

NATURE-BASED SOLUTIONS TO CLIMATE CHANGE IN URBAN AREAS AND THEIR
RURAL SURROUNDINGS - LINKAGES BETWEEN SCIENCE, POLICY AND PRACTICE

EUROPEAN CONFERENCE, BONN / GERMANY, 17-19 NOVEMBER 2015

Valuing the carbon sequestration and rainwater interception ecosystem services provided by Britain's urban trees

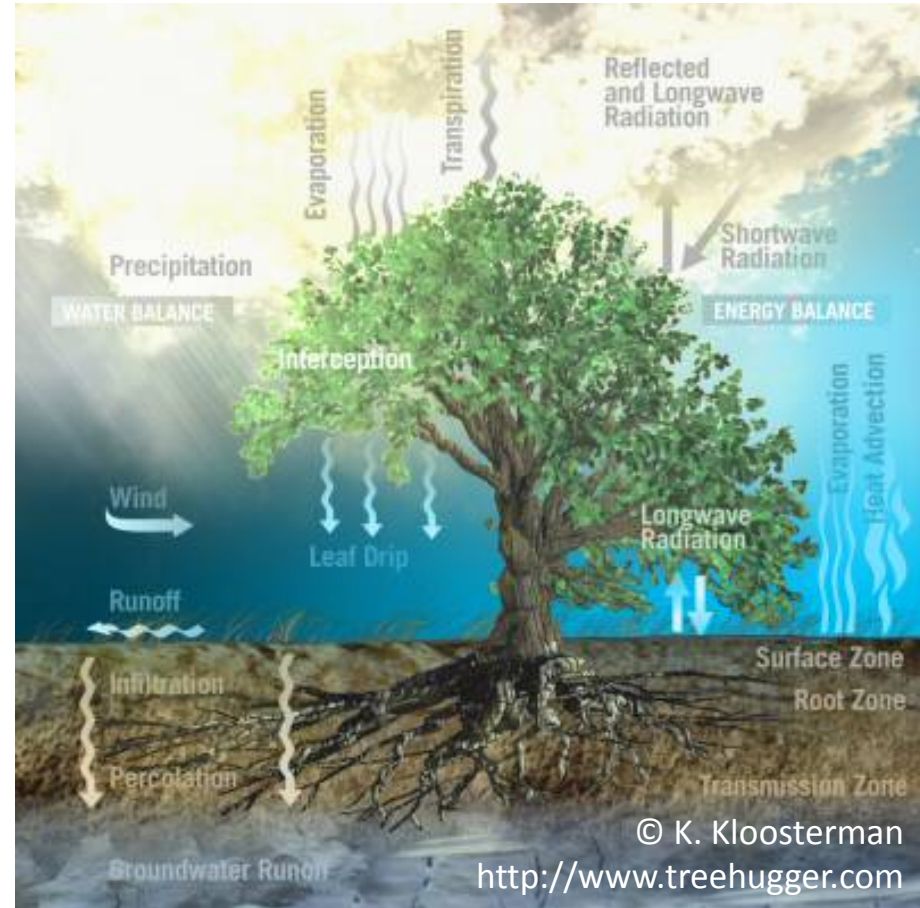
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Forest Research

What will this presentation cover?

- ☺ Benefits of urban trees
- ☺ Current investment in the urban forest
- ☺ Quantification and valuation of ES
- ☺ Use of i-Tree Eco
- ☺ Results of British i-Tree Eco surveys
 - £ Carbon sequestered
 - £ Rainwater intercepted
- ☺ Resilience to climate change
- ☺ Implications for economic viability of planting





Trees intercept and store rain water, relieving stress on municipal storm-water systems and reducing flooding.

Trees shade buildings, reducing the need for air conditioning.

Trees provide habitat for wildlife.

Trees filter pollutants from the air we breathe and release oxygen.

Trees increase property values and improve mental health.

Trees act as a windbreak.

Trees remove carbon dioxide from the air and store it in their wood, leaves and roots.

Trees provide a barrier to noisy traffic.

Trees cool outdoor temperatures and protect us from UV rays.

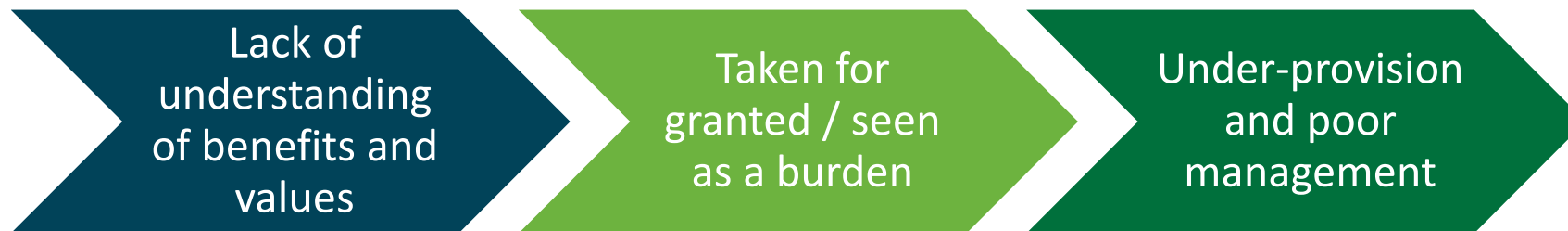
Other benefits:

- ☺ Improve water quality
- ☺ Reduce soil erosion
- ☺ Improve visual amenity
- ☺ Improve productivity
- ☺ Encourage recreation
- ☺ Provide goods



Current investment in the urban forest

- £ Most tree planting in England carried out by local authorities (LAs), but NOT a statutory function.
- £ Average planting and maintenance budgets in London in 2011 were £110 and £21 per tree.¹
- £ Tree planting budgets are one of the first to be reduced during times of austerity.
- £ Only 19% of LAs have an accurate record of the % of their district covered by trees and woods.²
- £ Only 50% of LAs in England have a tree strategy that directs their tree planting priorities.³



Solution?

Quantification and valuation of ES

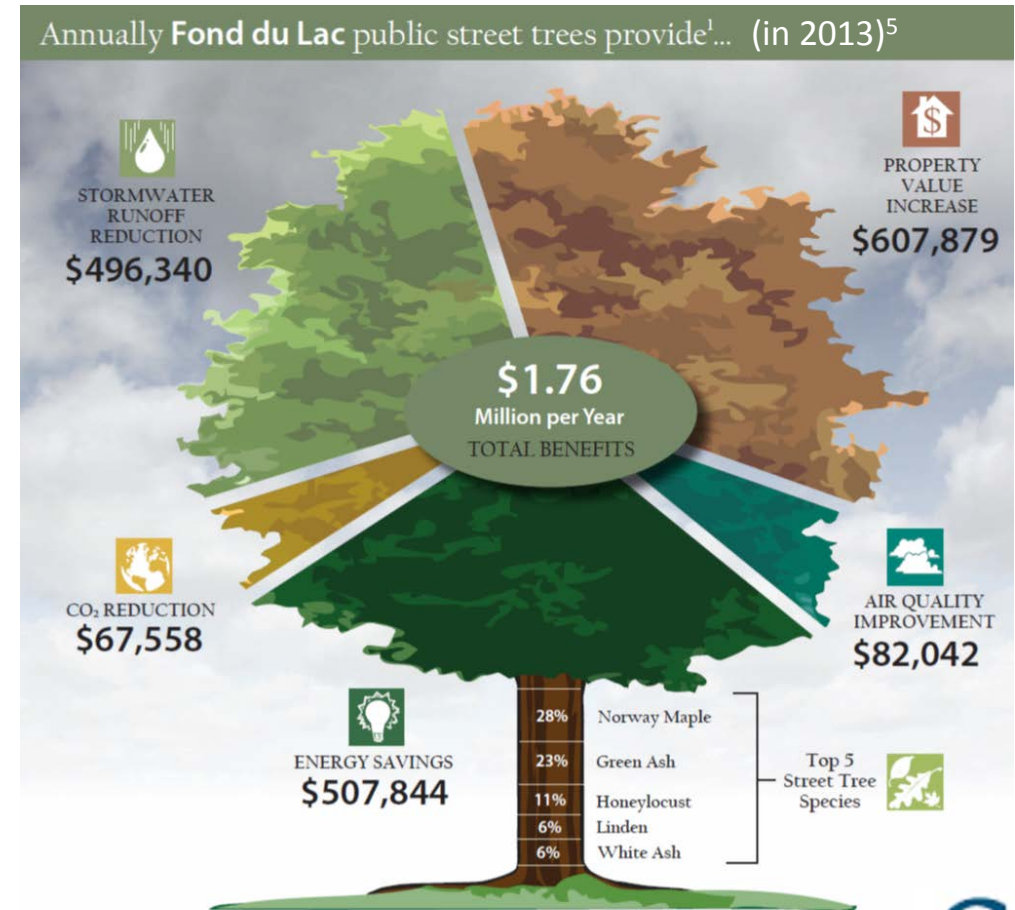
Measurements of urban tree canopy cover are **crucial for managing urban forests** and required for the quantification of the benefits provided by trees. These types of data are increasingly **used to secure funding** and justify large-scale planting programs in urban areas.⁴

Quantification Tools

Remotely sensed e.g. LiDAR, Ggl. Maps, aerial survey	Hemispheric photos (GLA)
	Physical survey
	GIS & LCM

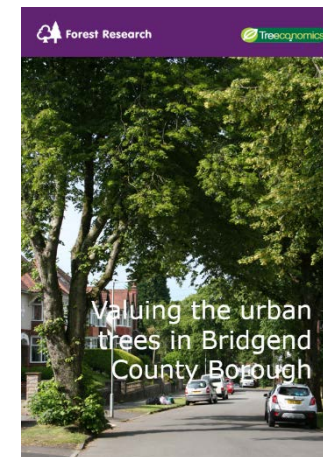
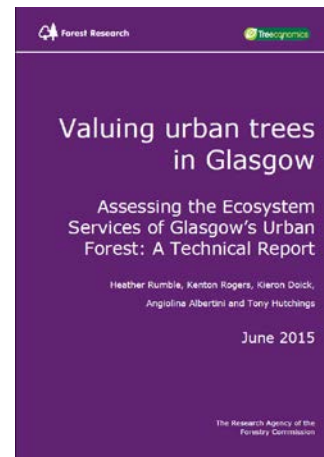
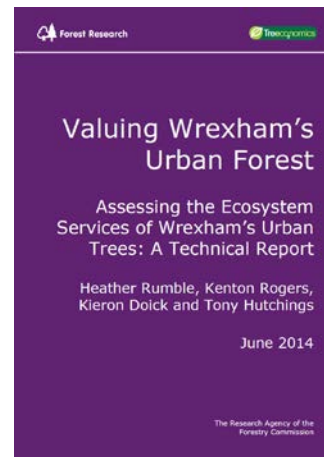
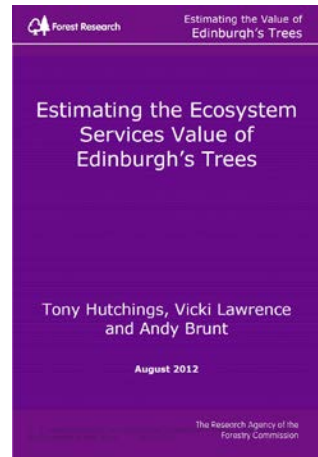
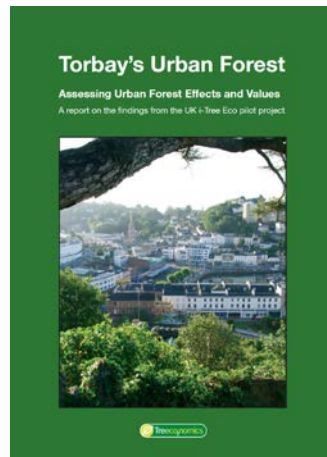
Quant. & Valuation Tools

CNT	Helliwell
CTLA	CAVAT
InVEST	GIVT
i-Tree Eco (UFORE)	Treezilla



Use of i-Tree Eco in Britain

- 🌳 Partnership between Forest Research and Treeco₂nomics, plus other stakeholders.
- 🌳 7 British cities surveyed: Torbay (2010), Edinburgh (2011), Wrexham (2013), Glasgow (2013), Bridgend (2014), Tawe Catchment/Swansea (2014) and London (2014).



- 🌳 Less resource-intensive i-Tree Canopy studies (based on Google Maps) have been undertaken by various organisations in Crawley (2014), Birmingham* (2012), Exeter (2013), Sidmouth* (2014), Worcester (2015), Oxford* (2015), Dudley (2015), Eastbourne (2011) and Telford (2012).

i-Tree Eco Methods

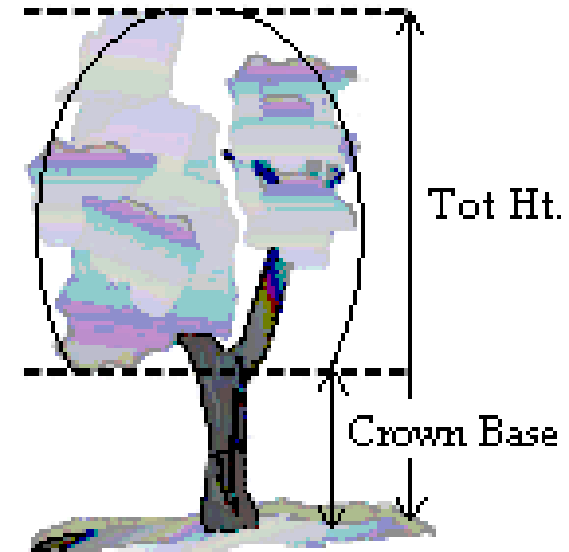


- 🌳 Trees surveyed in 200-250 randomly selected 0.04ha plots within each study area.
 - 🌳 Torbay – 1 plot / 26 ha
 - 🌳 Edinburgh – 1 plot / 57 ha
 - 🌳 Wrexham – 1 plot / 19 ha
 - 🌳 Glasgow – 1 plot / 88 ha
 - 🌳 Bridgend – 1 plot / 22 ha
 - 🌳 Swansea – 1 plot / 28 ha
- 🌳 Data later extrapolated up to cover whole study area.

i-Tree Eco Methods



- Recorded within each plot: number of trees and shrubs, land use classes, percentage ground and tree cover, plantable space.
- Recorded for each tree: species, number of stems, diameter at breast height (dbh), total height, height to base of live crown, crown width, % crown die-back, crown light exposure, position of tree relative to plot centre.



15% Canopy Missing

i-Tree Eco Methods



- 🌳 Various peer reviewed, open-source UFORE models used to quantify:
 - 🌳 Stormwater attenuation;
 - 🌳 Carbon storage and sequestration; and
 - 🌳 Air pollution removal.
- 🌳 Models developed in US, but input data replaced with UK equivalents, e.g. climate, species.
- 🌳 Not all input data yet converted, e.g. US growth rates.
- 🌳 Functions of building energy and air temperature cooling currently being trialled for UK context.

i-Tree Eco Methods



- 🌳 ES valued using:
 - 🌳 Avoided sewerage charges (standard household charge for local water company)
 - 🌳 UK Govt. non-traded price of carbon (gives values significantly higher than in US version)
 - 🌳 UK Social Damage Cost for listed pollutants (limited number of pollutants valued compared to US)
- 🌳 Replacement value (using US CTLA method)
- 🌳 CAVAT used in addition to CTLA in later British studies to quantify and value the cultural ES of visual amenity.

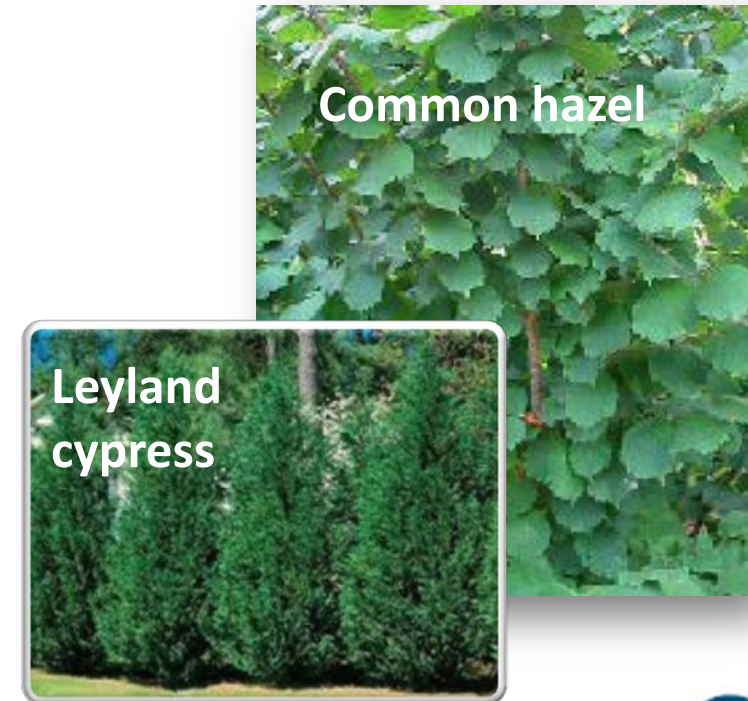
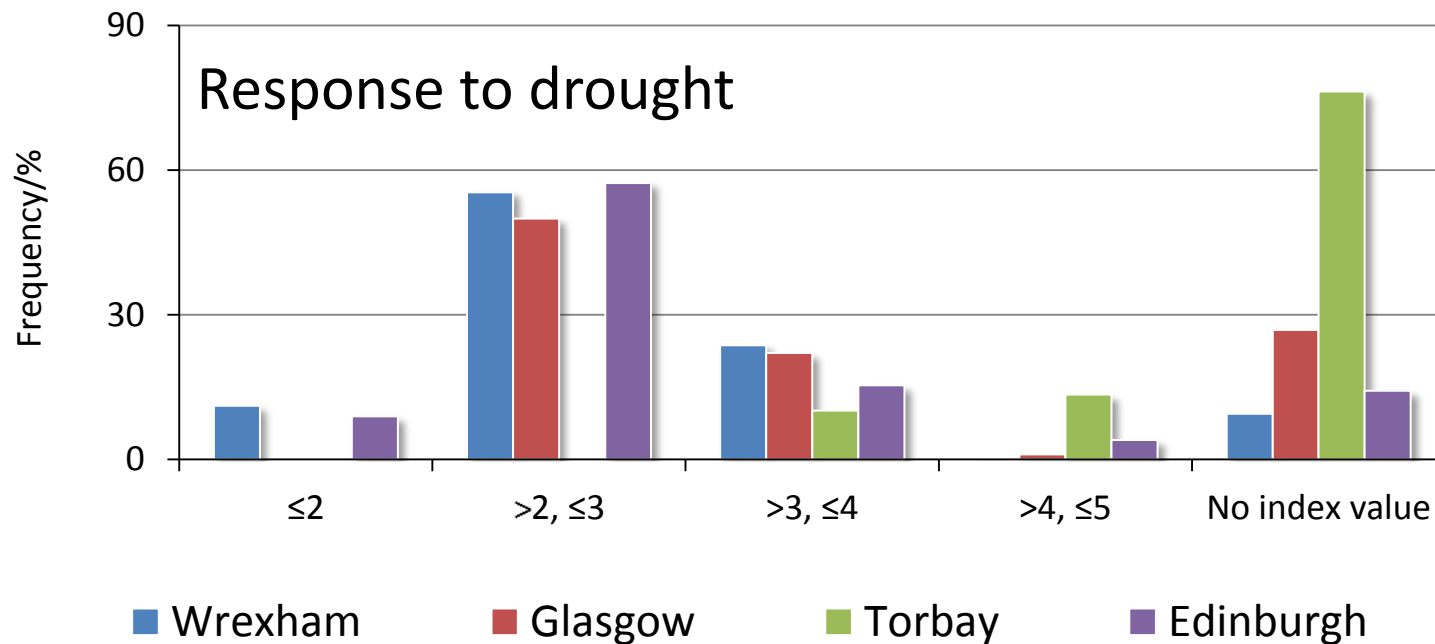


Results of British i-Tree Eco surveys

	ENGLAND	SCOTLAND		WALES		
SELECTED CLIMATE DATA	Torbay (2010) ⁵	Edinburgh (2011) ⁶	Glasgow (2013) ⁷	Wrexham (2013) ⁸	Bridgend (2014) ⁹	Swansea (2014) ¹⁰
Number of trees ('000s)	818	638	2,000	364	426	530
Urban tree cover (%)	12	17	15	17	12	16
Rainfall intercepted /tree /yr (m ³)	N/A	N/A	0.41	0.76	0.29	0.48
Avoided sewerage charges /tree /yr (£)	N/A	N/A	0.55	1.26	0.38	1.12
Carbon sequestered (net) /tree /yr (kg)	4.06	7.40	4.00	3.65	4.88	5.66
Carbon sequestered /tree /yr (£)	0.21	1.52	1.02	0.72	1.07	1.25
Proportion of urban land that could be planted (%)	N/A	N/A	32	28	27	24

Resilience to climate change (Rumble *et al.*, 2014b¹²)

- 🌳 Index developed by Niinemets & Vallardes (2006)¹³ scaled 1 = lowest drought tolerance and 5 = highest.
- 🌳 Torbay had lots of drought tolerant species, with many scoring 3-5, in contrast to Wrexham.
- 🌳 However not all trees listed in index, whilst some trees identified to only genus level so no index value.

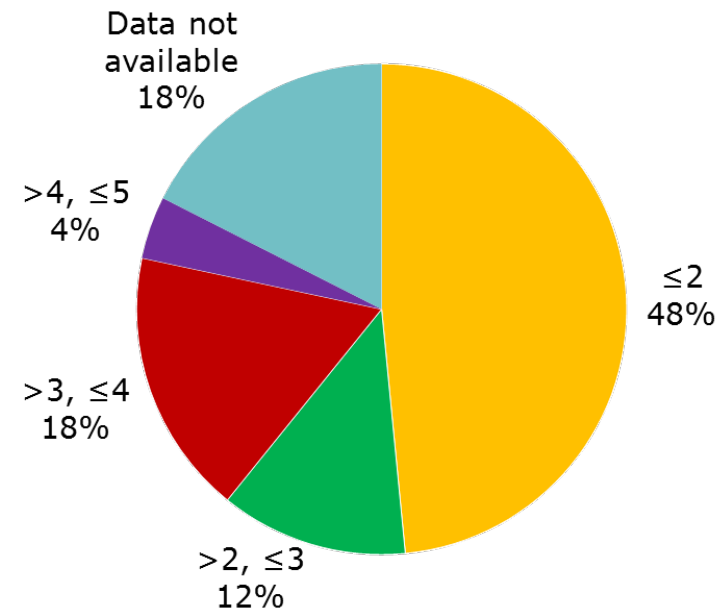


Resilience to climate change (cont.)

- 🌿 Index developed by Niinemets & Vallardes (2006)¹² scaled 1 = not tolerant of waterlogging and 5 = highly tolerant of waterlogging.
- 🌿 Glasgow had few waterlogging tolerant species, with the majority not tolerant at all.



Response to waterlogging, Glasgow



Implications for viability of tree planting

ECOSYSTEM SERVICE VALUES	Average for 6 cities
Number of trees	796,000
Avoided sewerage charges /tree /yr (£)	0.83
Carbon sequestered (net) /tree /yr (£)	0.97
Pollution removal /tree /yr (£)	1.3
Carbon storage /tree (£)	21.5
Asset value /tree (£)	2,249



The use of i-Tree Eco:

- ☺ Raises the policy profile of trees and their role in climate change mitigation/adaptation;
- ☺ Provides necessary baseline data for better management of the urban forest;
- ☺ Justifies an increase in planting and maintenance budgets.

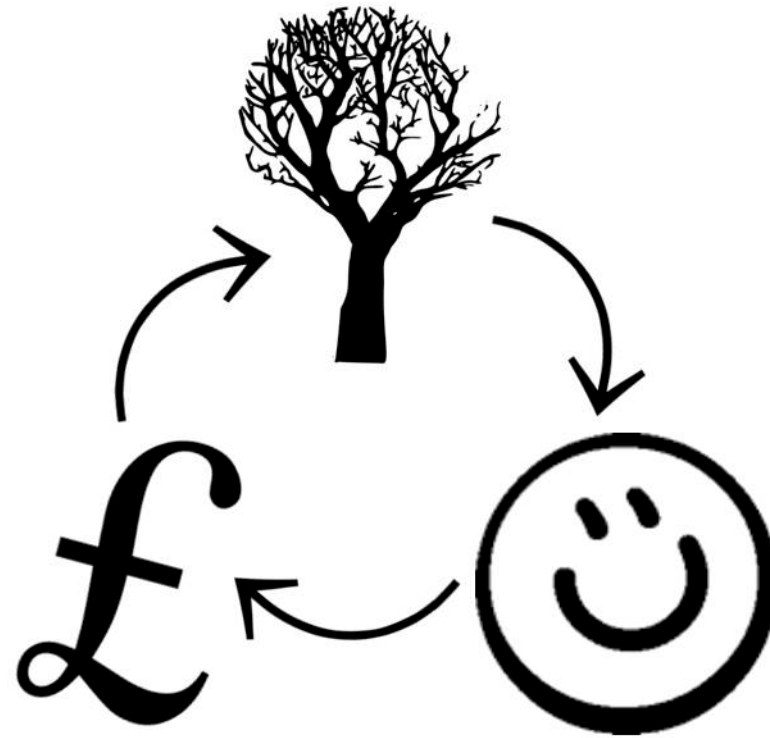
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