whilst the actual impacts are discussed in the analysis section below.

Not surprisingly this section also generated a lot of comments and commentary from respondents. These have been loosely grouped below and are in many cases subject of further commentary in the analysis and discussion sections:

- Does growing organically improve matters? Or is it just input substitution with equally long supply chains?
- What is the carbon footprint of seeds? Does home save seed reduce footprint significantly? What about pots and trays and modules and bought in transplants? Could use of paper pots recycled be promoted to reduce environmental footprint?
- Does using electric equipment make any difference to overall footprint as compared to petrol? What are the comparative energy uses of each type or are the differences ironed out in the round? Does a renewable source for electricity make a difference?
- What about day to day supplies like canes, thread, string, pots, trays, modules etc.? Should carbon cost of inputs go to the retailer or the gardener?
- What about other use of power in the garden such as BBQs and lighting? And what about other garden items such as decking and deckchairs? Should they all be counted in?
- Can novel production methods like potatoes in containers or strawberries in pots help in any way?
- What is the best way to dispose of garden waste? Mulch, compost or bonfire?
- What about clothes- need special clothes, higher wear and tear, wellies, clothes need washing more often?
- What about animals? Small animals, especially hens and ducks, can be used to supply products (eggs, etc.) and services (weeding, etc.) and could be used within garden systems.

Section 4: Outputs

Results

Of the 116 replies, **8 people** (**7%**) only grew vegetables while the majority, **108** (**93%**), reported that they grew vegetables and fruit. **19 people** (**16%**) grew these on an allotment, **25** (**21%**) on an allotment and in their gardens, and **72** (**62%**) in their gardens only.

Of those who grew on an allotment, the average distance to the allotment was **0.88 miles** as reported by 43 people and people went, on average, about **12 times per month** (11.9) averaged over the whole year. On the whole most went by foot or bike (**40** (**93%**)) but many also went by car on occasion (**16** (**37%**)) especially when carrying things or harvesting produce. **1 person** used public transport.

On average (from 109 replies) **65** (**60%**) people ate their own produce daily, **37** (**34%**) weekly and **7** (**6%**) monthly. This is reflected in the average proportion of fruit and vegetables that people reported that they grew at home, on average 52%, but with a wide range from 0% to 100% (see figure 4). The balance of produce was bought in. On average, 15% of fruit and vegetables were bought direct (from outlets like farm shops or box schemes), 22% was bought in supermarkets and around 3% consumed while eating out. For the remaining balance, people reported buying 8% from other sources (such as local markets, independent shops or green grocers) as shown in table 8 below. A significant proportion also obtained fruit and vegetables from friends or by sharing.

Figure 4: Proportion of fruit and vegetables obtained from various sources

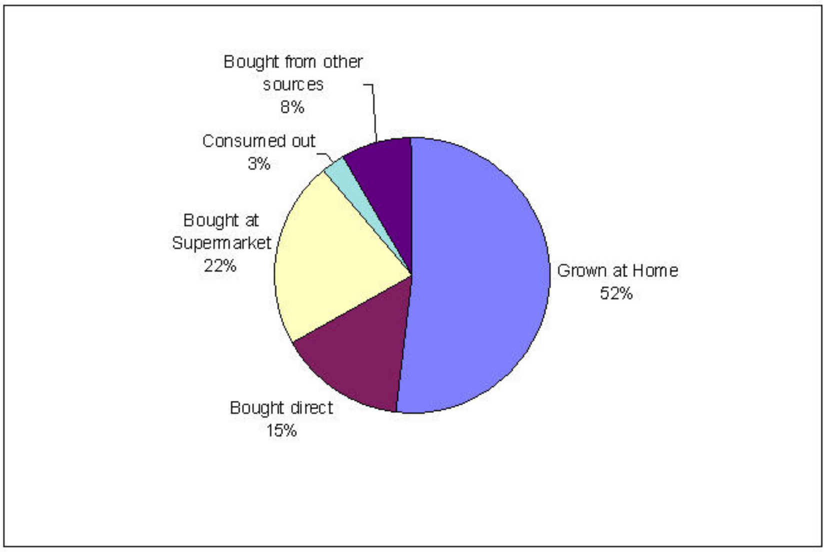


Table 8: Other reported sources of fruit and vegetables

Other sources	N⁰
(local) greengrocer(s)	15
(local) market	17
(local) organic shop(s)	3
farm shop	1
farmers market	7
from friends, exchange	7
independent shop(s)	7
market and veg shop(s)	3
not specified	3
pick your own (fruit)	1
sandwiches at work	1

wholefood shop/co-op	2
wild food	1

Rather that ask people to calculate or measure exact yields we asked them to estimate what proportion of their production met their consumption requirements. On the whole people reported that they produce just over half (52%) of the staple vegetables that they consume and this is corroborated by the lists of vegetables and fruit that they reported as growing and the proportion of their consumption that this met (see table 9 for vegetables and table 10 for fruit). Some crops (e.g. melons) are only grown by a few members but most members produced at least a few staples like potatoes or salads.

From the tables it is evident that the proportion of vegetable consumption met by their production varies between types of vegetables and fruit and that the range reported by different members is also wide. On average members reported that they produced about 55% of the potatoes they consumed and 56% of green leaf vegetables, but in each case the range spanned 0% to 100% of consumption. In general the proportion of minor vegetable crops (i.e. those grown by fewer people) produced was much higher proportion of total consumption (e.g. 78% for squashes and 82% for sweetcorn) and the range (slightly) narrower.

Table 9: Vegetables grown, showing average, minimum and maximum produced as a proportion of total consumption.

Crop Category	Crops	Percentage of total consumption (%)	Min of consumption	Max of consumption	N° Producers
Artichokes		100.0	100	100	2
Asparagus		100.0	100	100	4
Aubergines		52.5	5	100	2
Green Leaf Veg	brassicas, spinach	56.3	0	100	112
Herbs	oregano, mint, parsley	76.4	1	100	19
Legumes	peas, beans	65.9	1	100	108
Melons		90.0	80	100	3
Onions		57.1	0	100	102
Other alliums	leeks, garlic, shallots, chives	68.8	0	100	106
Peppers	incl chilli	27.3	0	90	10
Potatoes		54.7	0	100	105
Root Veg	carrots, beetroot, parsnips, swede	47.6	0	100	103
Salads	lettuce, leafed	57.0	0	100	107
	cucumbers	52.1	10	100	12
	tomatoes	55.5	0.5	100	111
Squashes	butternut, courgettes, marrows,pumpkins	78.2	10	100	58
Sweetcorn		82.3	4	100	26

When it comes to fruit (table 10) members are far more likely to be approaching covering all their consumption requirements, but in some categories like citrus or figs, understandably, very few members grow them. Even with the more staple soft and hard fruits fewer members report growing them as compared to vegetables. On the other hand where people produce them they generally produce a sizeable proportion of their consumption requirements (e.g. currants, raspberries and blackberries where most people produce over 90% of their requirements). Even for some top fruit categories many produce most of their requirements, presumably because one or a few trees can cover most needs. Many members reported that they didn't eat these fruits out of season either.

Table 10: Fruit grown, showing average, minimum and maximum produced as a proportion of total consumption.

Crop Category	Crops	Percentage of total consumption (%)	Min of consumption	Max of consumption	N°
citrus	oranges, lemons, tangerines	83.3	0	100	7
figs		83.3	50	100	3
fruit	?	39.6	1	100	7
grapes		58.0	2	100	4
hops		52.5	5	100	2
kiwis		90.0	90	90	1
nuts		97.5	90	100	4
quince		100.0	100	100	1
rhubarb		91.7	1	100	32
soft fruit		86.9	2	100	33
	blackberries	94.1	50	100	17
	blueberries	74.3	30	100	8
	boysen berries	100.0	100	100	1
	currants (black, red, white)	100.0	100	100	52
	greenguages	100.0	100	100	2
	gooseberries	98.3	70	100	31
	jostaberries	100.0	100	100	2
	raspberries	93.0	10	100	42
	strawberries	78.0	2	100	43
top fruit		47.5	25	70	2
	apples (cooking, desert)	50.7	1	100	78
	apricots	95.6	80	100	5
	cherries	98.6	95	100	5
	damsons	100.0	100	100	9
	pears	53.6	5	100	31
	peaches	82.5	50	100	5
	plums	90.8	5	100	36

As a final check on the proportion of home consumption met by production we asked people to estimate the amount of money saved by home production. The average saving was reported at **£336.89 per year** (about £28 per month). However, many people remarked that this often didn't take into account the cost of inputs (or all of them), which would reduce the relative value of the actual amount saved. Some members were also unsure as to the value of shop sold organic vegetables (mainly because they were almost self-sufficient and didn't tend to buy them). Also saving money was not the overwhelming motivation for most people in growing vegetables but was rather more of a lifestyle decision to produce their own food, to be self sufficient, to get exercise etc. depending on circumstances. Many people also commented that they would not necessarily buy or consume things that they did not grow and the value of a varied diet is hard to quantify!

Commentary

From this section it seems that with the land and resources devoted to home production most people could produce in the region of 50% of the fruit and vegetables that they consume. It is an open question as to what proportion of the population would have access to the land and resources necessary for this. It is also worthwhile pointing out that we have not included other production factors in this survey like animals which some of these households are likely to be producing and consuming as well. Even so, this means that most families are probably still going to rely on external food chains for a significant proportion of their food requirements and that, at best, and if garden production was ecologically or carbon neutral, it could potentially replace around half of the footprint normally associated with household food consumption.

The actual ecological footprint of gardening and home food production is analysed in more detail below but a superficial analysis is also possible. Given that food consumption accounts for around a third of ecological footprint then, in a neutral situation, home food production could halve this, so reducing a total footprint by around 15%, a worthwhile amount when summed over the entire population. This is likely to be achievable for vegans and vegetarians and considerably more difficult for heavy meat eaters. It is also worth pointing out that it also matters where the external food is sourced, so that food purchased at the end of long food chains will have a correspondingly large footprint associated with it, as compared to food purchased directly and locally from the producer. So, replacing supermarket produce with home grown is likely to have a correspondingly bigger impact than replacing food produced and bought at a local organic farm shop (for instance). But in this analysis it has been assumed that the ecological footprint of home production is essentially negligible. This is examined in more detail in the next section.

It is also interesting to note that the motivation for growing your own food is unlikely to be money saved! In fact in calculating a monthly wage if members devote on average 10 hours per week and saved around £28 they are effectively being paid 70p an hour! In many cases members were clear that they only saved a small amount or even nothing but that this was more than compensated by the taste and satisfaction of producing their own food, the exercise gained or the feeling of being part of a wider solution (which it has to be admitted are difficult to put a price to!).

In answering the survey in this section generated other comments which have been categorised below:

- Is it better to grow to be self-sufficient? Perhaps it is better to specialise in some things and buy in other things? Should you grow fruit perhaps? Or leafy vegetables? And buy in bulk produce like potatoes that tend to be produced in bulk and cheaply?
- What about cut flowers- can gardens and allotments replace this unnecessary generator of CO_2?

Footprint Analysis

In calculating what proportion of a persons footprint gardening is likely to take up it is necessary to put figures to many of the findings of the survey. This will also begin to answer the question above more realistically i.e. what effect does home food production have on ecological footprint? An analysis will also begin to address the previous assumption made (and made in some footprint calculators) that home food production is ecologically or carbon neutral in some sense.

In doing this analysis we have, in this initial survey, opted to take a broad-brush approach. Using figures from our study on carbon foot printing of organic farming (ref 17) we have calculated the carbon footprint of the inputs (largely derived from section 3) and then used this to calculate an overall average ecological footprint for home food production. In each case the carbon footprint has been averaged per year for each input and will therefore depend on factors like the materials it is made of, the quantity used, how long it lasts before being replaced, any maintenance resources, and any energy use (in the case of fossil fuels or electricity for example). In the final analysis we have then substituted an ecological footprint value for this carbon footprint using accepted conversion factors.

In principle we could calculate a footprint for each individual reply that we received. However in the first instance we have calculated an average footprint for all replies received. This is because as we began to do the explore the issues and concepts it became apparent that we first of all needed to develop our thinking and methodology and we had perhaps underestimated the resources and time that we would need to do this. In other words the whole field of lifestyle footprinting is not as developed as we had thought when we began the experiment. Using the figures produced in this initial experiment members can get a rough idea of their gardening footprint by substituting in the land area they use and comparing this with their overall footprint calculated in the first section. This provides a useful base from which to identify areas that could be improved. We are also working towards providing a calculator to let people calculate their individual gardening footprints though we now realise that we will need to obtain funding to do this in the medium term.

Taking each of the factors in section 3 in turn it is possible to draw general observations and conclusions about the footprint of gardening.

Tools: overall tools are responsible for around 12% of the gardening footprint in total (table 16). The most common tools are listed in table 11 together with their embedded energy costs. Generally the more complex the tool the more energy used per year. Petrol tools are generally more energy intensive than equivalent electric tools, which are in turn more energy intensive than any manual equivalents. In general good quality manual tools (e.g. spades, forks) with no mechanical parts have a long replacement time, a low maintenance requirement and hence a low energy equivalence and small footprint size. They can last many years (commonly 20 or more) despite their high usage. More complex tools will generally be less labour demanding but have a higher energy usage and footprint as they will need to be replaced more often, have higher maintenance costs and, in some cases, will require fuels to run them (although it is possible to run them on biofuels these are not, as commonly thought, carbon neutral, and also have an environmental footprint associated with their production and processing).

Many members pointed out that tool storage and security (e.g. garden sheds!) can be vital to a gardening operation and in this case the ecological footprint of such structures should be built into the equation although in this case we have not done this. This is also relevant if such structures are used for storage of produce (see below).

Table 11: Tools, energy use per year

Tool	% Use	Average replacement time	Average hours use (per year)	Mass (kg)	Energy manufacture & delivery (MJ/year)	Repairs ratio	Energy maintenance (MJ/year)	fuel (l/hour)	Energy fuel (MJ/year)	Total energy per tool (MJ/year)	Average garden footprint (MJ/year)
bucket(s)	98	4	60	0.4	11	0.10	1			**12**	**12**
chainsaw (petrol)	12	16	21	6.0	37	0.39	13	0.5	397	**447**	**55**
dibber	5	22	7	0.3	1	0.10	0			**1**	**0**
fork(s)	84	17	75	1.9	10	0.10	1			**11**	**11**
fork(s) (small)	5	20	137	1.0	5	0.10	0			**5**	**0**
hand tools	17	15	55	0.3	2	0.10	0			**2**	**0**
hedge cutter (electric)	19	12	10	3.0	24	0.39	8	0.5	194	**226**	**44**
hoe(s)	60	20	48	1.9	9	0.39	3			**12**	**8**
hosepipe	9	5		2.0	38	0.39	14			**52**	**5**
lawn rake	9	19	5	2.0	10	0.10	1			**11**	**1**
lawnmower (electric)	8	12	23	20.0	159	0.39	56	0.5	437	**653**	**52**
lawnmower (manual)	10	12	13	10.0	80	0.39	28			**108**	**11**
lawnmower (petrol)	12	12	34	25.0	199	0.39	71	0.5	641	**911**	**112**
long handled prunners	6	10	200	1.0	10	0.20	2			**11**	**1**
loppers	20	12	18	2.0	16	0.10	1			**17**	**3**
potato/ bulb planter	3	7		0.5	7	0.10	1			**8**	**0**
prunning saw	5	13	6	0.5	4	0.20	1			**4**	**0**
rake(s)	67	20	24	1.1	5	0.10	0			**6**	**4**
rotovator (petrol)	10	15	8	25.0	159	0.39	56	0.5	154	**370**	**39**
saw(s)	9	10	4	0.4	4	0.20	1			**5**	**0**
scythe	4	10	5	2.0	19	0.10	2			**21**	**1**
secateurs	50	7	46	0.3	3	0.10	0			**4**	**2**
shears	28	16	14	0.8	5	0.10	0			**5**	**1**
shredder (petrol)	17	15	17	20.0	127	0.39	45	0.5	328	**501**	**88**
sickle	3	20	4	0.8	4	0.10	0			**4**	**0**
sieves(s)	4	25	10	0.5	2	0.10	0			**2**	**0**
spade(s)	91	18	65	2.4	12	0.10	1			**14**	**13**
strimmer (electric)	5	10	10	2.0	19	0.39	7	0.5	190	**216**	**11**
strimmer (petrol)	5	10	14	3.7	35	0.39	13	0.5	258	**306**	**16**
trowel(s)	72	13	44	0.3	2	0.10	0			**2**	**2**
watering can(s)	84	20	65	0.4	2	0.10	0			**2**	**2**
wheelbarrow(s)	13	12	65	13.5	110	0.10	10			**120**	**16**

Products: members used a wide range of products in their gardens for fertility building, supplying nutrition and crop protection. The most common are listed in table 12 together with their embedded energy and, taken together account for around 13% of total energy used in the garden (table 16). In general terms the highly energy intensive materials divide into two groups; those that are used in small quantities but highly processed like pest control products and amendments (e.g. garlic spray or Bordeaux mix) and those that are relatively unprocessed but used in large quantities for fertility effects (e.g. manure or potash). Generally a home produced equivalent will have a much lower embedded energy (e.g. compare commercial compost and home made compost) not least because transport costs are zero and processing costs are usually very low.

Table 12: Products, energy use per year

Product	% Use	Average quantity	standard measure	Energy embedded (MJ/kg)	Energy embedded (MJ/year)	Average garden footpirnt (MJ/year)
anti coddling moth grease (Vaseline)	2	0.4	kg	10.5	4	0.1
bone meal	18	10.0	kg	10.5	105	19.3
Bordeaux mix	3	0.1	kg	90	12	0.4
comfrey & other liquids (home made)	35	50.8	l	0	0	0.0
compost (commercial)	44	320.0	l	1.14	365	163.2
compost (home made)	78	1500.0	l	0	0	0.0
derris (insecticide)	3	0.2	kg	199	45	1.6
ecover (pest control)	1	0.5	l	92	46	0.4
Epsom salts	3	1.5	kg	1.14	2	0.0
fertiliser general	8	35.0	kg	1.14	40	3.2
fertiliser organic	2	4.0	kg	1.14	5	0.1
fertiliser liquid	18	1.8	l	50	88	16.1
fungicide spray	2	1.0	l	92	92	1.6
garlic spray	3	5.0	l	90	450	11.8
grow bags	4	0.2	kg	95.57	19	0.8
herbicide pathclear (glyphosate)	7	2.5	l	454	1135	79.6
insecticidal soap	4	0.1	l	199	15	0.7
insecticide spray	2	0.3	l	199	50	0.9
lime (dolomite)	9	6.6	kg	1.05	7	0.7
manure chicken pellets	24	7.6	kg	1.14	9	2.1
manure farm yard	49	950.0	kg	182	182	91.0
manure horse	19	1359.2	kg	213	213	41.1
manure urine	3	3.0	l	1.14	3	0.1
mole & mouse trap	2	0.3	kg	95.57	29	0.5
organic pest control spray	5	1.0	l	90	90	4.7
pheromone traps	9	0.1	kg	95.57	10	0.8
potash	2	40.0	kg	6.4	256	4.5
rock phosphate	2	5.0	kg	7.02	35	0.6
seaweed extract	33	2.0	kg	1.2	2	0.8
slug pellets	19	1.0	kg	199	199	38.4
slug pellets (organic)	15	0.6	kg	90	56	8.4
soft soap	3	0.6	l	1.14	1	0.0
sonic cat scarer	1	0.3	kg	95.57	29	0.3
sulphur candle	2	1.0	units	3	3	0.1
vermiculite	4	21.3	l	10.5	223	9.8

worm casts	2	40.0	l	1.14	**46**	**0.8**
worm liquid	5	15.2	l	1.14	**17**	**0.9**
Seeds	98				**58.5**	**58.5**

Protected cropping: many products are used in protected cropping practices. Protective structures like glasshouses or polytunnels have the highest embedded energy cost, and when heated high running costs (see table 13, 16). Many of the materials are also made of plastics and consume non-renewable resources so also come with a large associated footprint. Even those that are 'recycled' have an embedded energy cost. Calculating a footprint for recycled materials presents a tricky dilemma because although the products have been given a extended working life and have been (at least temporarily) diverted from the waste stream they still have an embodied energy cost which should be noted in some manner.

Table 13: Protected cropping, energy use per year

protected cropping	% use	Average quantity	standard measure	Average Replacement Time (years)	Mass kg	Energy embedded (MJ/kg)	Energy embedded (MJ/kg)	Average garden footprint (MJ/kg)
black plastic	3		m	1.5	2.0	87	**116**	**4**
cloches (glass)	3			5.0	2.0	95.57	**38**	**1**
cloches (plastic bottles/containers)	45			2.0	2.0	87	**87**	**40**
cold frame(s)	22			5.0	10.0	87	**174**	**38**
conservatory	3			10.0	100.0	87	**870**	**23**
enviromesh	17		m	1.5	2.0	87	**116**	**20**
fleece	46		m	1.5	2.0	87	**116**	**54**
fruit cage(s)	6		m	10.0	10.0	87	**87**	**5**
heated propagators	2			5.0	10.0	95.57	**191**	**3**
mini plastic greenhouse/ polytunnel	9			10.0	20.0	87	**174**	**15**
netting (over fruit and/or cabbages)	16		m	1.5	2.0	87	**116**	**18**
plastic sheet	3	300.0	sq m	1.5	5.0	87	**290**	**8**
weed control fabrics/membrane	3	10.0	sq m	1.5	0.7	87	**39**	**1**
wire mesh cages	4		sq m	5.0	5.0	95.57	**96**	**4**
structures		% heated						
Polytunnel large	3	0%		10.0	75.0	87	**653**	**17**
Polytunnel medium	9	0%		10.0	50.0	87	**435**	**38**
Polytunnel small	7	0%		10.0	25.0	87	**218**	**15**
Glasshouse large	4	40%		20.0	150.0	95.57	**717**	**31**
Glasshouse medium	27	23%		20.0	100.0	95.57	**478**	**130**
Glasshouse small	39	13%		20.0	50.0	95.57	**239**	**94**
heating		Average use (hours)			kW		Energy (MJ/year)	
Glasshouse large	2	1428			0.3		1542	**27**
Glasshouse medium	6	1428			0.2		1028	**63**
Glasshouse small	5	1428			0.1		514	**27**

Storage: an often neglected aspect of home production is the footprint or energy costs associated with storage. Some members remarked that the best solution was to produce to eat fresh immediately but, in fact most members have some form of refrigeration and/or various cool or dry store methods. If fridges and freezers are counted in (although we accept that they may have uses apart from storage of home produce) they can account for up to 55% of the gardening footprint (table 14, 16). This might seem like a surprising result but the manufacturing cost is high and the running costs continuous through the year. In this study we have opted to allocate between a tenth and two thirds of the footprint costs of these devices to home produce as on average members (given that members stated that they substituted half of their vegetable and fruit production and we think it reasonable to assume that the bulk items like apples, potatoes, carrots etc. would not be stored in the fridge or freezer). Other storage methods are less energy intensive although cooking, sterilization and preservatives like vinegar will all have an ecological footprint attached. Arguably storage structures like sheds should also have a proportion of their footprint allocated to home production but we have decided that in this case, compared to other uses, the footprint is probably small.

Table 14: Storage, energy use per year

Storage method	% Use	Average replacement time	Average hours use (per year)	Mass (kg)	Energy manufacture & delivery (MJ/year)	Repairs ratio	Energy maintenance (MJ/year)	KWh per year	Energy fuel (MJ/year)	Total energy per tool (MJ/year)	Average garden footprint (MJ/year)
cool dry storage	72										**0**
drying	24										**0**
jam	52	20		10.0	48				0	**48**	**25**
bottling	29	20		10.0	48				0	**48**	**14**
chutneys	24	20		10.0	48				0	**48**	**12**
pickling	23	20		10.0	48				0	**48**	**11**
preserving (alcohol)	11	20		20.0	96				0	**96**	**11**
fridges*	8	15	8544	8.0	51	0.10	5	256	923	**978**	**5**
small freezers**	39	15	8544	8.0	51	0.10	5	342	1230	**1286**	**22**
large freezers***	33	15	8544	16.0	102	0.10	9	513	1846	**1957**	**37**

* assuming use of 10% for gardening ** assuming 50% use ***assuming 70% use

Other inputs: miscellaneous things like transport, waste and recycling can also account for a small but significant proportion of the gardens ecological footprint and we have not been able to accurately quantify all of the energy use associated with these (see table 15! and 16). Some of the issues are highlighted below:

- *Transport* in this case only represents the actual cost of getting to and from the site of production which in nearly all cases is on site or nearby. In these cases the cost associated with transport is only going to account for a small proportion of overall footprint. Transport of inputs from their source (e.g. farm or retail outlet) are either counted in to the energy cost of the material or are reasonably expected to be small (i.e. people don't generally go to a garden centre very frequently as compared to a food shop for example)
- *Composting* represents a challenging area when calculating footprints- strictly speaking much of the material will be derived from sources external to the garden and

thus comes with at least a nominal footprint cost. In this survey for instance most people recycled kitchen waste and other biodegradable waste which, at least in part, must be derived from other activities. An important point is that this material is diverted from the waste stream thus saving the considerable footprint associated with waste disposal. Its production in the garden will produce a small amount of CO_2 (and/or methane!) but if this is mainly derived from plant material will largely be carbon neutral (as long as it is produced without inputs!). This is an area of ongoing government funded research (see ref 17 for more details) and we hope to be able to more fully develop this area of enquiry.

- *Water* has a cost both for cleaning and distribution and this needs to be taken into account in a full footprinting exercise. We are currently assuming the footprint associated with water is small as the quantities used are generally small and many people use rainwater which has no carbon footprint attached (apart from the collecting and storage devices).

Table 15: Other inputs, energy use per year

Activity	% Use	Average replacement time	Average hours use (per year)	Mass (kg)	Energy manufacture & delivery (MJ/year)	Repairs ratio	Energy maintenance (MJ/year)		Energy fuel (MJ/year)	Total energy per tool (MJ/year)	Average garden footprint (MJ/year)
Transport:											
bicycle	1	10	25	15.0	143	0.39	51	20%		**194**	**3**
car	8	-									
Waste and Recycling:											
Rainwater use	91	-									
Graywater use	28	-									
Composting:											
Garden waste	99	-									
Kitchen waste	100	-									
Other Household waste	87	-									

Overview: an average footprint for members is shown in table 16. For the average person we have calculated that gardening will produce around **1.71 t CO_2 per hectare** and that this is equivalent to about **0.68 global hectares (gha) per hectare** or about **0.13 global hectares per garden** for this survey. In personal terms this is around 0.15 t CO_2 per person for gardening activities.

In a recent report on the footprint of the northwest (ref 18) the average footprint associated with food and drink consumption was 1.4 gha per person, which was also given as being very close to the national average, of which vegetables accounted for about 23%. In contrast a report on the UK as a whole (ref 19) puts the footprint associated with food and drink at 1.14 gha per person. Given then an average UK ecological footprint of about 1.4 gha per person for food and allowing that 25% of this is due to vegetables and fruit (=0.35 gha) it follows that, if our members are producing half of their own fruit and vegetables with a footprint of 0.15 gha per person, then they are saving the difference between this and a quarter of the normal footprint (=0.17). This is around 0.02gha per person or a saving of 13% on the portion attributable to fruit and vegetables. The implications of these findings are discussed below in the discussion.

Table 16: Overview GO Members Gardening Footprint

Activity	Energy Use		CO_2 Component of Ecological Footprint		Ecological Footprint	Proportion Footprint	
	MJ/year	MJ/ha	CO_2 t/ha	CO_2 t/person	gha/ha		
Production							43%
Tools	511	2614	0.204	0.018	0.082	12%	
Products (seed, fertiliser, pest control)	564	2886	0.225	0.019	0.090	13%	
Protected cropping manufacture…	561	2873	0.224	0.019	0.090	13%	
Protected cropping heating	117	600	0.088	0.008	0.035	5%	
Storage							55%
Jam, bottling, pickling jars	73	375	0.029	0.003	0.012	2%	
Freezer & fridges (manufacture)	64	325	0.025	0.002	0.010	1%	
Freezer & fridges (electricity)	1178	6028	0.880	0.076	0.352	51%	
Transport							2%
Average bicycle	3	14	0.001	0.000	0.0004	0.1%	
Average car	33km/year	*0.0065**	0.033	0.003	0.013	2%	
Waste and Recycling							0%
Rain and gray water use	0	0	0	0	0	0%	
Composting garden waste	0	0	0	0	0	0%	
Composting kitchen waste	0	0	0	0	0	0%	
Composting house waste	0	0	0	0	0	0%	
		Sum	1.71	0.147	0.684		
Average area	*1955*	*m^2*					
Average houshold size	*2.27*	*persons*					

* t/CO_2 per year

Discussion

The results of the survey to date have been discussed in the commentaries to each section and the final analysis of ecological footprint. In this section we aim to discuss the results in context and suggest ways of moving forward in future work.

Overview

From the survey it seems that the ecological footprint of those members participating in this study are already smaller than the national average. Whilst this was perhaps to be expected it was gratifying to confirm it and it helped to highlight two shortcomings with general footprint calculators; 1) it is difficult for them to be used to measure complex behaviour and whilst they are useful in a general sense to 'model' changes in lifestyles they are perhaps less useful in giving exact answers to specific questions, and 2) they do not generally account well for alternate lifestyles or ways of doing things. For this reason have initiated this current members experiment to begin a dialogue on the impact of gardening and home production on carbon and ecological footprint. In the ultimate analysis we would like to be able to judge what would the impact of a sizeable proportion of the population growing at least a proportion of their own food? And to be able to make a judgement on how sustainable this would be?

The land and labour devoted to organic garden production of fruit and vegetables (in this survey) was of the order of 0.1ha, which is on a par with the amount of arable land devoted to food production per person in the UK. This indicates that gardening (gardens and allotments) could potentially contribute a large amount to food self-sufficiency. Unfortunately it is not clear if even 0.2ha per person is enough to feed everybody adequately. One aspect of this is the time that needs to be devoted to food production. In this study the average was about 10 hours per week (depending on land area), which is one to two working days. Any production should at least aim to replace this time worked. Unfortunately when combined with the figures for money 'saved' in the final part of the survey indicates, in purely economic terms, and for the UK, a low rate of return for labour (about 70p an hour). However most people also indicated that gardening bought many other benefits in terms of health and well-being and this should not be overlooked. Most people also indicated that they set aside areas for wildlife and biodiversity in their gardens and allotments and this also makes a significant contribution to human and environmental welfare. The return to labour is therefore the minimum returns that a gardener (and society) can expect and we argue there are many other factors that must be therefore taken into account from a societal point of view which if costed would give a much higher rate of return.

Turning from the means of production, it is also important to look at the inputs necessary and the outputs achieved. From the survey it is clear that the major input factors in home production are evenly spread between production and storage. In the former case there is a even spread of factors between tools, products and protected cropping. Tools generally have the least impact as they (potentially) last a long time, especially the traditional hand tools. It is clear that as the manufacturing process and supply chains become more complex and long the environmental impact increases (e.g. glasshouse structures, fleece). With complex machinery the recurring costs of maintenance and fuel inputs create large footprints. Interestingly traditional fertility building materials like manure can also have high environmental costs even if sourced locally because of the high volumes and/or quantities used. In the case of storage most of the footprint comes from fridges and freezers, which although convenient have high cost of manufacture and supply as well as continuous running costs. Other more traditional forms of storage (e.g. cold or cool storage) have much reduced or even negligible ecological footprints.

Finally- is it all worth it? Our members indicated that they regularly supplied at least half of the vegetables and fruit they consumed and a superficial analysis indicated that potentially this could save up to half of the average UK footprint allocated to food, itself around a third of typical household footprint. However, in our analysis of the footprint of gardening we have shown that gardening does have a footprint attributable- mainly due to the input factors outlined in the previous paragraph. In the final analysis it seems that the footprint is around

13% smaller than the average footprint due to fruit and vegetables, or 6% on the whole portion of the footprint attributable to food and drink. This ranks well with savings possible with other methods of reducing carbon and ecological footprint like double-glazing, replacing an old boiler or reduced car use (although we should do these as well!) but not as high as for instance stopping flying or insulating your house.

It is also likely that the impact of producing food at home is more than that simply attributable to the reduced footprint. This is because home food production naturally leads to other ecologically efficient habits. For instance saving rainwater, recycling materials and composting biodegradable waste. All these things are likely to have impacts in areas other than simply food consumption and thus help reduce overall ecological footprints. There is some indication of this from the first part of the survey where our members had significantly lower footprints that the UK average. The positive effect of regular outdoor activity on health should also not be overlooked.

Some suggestions for reducing footprint (further!)

Given that producing food at home produces some reduction in the size of ecological footprint the next step is to ask can we do better? Looking at each of the areas of the footprint in turn we can make the following observations:

Tools: there would seem to be little room for reducing the footprint due to the standard manual tools (spade, fork, trowel etc.) as good quality tools last many years if cared for. The major area for possible reductions is in powered tools like lawnmowers and hedge trimmers. It seems that electrical tools are (slightly) more efficient but by far the largest saving would be to replace power tools with manual tools where feasible to reduce maintenance and fuel costs. Power tools also tend to contain higher proportions of non-recyclable materials like plastics. If renewable sources of energy (wind, solar) are used then this portion of the footprint can be correspondingly reduced.

Products: products account for a significant proportion of ecological footprint in two areas; those sourced from a long supply chain and those used in large quantities. Improvements are possible by substituting shop bought products with home made ones. For instance some amendments like seaweed might be substituted with, for instance home grown and produced comfrey or liquid worm compost. Other high bulk items with high transport costs like manure could be reduced by fixing nitrogen *in situ* using leguminous green manures like vetch or crimson clover. Home produced compost will have a lower footprint than bought-in compost and it might be possible to substitute growing media with home made compost with some experimentation. Seed and varieties should be locally adapted and more use made of home saved seed. Natural pest controls made on site can be a component of pest management programmes and are likely to be more benign to biodiversity and wildlife.

Protected cropping: is obviously an area of high inputs but useful to extend the growing season. One way of reducing energy costs would be to raise seedlings in spaces that are heated or likely to be hotter like conservatories and only move them to green houses when they are growing strongly. Getting the maximum life out of glasshouses and polytunnels is also important and more though should be given to the use of passive heat trapping systems. Any heating can also be potentially be supplied by renewable energy systems (wind, wood, solar) depending on the size and use of such structures.

Storage: storage accounts for a large proportion of a garden footprint and a lot more use of traditional storage methods and eating seasonal fresh food will obviously go some way to reducing this burden. Freezers could be switched off in summer when fresh produce is available and quickly consumed. Replacing old energy in-eficient devices with modern energy saving ones is likely to have a quick payback where freezers are in constant use.

Waste and recycling: it is obviously good to recycle water and compost and more thought should be given to using grey water.

Other considerations

The CO_2 footprint spent on your behalf (services, infrastructure) becomes a significant proportion of the footprint a person has once all personal actions such as energy saving or not flying are exercised. Some people find this hard to believe. A more or less large part of any footprint is to do with goods, services and infrastructure, which is apparently beyond our control. We can only usually address this issue through collective action by for example supporting green policy measures and promoting environmentally positive community action.

Continuation

We see this report as very much a start on the work looking at the ecological impact of gardening. In continuing this work we are proposing to concentrate on ecological footprinting as a theme and develop it with our members over the coming years. The work will to some extent be dependent on external funding and we would also like to invite members to become involved in any way they see fit. We are proposing to:

- To write up the experiment in the Organic Way.
- Continue the survey in a second year.
- Develop case studies of some of the returned forms (if members are interested).
- Develop an area of our website for resources, discussion and comment on the issues surrounding ecological footprinting.
- Provide in the medium to long term a benchmarking service to which people can refer to lessen the impact of their gardening activities on the environment.
- Make links with other government behaviour change programmes (climate change etc.).

Summary

- The average UK food and drink ecological footprint is around 1.4 gha/ha
- About a quarter of this (25% =0.35 gha/ha) is due to fruit and vegetable production and consumption
- Our members taking part in this survey produced about half their own with an average ecological footprint for their gardening activities of 0.15gha/ha
- This equates to a ‘saving’ of around 0.02 gha/ha, or a saving of 13% on the average UK footprint attributable to fruit and vegetables
- This equates to about a 6% savings in total food and drink footprint which is on a par with double glazing, replacing an old boiler or reduced car use
- Our members could take measures to reduce their gardening footprint by
    - buying ‘good quality’ tools that last a long time
    - using manual tools where possible

  - buying 'good quality' power tools and keeping them well maintained to reduce relative fuel consumption and embedded energy costs
  - by being wary of substituting long 'food chains' for long 'supply chains' of products that they use in their gardens
  - by trying to close nutrient cycles; e.g. producing amendments at home (e.g. comfrey), fixing N in situ (e.g. green manures), composting biodegradable materials
  - using protected cropping only where necessary and in an 'environmentally friendly way' e.g. reuse of materials, second hand strucutures etc.
  - reducing fridge and/or freezer use; e.g. turning them off when not in use and buying new A-rated energy-efficient appliances
- It is still uncertain what positive contributions waste and recycling can make in reducing gardening footprint as some of the issues are quite complex. Many are the subject of ongoing research.
- Producing food at home leads to other ecologically efficient habits as witnessed by the low overall ecological and carbon footprints of our members.
- It is important to realise that as you reduce your personal footprint the proportion due to services and infrastructure spent on your behalf becomes much more important. Solutions to this are likely to be collective and political. Many are likely to revolve around community based activities.

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Annex 1: Products recorded in survey listed by type.

Product category	Product	No using product	Average quantity used	standard measure	no for average	Source	Comments
Pest/Disease Control	anti coddling moth grease	1	400.00	g		D	
	beer (slug traps)	4	6.30	l	2	H/D	
	biological slug control	12	1.71	pkts	7	D	
	biological vine weevil control	1	2.00	pkts		D	
	bordeaux mix	4	131.67	g	3	D	
	brassica collars	1	60.00	items		D	
	cheshunt powder	1				D	Contains copper sulphate and ammonium carbonate. Traditional soluble powder fungicide that prevents damping off disease in seedlings.
	codling moth traps	5	2.75	items	4	D	
	derris	4	225.00	g	2	D	
	ecover (pest control)	1	500.00	ml		D	
	egg shells	2				H/C/D	recycled
	elder flower spray	1	2.00	l		H	
	enviromesh	2				D	
	fleece	3	1.73	m3		D	
	fungicide spray	1	1.00	l		D	
	garlic spray	3	5.00	l	1	D	
	horsetail spray	1	20.00	l		H	
	insecticidal soap	5	75.00	ml		D	
	mesh (pest control)	1				D	
	milk	1	6.00	l		C/D	
	mole trap	1				H/C/D	
	mouse traps	1				D	
	Multirose	1				D	synthetic insecticide/fungicide mix
	organic pest control spray	4	1250.00	ml	2	D	fatty acid spray (Chase catalogue PCRT)
	pheromone traps	1				D	
	plastic bottles	1				D	normally used as cloches and to protect against slugs
	plum moth traps	1				D	
	slug pellets	16	829.17	g	12	D	
	slug pellets (aluminum)	1				D	
	slug pellets (bird friendly)	1	15000.00	g		D	
	slug pellets (ferric phosphate)	1	1500.00	g		D	
	slug pellets (organic)	3	625.00	g	2	D	
	slug stoppa granules	3	4.87	l	3	D	
	slug traps (old bottles and jars)	1				H/D	recycled
	soft soap	4	600.00	ml	2	D	against soft bodied

							insects
	sonic cat scarer	1				D	
	sulphur candle	1	1.00	unit		D	
	sulphur chips	1				D	
	Ultimate bug killer	1				D	
	vaseline	1				D	
	white fly carba spray	1	250.00	ml		D	
	yellow sticky traps	3	10.00	items		D	
Weed Control/ Mulch	kitchen salt	1	2.00	kg		D	
	path weed killer	2	3.50	l		D	
	pathclear (glyphosate)	4	1.50	l	3	D	
	weed control fabrics/membrane	3	10.00	sq m	2	D	
	weed control sprays	1				D	
	weed killer	1				D	
Mulch	black plastic mulch	3				D	
	bracken mulch	3				H/C/D	
	cocoshell mulch	1	450.00	l		D	
	gravel	3	240.00	kg	2	D	
	green manure mulch	9				H	
	landscape fabric	1				D	
	leaf mould	34	690.30	l	27	H	
	mulch	14	1397.78	l	9	C/H	
	mulch (Bisleys)	1					
	mulch (cardboard and newspaper)	6				H/D	recycled
	mulch (pine needle)	1	180.00	l	1	H/C	
	mulch (shredded prunnings)	2	920.00	l	2	H/C/D	
	mulch bark/wood chips	18	1398.70	l	13	H/C/D	
	mulch carpet	2				H/D	recycled
	mulch dust	1				H	
	mulch grass clippings	6				H	
	mulch hay	1				C	
	mulch straw	6	1.50	bale	6	C	
	plastic mulch	2	300.00	sq m	1	D	
	sawdust	1				H/C/D	
	shreddings (home made)	3	2000.00	l	1	H	
	spent hops	2	400.00	l	1	H/C	
Amendments	bokashi liquid	1				H	but bins etc D
	comfrey	6	42.00	l	1	H	
	comfrey compost	1	20.00	l		H	
	comfrey feed	2				H	
	comfrey fertiliser	3	8.67	l		H	
	comfrey leaves	3				H	
	comfrey liquid	17	50.80	l	10	H/D	
	comfrey mix	1				H/D	
	comfrey pellet mulch	1	10.00	kg		D	

	compost	18	962.80	l	15	H/C/D	
	compost (commercial)	13	348.46	l		D	
	compost (green waste)	3	280.00	l	2	C	
	compost (home made)	72	1863.29	l	45	H	
	composted chippings	1				C/D	
	nettle liquid	6	91.67	l	3	H	
	seaweed	6	255.00	kg	2	D	
	seaweed (from beach)	1				C	
	seaweed calcified	3	5.00	kg	2	D	
	seaweed extract	19	657.81	ml	16	D	
	seaweed meal	11	3.28	kg	9	D	
	soil improver	2				D	
	stepped liquid greens fertiliser	1					
	tea leaves	1				D	recycled
	wood ash	4	27.33	l	3	H/C	recycled
	vermicompost	1				D	
	volcanic rock dust	1	5.00	kg		D	
	worm casts	2	40.00	l		D	
	worm compost	3				H	from worm bin
	worm liquid	6	15.20	l	5	H	from worm bin
Fertiliser/fertility	blood fish bone meal	14	12.77	kg	11	D	
	bone meal	6	3.40	kg		D	
	chicken manure compost	2				H/D	
	chicken manure pellets	26	7.61	kg	24	D	
	epsom salts	2	1.00	kg	1	D	
	fertiliser general	5	27.50	kg	2	D	
	fertiliser organic	2	4.00	kg		D	
	fertiliser rose	1				D	
	fertiliser tomato (solid)	5	35.00	g	2	D	
	fertiliser tomato (liquid)	10	1.75	l	10	D	
	gromore	2	25.00	kg	1	D	
	grow bags	5				D	
	hoof blood bone meal	1	10.00	kg		D	
	lawn feed	1	1.50	kg		D	
	lime (dolomite)	11	6.63	kg	8	D	
	liquid feed	1	1.00	l		H	
	litter (rabbit/chicken)	1	2000.00	l		H	recycled
	manure	36	1008.74	kg	27	H/C	
	manure (pig/goat)	1	500.00	kg	1	H/C	
	manure and compost	1	250.00	kg	1	H/C	
	manure chicken	3	600.00	kg	2	H/C	
	manure cow	5	1212.50	kg	4	H/C	
	manure farm yard	10	714.57	kg	7	C	
	manure horse	22	1359.16	kg	19	C	
	manure liquid	1	10.00	l	1	H	
	miracle-gro	1	0.50	kg	1	D	
	organic extra	2	25.00	l	2	D	concentrated farm yard manure

	potash	2	40.00	kg	1	D	
	rock phosphate	1				D	
	urine	3	1.00	l	1	H	
	various nutrients	1				D	
Propagation	bedding plants	1				C/D	
	coir blocks	1				D	
	compost potting	24	206.89	l	19	D	
	compost potting fibre	1	35.00	l		D	
	green manure seed	2				D	
	seedlings, tubs etc	1				C/D	
	seeds	1				H/D	
	sharp sand	3	60.00	kg		D	
	vermiculite	4	21.25	l		D	
Misc	chickens?	1					
	dry concentrate	1					
	plants for pest control	1				H	
	rough sawn timber	1				C/D	for beds?

Non-organic products in red!

Annex 2: Tools recorded in survey with average replacement time (average, min, max) and use per year (average, min, max).

Tool	Count Of Tools	Avg Of Replacement	Min Of Replacement	Max Of Replacement	Avg Of hours use per year	Min Of hours use per year	Max Of hours use per year
5 pronged cultivator	1				3	3	3
axe(s)	2				30	30	30
bilhook	2	20	20	20	2	0.5	3
brush cutter	4	23	20	25	21	5	30
bucket(s)	6	4	2	5	60	20	100
chainsaw(s)	13	16	8	30	21	1	72
clippers	1	20	20	20			
compost stirrer	1						
cutters	1						
daisy punch	1	10	10	10			
dibber	6	22	10	30	7	4	10
dibber (home made)	1						
edge trimmers	4	30	30	30	4	4	4
fork potato	2	20	20	20	6	2.5	10
fork(s)	108	17	2	100	75	0	365
fork(s) (small)	6	20	20	20	137	30	300
fork(s) border	3	25	25	25	10	10	10
grass shears	1	2	2	2	8	8	8
half moon cutter	1						
hand fork(s)	43	18	0.5	100	53	1	300
hand saw	2	25	10	40	2	2	2
hand tiller	1	10	10	10	380	380	380
hand tools	8	19	10	30	55	25	100
hand weeder	1	10	10	10	190	190	190
hazel canes	1	2	2	2			
hedge clippers	2	14	3	25	8	5	10
hedge cutter	8	13	4	25	11	3	20
hedge cutter (electric)	3	10	10	10	6	1	15
hedge cutter (petrol)	1	8	8	8	4	3.5	3.5
hedge lopper	1						
hedge trimmer	10	13	10	20	10	3	30
hedge trimmer (electric)	2	13	10	15	6	5	6
hedge trimmer (petrol)	1	10	10	10	30	30	30
hedging shears	1						
hoe (chillington)	3	30	30	30	100	100	100
hoe (draw)	1	20	20	20	0	0.2	0.2
hoe (dutch)	3	8	5	10	19	2	36
hoe (onion)	2	16	16	16	15	5	25
hoe (push)	1	30	30	30			
hoe(s)	70	21	5	100	48	2	300
hosepipe	1	2	2	2			
ibis weeder	2	15	15	15			

kirpi weeder	5	15	15	15	70	70	70
kneeler (x2)	1	2	2	2			
knife	3	8	5	10	10	5	15
knife (bowie)	1	40	40	40			
knife (penknife)	1	3	3	3			
lawn edger	3	20	10	30	6	6	6
lawn rake	11	19	5	50	5	2	10
lawn timmer (electric)	1				200	200	200
lawnmower	38	12	3	25	35	1	100
lawnmower (electric)	8	15	10	25	23	5	50
lawnmower (manual)	6	40	40	40	13	5	20
lawnmower (petrol)	14	16	6	40	34	4	80
lawnmower (push)	6	13	10	20	68	0	200
lawnmower (ride on)	1	3	3	3	100	100	100
lawnmower (rotary)	1	30	30	30	10	10	10
lawnmower (sit on)	1	20	20	20	30	30	30
leaf scoops	1	5	5	5	5	5	5
little paving stone	1	30	30	30			
long armed prunner	2	15	15	15			
long handled clippers	1						
long handled collecting bag	1				3	3	3
long handled prunners	2	10	10	10	200	200	200
loppers	23	12	5	20	18	2	100
manure fork	1	15	15	15			
mattock	3	14	12.5	15			
mattock (adze)	2	30	30	30	40	40	40
mulch mower	1				25	25	25
one hand shears	1	4	4	4	20	20	20
pavement weeder	1				2	2	2
pick	1	15	15	15			
post driver	1	30	30	30	1	1	1
potato/ bulb planter	3	7	3	10			
power saw	1						
pruners (anvil)	1	10	10	10			
pruning saw	2	18	10	25	2	2	2
prunners	5	8	5	10	12	5	20
prunning saw	6	13	10	15	6	2	10
rake (mini)	1	20	20	20			
rake(s)	77	20	2	100	24	1	300
riddle	1						
rotovator	9	20	7	40	8	0	30
rotovator (cultivator)	2	30	30	30	1	1	1
rotovator (petrol)	1				8	8	8
saw (electric)	1	25	25	25	15	15	15
saw (tree)	1	5	5	5	2	2	2
saw bow	2	3	3	3	2	2	2
saw running	1	10	10	10	10	10	10
saw wood	1				200	200	200

saw(s)	7	8	5	10	4	3	4
scarifier	2	25	25	25	2	2	2
scissors	1				10	10	10
scythe	5	10	10	10	5	2	8
secateurs	58	7	0	20	46	0	300
shears	33	16	1	100	14	4	30
shovels	1				50	50	50
shredder	19	16	8	30	17	2	100
shredder (electric)	2	10	10	10	24	8	40
shredder (petrol)	1	10	10	10	30	30	30
sickle	3	20	20	20	4	0.5	10
sieve(s)	2	33	15	50	10	10	10
sieves(s)	1						
sledge hammer	3	18	5	30	1	1	1
spade (small)	1	20	20	20			
spade border	2				4	2	5
spade(s)	106	18	3	100	65	2	520
sprayer	1	10	10	10			
strimmer	20	10	3	25	16	2	60
strimmer (battery)	3	2	2	2	55	50	60
strimmer (electric)	3	5	5	5	10	3	20
strimmer (petrol)	6	14	10	25	14	5	25
string	1	2	2	2			
tractor mower	1				20	20	20
tree pruners	1				20	20	20
trowel (copper)	1				10	10	10
trowel (small)	1	20	20	20	20	20	20
trowel(s)	81	13	0.5	100	44	1	200
trugs	2	5	5	5			
water spray gun	1	1	1	1	10	10	10
water tubs (plastic)	1						
watering can (metal)	1	35	35	35			
watering can (plastic)	1	10	10	10			
watering can rose	1	5	5	5	130	130	130
watering can(s)	6	3	1	5	65	10	130
weeding tool	2	5	5	5	15	15	15
wellingtons	1				2	2	2
wheelbarrow(s)	15	12	2	20	65	5	100

Annex 3: Protected cropping methods

protected cropping	CountOfprotected cropping
aluminum frame	1
black plastic	3
bracken mulch	1
bran	1
brassica cages	1
brassica collars (carpet scraps)	1
camelias (in wood)	1
canes, twigs, thread	1
cardboard	1
chicken wire (against wood pigeons)	1
clear plastic	1
cloches (bell)	1
cloches (glass)	3
cloches (plastic bottles/containers)	48
cloches (polythene tunnels)	3
cold frame(s)	25
cold frame(s) (recycled materials)	4
compost hot bed	1
conservatory	3
copper bands	1
early seeds in house	2
egg shells	1
enviromesh	17
enviromesh (tunnels)	2
fleece	51
fleece (tunnels)	2
fruit cage(s)	7
heated proagators	2
hedge planting	1
mini plastic greenhouse/ polytunnel	10
netting (over fruit and/or cabbages)	18
open back barn (tree seedlings)	1
plastic sheet	1
pond mesh	1
potting shed (with S window)	1
seed growing house (home made)	1
shed	1
wall training	1
wire mesh cages	4