

**LAND MANAGER DECISION-MAKING PRACTICES WHEN
ESTABLISHING PUBLIC FRUIT-BEARING PLANTS IN HENNEPIN COUNTY
MUNICIPALITIES, MINNESOTA**

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Abstract

Increasingly, public land managers face decisions about using fruit-bearing plants (including fruiting trees, shrubs, and vines) on public lands. While public trees provide many positive ecological, economic, and community health benefits, fruit-bearing perennial plants provide similar benefits and more. Expanded benefits include enhanced pollinator habitat, increased food access, unique educational opportunities, and ways for residents to interact more deeply with public vegetation. Despite the many potential positive influences of fruit-bearing perennial plants, their use and incorporation into public spaces vary among cities, resulting in an uneven and often inequitable distribution of public services. This study aims to better understand public land managers' decision-making processes by exploring what factors are considered when deciding to plant, or not plant, fruit-bearing perennial vegetation. Specifically, interviewees (n = 12) described what they perceive as the most significant benefits and barriers to establishing fruit-bearing plants in public spaces. Respondents reported using fruit-bearing plants to augment species diversity, community engagement, wildlife habitat, and public education. Barriers cited included limited time and financial resources to manage fruit-bearing plants, lack of specialized training, fears associated with liability, limited public awareness, and competing urban forestry goals. This study contributes to the literature on public land manager decision-making which has not previously focused specifically on fruit-bearing plants. The findings inform vegetation decision-making and urban natural resource planning by outlining key risks and rewards of adopting fruit-bearing plants.

Keywords: fruit-bearing plants, public land managers, vegetation decision-making, perceptions, non-timber forest products, urban forestry

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Preface

Once commonplace across the U.S., fruit-bearing plants are now experiencing a re-emergence within public urban green spaces in recent years. At the same time, research within urban forestry is increasingly using qualitative and mixed methods approaches to complement research on the ecosystem services trees provide by expanding our understanding of their social provisions. In parallel with research, public land managers consider a growing number of ecological and social factors when making decisions on public vegetation.

This thesis fills a gap by exploring land manager decisions related specifically to public fruit-bearing plants, building on previous research related to public land managers' decision-making practices. Specifically, this study explores the perceived benefits and barriers of public fruit-bearing plants, perceived tradeoffs to their adoption, as well as how public land managers consider **public input** when making vegetation decisions.

My personal experience implementing edible landscapes in public spaces within the nonprofit sector has helped me recognize the critical role public land managers play in determining how public green spaces are used and inspired my interest in this research topic. In addition to fulfilling requirements for my degree in Natural Resources Science and Management, this thesis has allowed me to build on my professional experience, hone my skills as a social science researcher, and contribute to the field of urban forestry in new ways.

1. Introduction & Literature Review

Urban green spaces serve many ecological, recreational, and aesthetic functions. Public land managers manage these spaces and make complex decisions related to public vegetation such as which variety of tree to plant in a specific location. The decisions of public land managers have significant ecological and human health consequences for the diverse users of public green spaces. Since public land managers act as gatekeepers for the potential benefits accessed through the diverse varieties of urban vegetation types, it is important to examine their decision-making process. A recent systematic review and synthesis of public land managers' perspectives in the U.S. and internationally found that budget and personnel for maintenance were some of the most commonly cited factors for vegetation decision-makers (Ordóñez et al., 2019). Additionally, recent studies on public land manager perceptions examined decisions related to implementing multiple types of vegetation, including turfgrasses in the Northern United States (Barnes, 2018, 2020), municipal trees in Los Angeles (Pincetl, 2010), and flowering bee lawns in the Minneapolis-St. Paul metropolitan area (Ramer, 2020). In general, these studies highlight the complex social and ecological tensions land managers face when making decisions that impact multiple public stakeholder groups. The studies found that some factors, such as maintenance, are likely to be a significant concern for public land managers across all public vegetation types. However, little is known specifically about what informs decisions around public fruit-bearing plants.

Traditionally, research on public tree benefits focused on the ecosystem services supported by primarily biophysical quantitative analysis. This research helped justify investments in the urban forest by highlighting important contributions of trees such as improving air quality (Akbari et al., 2001; Nowak, 2014), mitigating the impacts of stormwater (Scharenbroch et al., 2015), and reducing greenhouse gases (McPherson and Simpson, 1999). Complementing this literature on ecosystem services is a growing body of literature on the social provisions related to public trees. Often a qualitative approach, this work further expanded justifications for investing in urban forestry, with some arguing that “failing to consider the public-health benefits of urban trees will likely result in an inefficiently low level of investment in urban forestry” (Donovan, 2017). Proximity to trees has been correlated with improved mental (Kaplan, 1993) and physical health

(Donovan et al., 2013), increased social cohesion (Kuo et al., 1998), as well as economic benefits such as increased property values (Sander et al., 2010), decreased residential cooling costs (Simpson and McPherson, 1996), and even increased sales for local businesses (Wolf, 2005). While trees provide many services, there are also notable disservices, including nutrient runoff, production of allergens, hazards to property and life when they fall, and possible constraints on mobility or local economies (Janke et al., 2017; Cariñanos et al., 2019; Lyytimäki et al., 2008).

Fruit-bearing perennial plants (such as fruiting trees, shrubs, and vines) are somewhat unique in their ability to provide both ecological and social provisions (see Fig. 1). Also, exclusive to fruiting plants, they provide increased habitat for pollinators, food production, and possibly increased food security for residents (Clark and Nicholas, 2013). The literature on fruit-bearing trees in urban landscapes cites benefits such as expanded opportunities for education, recreation, connecting to nature, increasing wildlife habitat (Park and Kramer, 2019), and preserving cultural practices and identities (Wehi, 2009). Fruit and nut-bearing plants make up a significant number of the native plant species recommended by the National Wildlife Federation due to their ability to support butterflies and moths (NWF, 2020). McLain et al. (2012) argue that fruit-bearing plants may be a means to “bridge agriculture and forestry policy arenas” while also providing expanded opportunities for interacting with public spaces. Their study demonstrated that community members of many sociocultural backgrounds are interested in gathering fruits and tree nuts for diverse reasons. The increased opportunities to interact with public vegetation through harvesting activities may increase place attachment (the connection between residents and their environments). Public fruit orchards, which go beyond planting individual trees, may be correlated to an increased sense of community belonging and the creation of social connections (Clayton, 2007; Riolo, 2019) and may potentially provide spaces “where children can connect emotionally and cognitively to other organisms” (Askerlund, 2016). Place attachment can positively contribute to pro-environmental stewardship efforts (Carrus et al., 2014), ultimately building cities’ capacity to maintain their urban forests better. The many ecosystem and social provisions fruit-bearing plants provide may explain the reemergence of their use in public spaces demonstrated through recent efforts such as the

“Community Food Forests” mapping project in the United States (Bukowski, 2020) the United States.

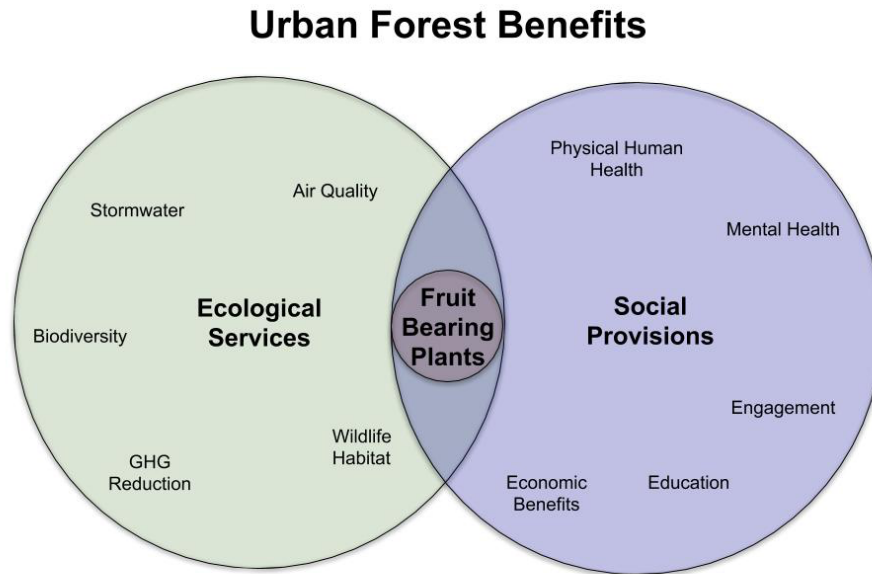


Fig. 1. Urban Forest Benefits. (Adapted from Shams & Barker 2019)

Urban forest benefits can be categorized as ecosystem services and social provisions—overlapping categories. For example, services such as improved air quality and GHG reduction have direct and indirect benefits for human health. Fruit-bearing plants provide both ecosystem and social provisions, including benefits unique to fruiting plants such as producing food and supporting pollinators.

However, despite a reemergence in popularity among the public, some public land managers (vegetation decision-makers) remain resistant to the use of fruit-bearing plants. A few factors may influence this hesitation, including increased liability risks from attracting dangerous pests or slipping on fallen fruit (Barker, 1986), additional maintenance requirements (Hopkins, 2015), and fears that the harvest will not be shared equitably (Colinas et al., 2018). Also, resident opinion influences land manager choices. Urban households in California saw fruit as potential “litter” and consider fruit trees problematic (Barker, 1986). Despite evidence that consuming fruit from public plants does not pose significant risks to human health, concerns about public safety related to consuming fruits grown in urban settings due to the potential of pollutants and heavy metals such as lead remain a barrier (Pauline von Hoffen et al., 2013; Antisari et al., 2015). While there are many valid concerns related to the introduction of fruit-bearing

plants, the presence of fear-based decision making (rather than decisions based on potential benefits to residents) among public land managers highlights their unique role as gatekeepers in urban forests.

Resident perceptions towards fruit-bearing plants influence municipal decisions, especially among those looking to serve community interests best. The USDA publication *Gathering in the City: An Annotated Bibliography and Review of the Literature About Human-Plant Interactions in Urban Ecosystems* notes that “householder views on fruit, however, are ambivalent” (McLain et al., 2012, pg.89). However, the few studies that exist suggest that attitudes vary greatly among cultural groups. Fraser and Kenney (2000) found that households in Italian and Portuguese neighborhoods of Toronto held a strong preference for fruit trees over shade trees while households of British descent preferred shade trees over fruit trees. While public perceptions may vary greatly across geographies, it is important to understand if and how decision-makers consider public input when making vegetation selection and planting decisions regarding these plants.

Public land managers vary in when and how they adopt innovations, in this case, new vegetation types. In *Diffusion of Innovations*, Rogers (2003) proposes a broad framework for categorizing the phases of adoption of new technologies that can be more narrowly applied to the adoption of vegetation types within cities to further explore the decision-making process of land managers. Despite the many potential positive impacts of fruit-bearing perennial plants, their use and incorporation into public lands varies between cities and sometimes even between neighborhoods within a city. These variations result in an uneven and inequitable distribution of the public services that fruit-bearing plants provide. Nesbitt et al. (2018) argue that benefits such as ecosystem services and other provisions “should be subject to equity analyses to determine the fairness of such interactions” and they propose an equity analysis framework that includes investigating resident involvement in decision-making. In addition to weighing the risks and opportunities of public fruit-bearing perennials, this study contributes to our understanding of how residents inform land manager decisions.

The purpose of this study is to explore the decision-making practices used by public land managers related to the use of fruit-bearing perennial plants. I

conducted a series of interviews with municipally employed land managers in Hennepin County, Minnesota and I explored their decision-making role in selecting public vegetation and their perceptions of the benefits and barriers to incorporating fruit-bearing perennial plants.

The research questions guiding this study are:

1. What factors do public land managers consider when deciding to plant (or not plant) fruit-bearing perennials?
2. What do public land managers see as the most significant benefits and barriers, if any, of publicly accessible fruit-bearing plants?
3. How do public land managers consider public input as they make vegetation decisions?
4. How do the tradeoffs of perceived benefits and barriers inform adoption across public land managers?

2. Methods

Public land managers were selected as the target interviewees for this study. The definition for public land manager used in this study included anyone with some decision-making authority to make municipal vegetation decisions for urban green spaces such as parks, sports and recreation areas, or playgrounds. Considering this broad definition, participants varied in terms of the amount of authority they held in their respective municipal organizational structures.

2.1 Study area

Hennepin County, Minnesota was selected as the study area because of its range of municipal population sizes within a similar county and state structure and ecologically homogenous geographic area to make comparisons between cities while limiting the variance of governance units and ecological factors in determining responses. In many municipalities, one person is ultimately responsible for making most vegetation decisions for the entire community. In Hennepin County, approximately 45 individuals make

decisions for 1,278,869 residents (2019 U.S. Census Population and Housing Unit estimates).

2.2 Interview recruitment & procedure

I employed a qualitative research approach to explore the decision-making practices used by public land managers regarding the use of publicly accessible fruit-bearing plants. I conducted one-on-one, semi-structured interviews with participants to collect their opinions, experiences, and perspectives.

A participants list, consisting of 45 potential participants representing each city in the county, was obtained from the Hennepin County forestry department. Participants met the following criteria: (1) employed by a city or park and recreation board in Hennepin County, Minnesota, and (2) in a decision-making role related to selecting vegetation used in public green spaces. An initial open invitation was provided to all individuals on the participant list, via email, in July 2020. The second and third rounds of invitations were sent out in August and September 2020 by email and phone. Ultimately, 12 individuals agreed to participate, 11 declined, and 22 did not respond. All 12 participants in this study represented municipalities with a greater than the median population size in Hennepin county (see Fig. 2 and Table 1). Only 2 participants represented municipalities with less than average (mean) population size in the county.

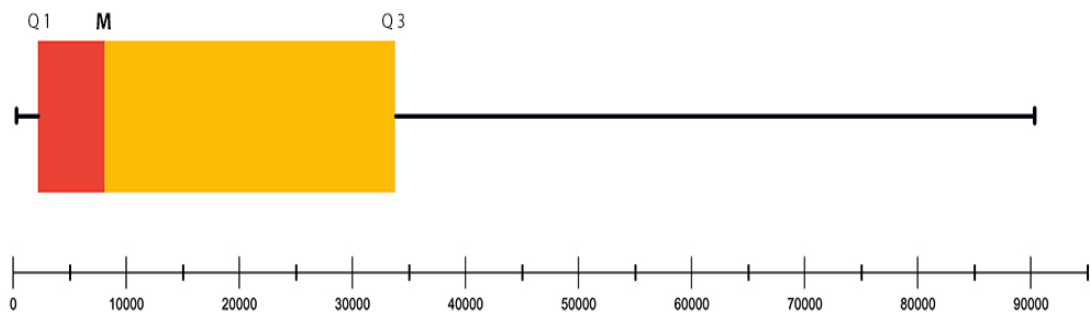


Fig. 2. Populations of all Hennepin County Municipalities (excluding Minneapolis). “M” denotes the median population size (8,108).

Table 1. Populations of Hennepin County Municipalities

Number of Municipalities *	44
Min Population	398

Median Population*	8,108
Average (Mean) Population*	20,869
Max Population*	90,271

*Does not include outlier Minneapolis (population 435,885)

The interviews followed an interview guide consisting of 9 open-end questions with additional follow-up probes (See Table 2, Appendix A). Interview questions were developed based on the study's research questions. A pilot study was conducted, which included interviews with county-level employees and staff of local non-profit agencies, to refine the interview questions used. The interview guide was subject to peer debriefing and refined through pilot interviews to assess each question's value.

Table 2. Interview Questions.

1. To start, please tell me about your role with [insert employer (city/park board)]?
2. What does the planning process look like when you design or redesign the vegetation for a public space? Please provide a brief step by step overview.
3. Does [insert city/park board name] manage publicly accessible gardens, edible landscapes, or fruit-bearing plants (such as fruit trees, shrubs, or vines)?
 - a. If yes:
 - i. What is your assessment of the positive and negative aspects of this experience?
 - ii. Overall, has your experience been positive or negative?
 - b. If no:
 - i. Is that something [insert city/park] has considered?
4. What factors do/would you consider when/if deciding to plant fruit-bearing perennials?
 - a. What does the planning process look like when working with fruit-bearing perennial plants? Are there any ways it is different than when working with non-fruiting vegetation?
 - b. Which factors do you see as the most important?
 - c. Any other factors you'd like to mention?
5. What do you see as the most significant benefits, if any, of publicly accessible fruit-bearing plants?
 - a. Any others you'd like to mention?
6. (if benefits are mentioned) Do you believe that these benefits are shared or accessed equally between all residents?
 - a. If no, please explain which residents or groups of residents benefit the most.

- b. Which residents benefit the least? Are there particular neighborhoods or groups of residents?
7. What do you see as the most significant barriers or challenges, if any, to having publicly accessible fruit-bearing plants?
 - a. Any others you'd like to mention?
8. Are you aware of any city (county) ordinances or policies in your city (county) related to fruit-bearing plants? If so, please describe them.
 - a. Can you direct me to them in the city ordinances or programs?
9. Do you believe that residents have influenced the city's approach to using fruit-bearing plants? If so, how?
 - a. Have residents influenced the way you think about using fruit-bearing plants in public spaces? If so, how?
 - b. How would you describe the residents that are most interested in public fruit-bearing plants?

All interviews were conducted remotely via Zoom computer video conferencing to ensure participants' safety during the ongoing Covid-19 pandemic. This study posed minimal risks as all participants consisted exclusively of public employees who participated voluntarily. Full consent was granted by all participants with a consent form (see Appendix B), and anonymity of the data was also ensured through the de-identification of participant's names and titles. City names (the participants' employers) were redacted. Research records were kept in a secure, safe location where only I had access to them. Hand-written field notes were taken during the interview to capture the initial reflections from the interview conversations. Interviews were audio and video recorded using Zoom and I later transcribed manually.

2.3 Data analysis

An inductive analysis approach was applied to the aggregated data to analyze and identify emergent themes. Following Creswell (2013), I reviewed and manually coded the data, iteratively, to develop a set of codes or themes (see Fig. 3). The transcripts were organized and reviewed in NVIVO 1.3 software. Peer-debriefing, allowing a second qualified researcher to access and assess my transcripts, codes, and themes (Janesick, 2015), was used to reduce bias and ensure consistency. Initially, face-value descriptions of the text resulted in 52 open codes. Subsequent readings of the data were conducted to group (reduce) the open codes and identify axial codes related to the benefits of fruit-

bearing perennials as well as the barriers and challenges for publicly accessible fruit-bearing perennials (see Fig. 4). Grouped codes were reviewed and collapsed to identify six emergent themes (see Table 3). Anonymous quotes were extracted and highlighted in order to illustrate examples of these themes and key findings. The perceived benefits and barriers to incorporating fruit-bearing perennial plants provided insights into the values and opinions informing the decision-making process.

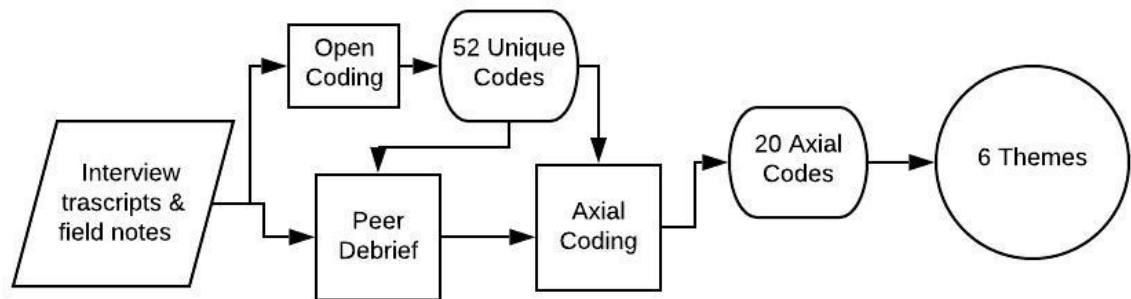


Fig. 3. Analysis process

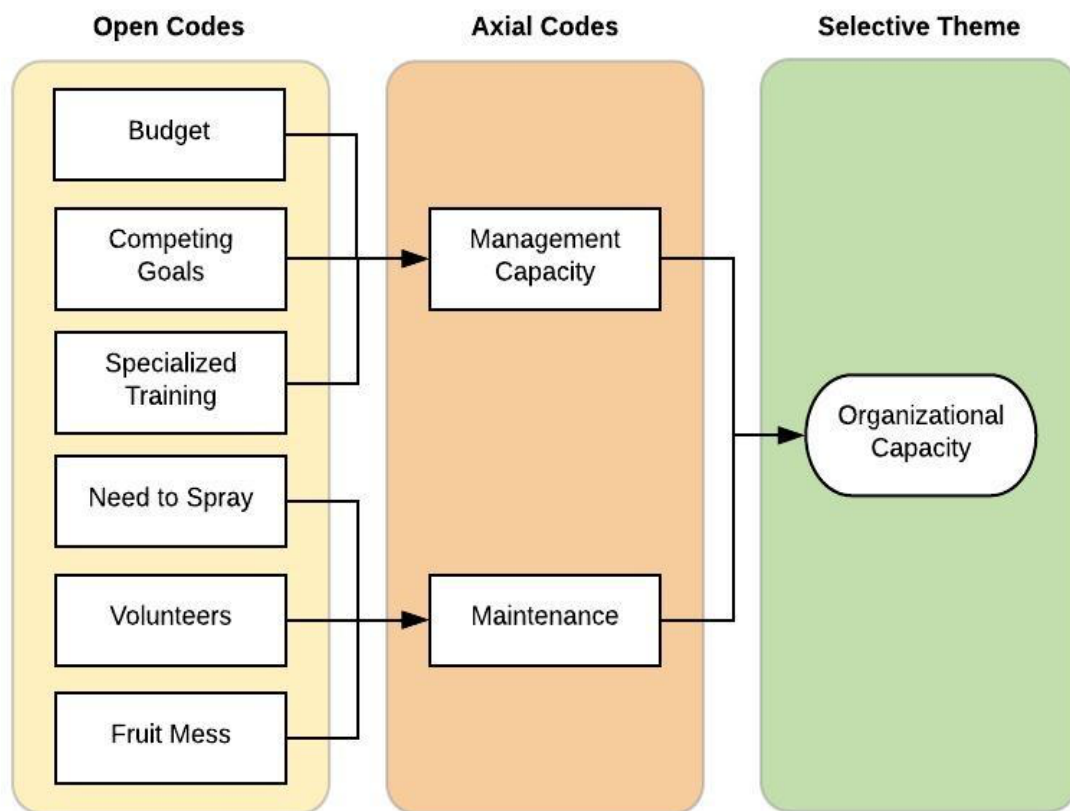
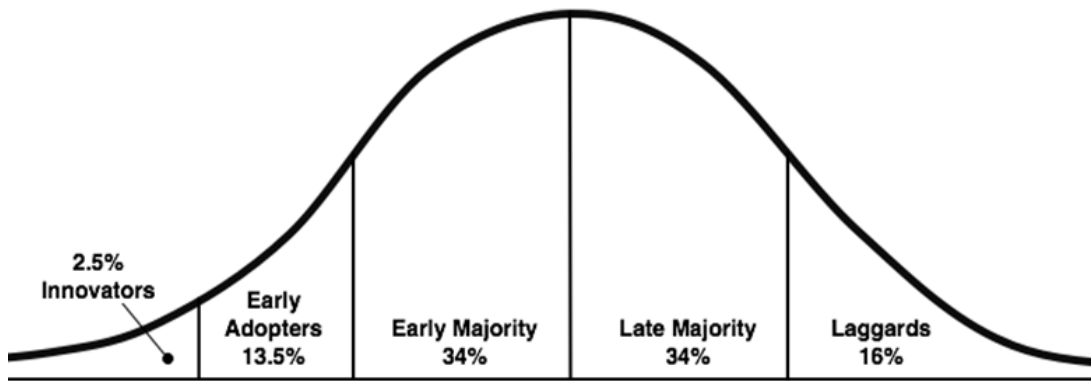


Fig. 4. Example of Code Grouping and the Emergence of Themes

Table 3. Theme/Code Definitions

Code/Theme	Definition	Benefit/Barrier
Organizational Capacity	The maximum workload (for tasks such as planning, implementation, maintenance, etc.) of a municipality due to staffing and budgetary constraints.	Barrier
Risk & Liability	Hesitations expressed by municipalities due to unknowns, fears of increased maintenance, and fears associated with being responsible for potential harm to residents.	Barrier
Awareness	A lack of knowledge, on behalf of the municipality and/or residents, of how to locate, harvest, or care for fruit-bearing plants. May lead to unrealistic expectations or reduced public demand.	Barrier
Ecosystem Services	The environmental benefits specific to fruit-bearing plants such as supporting pollinators and wildlife habitat.	Benefit
Education	Learning opportunities for residents due to the introduction of fruit-bearing plants.	Benefit
Community Engagement	Resident interest in, interactions with, and contributions to municipal parks and public green spaces.	Benefit

Adapting a framework from Rogers (2003), cities were categorized by their adoption category (innovativeness in each city’s use of fruit-bearing plants; see Fig. 5) to explore comparisons between groups. The phase of adoption categories, as outlined by Rogers, include *Innovators*, *Early Adopters*, *Early Majority*, *Late Majority*, and *Laggards* (see Table 4). Related to this study, interview transcripts were analyzed using five criteria for assigning adoption categories: (1) occurrence (does the city have publicly accessible fruit-bearing plants?), (2) duration (how long has the city used fruiting plants?), (3) extent (are fruiting plants integrated into their larger planting programs or are they limited to just smaller pilot projects?), (4) planning (does the city plan to incorporate more fruiting plants in the future?), and (5) programming and partnerships (does the city use fruiting plants in their educational and outreach programs and/or does the city have established partnerships with community groups to assist with maintenance and other challenges?).



Source: Everett M. Rogers; Diffusion of Innovations, 2003
 Fig. 5. Adopter Categories on Innovativeness

Table 4. Adopter Category Characteristics

Category	Ideal Type Characteristics*
Innovators	Venturesome; can cope with high degree of uncertainty; has resource and are able to absorb potential losses
Early Adopters	Respected by peers; help trigger a critical mass; decreases uncertainty about innovation
Early Majority	Deliberate; longer decision-making period
Late Majority	Skeptical; requires uncertainties to be addressed first; often requires pressure from peers to adopt changes
Laggards	Traditional; uses the past a point of reference; often resource scarce and most risk averse

Categories and Ideal Type Characteristics from Rogers (2003)

3. Results

Six prominent themes emerged related to which factors respondents consider when thinking about fruit-bearing plants during the vegetation decision-making process. These themes include perceived barriers such as (1) the *organizational capacity* of the municipality, (2) fears associated with perceived *risks* and potential *liabilities*, and (3) *public awareness*. Respondents also reported multiple perceived benefits such as using fruit-bearing plants (4) as a means of *providing ecosystem services* such as pollinator

benefits and increased species diversity in the urban forest, (5) to enhance public *educational opportunities*, and (6) to enhance *community engagement*.

3.1 Perceived Barriers to Establishing Public Fruit-bearing Plants

3.1.1 Organizational Capacity

All interview participants mentioned barriers related to organizational capacity and related to concerns around increased maintenance needs, staffing capacity, the need for added fruit-specific training, and budget. Maintenance, specifically the perceived limited capacity to manage fruit-bearing plants, emerged as the most significant factor considered during the decision-making process, with all respondents reporting this barrier.

Commenting on this, Participant 11¹ noted that "I think the biggest thing is just going to be maintenance. It's more weed whipping, more mulch, more watering." While maintenance is a common barrier across all types of public vegetation, some maintenance concerns are more specific to fruit-bearing plants that emerged through the interviews. For example, should fruit go unharvested, there is an annual mess noted through comments such as "the fruit later in the fall that doesn't get picked up just becomes a mess" (P10) and "we want to keep them away from boulevards because of the potential mess" (P4).

In addition to managing fruit harvesting or addressing messes from fallen fruit, participants also commented on the added management tasks of pruning and fruit disease control, noting that "It would likely require additional staff time and training" (P1). Many perceived fruit-bearing plants require unique management skills and specialized training for staff that would be too narrow in scope and possibly not worth the investment. Commenting on specialized pruning skills related to fruiting plants, Participant 11 said,

"I think one of the challenges would be the expertise. Just knowing how to prune the trees because you're not just looking for an open grown tree. You really want to prune [fruit] trees so that the product (fruit) will be maximized."

¹ The term "Participant" is used here to represent the public land managers who volunteered to participate in an interview for this study. "Participant" is abbreviated as "P" (e.g. P1, P12) throughout the study.

The introduction of fruit-bearing plants was also seen as requiring additional pesticides use. With remarks such as, “we have certified pesticide applicators working for us that are mainly trained in turf maintenance and pests. They're not really trained for fruit trees” and “...you need to spray them. That's another red flag for some of our users of the parks”, Participant 9 highlights concerns of over additional input costs, increased training, and staff time for managing fruiting trees on top of fears that pesticides can be a very divisive topic for residents.

Many decision-makers reported that they are trying not to create too much work for their already overtaxed maintenance crew employees. For some, the perceived need to spray, prune, and generally care for fruit-bearing plants was seen as doing just that, noting

“a lot of cities are already short staffed. If you're telling somebody who lays asphalt down and patches potholes to go trim these trees, you're probably not going to get the best results. So you want to have some level of expertise and people that are willing to assist with it...I think anybody who's just going to start planting apple trees and just hope everything goes well, it's going to be kind of a tough, tough road” (P11).

Community volunteers to maintain trees was proposed as an alternative to increased staffing. However, recruiting and training volunteers was also viewed as a barrier by some. Participants mentioned the importance of fostering a vested interest in the public plants, amongst residents, as a way to address this barrier, noting that “we probably could have more [fruit-bearing plants] if we have more of a neighborhood commitment to helping” (P4).

Competing priorities, interests, and goals emerged as barriers related to organizational capacity. Participant 1 mentioned, “...competing with others interested in park space. Either recreations, or sports, or other natural areas.” as well as competing goals, such as increasing canopy coverage. Participants acknowledged that fruit-bearing trees require more frequent attention than shade trees yet provide limited contributions to city canopy goals. For some, canopy coverage is perceived as the primary metric on

which their success is based. This issue was especially true for cities focused primarily on boulevard plantings. Participant 4 noted,

“When I talk to people, I tell them there's nothing wrong with fruit trees as long as they realize they take more maintenance, they don't live as long, and they don't really give as much canopy. So, they have their place, but our whole idea with boulevards is trying to get as much canopy as the space will allow.”

Participants expressed comfort and familiarity with shade trees which may be partially attributed to canopy coverage's quantifiable nature as a metric for success. In contrast, it is more difficult to quantify the benefits of fruit-bearing trees.

Participant 6 commented on this by saying “we know that when we have a play field, it's being filled with exactly what we needed: kids are using it, ball fields are being used, and hockey rinks are full. But how do you quantify a fruit orchard in a park? How do you know?”

Organizational budget constraints emerged as a broad barrier to establishing fruit-bearing plants. Many participants cited the recent financial hardships caused by the rise of Emerald Ash Borer (EAB) in their municipalities. Their already tight budgets were compounded by the pressing need to respond to EAB. As two participants pointed out, “It's pretty challenging with all the other things to do and emerald ash borer at our heels” (P9) and “I got my hands full with EAB. I think I'm in over my head because I'm the only person” (P10). Pilot projects such as establishing fruiting plants was not feasible while also confronting EAB. While study participants were in decision making roles, these budgetary challenges added to the difficulty of convincing supervisors about the benefits of fruit-bearing plants, exemplified with remarks such as “if I can get them on board with it, we could start planting fruit-bearing trees next year, two years from now, maybe” (P10).

3.1.2 Fear of Risk and Liability

Fears related to risk and liability emerged as a theme, with most respondents reporting a lack of experience or unfamiliarity with fruit-bearing plants increased risks. Fruit-bearing plants were perceived as an increased liability as well as potentially introducing unforeseen maintenance costs. Fear of the unknown emerged with comments such as “I just don't want ideas and initiatives to not be successful because we don't know what we don't know or because we haven't prepared to have it be part of our system” (P1).

Liability concerns related to fruit drop were frequently mentioned. In addition to adding to mess and maintenance concerns, unharvested fruit was perceived as attracting unwanted “pests” such as bees and wasps. For example, one participant asked, “is there going to be a ton of bees in this area? How many people are going to get stung? And what's the city's liability on that stuff?” (P2) and another said, “I guess you'd have the bees and the pollinators. If people are allergic to it, there's more risk” (P10).

Liability concerns related to fruit drop were often location specific. High traffic locations such as sidewalks and near boulevards were frequently mentioned and locations where youth regularly gather such as playgrounds and schools. While discussing potential locations for fruiting trees in parks, Participant 12 mentioned,

“my only concern at the elementary school is how close it is to the park. I could see at some point people getting worked up about the bees, potentially, on fallen fruit. That has not happened yet, so that might just be me thinking about it too much, and maybe it won't be an issue at all.”

Participant 6 also noted that “pollinators next to a playground probably aren't the best combination because now you're asking bees to be around kids.”

Many participants brought up fears of vandalism and the possibility of residents using fruit for unintended purposes. When asked about the possibility of introducing fruiting plants, Participant 11 replied, “I think in public parks, because we have vandalism, that it is going to be a challenge.” Adding to this, Participant 2 noted that “teenagers are going to come and pick them, and they're going to throw them at each

other. Or at least that's what we did when I was a kid.” Participant 5 also described the fallen fruit as an “attractive nuisance for throwing those things, from kids.” However, despite the concerns of vandalism or throwing fruit, municipalities that have established fruiting trees did not report this to be an ongoing concern. Participant 4 did recall concerns over fruit throwing raised when they first proposed planting fruiting trees. However, after many years of caring for them, they mentioned that “we've had no real complaints from somebody about fruit from trees being used as a weapon.”

A general fear of change was also mentioned:

“people don't like change. There's always going to be a component of people in the neighborhood who will not want whatever you are trying to sell them because it's new. They like how it is. They don't want it to change. That is always a barrier to get them on board and accept it because typically later on they will love it, it's just getting them past that point of change” (P6).

Participants expressed conflicting views when discussing their concerns related to the harvesting of fruit. Some participants expressed fears related to the possibility of residents overharvesting. Participant 5 extended the challenges they currently face with annual community gardens to fruiting perennials when commenting,

“we get a lot of people who walk in our community gardens, for example, that don't belong there and pick from random gardens, they just pick the fruit or the vegetables. And so, I think with a there's some education and the value of doing that with why would be planting a bunch of apple trees for example, in a little mini orchard or something of that sort. I think there's a lot of education you'd have to do to make it work.”

This statement highlights a possible association of fears related to a perceived loss of control with the introduction of fruiting perennials. Meanwhile, other participants viewed overharvesting quite differently, noting, “some of the questions or even concerns,

that were brought up were what if there is too much demand. What if people are taking too much? Our answer, if it happens, is that's a great problem to have and we would look to expand" (P1).

Lastly, some participants reported increased maintenance risks citing a fear that resident interest, and volunteer help, would wane over time. "It all sounds good at the beginning. Yeah, we're going to have this fruit available, but what if no one shows up?" Participant 6 remarked, "Who's going to pick up the fruit that didn't get harvested? The people who are there to harvest, they're only worried about the ones in the tree" acknowledging that once the fruit naturally falls, it would likely be the city's responsibility to clean up the mess.

3.1.3 Awareness

The awareness theme came up in a several forms. Participants cited awareness-related barriers such as the possibility of residents being unaware of which fruit-bearing plants are edible, city harvesting policies, when and where to harvest, what is involved in caring for and maintaining fruiting plants as well as how to provide input on plant decision-making.

Participants expressed worries that uneven public awareness of fruiting plants might lead to inequitable harvesting and fruit distribution. Participant 2 noted that "The other issue that we've run into is that of fairness, there's a worry that a couple people are going to come and pick all the fruit every year, and nobody else is going to get any." Some contributed this to a lack of awareness of what fruits are edible: "They don't know what they are and are just scared to eat them" (P3). Participant 11 suggested using new signage as a means to address these issues:

"I don't know eventually how much fruit this is going to produce. There might not be anybody there [to harvest], and we've kind of talked about how, down the road, we can get the neighbors to be putting up signs saying, 'help yourself' but we don't know how equitable the distribution of the fruit will be."

A plant's location was seen as influencing public awareness. Through comments such as, "If it's not a super visible location...how aware are folks of its existence" (P1), participants mentioned that if fruiting plants were not placed in highly visible and accessible locations, residents wouldn't be aware of the fruit, causing it to go unused and create an added mess. While participants appreciated fruiting perennials' ecological benefits, regardless of location, the location was seen as key to attaining the potential social provisions. Determining a good location for fruiting perennial plants was seen as a balancing act. Some decision-makers wanted the plants to be accessible and visible but not competing with other activities or causing undue burden on maintenance staff. Participant 12 outlined their decision-making process on this when commenting

"I always want to consider the worst-case scenario: nobody picks an apple or no one picks the fruit and they all fall, and is that going to be an issue? And If the answer is, well, the guys who mow might get a little bit annoyed with me, then I consider it a good spot, but if the answer is, well, people are going to be sitting here picnicking here or watching their kids play soccer then, probably not. I kind of try to balance that. Not in the middle of a high use recreation area, but somewhere kind of close enough that people will still know they're there. We don't want to hide them back in the woods somewhere either where no one's ever going to need them" (P12).

This response highlights the decision-makers' motivations to maximize the social provisions provided by fruiting perennials. While cities could receive all the ecological benefits, without any significant added maintenance, by hiding fruit trees, "back in the woods somewhere," there was some willingness to risk added maintenance in exchange for possible social provisions by placing fruiting plants in more publicly accessible spaces.

A lack of awareness of the unique maintenance challenges fruit-bearing plants can have was also brought up as a barrier. Participants mentioned that this could lead to

unrealistic expectations related to the inputs, the ongoing care needed, and the final product of harvestable fruit. Commenting on this, Participant 6 said,

“I see value in it (fruiting plants), but I also understand that there are some questions about how do you manage that and what are the inputs you're willing to do and who wants to do those? I think as more and more people become aware of those inputs [that might change]. I think people just see these apples sitting at the grocery store and they go, ‘well, that's what's going to be on our tree right?’ And I say, ‘well, not exactly. Unless you're willing to do this, this, and this, they're not going to look quite like that’” (P6).

Participants also reported a lack of public demand for fruiting perennial plants. Some contributed to this lack of demand to residents, possibly unaware that fruiting plants are an option or unaware that they, as a resident, can influence which plants are selected for public spaces. When asked, “do you believe residents have influenced the city’s approach to using fruit-bearing plants?”, half of the participants reported that no one is demanding it in their municipalities. The majority of participants that did report feeling that residents have influenced their approach to using fruit-bearing plants mentioned that pollinator-related benefits primarily drove demand. Very few participants reported that their residents were motivated by the potential for food production for human consumption.

Table 5: Barrier Themes

Themes	Codes	Sample Quotations
Organizational Capacity	Mess; Budget; Need to Spray; Management Capacity; Volunteers; Specialized Training; Competing Interests	"Somebody needs to take care of them and maybe spray them to get them going...so that never came to fruition." - P9 “Maintenance. Straight up Maintenance. It's just more.” - P10 “I gravitate more towards the trees that provide canopy coverage and shade vs. fruit.” - P8

Risk and Liability	Fear of unknown; Liability; Attracts Pests; Throwing Fruit; Aesthetics	<p>“Is there going to be a ton of bees in this area? How many people are going to get stung? And what's the city's liability on that stuff?” - P2</p> <p>“And then the other thing would be the Attractive nuisance for throwing those things from kids and dogs get into them and they get sick and various things like that” - P5</p> <p>“They don't know what they are and are just scared to eat them” - P3</p>
Awareness	Awareness; Equitable Harvest; Policy; Public Demand	<p>“Maybe it's not on their radar. I mean, if somebody were to bring it up to them it might take a front seat” - P10</p> <p>“People don't realize what's out there and what's available until sometimes, I feel like, I put something in the parks where it's visible to residents” - P3</p> <p>“I think it's just the awareness of where they are and what level of involvement people can have that they just don't know about” - P4</p>

3.2 Perceived Benefit to Establishing Public Fruit-bearing Plants

3.2.1 Ecosystem Services

In terms of the perceived benefits of publicly accessible fruit-bearing plants, most respondents cited augmented ecosystem services, educational opportunities, and opportunities for public engagements as factors in favor of planting fruit-bearing vegetation (See Table 6). Many participants saw the ecosystem services as outweighing other, more human-centric, benefits, noting “it's wildlife and ecosystem management, I think, and promotion more, than human consumption” (P5). The most commonly mentioned ecosystem services that fruiting perennial plants provide were supporting increased plant diversity, supporting wildlife and wildlife habitat, and supporting pollinators.

Table 6. Benefit Themes

Themes	Codes	Sample Quotations
Ecosystem Services	Biodiversity; Species diversification; Pollinators; Wildlife Habitat	<p>"It would add to diversity and pollinator benefits and things like that" - P2</p> <p>"It's wildlife and ecosystem management, I think, and promotion more than human consumption"- P5</p> <p>"I tend to focus more on diversification within a given boulevard or area versus just planting all the same for a pollination purpose" - P8</p>
Education	Education; Connection to Natural Environment	<p>"I think that's unique compared to more aesthetic only-type vegetation, I guess, to me there's also opportunity for education and programming" - P1</p> <p>"I think kind of just like education and showing them, you know, finding new cool things, showing them what you know what is out there and what's possible" - P3</p> <p>"They're very close to play areas and the elementary school does have a little garden nearby there as well. So it kind of ties in nicely with I think with their programming related to gardening and food sources" - P12</p>
Community Engagement	Public Engagement; Community; Connection to Natural Environment; Food Access; Access to green space	<p>"It was kind of community pride. It was kind of a catchy project that we thought also has the potential to fill in some uniqueness into some corners of our parks or larger right of ways" - P9</p> <p>"Partnerships, I would say, is the rewarding part of the [fruit] project, both the residents were really excited. I'd say the partnerships brought us a lot closer together to the County, [our local food shelf] and the residents" - P11</p> <p>"...the biggest benefit would be the ability to reconnect people with the natural environment and help them realize they are a part of that and that they should care" - P1</p>

Participants underscored the importance of increasing plant diversity in their decision-making. Participant 2 mentioned that they "...try to adhere as much as possible to biodiversity" and that they were motivated to plant fruit-bearing perennials as a means to "...add to diversity and pollinator benefits and things like that." Meanwhile, other

participants reflected that the diversity factors did not necessarily precipitate their decision to plant fruiting perennials. However, they appreciated the added benefits, noting that fruit-bearing plants “... just became a positive for part of what we were planting and it does add some diversity too” (P4).

Providing support for wildlife and wildlife habitat was seen as a strong motivating factor for planting fruit-bearing perennials. When asked about the benefits of fruit-bearing plants, participants mentioned that “obviously there's a lot of wildlife and ecosystems that are supported by those [plants] attracting wildlife into our parks” (P5) and noted that fruit-bearing plants “... can bring more diverse wildlife in for species that are attracted to feed on them...” (P7). Reflecting on their decision-making processes, some mentioned a preference for “...trees or genera that are used by multiple species...whether it be a pollinator or deer or any kind of animal” (P12).

Food produced from fruit-bearing plants was often perceived as being intended more for wildlife than for human consumption. For many participants, they are intentionally planting fruiting perennials for this purpose, noting “I think our fruits have been more for the wildlife value, not so much for human consumption...” (P6) and

“you know, like black chokeberry and a variety [of] things we do try to promote for wildlife and other smaller berry things not for human consumption necessarily. So we are actively putting out a lot of things and thinking consciously about wildlife food production” (P5).

Even for the few that reported planting fruiting perennials for human consumption, they recognized that, realistically, humans likely would not harvest all the fruit and they appreciated that the plants would also support wildlife. Participant 3 commented on this by saying, “whether or not I get any use out of the fruit there, I know the animals and stuff like that, like them, and that's a good enough reason for me to plant some of those too.” Wildlife was also seen as helping to reduce messiness due to fruit drop. This was especially true for plants that produce smaller fruits, with participants noting, “...my experience is that a lot of birds will eat that before they really become an

issue” (P8) and “I don't know [if] anybody actually goes and picks them or not, but I know the birds usually clean out the cherry trees that we have” (P2).

Supporting pollinators was frequently mentioned as an ecosystem service associated with fruiting perennials through comments such as “we're all aware of the bees and the pollinators, you know, it's something in support of that” (P9). Public demand for fruiting perennials was also attributed, in part, to their pollinator supporting benefits, with participants noting, “I think it's mostly through the pollinators. Pushing to improve pollinator habitat in the city has been a focus of the parks and Sustainability Commission, which are driven by residents. So I would say not necessarily for the sake of an urban food source, but more for pollinator habitat” (P12). Smaller fruits and native fruit-bearing perennials were many associated with providing ecosystem services, with Participant 5 saying, “we're trying to plant a lot of pollinator plants and the smaller fruit-bearing trees, and shrubs primarily, and trees like serviceberry (*Amelanchier*) and things of that sort as well to try to promote the wildlife aspect and that whole ecosystem approach using more of that native type of material.”

3.2.2 Education

Perceived benefits related to education were frequently brought up, with participants mentioning that fruit-bearing plants provide opportunities for new educational programming and public demonstration projects and help with resident learning related to the topic of food. For some participants, education was the primary benefit, noting that “The whole point, at least in my mind, is it's more of an education [and] outreach component than [our city] trying to produce enough fruit for every resident to equally have the same amount of fireside apples and stuff like that like” (P2).

Fruit-bearing plants were valued for their ability to provide opportunities for engaging educational programming. Participants mentioned they “...kind of allow for that natural explorative creativity” (P12) and are “...unique compared to more aesthetic only-type vegetation, to me there's also opportunity for education and programming” (P1). Food producing trees were also seen as another strategy to help residents understand their connection to, and the importance of natural systems, noting that

“the more you can include people in the equation of natural resources, and humans are a part of the natural environment, and the more we can work with the environment and expose people to nature and where their food comes from, the more people will care...” (P1).

Educational opportunities related to learning how food is grown and where it comes from were often specific to youth, noting that fruiting plants were often “very close to play areas and the elementary schools” and that they “...kind of tie in nicely with their programming related to gardening and food sources” (P12).

In addition to supporting youth learning, participants proposed using fruit-bearing plants as a means to provide new learning opportunities for homeowners by “potentially incorporating them into a demonstration garden” (P2) or public pilot projects. Participants suggested that such demonstration sites could help residents expand on what they thought was possible for growing in their yards, noting that demonstration sites could help with “education and finding new cool things, showing them what is out there and what's possible” (P3). Demonstration projects were also seen as providing examples and more realistic expectations related to growing one’s food. Participant 6 noted that

“I think that would be a great educational component to get people to understand that maybe you don't need every apple to be 100% perfect...does every apple have to look exactly the same? Can Some of them look a little deformed? Can they look a little different and still be edible? Yeah. But not from the supermarket they don't and that's what most people's idea is.”

Public demonstration projects were also seen fostering resident ownership, skill sharing, and resident-driven learning. Reflecting on a small orchard project the city had implemented, Participant 11 noted that residents organize “neighborhood seminars...like a group pruning of these trees” and expressed the importance of having “...somebody that's going to come in and show you initially how to take care of it” when first planting public fruiting perennials.

3.2.3 Community Engagement

Fruit-bearing plants were associated with community engagement through an increased resident interest in, interactions with, and contributions to municipal parks and public green spaces. When asked “what do you see as the most significant benefits, if any, of publicly accessible fruit-bearing plants,” participants highlighted engagement through responses such as “I would say just simply public outreach...and engaging people or reengaging people back into nature” (P2) and “I'd say it's mainly having people get another connection that involves them more” (P4).

The food produced by fruit-bearing perennials was often valued by participants more for its engagement benefits and ability to help residents “connect with nature” than for its direct nutritional benefits. Commenting on this, Participant 1 said that “...the biggest benefit would be the ability to reconnect people with the natural environment and help them realize they are a part of that and that they should care.” Others mentioned that they consider the passive engagement opportunities fruit-bearing plants provide residents when they are conducting their vegetation planning, noting that

“a lot of times when I'm planting fruit trees, I kind of picture a kid or family playing in an area and stumbling upon them and that kind of being like a fun activity or fun non-designated park use similar to just having a nice open space to play around in...I kind of see it as a way for people to connect to nature in more than just like It's just another way. I guess it's just another way for them to be motivated to go outside” (P12).

Also, fruit-bearing perennials were seen as attracting more residents to city parks, noting that “It could attract that clientele that might go out there consistently or more regularly. I mean, walk by the apple tree you go ahead and pick an apple” (P10). While many are wary of the added maintenance of fruiting plants, some participants saw this as a chance to provide additional engagement opportunities. Participant 2 mentioned that

“...a fruit-bearing tree is more appealing to people to actually go out and do something to it. There are more stages: there's flowering, fruit development,

pruning. There's more opportunities for people to actually tend to a fruit tree or even just a shrub or perennial.”

Providing opportunities for residents to engage in the maintenance tasks required of fruiting plants was also seen as important for building resident ownership and interest in public spaces, with one participant saying “we look at it as more of a recreation type thing. It's another thing people can kind of get involved with and feel like they're contributing. And [residents] can actually get something for what they're putting into it in terms of fruit” (P4).

In addition to promoting engagement between residents and parks, participants suggested that fruit-bearing plants may also foster engagement between residents. Commenting on this community-building potential, Participant 1 mentioned that “when you go to harvest, that's when you casually run into other residents and [one] can form relationships that way.” Reflecting on a completed fruiting plants project, another participant discussed the sense of community ownership that had been established, saying “It was kind of community pride. It was kind of a catchy project that we thought also has the potential to fill in some uniqueness into some corners of our parks or larger right of ways” (P9). Another city discussed how a fruit tree planting project had brought residents together to build new partnerships between residents, the city, the county, and their local food shelf.

Partnerships and engagement emerged as ways to address the previously mentioned barriers such as mess, liability, and even budget. Reflecting on messiness and liability, Participant 11 mentioned,

“...we don't want insects like bees and we didn't want to create a nuisance situation by having a bunch of rotten fruit. And that's why I think the partnerships, which I guess I would say, is the rewarding part of the project...the partnerships brought us a lot closer together because we work with them on this. They're informing us of a lot of other projects or trees...”

This highlights the potential role residents can play in helping the city monitor the maintenance needs of public vegetation. In terms of addressing financial barriers, one participant suggested that establishing fruiting plants had helped them to build awareness and public support for their programs, which they viewed as indirectly supporting their financial allocations. They reflected that they

“...could envision it becoming a much more visible [and] bigger component of what we do and with a lot more public involvement, because I kind of operate on the whole thing of the more the public is aware of your tree program, the better off you are just in terms of the [financial] support, you're going to get” (P4).

3.3 Phase of Adoption Participant Characteristics

Stepping back to consider Roger’s (2003) adopter typologies as applied to recent adoption of fruiting plants by Hennepin County public land managers, two managers were “early adopters”, five would be considered “early majority” and five “late majority”. No participants fit in the innovator or laggard categories. All participants reported using fruiting plants, even if only to a limited extent. Only the Early Adopters reported initially planting fruiting perennials in response to public demand. Years later, these participants are still planting fruiting perennials but instead report being motivated by social provisions such as increased education and public engagement benefits. Meanwhile, the other adoption category groups tended to report being initially motivated by other benefits, such as pollination, and were more likely to cite ecosystem services benefits over social provision benefits. This may suggest that the more residents are interested and involved in the decision-making process, the more likely they will be to actualize the social benefits of fruiting perennials. The social provisions of fruiting plants may also take more time to nurture and recognize. Fears related to liability (from bee stings, youth throwing fruit, etc.) were mentioned by all groups. However, this study found that the cities with the most experience with fruiting perennials reported that concerns about liability diminished over time. While they were initially quite concerned about bee stings or vandalism, they reported never actually receiving any complaints

relating to those concerns. This suggests fears related to liability may be unfounded or given disproportional consideration during the planning and decision-making process.

3.4 Perceived Trade Offs among Decision-Making Factors

Public land managers are constantly measuring the risks and rewards of public vegetation. Participants in this study reported several factors considered during their decision-making process related to fruit-bearing plants. Many of these factors were seen as tradeoffs that have both positive and negative influences (see Table 7).

Table 7. Weighing the Risks and Rewards.

Decision-Making Factor	Risks (Adverse effect)	Rewards (Positive effects)
Pollinators	<ul style="list-style-type: none"> ● Resident complaints about bees and wasps ● Liability from possible stinging harm 	<ul style="list-style-type: none"> ● Provides food sources for pollinators, biodiversity and habitat
Wildlife	<ul style="list-style-type: none"> ● May attract animals to unwanted areas (e.g. deer near high-traffic roads), human and animal injury or death 	<ul style="list-style-type: none"> ● Fruit is a food source for wildlife ● Increased resident interest in parks - wildlife sightings
Plant Diversity	<ul style="list-style-type: none"> ● Wasted staff time learning non-generalizable (fruit-specific) skills 	<ul style="list-style-type: none"> ● Adds to plant diversity
Maintenance	<ul style="list-style-type: none"> ● Overworked staff and expanded budget 	<ul style="list-style-type: none"> ● Opportunities for resident stewardship
Aesthetics	<ul style="list-style-type: none"> ● Reduced aesthetics from unsightly fruit drop in the Fall 	<ul style="list-style-type: none"> ● Increased aesthetics from Spring flowers
Food Access	<ul style="list-style-type: none"> ● Fruit could go unused and create added maintenance (reduced aesthetics; increased costs) 	<ul style="list-style-type: none"> ● Fruit could provide food source for residents
Location	<ul style="list-style-type: none"> ● Residents unaware of their existence, adding to mess from fruit drop (reduced aesthetics; increased costs) 	<ul style="list-style-type: none"> ● Fully utilized by residents, wildlife ● Incorporated into programming

4. Discussion

Public trees and vegetation support many ecological and human health benefits. Public land managers play a critical yet challenging role in determining the vegetation for public green spaces as they must work to meet resident demands and organizational goals despite maintenance requirements and limited organizational resources. Building on studies that explore land manager perceptions related to adopting low-input turf grasses (Barnes, 2018, 2020), flowering bee lawns (Ramer, 2020), or shade tree planting programs (Pincetl, 2010) largely for ecological benefits, the current study examines the adoption of fruit-bearing perennial plants with the use of in-depth interviews expanding on studies that used surveys or focus groups.

Literature on public fruit-bearing plants cites benefits such as expanded opportunities for education, recreation, connecting to nature, and increased wildlife habitat (Park and Kramer, 2019) as well as barriers such as additional maintenance requirements and fears related to liability, fruit drop, or the inequitable sharing of harvests (Hopkins, 2015; Barker, 1986; Colinas et al., 2018). The current study affirms that these factors are indeed taken into consideration by vegetation decision-makers. Using Rogers' (2003) adopter typologies, the study also found that the cities with the most experience with fruiting perennials reported that liability concerns diminished over time. This finding suggests that fears related to liability may be unfounded or given disproportional consideration during the planning and decision-making process.

The current study also demonstrates that *awareness* may be an additional barrier for adoption and provides a number of insights related to resident involvement in public vegetation decision-making. Half of the participants reported that they do not believe residents have influenced the city's approach to using fruit-bearing plants suggesting that residents currently play a limited role in decision-making. However, most participants also reported that they were not actively collecting input or feedback from residents in any meaningful way. This finding suggests that it may be possible that residents are not yet aware that they can influence planting decision for public spaces or how to provide that input. The cities that have reported implementing small orchards or pilot projects with fruiting plants report positive feedback from volunteers and nearby residents. Also, the few participants who mentioned collecting public feedback through in-person

meetings or events report that residents' feedback was generally positive. While some participants mentioned, they are waiting for public demand to increase before planting more fruiting plants, implementing small pilot projects may be needed to precipitate that initial feedback from residents on the topic. Participants also mentioned that they feel residents are no longer aware of food plants, how to identify and use them, citing a generational gap in knowledge and interest. While this is often used as a reason to not consider fruit-bearing plants ("why plant if people won't use them?"), public land managers could play a role in the reintroduction of food-producing plants for urban and suburban environments. Having public fruiting perennials may be a prerequisite for such education, food skills, and improving awareness.

Perceptions also likely vary between residents and public employees. Multiple participants suggested that residents were less hesitant and more supportive of fruit trees than public vegetation managers. Participants cited public perceptions of fruiting plants as being "endearing," offering more benefits (than shade trees) and having more overt benefits (such as food) than the benefits of shade trees (which have benefits that are more difficult to quantify and convey to the public such as improved air quality and improved stormwater management). The popularity of fruiting plants in municipal tree sales or distributions programs, noted by Dawes et al., 2018 and the current study, also suggests that residents may be less concerned about maintenance or liability maintenance and liability barriers. This perception could be attributed to unrealistic expectations related to maintenance and overly optimistic views related to the output of the plants in terms of fruit quantity and quality. While municipal vegetation managers interviewed for this study are seen as informed professionals with lived experiences, their suggestions about public perceptions are still speculative. More research is needed to gain a more nuanced and thorough understanding of resident perceptions and actions compared to those of public employees.

Together, the themes that emerged in this study provide a starting point for which factors to consider when weighing the pros and cons of establishing publicly accessible fruit-bearing plants. Findings contribute to the limited body of knowledge on publicly

accessible fruit-bearing plants and may be used to inform urban forestry decision-makers and natural resource planners and managers in general.

The primary study limitations are scope and depth. Focused on urban and suburban locations in one Minnesota county, findings from this study may not be generalized to other counties or other states. While the rich dataset provides in-depth insights, only 12 individuals responded. Additional data collection will be needed to corroborate or disconfirm the themes that have emerged. Participants in this study also disproportionately represented cities with larger population sizes. Views may vary widely between cities of different population sizes and resources based on tax revenue and allocated budgets for urban forestry efforts. Future studies with larger sample sizes should also consider using multiple coders to increase validity. Lastly, as I have former professional experience advocating for public fruit-bearing plants within the geographic area of this study, findings may be subject to interpretation bias².

4.6 Insights for Practitioners

This study has yielded several notable considerations and promising practices for practitioners considering publicly accessible fruit-bearing perennials. The following is a sample of strategies employed to maximize the benefits of fruit-bearing plants while minimizing the perceived risks (see Appendix C).

- Formalize public feedback mechanisms to ensure residents have a voice in decisions related to fruiting plants.
- Incorporate fruiting plants into initial site planning as they can be difficult to accommodate if incorporated as an afterthought.
- Identify planting locations with high public visibility and consider using signage to increase resident awareness of public fruit-bearing plants and maximize their social provisions.

² From 2010 - 2016, I managed a nonprofit program where they worked to plant and harvest public orchards that benefited food shelves located within and near the geographic setting of this study. Through this work, I came to appreciate the many benefits provided by public fruit-bearing plants and has advocated for expanding the popularity and acceptance of fruit-bearing plants in public green spaces.

- Use pilot projects as a means to prompt public feedback, build public interest and foster volunteer stewards, showcase best practices for homeowners, and build staff competencies related to fruit-bearing plants.
- Select disease-resistant varieties.

5. Conclusions

Public land managers consider multiple competing factors when deciding to plant (or not plant) fruit-bearing perennials. Based on public land managers in Hennepin County, this study found that the most commonly cited factors include barriers such as organizational capacity, perceived liability as well as benefits such as opportunities for public education, public engagement, and ecosystem services such as the diversification of plant species and support for pollinators. While the limited capacity to manage fruit-bearing plants emerged as the primary barrier, beneficial factors such as added plant diversity, education, and public engagement outweighed the barriers. This trade-off was especially true for public land managers who reported that their professional success is measured, at least in part, by their ability to engage the public, provide public education opportunities, or have exceptionally ambitious plant diversity goals. All of these factors can be aided with the introduction of fruit-bearing perennials.

Public land managers also act as gatekeepers to the benefits residents can access through urban vegetation. When vegetation decisions are made based on fears rather than opportunities, residents are denied access to potential benefits. The majority of participants in this study acknowledged the importance of considering the residents' preferences, recognizing that the urban forests ultimately belong to the tax-paying residents, and study participants saw themselves as stewards of that publicly owned land. They also acknowledged the many ecosystem and social provisions that fruit-bearing plants provide residents. However, some reported that they would not incorporate more fruiting plants until there is more demand from the public. While demand has been low to date, at the same time, relatively little has been done to collect feedback, passively denying residents a voice. A more proactive approach, in which cities implement more regular public input mechanisms or establish small fruiting plant pilot programs (for

residents to respond to), may be needed to inspire and precipitate public input on the topic.

As cities broaden their goals and the metrics used to define success, we may see fruit-bearing plants play an increasing role. We can promote better and more equitable urban natural resource planning and vegetation decision-making, by promoting a more complete understanding of public fruit-bearing perennial plants, including what strategies cities utilize to maximize the benefits, minimize the risks, and collect input from residents.

References

- Akbari et al, 2001. Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas. *Solar Energy*, Vol. 70, Issue 3, pp. 295-310.
- Antisari et al, 2015. Heavy metal accumulation in vegetables grown in urban gardens. *Agronomy for Sustainable Development*. Vol. 35 (3), pp. 1139-1147.
- Askerlund, P., Almers, E., 2016. Forest gardens – new opportunities for urban children to understand and develop relationships with other organisms. *Urban Forestry and Urban Greening*, Vol. 20, pp. 187 – 197.
- Barker, P.A., 1986. Fruit litter from urban trees. *Journal of Arboriculture*. Vol. 12(12), pp. 293–298.
- Barnes et al, 2018. Public land managers and sustainable urban vegetation: The case of low-input turfgrasses. *Urban Forestry and Urban Greening*. Vol. 29, pp. 284-292
- Barnes et al, 2020. Public Land manager discourses on barriers and opportunities for a transition to Low input turfgrass in urban areas. *Urban Forestry and Urban Greening*. Vol. 53, 126745
- Bukowski, C., 2020, Community Food Forests. Retrieved December 6, 2020 from <https://communityfoodforests.com/community-food-forests-map/>.
- Cariñanos et al. 2019. Considerations on the allergy-risks related to the consumption of fruits from urban trees in Mediterranean cities. *Urban Forestry and Urban Greening*. Vol. 45. 126303.
- Carrus et al, 2014. Place attachment, community identification, and pro-environmental engagement. *Place attachment: Advances in theory, methods and applications*. pp. 176-192.
- Clark and Nicholas, 2013. Introducing urban food forestry: a multifunctional approach to increase food security and provide ecosystem services. *Journal of Landscape Ecology*. Vol. 28, No. 9.
- Clayton, S., 2007. Domesticated nature: motivations for gardening and perceptions of environmental impact. *Journal of Environmental Psychology*. Vol. 27, pp. 215-224.
- Colinas, J., Bush, P., Manaugh, K., 2018. The socio-environmental impacts of public urban fruit trees: a Montreal case-study.

- Creswell, J.W., 2013. 30 Essential Skills for the Qualitative Researcher. SAGE Publications, Inc. pp. 334 - 337.
- Dawes, L. C. et al, 2018. Socioeconomic and ecological perceptions and barriers to urban tree distribution and reforestation programs. *Urban Ecosystems*.
- Donovan et al, 2013. The Relationship Between Trees and Human Health: Evidence from the Spread of the Emerald Ash Borer. *American Journal of Preventive Medicine*, Vol. 44, Issue 2, pp. 139 – 145.
- Fraser, E., Kenney, W., 2000. Cultural background and landscape history as factors affecting perceptions of the urban forest. *Journal of Arboriculture*. Vol. 26, pp. 106-113.
- von Hoffen, P. et al, 2014. Ecotoxicology and Environmental Safety Orchards for edible cities: Cadmium and lead content in nuts, berries, pome and stone fruits harvested within the inner-city neighbourhoods. *Journal of Ecotoxicology and Environmental Safety*.
- Hoover, E. et al, 2021. Growing apples in the home garden. University of Minnesota, Department of Horticultural Science. Retrieved February 16, 2021 from <https://extension.umn.edu/fruit/growing-apples#apple-varieties-recommended-for-minnesota-247061>.
- Hopkins, S., 2015. A Preliminary Assessment of Urban Fruit Tree Projects in the United States. Masters Thesis, School of Public and Environmental Affairs Indiana University
- Janesick, V.J. 2015. Peer Debriefing. In *The Blackwell Encyclopedia of Sociology*, G. Ritzer (Ed.). <https://doi.org/10.1002/9781405165518.wbeosp014.pub2>
- Janke et al. 2017. Trees and Streets as Drivers of Urban Stormwater Nutrient Pollution. *Environmental Science & Technology*. Vol. 51, Issue 17, pp. 9569-9579. DOI: 10.1021/acs.est.7b02225
- Kaplan, R., 1993. Urban forestry and the workplace: Managing urban and high-use recreation settings. St. Paul, MN: Forest Service, USDA. General Technical Report NC-163, pp. 41-45.
- Kuo, F.E., Miles, I., Sullivan, W.C., 1998. Ecological restoration volunteers: the benefits of participation. *Urban Ecosystems*. Vol. 2, pp. 27–41.

- Lyytimäki et al. 2008. Nature as nuisance? Ecosystem services and disservices to urban lifestyle. *Environmental Sciences*. Vol 5. pp. 161-172.
10.1080/15693430802055524.
- McLain, R. J. et al., 2012. *Gathering in the City : An Annotated Bibliography and Review of the Literature About Human-Plant Interactions in Urban Ecosystems*. Environmental Studies Faculty Publications, 10, pp. 1–116.
- McLain, R. et al., 2012. Producing edible landscapes in Seattle’s urban forest’, *Urban Forestry and Urban Greening*. Elsevier GmbH. Vol. 11(2), pp. 187–194.
- McPherson, E.G., Simpson, J.R. et al, 1999. Benefit-Cost Analysis of Modesto’s Municipal Urban Forest. *Journal of Arboriculture* 25(5): 235-248. (PDF) *The Value of Urban Trees: Environmental Factors and Economic Efficiency*.
- National Wildlife Federation (2020) Retrieved from <https://www.nwf.org/NativePlantFinder/Plants/Trees-and-Shrubs/1> on December, 30, 2020.
- Nesbitt, L. et al, 2018. The dimensions of urban green equity: A framework for analysis. *Urban Forestry & Urban Greening*, Vol. 34, pp. 240-248.
- Nordahl, D., 2014. *Public Produce: Cultivating Our Parks, Plazas, and Streets for Healthier Cities*” Island Press. pp. 115.
- Nowak et al, 2014. *Tree and forest effects on air quality and human health in the United States*. USDA Forest Service, 5 Moon Library, SUNY-ESF, Syracuse, NY 13210, USA.
- Ordóñez, C. et al, 2019. Urban forest governance and decision-making: A systematic review and synthesis of the perspectives of municipal managers. *Journal of Landscape and Urban Planning*. Vol 189, pp. 166 - 180.
- Park, H., Kramer, M., 2019. Urban food systems that involve trees in Northern American and Europe: A scoping review. *Journal of Urban Forestry and Urban Greening*. Vol 45.
- Wehi, P.M., Wehi, W.L., 2009. Traditional plant harvesting in contemporary fragmented and urban landscapes. *Conservation Biology*. Vol. 24(2), pp. 594–604.

- Pincetl, S., 2010. Implementing municipal tree planting: Los Angeles million-tree initiative. *Environmental Management*. Vol. 45, Issue 2, pp. 227-238.
- Ramer, H., 2020. Applying 'action situation' concepts to public land managers' perceptions of flowering bee lawns in urban parks. *Urban Forestry and Urban Greening*. Vol. 53, 126711
- Riolo, F., 2019. The social and environmental value of public urban food forests: The case study of the Picasso Food Forest in Parma, Italy. *Urban For. Urban Green.* 45, 126225. <https://doi.org/10.1016/j.ufug.2018.10.002>
- Sander et al, 2010. The value of urban tree cover: A hedonic property price model in Ramsey and Dakota Counties, Minnesota, USA. *Ecological Economics*.
- Scharenbroch, B., Morgenroth, J., Maule, B., 2015. Tree Species Suitability to Bioswales and Impact on the Urban Water Budget. *Journal of Environment Quality*. 10.2134/jeq2015.01.0060.
- Simpson and McPherson, 1996. Potential energy savings in buildings by an urban tree planting programme in California. *Urban Forestry and Urban Greening*.
- University of Minnesota Forest Resources Department Extension and Outreach, 2013. All You Need to Know About Community Gravel Beds. University of Minnesota, Department of Forest Resources.
- U.S. Census Population and Housing Unit estimates (2019). Retrieved on January 15, 2021 from: <https://www2.census.gov/programs-surveys/popest/tables/2010-2019/counties/totals/>
- Wolf, K., 2005. Business District Streetscapes, Trees, and Consumer Response. *Journal of Forestry*. Vol. 103, No. 8.

Appendix A. Interview Guide.

Date _____
Interview begins _____ Interview ends _____
Setting _____

Introduction

Thank you for participating in this discussion. My name is Jared Walhowe, I am a graduate student at the University of Minnesota enrolled in the Natural Resource Science and Management program. The information you share today will help me complete my masters thesis research project on decision-making practices related to fruit-bearing perennial plants in public green spaces. I invited you to participate in this interview because of your experience working with public parks and green spaces in Minnesota.

I am interested in learning about your experiences and hearing your honest thoughts and opinions. There are no wrong answers, only points of view. Your opinions are important and will help me to understand the multiple viewpoints related to this issue. The interview will take around 20 to 30 minutes. Your participation is voluntary, and you can withdraw or skip a question at any time.

Explain consent form.

Would it be okay if I recorded our conversation? A recording is important in helping me take accurate notes on our conversation and the recording will not be shared with others.

Yes / No

Do you have any questions before we begin?

Okay, let's begin –I am going to begin recording now.

1. To start, please tell me about your role with [insert employer (city/park board)]?

2. What does the planning process look like when you design or redesign the vegetation for a public space? Please provide a brief step by step overview.
3. Does [insert city/park board name] manage publicly accessible gardens, edible landscapes, or fruit-bearing plants (such as fruit trees, shrubs, or vines)?
 - a. If yes:
 - i. What is your assessment of the positive and negative aspects of this experience?
 - ii. Overall, has your experience been positive or negative?
 - b. If no:
 - i. Is that something [insert city/park] has considered?
4. What factors do/would you consider when/if deciding to plant fruit-bearing perennials?
 - a. What does the planning process look like when working with fruit-bearing perennial plants? Are there any ways it is different than when working with non-fruiting vegetation?
 - b. Which factors do you see as the most important?
 - c. Any other factors you'd like to mention?
5. What do you see as the most significant benefits, if any, of publicly accessible fruit-bearing plants?
 - a. Any others you'd like to mention?
6. (if benefits are mentioned) Do you believe that these benefits are shared or accessed equally between all residents?
 - a. If no, please explain which residents or groups of residents benefit the most.
 - b. Which residents benefit the least? Are there particular neighborhoods or groups of residents?
7. What do you see as the most significant barriers or challenges, if any, to having publicly accessible fruit-bearing plants?
 - a. Any others you'd like to mention?
8. Are you aware of any city (county) ordinances or policies in your city (county) related to fruit-bearing plants? If so, please describe them.
 - a. Can you direct me to them in the city ordinances or programs?

9. Do you believe that residents have influenced the city's approach to using fruit-bearing plants? If so, how?
 - a. Have residents influenced the way you think about using fruit-bearing plants in public spaces? If so, how?
 - b. How would you describe the residents that are most interested in public fruit-bearing plants?

Those are all the questions I have for you. Is there anything else you'd like to add? Are there questions you think I should be asking that I have not asked yet?

Appendix B. Participant Consent Form.

Interviews for Natural Resource Science and Management Masters Thesis Project

You are invited to participate in a research study about the use of fruit-bearing perennial plants, such as fruit trees, fruiting shrubs, or perennial fruiting vines, in public green spaces. You were selected as a possible participant because you have professional experience managing public green spaces in Minnesota. We are seeking your input to better understand the variety of opinions related to the topic of public fruit-bearing plants.

Background Information

The purpose of this study is to understand what factors motivate people to incorporate, or not incorporate, fruit-bearing perennial plants in public areas

Procedures

If you agree to be in this study, we will ask you to participate in an interview asking about your experience and perspectives. We will not ask anyone to share confidential information about you. Rather, we want your own opinion.

Risks and Benefits of Participating in the Study

The study poses minimal risks. Interview questions will ask for your opinion, along with your personal experience and perspectives. You may refuse to answer any question that may make you uncomfortable. Participation in the interview is voluntary and you may choose to end the interview at any time without consequence.

Compensation

There is no formal compensation offered with this research study.

Confidentiality

Interview answers and observation notes will be kept confidential. No individual will be named on interview or observation sheets, reports, or presentations made. Final reports

and presentations will not include any information that would identify a participant. All responses will be aggregated and de-identified.

Research records will be kept in a secure, safe location and only researchers will have access to those materials. All data, records, and potential photographs will be securely destroyed and shredded at the end of the study, or 6/1/2021

Voluntary Nature of the Study

All participation in this study is voluntary. The decision of whether or not to participate in the study will not affect your relationship with the University of Minnesota. If you decide to participate in the study, you are welcome to refuse any answer or withdraw your participation at any time without affecting the aforementioned relationship.

Contacts and Questions

Any questions or comments you may have about the project, interviews, observations, reports, or presentations may be directed to Jared Walhowe, walh0009@umn.edu, (612) 625-8693. Any questions you may have now or later are welcomed. If you have any questions or concerns of the study that you would like to discuss with someone other than Jared Walhowe, you are encouraged to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware Street SE, Minneapolis, MN 55455, or (612) 625-1650.

Participant

signature _____ Date _____

Research

signature _____ Date _____

Appendix C. Promising Practices for Practitioners.

A review of the academic and popular literature as well as the interview transcripts from this study has yielded a number of notable considerations and best practices for practitioners who are considering incorporating publicly accessible fruit-bearing perennials. The following is a sample of strategies that are being employed to maximize the benefits of fruit-bearing plants while minimizing the perceived risks.

Incorporate fruiting plants into initial planning

Fruit-bearing plants have many social and ecological benefits yet also have many drawbacks like the potential for fruit drop and excessive mess. The ideal location for a fruiting tree would be one that requires little or no mowing, is accessible to the public yet is far enough from away from sidewalks as not to drop fruit on them and would not be likely to be moved due to future infrastructure plans or redevelopment. Locations that meet all of these requirements may be scarce and/or difficult to identify. For this reason, it is important to prioritize the planting of fruiting trees and shrubs over other vegetation that can more easily be planted elsewhere. Cities that are pursuing ambitious plant diversity goals should consider ideal locations for difficult to place plants first, such as fruiting trees, in order to maximize diversity. Consider making fruiting plants a part of your overall planting program and not an afterthought.

Identify planting locations with high visibility

Awareness is incredibly important for realizing many of the social provisions that fruit-bearing plants can provide. Consider selecting planting locations that are visible to residents and near high foot-traffic areas. Planting fruit-bearing perennials adjacent to existing community garden efforts can be a great way to build awareness without competing with other uses such as sporting fields or canopy coverage.

Start small and ease into it

Fruiting trees can be more work than shade trees. If they are placed in unassuming locations, they can cause excessive fruit drop, making mowing more difficult while also contributing to food waste. In some communities, fruiting plants may generate new

excitement from the community and possibly even new volunteer stewards. However, fruiting plants also require fruit-specific knowledge and expertise to manage that staff or volunteers may not have. Gradually growing the use of fruit-bearing plants, while also growing volunteer support and expertise, will help city staff to not feel overwhelmed. In his book “Public Produce,” Nordahl suggests that we can minimize maintenance by more accurately considering what he terms the “carrying capacity” of public produce, noting that “The question is not how many plum trees can you plant in a park. Rather, the question is how many plums should you plant? Municipalities interested in edible landscapes need to consider the number of people passing by each and every public space, and whether those people are likely to consume the quantity and type of food offered. For example, you could line a suburban street with persimmon trees spaced forty feet apart. But this is bad practice. Why? Because all those trees would yield an overabundance of fruit for the relative paucity of residents in the typical low-density subdivision” (Nordahl 2014).

Plant small fruits first

One way to “start small and ease into it” is by incorporating trees, shrubs, and vines with smaller fruits first. While smaller fruits may be less attention-getting for residents, they are less likely to create a noticeable fruit drop (mess) and thus less likely to disrupt regular maintenance such as mowing. Birds may also play a more noticeable role in reducing mess as they favor smaller fruits. Perennials with smaller fruits, such as Juneberry (*Amelanchier*), Tart Cherry (*Prunus cerasus*), or Black Chokeberry (*Aronia melanocarpa*) are still very beneficial to pollinators and wildlife. In fact, some smaller fruiting plants, such as Honeyberry (*Lonicera caerulea*), are some of the first plants to flower each spring in colder climates, providing valuable early food sources for pollinators.

Select disease-resistant varieties

When selecting fruit-bearing plants, consider varieties with lower susceptibility to common diseases. This is especially important for apples as they are notoriously susceptible to bacterial and fungal diseases. Apple varieties such as Liberty, Wealthy,

William's Pride, and Triumph, are more resistant to common apple diseases such as apple scab or fire blight than many alternatives (Hoover et al, 2021).

Use signage

Using signage can help build public awareness in multiple ways. Signage can draw residents towards the existence of public fruiting plants, convey that they are accessible to the general public for harvest, and educate the public that they are edible. Signage can also be used to educate potential harvesters as to the best times to harvest each plant. This can help reduce mess and fruit drop by encouraging people to harvest before they are overripe but also reduce waste by encouraging individuals not to harvest the fruit too early when it is underripe and not useful to anyone.

Use community gravel beds

A sometimes-overlooked benefit of fruiting trees and shrubs is their hardiness. Not only are many well suited for colder climates but they are also particularly suited for use in gravel beds and for transplanting. Varieties such as Black Chokeberry (*Aronia melanocarpa*), Crabapple (*Malus* spp.), Amur chokecherry (*Prunus maackii*), and Nannyberry (*Viburnum lentago*) are considered to have "excellent" gravel bed suitability and transplant success (University of Minnesota Forest Resources Department Extension and Outreach, 2013).

Set an example through pilot projects

Some residents may request fruit-bearing plants yet be unaware or unrealistic about the added maintenance needs. Others may not think of fruit-bearing plants as a possibility at all. Pilot projects, such as small demonstration orchards, offer an opportunity to temper unrealistic expectations while also building awareness and enhancing educational opportunities. These may be especially useful for cities that sell fruit trees to residents through city-sponsored tree sales as they provide a public space where these residents can come together, learn best management practices from one another, understand what they are getting into should they elect to plant their own, and meet their neighbors. Even if perceived demand for fruiting plants is low in a city, it may be better to plant them in a

known and controlled environment rather than not plant them and risk residents taking things into their own hands and planting them in locations that are less than ideal. As one participant put it, "...if we don't start doing it under our control then we could have boulevards where we don't want them and have no control over it. At least for now we're able to say 'yes, we do plant fruit trees. We plant [them] in parks. Here's why we don't plant on boulevards'" (P4).

Further, incorporating fruiting-perennials into public spaces may help promote more realistic expectations for fruit quality and what is involved in plant management. Some participants in this study cited a need to spray pesticides or fungicides as a barrier to planting fruiting perennials. However, it is important to recognize the potential benefits of not spraying as well. For example, many common blemishes such as apple scab on apple trees are primarily aesthetic and do not impact whether or not the fruit is edible. Demonstrating imperfections in public pilot projects also contributes to resident education and may help to form realistic expectations

Expand upon community gardening efforts

All participants from all groups in this study reported implementing public community gardens prior to any concerted efforts to incorporate fruiting perennial plants. This suggests that community gardens may play a role in helping cities become more amenable to public fruiting perennials. Participant 8 (Early Majority) noted they are integrating fruiting plants into their regular tree planting planning efforts, but mentioned that their city's community garden was removed, due to a development project, and that there were no plans for replacement. They attributed this to a lack of appropriate public spaces as well as a lack of demand from residents. Participant 8 suggested that it was likely for them to continue planting fruit trees but increasingly unlikely for them to start a new public community garden.

Traditionally, many community garden efforts have been implemented in response to public demand and for the purpose of the social provisions community gardens provide such as increased healthy food access and increased social capital. Meanwhile, shade

trees have been planted primarily for their ecosystem services. Fruiting perennials, especially fruiting trees, have the potential to provide both social and ecological benefits yet are often overlooked as an option. This may be attributed to fruiting perennials being perceived as requiring more maintenance when compared to shade trees. However, when compared to community gardens, they typically require less. Considering that urban gardening provides no canopy coverage and annual vegetable vegetation requires significantly more management capacity than woody fruiting perennials, why are community gardens more commonplace and accepted by green space managers? Additional research may be needed to better understand the nuances in perceptions between varying types of urban agriculture activities. For public land managers, the decision may come down to *who* is responsible for the maintenance rather than *how much* maintenance there is. Fruiting perennials may provide cities with an opportunity to bridge their previously distinct efforts of supporting community gardens and urban forests. However, to be successful, cities may need to incorporate more “community” into their fruit tree planting efforts by recruiting, training, and engaging residents in their long-term care (as they have done with community gardens).

Host a tree sale event and include fruiting plants

A number of cities now host their own annual tree sale events as a means to support tree plantings on privately owned lands. Participants from this study noted that fruiting trees were consistently some of the first and best-selling items at their sales. In a recent study on reforestation (tree distribution) programs, Dawes et al (2018) also noted a possible preference for fruiting plants among residents. While some participants remain hesitant to go beyond a small pilot project or planting a few fruiting perennial trees due to the barriers outlined above, efforts such as public tree sales were seen as a less risky alternative, especially considering that the maintenance and care of the plants would be externalized to residents. Reflecting on this, Participant 6 said “...our emphasis has actually been on promoting fruits in private yards...we've probably put way more fruit out there by basically promoting it to private people.” They also viewed this as a means to have a bigger positive impact, noting “We've only got so much [public] land, 90 and above percent of the land here is privately owned. That's where our biggest impact really

is ever going to be.” Others noted a possible trend towards edible landscapes and alternative lawns on private property, adding “We're seeing a lot of people will convert their yards, front yard and backyard, into gardening spaces as well. So I think there's a movement that way and it's going to increase in the near future” (P5) and “there has been a bit of a transition towards native grass perennial areas within yards and rain gardens and things like that” (P7).

The popularity of fruiting plants in city tree sales suggests a small, but growing, interest in alternative lawns that include food producing vegetation. Participant 6 mentioned that they believe “...when a younger generation, who is more environmentally conscious, comes into some of these older neighborhoods, that will spur this idea on. I've seen that just in the landscaping of yards. In general, we're seeing more alternative landscaping.” Cities do in fact have an opportunity to externalize the added maintenance and potential liability of new fruiting plants by facilitating their planting on private rather than public property. This may also be a means of having the largest impact considering the majority of land in most cities is privately owned. However, solely selling fruiting plants through city-run tree sales does little to support non-land-owning residents and a multiple-strategy approach may be necessary in order to ensure that the benefits of fruiting perennials are accessed equitably. For example, a tree sale coupled with a small public demonstration orchard would externalize the majority of the barriers such as maintenance and liability while also providing an accessible public space for residents to learn more about fruiting plants and their maintenance needs, form realistic expectations around growing fruiting perennials, meet neighbors, and harvest food. It may also provide a gateway for residents to become involved in the stewardship of the urban forest.

Formalize public feedback

Many in this study mentioned that they would plant more fruiting perennials if they were to receive more public demand for it. However, many also acknowledged that they are not collecting feedback in any sort of regular or formal way. At the same time, residents may be unaware that fruiting-perennial plants are an option for public spaces. They may also be unaware that they could have an impact on the makeup of their urban forest or

what formal or informal channels exist for providing such input. Don't wait for unsolicited feedback that may never come. Be proactive and create a standardized way of collecting feedback. This could be through surveys at annual meetings, online surveys through city newsletter, mailings, or in-person feedback at volunteer events or public tree sales. Too often, changes only come from complaints which inherently does not allow for all voices to be heard in an equitable manner.