Volunteers in Portland, Oregon, USA, at a neighborhood tree planting organized by Friends of Trees. Photograph courtesy of Friends of Trees.

How a Random Conversation Led to Innovative Research

Perspectives from a Scientist and an Urban-Forestry Practitioner

By Geoffrey H. Donovan, Jeffrey P. Prestemon, Yashar Vasef, and Abigail R. Kaminski

Urban-forestry research can seem far removed from the on-the-ground realities of planting and maintaining urban trees. How can obtuse articles published in obscure journals help get more trees in the ground? Some scientists think that the opposite is also true: urban-forestry practitioners have little to contribute to new research. Both views are short-sighted and fail to see opportunities for mutually beneficial collaboration between urban-forestry practice and research. The purpose of this article is to showcase an example of a successful collaboration between researchers and practitioners. We hope that sharing this story will encourage other scientists and practitioners to look up for a moment from their day-to-day concerns and find ways to work together.

Perhaps the biggest collaborative thread connecting research and practice is data. Research needs data, and practitioners produce data. However, that data may not be usable unless practitioners invest time and resources in good data-management practices. What may be less obvious is the link between data quality and scientific originality. Research is only as good as the data it's based on, so when you see uniquely innovative research, you are likely seeing the end result of access to unusually rich data.

Where does good data come from? Sometimes, scientists collect their own primary data, but often they rely on secondary data that were collected by others. Tree-planting data, for example, likely come from the organizations that did the planting or provided the planting permits. Similarly, data on tree maintenance and mortality probably come from the people doing the on-the-ground work. Giving scientists access to these types of data can help them to answer new and important questions. However, the benefits of providing good data go both ways. If practitioners provide scientists with data, then they are shaping the questions that scientists answer. In addition, providing scientists with data gives practitioners an opportunity to lobby for questions that are relevant to them.

An example of the benefits of closer collaboration between practitioners and scientists is a joint project between scientists at the USDA Forest Service and the nonprofit Friends of Trees. Using 30 years of meticulous tree-planting records from Friends of Trees, Forest Service scientists were able to show that neighborhoods in which Friends of Trees planted more trees had lower rates of human mortality (Donovan et al. 2022b). This is the first study to find an association between tree planting and improved human health. From the scientists' perspective,

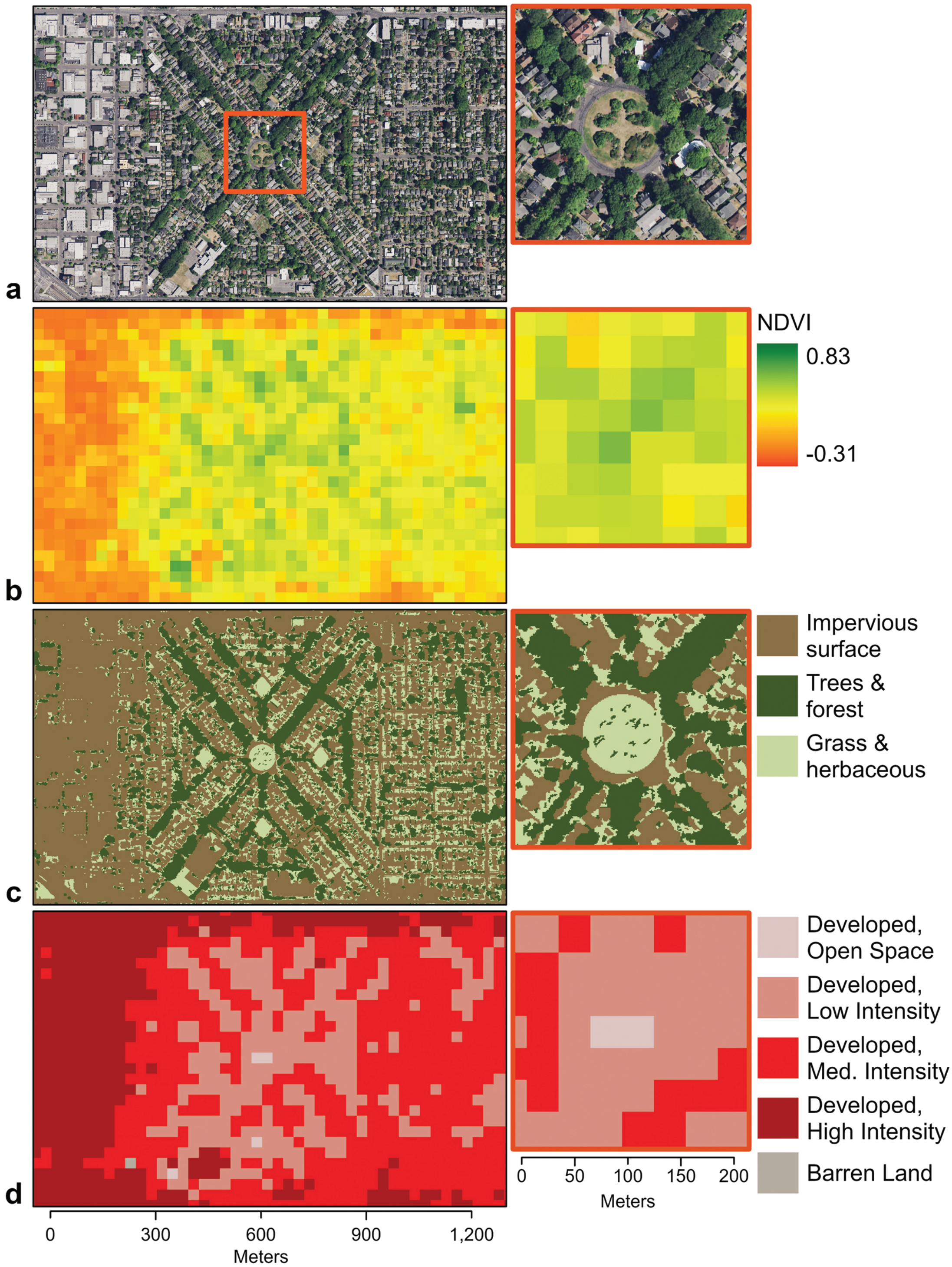

Figure 1. Images of the Ladd's Addition neighborhood in Portland, Oregon, USA. (a): National Agriculture Imagery Program (NAIP) digital orthomosaic (0.3-m resolution; 2018). (b): normalized difference vegetation index (NDVI) derived from Landsat 8 surface reflectance (30-m resolution; 2018 May 14). (c): EnviroAtlas meter-scale land cover (1-m resolution; 2012). (d): National Land Cover Database (NLCD)(30-m resolution; 2019).

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the research wouldn't have been possible without access to planting data. However, the research also helped Friends of Trees to demonstrate the value of their work. In particular, the research showed that the benefits of tree planting by Friends of Trees far exceeded the costs.

Scientists' Perspective

Untangling the relationship between the natural environment and human health typically requires big datasets that cover large geographic areas. Therefore, when describing people's exposure to nature, most studies are forced to rely on remotely sensed data to describe the natural environment around a study participant's home. The most commonly used metric in green-health studies is the normalized difference vegetation index (NDVI), which is a measure of photosynthetic activity (Donovan et al. 2022a). It relies on the fact that photosynthesizing plants strongly absorb red light with a wavelength of between 620 and 750 nm and strongly reflect near infra-red light with a wavelength of between 780 and 1,100 nm. NDVI can be calculated from a variety of data sources, but the most widely used source is Landsat imagery, which has been freely available globally since 1972. However, Landsat imagery has a resolution of 30 m, so it does an imperfect job of representing highly heterogeneous urban vegetation where most of us live. For example, Figure 1a shows an aerial photograph taken in Portland, Oregon, USA, and Figure 1b shows corresponding NDVI imagery. From the figure, it's clear that NDVI can distinguish between large areas of low and high greenness, but it's also clear that some important information is lost. Another way of describing people's exposure to the natural environment is to use land-cover maps. For example, Figure 1d shows the same area in Portland using National Land Cover Database (NLCD), which is produced by the US Geological Service (US Geological Survey 2018). As with NDVI, the NLCD map is, at best, a coarse representation of Figure 1a.

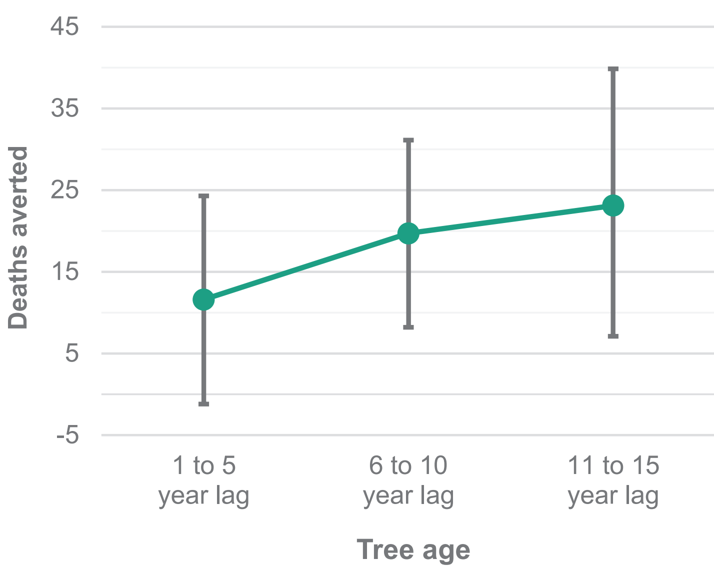

Figure 2. The association between averted non-accidental deaths and trees 1 to 5, 6 to 10, and 11 to 15 years after planting in Portland, Oregon. Results are for planting 1,638 trees, which is the mean annual number of trees planted by Friends of Trees in Portland from 1990 to 2019.

Both NDVI and NLCD imperfectly represent urban tree canopy, so scientists have responded by producing high-resolution tree-canopy maps for select cities. For example, Figure 1c uses imagery from the US EPA EnviroAtlas (US Environmental Protection Agency 2012). Figure 1c certainly does a better job of representing tree canopy than NDVI or NLCD; however, these maps are only available for a few cities and they typically aren't produced regularly, so they aren't good tools for measuring changes in tree canopy over time.

How, then, can we do a better job of capturing changes in tree cover over time? One innovative way is to augment existing tree-canopy maps with tree-planting records, as these records can account for small changes, such as planting a single tree. However, there are few large tree-planting datasets available. One exception is Friends of Trees, a nonprofit tree-advocacy organization based in Portland, Oregon. Since 1990, Friends of Trees has planted about 50,000 street and yard trees in Portland (Figure 2). Friends of Trees consistently and carefully recorded the date and address where each tree was planted. Without these good data-management practices, the study wouldn't have been possible. In addition, few nonprofits have been planting trees for over three decades. Although we had access to good tree-planting data, we didn't have data on other types of landscape improvements, such as planting shrubs or turf.

Using mortality data from the Oregon Health Authority, we found that when Friends of Trees planted more trees in a neighborhood, non-accidental mortality declined (we also accounted for differences in neighborhood-level income, race, age, and educational attainment). The size of this association wasn't trivial. From 1990 to 2019, Friends of Trees planted an average of 1,638 trees annually in Portland. We found that 1 to 15 years after planting, these trees were associated with 15.6 (95% confidence interval: 8.8 to 22.4) fewer non-accidental deaths a year (Donovan et al. 2022b). We also found that as trees aged and grew, the association between trees and mortality increased in both size and significance. For example, 1 to 5 years after planting, 1,638 trees were associated with 11.6 fewer non-accidental deaths annually (95% confidence interval: –1.1 to 24.4), whereas 11 to 15 years after planting, this same number of trees was associated with 23.1 fewer deaths annually (95% confidence interval: 6.35 to 39.1)(Figure 2).

We also conducted a benefit-analysis of the trees planted by Friends of Trees. To do this, we assumed that each averted death was worth $10.7 million, which is the value used by the US Environmental Protection Agency when they are assessing the benefits and costs of environmental regulations (US Environmental Protection Agency 2023). We further assumed that the annual planting and maintenance costs of a tree was $58.70 (McPherson et al. 2005). Using these two numbers, in combination with results from our analysis, we estimated that the benefit:cost ratio of tree planting by Friends of Trees is 1,727:1.

In summary, we were able to show, for the first time, that tree planting is associated with reductions in human mortality, and that the health benefits of tree planting far exceed their costs. Without data from Friends of Trees, this analysis would not have been possible.

Practitioners' Perspective

Friends of Trees uses its data for myriad reasons: to track tree-planting goals, to understand which species do well in particular areas, and to keep in touch with tree recipients, to name a few. In addition to these practical applications, it is tremendously useful when our data is used by scientists to better understand the benefits of trees to the communities we serve. While many benefits of trees are intuitive, like their ability to keep us cool by providing shade, some are less obvious, and it's helpful when scientific study can illuminate them. The association of tree planting with reductions in human mortality adds significant weight and credibility to a core Friends of Trees message that trees improve the quality of life of community members and at a significantly lower cost than many other solutions.

Not only do these findings help us make our case for more trees and more funding, but they also help us target communities that need trees most. Our goal is to build an equitable urban forest where all communities have access to trees and their benefits. To achieve this goal, we need to understand the many benefits of trees so that we can maximize the impact of our planting programs.

In sum, having planting data analyzed to understand community impacts is very valuable. That the findings can be useful to scientific, public health, and environmental justice communities shows how crucial it is for researchers and practitioners to collaborate. It allows for our work to reach beyond where we plant.

Conclusions

We hope that this article encourages other fruitful collaborations between researchers and practitioners. Our experience tells us that the most important thing that you can do to foster these collaborations is simply to talk. This study arose from a random conversation about an unrelated topic. Absent that serendipitous chat, this study never would have happened. Therefore, it's important to create opportunities for scientists and practitioners to talk about shared interests and just to get to know each other. Conferences where both scientists and practitioners speak, such as Partners in Community Forestry, are a great opportunity. However, informal local contacts are perhaps the best way for scientists and practitioners to get to know each other.

It is also crucial that practitioners use good data-management techniques. These practices take time and resources, and the payoff may not be immediately obvious. However, investments in data will achieve two things. First, the data will be more useful to scientists. Second, practitioners who collect data carefully will be able to influence the questions that scientists ask.

We encourage people to make the effort, as the payoffs can be substantial. This collaboration resulted in a major advance in our understanding of the health benefits of exposure to nature, and it helped a nonprofit show its donors that investments in tree planting can generate substantial returns on investment.

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