Urban Food Forestry: A Case Study of the Dunbar/Spring Neighborhood

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Abstract

Urban food forestry can provide many benefits to communities that have the time and resources to invest in and manage them. In addition to food production, some other benefits include energy savings, carbon sequestration, and improved human and ecosystem health. The objectives of this paper are to review the benefits and challenges associated with urban food forests, as well as to introduce a food forest case study from Tucson, Arizona. The Dunbar/Spring Neighborhood is using community awareness programs and outreach as a foundation for conserving water, wildlife, and creating a more vegetated neighborhood to improve public health and sustainability. Planting native vegetation and ensuring that those plants get the necessary amount of water using innovative rainwater harvesting techniques allows for longer life for the plants and the most efficient use of resources as possible. Some successes the neighborhood has accomplished are planting over 1,600 trees as well as many more shrubs and other plants, harvesting over 1 million gallons of water every year, and creating a community garden.

Chapter 1: Introduction

Urban forestry is a forestry practice involving strategically planting and growing trees in the urban environment that has been used for centuries (Gerhold 2007). Pruning trees and fertilizing is discussed in publications dating back to 1597 (Gerhold 2007). It was not until 1965, however, that the term urban forestry was coined by Erik Jorgensen of University of Toronto (Gerhold 2007). Today, urban forestry is defined as "an integrated concept, defined as the art, science, and technology of managing trees and forest resources in and around community ecosystems for the psychological, sociological, aesthetic, economic, and environmental benefits trees provide society" (Konijnendijk and Randrup 2004). Some areas that have been recognized as being among the best urban forests in the U.S. are the cities of Seattle, Sacramento, Washington, D.C., and New York (American Forests 2021).

Although most of the public sees urban forestry as the management of aesthetics, that is just one of the many purposes of urban forestry. Physical benefits range from better human health due to an increase of settings for physical exercise and decreases in pollution to mental health boosts from stress reduction. Social benefits include improved recreation, education value and aesthetics (Konijnendijk and Randrup 2004). The goals of these urban forestry systems include developing networks of open spaces and habitats, such as "watersheds, airsheds, woodlands, and parks" that are easily accessible by the public (McLain et al. 2012). A less common type of urban forestry system that gives many of the same benefits, with the addition of food, is a food forest.

A food forest is defined as the deliberate usage of woody perennials on the same land-management units as for agricultural crops and animals (Ramachandran Nair 1993). A food forest, then, is a form of agroforestry in which there is a multilayered planting of various trees,

shrubs, and underbrush with a particular structure. This structure is defined by seven typical layers, which include: the canopy layer, the lower tree layer, the shrub layer, the herbaceous layer, ground cover, the rhizosphere, and vines and climbers (Bukowski and Munsell 2018). Figure 1 shows how the different layers can all be integrated into one forest for high productivity.

Food forests are established to better the livelihood of the people who live nearby. Benefits that food forests provide include fresh food, improved air quality, carbon sequestration, energy savings, reduced crime, improved public health, water savings, improved aesthetics, and increased wildlife habitat (Donovan 2017, Akbari et al. 1997, Kuo et al. 2001). Figure 2 shows the relationship between agroforestry, food trees in urban environments, and their common ground with food forestry. By combining the goals of a food forest with the management of an urban forestry system, a unique system, called urban food forestry, can be implemented.

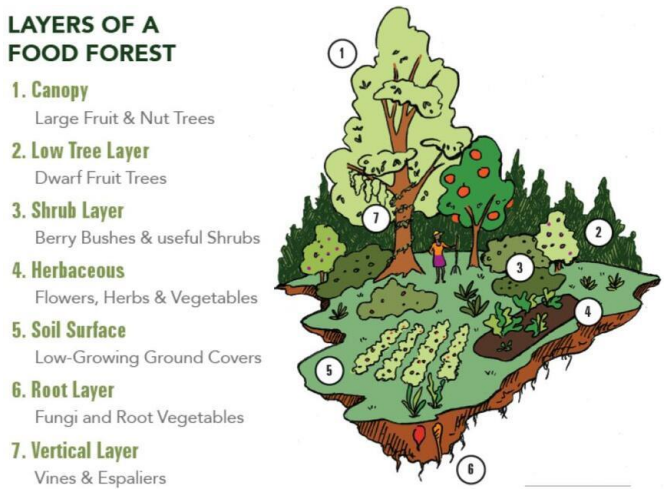

Figure 1. Diagram of the typical design layers for a food forest. Photo from Fair Amount Food Forest, https://www.fairamountfoodforest.org/what-is-a-food-forest.html

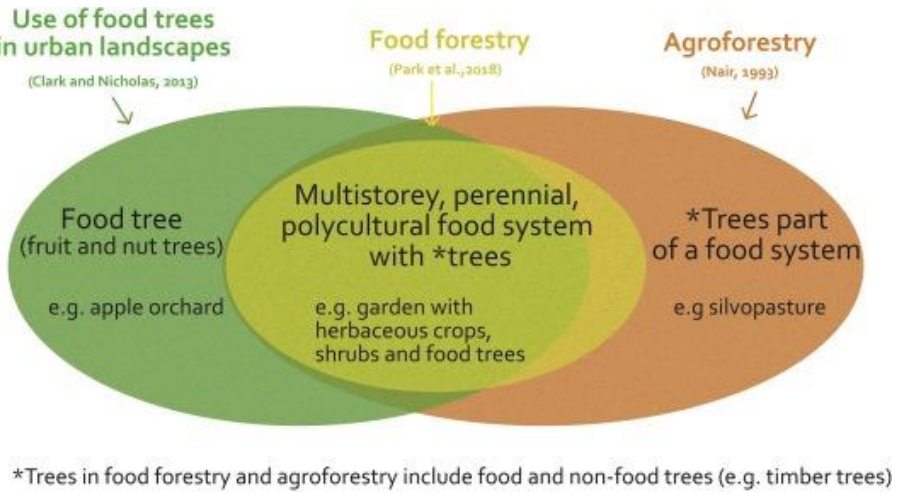

Figure 2. Visualization of different food practices involving trees in different locations (Park et al. 2019)

As defined by Clark and Nicholas (2013), urban food forestry is the "intentional and strategic use of woody perennial food producing species in urban edible landscapes". Urban food forestry has the potential to provide an incredible number of benefits relative to the time and effort required to establish them. As the need for urban sustainability increases with climate change and rapid urbanization, having a system that can securely produce sustainable food while simultaneously providing other benefits make these multifunctional urban food systems a great option. Common names for similar types of urban food forests across North America and Europe include household gardens, school gardens, therapeutic gardens, community food forests, community gardens in urban parks, or simply forest gardens (Park et al. 2018) Urban food forests utilize the standard food forest structure and produce but are individualized for the specific aesthetic and needs of the location. This includes using native vegetation and adding community based art in the area. Urban food forests are meant to combine the benefits of both

urban forestry and food forestry to communities that are in need as well as bring new techniques of sustainability to areas that are lacking.

The objectives for this paper include the introduction of urban food forestry, and in particular the many benefits it can provide to communities, while also exploring challenges that communities may face while getting a food forest started. Chapter 2 is a literature review on the benefits and challenges that come with urban food forestry practices. Chapter 3 will introduce the Dunbar/Spring neighborhood food forest in Tucson, Arizona, what species the food forest uses, how they manage the food forest, and how the community is benefitting. Lastly, chapter 4 will discuss future implications for the Dunbar/Spring food forest and urban food forestry expansion to other neighborhoods.

Chapter 2: Literature Review

Benefits of Urban Forestry and Food Forests

Food Source

Forests – whether they are food forests or natural forests – can provide many food products and other resources. Trees supply fruits, nuts, seeds, and even edible oils that provide direct sustenance (Jamnadass et al. 2015). Resources other than food can be just as important and include wood, natural aesthetics, and the most important resource, oxygen. If a forest incorporates animals for their meat or eggs, the forest can also supply the fodder for those animals while the animals supply fertilizer to the soil as well as pollination services. Food forests are specifically designed and managed to produce edibles and when possible, other resources such as shade and wood. Depending on the goals of the food forest, they can produce enough to fully sustain a household or, at the least, enough to lower the grocery bill.

Food security is the state of consistently having reliable access to food that contains all nutrition needed to survive (Food and Agriculture Organization of the United Nations 2021). Unfortunately, there are many households that do not have food security, but the use of urban forestry and local food forests can bring more security to those who need it. Parts of cities that experience a lack of nutritional, healthy food are called food deserts and tend to lead to an unhealthier community (USDA 2012). Recently, it has become common practice for these cities to adapt open spaces or vacant lots into gardens to combat food deficiency and poor food quality. However, moving beyond gardens and into food forests could heighten productivity while bringing additional benefits to communities in need.

Not only does a food forest allow for food production; it also ensures that the growers and consumers know directly where the product comes from and what is being used to grow it. Knowing and understanding where our food comes from and how it affects one's health is known as food literacy (Fraserhealth 2021). Being food literate can be a great step in using food more sustainably. Most food forests generate food for the person who started the forest or for the local community the forests serve. Eventually, after some forests begin to produce a surplus, selling the additional food not only adds a source of income, but also spreads awareness about fresh-grown, local food from these food forests. Additionally, income and awareness can also be increased through tours and workshops as some food forest growers charge a fee for those interested to take tours or participate in workshops (Elvers 2019). One forest garden that is an outstanding example of charging fees to help upkeep and maintenance under control while helping educate is the Central Rocky Mountain Permaculture Institute (CRMPI). CRMPI offers weekend workshops, a permaculture academy and a permaculture design course (CRMPI 2021).

Although making a profit is not usually the main goal of food forests, it can support the grower's finances, which will help to continue the upkeep and expansion of the forest.

Public Health

In addition to food production, the naturalization of urban areas, including the creation of urban parks, and green space planning, can have positive impacts on public health both mentally and physically. Research has shown that people who live near larger spans of natural areas have lower levels of stress, lower risk of mental health, and higher rates of physical activity. An article by Kaplan (1995) showed that respondents who did physical activity in urban parks saw their exposure to nature as restorative. Exercise in parks can also lead to higher levels of happiness, lower aggression and lower anxiety, all leading to better mental health for those who took advantage of the local urban parks (Giles-Corti et al. 2005). In addition to exercise, access to highly nutritional foods helps fight against health issues such as hunger, obesity, and diabetes, which are prevalent in food deserts (Clark and Nicholas 2013). In 2019, over 820 million people worldwide struggled with hunger, and since 1975, obesity rates have tripled (World Health Organization 2020). In the United States alone, over 35 million people experienced hunger in 2019 (Feeding America 2021). Since food forests can help people meet their nutritional needs for a healthier life, there is a sufficient argument to have more communities and cities establishing a bigger push towards urban food forestry.

In terms of helping human physical health, food forests can be planted and grown with medicinal plants that can be used to treat various ailments. Having access to plants with medicinal properties can help improve local health issues and not only keep a person healthier, but also help them save and even produce money. Local small-scale garden farmers have made incomes by growing medicinal crops and selling them in wholesale markets (Geldenhuys 2007).

Improved Air Quality

Air pollution has been linked to increased reports of asthma, cardiovascular disease, and chronic obstructive pulmonary disease in those who already have these diseases, as well as reduced lung function and airway inflammation (Shah et al. 2011). Although air quality changes can differ based on the types of vegetation in the area, any large amount of vegetation in one place such as a food forest can increase air quality. By implementing urban food forestry systems, instances of these diseases may be reduced as a result of the increased oxygenation and trapping of particulates matter due to the larger number of plants (Nowak et al. 2006).

Common air pollutants seen in urban environments are carbon monoxide, nitrogen dioxide, sulfur dioxide, and ground-level ozone (USDA 2018). Trees and vegetation help improve air quality by removing pollutants and reducing air temperature which helps lower energy needs and therefore lessen the emissions from power plants (USDA 2018). A study in Australia found that sites with low greenspace densities had higher levels of particulate matter while sites with higher greenspace densities had lower levels of particulate matter (Irga et al 2015). Even though other weather events such as high winds and precipitation do have effects on particulate matter levels, canopy cover was the second most predicting factor for particulates behind time since the last rain event (Irga et al. 2015). Not only can vegetation help improve overall air quality and people's lives, but it can also help reduce monetary spending of those who live within or near the vegetation. Although no paper specific to food forestry was located, presumably they would offer the same types of benefits.

Decrease in Crime

There is a stereotype that vegetation encourages crime because it can be an easy way to conceal criminal activity (Wolfe et al. 2012). For hundreds of years, vegetation has been

removed from areas that are thought to have higher crime rates and today this is mostly seen in inner-city neighborhoods (Kuo et al. 2001). However, research has shown otherwise for almost all types of criminal activity including assault, robbery, and burglary (Wolfe et al. 2012). When vegetation cover is higher, residents tend to use outdoor spaces more and therefore have more eyes watching the neighborhood (Kuo et al. 2001). Mental fatigue has also been shown to cause higher rates of irritability, inattentiveness and decreased control over impulses which lead to violence (Kaplan 1987). Vegetation can help manage and decrease mental fatigue by allowing our brains to be engaged with the surroundings while not actively paying attention. (Kuo and Sullivan 2001).

Food forests can bring communities together – whether that be for planting the vegetation, maintaining the forest, harvesting the edibles, or just spending more time within the environment. Community or social cohesion is the outcome of a community's aspect of togetherness and bonding through common interests and places (Weinstein et al. 2015). Natural environments and more vegetated spaces have been linked to increasing community cohesion (Weinstein et al. 2015). The more time a person spends in nature the higher the amount of empathy they have toward others, and the more time community residents spend together in the outdoor environment the better they will treat each other (Weinstein et al. 2015). As community cohesion increases, the amount of crime in the area will decrease as people are less likely to commit crimes against those they show empathy toward. Creating a food forest as a community gives each individual their own responsibility and sharing that responsibility, especially if the food forest thrives, strengthens the community bond. While building and recreating in the food forest more eyes are on the streets, creating less crime and a safer place to live (Lancaster 2017).

Carbon Sequestration

As climate change rages on, carbon sequestration can increase with urban food forests. Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide (USGS 2021). Trees are a prime carbon storage system as they use carbon during photosynthesis and store carbon as biomass. Although the number of urban areas in the U.S. is increasing as cities grow, more opportunities to plant trees have arisen as urban forestry becomes a greater necessity to help the livelihoods of those who live in cities. In 2005, trees and forests in urban U.S. areas were estimated to store roughly 643 million tons of carbon and sequester 25.6 million tons annually (Nowak et al. 2013). Urban trees store about 3.2% of all estimated carbon stored in the U.S. (Nowak et al. 2013). Unfortunately, the rapid growth of urban infrastructure is leading to fewer total urban trees and less urban forest cover, causing an overall decrease in amounts of carbon stored and sequestered (Nowak et al. 2013). Urban trees, when planted in locations that can be energy conserving, can create microclimates that reduce temperatures which can help decrease carbon emissions (Nowak et al. 2013).

Cooling and Energy Savings

When trees are planted in the correct locations, they provide external cooling which increases energy savings for the households they shade. In a research study by Akbari et al. (1997), energy consumption differences between unshaded houses and those shaded by trees were recorded and the team found that energy savings for houses with shade provided by trees can reach up to 45% during winter months. Although energy savings in the summer are not as large, at around 23%, the monetary savings that homeowners can have is still significant (Akbari et al. 1997). These statistics were from 1992, before a big push to reduce the speed of climate change occurred. Now, reducing electricity consumption could be a huge help on the path to aiding the slowing of climate change. One important factor that needs to be carefully planned if

someone is seriously looking at using vegetation as an energy saver is to pick which plants will give the most benefits. An article by Pandit and Laband (2010) made it clear that "not all shade is created equal". The extent and density of the shade is dependent on the plant species and will directly correlate with the amount of energy consumed (Pandit and Laband 2010). Not only do trees and other vegetation help cool homes nearby, but sidewalks and walking paths are also drastically cooler. Having cooler walking paths allows for more community involvement and is one more factor for bettering overall community health, as mentioned previously under the public health section.

Urban areas that are highly concentrated with buildings and lack greenery causing higher temperatures are called heat islands (EPA 2021). Research has shown that green spaces such as parks and gardens within cities can help revert heat islands and create cool islands within cities (USDA 2018). The micro-evapotranspiration and shading can cause significant changes in temperature in greener spaces compared to temperatures in the middle of a big city (Levermore et al. 2018). If enough cooler green spaces are planted and placed close enough together, there can be an improvement of cool air flow throughout the city (USDA 2018).

Challenges of Urban Food Forestry

Social Challenges

Projects as large as food forests can have challenges with any of the planning, planting, growing, or maintaining stages. The biggest distinction that categorizes challenges in food forestry is whether the food forest is public or private. If a homeowner does not live in an area with a homeowner's association, they can begin construction of a food forest with only permits needed, although not always needed, being for digging and being mindful of neighbors. This includes having companies out to check for power lines and plumbing to ensure no harm comes

to them while digging. On the other hand, public food forests can take much more planning, permitting, and working with local governments to allow for planting and maybe even creating collaboration efforts with local organizations (Bukowski and Munsell 2018). An essential part of the planning process is finding the best site for the project. Planning for a city center is much different than planning for a suburban neighborhood. Open space is a highly valued commodity, especially in highly developed areas (USDA 2016). Even if food forests can be squished into small plots of land, they are few and far between.

A challenge some people face is startup. Planning budgets and having sufficient time can be overwhelming and there are many questions that need to be answered. Do you plan on living in the same place long enough to reap the benefits? What is the plan for the food forest after you are done cultivating it? After deciding that you are willing to take on this timely project, the next step is designing the space, including which plants will grow best and which plants result in the most efficient use of resources. The next step is purchasing them, but a further decision must be made regarding how old each of your plants should be when purchased. Although plants can be bought at different stages of their lives, the more expensive options are those that have already grown beyond their seedling status. Budgeting and creating efficient plans can make the process less stressful (USDA 2016). Most growers choose to either grow from seed or from very early on in the plant's life, due to the lower expense. Even though they are saving money, they will have to wait much longer for their plants, especially trees, to mature enough to start producing, so time is another consideration. Time becomes the ultimate challenge in this circumstance, for those who spent the most time producing the urban food forest may not be able to see the eventual fruits of their labor. The USDA does have an urban agriculture toolkit that helps break down the whole process to make learning and implementing easier to digest (USDA 2016).

Looking for help and advice can be an essential resource and professionals such as Brad Lancaster and Catherine Bukowski have websites and books to look for help. Brad Lancaster's books are titled *Rainwater Harvesting for Drylands and Beyond: Volumes One and Two* and Catherine Bukowski's book is titled *The Community Food Forest Handbook: How to Plan, Organize, and Nurture Edible Gathering Places* and it is written in partnership with John Munsell, an agroforestry professor at Virginia Tech.

Biophysical Challenges

Part of the planning process is ensuring that, even if a site is available for an urban food forest, it can support various types of plants. Urban sites have the potential for soil contamination that could stifle plant growth or pose a health risk to consumers of food from the site. The contaminant that most often affects urban agriculture and planting is lead (Wortman and Lovell 2013). Lead is a common contaminant because of its history in gasoline and housing paints and the results of its presence in those products are still being seen 30 years after lead was removed from these products (Wortman and Lovell 2013). Other common contaminants include mercury, arsenic, and cadmium (Wortman and Lovell 2013). Although plants can grow in soil with small amounts of contaminants, there are concerns that the contaminants in the ground will be in the produce that comes from the plants and may cause harm to those who eat it (Wortman and Lovell 2013). Various studies across the world have found levels of lead in marketplace fruit and produce to be higher than the acceptable safe limit (Chaleshtori and Jadi 2019; Othman 2010). In addition to lead absorbed through the contaminated soil, food products grown in or near highly industrialized areas can also be contaminated from heavy metals in dust form on the surface of the product (Kim et al. 2016).

Unfortunately, once lead has contaminated a plant and its fruit, this metal cannot be fully removed by washing the fruit or vegetable (FDA 2020). However, total lead content will be minimal after washing, and you are more likely to have more lead in your tap water (Wortman and Lovell 2013). Urban locations can still be suitable for food gardens and other forms of food forests, but extensive planning and management of the area must be undertaken to reduce the total amount of metal contamination in the produced food. Beyond metals, pesticides are also another common source of soil contamination. Some pesticides have been linked to heavy metal contamination (FAO 2018). Pesticides can lead to soil degradation, microbial degradation and chemical degradation potentially leading to a decrease in plant productivity and food chain contamination (Singh 2012).

Another persistent challenge that arises when growing plants in an urban environment is water availability. With temperatures rising due to climate change, water is becoming more and more scarce in areas such as the southwest, U.S. One way to reduce dependency on city water systems, which often draw water from lakes, is to make watering systems and water collection for the urban food forest as efficient as possible. Using water collection tanks, scheduled irrigation, and low-pressure irrigation are all good methods of saving water (Wortman and Lovell 2013). A source of water that is often overlooked but can keep plants just as moist comes from recycling the greywater that is used in homes (Lancaster 2019). Greywater is all water that is used in the house that is not used as wastewater such as toilets. Recycling used water will lower the overall water bill while providing the plants the moisture they need (Lancaster 2019).

The lack of soil organic matter in many urban spaces can cause challenges but there are many management options available. In urban spaces, organic matter such as leaves, twigs, berries, and flowers are cleaned up and disposed of, because they are dirty and make the roads,

homes, and other spaces look messy and unkempt. The cleanup of these organics leads to a lack of organic matter on exposed soils. The lack of decomposing materials such as the leaves limits the amounts of carbon being returned to the soil (Vodyanitskii 2014). If more urban spaces leave those organics on the ground, soils can be better prepared to produce or store carbons. Another method to help soils regain nutrients is the use of wood chips as mulch. I will go into more detail about the benefits of mulch in a later chapter, but a useful tool that gardeners and landscapers are using is a smartphone application called ChipDrop. Using this app, anyone who is looking for free wood chip mulch in their vicinity can find it and get some to help their garden thrive. Apps like this are making resources easier to come by, helping overcome some challenges of urban food farming. Urban areas tend to use landscapers to clean up and make neighborhoods aesthetically pleasing, but with that can come soil compaction from trucks and the various tools used (Batey 2009). The compaction of soils can also lead to a decrease in carbon (Vodyanitskii 2014).

Other pollutants and factors that are relevant in urban areas that could threaten urban food growing are temperature, wind, humidity, and ozone (Wortman and Lovell 2013). These factors are hard to truly research and get exact numbers because everything is dependent on the size of the urban space and how much pollutants are being put into the air. However, with careful consideration of the primary pollutants, namely lead and other metals and pesticides, and water management, urban food forests can thrive. We will now explore one such example of an urban food forest.

Chapter 3: Urban Food Forestry in the Dunbar/Spring Neighborhood

Dunbar/Spring Neighborhood

The Dunbar/Spring neighborhood in Tucson, Arizona is an up-and-coming food forest that is paving the way to a more sustainable and beneficial tomorrow. This neighborhood was created in the 1920's by one of Tucson's first teachers, John Spring, and an African-American poet, Paul Dunbar (Dunbar/Spring Neighborhood 2021). The neighborhood is bordered by Stone Avenue (east), the Union Pacific railway (west), Speedway Boulevard (north), and 6th Street (south), just north of downtown Tucson as seen in Figure 3. The Dunbar/Spring Neighborhood is currently 140 acres with homes, a school, gardens, stores, churches, and a community center. The United States Census estimates that approximately 1,300 residents live in Dunbar/Spring according to the 5-year demographic and housing estimate (United States Census Bureau 2019). The neighborhood can be seen in the satellite image below (Figure 3).

Figure 3. Satellite image of the Dunbar/Spring neighborhood (outlined in black) and its proximity to downtown Tucson directly south.

For this case study of the Dunbar/Spring neighborhood and its food forest, I used several methods of information collection such as conducting interviews, researching articles, and searching credible websites. I was lucky enough to have the opportunity to interview a key individual, Brad Lancaster, and learn about his history with the Dunbar/Spring neighborhood. One of the most useful sources of information I had was the Dunbar/Spring Neighborhood Forester website (https://dunbarspringneighborhoodforesters.org/). This website is a rich source of information and tools for success when it comes to starting and managing a food forest. The Neighborhood Foresters website uses photos and outside resources to make education and awareness as easy as possible to share and learn from.

Development of the Dunbar/Spring Neighborhood Food Forest

Brad Lancaster, a resident of the Dunbar/Spring neighborhood, is recognized as the founder of the neighborhood food forest and other sustainability initiatives. Lancaster moved to this neighborhood in 1994 because it was central, historic, affordable, and he knew it was "anything but dull" (B. Lancaster, pers. comm. 2021). After talking to an elder woman in the neighborhood about the oasis that it used to be, Lancaster knew there was potential to bring the community together all while, as he says, "planting and harvesting the rain" (B. Lancaster 2021). He specifically remembers her telling a story of how years ago all the children in the neighborhood would come together and play in the rain puddles as their parents would watch (B. Lancaster 2021). This does not happen as often now – and whether that is due to climate change causing a lack of precipitation, video games and other technology dependence or fewer opportunities, causing a lack of community togetherness – Lancaster knew something could be done. Hearing stories of past residents planting trees throughout the neighborhood in attempts to beautify the area but having very little success inspired him to follow in their footsteps, this time making sure the plan came to fruition.

Lancaster's first step in creating this community food forest was to plant native species on his own property and in the adjacent rights-of-way. He hoped that by setting a strong example of the desert aesthetic with its native plants and unique landscaping, he could inspire the other residents to do the same (Lancaster 2021). To ensure his message was being heard, Lancaster went door-to-door in the neighborhood, spreading awareness about the benefits that these plants could provide to not only the entire neighborhood, but also for the rest of the city to view as a go-to resource (Lancaster 2021). Having an example at his home, involving the community, answering public questions, and educating other residents and non-residents, led to more and

more homeowners planting native plants in their yards, and, for perhaps the first time in years, stepping beyond their property to public rights-of-way to meet and help others. Then, in 1996, the annual tree planting began, and native, tree bearing plants were planted along the streets, walkways, and property lines (Lancaster 2016). Soon afterward, cars that once parked along the dirt sidewalks began to move off of the walkways into the streets, wildlife presence became more apparent, and more people were walking and biking (Lancaster 2016). Now the neighborhood has flourished into a place of greenery and sustainability. With all the progress being made and the interests of residents on the rise, a group was put together led by Brad Lancaster to help continue progress and ensure organization. This group is called the Dunbar/Spring Neighborhood Foresters.

This forester group is unique in that they are working toward greening a desert environment that most people would look at and see as an arid, dirty landscape, hardly capable of growing vegetation, let alone a whole forest. The goals and aims of the neighborhood foresters are as follows, as taken from their website:

- Bringing back, and enhancing, life in our public commons in a way that enhances health, accessibility, abates the effects of heat-island/climate-change, sequesters carbon, and improves water/food security and flood mitigation for all.
- Enabling a daily reconnection and collaboration with nature unique to our bioregion.
- Building community, and evolving our skills and capacity as we collaborate together planting and stewarding our neighborhood forests in public rights-of-ways and other public commons.

- Create and practice what we'd like to see grow community-, watershed-, and state-wide.
- Demonstrate public food forests that thrive solely on passively harvested rain and stormwater—no pumped or extracted waters from wells, or municipal systems. So, our practices contribute to the regeneration—not the depletion—of groundwater and surface waters.
- Increase the fertility/organic matter content and diversity of beneficial life within our soils with free, on-site nutrients in a way that increases the infiltration rate, filtration, accessibility, and residency time of stormwater for plants and other soil life.
- Continually grow and deepen our understanding of this place in the Sonoran Desert as we evolve our beneficially reciprocal relationships with our diverse plant, animal, insect, soil, human, and watershed communities.

From the progress that has been made it is clear to see that the foresters are reaching their goals and continuing to aim toward a bigger and greener community. They hold workshops that teach the importance of water harvesting, weeding, pedestrian access, and even graffiti removal for when that unfortunately happens (Dunbar/Spring Neighborhood Foresters 2021). One of Brad Lancaster's goals is that people moving away from this neighborhood can take what they have learned and implement the same practices somewhere else (B. Lancaster 2021). Education and finding different ways to teach those who are interested is such an important part of spreading awareness. One way the forester's group is working toward educating as many people as possible that are interested is by creating different levels of Neighborhood Foresters. Each level

comes with different opportunities and learning goals depending on how invested the person wants to be. There are four different levels: 1) Home & Public Right-of-Way Forester, 2) Neighborhood Forester, 3) Neighborhood Forester & Mentor and 4) Multi-Neighborhood and Watershed Forester. The next two diagrams present a brief overview of the different learning outcomes, practices and collaborations that each level brings, and what people can look forward to as they work their way up the levels.

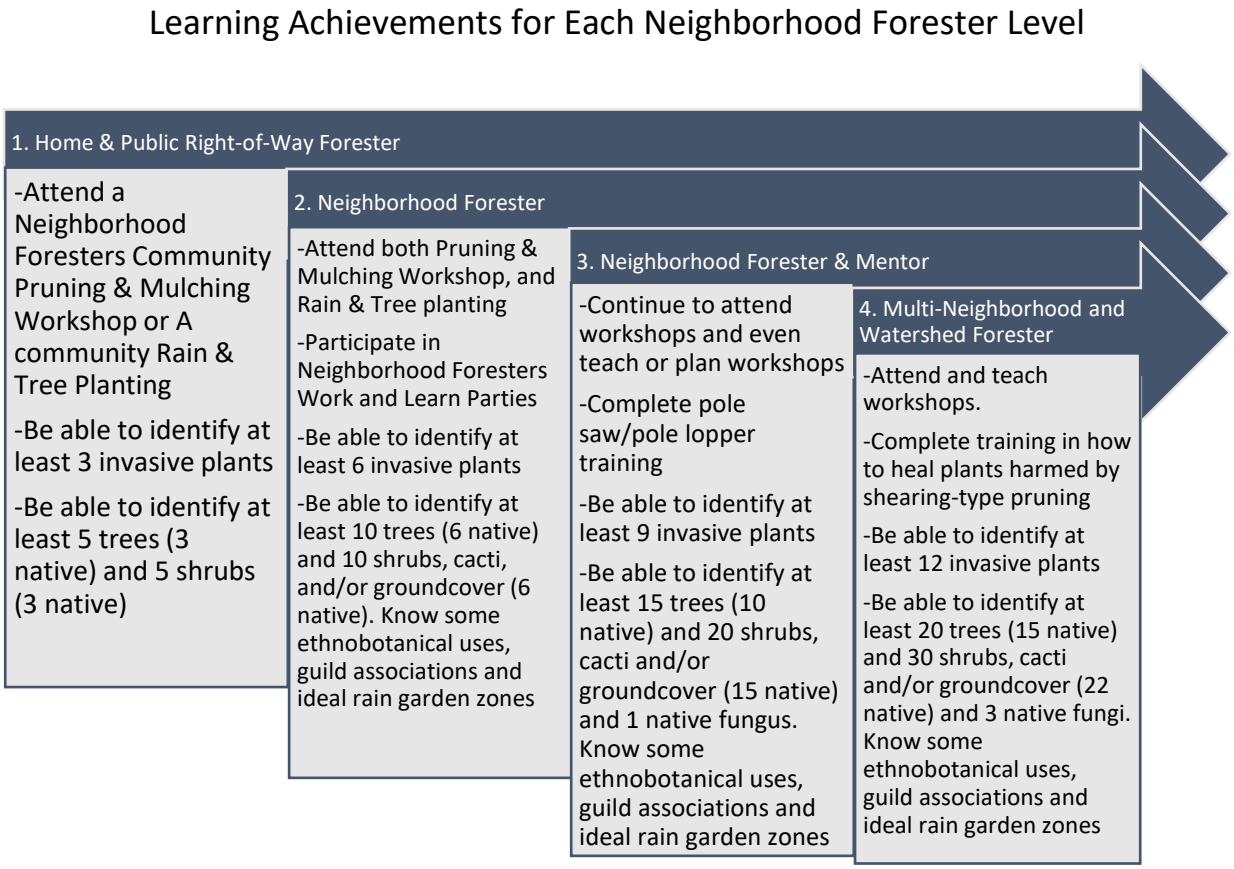

Figure 4. A figure showing the progression of learning that will take place every level of the Neighborhood Foresters program. Diagram made by Anastacia Lopez using information from https://dunbarspringneighborhoodforesters.org/be-a-neighborhood-forester/four-levels-of-neighborhood-foresters/.

Practice Achievements for Each Neighborhood Forester Levels

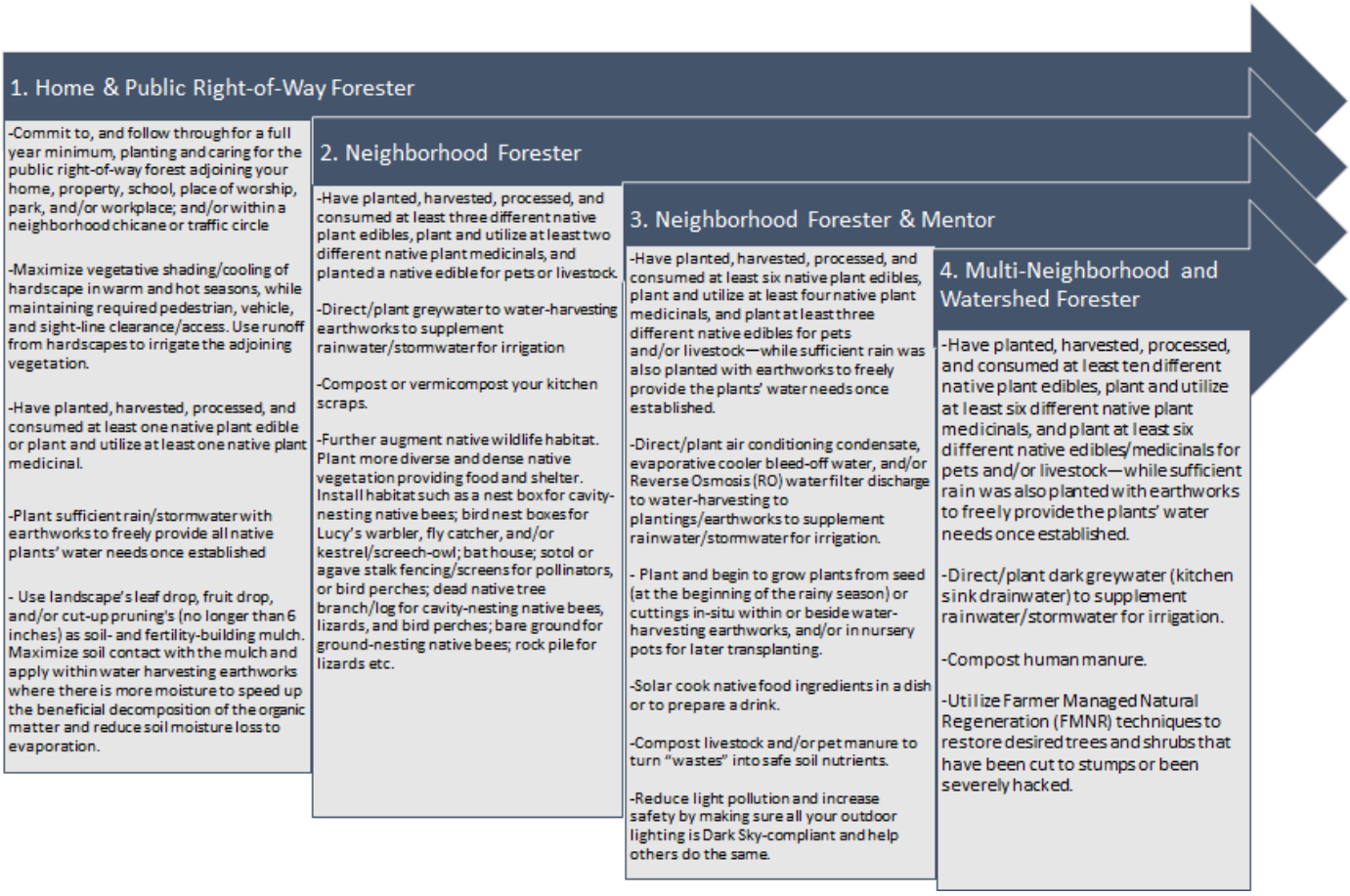

Figure 5. A figure showing the progression of techniques practiced that will take place every level of the Neighborhood Foresters program. Diagram made by Anastacia Lopez using information from https://dunbarspringneighborhoodforesters.org/be-a-neighborhood-forester/four-levels-of-neighborhood-foresters/.

Along with every level reached comes various rewards starting with the choice of a Neighborhood Foresters shirt, gloves or even an adolescent saguaro when the Home and Public Right-of-Way Forester is reached to various certifications when the Multi-Neighborhood and Watershed Forester is reached. Rewarding those who take on the challenge of completing a level not only gives an incentive to have more people participate but also give those who earn the

rewards a sense of accomplishment. After becoming a level three forester, commercial grade tools can be checked out from the Neighborhood Foresters group to help ease practices and encourage more forest improvement (Dunbar/Spring Neighborhood Foresters 2021). The neighborhood foresters group is mainly all composed of volunteer work and projects are mainly paid for by residents who are willing to make the space in front of or around their property more vegetated.

Every year, run by the Neighborhood Foresters group, the community holds an event called the Annual Dunbar/Spring Neighborhood Rain, Tree, & Native Food Forest Planting (Dunbar/Spring Neighborhood Foresters 2021). During this event, residents can order specific native plants and other water harvesting services for the property in front of their home or for their personal property. This specific community event has drastically increased the amount of vegetation in the neighborhood. To ensure that the food forest will thrive to its fullest extent, there are a few requirements that must be met before any project work will be done on the property. One requirement is that all invasive weeds must be removed before any work takes place (Dunbar/Spring Neighborhood Foresters 2021). This requirement is very important because it ensures that the invasive species will not spread during the plantings and helps reduce the number of invasive species within the neighborhood. Members of the neighborhood foresters group check the site before any work takes place to ensure all requirements have been met. This ensures the natural resources of the land are being used by the native species, giving them a better chance of survival. The only other requirement is that the right-of-way must include a pedestrian walkway to not only allow walkability, but also easy access to plants and other resources (Dunbar/Spring Neighborhood Foresters 2021).

When these plantings began in the 1990's, all plantings and water harvesting systems were put in by volunteers. Residents would come together and give their time and energy to put in these plantings. As of late there has been such a high quantity of residents wanting work done that the neighborhood has brought in contractors to help accelerate the plantings (Dunbar/Spring Neighborhood). Although it was significantly cheaper for the residents and others to volunteer their time, hiring contractors was faster but also helped eliminate volunteer abuse. When talking with Brad Lancaster, he mentioned that volunteer abuse was a problem that was unfortunately happening within the neighborhood. Volunteers were getting overworked and taken advantage of which should never have happened (B. Lancaster 2021). To ensure all parties were being treated responsibly and all plantings were getting done in a timely manner, contractors now dig holes with tractors, lay the rocks needed for the basins, and help with the permitting needed rather than having volunteers doing everything by hand with shovels and other tools (Dunbar/Spring Neighborhood Foresters 2021). To make sure the plantings goes smoothly, residents who are willing to pay for and have work done in front of or on their property will pay for the work to be done. The money will be sent to the Neighborhood Foresters group who then orders the plants, schedules, and pays the contractors as well as helps process city rebates for up to 50 percent off the project price (Dunbar/Spring Neighborhood Foresters). Residents have taken advantage of the rebates and contractors and huge progress has been made.

Since 1996, over 1,600 trees and many smaller shrubs and cacti have been planted in public rights-of-way in the Dunbar/Spring neighborhood and have been used for their food and other resources (Dunbar/Spring Neighborhood Foresters). With intentions to expand and increase community involvement, the number of plantings can drastically increase. This neighborhood is known for its strong community, whose residents have put hard work into making a sustainable,

productive food forest. The food forest is made possible through various community efforts such as a neighborhood forester's program, community plantings and work-and-learn stewarding parties (Dunbar/Spring Neighborhood 2021). The work of residents and volunteers is the only way that this food forest was able to expand and prosper, showing that communities coming together can really make a difference.

Dunbar/Spring Food Forest

Food forests typically have seven layers of different vegetation types, as mentioned in the introduction to food forestry section. This ensures that all space is being used to its fullest extent and that food and resource production is maximized. In this native food forest, not all layers of the typical food forest design are met, but it is still being planted as efficiently as possible. Native plants were chosen as the best option for this food forest because they are well-adapted to the desert environment. The trees that are planted in the neighborhood are almost all native to the Sonoran Desert and therefore are adapted to the environment, tend to need only minimal maintenance, and have low water requirements. Using native Sonoran Desert species allows the neighborhood to have greater access to plants for their local plantings while helping bring the desert neighborhood back to its original landscape. Native trees make up the canopy and low tree layers with a few non-native fruit trees mixed in, various native shrubs and larger cacti make up the shrub and herbaceous layers, and the ground level or soil surface layer is mainly ground-level cacti. A vine layer can be found in the neighborhood made up by the Coyote Gourd (Harvesting rainwater 2021). Some of these different layers can be seen in Figure 7 below. The root layer of the typical food forest is not used here because the poor soil conditions make growing difficult. Although not all seven layers are taken advantage of here, the level of production is still quite high.

Figures 6 and 7. Figure 6 (left) shows a public right-of way before being planted and Figure 7 (right) shows the same area after being planted. Photo: Brad Lancaster, Dunbar/Spring Neighborhood Foresters

Growing and maintaining a food forest of this size takes a lot of time and resources. A couple of the most used maintenance practices are pruning and mulching. Pruning is important because it ensures that public walkways are fully accessible and the prunings taken from the trees can be made into mulch. Trees may be pruned three different times of the year depending on the reason for the pruning, whether structural or for accessible walkways (Lancaster 2016). Pruning in late spring or post-monsoon can lead to large amounts of growth thanks to the large amount of precipitation (Lancaster 2016). Structural pruning is best done in late winter when there are fewer leaves, allowing for better views of the branches (Lancaster 2016). Mulching can bring some significant benefits to the soil including increasing the rate of water infiltration, reducing soil moisture lost to evaporation, reducing weed growth, filtering toxins taken up from the road, and enhancing the growth rate and health of plants (Lancaster 2016).

Table 1. The table below lists the native trees planted in the Dunbar/Spring Neighborhood and the main resources they provide.

Native Tree	Scientific Name	Main Resources
Velvet Mesquite	*Prosopis velutina*	Nitrogen fixer, edible seed pods
Screwbean Mesquite	*Prosopis pubescens*	Edible seed pods, medicinal properties, Nitrogen fixer
Desert Ironwood	*Olneya tesota*	Edible seeds, nitrogen fixer, medicinal properties
Cat Claw Acacia	*Acacia greggii*	Medicinal properties, nitrogen fixer
White Thorn Acacia	*Acacia constricta*	Nitrogen fixer
Canyon Hackberry	*Celtis reticulata*	Edible fruit
Foothills Palo Verde	*Cercidium microphyllum*	Edible flower and seeds
Blue Palo Verde	*Cercidium floridum*	Edible flowers and seeds
Desert Willow	*Chilopsis linearis*	Medicinal properties

The native trees listed in Table 1 above make up most of the canopy layer and lower tree layers of the food forest. The velvet and screwbean mesquites provide an abundance of resources that tend to be overlooked. Most Tucson residents look at these large trees and see them as messy

due to their pods littering the ground; however, these pods can be made into flour to be used in recipes. Even though it cannot completely replace regular flour, it can substitute up to certain amounts and bring different flavors to foods (Desert Harvesters 2018). Mesquite flour is gaining attention because it lacks gluten found in regular flours made from wheat (Muellar 2021). Gluten-free diets have become popularized in the last few years and mesquite flour provides an attractive alternative for gluten-free recipes. Another source of flour from the food forest is the seeds of the Desert Ironwood trees. When the pods are mature, the seeds can be processed and turned into flour (Dunbar/Spring Neighborhood Foresters 2021). The other big commodity that comes from mesquite trees is mesquite honey. Bees take nectar from the Screwbean mesquites and return to the hive to make a light, floral honey (Walker Honey Farm 2021). The different flavors that the mesquite nectar honey introduces can add to recipes that other honey cannot, while also providing the same benefits that other honeys do.

Two non-native fruit bearing canopy trees that are grown in this neighborhood are the Fan Palm (*Washington filifera*) and the Pomegranate tree (*Punica granatum*) (Lancaster 2021). Although these are not native trees, they do grow well in the desert environment and both produce edible fruits.

Table 2. The table below lists understory native plants that may be seen in the Dunbar/Spring neighborhood and the main resources they provide.

Native Plant	Scientific Name	Main Resources
Prickly Pear	*Opuntia*	Fruit, edible cactus pads
Desert Oregano (Wright's beebrush)	*Aloysia wrightii*	Spices, can be used as tea
Hummingbird Bush	*Justicia californica*	Nectar
Desert Hackberry	*Celtis pallida*	Edible fruit
Wolfberry	*Lycium* Species	Edible fruit
Cholla	*Cylindropuntia*	Edible buds and fruits
Golden barrel cactus	*Echinocactus grusonii*	Edible fruit
Saguaro	*Carnegiea gigantea*	Edible fruit
Desert Chia	*Salvia columbariae*	Edible seeds
Chiltepin	*Capsicum annuum var. glabriusculum*	Edible fruit

Not only are trees an essential source of resources but many smaller shrubs and cacti, seen in Table 2, have been planted. One of the biggest food producers in this food forest are the cacti. Nearly all parts of the prickly pear cacti are edible. The pink fruits are the most known

edible component, as they are often made into syrups, candies, and even eaten raw when ripe (Desert Harvesters 2018). The lesser-known edible part of the cacti are the green prickly pear pads. The cactus pads are called nopales and are traditionally used in various Mexican dishes. The preparation at first appears to be difficult due to the thorns, but with how quickly the cacti can grow the produce, the savings and interest is well worth it. Other fruits that come directly from the plants are wolfberries and hackberries. These can be eaten directly from the plant or dried to last longer (Dunbar/Spring Neighborhood Foresters 2021). The neighborhood forester's website mentions edible cholla cactus flower buds and edible nectar from the Hummingbird bush flowers that can be eaten directly from the flowers or added to salsas and other recipes (Dunbar/Spring Neighborhood Foresters 2021). The amount of edible production from these plants is considerably underrated. The Desert Harvesters, a group co-founded by Brad Lancaster, have created cookbooks and harvesting guides to help educate and help others use the landscape as much as possible.

An important use of plant clippings and excess produce is as chicken feed. Chickens can be an important factor to food forests as they can improve soil with fertilization from their waste while eating fallen fruit and seeds (Lancaster 2021). Chickens also produce eggs which are a great source of protein, and their shells can return great nutrients such as calcium back to the soil (MSU 2013). Chickens are an animal that are brought into the neighborhood purposely, but other animals are finding their way into the neighborhood and using it as a home.

The large numbers of species that have been planted have led to an increase in wildlife in the neighborhood. The number of birds now living in or using the area has noticeably increased according to residents. A woman named Maria, who has lived in the Dunbar/Spring neighborhood since 1966, spoke about a time where so many areas were lacking trees and

vegetation, there was an odd quietness in the air. She now believes that, thanks to the plantings, the birds have returned, and their songs are abundant (Dunbar/Spring Neighborhood Foresters 2021). Tucson is in a flight path for many migrating birds and the neighborhood foresters web page specifically mentions the Wilson's Warbler and how important the Velvet mesquite are to their journey. The Wilson's Warbler can gain 10 to 20 percent of their body weight in a couple of days of feeding in Velvet mesquite trees (Dunbar/Spring Neighborhood Foresters 2021). Many native bird species have made homes in the neighborhood plants and have helped pollinate them. In addition to the birds, other pollinators that have moved into the neighborhood are bees. Black carpenter bees and solitary bees are just two of the many bee species that help pollinate the native Sonoran plants. Residents have helped bees thrive by creating window hangings for them to live in and use. During rainstorms, toads such as the Spadefoot toad come out from underground and have been seen hanging out in the sideroad water basins (Dunbar/Spring Neighborhood Foresters 2021). The more vegetation that is planted in this food forest and the continuation of vegetation into surrounding neighborhoods and urban settings will lead to higher amounts of wildlife being seen and enjoyed.

Not only do these plants give food, wildlife habitat, and bring back memories, they also sequester and store carbon. As mentioned in the earlier literature review, plants can sequester and store significant amounts of carbon. Plants that are usually thought of when sequestering carbon are those with tons of leaves and big canopies to help the respiration process work faster. As cacti are a main component of the Sonoran Desert they can be planted and used to sequester carbon as much as other forest types, depending on the health of the soil (León-González 2018).

Watering the Food Forest

To maintain a successful food forest, there must be a reliable water source, especially in the desert. To help solve this, Lancaster has created many ways to "Harvest the Rain". This phrase, often used by Lancaster, has led to the neighborhood homes and rights-of-way hosting many different techniques for collecting rainwater. These techniques include water basins, curb cuts, and holes and water tanks (Lancaster 2019).

Infiltration basins are dug into the ground near the road and are usually five to eight feet long by five feet wide by one foot deep (Dunbar/Spring Neighborhood Foresters 2021). These basins collect rainfall off the road using curb cuts or curb holes. The water from the street collects in the basins and slowly seeps into the ground and evaporates helping to recharge the groundwater or be absorbed by surrounding plants. This collection of rainwater decreases the need for using and paying for city water to keep plants alive. With the yearly average rainfall in Tucson dropping due to rising temperatures, it is imperative to use and store as much natural rainfall and help replenish groundwater to ensure we do not overuse desert resources. The total rainfall for 2020 was 4.17 inches, which is much lower than Tucson's average rainfall of 11.15 inches (NOAA 2020, Western Regional Climate Center 2021). At 11.15 inches of rainfall annually, a single water basin can collect up to 4,500 gallons of stormwater (Dunbar/Spring Neighborhood Foresters 2021). With the number of basins within the neighborhood, over one million gallons of rainfall can be collected every year (Dunbar/ Spring Neighborhood Forest 2021). A water resource that is overlooked is the recycling of greywater from homes. The water from sinks, showers and washers can be redirected to either holding tanks for future use or to water basins for direct soil consumption.

Figure 8. This image above shows a water basin that is lined with rocks placed directly off the road. Photo by Anastacia Lopez

Figures 9 and 10. Figure 9 (left) shows a curb cut lines with stone to help the flow of water from the street to the water basin. Figure 10 (right) shows how water drains down the road and into a water basin. Figure 9 taken by Anastacia Lopez and Figure 10 from harvestingrainwater.com

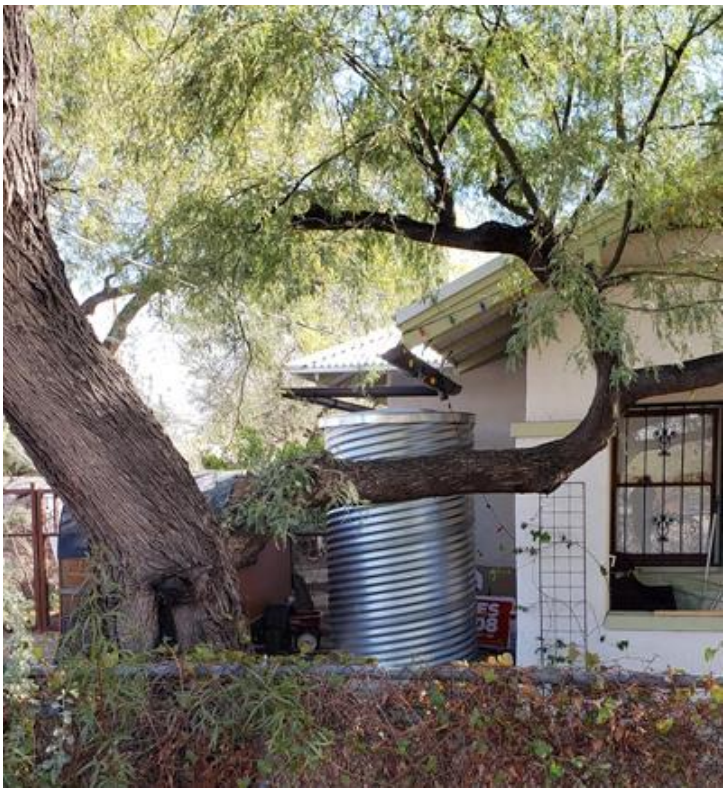

Figure 11. The image above shows a water tank outside a home to collect rainwater for future use. Photo by Anastacia Lopez

How is the Dunbar/Spring Food Forest Benefiting the Community?

Although the Dunbar/Spring neighborhood is not considered an urban park, it does have many of the same features that parks do and gives people a sense of mental restoration.

One of the biggest benefits the Dunbar/Spring food forest provides to the community is food. For now, the plants growing are not able to fully sustain a household, but they still provide some sustenance and add variety to foods. Homeowners can continue these practices in their own yards and add non-native food-producing plants if they want to create a food forest to bring them closer to fully sustaining themselves and those around them.

Large trees in the neighborhood can grow upwards to 15-20 feet with a canopy spread just as large. The shade significantly lowers the temperature and protects walkways and

understory vegetation from direct sunlight. Even with the understory plants being native to Tucson, the extreme summer heat can still cause damage, especially in years that experience low precipitation. Cooler temperatures allow for residents to walk the neighborhood, care for plants, and, in the right seasons, take time to harvest what the plants have to offer without suffering extensively from the Tucson heat.

The Dunbar/Spring neighborhood is located close to downtown Tucson and 4th Avenue, two very densely populated areas full of tourism and events. With populated areas comes higher amounts of pollution, especially with the number of cars that are in the Dunbar/Spring downtown area. As mentioned in the literature review, plants can be great sources of clean air and carbon storage and this could be vital to helping improve environmental conditions in downtown Tucson. Vegetation can be most impactful for air pollution cleanup when planted near the source of the pollution. Plantings are taking place in traffic circles and chicanes to have vegetation as close to the roads as possible. This can help clean the air quicker while providing more aesthetics to the community rather than just concrete pads.

Just like parks, Dunbar/Spring has trees and vegetation, wildlife, art pieces, and even some places for social gathering, such as the community garden and park. When talking with Brad Lancaster, he made it very clear that the food forest has brought the community together in multiple different ways. I will talk more about how the community has benefited and come together in the next section of this chapter.

Community

This food forest has grown and is an amazing example for other neighborhoods of how residents and members of the surrounding community members can come together for a common cause. Most of the work in the neighborhood has been done by residents giving their time to

volunteer with plantings and maintenance. The bulletin board in Figure 12 is just one example of how the neighborhood keeps its residents in the know and helps tourists understand, and potentially participate in, what the food forest is and activities in the neighborhood. The bulletin board has multiple maps showing the ways the watersheds work within the neighborhood, before-and-after pictures of the neighborhood food forest, benefits of the food forest, and information regarding the art installations in the neighborhood.

Figure 12. The image above shows the community bulletin board, a great way to spread information to the neighborhood and also to introduce tourists to the area. Photo by Anastacia Lopez.

The Dunbar/Spring neighborhood also has a community garden to help teach gardening and sustainable food growing. The IDEA School, a K-8 down the street from the garden, uses the garden as an opportunity to teach young children the importance of and tools needed to grow their own food. The hope is that the students will take what they learn back home to their

families and start a more sustainable household as well as create a space for the community to bond and come together to create something beautiful. The garden, shown in Figure 13, not only grows various fruits and vegetables but also composts clippings and other plant material so that it can be reused in the garden later. There are also picnic tables and ramadas in the garden area to give residents and the school a space to recreate or teach. A community bulletin board at the garden hosts guides to the best planting time in Tucson as well as some reminders on what it means to be part of a community and how to continue its growth. These boards, whether the main one of the neighborhood or one at the garden, can be great ways for residents to communicate with each other about events and help bolster attendance. Specifically for this neighborhood, it is an important way to spread awareness of plantings and workshops.

Figure 13. The figure above shows the Dunbar/Spring Community garden. Photo was taken in the winter when the garden was in the off season. Photo by Anastacia Lopez.

The latest additions to the food forest are the multilingual plant identification signs. In partnership with the University of Arizona Campus Arboretum, 10 small plaques have been

placed beneath some of the most abundant vegetation. The plaques contain the plant name in 4 languages as well as a QR code that leads to more information about the plant (Dunbar/Spring Neighborhood Foresters 2021). These languages include English, Latin (scientific name), Spanish, and O'odham. These plaques created a faster and easier way for residents and tourists to become more educated while exploring the Dunbar/Spring neighborhood. If these signs are used often, the arboretum and the neighborhood will try to add more plaques throughout the popular places of the community. This work with the University of Arizona could lead to greater opportunities of collaboration in the future.

Figure 14. This is a photo of the educational plaques that have been installed in the neighborhood. Figure 14 from Dunbar/SpringNeighborhoodForesters.org.

The neighborhood has seen a boost in community involvement and social gatherings as a result of the food forest. Living in a place like Tucson, AZ means sweating almost every time you are outside and wearing sunblock everywhere you go. Unfortunately, it also means that most

residents spend their time indoors trying to keep cool. Residents of the Dunbar/Spring Neighborhood still may find themselves staying out of the Tucson heat, but the food forest has made spending time outdoors more manageable. The amount of canopy cover given to walking paths has improved conditions for walking, biking, and plant harvesting. When I spent time in the neighborhood the number of people recreating was much higher than I have ever seen in my own neighborhood in Tucson. Knowing that residents are becoming much closer and are willing to take part in activities, tables and chairs like those in Figure 15 have been installed so that those who want can be social and play a good game of chess. Other community activities include two "take a book, leave a book" libraries, art installations and events such as porch fest and mesquite millings. Residents get together to harvest plants and process them to eat. Events like this really show the progress made in the neighborhood both biophysically and socially.

Figure 15: The image above shows the art, plantings, and community involvement all in one picture. Photo by Anastacia Lopez.

Chapter 4: Implications

How Can Other Neighborhoods Implement These Techniques?

These practices could bring benefits to many communities all over the world but how can these benefits be achieved? With climate change causing drastic changes to the way we can farm and collect resources in masses, it is time that the public take matters into their own hands and do what they can to create a more sustainable future. As seen in the Dunbar/Spring neighborhood, all it takes is one very passionate person to make a difference. According to Lancaster, some of the most important pieces to implementation are ensuring the planning stages are as efficient as possible, ensuring plans allow for different aesthetics, and creating an example that can be shown to others. Planning a proper food forest takes a lot of time to perfect and to get others on board you must be confident in your work. The Dunbar/Spring food forest is a great example of community cohesion that expands beyond this neighborhood to others. Following in their footsteps can be a great starting point.

If anyone is interested in embarking on this food forest journey, the Dunbar/Spring Neighborhood Foresters have a very detailed and eye-opening website. On this website there are sources for how to implement projects, ways to bring a community together, and resources for Sonoran Desert specific needs. This community knows how important these food forests can be and because of this, they have opened their logo, goals, aims, and materials to be used by anyone for free. They hope that if they give anyone a head start, together we can make the world a greener place. The website is https://dunbarspringneighborhoodforesters.org/be-a-neighborhood-forester/. Another great resource for helping conserve water and other resources is Brad Lancaster's site harvestingrainwater.com. This is a website with resources needed for harvesting rainwater, wind, snow, sun, and shade. He uses examples and experiences from his life to show

others what is possible. Finding people like Brad Lancaster in other communities can be a great place to start and to ask questions. Implementing food forestry and other techniques into a neighborhood can be much easier when others are on board and having a support circle of others interested will make progress happen faster.

One option that could be expanded on is building residential communities with these practices as part of the planning stages. With housing developments on the rise, and similar styled homes being built as close together as possible so that the developers and homeowner associations (HOAs) can make as much money as possible, there may be less of a priority for the well-being of the residents and the local environment. New developments could be built with water basins and curb cuts already implemented bringing a different kind of value to the properties. If developers are willing to implement these practices, they need to bring someone knowledgeable on board to ensure that the practices and techniques are being built and used correctly. Using this sort of auditing can help prevent developers and contractors from cutting corners and building incorrectly, allowing for correct harvesting and energy savings that the homeowners were promised. This implementation could be good for the housing developers because they can advertise and sell the homes as more eco-friendly. People who are willing to buy in a neighborhood with these ideas in place are more likely to be more eco-friendly and will take the time to do the upkeep and add additional conservation techniques to their homes, especially if resources are available.

Future Research

No data collection took place during this case study but there are plenty of opportunities to be explored. Future research could include quantifying the amount of water being conserved, quantifying the amount of carbon being sequestered, quantifying the amount of energy that has

been saved, creating a full plant inventory, and comparing housing values before and after the establishment of the food forest. These data could lead to concrete research on how food forests can benefit residents and help make food forests more attractive to neighborhood developers and neighborhoods that are lacking vegetation.

When looking through old photos or satellite images there is clear evidence that progress of the food forest has been made. Because there has not been any documented quantitative evidence of progress made such as biomass planted, pounds of produce grown, or exact gallons of water conserved, that is an area that I would love to see myself or others take the time to complete.

Conclusions

This paper focused on introducing urban food forestry, and the Dunbar/Spring neighborhood food forest. I explained techniques used in the neighborhood and what benefits the food forest can and has brought to the Dunbar/Spring Neighborhood. Food forests and especially those in the urban setting can bring great solutions during the climate crisis. Growing foods can help fight hunger in urban areas while increase public health through cleaner air and access to fruits and vegetables. Information to start a food forest are out there and finding people who have the want and passion to do so is the first step to implementing this food bearing forests to more places around the world.

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