Edible forests: building resilient communities through perennial fruit and nut production

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Abstract

Edible forests are landscapes made up of woody edible plants, and they have been growing in popularity across the U.S. Also known as food forests, these spaces integrate fruit and nut trees into streetscapes, parks, residential yards, private lands, etc. In addition to food production, edible forests address a variety of challenges communities face. These include economic, ecological, and social issues such as poverty, climate change, flooding, greenspace, and revenue streams. Understanding how to plan, implement, and manage edible forests is critical to their viability and longevity. Michigan State University Extension has established an edible forest in Detroit to study best management practices for sustaining these landscapes.

Keywords

urban agriculture, food, landscaping, trees

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INTRODUCTION

The commodification of food is a primary cause of food insecurity across the world. Thus, poverty is more of a determinant of chronic hunger than the actual capacity of people or land to cultivate food for sustenance. There are structural and political barriers that limit peoples' access to nutrition, like municipal policies that prohibit crop and animal husbandry and challenges to land tenure. Despite increases in the production and manufacture of processed foods since 1970, 16% of the global population suffers from chronic hunger (Mc Carthy et al., 2018).

Along the entire food chain from farm to table, on average 90 kg/yr per capita of food is wasted annually in the United States (Hall et al., 2009) and other western nations. Food waste is partially due to the geographic separation of where food is produced and where large populations of people live. Inefficiencies in harvesting, storage, and distribution lead to food being wasted, that could have fed people if it was cultivated closer to consumers. Once again, the cost of food is a significant contributor to food insecurity. Furthermore, costs combined with segregation of populations and production lead to large volumes of food waste.

One way to address chronic hunger is the establishment of edible forests, which generate healthy, local produce where it is needed at little or no cost to the consumer. Also called community food forests or forest gardens, these spaces are managed to produce food, medicinal plants, and other resources from woody crops that are integrated into areas where people live (Bukowski and Munsell, 2018; Pilgrim et al., 2018). Edible forests vary in how they are managed based upon the goals of the stakeholders involved. The main distinction of an edible forest from a farm or orchard is the layout and focus on cultivating a diversity of crops. Although they may be managed commercially, they are more often centered on providing food and placemaking to neighbors (Bukowski & Munsell, 2018).

Edible forests are designed to be low maintenance requiring minimal inputs of labor and resources. Selected plants should be adapted and resilient to the environment, soil, and climate. The diversity of edible plants around the world provides options for planners to select varieties that may survive and thrive. Prioritizing crops adapted to the local environment allows managers to utilize resources like compost and water more efficiently, whereas cultivation of common annual crops often require numerous inputs that communities may not be able to afford or acquire.

Health and Income

Centering food forests in communities addresses numerous social challenges. These include food insecurity, income opportunities, physical and mental health, and engagement. As crops mature and yield, areas once marked by little to no local food production or access to fresh produce now have growing yields of fruits and nuts. Fruits and nuts are nutrient rich foods, which provide more protein, complex sugars, and healthy fats (Alasalvar et al., 2020) than common annual crops. Consumption of more fruits and nuts has been documented to improve health outcomes like reduced risk of diabetes, cardiovascular disease, and obesity as well as improved cognitive function and physical health (Carughi et al., 2015; Planet Forward 2015). Edible forests localize cultivation of fruits and nuts and give communities direct access to these healthy foods, some of which are not available on grocery store shelves.

In addition to direct consumption, harvests sold or processed into value added products can generate revenue streams. Maintenance of the forest requires physical activity and outdoor work, which further benefits health outcomes and provide opportunities for income through labor. Small businesses may develop around food products, plant propagation, distribution, and more. Communities explore new cuisine and expand culture around newly discovered foods. Similarly, forest gardens allow people to reconnect with ancestral foods that may not be available in stores. Finally, the collective management required to maintain edible forests fosters interdependence and connectivity leading to more resilient social networks.

Ecological Benefits

Food forests create opportunities for ecological restoration and biodiversity conservation. Increasing plant diversity, especially native plants, offers direct benefits to local fauna. Insects, birds, mammals, fungi, and other organisms experience increased habitat with the establishment and growth of food forest. Amending soils for enhanced crop production improves water absorption and retention from rainfall, alleviating stress on stormwater systems and reducing flooding (Drummond, 2020). Microhabitats created from forest plants add cooling and moisture retention in the air and soil during hot and dry periods. Finally, the biomass and conversion of carbon dioxide into cellulose and other compounds in the roots, leaves, stems, and rhizosphere of edible forest plants removes greenhouse gas from the air, rendering food forest a carbon sink for reducing the effects of climate change.

DISCUSSION

The Michigan State University – Detroit Partnership for Food, Learning, and Innovation (DPFLI) began cultivating an edible forest in 2020 to create a demonstration and research site for studying community food forests and urban agriculture. Housed within MSU Extension, the site is 1.3 hectares (3.3 acres) and currently has over 150 perennial fruit and nut plants representing over thirty species (Table 1; Figure 1). Research topics include best management practices, biodiversity surveys, and community nutrition. MSU Extension offers educational programming and is developing infrastructure to support local food production.

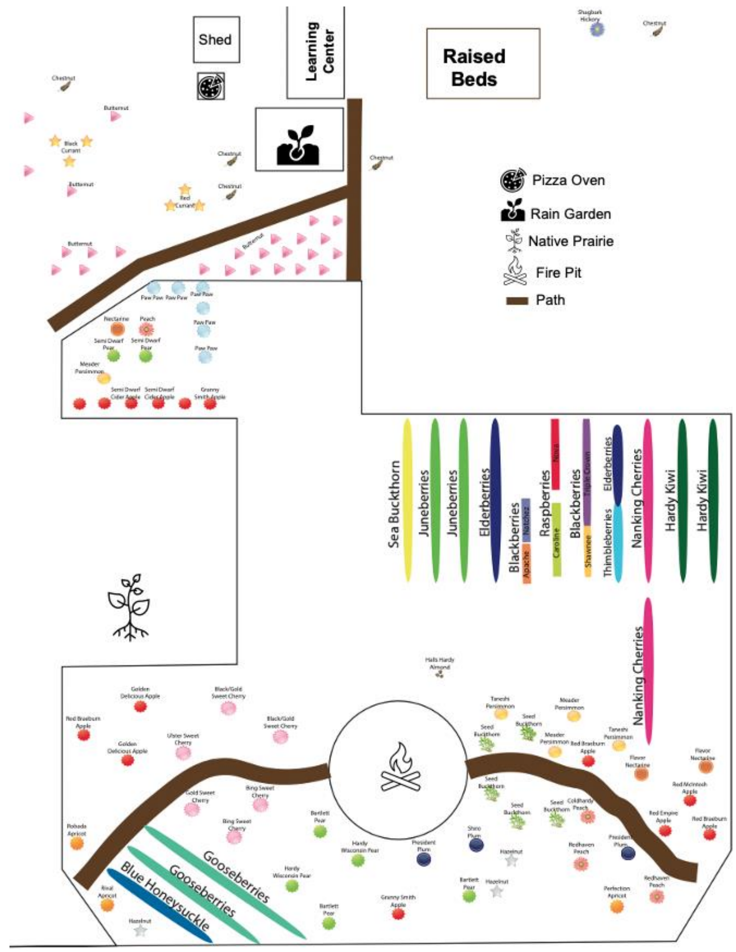

Figure 1. The diagram shows an overhead layout of the Detroit Partnership for Food, Learning, and Innovation with the distribution of perennial woody plants across the site. Other site amenities are included. Elongated bubbles indicate a group of plants grown in a straight row. The black line forming a shape around most of the plants represents a deer fence.

Table 1. A list of the perennial vegetables, fruits and nuts cultivated at the Detroit Partnership for Food, Learning, and Innovation. The plants are distributed across the site and vary in quantity of each species and cultivar.

Vegetables

1. Asparagus (*Asparagus officinalis*) - Mary Washington, Viking
2. Horseradish (*Armoracia rusticana*) – Czech
3. Rhubarb (*Rheum rhabarbarum)* - Red Victoria

Fruits

1. Apple (*Malus domestica*)
    - Golden delicious, Red McIntosh, Braeburn, Empire,
2. Apricot (*Prunus armeniaca*)
    - Perfection, Rival, Robada,
3. Arrowwood (*Viburnum dentatum*)

4. Blackberry (*Rubus fructicosus*)
    - Triple Crown, Shawnee, Apache, Natchez
5. Blue Honeysuckle (*Lonicera caerulea*)
6. Cherry (*Prunus avium*)
    - Blackgold, Gold Cherry, Dark Sweet, Bing
7. Highbush Cranberry (*Viburnum trilobum*)
8. Currants (*Ribes Americanum*)
    - Wild, Crandall American, Cherry Red
9. Cornelian Cherry Dogwood (*Cornus mas*)
10. Elderberry (*Sambucus canadensis*)
11. Fig (*Ficus* spp.)
    - Chicago Hardy, Long Island
12. Gooseberry (*Ribes uva-crispa*, *Ribes* 'Oregon Champion' x *R. missouriense*)
    - Captivator, Pixwell
13. Hardy Kiwi (*Actinidia arguta*)
14. Hickory (*Carya ovata*)
15. Juneberry (*Amelanchier canadensis*)
16. Lemon (*Citrus* x *meyeri*)
17. Nanking Cherry (*Prunus tomentosa*)
18. Pawpaw (*Asimina triloba*)
    - Susquehanna, Mango, Pennsylvania, Wells
19. Peach (*Prunus persica*)
    - Early Redhaven, Flavortop Nectarine, Flamin'Fury
20. Pear (*Pyrus communis*)
    - Bartlett, Hardy Wisconsin, Juicy Jewel,
21. Persimmon (*Diospyros kaki*, *Diospyros virginiana*)
    - Meader American, Hira Tanenashi Asian, American
22. Plum (*Prunus americana*, *Prunus domestica*, *Prunus salicina*)
    - President, Shiro, Wild
23. Raspberry (*Rubus idaeus*)
    - Nova, Encore, Caroline, Joan J
24. Sand Cherry (*Prunus pumila*)
25. Sea Buckthorn (*Hippophae rhamnoides*)
26. Strawberry (*Fragaria* x *ananassa*, *Fragaria virginiana*)
    - Galletta

Nuts

1. Halls Hardy Almond (*Prunus dulcis*)
2. Butternut (*Juglans cinerea*)
3. Filbert/Hazelnut (*Corylus* americana)
4. Pecan (*Carya illinoinensis*)
5. Silveray Korean Stone Pine nut (*Pinus koraiensis*)

From 2019-2020, we conducted a two-year soil management study, which investigated how different degrees of tillage affected water infiltration, weed density, crop size, and compaction. Two of our conclusions were that minimal soil disturbance led to larger and greener crops, and deep tilling exposed debris and increased the depth of compaction (Edwards et al., 2022). The results influenced us to consider transitioning more of our land to perennial crop production. Annual production typically requires soil disturbance via tilling, which has numerous consequences including increased erosion, reduced soil organic matter, and diminished soil structure (Triplett & Dick, 2008).

Perennial crops allow us to concentrate energy into preparing soil in specific locations where plants will grow rather than tilling larger areas to sow seeds or transplant. Since the DPFLI was historically a school property, remnants of the school and other debris persist underground throughout the site and may inhibit plant growth. When preparing soil for perennial plants, we dig and amend soil up to 60 centimeters below the surface (2 feet), which allows us to remove material that may restrict plant growth and add compost and other amendments to ensure healthy plant growth. This initial effort is intensive, but subsequent years require less labor as plants mature. After year one, we loosen soil around crops with a broad fork and add amendments as needed to each plant. This technique uses less energy and costs of machinery to till and amend soil annually.

Trees and shrubs add biomass above and below ground every year, and the roots grow into new areas to absorb nutrients. Furthermore, plants produce more fruit as they grow larger in size, leading to larger yields without increasing the quantity of plants. Yields can also be augmented by layering a diversity of plant species varying in height and size. This method presents the ability to harvest produce throughout the year in the same space as different species vary temporally when they bear fruit (Pilgrim et al., 2018). Similarly, the risk of losing an entire harvest is reduced when a variety of crops are layered rather than cultivating a monoculture (Shepard, 2013).

DPFLI strives to eco-consciously maximize production on a small-scale urban space. Our research focuses on identifying fruit and nut crops that grow well in our region with minimal inputs. We also experiment with generating our own inputs through composting, nutrient cycling, and building biodiversity to be self reliant and reduce expenses on transporting resources from external vendors. We offer programming relevant to the edible forest in areas including tree care, nutrition, food storage, horticulture, and natural resource conservation.

So far, we have hosted programs on food safety, tree care, and canning fruits and vegetables (Figure 2). As yields increase, we will invest in technology for dehydrating, freezing, and fermenting. These programs build food security by educating residents on ways to preserve food and reduce food waste, as well as develop skills that can be transferred into small business ventures. We partner with a commercial kitchen and other farms as well, strengthening community ties. We intend to scale up production at the DPFLI and train others to establish food forests to significantly boost local production of fruits and nuts and establish systems for maintaining these landscapes.

A.

B.

C.

D.

Figure 2. Photos from DPFLI programs: A. Urban forestry class; B. Canned tomatoes from a class; C. Community tree planting day for edible forest; D. Strawberry canning class.

We also study the ecosystem services of our edible forest. We will document the abundance of life known to be supported with habitat and food from our forest ecosystem (Crawford, 2010). There is potential for these landscapes to absorb rainwater and reduce stress on sewerage systems. The plants absorb rainwater, and their root systems increase the soil's capacity to retain water (Drummond, 2020). Fruit and nut trees also provide shade and reduce the dangers of urban island heat effect (Davis et al., 2005). As the climate continues to warm in cities across the world, trees can play a crucial role in mitigating the stress on people and the energy grid for cooling.

CONCLUSION

Edible forests can play a critical role in addressing food security in communities across the world. By growing a diversity of perennial crops that are adapted to local conditions, food forests require less maintenance and inputs than annual crop production. In addition to increasing access to free food, harvests can be sold and processed into valued added products for storage and revenue. These spaces foster resilient communities through collaboration, healthier populations, community development.

The Michigan State University – Detroit Partnership for Food, Learning, and Innovation planted an edible forest on our 3.3 acres urban agriculture center. Here, we will research best practices for fruit and nut tree management and offer programs in nutrition, crop management, food preservation and other areas. We will donate harvests and incorporate them into our programs to build capacity for others to replicate.

Acknowledgements

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