WHERE SHOULD ALL THE TREES GO?

Marco Amati

RMIT

Abstract

Trees play an essential role in the urban environment but how can the benefits they deliver be better integrated into the planning process? This talk will report on the results of the study "Where should all the trees go?" funded by Hort Innovation.

In the study we aimed to benchmark progress on the amounts of green spaces in urban Australia. We then took the amounts of green space in different local authorities and examined how these correlate with hotspots and areas of socio-economic disadvantage. The presentation will detail the findings and describe how these numbers can prioritise which local governments should be urgently greening.

Introduction

Tree planting has been part of Australian local government activity since the early part of the twentieth century. It has remained a part of the maintenance activity of roads and infrastructure crews, tasked with planting and adding to a pleasant green suburban environment (Figure 1). Local and city governments have planted large stands of trees at different stages as suburbs grew. In Canberra for example, this rush of planting began in the 1920s and 1930s (Banks and Brack, 2003). For suburbs in Australia's larger cities, such as Melbourne planting would have occurred as early village settlements became part of the post-War suburban expansion (Koutsivos, 2016, Figure 2).

Figure 1: Brighton City Council Workers Maintaining a Nature Strip, 1960s
(Brighton City Council, 1960 in Koutsivos, 2016)

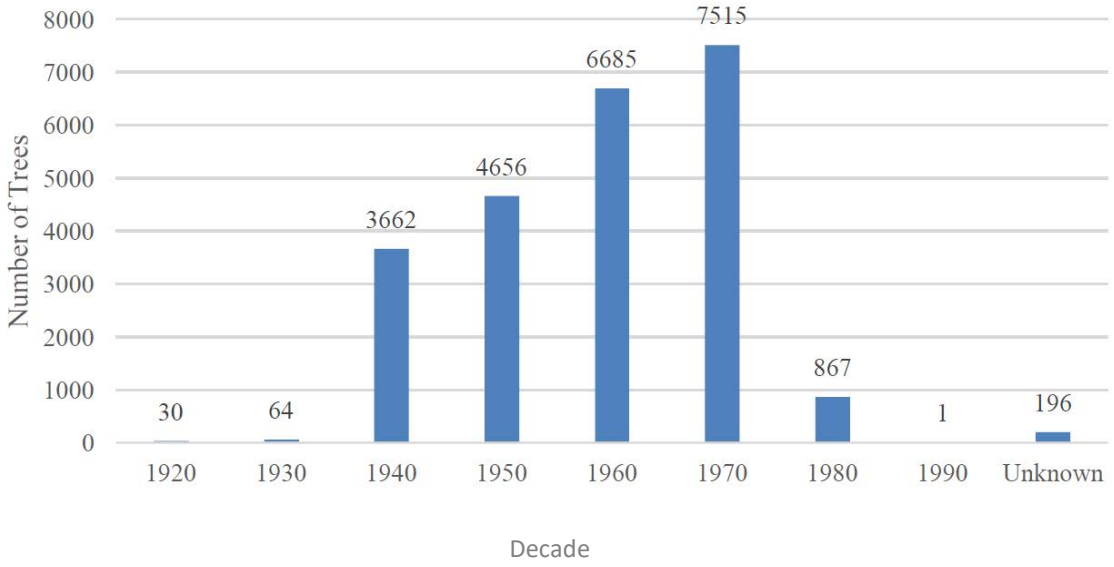

Figure 2: Number of Trees Planted Per Decade in Brighton/Bayside City Council (Koutsivos, 2016)

Yet, despite decades of investment in greening it is only in the last twenty years that Australian governments at different levels have started to realise the value of greening in general and tree canopies in particular. Notable milestones have included early calculations of the value of canopies using the DISMUT model in the early 2000s (Brack, 2016). They include the adaptation of the i-Tree suite of tools to Australian conditions and the first benchmark project to establish the quantity of green spaces in metropolitan LGAs (Jacobs et al. 2014).

In this, Australian Local Government Authorities (LGAs), State and Federal governments are following greening trends internationally. Urban greening was a priority for Singapore's Prime Minister Lee Kuan Yew even in the 1970s when urban development threatened to hamper economic prosperity. Initially started as a plan to bring rain and mitigate the effects of a drought, the plan later morphed into a complete physical, social and cultural makeover (Auger, 2013). More recently, the greening programs of large US cities such as Los Angeles and New York have gained attention and captured the public's imagination (McPherson et al. 2011). In the US, the signing of the 'Farm Bill' 2014 marked a watershed for urban forestry as it instructed the Forestry Inventory and Analysis program of the US Department of Agriculture to "implement an annualized inventory of trees in urban settings, including the status and trends of trees and forests, and assessments of their ecosystem services, values, health, and risk to pests and diseases" (Majewsky, 2015). For Australia the closest equivalent would be the Department of Infrastructure, Regional Development and Cities' National Cities Performance Framework (2017)[1] which includes 'Dwellings with access to greenspace' as a key performance indicator for 21 cities. As proof thatgreening benefits are widely recognized, greening such as the Highline in New York, is integral to the high profile revival of urban areas. It is of value to the point that it is starting to be seen as a problem, contributing to 'green gentrification' (Anguelovski et al. 2018).

Interest in measuring and monitoring green cover is likely to increase given common aims among different levels of government in Australia to achieve more eq uitable cities, adapt to climate change and improve liveablity. How are local governments performing in their greening work and what themes exist that enable or impede the roll out of further greening efforts?

The following describes the results of a 2017 study on 139 metropolitan LGAs to understand whether their greening efforts are increasing or decreasing the amount of urban greenery (Amati et al. 2017). The study also pointed out the amount of heat present in the LGA areas and examined the links between socio-economic resilience and greening. Prior to publication, the results of the study were sent to individual LGAs.

[1] https://smart-cities.dashboard.gov.au/all-cities/overview

These LGAs were invited to respond over the course of several months. The comments of the LGAs have been analysed by 2020 Vision to highlight LGAs' overall concerns about greening. These are presented below.

How are Australian LGAs performing in urban greening nationally?

An i-Tree method was used to identify changes in canopy cover and other land uses. This method was successfully used by Jacobs et al (2014) and its limitations are well understood (Parmehr, et al. 2016, Kaspar et al. 2017). The method relies on satellite or aerial imagery and an operator's identification of land cover associated with a set of random points generated within fixed boundaries. This enables the users to identify the percentage of land cover categories within an area. In this case we used the fee for service provider Nearmap with coverage over all of the 139 LGAs.

In addition, we calculated land surface temperature from Landsat satellite data (Devereux and Caccetta, 2017). From this we were able to calculate the size and location of heat islands in our selected areas. Our identification of a heat island relied on:

Calculating the heat that is generated from urbanization compared to the heat that would have been present if the land use had been native bushland.

Of the heat identified in 1. which areas are significantly higher compared to other heat islands in the city? Because the extremes of temperature vary by city (e.g. some tropical cities have little variability) the heat islands were calculated for each city by identifying areas of heat with two standard deviations above the mean.

Finally the health and socio-economic data in the LGA was calculated using census data. This was combined with the heat and the loss of canopy cover to define an index of vulnerability.

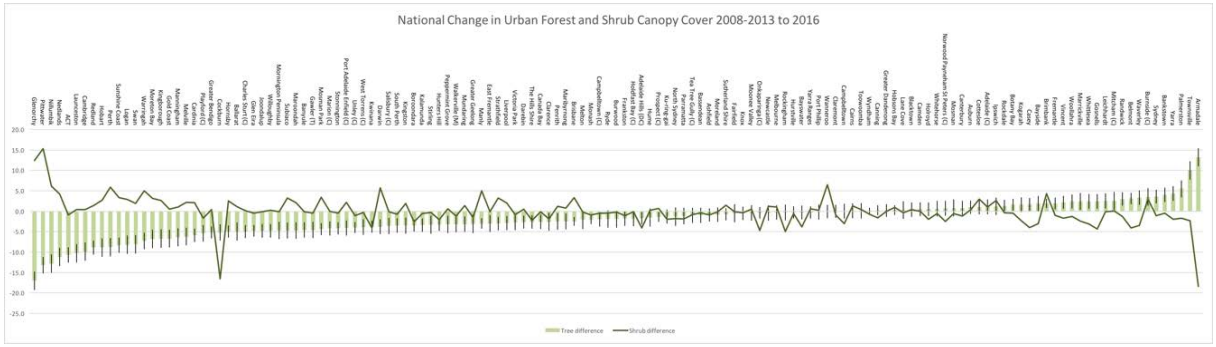

Figure 3: National Change in Urban Forest and Shrub canopy cover 2008-13 to 2016

Figure 3 displays the loss of tree canopy cover and shrub canopy over the period. While the loss is greater than the overall gain it is important to note that for many LGAs the loss of canopy is substituted by a gain in shrub (or vice versa). This is because there are two types of LGAs that were used in the study (Table 1). One type is urban and in control of an urban forest estate that comprises street and park trees, albeit with significant exogenous forces that can reduce greening such as lot subdivision that falls outside of the planning system. In these LGAs we would expect that the agency and control of the LGAs to be a dominant factor in the increase or decrease of greening. Other LGAs are peri-urban or suburban but with large areas of National Park or other state lands that they have little control over. Some LGAs, such as City of Greater Bendigo include both. For these LGAs greening relies on embracing a broader suite of measures that includes coordinating with State agencies and landowners of large properties.

Table 1: A simple binary description of Local Governments and their ability to control urban greening

Urban local governments	**Peri-urban / State Land**
E.g. City of Port Philip (Vic), City of Marion (SA)	E.g. Pittwater (NSW)/Northern Beaches (NSW), Vincent (WA)
Techniques to increase or maintain urban greening: Planting programs; strategic planning; control of removal of trees on private land; subdivision control	**Techniques to increase or maintain urban greening:** Largely reliant on the actions of other agencies, communication and effective coordination with other agencies and large landowners.
Exogenous factors that lead to a change in greening: Subdivision; removal of trees by homeowners; vandalism of street trees; senescence after the post-War planting boom; legislation outside of the jurisdiction of the LGA (e.g. bushfire clearance legislation)	**Exogenous factors that lead to a change in greening:** Natural forces that act on the urban forest, as a forest: droughts, bushfire, senescence.

These large areas operate like natural forested areas undergoing natural cycles of dieback and regenerative growth. The number of LGAs in urban Australia that are reliant on natural forestry effects call into question the wisdom of tieing LGAs to a benchmark of performance. Nonetheless the challenge is significant as the data also reveal that 2.6% of total greenery was lost during this period (Figure 4)

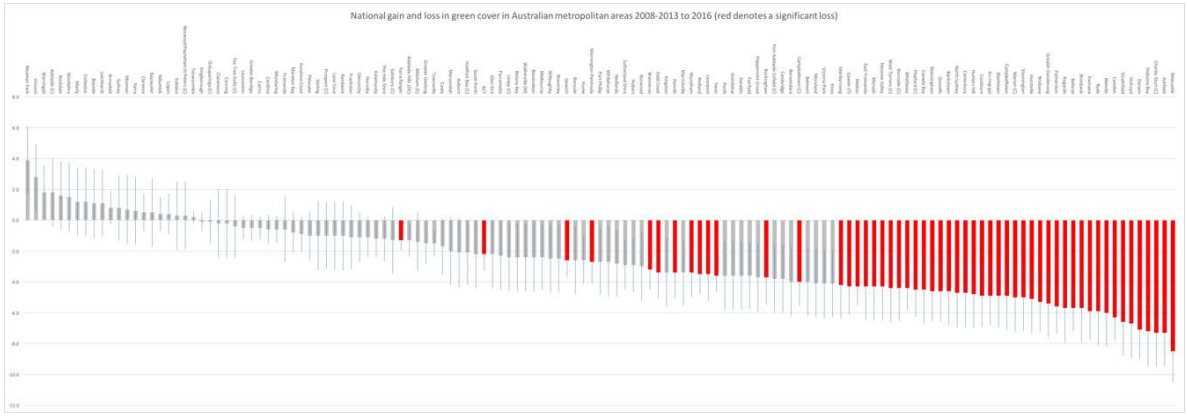

Figure 4: Total loss of greenery 2008-13 to 2016.

Looking through the LGAs that have lost green cover there appears to be no consistent trend for where these losses are coming from. For example, the largest percentage of decreases are not happening in peri-urban or inner-city areas but are happening in all the States and in all variety of different LGA location. This green cover loss would therefore result from a variety of processes that range from legislation to reduce tree cover in the event of a bushfire; subdivision of large suburban blocks; consumer trends in housing towards smaller gardens; risk aversion of local governments towards trees and falling branches and green field development on the edge of urban areas.

Large temperature fluctuations occur within Australian cities where a hotspot can be defined as 10 degrees centigrade warmer than the norm. It is important to note that a 10 degree centigrade as calculated for this project may not represent the extra heat in one part of the city compared to another in the middle of the day or at night. Instead it represents the temperature at a given time in the morning. This means that on a 40C day a city's heat island, by our definition, will warmer up faster and cool down slower.

In other words, the temperature is relative. However, when considered in relative terms the data are useful for strategic greening. For example, a single hot spot can cover large areas of a city. They are also associated with areas of socio-economic disadvantage. Breaking up patches of high heat anomalies such as through planting corridors should be a key component in strategic planning of green infrastructure in large metropolitan areas. These large patches form a stable area of heat in a city and may resist mitigating effects of wind when compared to smaller patches. Some areas of extreme heat anomalies exist in areas of relative socio-economic disadvantage, for example, in Sydney's West.

Overall the heat in Australia's cities can be considered to have the following properties:

- *Inside out heat islands:* The heat islands in the urban areas of Australian cities are generally less prevalent than in rural areas. This is because of the latter's inland location and the lack of irrigation on farmland. This is particularly evident in the case of Bendigo and Townsville.
- *A strong link between the affluent areas of towns and a lack of heat:* In some of the larger cities such as Melbourne and Sydney, the influence of national parks and also affluence can be seen. Melbourne's areas to the east are generally cooler than those to the West. In Sydney, the upper North Shore is cooler compared to areas to the South and West.
- *The impact of infrastructure:* The heat generated from large areas of infrastructure, such as ports, railyards and airports are evident in, Newcastle, Darwin and Sydney.
- *Heat continents not heat islands*: In Australian cities a single patch of heat island (or 'continent') can occupy large areas of the city. These large patches would form a stable area of heat in the city and may resist changes in wind and temperature more than smaller patches. A key task for strategic planning of green infrastructure would be to invest resources in planting corridors to break up these large areas.

What are local governments focused on in response to this exercise?

All of the LGAs in the study were contacted by the 202020 Vision between June and November (2017). They were provided with a five page snapshot for their area that included a brief description of how to interpret the data, the methods used by the team and data. One of the pages gave the LGAs an opportunity to view their own position in terms of green space gain and loss compared to the State and showed them how vulnerable they were. Finally the LGAs were given two maps, one of hotspots and the other hotspots overlaid on an ABS map of socio-economic disadvantage identifying greening opportunity areas where the hotspot would intersect with an area of socio-economic disadvantage.

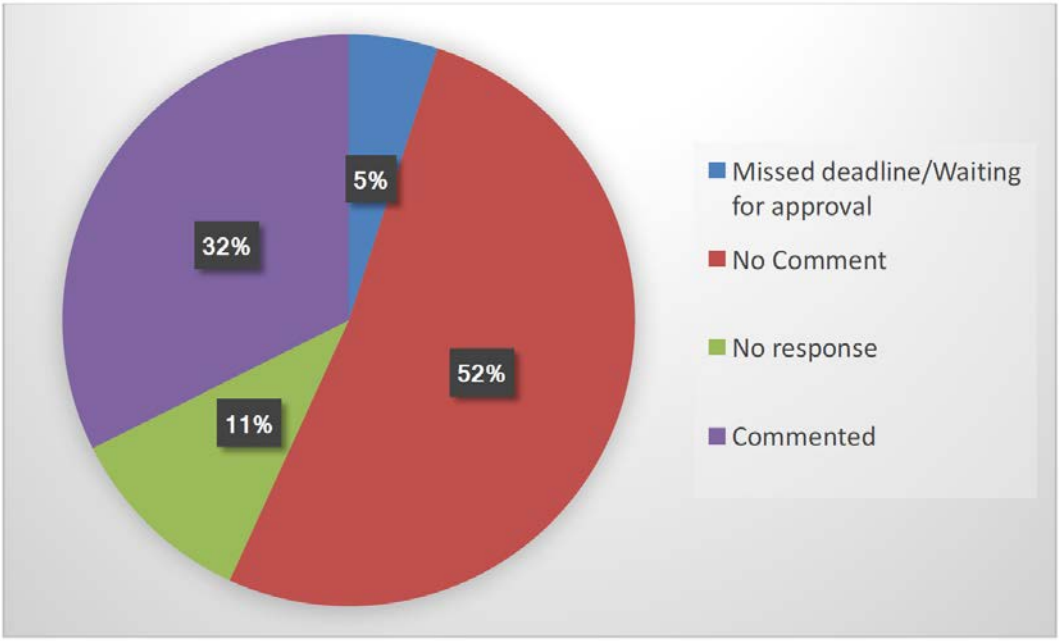

Figure 5: LGA response rate to "Where should all the trees go?" (N=139) (source: 202020 Vision, 2018)

A staff member in the LGA was invited to comment on the findings. 11% did not respond. Out of the 139 LGAs 32% responded with some information however the majority chose not to comment (Figure 5).

It can be assumed that the LGAs who do respond to the information are motivated by an interest in the area. They could either be interested in using the data, they could have data of their to compare against or they could have a criticism of the data gathering method. As such, the responses of the LGAs provided by the 202020 Vision exercise are useful for showing a snapshot of a variety of data gathering and benchmarking exercises around urban greening.

The analysis by the 202020 was conducted by reviewing the contents in all of the responses and sorting these according to themes. Figure 6 shows the frequency with which certain themes occurred.

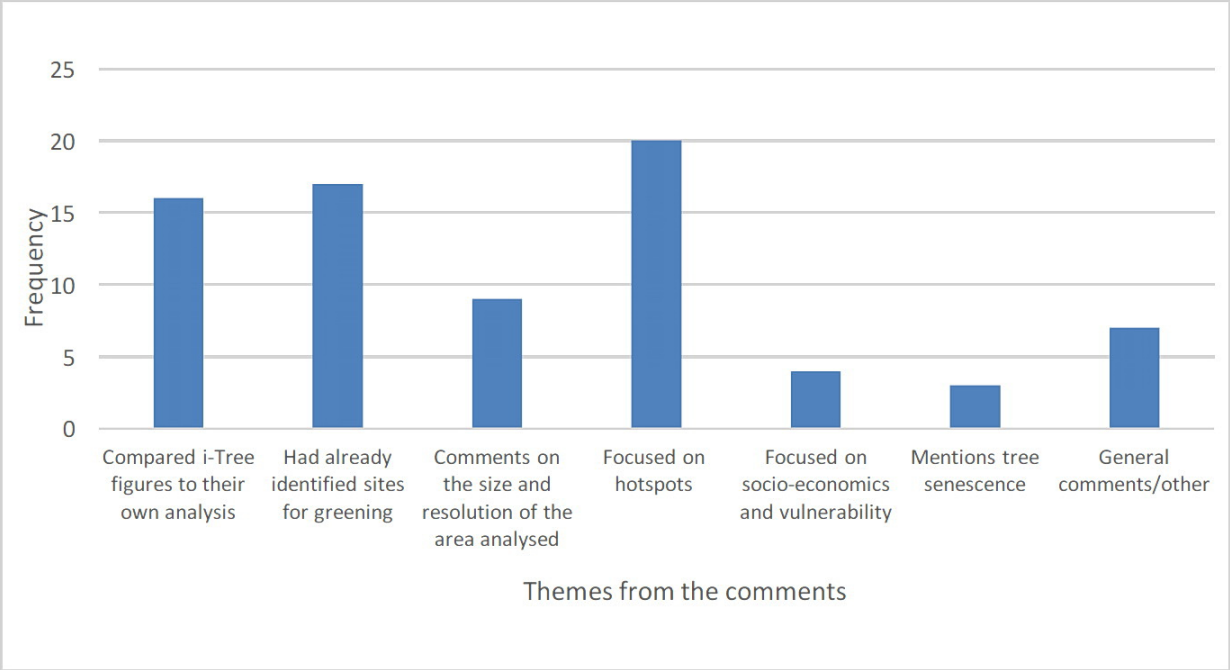

Figure 6: Frequency of mentions from among the 45 LGAs who responded to the 202020 Vision exercise (source: 202020 Vision team)

The data show that the most important theme chosen by the respondents was the hotspots. Overwhelmingly, the exercise of identifying hotspots was thought to be useful. In some cases the LGAs commented that the hotspots accorded with their understanding (e.g. that hotspots were located on car parks and the rooves of warehouses). In others the LGA officers commented that the finding that the hotspots were located on rural land was surprising. In addition many LGAs pointed out that the amount of private land in their area prevents taking action on greening.

18 out of the 45 responses noted that they had already begun the process and had reached their own conclusions about where to green. Hotspots provided a direction for these. Some of these greening efforts were focused on aesthetics (e.g. creating a tunnel effect in certain streets), others were mainly about balancing the amount of greening in some areas compared to others.

A similar number (16) compared their own calculations of the amounts of tree and other greening coverage to the data by the RMIT team. The methods that were mentioned to collect data varied a great deal. They included techniques with a high level of precision such as LiDAR but which are also expensive to collect and process. They also included data bases of tree location and condition. LGAs had also conducted their own benchmarking exercise using i-Tree canopy.

One of the most important considerations for future benchmarking exercises is the scope of the area examined. In the period that was looked at 15 LGAs were in the process of amalgamating and 1 was in the process of splitting up. Furthermore, a significant number (9) commented on the size of the area that was looked at. This means that some of the LGAs are examining only their urban areas and some take the whole of the LGA into consideration.

Finally, it should be noted that it is interesting to see that greening to solve the problem of socio-economic disadvantage and vulnerability does not appear to be a serious consideration for many local governments.

Considerations in selecting a benchmarking method for urban greening

In conclusion, as local governments grapple with multiple pressures and greening becomes more popular and politically salient, what is the most appropriate method of benchmarking and monitoring green space in Australia's cities? This paper has described some of the challenges that are faced in trying to reach a stable and comparable benchmark. One of the major questions is whether the local government is a suitable unit for analysis. The National Cities Performance Framework uses cities but these are not represented politically. The challenges identified by the local governments also point to the difficulties that governance faces in greening.

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