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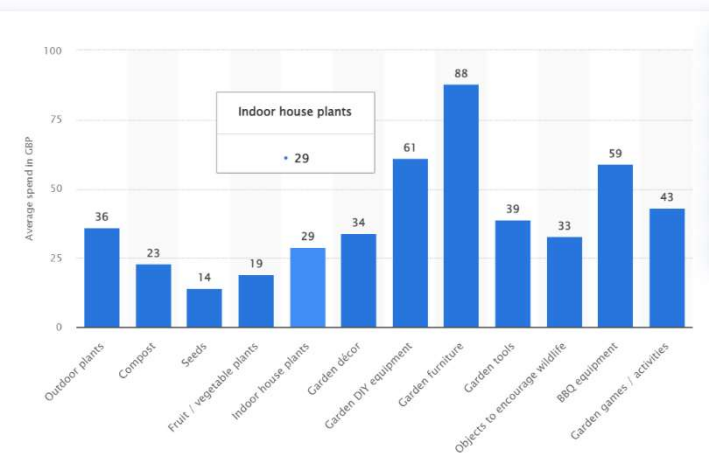
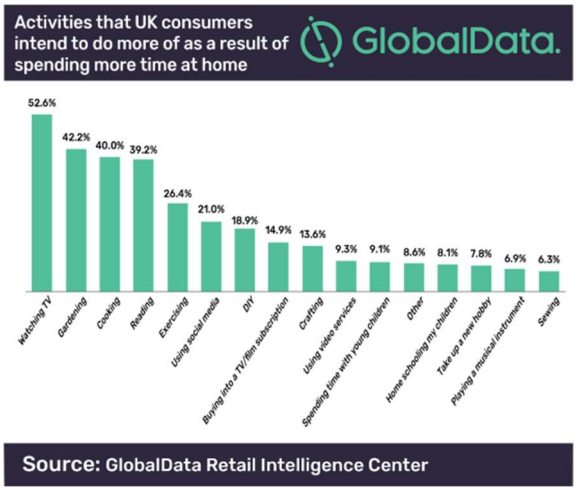
Sustainability Internship Fall 2021
Edible Forest Gardens

Approximately six hundred million years ago, green algae began to make its way on land becoming the ancestor of all future terrestrial plants. Both terrestrial and marine plant evolution has "transformed the planet and its atmosphere and was one of the pivotal transitions in the history of life- a profound breakthrough in biological possibility" (Sheldrake, 123). As of 2019, the United States produced ~6558 metric tons of carbon dioxide, a net change of ~5769 metric tons after taking into account carbon sequestration. Something we as average people can do in order to create a lower carbon future and reduce our carbon footprint is gardening. The concept of gardening has been around since ancient Egyptian times when personal agriculture/permaculture became more reliable with predictable flood seasons. It is a great time consumer and teaches us to care for something else other than ourselves. It's similar to taking care of the Earth, just on a smaller scale. When given the care it needs, it will flourish and take care of us in return. Producing some of your food yourself is not only affordable, but it weakens the support of large corporations that mass produce food and reduces the miles between the farm and your table. Farms require fossil fuels which have to be mined, producing "vast amounts of waste and pollution" (Jacke). Farming as

"modern agriculture lacks resilience and displays fragility" (Jacke) due to its human dependence, so the littlest disturbances cause it to be unable to regenerate itself. Forest ecosystems, however, develop high species, genetic diversity, interconnectedness and resilience as they grow. The term ecology, coined in 1866 by a German zoologist, is "a branch of science concerned with the interrelationship of organisms and their environment" (Jacke).

It is also a healthier option for your body, as you know exactly what is going into your food. Research shows that there is a link between the Mediterranean diet (high in fruits, vegetables, legumes, whole grains, nuts, fish, and olive oil) and slower aging. There has also been an increase in evidence supporting that the *act* of gardening can be beneficial to both your physical and mental health as well as providing social benefits. A domestic garden "provides regular access to sunshine and fresh air which bring indirect benefits on health, including aiding sleep and eating patterns" (Corley, et al.). Studies have shown that the amount of time people had spent in a garden pre-covid was significantly less than during the peak of the Covid-19 Pandemic when the stay-at-home order was in place. Gardening and other green activities were proven to have a beneficial effect on mental health. It is related to "lower psychopathological distress through decreased Covid-19 related





distress" (Theodorou, et al.). This graph represents the average amount of money spent on gardening supplies during the height of the pandemic in the UK. And the bottom graph shows that gardening was the second most influenced activity that people intend to spend more time doing. A study on how gardening was related to the health of older individuals showed a link between home garden use and greater wellbeing during the COVID-19 pandemic. In these unprecedented times of uncertainty and stress, "domestic gardens may provide an outlet for mental activity as well as boosting physical health" (Corley, et al.). Based on UK census data, there was also "a link between garden *size* and population health; people with larger gardens had better self-reported general health" (Corley, et al.).

The greatest sustainable environment for edible plants is the wild. This is where foods are in their purest form and untouched by human hands. Flora that is

not adapted to the climate will not grow and those that are can flourish without restraint. Wild plants have overtime grown to possess some characteristics that cultivated plants do not. Phytochemicals, bitter tasting chemical compounds that some plants release to deter predators, can provide us with health benefits if we eat them regularly. Wild blueberries, compared to cultivated blueberries, contain ~30% more anthocyanins which are linked to reduced heart disease and breast cancer as well as improved blood cholesterol and glucose.

The best ways to mimic environmental conditions is with a design concept called a forest garden. This is a mix between a wild domain and a cultivated garden. A forest garden can exist on any scale but its main premise is a self-sustaining garden that mimics a natural ecosystem, fitted for the climate if not enclosed in a greenhouse. It is self-fertilizing and should maintain a stable nutrient and compound cycle from the sun, to the plants, to the soil. It is also unnecessary to water a forest garden since a natural forest obtains all of its water from precipitation.

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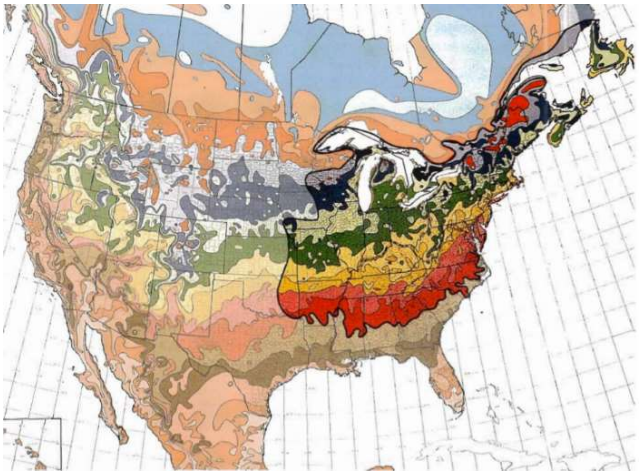
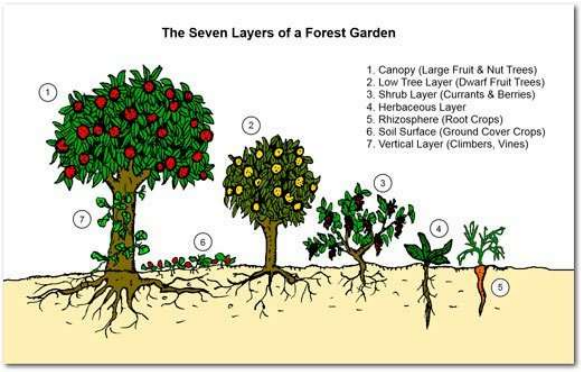
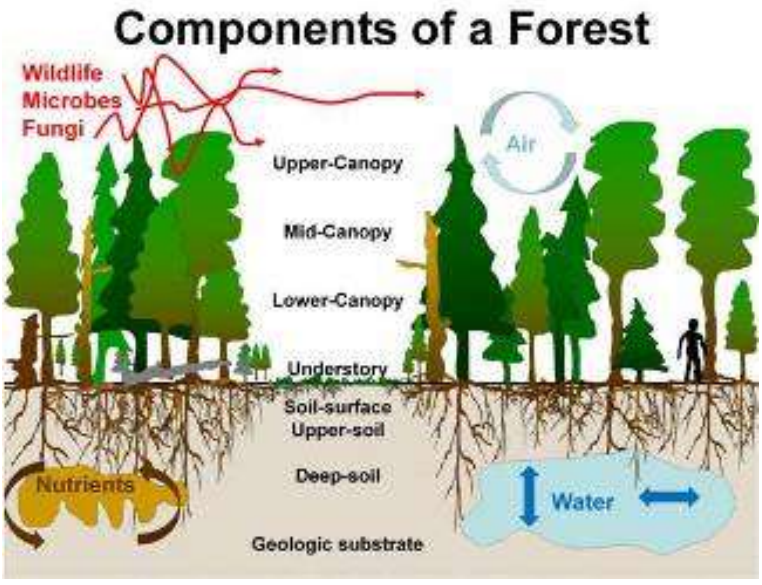
Another distinguishing difference between a forest garden and a formal garden is its composition of perennials rather than annuals. Because it is self-sustaining, replanting annually should be unnecessary. It is said that a forest garden should provide the seven F's: food, fuel, fiber, fodder, fertilizer, "farmaceuticals", and fun. Depending on where it is located it may not be essential or reasonable for all 7 to be produced. An edible forest garden will be easily successful in a climate where deciduous forests are the native vegetation. In the United States, this includes all of the North East, Mid-east, and into some of the North Central states. You could accommodate plants for other climates to match the definition of a 'forest' garden mimicking the natural environment of the Midwest and western states as well. Components of a successful *edible* forest garden (for a Northeastern climate) include: layers, hearty shelter plants, edible plants, system plants, and fungi. It is important to know the plant hardiness zone of



your location before beginning to choose your plants. One of the most important features of a natural ecosystem is its layers. Forest gardens are especially good for



carbon sequestration because it doesn't just contain agricultural plants like vegetables and herbs, but larger trees such as nut and fruit. All the layers of a forest have different purposes that help the forest work together as a whole. Plants that do not have fruiting bodies are often hearty and used for shelter from harsh winds and precipitation. Plants that contribute shelter or sequester rainwater or provide a service of indirect use to help the system



function better are aptly named 'system plants'. When planting system plants you must know their abilities at the age of planting as well as how much space they will take up in the future. Evergreens are very good shelter plants especially in the colder months.

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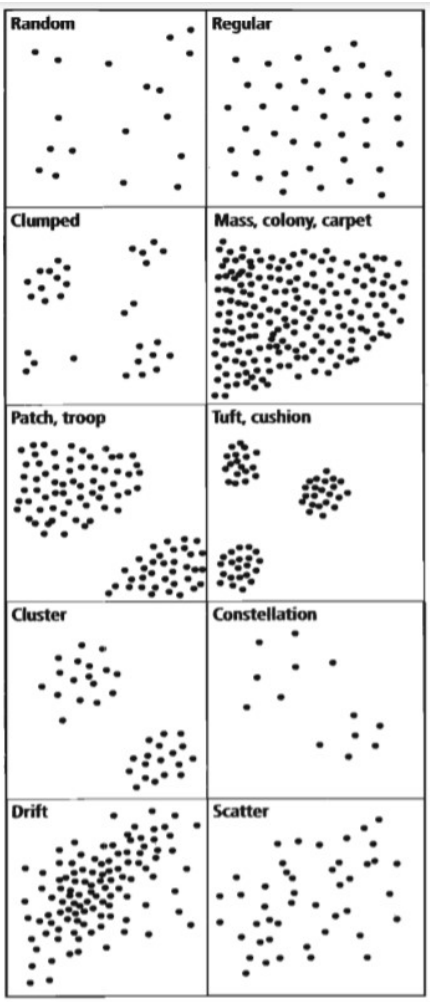
Not only plants, but fungi, are an important part of a wild ecosystem. The mycelium, a network of fungal threads, in the soil forms a network between some communicating plants that share nutrients with not only each other through the fungi, but with the fungi themselves. It is an essential part of the planet's ecosystem maintaining soil structure and preventing erosion. They also assist in the decomposition of organic matter. Without decomposers the soil would not be able to maintain its nutrients and plants would not be able to receive proper resources.

Because mycelium forms in a network, the tilling of formal gardens and agricultural fields is detrimental to its formation. In the wild, no one digs up the top surface of every forest every year. The plants and mycorrhiza communities work together to maintain optimum health with no help of human made pesticides and insecticides. Mycelium receive signals if a plant is being attacked or harmed and may assist the plant in defenses to come back to health and build immunity to its threats (permaculture xnews). They may also stimulate root growth in order to protect plant roots against worms and insects which in turn helps them continue to

receive sugars and nutrients from the plant's photosynthetic processes. The communication of plants through fungi mycorrhizal is known as the "wood wide web" and studies have shown that not all plants are able to communicate with each other but some have special bonds, for example birch and fir trees sharing carbon. When the same communication study was done between birch and cedar, there was no passing of carbon between the two via the underground network (Sheldrake). While on the topic of soil health, I will talk about the importance of plants, dead organic matter, and soil organisms. In the soil of disturbed sites usually "nitrogen is the primary nutrient that limits plant growth". Studies show that in order to speed up succession, adding nitrogen fertilizer will increase the growth of early-succession species at the expense of mid succession species. Before using any types of fertilizer, you should be aware of what plants will mature when in order to prevent their growth from being stunted. Ecological or "biological succession refers to the progression an ecosystem follows as it changes over time" (Time). There are four main designs of succession: classical linear succession to climax, linear succession to shifting mosaic, patch dynamics, and a hierarchy of successional causes. Some are based on pattern, some on process. Although



Clump: a dense, compact grouping with fairly definite edges; frequently one plant with many stems, or a plant and its daughters; somewhere between a tuft and a patch or troop in size

Mass, colony, carpet: a large, dense grouping with fairly definite edges; a huge clump, or many clumps or numerous individuals growing densely over a large area

Patch, troop: a dense, medium-size grouping with fairly definite edges; a medium clump, or several clumps, or many individuals growing in a clump

Tuft, cushion: a small, dense grouping with fairly definite edges; a small clump, or a few individuals growing closely together

Cluster: a loose clump, less compact, but still with fairly definite edges; often roundish, usually with fewer individuals than a clump

Constellation: a very loose cluster with few individuals, but still in a definite group; may take any shape

Drift: a grouping where the spacing between elements varies from dense near the middle to scattered at the edges; often in an overall pattern that is somewhat linear, curvilinear, or elliptical

Scatter: a helter-skelter accumulation; similar to a drift, but less dense, with no consistent pattern of density and not in an overall linear or curvilinear pattern; may cover a larger area than a drift

designing succession seems counterintuitive to a forest garden, it allows for a more accurate representation.

In a natural forest there is no one actively putting plants in the ground in a specific arrangement. Though a forest garden requires this there are ways of organizing it so it does not appear as purposeful and well-groomed as a formal garden. The chart on the right shows the different types of spacing you can have in your edible garden (Jacke). It is important to know the relationships between your plants and which ones complement each other best when choosing a planting pattern. We often organize orchards according to the regular cluster model but in the forest, this pattern may be a sign of competition for the same scarce resource. In a ‘naturalistic landscape’ landscape designers say that the clump and drift patterns look more appealing and realistic. In forests many different factors contribute to plant’s “distribution patterns, including soil pH and nutrients,

elevation, temperature regimes, moisture, water-table depths, and so on" (Jacke). Broadly, plants are either 'clumpers' or 'runners'.

When exploring diversity in choosing your plants, you must be familiar with your area's native diversity. A diverse system makes for maximum resilience against weather and disease. This way not all species will be wiped out at once if a detrimental event occurs. In eastern North America, our temperate deciduous forests grow on moist soils and exhibit high tree canopy richness and overall high evenness (meaning one species doesn't dominate to excess). If the goal of your edible forest garden is to increase natural communities, biodiversity, and wildlife, you may want to pay close attention to polycultures. Polycultures "are a human created analog of natural communities, [for example] a viceroy butterfly mimicking nature's monarch" (Jacke).

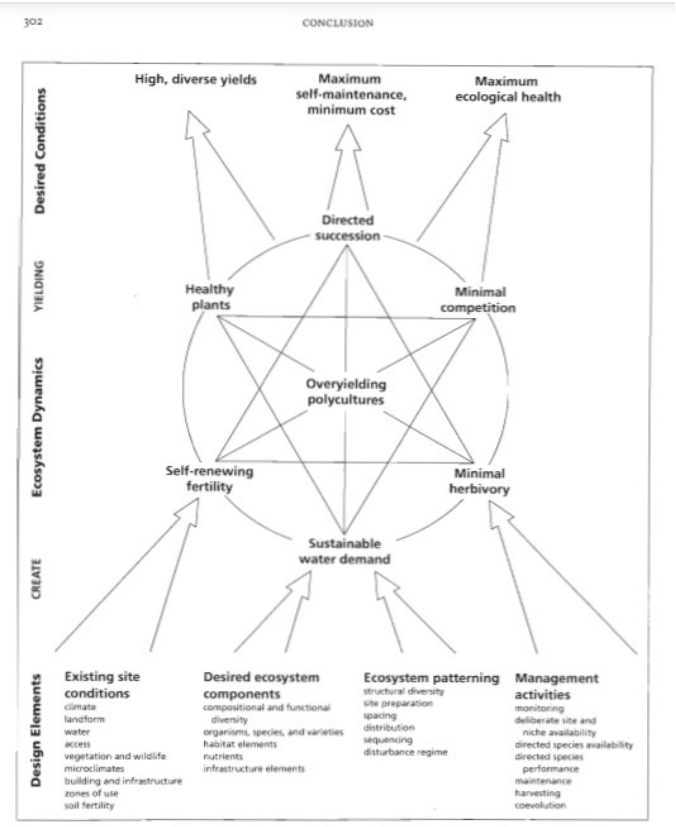


FIGURE 7.1. This diagram summarizes at a deeper level exactly what we are doing when we forest-garden: we use design elements to create ecosystem dynamics that, by their inherent nature, achieve our desired conditions. Volume 2 of this work delves into specifically how to use these design elements to create these ecosystem dynamics so our forest gardens generate our desired conditions.

The diagram on the right "summarizes at a deeper level exactly what we are doing when we forest-

garden" (Jacke, see figure caption). Forest gardens, even better, edible forest gardens are a wonderful community project to unite people with people and people with nature. The Earth is its own best caretaker and by essentially letting natural processes carry out by themselves your forest garden will be successful!

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