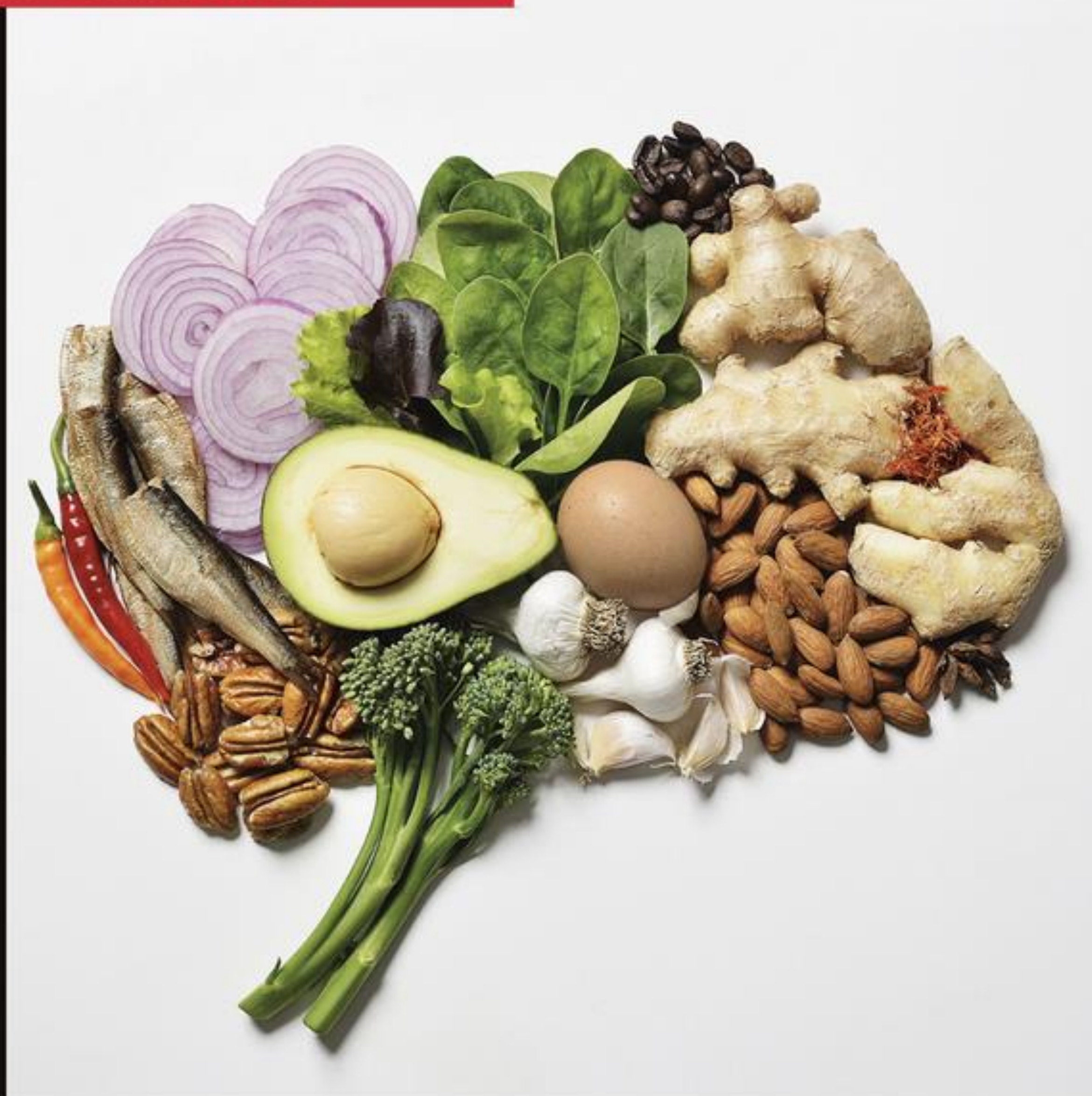
ROUTLEDGE ENVIRONMENT AND SUSTAINABILITY HANDBOOKS



Routledge Handbook of Sustainable Diets

Edited by Kathleen Kevany and Paolo Prosperi

earthscan from Routledge

Cover image: Getty Images

First published 2023 by Routledge
4 Park Square, Milton Park, Abingdon, Oxon OX14 4RN
and by Routledge
605 Third Avenue, New York, NY 10158
Routledge is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
Names: Kevany, Kathleen May, editor. | Prosperi, Paolo, 1979- editor.
Title: Routledge handbook of sustainable diets / edited by Kathleen Kevany and Paolo Prosperi.
Description: New York, NY : Routledge, 2023. | Includes bibliographical references and index.
Identifiers: LCCN 2022022903 (print) | LCCN 2022022904 (ebook) | ISBN 9781032004860 (hardback) | ISBN 9781032004976 (paperback) | ISBN 9781003174417 (ebook)
Subjects: LCSH: Food--Moral and ethical aspects. | Food habits--Environmental aspects. | Sustainable living.
Classification: LCC GE196 .R68 2023 (print) | LCC GE196 (ebook) | DDC 304.2--dc23/eng20221004
LC record available at https://lccn.loc.gov/2022022903
LC ebook record available at https://lccn.loc.gov/2022022904
ISBN: 978-1-032-00486-0 (hbk)
ISBN: 978-1-032-00497-6 (pbk)
ISBN: 978-1-003-17441-7 (ebk)

DOI: 10.4324/9781003174417

Typeset in Bembo
by Deanta Global Publishing Services, Chennai, India

Food gardens for sustainable diets in the Anthropocene

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[In *Routledge Handbook of Sustainable Diets*, Kevany, K.; Prosperi, P., eds., pp. 281-293. New York, & Oxon, UK: Routledge. DOI: 10.4324/9781003174417-28]

Introduction[1]

Food gardens with a mixture of plant species have likely been an important human subsistence strategy in many places for a long time, (e.g., 1500 years ago in Mesoamerica) (Slotten et al., 2020). So, it's not surprising that they have been a persistent component of programs and projects to improve household and community food production, nutrition, income and savings, and gender and social equity (Cleveland & Soleri, 1987). They have been a featured part of national emergency programs, such as Victory Gardens in the US during WW I, WW II, and the 1930s depression (Lawson, 2005). Since the 1950s, gardens have been part of many "development" programs in the Global South (GS), with some being sponsored by the Global North (GN) and by international organisations like the UN Food and Agriculture Organisation (FAO).

We define food garden diets as sustainable when they contribute positively—to human nutrition and health, community functioning, social equity, biodiversity, animal welfare, and environmental and climate stability—relative to other ways of obtaining food (Soleri et al., 2019). While data show that food garden diets can be sustainable, they can also be relatively unsustainable: It depends on how gardens function within their specific biophysical and social contexts.

The Anthropocene and food garden diets

Human impact on the Earth became so significant by the end of the 20th century that scientists proposed a new geological age, the Anthropocene epoch (Steffen et al., 2015). The Anthropocene is widely conceptualised to include the social, cultural, and economic consequences of increasing human population and per capita consumption, resulting in a public and planetary health crisis (IPCC, 2019; Nugent & Fottrell, 2019; Ripple et al., 2020; Steffen et al., 2018; Swinburn et al., 2019), including the anthropogenic climate crisis (ACC). As a result of these Anthropocene global trends, gardens face new challenges, and new strategies may be needed for them to be sustainable.

Based on our personal and professional experiences gardening and working with gardeners in different locations in the US and elsewhere in the GS and GN, and our research and review of the literature, we have found that successful Anthropocene food gardens depend on understanding their biophysical contexts through ecological and evolutionary thinking, and their social contexts including the roles of individual behaviours, social organisation, and knowledge systems. We have summarised these five key ideas in Figure 24.1 (Soleri et al., 2019).

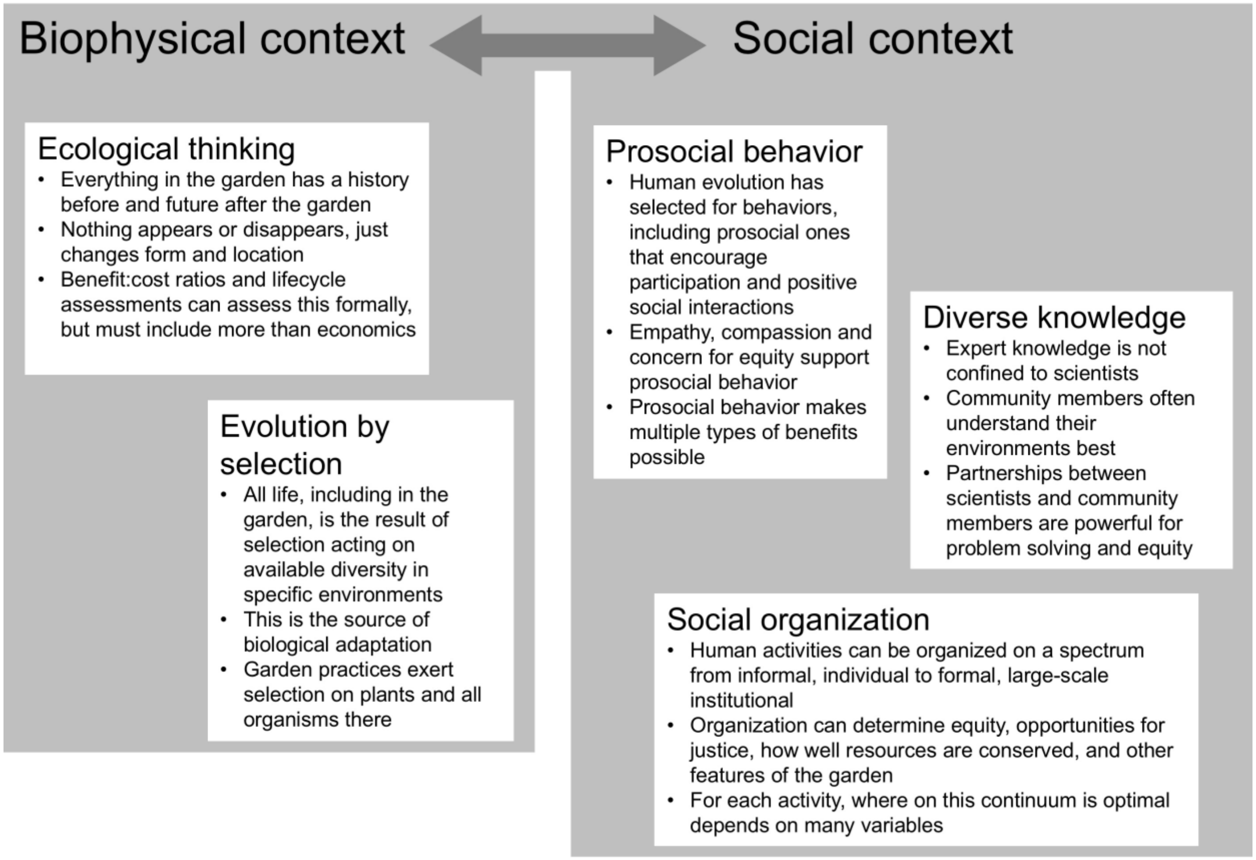


Figure 24.1 Five key ideas for fostering sustainable diets through food gardens. Adapted by the authors from Food Gardens for a Changing World (Soleri et al., 2019), used with permission.

In this chapter, we answer the following questions, with a focus on the US and GN.

What are the potential contributions of food gardens to sustainable diets?
What are the challenges for achieving this?
How can food gardens successfully respond to these challenges?

Potential contributions of food gardens to sustainable diets

Food systems are increasingly dominated by large corporations whose main goal is profit, resulting in diets dominated by ultra-processed foods (UPFs) and animal-based foods, which are environmentally, socially, and economically unsustainable. These diets dominate the GN and are spreading rapidly to the GS, resulting in a pandemic of non-communicable diseases, wide scale degradation of resources, exacerbated climate change, and increasing inequity and inequality (Swinburn et al., 2019). Food gardens today can support sustainability by contributing to physical and mental health, social and economic benefits, and environmental and climate stability.

Nourishing food for physical health

Fresh vegetables and fruit from the garden are good sources of many nutrients important for human health, including vitamins, minerals, and amino acids, as well as valuable non-nutrients like antioxidants and dietary fibre (Soleri et al., 2019). These garden foods can supplement diets, or replace UPFs, either with the same number of calories while providing more nutrients and healthy compounds, or with the same volume, reducing calories and also increasing healthfulness. Garden crops like basil, chilis, fenugreek, garlic chives, papaloquelite, and rose, feijoa, and calendula petals, can provide flavours and colours with cultural significance and help replace less healthy ingredients in the diet, like added sugars and salt. In the GN, working in gardens can also increase vegetable and fruit consumption, for example, by children and youth (Savoie-Roskos et al., 2017), and by community gardeners, compared with home gardeners or non-gardeners (Alaimo et al., 2008; Litt et al., 2011).

Mental health and social benefits

Food gardens can be "therapeutic landscapes" (Hale et al., 2011), and gardeners appreciate the physical, emotional, and social benefits of gardening (Egerer et al., 2018b; Waliczek et al., 2005). A study in Denver found that community gardeners' perception of how pleasant their neighbourhood is was positively associated with fruit and vegetable consumption, and with community gardening compared to home gardening or no gardening (Litt et al., 2011). Gardens provided members the opportunity to experience a diversity of social roles, including being leaders, followers, and learners (Teig et al., 2009).

Working in food gardens can increase awareness of biological and ecological processes, which improve gardeners' understanding of human and environmental health (Hale et al., 2011) and facilitate interactions with natural and social environments, especially in the poorest neighbourhoods (Voicu & Been, 2008). Participating in community gardens increases face to face interactions and can create mutual trust and social cohesion. In New York City, for example, gardens were the source of the social cohesion that was the basis of organising and mutual support following Hurricane Sandy in 2012 (Chan et al., 2017). Food gardens can also help immigrants and refugees feel connected through familiar activities (Wen Li et al., 2010). When controlled by gardeners themselves, gardens growing traditional crops and varieties can be a part of healing responses to the historical trauma that affects many people (e.g., African, Asian, Mexican, and Native Americans in the US) (Ramírez, 2015).

Community gardens may also be organised to increase access and social equity. For example, in Seattle, the P-Patch Community Garden Program comprises 89 gardens throughout the city, worked by hundreds of gardeners, who in 2020 contributed 1628 kg (3583 lb) of produce/month to local food assistance programs (SDN, 2021). In the same year, this program declared an antiracism focus, with commitments to revising plot applications to encourage and support BIPOC participation.

Economic sustainability

In the US, saving money is a major motivation for food gardening (NGA, 2014). The few studies available found garden harvest values to be from $12–$35 per m2, but these did not include the cost of inputs (Soleri et al., 2019). With resources becoming increasingly scarce and many growing environments becoming more stressful, the cost of inputs such as piped water or imported compost will become more important in calculating the economic sustainability of gardens; thinking in terms of ecological networks and life cycles of what comes into and out of the garden is essential.

Environmental sustainability

Compared with the industrial food system, food gardens can produce food in more environmentally sustainable ways, using less energy and resources per unit of food production, storage, cooling, and packaging (Cleveland et al., 2017). Fruit trees and other large perennials can capture and store carbon, absorb some soil pollutants, block the movement of airborne pollutants, and provide cooling and shade (Pataki et al., 2011). Gardens can attract and protect pollinators and other wildlife through their plant diversity and planting complexity (e.g., with tall and short plants and different growth habits and life cycles, Goddard et al., 2010).

Still, garden management determines whether they are providing positive ecosystem services or negative “disservices” (Cameron et al., 2012). Ecological thinking and consideration of the benefit:cost ratio is needed to distinguish between services and disservices. For example, it may take years for a transplanted fruit tree to sequester as much carbon in the plant as was released as a result of growing the tree, transporting it to the garden, and disturbing the soil during planting (Cameron et al., 2012).

Yields of harvested food per unit area are often greater from smaller areas, like gardens, primarily because small areas are more carefully managed. Gardens can also be more efficient in harvest per unit of other inputs like water or compost but are less efficient in harvest per unit of labour because of the time required. However, time spent in the garden is often a benefit rather than a cost. In addition, the environmental and social costs of the fossil fuels that increase labour efficiency in industrial agriculture would need to be calculated for an accurate estimate of their true efficiency.

The need to be vigilant

The many potential benefits of gardens for sustainable diets are not automatic. Even contributions from food gardens that are positive in some ways can have negative effects in others (Soleri et al., 2019) because they are embedded within larger inequitable, unjust, environmentally destructive food systems dominated by neoliberal economic policies that don’t prioritise individual, community, or planetary wellbeing (McClintock, 2014). That is, there are trade-offs. For example, the gardening industry promotes the use of toxic pesticides and herbicides, and crops with high water, nutrient, and management requirements, which can increase short term yields and improve diets. Yet these practices also have negative effects on the environment, biodiversity, and long-term human health.

An approach that integrates biophysical and social perspectives is needed, which can help us identify and weigh the trade-offs that will often be required. For example, garden projects that increase social equity in some ways can increase social inequity in others (McClintock, 2014). Garden space in housing projects can be a source of fresh vegetables and fruits but can promote gentrification and is not a substitute for structural changes that would result in better wages and living conditions, play spaces for children, or affordable grocery stores (Wolch et al., 2014).

Challenges to food garden sustainability in the Anthropocene

The need for the benefits of food gardens is greater than ever, but so too are the challenges to realising these benefits. These challenges go beyond the environmental and social variation gardeners are familiar with, to the novel challenges brought by the accelerating directional change that is the hallmark of the Anthropocene.

Familiar variation v. trends

To respond to these Anthropocene challenges in ways that will support food gardens for sustainable diets, we need to distinguish between familiar variation and trends. Experienced gardeners are aware of a range of familiar variation that affects them and their gardens (e.g., variation in the date of first frost, annual rainfall, or the size of pest populations), and they often have effective strategies for dealing with the range of this variation. In contrast, trends are changes that are directional and cumulative, lead to conditions not previously experienced, and present new challenges that may require new strategies.

The rates of change in trends over time can be accelerating. For example, the average rate of global temperature increase went from 0.04 °C (0.07 °F) per decade over the 70 years from 1880–1950, to 0.13 °C (0.23 °F) per decade over the 64 years from 1951–2015 (NOAA NCEI, 2016). Accelerating rates of change characterise trends in many indicators of the Anthropocene (Ripple et al., 2020). For all these reasons, trends can be especially challenging.

Trends challenging food garden contributions to sustainable diets

To support sustainable diets, food gardens must respond to four major Anthropocene trends: 1) Declining quantity and quality of garden resources like water and land; 2) the ACC; 3) rising social and economic inequity; and 4) an ageing, urbanising population.

Anthropocene trends can interact synergistically in ways that increase their combined impact. For example, the ACC is decreasing the quality and quantity of water in many areas, and existing inequitable structures of resource distribution mean that people most in need of food gardens have a harder time accessing water for irrigation.

However, the results of interacting variables are often difficult to predict. For example, because of the ACC, food gardens everywhere will experience increased atmospheric CO2 concentrations, but some areas will have higher temperatures and less precipitation, while others may receive the same amount of precipitation as in the past but it will arrive in more extreme weather events that diminish the water storage capacity. With so many interacting variables, the net effect of ACC on plants is difficult to predict in detail, but in general, growing food gardens will become more challenging. The effects of ACC also vary spatially. Parts of northern and southern Africa, southern Europe, and much of the western US will receive less precipitation (IPCC, 2014), meaning gardeners will have to supply more of the water their gardens need through irrigation. In other areas, like south Asia, northern Europe, and the north-eastern US, gardeners will be challenged by increasingly intense seasonal rainfall and flooding.

How food gardens can be a response to Anthropocene challenges

For food gardens to support sustainable diets now and in the future, they must be able to respond effectively to Anthropocene trends. Critical to success is understanding how these trends differ from familiar variation, and then responding by using observation, experimentation, and collaboration among gardeners and others across wide social and physical spaces.

Conceptualising change and response

The probability that trends will have a negative impact on food gardens depends on exposure to the change (how much and how frequently) and how sensitive the garden is to the change (Fellmann, 2012). This relationship can be quantitatively estimated, but gardeners can also use it qualitatively to see how to minimise exposure to a change by escaping it and reduce sensitivity by avoiding or tolerating potential harm.

Our ability to respond to change by reducing exposure and/or sensitivity to the effects of change, is our response capacity, as shown in Figure 24.2. Responding successfully leads to resilient, sustainable gardens—but resilience does not always mean returning to the way things were before. When a trend results in large changes, and increased uncertainty, resilience can also require successful transformation, such as replacing heat- and drought-sensitive crops that have been a good source of iron and vitamin C, like spinach, with new ones that are not so sensitive, like chard or nopales. Vulnerability is the negative impact experienced when our response capacity is inadequate.

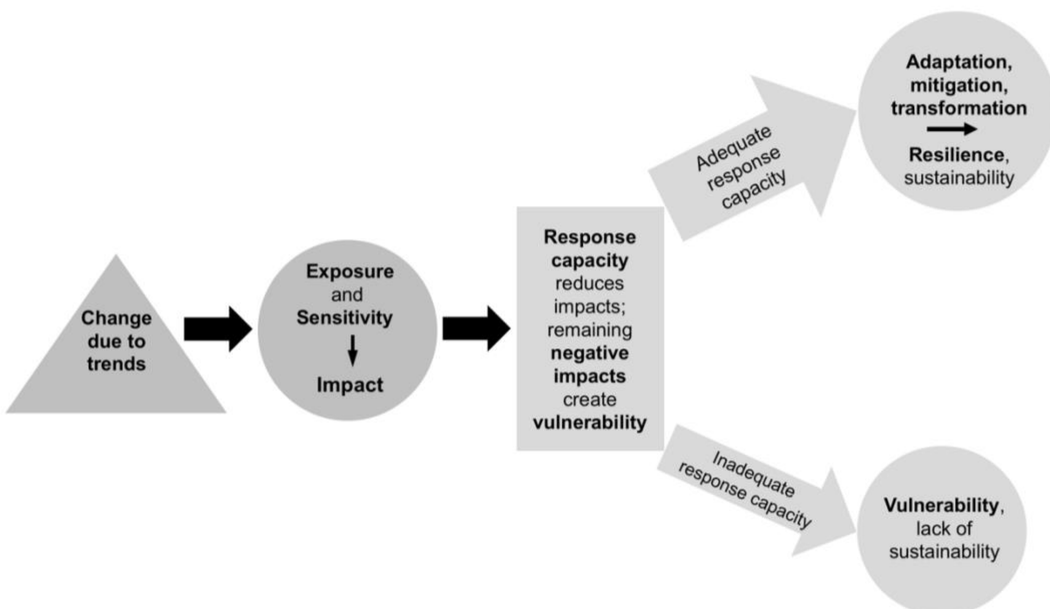
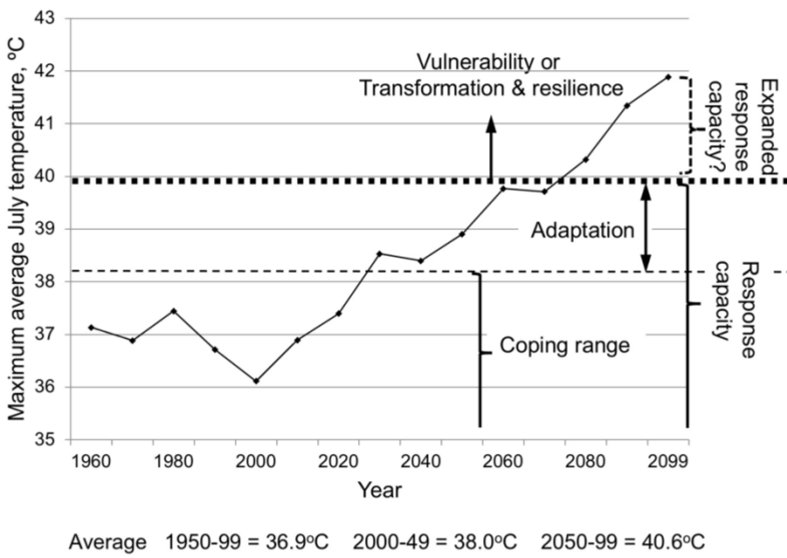


Figure 24.2 Responding to the changes of Anthropocene trends. Adapted by the authors from figure in Soleri et al., 2019, used with permission.

The greater our response capacity, the larger the range of conditions we can effectively respond to, remaining resilient, sustainable, and not be vulnerable to the negative impact of the changes (Fellmann, 2012). Coping is our capacity to respond to the recurring, temporary changes of familiar variation. But trends can result in new conditions with which gardeners have no experience. Therefore, responding requires more than coping—it requires behavioural adaptation to the changes we are experiencing now and preparation for the future (Fellmann, 2012), which frequently requires new strategies. It's important to keep the specific goals of our garden in mind so our responses to change support sustainable food garden diets. For example, if the main goal of a community garden is growing vegetables for members, responding to change would be very different than if the primary goal is to provide youth with outdoor activities.

Some trends have been predicted with certainty. For example, increasing temperature due to ACC means that in some locations the usual coping strategies won't be sufficient, and new strategies to adapt or transform will be needed, as shown in Figure 24.3. Gardeners can reduce exposure to heat by shading and mulching, reduce sensitivity by changing to more heat-tolerant crop varieties, and ask for ideas from gardeners who have experience working with high temperatures.



External uncertainty	Human response capacity	Resulting condition
Trend large, high uncertainty	Inadequate, unless transformation	Vulnerability; resilience if transform
Trend small, medium uncertainty	Adequate: adaptation, mitigation	Resilience
Familiar variation, no trend, low uncertainty	Adequate: coping	Resilience

Figure 24.3 Hypothesised scenario involving coping, adaptation, and vulnerability related to average daily maximum temperature in July (°C), 1950–2099, Bakersfield, California. Concept based in part on Fellmann (2012) and sources therein. Data (decadal means) from GIF (2018), observed data 1950–2015; 2016–2099 projections based on high emissions scenario [A2] and CNRM CM3 model; station GHCND: USW00023155. Adapted by the authors from figure in Food Gardens for a Changing World (Soleri et al., 2019), used with permission.

Other examples of responding to trends in order to maintain sustainable food gardens and diets are reducing sensitivity to increasing urbanization and population ageing by developing infrastructure and institutions that make gardening easier for older city dwellers; reducing sensitivity to rising social inequity by developing partnerships and policies supporting community gardens for food sovereignty in disenfranchised communities; and reducing exposure to, and mitigating, the diet-related noncommunicable disease pandemic by expanding community and school gardens for growing and eating fruits and vegetables, while providing physical activity and social interaction.

Observing, experimenting, and collaborating

Gardeners can improve response capacity, reduce vulnerability, and support mitigation through observation and experimentation to find effective practices, and by working together to connect and organize through networks and institutions. A key to effective observation and experimentation is the complementarity of local and formal scientific knowledge. It is increasingly recognized that the local knowledge of gardeners and farmers is similar to scientists' knowledge in many ways, since both are based on empirical observations over time of the same reality, and on testing relationships between different variables (Soleri & Cleveland, 2009).

Observing—Observant gardeners can understand a lot by simply looking carefully and consistently (e.g., at pest and beneficial organism activity). Observations can help gardeners determine which garden practises work best or compare ideas about improvements that can be made right away. For example, a gardener may compare a crop’s response to amounts of irrigation or added compost. However, informal experiments don’t control for variables other than those being experimented with, and therefore the results can sometimes be unclear, or not supported by subsequent experience. If this is the case, more formal experiments that minimise confounding variation can be used to make the results more reliable. These experiments will require more work, time, and often space, so are most appropriate for school and community gardens (Soleri et al., 2019).

Experiments—Formal garden experiments typically involve identification of a hypothesis to be tested, including dependent and independent variables. Formal experiments can quantify responses to those variables, giving gardeners a more certain, generalisable understanding of the benefits and costs of gardening practices than is possible with single-year informal experiments. With this understanding, gardeners can adjust to increase the benefit:cost ratio by modifying or eliminating a crop, practise, or output with a low benefit:cost, or increasing those with high benefit:cost.

When estimating benefit:cost, it is important to include inputs as well as outputs and measure variables that are good indicators of the garden’s goals. Harvests are a key output and can be measured in different ways (Soleri et al., 2019) but may not be appropriate for many gardeners’ goals. For example, if the goal is improved nutrition, indicators should include the amount harvested, its nutrient content, and how much is eaten and by whom. Garden impacts on social networks can be measured with short surveys, asking how many and what type of new acquaintances and friendships gardeners developed through the garden (Grewell, 2015). Inputs, or costs, also have to be measured in order to estimate benefit:cost ratios. In locations where droughts and water scarcity are increasing due to ACC, documenting garden outputs per unit of water used is especially important (see Cleveland et al., 1985).

Working together—Anthropocene trends have increased awareness of the need to consider and manage food gardens on broader community, regional, and even global scales. For example, a three-year study of urban community gardens in California documented how regional social and environmental change affects garden regulations and gardeners’ management decisions, which in turn affect biodiversity and ecological functioning of the entire community garden and the larger surrounding area (Lin & Egerer, 2020). Working together in formal and informal institutions with shared rules of interaction regarding a resource or process (Soleri et al., 2019) increases response capacity by expanding the social and biophysical resources available to achieve goals. For example, in gardens with more rules and regulations around water use, gardeners tend to use less water (Egerer et al., 2018a), thus conserving more of that resource, and enabling more to have access to it.

The five key ideas outlined earlier (see Figure 24.1) support working together effectively, such as ecological thinking for garden sustainability in larger contexts. Quantifying the impacts of different forms of composting by household gardeners (none, household, municipal) we found that waste management organised at a larger municipal scale, including methane capture and energy generation, would result in lower greenhouse gas emissions than household composting (Cleveland et al., 2017). This information could be used by gardeners to encourage prosocial action by local governments to create these facilities.

Some gardeners are developing and maintaining their own, locally grown seed stocks, and identifying new varieties to adapt to and mitigate ACC, based on an understanding of evolution by selection. Gardeners also do this by working together to create seed libraries, prosocial institutions supporting semi-formal, non-commercial seed systems with free access to seeds and information (Soleri, 2017). Seed libraries and similar institutions are organised at a community or regional scale, often encourage diverse forms of knowledge, and have been increasing rapidly in response to the Anthropocene trends of biodiversity loss and increasing neoliberal domination of the food system. In a few cases, working together in these kinds of semi-formal seed institutions expanded the response capacity when the COVID-19 pandemic occurred (Soleri et al., 2022).

Responding to the COVID-19 pandemic with social innovation

The beginning of the COVID-19 pandemic coincided with the northern hemisphere spring planting season and led to a dramatic increase in the demand for garden seed in the US, as people looked to gardens for fresh food, outdoor exercise, and improved mental health. Commercial seed suppliers could not keep up with that demand due to lack of staff and new public health requirements; many suppliers shut down for a time. Recognising the need, some small, semi-formal garden seed organisations built on their prosocial practices, expanding their response capacity. Two such US-based institutions are Richmond Grows Seed Lending Library (RGSLL), which was established in 2010 in Richmond, CA; and the Experimental Farm Network (EFN), founded in 2013, which started the Community Garden Commission (CGC) in March 2020 (Soleri et al., 2022). Both RGSLL and EFN have biological investigations into community-scale biodiversity conservation and crop adaptation, and implicit social investigations into prosocial processes and practises including common pool resource management and mutual aid. In March 2020, using different strategies, RGSLL and EFN, through the CGC, pivoted quickly from their biological investigations of local seed and built on their social investigations to provide emergency seed and gardening support. With 60 volunteers, RGSLL created 12 tiny free seed libraries across Richmond, distributing 20,000 seed packets in 2020. Hundreds of people joined CGC and established 257 seed distribution hubs in 41 states, providing seeds to approximately 12,000 gardeners in 2020, as well as establishing working groups to discuss and take action in areas such as food systems policy. As seen during the COVID crisis, both organisations' investigations of social processes offered pathways to more just and effective responses by food gardeners to Anthropocene crises.

Recommendations and conclusions

Food gardens at the level of household, community, school, or workplace can be a key part of sustainable diets in the Anthropocene. They can contribute to a diversity of benefits, including increased availability and consumption of healthy foods, physical and mental wellbeing, social interactions, community organisation, resource sharing, and ecological stability. However, attaining these benefits is not inevitable; it requires ongoing engagement, inquiry, and evaluation.

A major cause of the Anthropocene crises is the emphasis on the human traits of materialism, selfishness, short-sightedness, and individuality, embodied by the assumptions of neoliberalism. To successfully respond to the challenges of Anthropocene trends, we need to emphasise different human traits—creativity, compassion, generosity, and prosociality. The empirically-based knowledge of both gardeners and scientists also is needed to counter the unsupported assumptions of neoliberalism.

The five key ideas described in Figure 24.1 summarise the core of such a successful response. The combination of prosocial values and concepts from scientific research that underpin these ideas provide an empirically-based counter to neoliberal assumptions. These key ideas can help gardeners and their allies develop responses to Anthropocene challenges that support goals of equity and justice, healthy people, communities and environments, a more stable climate, and sustainable diets.

Note

[1]*Acknowledgements*. This chapter is based in part on our book, *Food Gardens for a Changing World* (Soleri, Cleveland, & Smith, 2019).

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