

Can small-scale forest gardening ensure food security in the face of climate change and the biodiversity crisis?

Food security is everyone having physical, social and financial access to sufficient safe and nutritious food at all times.^[1] With the global population expected to reach nearly 10 billion by 2050 this is increasingly challenging.^{[2][3]} Climate change is resulting in more extreme weather and increasingly difficult growing conditions.^[4] Without addressing this fewer staple food crops will tolerate the conditions, increasing the risk of famine.^[5] The biodiversity crisis also presents a significant risk to food security as pollinators, which are vital for 87/115 main food crops, decline and pests and diseases increase.^{[6][7]} If the biodiversity crisis is not addressed this leaves a smaller gene pool to develop pest/disease resistant varieties and crops reliant on insect pollination may fail. Additional challenges include; fair distribution globally, affordability and nutritional quality of food.^[1]

Small-scale forest gardening, particularly with agroforestry and permaculture principles, shows promise to achieve and maintain food security throughout the current climate and biodiversity crises and increase sustainability. However, a number of challenges remain before this approach can be widely implemented.

Agroforestry uses trees alongside crops with thought given to how the two interact.^[8] Permaculture is the concept of working with nature to achieve permanent agriculture through the ethics of earth care, people care and fair shares.^[9] Forest gardens combine agroforestry and permaculture into sustainable, productive and low maintenance systems by replicating natural woodland ecosystems, utilising predominantly perennial plants.^[10] A key feature is their (usually seven) layered structure (Figure 1) that require minimal inputs, once established, as natural forest ecosystems are self-sustaining.^[11]

Established forest gardens provide many beneficial outputs and services, including crop yields, building materials and natural habitat for animals and insects.^[12] Nothing gets wasted, excess crops are shared or processed for storage and waste is composted to recycle nutrients.^[13] This system differs significantly from traditional monoculture agriculture as the interactions of species negate the need for chemical fertilisers and pesticides.^[12] Forest gardens are suitable for a wide range of situations under both private and community ownership, not just in Scotland or other developed countries, as examples can be found worldwide including developing countries in Africa.^{[14][15][16]}

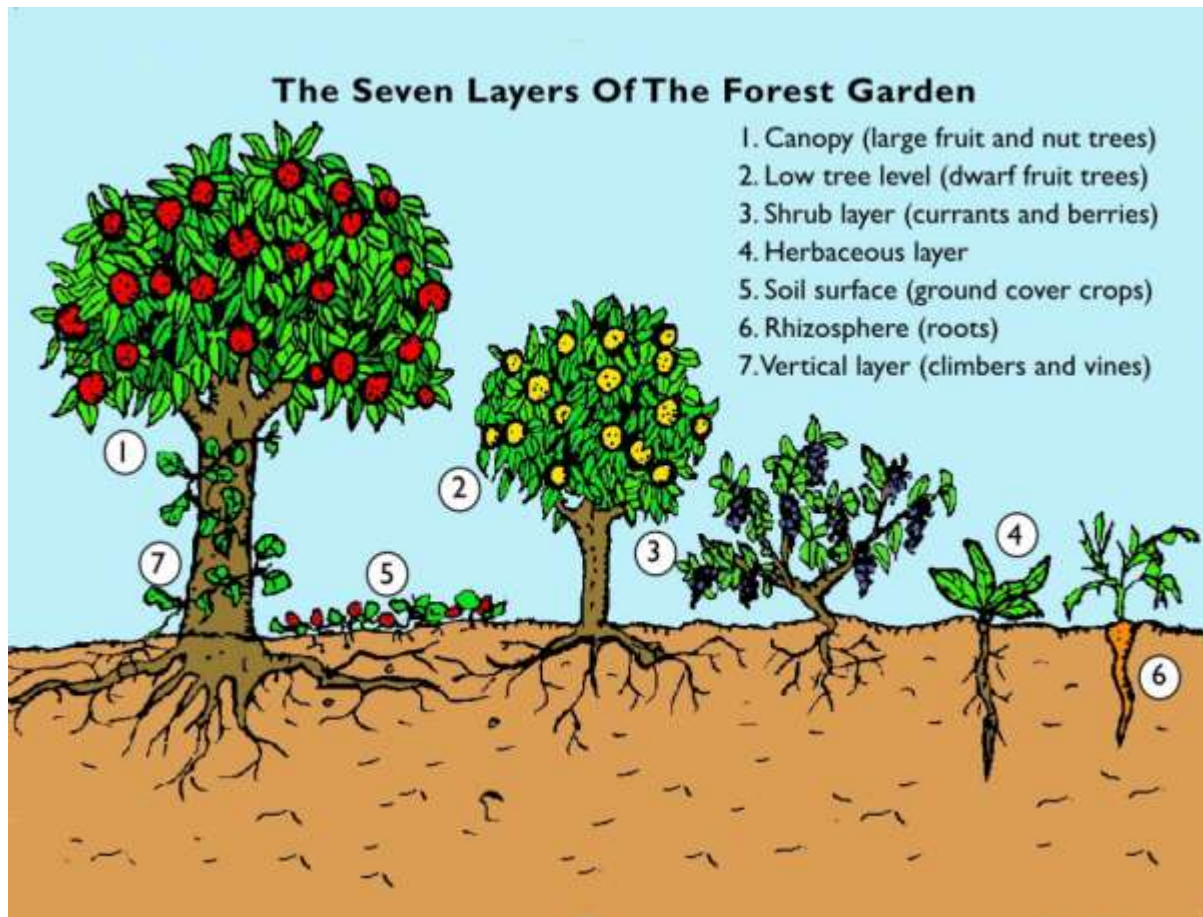


Figure 1. An illustration of the seven component layers usually incorporated in a forest garden design.^[17]

Forest gardens are more resilient to climate change, pests and diseases, being planted with diverse plants attracting and providing habitats for diverse creatures.^{[18][19]} Growing plants produce oxygen and capture carbon dioxide, helping to mitigate climate change. Trees stabilise the soil preventing top soil erosion and run off whilst regulating temperature and humidity, creating more hospitable microclimates.^[20] Incorporating nitrogen fixing plants removes the need for harmful petrochemical fertilisers, reducing risk of eutrophication in nearby waters.^[21] Forest gardens are designed on natural forest structures, leaving the system flexible enough for implementation across a range of climates.^[10] The diversity of crops and resources produced removes over-reliance on any single aspect to perform, thus stabilising income.^[22]

Food produced locally can reach market quicker, retaining more nutrients, creating less transport emissions and responding to market demands, avoiding waste. Producing food in home and community gardens makes good quality, highly nutritious food accessible, geographically and financially, regardless of socioeconomic status.^[23] Benefits of forest gardening extend beyond nutritional produce to improved physical, mental and community wellbeing.^[24] Small-scale forest gardening with agroforestry and permaculture principles shows promise to overcome the challenges faced by traditional agriculture in achieving food security, despite the climate and biodiversity crises.

Genetic diversity has already been lost.^[25] Small producers of open pollinated seeds cannot afford to register their seed varieties for sale.^[26] Multinational corporations increasingly sell F₁ hybrid seed so seeds saved from crops do not grow true, meaning varieties cannot be adapted to local microclimates.^[27] Forest garden crops may be unfamiliar, leading to wastage if their usage isn't understood.^[28] Land degradation and climate change increase the challenge of establishing new gardens (The Open University, 2020i).^[29] Planting choices require thought and expert knowledge of their needs to ensure success.^[11] Although requiring minimal inputs once established, some maintenance work is required so sufficient education and time is needed.^[22] Routes to market for excess produce to provide an income are lacking as initiatives such as The Food Assemblies were not continued.^[30] Despite increasing technological developments the typical working week remains at 35-37.5 hours to provide financial security leaving little free time to commit to establishing this way of gardening. As less people grow their own we become more removed from our food systems and local knowledge passed through generations is lost, requiring explicit teaching to be reinstated.^[31] Initial inputs can be expensive, particularly for good quality grafted fruit trees as this is currently a specialist pursuit rather than shared between gardens.^[32] Overall, a lack of political and economic will to implement supportive policies prevents this system being widely used.^[33]

Food security is vital for society globally and under increasing pressure from population growth. Key challenges to achieving and sustaining food security arise from climate change and the biodiversity crisis. Transitioning to small-scale forest gardening with agroforestry and permaculture principles would help to mitigate the climate and biodiversity crises. There are currently challenges to its wide scale adoption, however, these could be overcome with sufficient political and economic will. Supportive policies could enable forest gardening to be adopted more widely, bringing quality food into the heart of communities and improving food security.

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