

Manchester Metropolitan University

My back yard: the contribution of gardens to urban ecosystem services in Manchester

Dr Gina Cavan
 Email: g.cavan@mmu.ac.uk
 Manchester Metropolitan University
 @GinaMCavan @MMUGeog

The My Back Yard project was conducted by:

Manchester Metropolitan University UNIVERSITY OF LEICESTER

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In collaboration with:

MANCHESTER CITY COUNCIL Manchester City Trees Southway Housing Group

MANCHESTER WILDLIFE TRUST THE NATURE FOREST countryscape

my BACK YARD

This two-year, 3-month project ran from January 2016- March 2018. Led by Manchester Metropolitan University.

Co-created with four project partner organisations – Manchester City Council, Manchester City of Trees, Lancashire Wildlife Trust, and Southway Housing Trust.

Funded by the Natural Environment Research Council under their “Green Infrastructure Innovation” scheme. The scheme was about translation of research into policy and practice – responding to the needs and challenges faced by stakeholders.

Outline



- ▶ Introduction
- ▶ Project aim and objectives
- ▶ 'My Back Yard' citizen science survey
- ▶ Validating survey responses
- ▶ Analysis of green infrastructure in Manchester's gardens
- ▶ The benefits of Manchester's green infrastructure
- ▶ Key messages



Content of presentation

Introduction



- ▶ Green Infrastructure (GI) is a core component of urban ecosystems
- ▶ Urban Ecosystem Services (UES) have potential to adapt cities to climate change (Gill et al., 2007; Bowler et al. 2010)
- ▶ Domestic gardens are a valuable source of GI



"An interconnected network of green space that conserves natural ecosystem values & functions and provides associated benefits to human populations" (Benedict & McMahon, 2002)

- Green infrastructure is defined as "An interconnected network of green space.... ". Here, we are talking about the network of trees, grass, flowers, etc. across cities, which is a core component of urban ecosystems.
- The current interest in urban greening is driven by the pressures of urbanisation and a changing climate.
- Cities are vulnerable to warming temperatures and extreme weather, which has prompted action to increase the resilience of cities to protect the health and wellbeing of citizens.
- Urban greenspace offers potential to help adapt cities for climate change, as well as a whole host of other benefits, termed 'ecosystem services'
- Urban greenspace can help to mitigate flooding:
 - Reduces rate & volume of surface water runoff when rainfall is intercepted and captured by vegetation
- Urban greenspace can help to moderate microclimate:
 - Cooling through evapotranspiration
 - Storing & re-radiating less heat than built surfaces
 - Direct shading
- Gardens are an important source of green infrastructure. They provide the mosaic in cities, helping to connect larger areas of green space such as parks.
- By 'domestic gardens' – we are talking about all outdoor space associated with residential housing.
- By the term 'green infrastructure', we are talking about all green space (trees, grass, plants) and blue (water) space

Garden GI has received little attention in research and policy-making



- ▶ The quantity and quality of green infrastructure provision by domestic gardens is not well-defined
- ▶ Current datasets significantly over-estimate the amount of vegetation within domestic gardens
- ▶ Perceived a challenging to influence due to lack of regulation
- ▶ The general public are often unaware of the environmental value of their own garden and how they could improve it



Previous study has focussed on publically accessible spaces, and comprehensive datasets often exist for GI in public spaces to aid GI planning (such as tree inventories).

There is, however, less information regarding domestic gardens.

Given that domestic gardens comprise a large area in cities, this represents a significant gap in knowledge.

Furthermore, policymakers and practitioners often perceive it to be too challenging to influence the land management of these private urban spaces.

Additionally, people are often unaware of how their garden contributes to the city's GI. Given this is private space, there is a recognised need to engage citizens in this agenda.

Introduction



Manchester's Great Outdoors

a Green and Blue Infrastructure Strategy for Manchester

2015-25

July 2015



“Manchester’s green and blue spaces cover 58% of the city.”



Manchester’s Green and Blue Infrastructure Strategy, published in 2015, is the policy document for guiding GI in the city.

The Strategy undertook an initial analysis of Manchester’s GI and estimated that it covers 58% of the land area of the city.

This was an estimate and seemed a bit high. After discussion, it was clear that a source of error could be in the estimation of gardens, which were assumed to be 100% green and blue space. Whilst this was unlikely to be the case, no better knowledge was available at the time.

There was a lack of understanding of what was going on in gardens and therefore this statistic could not be further refined.

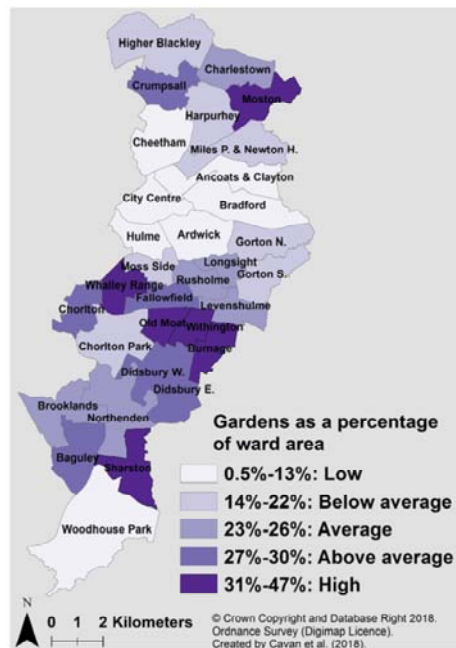
Gardens are an important component of Manchester



- ▶ One fifth of Manchester is domestic gardens
- ▶ Around one third of Manchester's green and blue space assumed to be contained within domestic gardens

Fig: The area of gardens as a percentage of the total ward area

Wards with the largest coverage of gardens relative to the total ward area include: Whalley Range, Old Moat, Withington, Burnage, Sharston & Moston.



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Given these figures above, it was clear that there could be a large error in the estimations of GI for Manchester, which may also have a spatial dimension – since some wards have more gardens than others.

Manchester area = 115.6km²
Gardens = 20.4%

By gardens, we are talking about all outside space associated with a residential property.

View the maps interactively online at: www.mmu.ac.uk/mybackyard

Manchester's garden stock



Garden size	No. of gardens	Proportion of total no. of gardens (%)	Total garden area (km ²)	Proportion of total garden area (%)
<44 m ²	31,576	20.2%	0.8	3%
44-98 m ²	30,983	19.8%	2.2	9%
98-154 m ²	31,291	20.0%	4.0	17%
154-216 m ²	31,311	20.0%	5.7	24%
>216 m ²	31,411	20.1%	11.0	46%
Total	156,572	100%	23.6	100%

- ▶ *One fifth of Manchester's gardens are roughly the size of 4 car parking spaces*



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Looking at the stock of gardens, there are over 156,000 gardens in Manchester.

Many of these are very small plots.

This means that there is a lot of people to reach in terms of engagement.

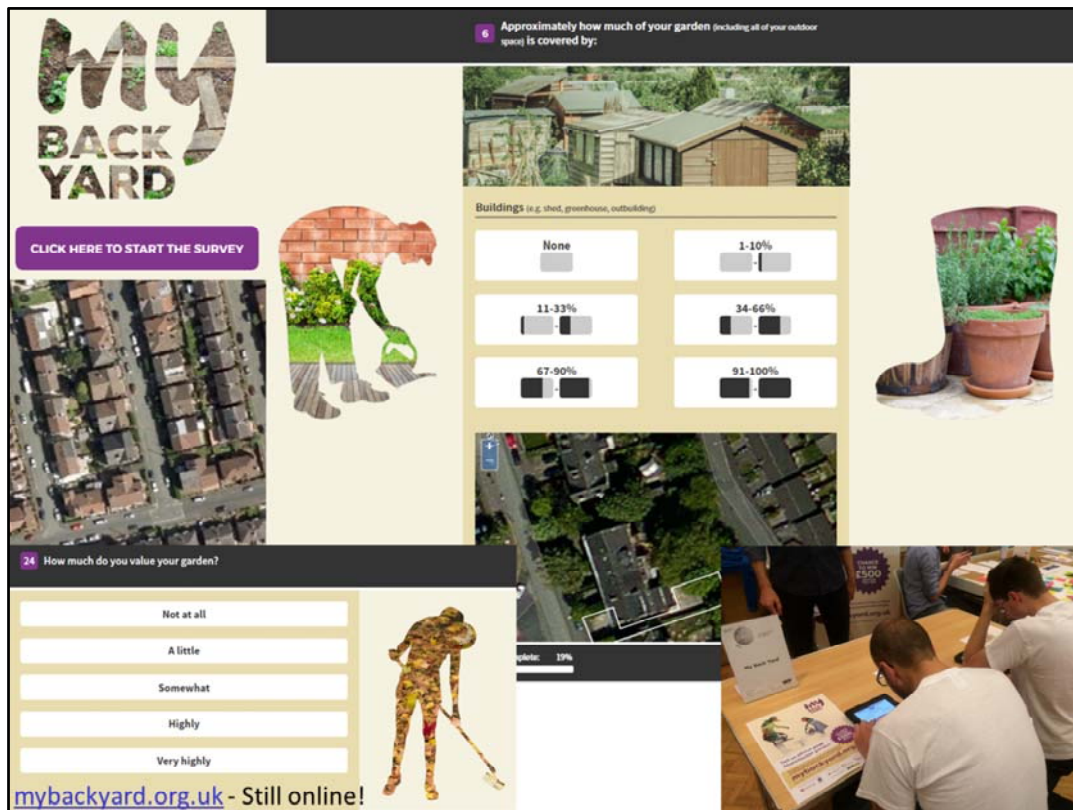
Project Aim and Objectives



- ▶ **Aim: To assess the contribution of domestic gardens to urban ecosystem services**
- ▶ **Objectives:**
 1. Develop a citizen science online survey tool to capture the GI provided by domestic gardens
 2. Validate and extend the citizen science database using accurate areal imagery
 3. Estimate the benefits of GI relating to reduced risks from heat waves and flooding, incorporating the new garden data
 4. Co-develop an action plan to improve the benefits provided by gardens

The project had four objectives.

This involved a public engagement and education element and the creation of new data, to translate into evidence for policy and practice.



The citizen science survey asked a series of questions.

These included asking residents to estimate the proportion of ten surface cover types in their garden. This included:

- Green and blue space: trees, mown grass, rough grass, shrubs, cultivated ground (flower beds, vegetable patches), water
- Artificial permeable such as decking, porous paving, artificial grass
- Buildings (e.g. shed, greenhouses)
- Hard impervious surfaces such as concrete or tarmac
- Bare soil or gravel surfaces

As well as some socio-demographic information (age, tenure) and other questions relating to value and use of garden.

The survey was promoted for 6 months during 2016 online via Facebook and twitter, through partner organisation networks as well as local public engagement events.

Online survey tool: 'My back yard'



my BACK YARD

RESULTS

From the responses so far, the results for **your** neighbourhood are...

In your neighbourhood, Moss Side...

21% of gardens are green space

Vegetation is important in urban environments. Garden plants and trees help to prevent flooding by intercepting rainfall and slowing runoff, cool cities in summer, and provide a habitat for wildlife.

In your neighbourhood, Moss Side...

73% of gardens are hard surfaces

Water cannot drain through these hard surfaces into the soil, which can increase the risk of localised flooding.

MAKE THE BACK YARD PLEDGE

What can **you** do to improve **your** garden and enhance the environment in **your** neighbourhood?

Your back yard is very important

In Manchester, our gardens and back yards collectively make up around 20% of the total land. By making some simple changes to your outside spaces, you can make a difference to the environment in your neighbourhood.

Enjoy your garden! It is a valuable resource and can help to improve your overall health and well-being. Green space, including trees and flowers, help to reduce stress, and gardening can improve your physical health.

What can I do?
Top tips for improving your back yard

Tip 1 of 5

Help Manchester cope with intense rainfall:

Consider replacing existing hard surfaces that water can't drain through. These can cause rainwater runoff and lead to flooding. Consider replacing them with surfaces that water can drain through. Ideally with vegetation such as grass and trees which can have many other benefits, or surfaces such as gravel and artificial grass. If you have a larger garden, a pond, wetland area or bog garden can also help to store rainwater.

I will do this
(click here to submit)

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The tool had a live update element, which enabled participants to view their own responses in the context of their neighbourhood.

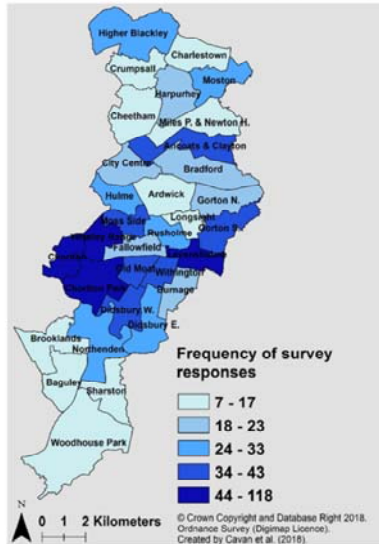
An educational element was also incorporated, giving respondents information on the benefits of their garden for addressing climate risk and wildlife, and 5 top tips suggested what action respondents could take to improve their garden to benefit the local neighbourhood.

Through this, they could also pledge their support for taking positive actions in their garden.

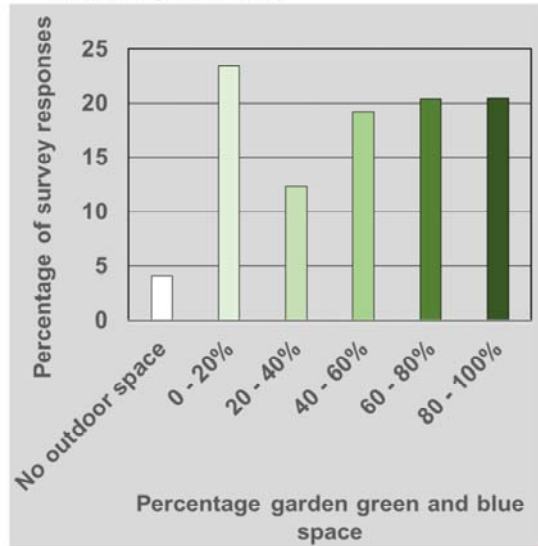
'My Back Yard' survey responses: Over 1000 survey responses for Manchester



Most responses from central south Manchester, e.g. Chorlton, Chorlton Park, Whalley Range, Levenshulme



Good diversity of responses: not only those with large 'green' gardens completing the survey



The sample had a good diversity of responses. We were interested in capturing a range of responses from different types of gardens.

Since some wards have very few survey responses, the next step – validation of survey responses, was particularly important.

The social survey questions / socio-demographic information also provided some useful data to understand more about who values their garden.

Citizen pledges



- ▶ Respondents pledged their support for actions to improve ecosystem service delivery of their gardens
 - ▶ **252** agreed to plant variety of plant types to improve wildlife
 - ▶ **228** agreed to use drought-resistant plants and collect water
 - ▶ **150** agreed to plant trees for shade and improve air quality
 - ▶ **119** pledged to replace hard surfaces with green space



What can I do?
Top tips for improving your back yard

Tip 5 of 5

Help your area cope with drought:

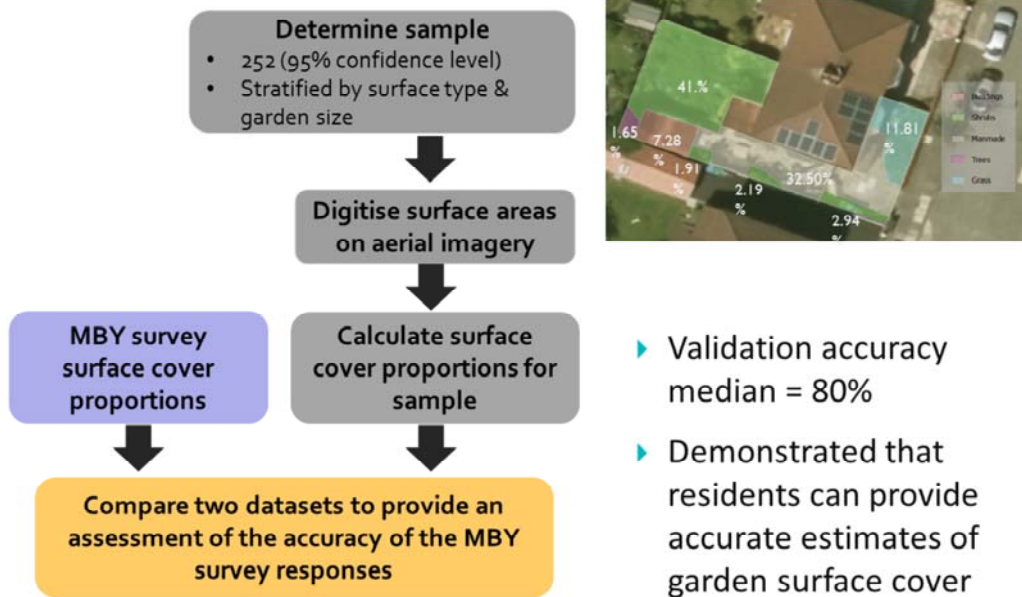
Use drought-resistant plants, and collect water in your garden to use for watering during hot dry spells. Water plants in the morning or the evening and keep grass longer during hot dry spells because it is better able to cope with drought.

Bob on!
I will do this

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Results from the survey pledges. Demonstrating that there is willingness to take action.

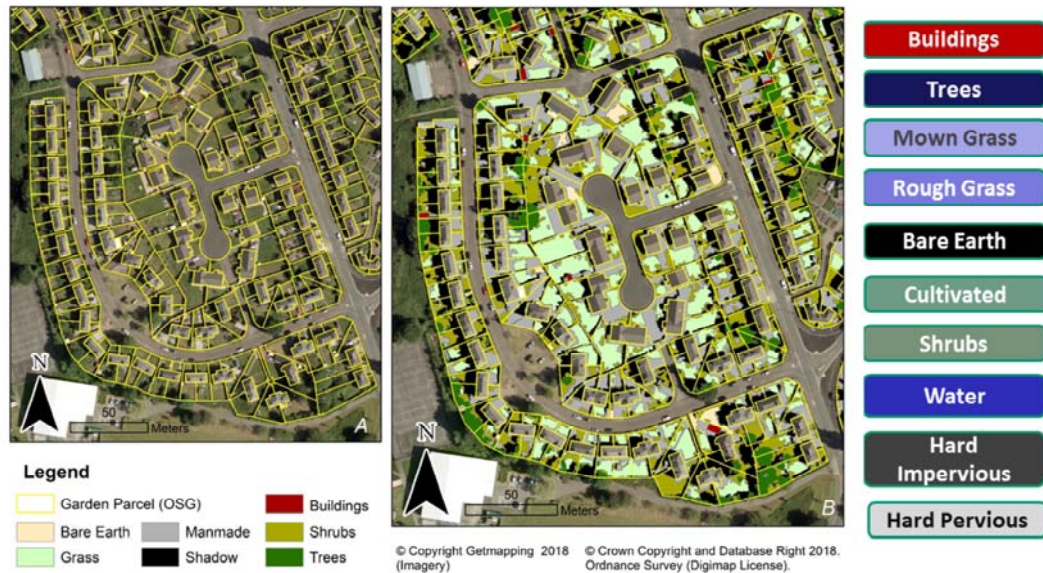
Validating responses



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- A sample of the survey responses were analysed by comparing people's estimated surface cover proportions in their gardens, to accurate aerial imagery at 12.5 cm resolution.
- This validation of responses is important to give an estimate of how accurate the respondents were in estimating their garden surface coverages
- This allows analysis of garden features at a high level of detail
- However, some data for the south part of the city was older (2009/2010) and changes may have occurred since then – what people tell us therefore may be more accurate
- The high validation accuracy tells us that residents are able to estimate their garden surface cover proportions. The reason above is why the correspondence between the survey responses and aerial imagery is not 100%, plus other technical issues in relation to the methods.

Combining survey responses with image classification



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We then use remote sensing methods to undertake an automated image classification to cover all gardens across Manchester.

However, image classification is based on the colours of the image. It is impossible to distinguish some of the original 10 surface classes from each other. For example, mown and rough grass; or cultivated from bare earth.

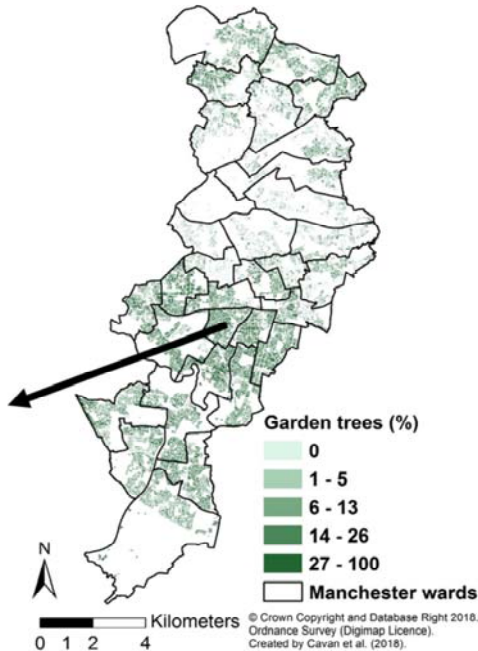
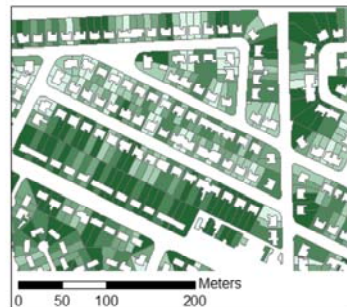
Therefore, we undertaken image classification with a limited number of 6 surface cover classes and then combine this with the proportions of the 10 classes from the MBY survey.

This provides us with a garden dataset for the whole of Manchester.

Final Manchester garden database



- ▶ Extrapolated areas of 10 surface cover types (combining survey data and image classification)
- ▶ For every garden in Manchester(!)
- ▶ Example: map of the proportional cover of trees in each garden

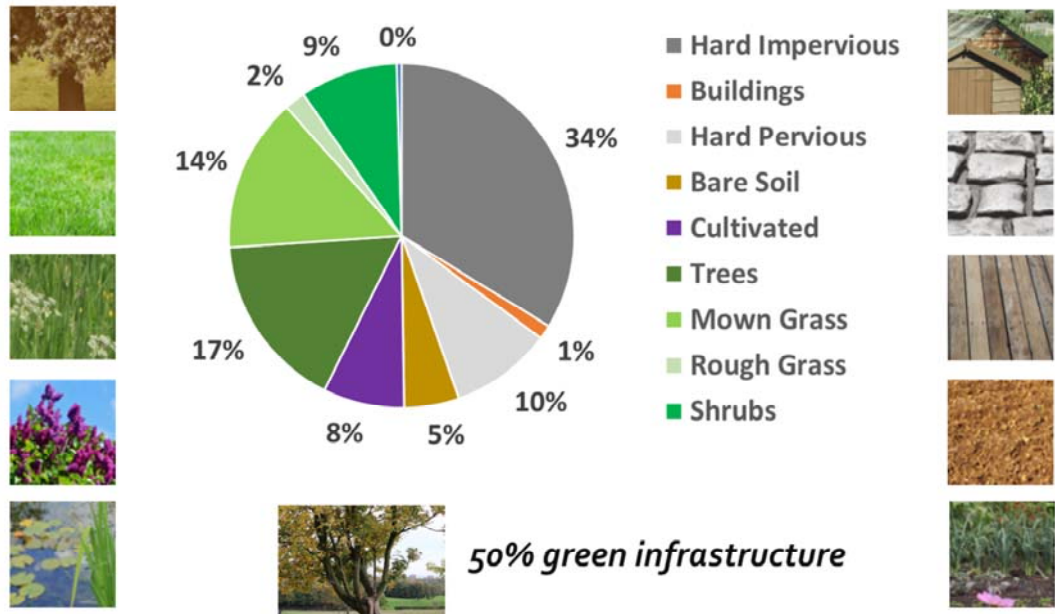


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The final garden database contains the proportion of 10 surface cover types for every garden across Manchester.

Whilst we have this fine resolution data, we have analysed the spatial patterns at ward level, which is reported in the remainder of the presentation, and useful for planning and decision-making.

GI in a typical Manchester garden



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This shows the surface cover proportions in a typical Manchester garden.

Only 50% is green infrastructure.

Half of what was previously estimated.

Contribution of garden green infrastructure at ward level

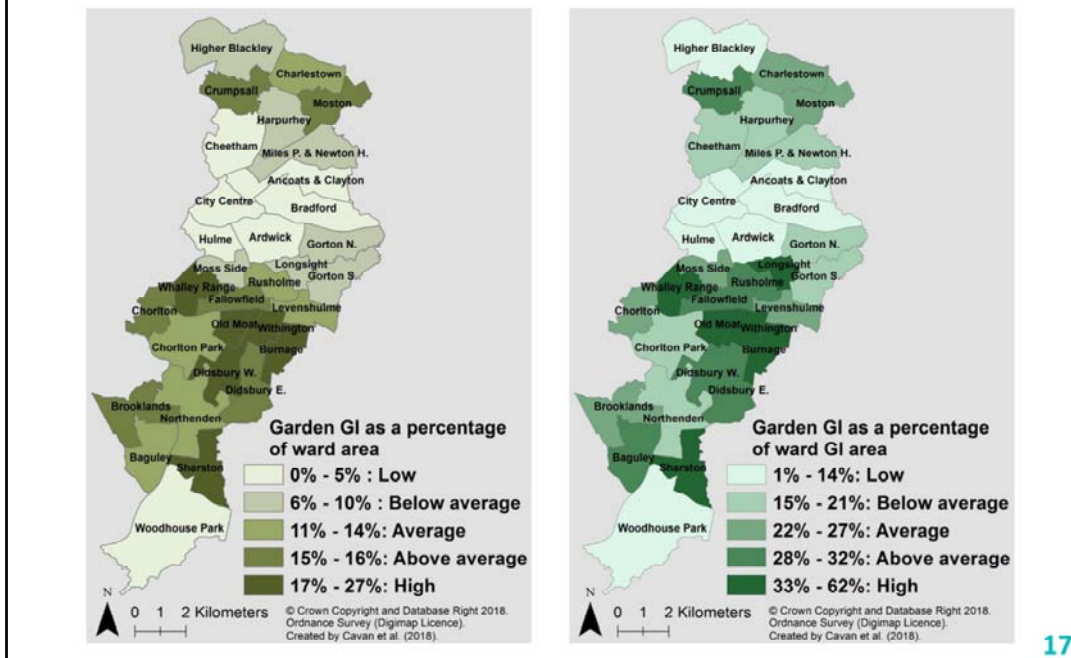


Figure 1: Garden green infrastructure is important at the ward level. On average, around 11-14% of the area of the ward is garden GI. This is highest in wards including Whalley Range, Old Moat, Withington, Burnage, etc. reflecting the larger total area of gardens within these wards.

Figure 2: We can also look at the garden GI as a percentage of ward GI. In some wards, the garden GI is particularly important – containing 33-66% of the ward's GI. Consider again that this is private space. So, up to two-thirds of the green infrastructure in the ward is private space – controlled by residents, who can decide how to manage this.

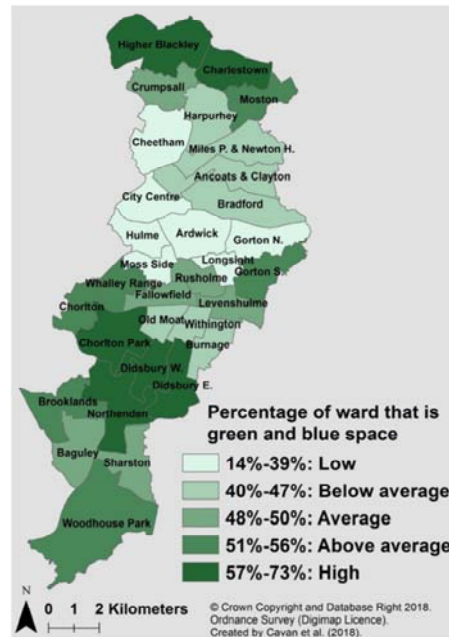
Overall, gardens are not performing as well as they could be.

View these maps online interactively at www.mmu.ac.uk/mybackyard

Manchester's garden GI is less than expected, greatly affecting Manchester's total



- ▶ Manchester's total GI cover is 49%
- ▶ The total area of gardens is 24 km²
- ▶ The total area of garden green and blue space is 12 km²



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When we combine the garden GI with GI in public spaces (e.g. parks, verges, allotments, etc), we find that Manchester's total GI cover is estimated at 49%. Almost 10% less than initially estimated in the Manchester GI Strategy (58%).

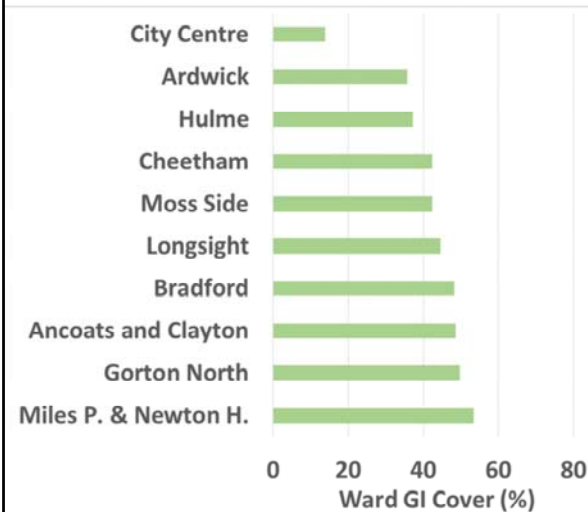
This also shows considerable variation at ward level. Wards in central and north Manchester are particularly devoid of GI.

We find that out of the total area of gardens of 24km², only half of that is green and blue space. Therefore, gardens are not performing as well as they could be, affecting the total amount of GI in Manchester greatly.

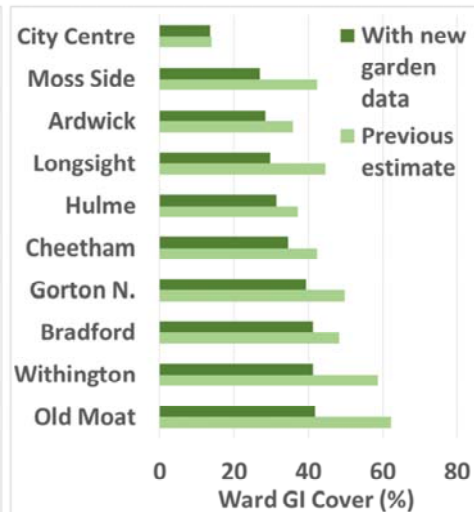
Top 10 wards with lowest GI cover



➤ Assuming gardens are 100% GI



➤ With new garden GI estimates



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When we look at the top 10 wards with lowest GI cover before and after the new data, we see a few changes.

The previous map showed that below 40% of green and blue space in the ward is “low” for Manchester. Assuming gardens were 100% GI, there were 3 wards which had “low” amounts of GI. Estimating gardens correctly means that now 7 wards have “low” amounts of GI.

Furthermore, significant change is shown in some wards. Previously, it was assumed that Withington and Old Moat wards had a lot more GI. However, because much of these wards is private gardens, and these are not completely green and blue space, there is in reality, much less GI in the ward.

Assessing the benefits of Manchester's green infrastructure



Ecosystem services modelling

- Cooling potential: using urban energy exchange model
- Runoff attenuation: US SCS curve number approach



Online at:
maps.merseyforest.org.uk/grabs

Estimate the benefits of green infrastructure relating to reduced risks from heat waves and flooding

We then undertake some further analysis to estimate the benefits of green infrastructure in the city.

It is worth stating again here about the multi benefits that green infrastructure provides (See slide 1).

We were interested in the benefits relating to reduced risks from heat waves and flooding.

These benefits were assessed using previously developed STAR tools that were developed for Greater Manchester and are freely available online.

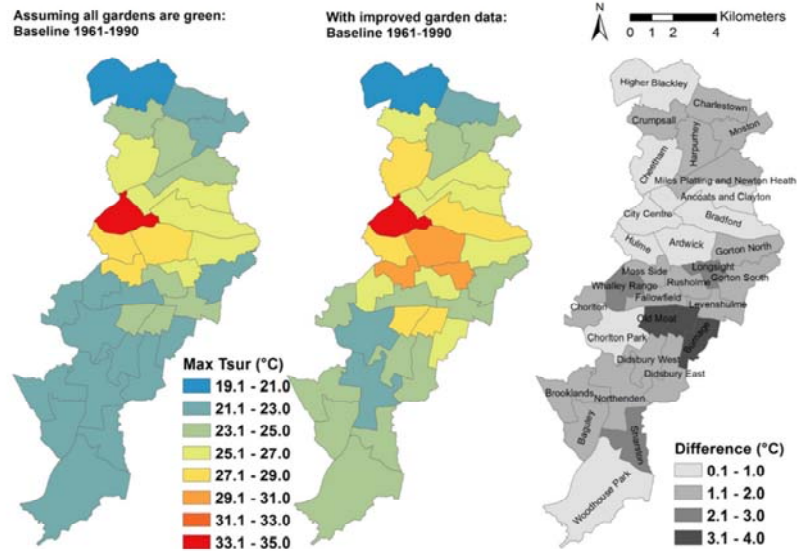
The amount of green and blue space influences both the amount of cooling and the amount of runoff attenuation – since plants and water cool the air and take up water.

We run these tools to compare the previous estimates of GI across the city, with the new estimates with improved garden data.

Less green space means fewer benefits than previously assumed



Ecosystem services (ward level): Cooling potential



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We find that because there is less green space, the benefit of cooling potential is also reduced.

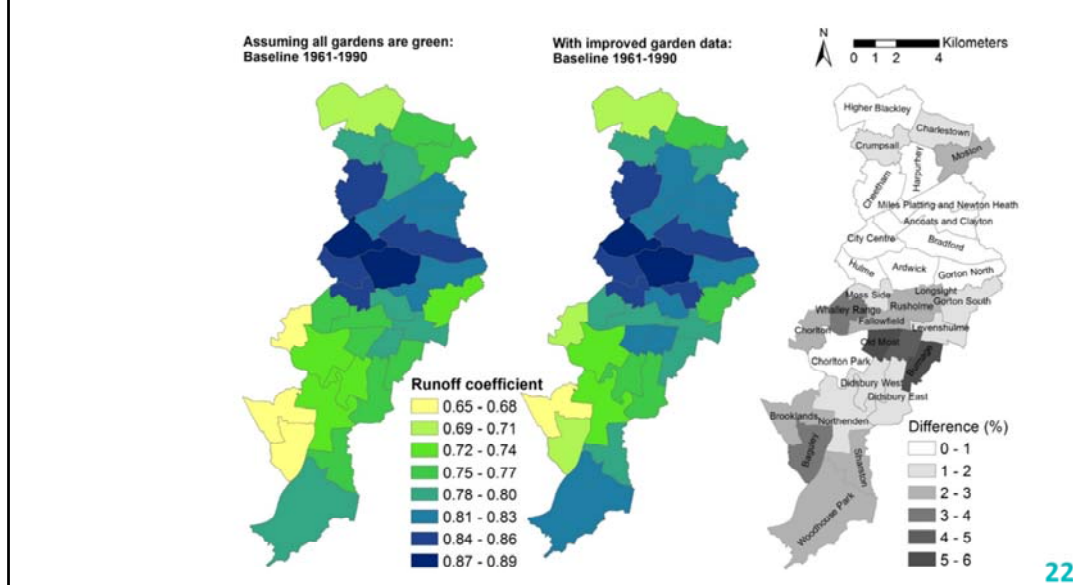
This is the surface temperature modelled during a summer heat wave event (which is highly correlated to excess mortality rates).

Differences are greatest in those wards which have more gardens and less garden GI.

Less green space means fewer benefits than previously assumed



Ecosystem services (ward level): Runoff attenuation



We find that because there is less green space, the benefit of runoff attenuation is also reduced.

This is the runoff modelled during the wettest day in winter (the runoff coefficient varies between 0-1, where 1 is complete runoff).

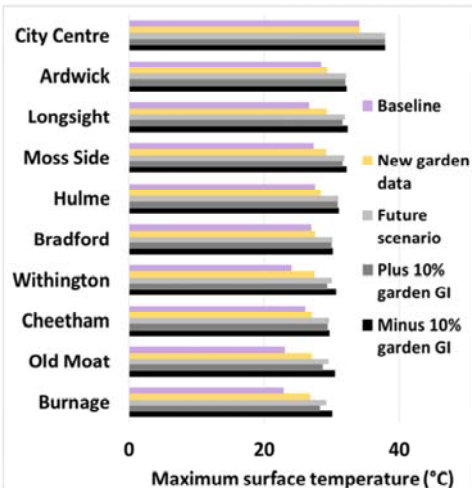
Differences are up to 6% and are greatest in those wards which have more gardens and less garden GI.

Less green space means fewer benefits than previously assumed

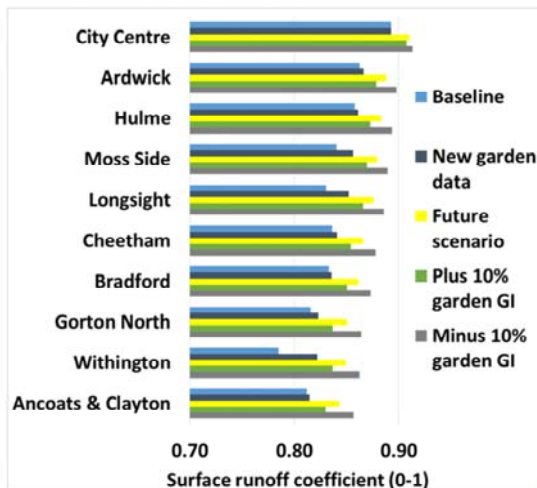


Ecosystem services (ward level): Top 10 comparison

▶ Cooling potential



▶ Runoff attenuation



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We also looked at the top 10 wards.

Also did some other simulations:

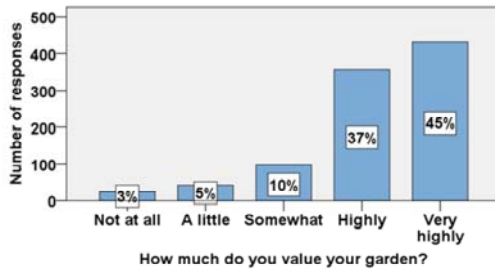
- 1) Baseline – assume gardens completely GI
- 2) New garden data – will improved garden GI estimations
- 3) Future scenario – future scenario for 2050 incorporating effects of climate change
- 4) Plus 10% garden GI (from new garden data scenario)
- 5) Minus 10% garden GI (from new garden data scenario)

The effect of adding or subtracting garden GI varies by ward. In wards with greater area of gardens, adding or taking 10% makes much more difference. Though action is needed everywhere.

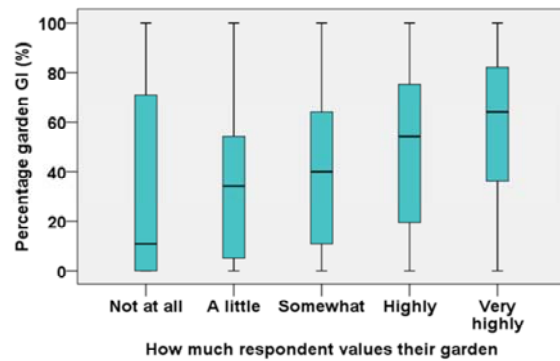
People value their gardens highly and for many different reasons



➤ 97% of respondents value their garden



➤ Those who have more garden greenspace place a higher value on their garden



Value & garden greenspace

Returning to the My Back Yard survey.

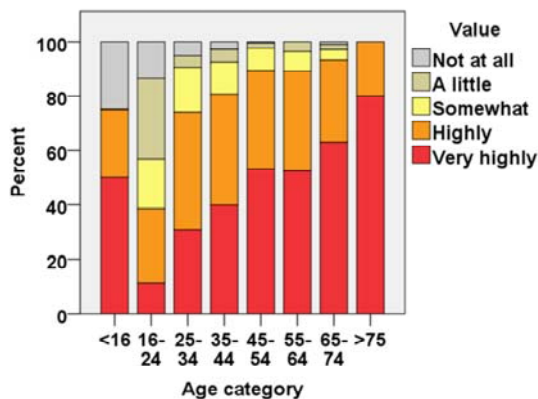
It is clear that people value their gardens and for many different reasons.

The more green and blue space in a garden, the more people value their garden. With around 60% garden GI, people will value their garden 'very highly'.

We need to engage younger age groups with their gardens

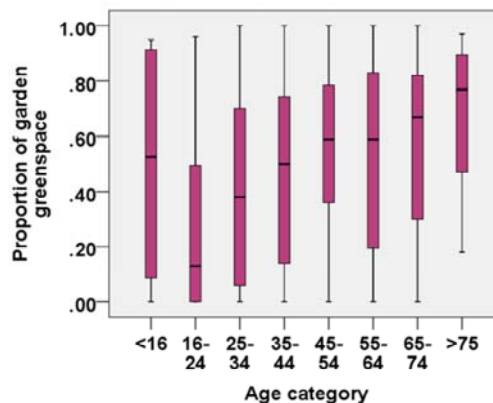


- Older age groups place more value on their garden



Value, age & garden greenspace

- And tend to have more garden greenspace



Looking at relationships between age and value, we find that older age groups place more value on their garden (many more value their garden highly and very highly than expected).

Additionally, older age groups tend to have more garden greenspace. This may be explained by many factors, including house type at life stage, more likely to own, spend more time in garden, retired, gardening. But, younger age groups do value their gardens less than expected.

NOTE: the <16 age category in both charts should be ignored. Survey respondents under age 16 had to confirm that an adult was present in order to answer the survey. In many cases (found at public engagement events), the adult gave the responses, and because the adult could be any age, this explains why there is the greatest diversity in responses (and proportion of garden greenspace).

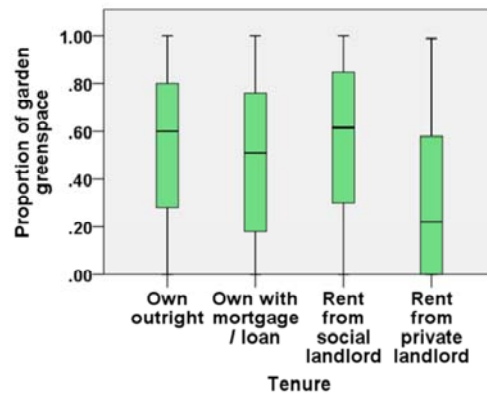
We need to engage private rented tenants with their gardens



- Private rented tenants do not value their gardens as highly as other groups



- And tend to have less garden greenspace



Value, tenure & garden greenspace

Private rented tenants (renting from private landlord or agency) do not value their gardens as highly as other groups.

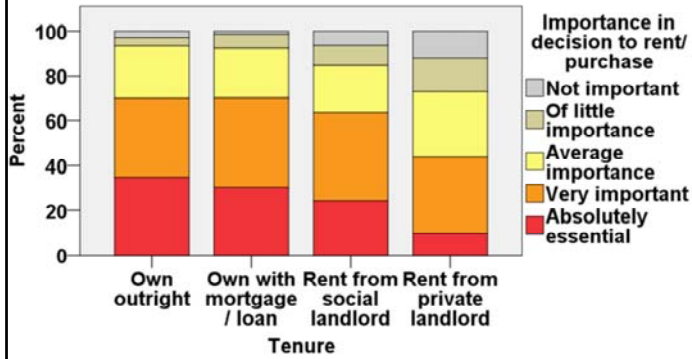
The distribution of green space is not the same across categories of tenure.

But, is this just because private rented tenants have less green space and therefore don't value their garden?

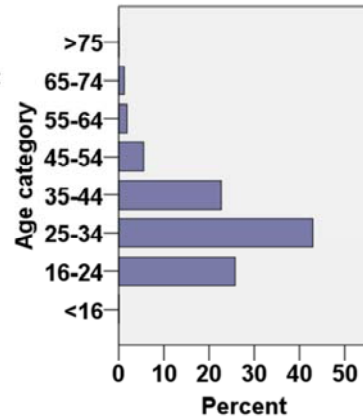
We need to engage private rented tenants with their gardens



- Private rented tenants place less importance on the garden in decision making



- Age categories of private rented tenants



Tenure & importance of garden in decision to rent/buy

We also asked how important the garden was in the decision to purchase or rent the property.

We find that private rented tenants place less importance on the garden in decision making.

This is again related to age, since we are picking up younger age groups in the private rental sector.

Key messages



- ▶ Domestic gardens are an important component of Manchester making up around one fifth of the city
- ▶ There is less green infrastructure in domestic gardens than previously estimated, and, gardens provide fewer benefits to people and the city than they could
- ▶ This affects the total amount of green space across Manchester and its benefits for people and wildlife
- ▶ There is a need to engage private rented tenants and younger age groups with the benefits of gardens
- ▶ More research is needed to understand the dynamics of change in GI across the city and drivers for change



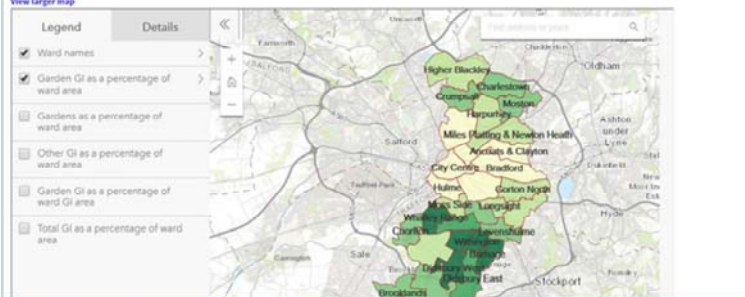
View the mapped data interactively online



www.mybackyard.org.uk
www.mmu.ac.uk/mybackyard

Project results
Domestic gardens cover a significant proportion of the total area of Manchester, with around one fifth of Manchester's land area being gardens. The average proportion of domestic gardens to total ward area is 22-26%. This ranges between 0.5% (City Centre) to 47% across Manchester's wards.
The findings of the My Back Yard project demonstrate that gardens are not completely green infrastructure (green and blue space). This affects the total estimate of green and blue space cover across Manchester, which is now estimated at 49%. The previous estimate of GI across Manchester that assumed gardens were completely green and blue space was 58%.
Less green space in domestic gardens means that the potential benefits they provide to people (ecosystem services) are reduced.
Further project results and the final project Action Plan can be downloaded from the link below:
My Back Yard: The contribution of domestic gardens to urban ecosystem services

Mapped Outputs
You can also view the mapped outputs interactively below:
[View larger map](#)



Thank you



References:

Cavan, G., Smith, C., Tzoulas, K., Baker, F., Barlow, D. Hall, J., Reece, P., Stringer, P., Butlin, T. (2018). *My Back Yard: An action plan to increase green space and enhance wildlife in domestic gardens across Manchester*. Manchester Metropolitan University, 24pp.

Baker, F., Smith, C., & Cavan, G. (2018). A combined approach to classifying land surface cover of urban domestic gardens using citizen science data and high resolution image analysis. *Remote Sensing* – in review.

Further information

www.mybackyard.org.uk / www.mmu.ac.uk/mybackyard

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