CHAPTER 14

Agroecological Symbiosis

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Abstract

Food systems present a nexus of challenges and potential solutions to the unsustainable global crises of the Anthropocene. Most of humanity interacts with multiple food systems as a result of being involved in our highly globalized, extractivist, and productivist paradigm. This chapter explores Agroecological Symbiosis as a situated example of a food-system (re)design aimed at fostering sustainable interactions from environmental, economic, and sociocultural perspectives. This chapter contributes to our understanding of sustainability through the many emergent and interconnected elements of food systems. We ground the theoretical enquiry in lived

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experience by drawing parallels to the real-world case example of Agroecological Symbiosis. In light of the complexity and interconnectedness of food systems, careful contextualization is needed to enact meaningful sustainable transitions in food systems. There is no one-size-fits-all approach to food systems (re)design, and a variety of actions along the whole food system are required.

Sitting Down at the Table

> We do not know how bread is made, how cloth is woven, how a table is manufactured, how glass is made. We consume, as we produce, without any concrete relatedness to the objects with which we deal; we live in a world of things, and our only connection with them is that we know how to manipulate or to consume them.
>
> Erich Fromm, *The Sane Society* (1990: 130)

People gather down both sides of the long tables, with exuberant conversations and easy smiles—this is a joyful space. Folks mingle about the vendor tables, kids run through the crowd, sellers stand behind collections of hand-crafted goods and wares for sale. The air is warm and heavy with the smell of coffee and cake. The room buzzes and hums with layers of sound: steady conversation punctuated by a child's shriek of delight and the sharp sound of chairs scraping on the floor. An accordion player springs to life in the far corner, adding a festive layer over the din. To move through the crowd is akin to swimming through molasses. Karelian pies piled high with egg butter and other sweet and savoury home-made delights, edible expressions of the Finnish countryside.

This space is pure energy. However, as the event ends and the groups break up, it is gone as quickly as it forms. While ephemeral, it is powerful, and the air vibrates with the promise that this will happen again.

The above is a brief sensory description of a visit to the farm market at Knehtilä Farm in Palopuro Village, Finland. The Knehtilä Farm is part of a pilot project called Agroecological Symbiosis (AES). This food system experiment is premised on closing biomass loops and supporting a vibrant and viable countryside. The Palopuro AES is an example of the development of sustainable localized systems for human-scale production and processing of organic food (Helenius et al. 2017). The term 'human-scale' is used here to refer to an agricultural system designed from the ground up with localized sociocultural, environmental, and economic perspectives (see Chapter 7 on *Scales* in this book). This is not a 'sustainable' iteration of an industrial-conventional agricultural model, but an agricultural model designed around a locality in which people live and are an integral part of the agricultural system (Condon et al. 2010). In this iteration of the AES concept, there are four local organic farms, an anaerobic digester for biogas production, and a farm cafe/market. Organic farming does not rely on synthetic chemical fertilizers and pesticides, and further differs from conventional farming in that organic agriculture has certification requirements that aim to integrate agroecological practices to nourish plants while conserving water and soil resources (Gliessman 2014).

Agroecological practices approach food systems holistically. On a fundamental level, agroecological food systems are based on developing and supporting sustainable food system practices that encompass the environmental, economic, and social aspects of food systems. Agroecology is a science, a practice, and a relational approach to food both socially and culturally (Gliessman 2014). It was developed in the 1970s as agronomists recognized the value of ecosystem approaches to understanding the science of agriculture (2014). As a practice-oriented way of relating to agricultural systems, agroecology regards the cultivated and uncultivated landscape as part of an integrated ecosystem, rather than agricultural practice as removed from nature (Helenius, Wezel and Francis 2019).

The scope of this chapter is to present a brief introduction to aspects of sustainable food systems. To this end, we use Palopuro AES as a situated example of a sustainable food system model. Our objective is to introduce a real-world case study of a food system designed to support wider goals of sustainability. We follow the examples of Haraway's (1988) 'situated knowledges' and Sze's (2018) 'situated sustainability', which rely on analyzing context, power, and positionality. To better understand sustainable food systems, we demonstrate situated sustainable practices through an AES case that has established tangible, local solutions to the larger challenges facing food systems on a global scale.

Agroecological Symbiosis: Human-Scale Food System (Re)design

Agroecological Symbiosis is a contextually situated application of agroecological knowledge and processes. AES uses an agroecological lens to interpret, understand, and redesign the functions of localized agricultural practices and food systems (Francis et al. 2003). A food system encompasses all aspects of production, processing, and consumption of food, and includes all the interrelated actors associated with each of the multiple levels from farm to fork (Willett et al. 2019). AES is essentially a series of recommendations for the structure and interaction of adjacent agricultural entities for cooperation that promotes locally and regionally sustainable food systems (Koppelmäki et al. 2016). As a concept, AES is intended to be adaptable on different scales in a variety of settings and to allow for the intentional contextualization of food systems in practice. Each AES is designed to correspond to the sociocultural and environmental strengths and constraints of the area in which it operates (Helenius et al. 2017; Helenius et al. 2020).

AES is a situated development of food systems focused on the relocalization of production, processing, and consumption of food products. Palopuro AES was established to close the energy loop through nutrient (re)cycling and making use of system-produced bioenergy (Koppelmäki et al. 2019). Beyond the environmental considerations, the Palopuro AES provides a living example of a localized food system that acknowledges the place-based natural and social components of agricultural systems (Koppelmäki et al. 2019, see also Chapter 13 on *Traditional Ecological Knowledge* in this book). The Palopuro AES reveals the processes and interconnections of how food gets to consumers, where it comes from, who interacts with it, and where it goes when consumers are not using it (Clapp 2016). AES provides an alternative to the globalized food chain, whose predominant extractivist paradigm deepens the agricultural metabolic rift, with continued depletion of natural resources and production taking place far from the places of consumption (Patel and Moore 2017; see Chapter 17 on *Extractivism* in this book).

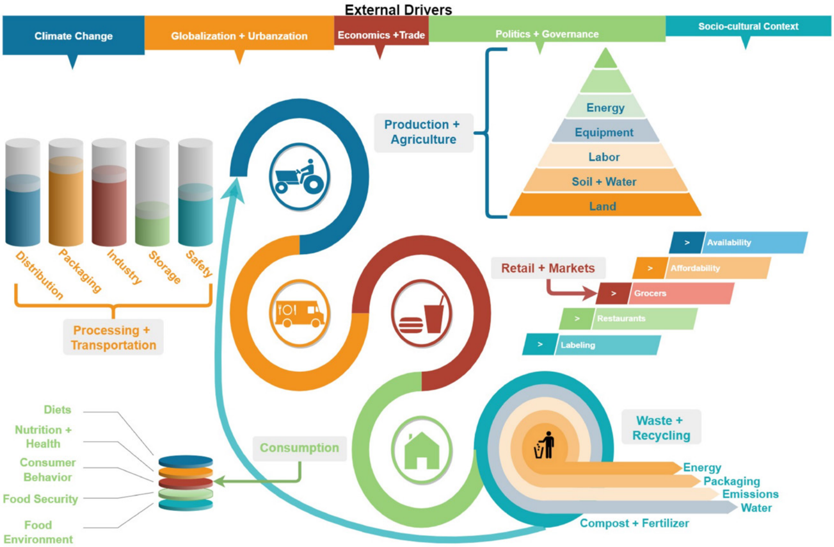

Figure 14.1: The globalized food system is a complex system of connection and interconnections between the environment, economy, and society. This figure illustrates some of the many facets and connections present in the overarching global food system. Adapted from the Food Systems Dashboard (Johns Hopkins University 2020).

Global-Level Pressures on Food Systems

Food systems are crucial for supporting sustainable futures because they crosscut globally interconnected biophysical, economic, and sociocultural spheres (Tuomisto et al. 2017). Figure 14.1 provides a top-level overview of some of the many facets that comprise the global food system. As this figure illustrates, there are many entities involved and connected at different scales with many overall external drivers of the food system. Figure 14.2 depicts current examples of inequality, waste, and excess within the system, which make achieving healthy and sustainable food systems challenging (Foley et al. 2011). Current industrial agricultural practices, in combination with expanding deforestation and competition for land, energy, and water, have pushed the Earth system well beyond its planetary boundaries (Steffen et al. 2015). Productivist agricultural practices, especially mono-cropping, have systematically stressed the Earth's biosphere integrity (i.e., genetic

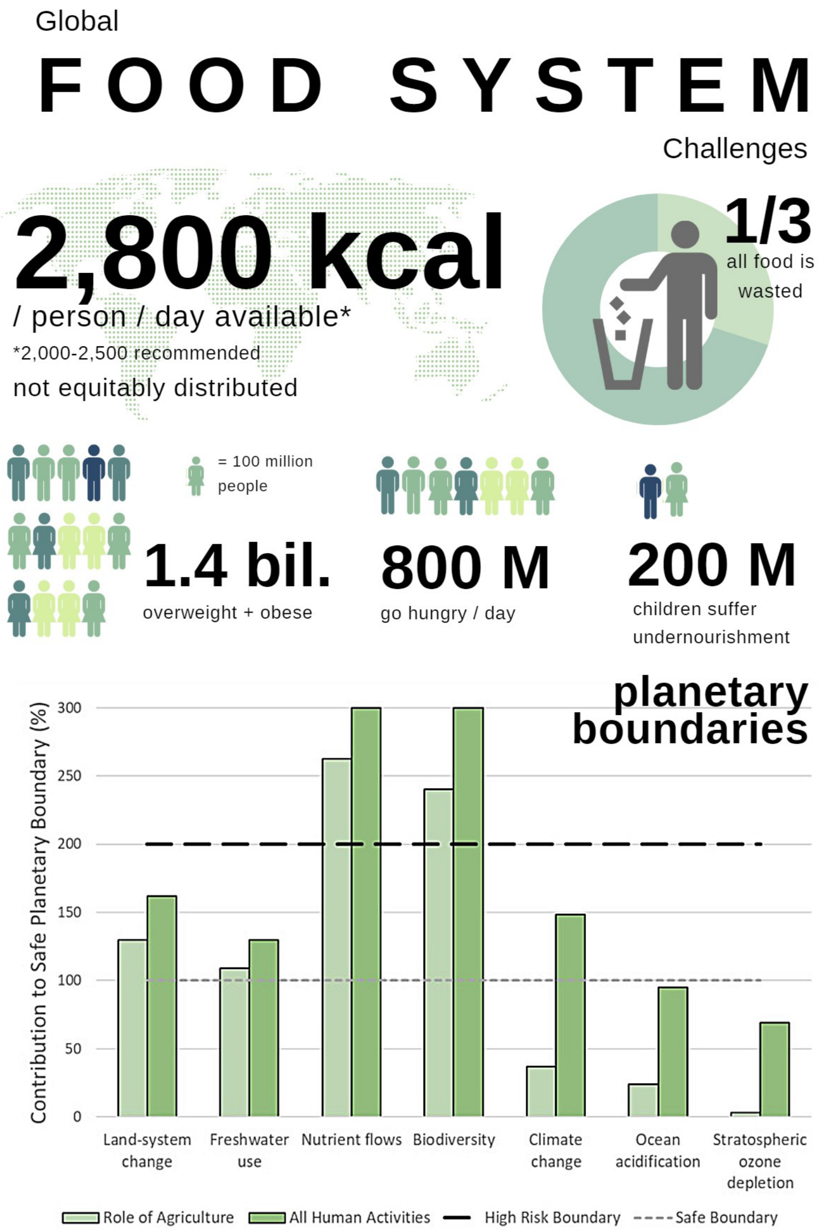

Figure 14.2: Major global food systems challenges, highlighting the impacts of agriculture and nutrition inequities (FAO 2019; Haddad et al. 2016). Planetary boundaries show the role of agriculture in all human activities as they impact or surpass safe and high-risk boundaries (Campbell et al. 2017).

and functional biodiversity) and biogeochemical flows (Campbell et al. 2017).

Our globalized, fast-paced food system has accustomed people to 'McDonaldized' foods that are efficient, calculated, predictable, and controlled (Ritzer 2013: 1–26, 186–88). Bolstered by societal demands, foods are faster, pre-made meals are meatier, and people are eating more, which is efficient in production, but deficient in nutrients (FAO 2018). Streamlined food systems, while they have supported the creation of 'cheap' food, have homogenized cultures and caused huge negative impacts on human health and the planet (Patel and Moore 2017). Trade liberalization has also caused major shifts in institutional practices and led to the growth of transnational food corporations and greater food industry marketing for normalized processed/packaged products (Vermeulen, Campbell and Ingram 2012).

Food is more than simply the nutrition it provides. There are sociocultural components that must be honoured when designing sustainable food systems. Wide disparities exist between having food security (i.e., adequate access to, availability, stability of, and being able to utilize food) and food sovereignty (i.e., the right of producers and consumers to have a say in how the food system is set up, regulated, and maintained) (Desmarais and Wittman 2014; Rosset 2008). Global diets are changing reciprocally with the global food system. For example, the increased global demand for livestock products, in parallel with increasing wealth and the urbanization of populations, is one of the main drivers of environmental changes (Willett et al. 2019). Compared to plant-based food, livestock products generate generally higher environmental impacts, such as climate change and land use, water resource depletion, and pollution of waterways (Willett et al. 2019). Worldwide, rates of hunger and undernutrition have fallen, meaning lower mortality rates and improved lives for millions of people (Haddad et al. 2016). Yet concurrently, the rates of overweight, obesity, and diet-related chronic disease (e.g., diabetes and hypertension) are increasing in every region globally (Haddad et al. 2016).

Other factors that impact food systems include power relations and imbalances, which can serve as supports or barriers to sustainable transition (see Chapter 10 on *Exclusion and Inequality* in this book). The roles of power relations are particularly important in developing a contextual understanding of food systems. For many, the privilege of making conscious, directed, sustainable choices is limited due to the daily need to find food and have enough time and energy to prepare it. The varying power relations at play in food systems come from an increasingly globalized and neoliberal paradigm (Tilman and Clark 2014). For example, large agribusinesses (e.g., Monsanto, Bayer) have dominated global fertilizer markets, forced farmers into buying corporate seeds annually, and maintained lobbies that wield vast influence over governments (Clapp and Scrinis 2017).

Sustainability and Food Systems

Food systems are complex and context-dependent, interacting simultaneously on many spatial scales and in multiple temporal dimensions (see Chapter 7 on *Scales* in this book). Depending on how these food systems are designed and managed, they can support sustainability, or they can contribute to worsening climate change, environmental degradation, and social and health inequities (Willett et al. 2019). Global and regional interventions and measures for food system redesign run the risk of overlooking the importance of local conditions when attempting to manage or ameliorate sustainability challenges. There is a persistent need for contextualization when discussing food systems at all scales. One-size-fits-all approaches to food system transition will not bring about meaningful changes (Hinrichs 2014).

What constitutes a sustainable food system? There are many interpretations of what combination of factors makes a food system sustainable. Willett et al. define a 'safe operating space for food systems' as 'a space that is defined by scientific targets for human health and environmentally sustainable food production... operating within this space allows humanity to feed healthy diets to about 10 billion people within environmental limits of the earth system' (2019: 450). According to the United Nations, a sustainable food system 'is a food system that delivers food and nutrition security for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised' (UN 2015: 32). In addition to food security, sustainable food systems must also consider the food sovereignty of the participants in the system. This means designing and implementing systems that support the 'right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems' (La Via Campesina 2007).

AES is an example of a food system model that can improve sustainability and address the issues of the global-level pressures of food systems on a context-based, local scale.

Is AES a Sustainable Food System?

Environmental, Economic, and Sociocultural Properties Of Palopuro AES

AES systems address the issues of unsustainable global food systems and model greater resilience to environmental changes. For example, AES uses crop rotation, including clover-grass lays, to improve the soil structure and, therefore, the long-term productivity of the soil and resilience to climate change (Helenius et al. 2017). Clover crops fix nitrogen from the atmosphere so that synthetic nitrogen fertilizers are not needed, which reduces the environmental impacts of input production and improves the self-sufficiency of the farm. Chemical pesticides are not used in AES, which increases biodiversity and reduces ecotoxicity, lessening the potential for human health issues. In mixed-farming systems that contain livestock and crop production, the nutrients can be recycled efficiently, and losses to waterways are reduced. Anaerobic digestion of the manure and crop residues improves the quality of the fertilizers and provides renewable energy for the farm, which reduces dependency on fossil fuels.

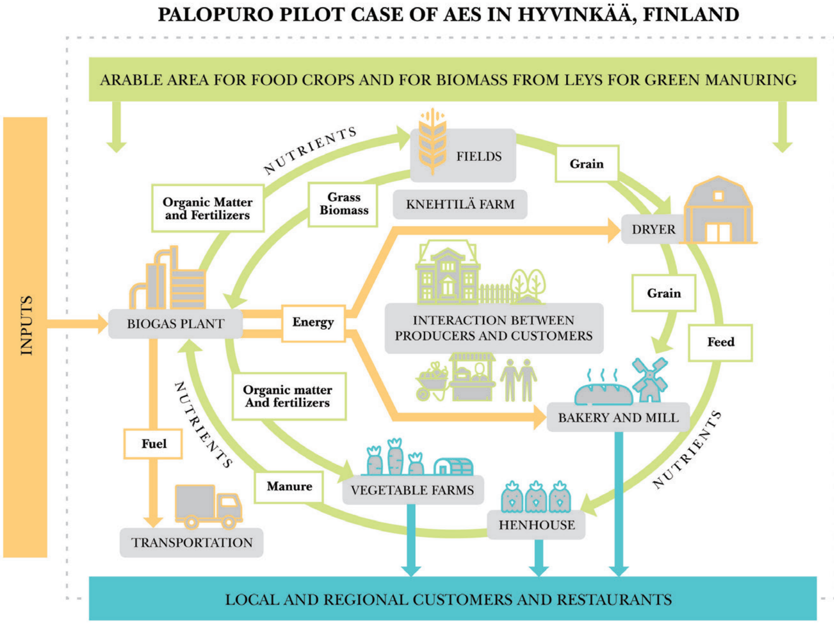

Figure 14.3: The idealized AES model for Palopuro village from the perspective of nutrient and energy flows. **Note:** the interaction between the producers and consumers through the farm market is at the heart of the AES model. This figure is developed from a figure used in Koppelmäki et al. (2019).

Palopuro AES recycles organic materials to produce biofuel and fertilizers (Koppelmäki et al. 2019). The manure from the animal operations, the excess silage from the organic leys, and other crop residues are combined and deposited in an on-farm anaerobic digester. The anaerobic digester converts the organic material to biogas (i.e., gas consisting mainly of methane and carbon dioxide) and digestate (i.e., the remaining solid and liquid fractions of the organic materials). The resulting digestate is used as a fertilizer for the grain and vegetable fields. The biogas produced is used to run the machinery on the farm, with the excess sold to power consumer vehicles. This creates a system, depicted in Figure 14.3, wherein the nutrients from the side streams of organic materials are recycled and subsequently used as biofuel. This system was developed from the grassroots level; the farmers themselves wanted a way to use their side streams and create biofuel on a local scale (Koppelmäki et al. 2019).

The AES model also acknowledges the economic facet of sustainability through a focus on creating actionable opportunities for farmers to operate profitable farms. In the Palopuro AES, one way this is achieved is through side-stepping the raw materials market and making their own value-added products. Food processing, in addition to food production, is performed at the farm level. Bringing food processing into closer proximity to food production serves to reduce the number of steps in the supply chain and reduces the need for intermediaries (Koppelmäki et al. 2016; Helenius et al. 2020). This allows the farmers to retain a greater degree of autonomy. Such autonomy is important, as many farming practices are no longer independently viable due to the contrasting economic properties of the global food system. AES systems directly improve unsustainable food systems issues by increasing the profitability of farms, creating jobs in rural areas, and boosting rural economies.

The sociocultural aspects of the Palopuro AES are represented most strongly through the farm-market events, which, in essence, bring the community into the farmers' front yards. Social and cultural reclamation and education happen through activities at the farm markets. The markets consist of prepared food, vegetable, and handicraft vendors. In addition, there is usually musical and/or other forms of entertainment and expressions of cultural traditions. These events are attended by several hundred participants and have occurred regularly since 2012. The AES model actively promotes the inclusion and creation of community spaces as an aspect of food system redesign.

The community and sociocultural supports in this AES juxtapose more globalized systems by bringing producers and consumers into closer contact. Such localization and connections work to boost the food literacy of the consumers in the community who interact with the AES. Consumers have direct knowledge and appreciation of where their food comes from, how it is produced, the working conditions of farmers, and how AES practices improve the sustainability of their local food system. Further connections foster improved food security through the availability of local food in stable, accessible, available, and utilizable ways that are less reliant on external inputs. Food sovereignty is also addressed by localizing the systems, giving producers more power and control over their means of production, processing, and interacting with consumers.

Conclusion

In a successfully redesigned local (or broader) food system, the goal is not to apply a single iteration of the AES model to solve all problems and implement all sustainable solutions, but rather to develop a network of overlapping systems that are able to respond as a whole to the unsustainable practices of each particular place. The overarching goal of the AES model is to create a localized food system premised on transparent biomass cycling, human-scale food production, and supporting liveable and viable countrysides. The AES pilot project at Palopuro, used here as an example of situated sustainability, continues to evolve and develop in support of these overarching goals.

Transitions to sustainable food systems will require a variety of actions across the entire system. The risks of unsustainable food systems are felt globally, but lack of action in a concerted and timely manner will likely cause the greatest impact on local agricultural livelihoods, resources, and food availability (FAO 2011). If significant changes in production and consumption are not made, the impacts of climate changes on food systems will be significant, disproportionately affecting poorer populations more than wealthy ones (Vermeulen, Campbell and Ingram 2012). Given the negative environmental impacts and the extreme pressure that food production has placed on our planetary boundaries, agriculture, and the food systems feeding the world need to make large course corrective shifts (Willett et al. 2019). Many possible future food systems have been suggested that address the environmental, economic, sociocultural, and other dimensions of sustainability discussed. Major changes are needed on multiple levels to enact food systems (re)designs that support sustainability.

Even in the face of such challenges, there are actions that can be taken to transition to sustainable food systems. Recommended actions include adopting healthy diets following national dietary guidelines and reducing animal-based foods (Willett et al. 2019), implementing novel foods and technological solutions (e.g., cellular agriculture, insects, seaweed, mycoproteins) (Parodi et al. 2018), reducing food losses and waste (Kummu et al. 2018), and leveraging strategic economic and fiscal incentives (e.g., eco-taxes and eco-labelling, marketing and education around new foods, and subsidies) (Lindgren et al. 2018). Furthermore, deeper paradigmatic shifts in the ontologies underlying diets have also been suggested for transitions to 'post-Anthropocene diets' for sustainable future food systems (Mazac and Tuomisto 2020). All suggested actions complement and support the development of localized systems such as the AES model. The opportunities and challenges of future sustainable food systems highlight the importance of context-dependent solutions.

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