A Good Food Journey

Investigating the Wisdom of Regenerative Food Systems in Arid Regions

by

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ABSTRACT

Good food, or food that is good for people and planet, demands a different worldview and approach than the current industrial food system. As an ecofeminist researcher who values reciprocity, justice, and a holistic approach, my research investigates varying good food perspectives by integrating scientific evidence and practical experience. Specifically, I explore the opportunities climatic change have created for innovative and solutions-oriented small-scale food systems techniques in arid regions to define, identify, regulate and communicate good food and its related practices. A significant gap exists between current small-scale good food practices and how they can fit and be valorized into a wider food system. This dissertation combines social science and arts-based methodologies with the intention of digging deeper to understand what is required to support a food system that produces good food. This dissertation is broken down into three deliverables, bound by this introduction and a conclusion: (1) a theoretical research framework for regenerative food systems, grounded in biomimicry and traditional ecological knowledge (TEK) defining and identifying good food and the systems that produce it, (2) a research paper that follows three traditional fermented foods in Arizona to contextualize their socio-cultural aspects within a regulatory framework and propose a way to make food governance more inclusive, and (3) an analytical autoethnographic exploration of the normative aspect of sustainability, and how it can be more regenerative. The narrative is an exploration through the author's past, present and future in finding ways to instill more regenerative practices in their life in Arizona, as well as amplify the voices of others using podcasts. The dissertation aims to expand the field of food system sustainability to be more inclusive of diverse knowledge systems and arts-based methods in creating an understanding of good food in arid regions.

DEDICATION

To the indigenous communities and natural ecosystems that sustain them throughout the world. To all those who have continued to steward and protect the land and life living on it, who carry forward the legacy of generations of learning. May we all learn to walk in their footsteps and learn from their wisdom to create a world of bounty.

ACKNOWLEDGMENTS

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I thank all my friends and family who have supported and cheered me on from Egypt, Arizona, and globally. I want to thank the people in my networks like the Slow Food Network. The list is way too long to spell out. To my students who have given me a reason to be interested in working in sustainability.

I acknowledge the twenty-two Native Nations that have inhabited this land, now called Arizona. I currently reside on ancestral territories of the Akimel O'odham (Pima) and Pee Posh (Maricopa) Indian Communities, whose care and protection of these lands allows us to be here today. I also acknowledge and pay respect to Indigenous elders – past, present, and future – who steward their lands throughout the generations and who have taught me deep lessons in sustainability pertinent to this research.

I acknowledge all forms of nature, including the invisible microbes which connect us in a web of connections, and even the not as welcome viruses such as SARS-CoV-2, that taught me how to be adaptable and more resilient. I acknowledge the thousands of plants and animals that have nourished me and my family along the way, and the producers who have cared for them in the best possible way.

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GENERAL INTRODUCTION

Introduction:

I have worked with small-scale farming communities in Egypt and North Africa since 2011. Since beginning this work, I find myself continually intrigued at how resilient and frugal they were in finding solutions to their problems, despite economic and educational hardships, and lack of access to land and resources. This inspired me to search for parallels of small-scale and traditional producers in the arid Arizona region of the Southwestern USA. This dissertation presents a personal narrative woven together with empirical research to illustrate how small-scale producers pave a pathway for a regenerative food system in arid regions of Arizona. I draw on my experience working in Egypt to show some parallels. The different chapters contextualize the opportunity for alternative food and knowledge systems, then braid biomimicry and indigenous knowledge together to characterize a regenerative food system in arid regions. I delve into one of the many traditional practices of fermentation and use it to illustrate how to promote more inclusive governance structures. Finally, through an arts-based autoethnography I explore the normative aspect of sustainability.

History on Arizona, Indigenous Communities and Migrants

Like Egypt, Arizona has a rich history connected to agriculture; both regions have river and desert people. In Egypt, *Bedouins* occupy desert lands and *Saidi* live along the Nile river. In Arizona, *Pima* people occupy rivers such as the Gila River and *Tohono O'odham* are the desert people (DeJong, 2009). Extensive canal networks were built 2000 years ago and 5000 years ago respectively on the Gila, Salt and Verde River; this is similar to the River Nile (DeJong, 2009; Mays, 2010). These systems enabled large-scale production of grains: corn in Arizona and emmer in Egypt. Both grains ensured a surplus

for periods of drought. Periods of drought and flood were equally marked with decline and growth in populations. More recently in the 20th century, both Egypt and Arizona invested in state-run massive dams to control the water (Bausch, Luis Bojórquez-Tapia, & Eakin, 2014; Fahim, 2015). Both saw the development of extensive industrialized farming, with increased mechanization, intensive use of pesticides and chemicals as well as a focus on cash crops, such as cotton, fodder and citrus with the addition of wheat in Egypt and cattle in Arizona. These moves have been at the expense of traditional and often more ecologically sound traditional food production practices.

Small-scale Producers

Today, traditional food production practices in both Arizona and Egypt are in decline and are threatened. This is due to the industrialization of the food system as well as regulations that implicitly or explicitly prioritize industrial-scale farming. Many smaller-scale producers, including cottage industries and farms, operate at the fringes of or outside of food safety laws and regulations set up to govern food production. However, these traditional food practices continue to persist within small pockets and exemplify agroecological traditions that offer place-based and well adapted solutions that enhance ecosystem services, while being both healthier and more culturally relevant (M. Altieri, 2009; Nabhan, 1997). These small-scale and traditional producers and their practices should be protected, and valorized since they provide 30-34 % of the global food supply (Ricciardi, Ramankutty, Mehrabi, Jarvis, & Chookolingo, 2018), yet continue to live in poverty and often lack access to a healthy diet.

Marginalized groups such as people of color and women are particularly vulnerable to the loss of traditional productions, as they have often been the bastions of maintaining traditions (Shiva, 2014c). In Egypt, where I have worked as a practitioner for 17 years, women have become invisible in the agriculture sector, despite centuries of

being involved in seed saving, post-harvest practices, and food preparation (Ayeb & Saad, 2009). Over the years, in the name of food safety, their practices have been ignored and their voices suppressed, despite research indicating that these practices result in foods with higher nutrient content, more nuanced flavors, and cultural relevance (Ayeb & Saad, 2009; Shiva, 2014b). Similar trends can be seen in Arizona, where national interests create a homogenizing push and pull to align foods to World Trade Organization (WTO) guidelines for international trade (Gallagher & McKevitt, 2019). The result is a loss of smaller-scale production methods (Patel, 2012; Shiva, 2014b), and shifting traditional practices of food production (Grasseni & Paxson, 2015) to commodity-driven ones. These shifts have removed small-scale producers from having a seat at the policy-making table and thus have not been involved in defining what is considered good food.

Opportunity Statement

To highlight small-scale producers' roles in defining good food, I expand on Dahlberg's (1993) call for and characterization of a regenerative food system. He argued that food should first be considered systematically, in every stage of the system (K. Dahlberg, 1993; Delind, 2011). Furthermore, he proposed that a regenerative food system must go beyond food system sustainability, which has focused mainly on organic farming. While both are important practices and framings, neither include a truly holistic approach. A regenerative food system must account for both process and context, integrating social justice, intergenerational equity, and interspecies balance (Dahlberg, 1993). A regenerative food system inspired by Dahlberg's work creates an alternative space for traditional producers to exist and create a path for themselves to define what is good food.

Dissertation Organization

This dissertation seeks to identify, define, characterize, and understand how it may be possible to communicate good food wisdom and practices. Focusing in particular on small-scale and traditional producers operating at the edges of regulatory and social boundaries in the two different geographies. The comparison is not direct, but rather I share the experience I have working with small-scale farmers in Egypt and mesh it with ethnographic work conducted over the course of three years in the Southwest, specifically Arizona. Faced with climatic changes and desertification, and disenfranchisement due to not fitting the mold of contemporary production governance structures, these producers serve as the proverbial "canary in the coal mine" for future challenges that food systems may soon face. Understanding how small-scale food production practices operate offers insight into the potential for good food at different scales.

Guiding Ethics

The dissertation has many personal narratives. It uses a clearly defined positionality. As an ecofeminist scholar, I draw on the custom of acknowledging one's positionality, to ensure a more transparent analysis. Haraway states that it is a matter of situated knowledge (Haraway, 1988), and thus important to take into account the embeddedness of social accounts (Gottschlich, Mölders, & Padmanbhan, 2017). As such, food systems are not just a research subject for me, but are the medium by which I navigate the world: I am passionate about food, and the small-scale and traditional producers that produce them. I therefore bring biases to my narrative, and want to ensure I acknowledge those biases. Understanding that the environment is socially situated within narratives based on people's lived experiences, engagements and socio-political structures (Harcourt, 2017), I used these guiding ethics to guide my work: (1)

highlighting a positive and realistic development framework (Birkeland, 2008), (2) acknowledging that there are multiple ways of knowing, and as such aiming to incorporate when possible arts-based approaches to enable more embodied knowledge (Leavy, 2017), and (3) honoring a reciprocal relationship between myself and research participants, by offering my network and research outputs as part of the exchange.

Theoretical Framework and Methodology

I conducted literature reviews, open-ended interviews, and focus groups. I additionally adopted a geographically-informed "follow-the-thing" approach, following certain products as they circulated through social and cultural structures. I co-created a series of podcasts that enabled me to identify a number of gaps in food system sustainability research. Although the field(s) I work in attempt to be interdisciplinary, many knowledge systems are currently lacking from their approaches. For example, Traditional Ecological Knowledge (TEK) continues to remain absent from most sustainability guidelines. Smaller scale and traditional productions that may be considered more artisanal don't fit into the regulatory frameworks of the USA that are designed to regulate more industrial food productions. This is unfortunate given that food and its production to many communities is a sensorial and embodied experience, deeply rooted in culture.

Sustainability scholarship currently lacks a framework for defining a regenerative food system. As such, I developed one that bridges the emerging academic fields of biomimicry and TEK. Furthermore, food system sustainability despite being in its infancy lacks sensorial and artistic methods. Therefore, to address this, I used qualitative social science methods and combined it with arts-based tools. To align with my guiding principles, I incorporated feedback, used a

deliberative approach, and acknowledged the positionality of myself and my co-creators. Inspiration from arts-based research means adapting the tenants of creative arts for social science research to describe and evoke a more in-depth approach (Leavy, 2017). Using an inductive process inspired by grounded theory approaches (Charmaz, 1983), I collected data via semi-structured interviews of open-ended questions. I followed some interviews with in-depth field visits that included participant observation, and arts-based tools such as walk and talks and visualization; many were filmed and recorded. I attended in person and online workshops. I conducted a focus group to gain insight about how small-scale producers are being challenged by policy and regulations. Finally, I did an analytical autoethnography narrating my process as a researcher/practitioner. I gathered data in a journal since November 1st 2018, as well as transcripts from meetings held with students working on a podcast on regenerative food systems. The infusion of arts-based methods is my attempt to capture embodied knowledge, and empower research participants' ownership of any new knowledge created, given my own personal biases and interests in advancing good food.

Chapters and Research Questions

My research is guided by an overall premise and three fundamental questions, each explored by one chapter. The premise is that creating a successful sustainable food system requires expanding the borders of sustainability as a discipline and field to be more inclusive of diverse knowledge systems and methods. Sustainability scholars should strive for promoting systems capable of producing what I understand as good food: food that goes beyond sustainability to be regenerative of land and people. This approach sees sustainability as capaciously interdisciplinary; a field that moves beyond just ensuring a normative desirable state of ensuring food security for all humans at all times. The overall questions are: what is good food, how is it produced, by whom, and

what are the best tools to communicate it? The first question and chapter, co-authored with my co-advisor Scott Cloutier, explores the characteristics of good food in arid regions from small-scale traditional producers. I ask what are the appropriate theoretical frameworks to research and more deeply understand good food systems? This chapter answers these questions by defining a regenerative food system and by characterizing its principles by weaving biomimicry and traditional ecological knowledge within the context of an arid region. The second chapter is co-authored with my co-advisor Christy Spackman and researches the question of how can the production of traditional foods inform more inclusive and regulated food systems? This is answered by following three fermented foods presently produced and consumed by marginal communities in Arizona. The final chapter and question, solely authored by myself, inquires how can sustainable food systems can be more inclusive of knowledge systems and diverse methods?

CHAPTER 2

WEAVING DISCIPLINES TO CONCEPTUALIZE A REGENENERATIVE FOOD SYSTEM

Introduction

"If we are looking for models of self-sustaining communities, we need look no further than an old-growth forest. Or the old-growth cultures they raised in symbiosis with them."

— Robin Wall Kimmerer- Potawatomi Nation

I Sara El-Sayed, am originally from Egypt and have lived in the American Southwest since 2017. My experiences in collaboration with small-scale producers in both of these places have piqued my interest and provided me with insight for identifying common characteristics of a regenerative food systems in arid regions. My research is influenced by both Indigenous and intersectional eco-feminist research (Ackerly & True, 2010; Harcourt, 2017; Merchant, 1996; Trauger, 2017) that acknowledges one's positionality (Haraway, 2008; Trauger, 2017) and ensures relational accountability, meaning based on a community's and individual's context, relational and respectful, thus accountable (Wilson, 2008). The understanding is that the environment is socially situated within narratives based on people's lived experiences and socio-political engagements within their communities (Harcourt, 2017). Within these parameters, I have worked and studied producers who are creating innovative and frugal practices that ensure that seeds are adapted to their harsh environments, preserve and ferment foods while collaborating with microbial life, hold rituals and ceremonies connecting different generations with food, all while safeguarding traditional cultural and spiritual connections (Adamson, Gleason, & Pellow, 2016; Portman, 2018; Wilson, 2008). I Scott

Cloutier am originally from New Hampshire, USA and have spent countless hours in New England forests and gardens. My intellectual work focuses on practices that simultaneously regenerate ecological systems and human happiness, while honoring our spiritual connection and service to the land which expresses everything. I have worked with and beside small-scale farmers ranging from dairy farmers to foresters to local mom-and-pop vegetable stands in New England inspired from regenerative development practices. Together, we El-Sayed and Cloutier are integrating our academic and practical experience with regenerative development theory to propose a theoretical and practical framework while honoring the voices and wisdom of small-scale producers. Finally, our paper takes an eco-feminist approach, of acknowledging narratives, and positionality (Ilmonen, 2020) in writing style by blending storytelling with academic prose.

Given the lack of attention to regenerative food systems frameworks in academic literature, this paper aims to create a conceptual framework that defines a regenerative food system and identifies its characteristics. The paper (1) contextualizes how a regenerative food system fits within the larger context of modern food systems, then (2) defines a regenerative food system by building on Dahlberg's (1993) regenerative food system definition, and (3) delineates a framework that emerges in an iterative process inspired by tools in grounded theory (Charmaz & Belgrave, 2019) and weaves practice drawn from nature-inspired design (specifically Life's Principles (LPs) (Baumeister, 2017; Benyus, 1997), Traditional Ecological Knowledge (TEK) (Berkes, 1993; Kimmerer, 2002; Whyte, 2013), and a series of interviews and workshops. Specifically, the research compares and contrasts food-related TEK principles (Hoover & Mihesuah, 2019; Shilling, 2018) with LPs (Baumeister, 2017) to bolster thematic findings from field research conducted in 2019-20 by both interviewing rural communities of small-scale

producers in arid regions of the Southwest, USA, as well as attending various Indigenous food workshops.

A food system is the transformation of food across a chain of activities from production, processing, marketing, consumption to waste management (Ericksen, 2008). We compare three types of conceptual frameworks of systems: *industrial* which began in the 1900s, *sustainable* whose transition began in the 1980s (Rhodes, 2017), are mostly western and, most recently, *regenerative*. We are proposing the need for a regenerative food system that blends together small-scale traditional productions with nature inspiration. Rural small-scale producers, who number about 2.1 billion (Steward et al., 2014), provide 60% of the world's food needs (Patel, 2012; Rhodes, 2017). Yet, they don't have an equal seat at the table in defining what constitutes good food in the dominant modern food system (Patel, 2012). At the same time those producers in arid regions, known as drylands, have an even bigger strain given the changes in climate (Blanco, Michon, & Carriere, 2017; Nations, 2010). In today's world, different food systems operate concurrently.

Western Food Systems Moving from Industrial to Sustainable but Needing More Regenerative

The industrial food system, rooted in capitalism, grew in reaction to a starving population and became a means of expanding corporate power through cheap and abundant food (Baret, 2018; Patel & Moore, 2017). A handful of scholars, backed by a conglomerate of institutions, innovated systems to increase production. Borlaug, named the father of the Green Revolution, focused on grain intensification, while Haber and Bosch together invented synthetic fertilizers (R. Dunn, 2017). This current system's success is based mainly on monocultures, synthetic fertilizers, pesticides, and genetically

modified crops, which has led to unintended consequences. The choices made have put the global food systems on a path dependent on ever-growing corporations (Bausch et al., 2015). It has also resulted in depleted soils, pollutants leaching into water sources and a commodity-based economy that has harmed small-scale producers unable to compete in a global market (Carlisle, 2016; Patel, 2012; Portman, 2018; Trauger, 2017). This "food regime" (Glennie & Hope Alkon, 2017; Portman, 2018) is based on a neo-liberal economy that focuses on profits and concentrates both resources (i.e., patents by a few large agribusinesses) and decision-making power (Patel & Moore, 2017; Rhodes, 2017). Consequently, we are left with a system that overproduces food (FAO, 2015) but concurrently results in poor nutrition and an obesity epidemic, while one billion people are hungry (Birkeland, 2008; Patel, 2012). To counter these issues, a paradigm shift took place in the 1980s, led by environmentalists toward a more sustainable food system (K. Dahlberg, 1993; Rhodes, 2017).

The sustainable food system narrative emerged to counter the industrialized system, promoting food security under uncertain and dynamic socio-ecological conditions, ensuring food for current generations without compromising future generations' ability to provide their own needs (Eakin et al., 2017; Rhodes, 2017; World Commission on Environment and Development, 1987). The result has been a plethora of alternative solutions across the value chain and difficulty to clearly define what is considered sustainable (Kloppenburg, Lezberg, De Master, Stevenson, & Hendrickson, 2000). It includes, but is not limited to, sustainable agriculture practices such as organic production (Kloppenburg et al., 2000), labeling, land intensification (Eakin et al., 2017), community gardens (Delind, 2011), diversified diets, nutrition assistance programs, and heightened awareness of food justice (Eakin et al., 2017).

However, sustainability stemming from the Latin word "*sustener*" or "to hold" (Shilling, 2018) is about causing less harm (Rhodes, 2012), absorbing perturbations, and maintaining function (Thompson & Scoones, 2009). Sustainable agriculture practices that focused only on farming practices and didn't address issues of hunger and injustices for small-scale producers, women, and people of color, have been criticized as not doing enough (Patricia Allen & Sachs, 1991; K. A. Dahlberg, 1994; Kloppenburg et al., 2000). Machinery and cheap labor subsidize the industry and eventually replace the small-scale farmer who cannot compete within the economies of scale (Patel & Moore, 2017). Furthermore, even labels such as organic and Fairtrade have been co-opted and greenwashed into the neoliberal economy's pursuit of economic gain (Edelman et al., 2014; Trauger, 2017). Nonetheless, while there is an important niche played by the various alternative forms that make up sustainable food systems, it doesn't necessarily address the role of small-scale producers and their communities' cultures, nor the loss of cultural food diversity, or biological differences of what people can eat (Guthman, 2014). These alternatives still fall short; they offer blanket solutions of idealized vegetarian diets, with hundreds of certification programs still excluding smaller farmers. Thus, another shift is taking place - one toward a regenerative food system driven by community-based small-scale and Indigenous producers.

Unlike the reductionist, positivist approach embraced by the proponents of industrial food systems (Berkes, 2008a), the regeneration narrative embraces complexity. The path to regeneration is one of positive and regenerative development (Birkeland, 2008; Gibbons, Cloutier, Coseo, & Barakat, 2018), reciprocity, restoration, life-promoting (Gibbons et al., 2018) with a net-positive impact (Elevitch et al., 2018; Hes & Du Plessis, 2015; Mang & Reed, 2015; Rhodes, 2012). The concept of regeneration is used between farmers and communities to define a space that is not just sustainable

but bountiful. It is a pathway that is inclusive of small-scale and traditional practices. Frameworks exist for aspects of regeneration, such as regenerative development, a process where human communities and economic activities align with life processes (Mang & Reed, 2012), manifesting their potential (Gibbons et al., 2018). There is also a framework for regenerative agriculture or holistic management (Savory & Duncan, 2016), which aims to enhance the ecosystem services of the land (Du Plessis & Brandon, 2015) with a focus on improving the health and quality of soils, water, and vegetation (Rhodes, 2015; Savory & Duncan, 2016). However, to date, a regenerative food system framework doesn't exist. Dahlberg (1993) was the first to define a regenerative food system across the value chain; this research builds and expands on this definition and conceptualizes a framework to support it. Table 1 illustrates the three food system categorizations covered above in worldviews, narratives, and practices.

Table 1

Comparing industrial, sustainable and regenerative food system narratives and key terms.

	Industrial	Sustainable	Regenerative
Worldview	-Man over nature, (Patel, 2012) Patriarchal -Neoliberal economy and capitalist (Patel, 2012; Portman, 2018) -Commodity drive (Carlisle, 2016; Shiva, 2014a). -Linear approach (Jackson, 2010)	-Stewards of the land -Maintains neoliberal economy (Edelman et al., 2014; Trauger, 2017) -Foods are organic or sustainable -Cyclical approach	-Reciprocal relations -Eco-feminist and Indigenous -Decentralized small-scale -Spiral approach
Narratives	-End hunger. Provide sufficient, cheap food for a growing population (Baret, 2018) -Incentivizing monocultures, chemical fertilizers and pesticides for efficiency -Standardization for food safety -Increasing profits and sales -Waste doesn't factor into the system if it's not profitable	-A system that balances between nature, society and the economy -Diversifications, but Monocultures are accepted, using regulated biocides -Alternative labelling, Organic, fair-trade -Consumer education is critical -Encouraging large scale composting	- A whole systems approach creating reciprocal relationships - Creating net-positive impact, carbon capturing, increasing biomass, cycling waste, and enhancing ecosystem services (Rhodes, 2017; Soloviev & Landua, 2016) -Restoring cultural heritage, identity, and appreciating flavor
Practices	-Third party regulations, and codifying -GMO for improved crops (Baret, 2018) -Consolidations between - Corporations such as Bayer uying Monsanto (Varinsky, 2018)	-Organic/Fairtrade labels and HACCP certifications. -Non-GMO, Farmers markets, community gardens	-Polycultures, perennials, inspired by agroecological practices -Food products focused on flavor and quality -Preservation techniques, including fermentation and drying

Methods

To create a conceptual framework for a regenerative food system, two main themes emerged from interviews with small-scale producers and workshops attended in the arid Southwest (Table 2 and Appendix C for workshop titles), namely nature-inspired design and traditional practices as the impetus for regeneration. Next, we weaved principles of nature-inspired design, namely Life Principles and principles of Traditional Ecological Knowledge, with those that emerged through interviews and workshops. The methods employed borrow from grounded theory tools (Charmaz & Belgrave, 2019) to establish a framework. This includes data analysis aimed at developing theory through an iterative process where data guides where to find the next piece of data using theoretical sampling and literature review. As themes emerged, first through open and subsequently selective coding, then processes of memoing, taking notes and data analysis where emergent themes arose (Charmaz & Belgrave, 2019; Tie, Birks, & Francis, 2019). The themes were then compared to LP and TEK's existing principles for further clustering (Bernard, 2006; Charmaz & Belgrave, 2019).

The literature review was an iterative process, initially enacted through the identification of significant contributions to regenerative food system theories. Search keywords included regenerative agriculture, regenerative development, agroecology, permaculture, and food system sustainability using Google scholar, Web of Science, and Scopus. Literature was drawn from peer-reviewed articles and online publications from various institutes (i.e., the Land Institute and Savory Institute). Initial findings were used to establish a baseline of principles and their definitions for a deeper understanding of regeneration. The effort led to an enhanced definition of a regenerative food system.

The initial review revealed regenerative practices as often emulating natural systems and/or drawing on traditional practices. Thus, to delve deeper into nature-

inspired systems, LPs were integrated with the initial review. TEK was also used to account for traditional practices, as well as the works of Indigenous scholars, including Robin Wall Kimmerer (2002; 2013; 2018), Kyle Powys Whyte (2013; 2017), Melissa Nelson (2017), Elizabeth Hoover (2017), and Nicholas Houde (2007). The process involved several iterations of matching principles, eliminating others, and aligning the frameworks to define and characterize a regenerative food system.

Simultaneously, twenty-four semi-structured interviews were conducted through purposive sampling that responded to what is a regenerative food system to them, and five workshops attended by El-Sayed on Indigenous foodways to more deeply integrate the findings from the methods above (Table 2 and Appendix B for titles of workshops). The people interviewed were artisanal and Indigenous producers working across the food system. Subsequent interviews were based on interviewees' recommendations and based on rising thematic analysis. The recorded interviews included open-ended questions and field observations and were infused with arts-based games (i.e., visualization exercises and walk and talk) (Lerman, 2018). The workshops attended were a mix of interactive and online gatherings. The workshops attended were based on interviewees' recommendations, and notes and pictures were taken at each one. The longest workshop was an in-person 10-day Indigenous Sustainable Communities Design Course (ISCDC) run by two indigenous educators Clayton Brascoupe and Louie Hena. Interviews, workshops, fieldnotes, and pictures were all imported into the software MAXQDA for both in vivo coding and principles-based coding. The concepts extrapolated from the interviews and workshops, driven by their community efforts, were classified into categories; nature-inspiration and traditional know-how, and were matched to the principles identified from the literature. Given the wealth of information

and practices across the interviews and workshops, each principle has been supported by examples and practices (Figure 2; Table 2).

Table 2

Interviews and Workshops

Interviews 24	**Jobs** (interviews fit several categories)	Farmer/Gardner	**11**
		Processing	**4**
		Chef/Cook	**8**
		Educator	**17**
	Race	Native American	**8**
		White American	**8**
		Other	**8**
	Gender	Female	**18**
		Male	**6**
	Location	Northern Arizona	**7**
		Southern Arizona	**11**
		Southwest (not Arizona)	**3**
		North Africa	**2**
	Themes	Indigenous food systems	**4**
		Traditional processing practices	**2**
		Rights of Nature	**2**
Workshops 8	**Number of days/ time**	1 hour	**3**
		1 day	**2**
		2 days	**2**
		10 days	**1**
	Format of workshop	Online	**3**
		Lecture	**3**
		Interactive workshops	**2**
	Author engagement	Listener	**5**
		Active Participant	**1**
		Volunteer	**2**

Results

The results of this study (seen in Figure 1) are organized as a (1) baseline of principles based on the initial emergence of themes (nature-inspired and traditional knowledge) and principles; (2) Developing a definition for a regenerative food system; (3) weaving LPs and TEK and (4) development a conceptual framework. This framework

is illustrated in the form of a spiral highlighting the most significant characteristics of a regenerative food system (Figure 2).

Establishing Baseline Regeneration Principles

The baseline principles were extrapolated from the literature and revealed recurring themes of nature-inspired solutions, designs, and traditional practices passed down through generations.

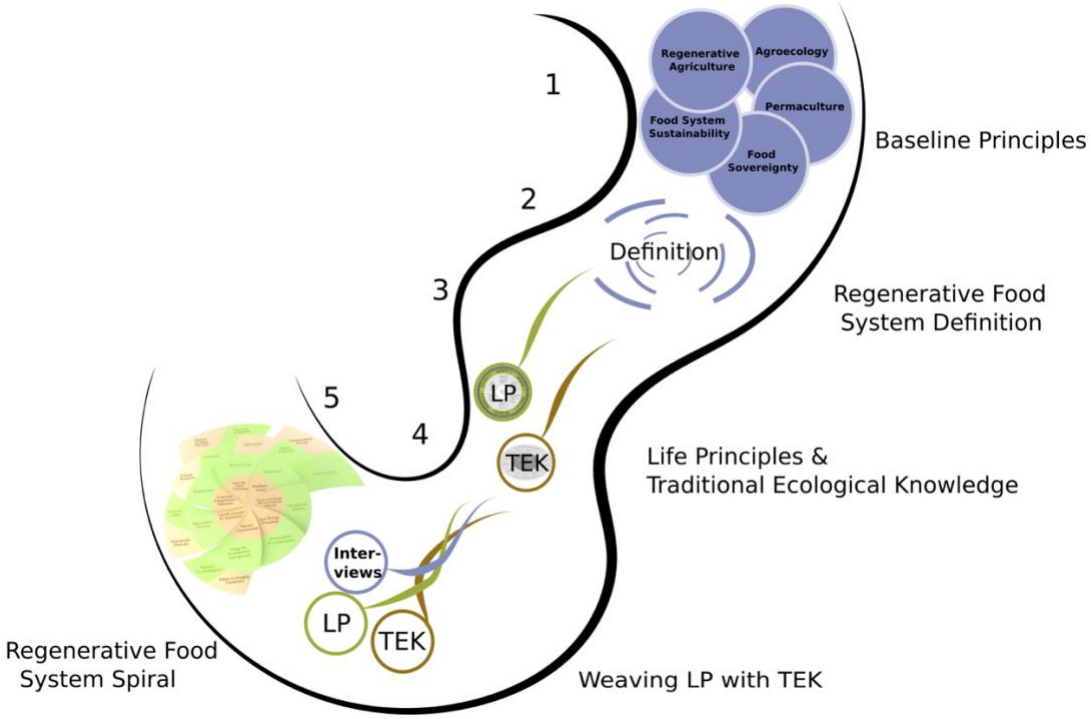

Figure 1. Five-step flow for the conceptual framework of a regenerative food system: (1) Establishing baseline principles by drawing on extant literature (Table 1); (2) Extrapolating an overarching regenerative food system definition; (3) Focusing on Life Principles circular diagram of 26 principles (Biomimicry3.8 framework), and a circular diagram representing Traditional Ecological Knowledge diagram developed in 2006 by Turner and Berkes, (refer to Appendix A); (4) weaving LP and TEK; and (5) developing a spiral framework for a regenerative food system.

Definition of a Regenerative Food System

By integrating Dahlberg's (1993) definition of a regenerative food system with research on Indigenous knowledge and nature-inspired design, we propose a new definition for a regenerative food system.

A regenerative food system is a whole systems approach to food that: is place-based (Jackson & Jensen, 2018; Mang & Reed, 2012)*, integrating agroecological* (M. A. Altieri, Funes-Monzote, & Petersen, 2011)*, and nature-inspired solutions* (Rhodes, 2017)*, while being engaged civically and economically* (Hintz, 2015a; Trauger, 2017). *It is a system that produces flavorful and culturally appropriate food* (Fontefrancesco, 2018) *that is ecologically net positive* (Hes & Du Plessis, 2015; Pedersen Zari, 2018a) *to achieve intergenerational and interspecies justice* (K. A. Dahlberg, 2009; Paxson, 2008).

This definition acknowledges that food systems should be approached holistically while being attuned to the nuances and circumstances of a place and its community. Solutions by in situ producers developed in the name of regeneration are inspired by nature's adaptation to place. Thus, Native people who have observed local adaptations and created agroecological systems should not only be included and consulted, but their know-how protected. Moreover, for this system to grow and develop properly, it should involve its people civically and economically while being embedded in cultural traditions that value flavors, rituals, and ceremonies. Finally, a regenerative food system should never be resource exhaustive or even carbon neutral; rather, it should have a net positive and regenerative impact, with the aim of fostering justice. In other words, a regenerative food system must address the disproportionate burdens of environmental harms and lack of access to natural resources due to systemic injustices related to race, class, and

gender (Guthman, 2014) for present and future generations of humans towards other species.

The baseline principles and definition served to pave the way for bringing together Life Principles and Traditional Ecological Knowledge.

Life Principles and Traditional Ecological Knowledge.

As the emergent themes in the literature indicated the importance of nature's patterns to regeneration, and we turned to Biomimicry's overarching characteristics called "Life Principles" (LPs) (Baumeister, 2017). Synchronously, small-scale producer's practices of production, processing, and managing food illuminated that their knowledge was born from traditional wisdom, constituting knowledge meshed with practice and belief systems (Berkes, Colding, & Folke, 2000). This traditional wisdom has different names but is commonly referred to as Traditional Ecological Knowledge (TEK). Subsequently, we describe and synthesize LPs and TEK and then contextualize them in relation to food systems.

What are Biomimicry's Life Principles? Biomimicry in this paper refers to the strong form of biomimicry as conducive to ecological health, rather than the weak form of being mechanistic (Blok & Gremmen, 2016). It is defined as design that is emulated from nature to enhance sustainability (Benyus, 1997). The nascent discipline looks to nature as inspiration for strategies that are most suited to the planet. Like TEK, Biomimicry is an ancient practice - humans have typically looked to nature for inspiration to design our world; Alaskan hunters will stalk seals emulating polar bears. Although looking at nature for inspiration has roots in Indigenous traditions, we refer to the growing western-based field of Biomimicry. Biomimicry, as it has evolved as a

western-based discipline, has three main elements: emulate, ethos, and reconnect. Emulation is the process of learning from nature's strategies and adopting them to help solve sustainability challenges. Examples include self-cleaning paints that mimic the nanostructure of lotus leaves or the ecological machine that mimics a wetland to purify greywater. Ethos is the philosophy that humans are part of nature and therefore should steward it. Reconnecting is an invitation to be in nature and learn from it by nurturing our relationship with the Earth (Baumeister, 2017). Learning from nature offers the potential for a different worldview to sustainability, based on both understanding that nature is a "supra-system" of organizations and elements intersecting in complex relations, as well as a model, measure, and mentor (Benyus, 1997; Olaizola, Morales-Sánchez, & Eguiguren Huerta, 2020).

Biomimicry 3.8[1] developed the Life's Principles (LPs) (Baumeister, 2017) framework over the course of 20 years and several iterations. It consists of 26 guiding principles of patterns ubiquitous to and extrapolated from the natural world (Diagram of 26 LP in Appendix A). The principles serve as a valuable tool to establish sustainability baselines and beyond into regeneration, to support conditions conducive to life (Baumeister, 2017).

What is Traditional Ecological Knowledge? I El-Sayed am still navigating the world of TEK, having not been raised in an Indigenous family. I have been drawn to Indigenous ways of knowing and the many storytellers in my life that have explained the world around us using science and spirituality. As an Egyptian/Italian, I felt compelled at a young age to connect with Indigenous elders in the Sinai, where I interned with Jabaliya elders, and unbeknownst to me was learning TEK –through rituals and

[1] Biomimicry3.8 is a Montana based B-Corp that has pioneered in research, education and application on Biomimicry topics since 1998, founded by Janine Benyus and Dayna Baumeister.

observing nature. I, Cloutier, have long felt drawn to TEK, learning about Indigenous farming practices like the Three Sisters, an Indigenous polyculture of corn, beans, and squash as a young boy. I later connected with TEK practices through Western perspectives like permaculture and natural building, followed by experiences with Celtic shamanism and ceremonial practices of connecting with and honoring the land and intuitive wisdom, Indigenous to all beings.

The term TEK became popularized in the '80s and is currently finding its way in academia, especially in relation to environmental issues such as adapting to climate change (Hosen, Nakamura, & Hamzah, 2020); however, they are ancient practices (Berkes, 2008b). Traditional Ecological Knowledge(s) TEK are different forms of knowledge that represent a diverse worldview of traditional and Indigenous people. Different scholars have referred to them as "Indigenous knowledge" (IK), "traditional knowledge" (TK), and "Native science"(Berkes, 2008b; Cajete, 2018; Whyte, 2013). TEK is a knowledge system that stems from Indigenous ways of knowing passed down by oral tradition of elders, and cultural expression of arts, crafts, and ceremonies (Tsosie, 2017). It is a blend of science, spirituality, and ethics (McGregor, 2018) and includes the diversity of interactions among plants and animals, landforms, watercourses, and other traits of the biophysical environment (Berkes, 1993; Frank, 2011). TEK has been defined by Nelson and Shilling (2018), as the 'soul' of sustainability, highlighting Indigenous ethics long before western science defined sustainability, believing in reciprocity, being nature-centered, valuing the dynamic expression of sensing the world, as well as a responsibility to the future generations (Shilling, 2018). It fits an eco-feminist belief where humans are not separate from nature. It's not about the domination of human over nature, or man over woman, but rather a co-existence, based on caretaking, love and reciprocity between the multispecies (Kimmerer, 2013; McGregor, 2018; Plumwood,

1993; Trauger, 2017; Whyte, Brewer, & Johnson, 2016). It is a knowledge–practice–belief complex (Whyte 2013, Berkes, 2000) with an emphasis on care and stewardship (Kimmerer, 2002), spanning generations (M. Nelson, 2017) (Framework diagram of TEK in Appendix A).

Unlike the industrialized relationship to food, as a commodity, the TEK-food relationship is sacred and founded on a profound ethics of respect and gratitude for culture-land-resources (Huambachano, 2018). Because of the sacredness of the relationship, Indigenous communities give prayer at many meals and sites visited. Food has an obvious sustenance value, but is a reconnection to culture, and can be expressed more accurately through a message of food sovereignty, and regenerative processes, rather than just a matter of sufficiency (Hoover & Mihesuah, 2019). Such views on food are complicated, given the impact colonialism that has divorced Indigenous communities from their culture and place, as well as their sovereignty over their food. It can be illustrated in the case of Native American boarding schools, that disinfranchised Indigenous children from their foodways (Hoover & Mihesuah, 2019) which were supplanted by Western diets high in sugar and starch. This paper will not explicitly address two key elements of TEK - namely food sovereignty, nor the relationship towards cosmology and the importance of spirituality in Native cultures (Houde, 2007; Wilson, 2008). Rather, the paper focuses on areas of intersection with another ancient, but reformulated discipline of nature inspiration.

Synthesis of LPs and TEK. LPs and TEK are strongly linked, but also weaving them together would strengthen them both. Many Indigenous communities readily refer to how nature works as core to their understanding, which is the essence of Biomimicry, and Biomimicry refers to understanding traditional knowledge as a reconnection to

nature. Kimmerer describes how both TEK and scientific ecological knowledge (SEK) rely on a systematic observation of nature, where nature is the subject in TEK and is the object in SEK (Kimmerer, 2002). Hoover describes how Native women have continued to be holders of ecological knowledge through plants and medicines, and more, emphasizing its eco-feminist approach (Nelson, 2017). Vandana Shiva endorses compassion for plant diversity (Shilling, 2018); Janine Benyus talks of learning from Native insights, which often mimic nature (Benyus, 1997), highlighting how the discipline of Biomimicry has roots in Indigenous knowledge systems. This relationship is not explicitly correlated; therefore, this paper weaves them together, starting with LPs as an initial reference of how nature works and overlays equivalent TEK principles from various publications, Indigenous scholarship, interviews, and workshops.

In order to be true to both Biomimicry and TEK, which focus on place-based knowledge (Kealiikanakaoleohaililani & Giardina, 2016) and local attunement (Baumeister, 2017), this paper focuses on the food system of arid regions. Given the precarious nature of arid regions, the successful strategies and practices in these ecosystems may serve as models to emulate in a future whose temperatures are rising, and rainfall regimes shift. Although there are many similarities between the two disciplines, there are differences. Biomimicry, as is defined in this paper, stems from western epistemology, focusing on sustainability, while TEK is about Indigenous sovereignty, justice, and the relationality of humans and non-humans (Peña, 2019). Peña articulates (2019), Indigenous agroecological heritage exists before the arrival of the more fashionable practices such as permaculture but have not been acknowledged. This paper values each system but mainly highlights how the similarities between TEK and LPs can allow us to create a more regenerative food system, one that can benefit people and the earth that sustains us.

Weaving LPs with TEK. The iterative process highlighted in Figure 1 enabled us to eventually distill 13 principles from the LPs initial 26, whilst aligning to principles in TEK that stemmed from literature, coded text from interviews and workshops. The principles were mapped onto a framework in the form of a spiral, showcasing the relationship between LPs and TEK and the equivalent practices that related to arid regions. The principles layout the LP and its equivalent TEK [principle], supplemented by examples of each within food systems practices.

Discussion

The regeneration spiral (Figure 2) illustrates the parallel between LPs and TEK, beginning with the central circle and spiraling out in time and complexity to the two outer layers. A spiral, as Louie Hena a member of Tesuque and Zuni Pueblos explains, shows how we are all related, a pattern that repeats itself, in the galaxies, the eye of the hurricane, our fingerprints, the seashells in the oceans; in Indian community we start at the center of the circle and expand out (Bioneers 2014; also mentioned in ISCDC 2019). Table 3 provides more details and descriptions, along with related practices, for each principle. The spiral does not value one principle over another; rather, the principles occur over time, the first seven principles form a system's foundation, ending this inner circle with the principle of *integrate development with growth/nested communities*. The process leads to *adaptations* in the second spiral and *evolves over time* through the generations as the system matures in the outer spiral. Below is a detailed description of the principles, each section contains (a) an explanation for each LP and the equivalent TEK principle; (b) the saguaro cactus has been used as an example to explain the LP, given its cosmological tie to the Tohono O'odham tribe (Rea, 1997; Yetman, Búrquez,

Hultine, & Sanderson, 2020) and connecting to strategies of arid regions; (c) one or more traditional food system practices, stemming from the communities knowledge based on literature, observations and interviews from producers and workshops attended in the arid Southwest (Figure 2 and Table 3). (The italicized words or phrases represent the LP and TEK principle respectively).

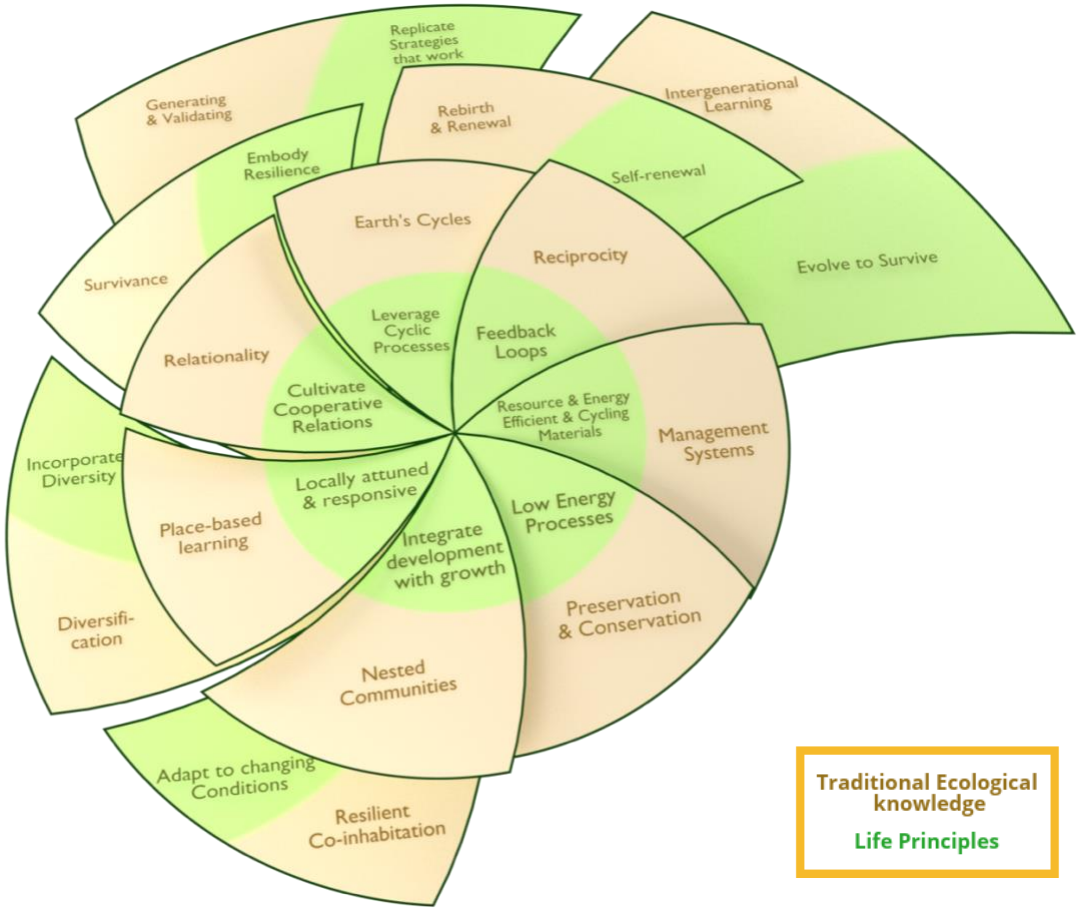

Figure 2. Regenerative food system spiral. Represents the intersection between Traditional Ecological Knowledge (brown) and Life Principles (green). The internal spiral is the base of 7 principles and then the first tear is the expansion in time and the second tear is expansion in more time. The spiral is a recurring pattern and symbol both in nature and in Indigenous communities that shows an optimal growth form.

More amazing perhaps than any aspect of its biology is Man's emotional involvement with the saguaro – the saguaro is a "hero" among plants.

- *Scotty Steenberg and Charles Low, Ecology of the Saguaro II* (Yetman et al., 2020)

[Inner Spiral] Locally attuned and responsive/Place-based knowledge. *Being locally attuned and responsive* (Baumeister, 2017) is nature's ability to fit and integrate into the surrounding environment. Indigenous knowledge is grounded in *place-based knowledge*, translating into eating what is adapted to the land, and in relation to the cycles specific to a place (Kealiikanakaoleohaililani & Giardina, 2016). A saguaro cactus is attuned to the desert by storing water in its pleated expandable reservoir, protected from evaporation with a thick waxy skin, and with spines that help it avoid predation as well as cool it (Gibson & Nobel, 1986). In arid regions, local attunement requires adapting to hot and dry summers with monsoonal summer periods, sparse rains in winter, and significant temperature differences from hot days to cold nights. The Tohono O'odham of the Sonoran Desert have mastered local attunement and place-based knowledge by using multiple growing seasons (i.e. wheat, greens and agave), diversifying and foraging for food, such as Saguaro, velvet mesquite, hunting for rabbits, and fishing (Rea, 1997). A Salt River Pima Indian community member stated that in the past they managed ridges near the Verde river with Agave groves that both stabilized the soil, and were a source of food.

[Inner Spiral] Cultivate Cooperative Relationships/Relationality. Nature thrives on *cooperative relations*; it nurtures mutualisms and win-win relationships (Baumeister, 2017). To nurture place, Indigenous communities build strong bonds with both the place, and people, creating strong *relations* (LaDuke, 2016). Indigenous people will often introduce themselves, their names, and their clan, giving respect to both the ancestors as well as the land they have come from. A saguaro cactus creates a symbiotic

relationships with a Gila woodpecker, where the cactus protects the bird by allowing it to build a nest and be protected from the desert sun, and the woodpecker in turn eats diseased parts of the plant, and insects that might harm the cactus (Phillips, Comus, & Museum., 2000). A regenerative food system assumes a nurtured relationship whose end result is not limited to feeding humans, but maybe a habitat for pollinators, or creating a positive soil biology by creating conditions that foster the growth of beneficial microbes and fungi in the soil. In TEK it's all "*relational*", the interpersonal relations with people, with all of creation, the cosmos, the plants and animals - it is a responsibility for the earth. An interview with a Tohono O'odham illustrated traditional songs referred to a freshly harvested saguaro fruit as a little girl, plants and even seeds are seen as related (Interview, 2020). In ISCDC, a Mohawk / Anishinabek instructor began each session with a prayer thanking the elements, the plants, animals, the food and ourselves for our presence at each activity, as giving thanks also honors our relationships (ISCDC Workshop 2019).

[Inner Spiral] Leveraging cyclic process/Cycles of the Earth. Nature *leverages cyclic processes* that repeat themselves, like day and night, tides, and seasons (Benyus, 1997). Understanding place is also about understanding its physical conditions, the *natural cycles of Earth* that dictate a place and how to leverage them. Indigenous communities have historically leveraged cycles via rituals, ceremonies and festivals (Whyte et al., 2016). The saguaro leverages the seasonal august monsoonal rains that enables it to adapt and to survive its arid climate. The *Tekna* herders, an Arab-Berber tribe in Southern Morocco leverage the seasonal ephemeral plants found after rains, by moving several hundred kilometers, since they provide a good diet for animals, but also diversify by buying forage in other periods (Blanco et al., 2017). Therefore, they leverage

cycles over a year and a day to ensure a diverse diet for their herds. The *Zuni* people of New Mexico traditionally managed water before the monsoonal seasons by creating check dams, small dykes and *Zuni* bowls to slow the water down as it came down the valley (Lancaster, 2014; Nabhan, 2013b). In the past, work parties would be organized and gather annually to manage the mountains and valleys, preparing them for the next period of rains, to ensure the cycles had been leveraged to optimize water retention (ISCDC Workshop 2019).

[Inner Spiral] Feedback loops/ Reciprocity. Leveraging cycles is dependent upon a larger *feedback* system in nature, where both negative and positive feedback allow for self-regulation to take place (Benyus, 1997), creating a form of *reciprocity*. During the summer, a saguaro's white flower blooms at night and sends a signal to migrating lesser long-nosed bats. This creates a positive *feedback*, signaling to the bats and inviting them to eat nectar, pollen and fruit and, in the process, helps the cactus in pollination (Yetman et al., 2020). Indigenous communities also have cycles of regulation in the form of *reciprocal* caretaking (Kimmerer, 2013). *Reciprocity* is also referred to as "all our relations" to animals, fish, trees, brothers, sisters where prayers are whispered across generations to all "our relatives" (LaDuke, 2016), stressing the importance of caretaking. Honorable harvest is another concept of reciprocity (Kimmerer, 2018), when harvesting first permission is asked to take, only what is needed is taken, praise is given and a gift reciprocated, such as tobacco burning (Kimmerer, 2018). A Pueblo artist and permaculture designer in New Mexico emphasizes the importance of creating micro-environments in her home to feed herself and her family, and creates opportunities for other life to thrive in the harsh desert environment, such as creating a rock habitat that enables small pockets of shelter and life to exist (Interview 2019).

[Inner Spiral] Resource & Energy Efficiency & Cycling/Management systems. A tight feedback loop also includes *resource efficiency*, the ability to manage *resources* and *energy* conservatively and *efficiently* (Baumeister, 2017), also known as *management systems* in Indigenous communities (Berkes, 2008b). The structure of a saguaro is designed to both cool the plant by creating micro-convections around the spine, as well as expand and contract to store water (Phillips et al., 2000). Dryland farming is an example of *management systems* practiced by the *Hopi* of Arizona. Dryland farming uses minimal water, mainly that which falls during monsoons, to grow highly adapted corn seeds cultivated up to a foot under the soil. Other resource efficient farming practices include using compost and mulch to retain moisture and nutrients in soil. The Western Apache of Whiteriver are growing crops needed on the reservation by managing the cycling of nutrients and enriching the soil with mycelia as well as compost mixtures at different intervals in the growing season. Albeit not traditional practices, but as a farming community, they recognize that cycling nutrients using local resources is important to enable the soil to regenerate and enable crop diversity (Interview, 2019).

[Inner Spiral] Low energy processes/ Preservation and conservation. Another level of resource efficiency in the natural world are *low energy processes* (Baumeister, 2017), that are expressed as *preservation and conservation* practices by Indigenous communities. These include using the sun to photosynthesize, the saguaro cactus has a large green surface area for this process, it also leverages capillary action to move water up the plant, and is composed of a tough composite waxy cuticle to reduce water loss. Especially in arid regions, or places where food harvest is limited *preservation and conservation* practices are key at certain periods of the year, drying

and fermenting foods is especially important. In Egypt, many vegetables (i.e. okra, tomatoes) are sun dried, while dairy and grains are fermented and dried to be used throughout the year. In the summer, the Tohono O'odham from the Sonoran Desert organize foraging parties to gather saguaro fruits, which are processed in many different ways, into a thick syrup, a jam as well as a fermented ceremonial rain-making wine to preserve it due to its short fruiting season (Interview, 2020,Yetman et al. 2020).

[Inner Spiral] Integrate development with growth/Nested communities. A food system needs time to develop and, in the natural world, *development is integrated with growth*, similarly traditional *communities* have *nested* structures(Baumeister, 2017). For instance, saguaro needs many years of forming its columnar structure to 3-4 meters, before any branch is formed, the cells then differentiate to begin the branch by creating a small bud (Pierson, Turner, & Betancourt, 2012). Life doesn't happen from top-down, but rather from the bottom up in small nested units. Many Indigenous communities grew and developed in modular nested units of small bands that then organize into larger more *complex units*. The Navajo or Dine people of the past organized themselves in complex food systems that came together around important food activities forming nested communities. They organized matrilineal clans and often organized around food related activities, with some calling themselves based on foods such as the Naadaa Dine'e (Corn People Clan). They came together to plow, plant, weed, harvest as well as prepare certain foods collectively such as making together ground-baked corn cake (Mckenzie et al., 2014). The Native Southern Californians, such as the Cahuilla also established complex clans and families creating nested communities around pruning oaks for acorn production, sowing, weeding, and burning meadowlands to produce grassy pastures that in turn supported wild animals (Hoover & Mihesuah,

2019). This sustainable management of lands maintained a balance to manage fires, in comparison to today's lack of management (Hoover & Mihesuah, 2019). The Indigenous *Siwans* of Egypt have created complex agroforestry systems, grown from small units of grove gardens with polycultures of palm trees, figs and apricots with an understory of vegetables in a very arid environment, with little to no rainfall.

[Second Spiral] Adapt to changing conditions/ Resilient co-inhabitation. *Adapted to changing conditions*, is the ability to continually incorporate changes to the local conditions, Indigenous communities have embodied this as *resilient co-inhabitation*. A saguaro cactus has adapted to grow in the arid Sonoran desert and deal with the harsh climatic conditions, with small seeds that are drought resistant, multiple ways to capture and store water, ways to self-cool and ways to defend itself from predators, however to ensure the successful growth a juvenile saguaro it can only be established after two consecutive years of summer monsoonal rains (Pierson et al., 2012). Such an ability to persist is called *resilient co-habitation* and has allowed traditional communities to adapt and respond to the biosphere's rules (Peña, 2019). It is through trial and error that communities had selected for the most drought tolerant crops, creating living seed banks (Interview, 2019), and understood the important local practice such as allowing certain areas of a forest to burn (i.e. Californian tribes).

[Second Spiral] Incorporate diversity/ Diversification. For adaptation to take place, it is important to *incorporate diversity*. Genetic diversity ensures that organisms can withstand disturbances and, as such, diversity is supported in food systems through the cultivation of perennial crops, diverse cover crops with intercropping rotations (Crews & Rumsey, 2017). A saguaro's multiple strategies of dealing with aridity have

enabled its survival. Indigenous communities value *diversification* in different aspects of food production, from growing polycultures to growing different crops in different seasons, as well as tending wild plants (Nabhan, 1997). Traditional communities in the Americas have grown the Three Sisters of corn, beans and squash, maintaining the diverse varieties within these three groups (Interview, 2019). In Sinai, the Jabaliya Bedouins grow orchards with apples, apricots, almonds, quince, figs, pomegranate and mulberries (Gilbert, 2011). Jabaliya maintain orchards, and grow hardy grains, and raise herds of goats and sheep, diversifying their source of food.

[Second Spiral] Self-renewal/Rebirth and renewal. Within this diversification is also *self-renewal* or *rebirth* or replenishment. This can be in the form of new cells, or new parts of an organism (Baumeister, 2017), or a ceremonial rebirth. The glia woodpecker will puncture into the trunk of a saguaro, but quickly the plant will heal itself and create a hard scab that is water tight and can become a habitat for other organisms (Phillips et al., 2000). Indigenous communities are very attuned to renewal, herders will move from one grassland to another to ensure the grasses have enough time to self-renew. The same self-renewal is sparked in Indigenous communities through rituals such as smoke ceremonies intended to create a sense of rebirth (Frank, 2011; Peña, 2019). A Kiowa Chef shared how Hopis rituals of rain and fertility are songs to the spirit of the Corn Mother, and how Diné perform Sun Dances as a form of summer purification (Interview, 2019; Frank 2011).

[Second Spiral] Embody resilience/Survivance. Such strategies lead to resilience in the face of disturbances, having variation, redundancy and decentralization are mechanisms that ensure *resilience* in living things (Baumeister, 2017). Part of saguaro's

resilience strategy is its ability to withstand the arid climate, with defense mechanism against predation with its many spikes, its diverse water capture mechanisms, as well as its self-cooling strategy. In TEK the ability to ensure resilience amongst communities and their endurance despite dominance has been described by Visnor (1994) as *survivance*, or a sense of active presence and continuance through living and recounting Native stories (Whyte, 2017). It is customary within the Tohono O'odham to have children follow the grandmothers on nature walks, to collect wild plants, or catch rabbits, and in these walks many songs and stories are told, by so doing actively continuing the presence of their traditions (Interview, 2019)

[Outer Spiral] Replicate strategies that work/ generating, validating and interpreting. Organisms continually *replicate strategies that work* through passing on this information in their genetic makeup (Baumeister, 2017). Communities *generate, validate and interpret* information that they have observed in their surroundings, Peña (2019) refers to it as agro-biomimicry and the preferences to creating systems that mimic the environment including wild plants to create ecosystems. This is what has enabled the saguaro to persist and evolve through millennia despite dramatic changes in climate (Yetman et al., 2020). *Generating, validating and interpreting* knowledge enables the passing of persistent strategies such as the growing of perennial trees that complement each other, preferring annual polycultures, soils that are not tilled, and the integration of animals (Elevitch et al., 2018; Peña, 2019). These strategies continue to exist, especially as place-based knowledge, such as dryland farming, that has persisted with the continual understanding of rain patterns, soils and using canals and other irrigation systems to growing perennial and maintaining foods through different preservation techniques (Ingram & Hunt, 2015).

[Outer Spiral] Evolve to Survive/ Intergenerational learning. For a regenerative system to persist, it needs to evolve over generations, continually embodying information to enable it to *evolve to survive*, communities also need to pass on the knowledge *intergenerationally*. Adaptation happens through natural selection. This has enabled the Cacti family to evolve to many niches, the saguaro evolved its mechanism of obtaining carbon dioxide from the typical photosynthesis process of C3 to CAM (crassulacean acid metabolism) mechanism. CAM process enables it to gather sunlight energy by day without losing water and then use it to produce its sugars by night (Gibson & Nobel, 1986; Yetman et al., 2020). The *Intergenerational learning* of Indigenous people happens through songs and poetry passed down across generations, up to seven generations, considering three in the past, the present and three in the future (LaDuke, 2016). This intergenerational learning is exemplified by the work of Tohono O'odham Gila River Indian farmer and her daughters taking lead in educating the next generation, and the tepary beans they grow today that originated from her parents (Interview, 2019). An Indigenous permaculture course led by Traditional Native American Farmers Association (TNAFA) is a modern way of passing the knowledge of the elders to the younger generations.

Table 3

LP and TEK definitions in relation to food systems and corresponding examples. (numbers correspond to numbers in discussion section)

Biomimicry's LP	TEK Principles	Definition in relation to food system	Practice/Example
1.Locally attuned and responsive	**Place-based knowledge**	Food production that fits the surrounding environment, through generational experience based on place.	- Being a nativore and connecting to ancestral foods - Building a local food economy
2. Cultivating Cooperative relationships	**Relationality**	Win-win mutualisms that strengthen interrelations among humans, non-humans, spiritual entities and landscapes.	- Introducing oneself and one's ancestry (Wilson, 2008). - Facilitating the growth of other organisms, including pollinators, microbes and fungi
3. Leverage cyclic processes	**Cycles of the Earth**	Take advantage of phenomena that repeat themselves, food practices based on seasons, ceremonies, and festivals.	- Periodic Zuni bowls and dykes to divert seasonal waters. - Cosmology related rituals including fasts. - Biodynamic farming practices
4. Feedback loops	**Reciprocity**	Food production that embed self-regulating systems and tight feedbacks, including reciprocity through gifts.	- Honorable harvest (Kimmerer, 2002) - Gift economy - Hopi grow corn protected deep in ground and corn reciprocates by producing food
5. Readily available materials/energy & recycle all materials	**Management systems**	Systems based on a deep understanding of both the local and readily available resources, and how to recycle energy and resources.	- Hopi dryland farming relies on rain, hard work and prayer (Wall & Masayesva, 2019). - Nahuatl's "quauhtalli," meaning rotten wood turned into rich soft soil (Peña, 2019).
6. Low energy processes	**Preservation and Conservation**	Techniques that use low and available energy sources, including strategies of food storage and preservation for times of stress.	- Fermentation of foods such as pickles, kombucha, kishk. - Using passive energy such as gravity, net and pan farming
7. Integrate Development with growth	**Nested communities**	Invest optimally to promote both development and growth, based on nested elements that are built from the bottom up.	- Small bands organize into intricate structures - O'odham people built on Hohokom canals, and stabilized rivers by growing agave and century plants (Nabhan, 2013b)
8. Adapt to changing conditions	**Resilient co-habitation**	Responding to dynamic contexts over time, and producing foods adaptable to changes in climate, where the biosphere provides the rules and humans use trial and error to adapt to socio-ecological system.	- Maintaining living seed banks - Drought tolerant crops - California tribes managing forests via controlled ceremonial fires based on trial and error.
9. Incorporate diversity	**Diversification**	Incorporating multiple forms, processes, and systems, such as diverse species, multiple rotations, successions, guilds, and creating a diverse diet.	- Growing polycultures (three sisters) - Encouraging perennials. - Seasonal and ceremonial foods.
10. Self-renewal	**Rebirth/ renewal**	Maintain integrity through self-renewal, increasing hybrid vigor of plants/animals, as well as through rituals such as spiritual ceremonies.	- Smoke ceremonies for cleansing and detoxification - Succession management, holistic grazing and herd rotations like the Sahel.
11. Resilience through variation, redundancy and decentralization	**Survivance**	Resilient food systems and survivance of their people, withstanding environmental/economic disturbances by incorporating variation, decentralization and an active sense of presence by keeping stories alive.	- The Gilenos/Pimass use double/triple cropping, harvest wild crops, and fish and hunt (Rea, 1997). - The Jebilya of South Sinai, have fruit forests and raise sheep telling stories through poetry.
12. Replicate strategies that work	**Generating, validating and interpreting**	Repeat successful food production strategies and traditions, observed from patterns in nature, interpreted and replicated.	- Telling food stories and songs marking pivotal moments or teaching lessons. - Selecting and passing down drought tolerant seeds
13. Evolve to Survive	**Intergenerational learning**	Through intergenerational learning from ancestors to posterity, by telling stories, poetry, songs and dreams, embodying information that allows for endurance of food practices.	- Maintaining knowledge for 7 generations, 3 generations back, the present, and 3 generations forward, such as through apprenticeship. - Transitioning from annual staples to perennial crops (Jackson & Jensen, 2018)

Conclusion

We have provided a path demonstrating how TEK and LPs can weave together and create a conceptual framework for a regenerative food system, guided by community practices from food systems in arid regions. In the same spirit of Albert Marshal's Two-Eyed Seeing, "one eye sees with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing … and learning to use both these eyes together, for the benefit of all" (2010, p. 11). It is imperative to move beyond the industrial food system, and though sustainable solutions have filled a niche to improve some of the unintended consequences of the industrial food system. These two systems have not taken into consideration small-scale producers and their traditional and Indigenous processes. A need remains to create a more equitable system across generations and species to ensure a positive impact of food production on our environment and our communities, which the regenerative food system is beginning to fill.

Limitations of the article include acknowledging my positionality, it is not common practice in in academia, since this narrative is viewed as subjective. It is however, an attempt at being truly transparent. Haraway (1988), states that it is a matter of situated knowledge, and thus important to consider the account's embeddedness (Gottschlich et al., 2017). For us El-Sayed and Cloutier our personal journey, and subjectivity are inherent in the narrative. Another limitation is using emergent methods of grounded theory. We acknowledge that we have not reached saturation (Tie et al., 2019) making the research a work in progress, that needs further validation from Indigenous communities, as well as possible new principles that may arise. We frame this work as a narrative in progress and in collaboration *with* Indigenous communities

with the precise goal of centering our focus – through both Indigenous and Western eyes – on regenerative food systems.

In conceptualizing a regenerative food system, Biomimicry's ubiquitous LPs were weaved with TEK principles and thirteen principles were identified and contextualize to arid regions. In conclusion, the principles highlight the importance of (1) place-based knowledge, and a local attunement, that is established through strong (2) cooperative relations, not just interpersonal relations with people, but with all of creation, that in turns supports our foods. Therefore relations that are reciprocal with non-humans (Kimmerer, 2013) and the cosmos (Wilson, 2008). Reciprocity is about creating a (3) feedback loop, a cycle of care (Kealiikanakaoleohaililani & Giardina, 2016) and gratitude, that could also be in the form of a gift or an offering. Such local attunement is achieved by understanding (4) nature's cycles and leveraging them by knowing when to grow in tune with the seasons, the cycles and more. However, given this stewardship toward the earth, there is also a sense of frugal and (5) resourceful management, how to utilize resources and energy effectively and using (6) low energy processes, that preserve and conserve foods.

Once a regenerative food system is established, (7) growth happens slowly from the bottom up, where complex communities are nested within and benefit one another, while trading together to create a complex interdependent society. In turn, communities grow to become well adapted ecosystems, known in TEK as (8) resilient co-habitation, because they have (9) diversified their diet, their growing patterns, their crops and incorporate patterns of (10) self-renewal through ritual and ceremony. This ultimately enables a system to be resilient due to the community's (11) survivance, the ability to persist, with food traditions passed through stories, songs and rituals. As a community

persists it evolves, and passes this knowledge across generations, adapted to present situations with a forward outlook. In Indigenous traditions, learning and (12) replicating strategies that work and validating them ultimately (13) evolving across seven generations (Kealiikanakaoleohaililani & Giardina, 2016; Whyte et al., 2016). A regenerative food system in this light honors small-scale and traditional practices, whilst being grounded and adapted to teachings of the past, realities of the present and ways to be more in tune for the future.

In weaving together these two disciplines we aim to bridge between them, given their strong correlations. However, many questions remain unanswered: How can non-Indigenous communities embody such principles? How do these principles translate into strategies and policies? Can we create truly regenerative systems that have a net positive impact on nature and their communities?

CHAPTER 3

FOLLOW THE FERMENTS: INCLUSIVE FOOD GOVERNANCE IN ARIZONA

Introduction

As a child, I (Sara) remember being told by Nonna Rosa, my Italian grandma, to bring a pan and fresh milk. As I watched her add a spoon full of a pungent white creamy substance into the pot, I asked, "What's this Nonna?"" It's Yorgut," responded Nonna Rosa, my mom interjecting and clarifying, "she means yogurt." My Nonna's kitchen often smelled of fermentations, but making yogurt was a weekly task. At that age, I did not know how to describe what was happening beyond simple kitchen alchemy; but today I have the terminology that goes with the process. I have experimented with various fermentations through my travels and home culinary efforts inspired by my Italian and Egyptian traditions.

In contrast to Sara's experience, I (Christy) do not remember my grandmother fermenting anything. I know she did—my mother has my grandmother's sourdough crock and regularly made sourdough waffles for us after my grandmother's passing. My journey exploring ferments came later, inspired first by a bread-making course I took in culinary school where we made our own sourdough starter, an interest that later exploded as I began following governmental restrictions on kombucha retail operations in 2010 (Spackman, 2018). While these time-tested practices provided our families with beneficial nutrients, the ability to produce and market some of our heritage foods remains fraught.

In the essay that follows, we, Sara and Christy, explore the complexities of fermentation. The breads Christy and her grandmother made could be sold in a local farmer's market with minimal change to production. In contrast, the yogurt Sara's

Nonna made would never be allowed, circumscribed by the regulatory structures and scientific norms of twentieth and twenty-first-century food safety concerns. One product is seen as safe, the other as dangerous. We have both in one way or another followed ferments, and continue to do so within the regulatory framework.

Together with salting and drying, fermentation is one of the oldest approaches to preserving food. Historians believe that many of these traditions were developed by women to preserve food for times of scarcity by extending shelf life, increasing the digestibility, improving flavor, and reducing toxicity (Ellis Katz, 2012; Farag, Sheikha, & Hu, 2020; Marshall & Mejia, 2012; Ranjan Swain, Anandharaj, Chandra Ray, & Parveen Rani, 2014). Today fermentation exists as both a traditional and Indigenous way of preserving food and an industrialized food production approach used by large corporate entities such as industrial cheese producers or beer brewers. While regulations have facilitated trust in large corporate fermentation processes, industrialization has hidden fermentation from everyday eyes. In many cases, smaller producers and their fermentative operations remain at the food system's margins, fitting uneasily into twentieth-century regulatory systems. Although there is a comeback in Western markets to fermented foods, such as kombucha and sauerkraut (some are considered superfoods with life-changing or curative effects (McDonell & Wilk, 2020), many remain illegal to market in the USA. Fermented products created in controlled and regulated environments with industry standards such as pasteurization and limits to storage in cheeses are approved scientifically and are allowed (USDA.gov) to be brought to markets. In contrast, less standardized products created using uncharacterized cultures or back-slopping—the practice of taking a small amount from an existing culture to start a new one—or that rely on cultural protocols rather than food safety standards, struggle to fit within the industrial food safety ecosystem (Finnis, 2012; Holzapfel, 2002).

Scientific understanding of what causes food to become dangerous is one of the twentieth century's public health triumphs. The discovery that heating for appropriate times and temperatures could prevent unnecessary deaths from botulism or that pasteurization could prevent typhoid created a world where eating foods produced by people you had never met, in places you had never visited, an increasingly usual practice (DuPuis & Goodman, 2005; Petrick, 2011; Zeide, 2018). The ascendance of an increasingly industrialized food system created an ecosystem of standardized norms and rules in the US. Set in place to guard the eating masses' safety, food safety regulations have excluded many traditional forms of fermented foods produced through modes outside of regulatory norms. The home kitchen is often talked of as the bedrock of American identity. Over the twentieth century, it has become framed by food safety conversations as a suspect space teeming with dangerous bacteria and overseen by ignorant cooks.

In the early twentieth century, home cooking, at least "American" home cooking, was seen as the safest sort of food. Immigrant foodways were more suspect (Levenstein, 2003). Even more concerning were the ingredients and products found at the grocers: chemical testing revealed that producers were adulterating spices, flour, milk, bread, and even candies (Wood, 1985). Reformers mobilized to create a legal and regulatory landscape that did away with adulterated foods (P. F. Baur, 2016), successfully creating regulatory structures in the early twentieth century to address adulteration at small and industrial-scales of food production (P. F. Baur, 2016; Levenstein, 2012). The movement's crown jewel, the Pure Food, and Drug Act (PL 59-384), passed in 1906, putting in place meat inspection, and targeting food adulteration. It set in place the foundation for the Food and Drug Administration (FDA) (P. F. Baur, 2016; Petrick, 2011; Wood, 1985).

Then in 1924-1925, following the worst foodborne illness outbreak in recorded US history, typhoid fever spread through improperly handled oysters, and intensification of regulations (Jarvie, 2014). More recently, food outbreaks created an intensification of food safety regulations, mostly designed as one-size-fits-all, with little nuances to scale or type of production (Condra, 2013; Worosz, Knight, Harris, & Conner, 2008). In 1993 the FDA developed the "Food Code" (FDA.org) giving standards to food establishments (Condra, 2013), these were further intensified with requirements of Hazard Analysis and Critical Control Points (HACCP) certifications (Jarvie, 2014; Worosz et al., 2008). Then the Food Law was passed in 2002 and enforced in 2005 (Rouvière, 2016). In 2007, a major E. coli contamination outbreak in spinach killed three. An industrial-scale organic production caused the outbreak, resulting in the passage of The Safe Food Act. Finally, in 2011 Food Safety Modernization Act (FSMA) was passed, with a later amendment called Tester-Hagan, which exempts small-scale food firms (Ribera & Knutson, 2011). In sum, the twentieth century has seen a tightening of regulatory control over food production in a way that seeks to protect consumer health.

However, many scholars point out that although these regulations do not target small-scale producers, they directly affect small-scale producers' ability to succeed (DeLind & Howard, 2008; Worosz et al., 2008). Indeed, it is this regulatory history that has shaped gradual growth of suspicion of home-cooking—as scientific understanding of food safety increased, it became evident that best practices imposed by regulations on industrial producers rarely appeared in home kitchens (Redmond & Griffith, 2003). On one side, these regulatory changes have created a social expectation of safe food. This is good. On the flip side, these regulatory changes had stigmatizing impacts on smaller-scale producers, seen by a growing number of consumers and regulators as producing

unclean food. Scholars point out that these stigmas situated smaller-scale producers as making inferior quality foods to larger producers (DeLind & Howard, 2008; Worosz et al., 2008). The regulatory changes also placed significant bureaucratic and regulatory barriers for small-scale producers. These regulations, combined with disproportionate penalties, and the fiscal cost of adopting new technological forms of production and monitoring, as well as the inability to lobby their interest have resulted in small-scale producers disappearing over the years or going underground (P. F. Baur, 2016; DeLind & Howard, 2008; E. Dunn, 2007; Worosz et al., 2008).

The subsequent regulatory restrictions that have emerged over the twentieth-century limit the ability of foods like those Sara's grandmother made to be sold at farmer's markets or corner stores. Similarly, those same restrictions transformed the kombucha retail landscape in 2010 after a regulatory inspector noticed this growing niche product was behaving in a way disproportionate with its labeling. These little moments where microbial life's exuberant actions encounter regulatory challenges reflect what Paxson (2008) calls microbiopolitics. Microbiopolitics are the intricate entanglements between humans and microorganisms taking different forms. Pasteurian microbiopolitics emphasize the need to eliminate microbes hitching a ride on foods (Latour, 1993). Post-Pasteurian microbiopolitics see the value of microbes and invest in the potential collaborations between humans and microbial cultures, promoting certain forms of microbial life over others (Paxson, 2008). This concept of cooperation and management of human and microbial ecologies builds on Haraway's work (2003, 2008). It is especially notable with fermented foods, exemplified by Paxson's study of raw milk cheese (Paxson, 2008). Paxson argues that how people have come to shepherd microbial life under contemporary food safety regimes in the U.S. is a form of biopolitics, specifically microbiopolitics. Microbiopolitics are enacted, for example, in cheese

production, when producers prioritize raw or wild ferments over standardized, or when they use unpasteurized milk. In turn, these decisions activate certain forms of political oversight that limit how the ensuing cheeses can circulate in formalized economic circuits. We posit that expanding our understanding of the microbiopolitical entanglements that shape fermented foods opens the possibility for identifying approaches and tools to enable the growth of more diverse small-scale foods, subsequently creating an opportunity for a more expansive regulatory system.

Fermentative processes highlight the entanglement that exists between different ecosystems. As much as humans try to separate and categorize, the lines separating microbial populations are blurred. This blurriness creates composites of human and non-human, no matter one's imagination of oneself as an individual, we all live in a community with microbes living in our body. Some people proactively produce bubbly fermented foods intending to activate healthy microbes in their own bodies. Microbes are also present in our soils, and adding fermented concoctions can also improve the health of plants and soil (Granjou & Phillips, 2018). Within this framing, prioritizing beneficial microbial life forms and cultivating relationships of care with microbial life is critical to creating more regenerative food systems. While perhaps not as evident as agricultural practices, food preservation is one of the many principles that enable a regenerative food system (El-Sayed, Cloutier Ch. 2). We understand a regenerative food system as a beyond sustainable system that takes inspiration from nature and traditional ecological knowledge to create a net-positive impact for people and land across generations (K. A. Dahlberg, 2009; Gibbons et al., 2018). Small-scale and traditional producers are claiming regenerative food systems as an alternative to the industrialized systems by acknowledging their knowledge systems the entanglements between ecosystems. Regenerative food systems seek to promote ecological complexity, to create

conditions that enhance already-existing systems rather than merely sustaining the current status quo.

Recently, El-Sayed and Cloutier (Ch. 2) identified 13 core principles central to a regenerative food system framework. Three of these principles, relationality, preservation and conservation, and intergenerational learning, these shape many historical and contemporary small-scale fermentation practices. Drawing on these three principles, we explore how including the production of these bubbly foods expands on Paxson's microbiopolitical (2008) entanglements. We highlight how following fermentative processes and expanding them to the regulatory sphere might allow us to create a more diverse, representative, and regenerative food system (El-Sayed, Cloutier, 2020). We acknowledge that these entanglements of coexistence are messy. Abrahmson and Bertoni (2014) illustrate this messiness by presenting the constant production and redefinition in compost politics. This messiness calls for navigating a bubbling process (Sandro, 2020) and assembling, arranging, composing, separating, and working—often in divergent worlds—in a togetherness that is lively, adaptable, evolving (Granjou & Phillips, 2018). This messiness is based on the necessity of getting our hands involved in unknown and sometimes messy processes (Abrahamsson & Bertoni, 2014). These scholars highlight how a healthy ecosystem lives in tension between microbes and humans. In the composting world, this tension produces relatively benign outcomes, but the risk can be significant to human life in the food production world. As a result, much of the definitive work of making food safe over the twentieth century focused on technological interventions to bring microbiological life into what one may term a food safety ecosystem. The food safety regulatory network developed over the twentieth century created systems to modulate food-borne illnesses. Yet, in the process, it sets in place priorities around what is defined as good food while marginalizing traditional and

culturally-defined foods. Despite these challenges, we posit that one can better understand how the alternative food system is also intricately dictated by a mesh of different players and their respective interests through following the ferments.

Building on those insights, here we question how the U.S. food safety ecosystem intersects with fermented products made by communities that are, themselves, often situated as outsiders, either a minority group or producing traditional and thus unknown products. We examine how the tensions present between the production practices that occur in the home's sovereign space and the marketplace's regulated space invite food scholars to question the binaries and control mechanisms that exist and explore how to navigate the entanglements. We specifically follow three fermented foods, *gundruk*, saguaro syrup/wine, and yogurt/soft cheese, all traditional products of different communities around Arizona. These foods do not carry the cultural prestige of more commonly analyzed foods such as wine or cheese, nor do they fall within the category of known superfoods. Looking beyond these popularized foods invites a more complete examination of how what is considered good and clean food (Parasecoli, 2017a; Paxson, 2019) comes to interact with larger food safety and economic systems. We open each section with personal narratives to illustrate the steps of an idealized fermentation process as we build on these concepts. These steps include preparing ingredients and inoculating bacteria, feeding and fermenting, sensing and making adjustments, and sharing and coming together. We weave these together with the stories of three Arizona-based fermented foods to illustrate the messy microbiopolitical entanglements that exist and suggest a more inclusive space for less popular traditional fermented foods. Following the ferments encourages expanding, diversifying, and decentralizing food regulation to enable more players to partake, concurrently expanding the food palate and ability to access more culturally appropriate foods.

Preparation

Preparing the appropriate ingredients and creating the right conditions for fermentation is essential for successful fermentation, where success means achieving desired flavors, forms, and aesthetic characteristics. Commercial production approaches valorize the use of standardized ingredients, microbial populations, equipment, and sterilization protocols. In traditional fermentation, quality ingredients and microbes are also vital, but the processes often rely heavily on tacit knowledge and apprenticeship rather than a standardized set of instructions and ingredients. For example, traditional approaches to making buttermilk in Egypt involve extensive tacit producer knowledge. This includes selecting the cow that produces good quality milk and timing the milk production season to coincide with specific feeds. For example, people Sara has worked with through Slow Food Egypt regularly use a baby goat's stomach as the churning container. Western consumers may initially find this off-putting. However, before beginning, the stomach lining is washed multiple times with a high salt solution dosage. This eliminates some bacteria yet leaves alive other bacteria--specifically the ones necessary for making buttermilk. In an industrial process, regulations render this approach unacceptable, outside of the strict standards for materials used, pasteurization of milk, and specifically selected disinfectants. Nonetheless, whether traditional or industrial, this process of preparing ingredients and equipment can be viewed as the primary method and context. This section reviews this paper's methodology and the context within which fermented foods operate.

Methodology

This paper adopts a "follow the thing" methodology, whereby an item and its constellations are mapped out (Cook, 2004; Cook & Harrison, 2002). Typically,

"following the thing" involves multi-sited ethnography (Marcus, 1995) of commodity products, such as Ian Cook's study of papaya (2004) and Sidney Mintz's study of sugar (1986). Here we focus not on commodity products but marginal ones, meaning food that in a particular time and space is considered inedible, inappropriate, or low status (Finnis, 2012), specifically fermented foods produced in home kitchens. Research in marginal foods highlights marginalized communities' intricate relations to their foods in reimagining their role in given communities or reaffirming a sense of identity, creating an interplay between identity, globalization, and livelihoods (Finnis, 2012). We are specifically interested in fermented foods that have long been associated with specific cultural traditions (Ranjan Swain et al., 2014). Given the connotation in food regulatory structures on foods that contain microbes and their potential dangers, foods such as kimchi, kombucha, and natto, don't fit easily within the U.S. food safety ecosystem of the twentieth and twenty-first century (Spackman, 2018).

We focus here on three less popular and traditionally-fermented foods produced by communities that call Arizona home: *gundruk,* saguaro syrup, and yogurt/soft cheese. We frame our analysis of how these three foods are produced, circulated and what constraints exist around them within their respective communities and markets weaved with our narratives (Grasseni, 2012). By following *gundruk*, saguaro syrup, and yogurt/soft cheese, our research uncovers how marginal foods move and interact within communities. Following these things demonstrates how food safety regulations shape them and how regulatory boundaries and limitations shape these foods. Following these three foods offers insights into possible steps for helping build a food system that is more representative and regenerative. The regulatory and social challenges exposed emphasize that expanding existing food governance structures to allow for traditional/Indigenous

marginal fermented foods is similar to setting in place a fermentation process: it requires putting in place new ways of thinking that can ferment additional, synergistic possibilities. To do this, we conducted a literature review of the three foods followed, along with regulatory aspects surrounding small-scale production, including traditional fermented products. Also, we conducted 18 semi-structured interviews (see Table 3). We selected our interviewees through a purposeful snowball sampling procedure following who is producing these foods/drinks. Sara interviewed six people per food since six is the minimum number stated in the literature to reach a meta-theme (Guest, Bunce, & Johnson, 2006). We additionally conducted a focus group with five producers that also produce fermented foods. These efforts sought to provide insights and understanding about how producers operated within Arizona's specific regulatory regime and help identify opportunities for creating more. We gathered the results to create mini vignettes about each product.

Table 4

Demographics of Interviewees

Community	**Interview numbers in text**	**Gender**		**Food producer - FP Homecook-HC**		**Age**		
		F	M	FP	HC	18-25	26-35	35 and above
Nepali living in Arizona	1-6	5	1	1	5	1	1	4
Indigenous community in Arizona	7-12	3	3	5	1	1	1	4
Middle Eastern community in Arizona	13-18	3	3	3	3	2	0	4

Context of Fermented Foods

While preparation may seem like an isolated event, it occurs within a larger ecosystem of geographical, regulatory, economic, and social conditions. This section lays out the fermentation context in Arizona, USA, and specifically amongst traditional producers. Arizona's population is growing fast and is home to diverse communities, with 22 official Indigenous tribes and a growing Latinx, Southeast Asian, and Middle Eastern population. The state is expected to become a minority-majority state by 2027 (“World Population Review: Arizona Population 2020,” 2020). In 2015 Tucson won the UNESCO designation of "City of Gastronomy" because of the concerted effort to valorize the local food system and increase food diversity (Nabhan, 2018). The rest of Arizona could equally represent the diversity; however, in many Indigenous and traditional communities, a more standardized American diet is found, which is often viewed as cheaper, safer, and more accessible. This, unfortunately, has also resulted in health concerns and loss of traditional and innovative foodways (Nabhan, 2013a).

The standardization of foods in the USA over the twentieth and twenty-first century is the product of many factors and players. It includes the push to expand profit by extending shelf life (through the addition of preservatives), developing local to national food safety standards to ensure consumer safety, changing production approaches, and consolidation of agribusiness (P. F. Baur, 2016; Thomé Da Cruz & Menasche, 2014). As a result, food and crop diversity have inadvertently decreased (Dunn, 2017), with smaller-scale producers disproportionately impacted by these changes (Patel, 2012). Yet, food safety isn't black and white. As Nestle (2003) argues, food safety is relative from one person to another. Scaled up, this "relative" nature of food safety is illustrated by how some states allow raw milk while others have strict pasteurization regulations (Thomé Da Cruz & Menasche, 2014). There is also a mesh of

players with different interests. Those that wield the most power can lobby for policy, and advocates are often larger players. "Food companies often place commercial interests above those of consumer protection, and… government agencies often support business interests over those of public health" (Marion, 2003, p. 272). This mesh of players becomes more complex within the global market where international trade agreements such as the codex Alimentarius impose standardized regulations and restrict smaller and more traditional players (Gallagher & McKevitt, 2019; Parasecoli, 2017c). Therefore, although such traditional foods may have cultural, economic, and health benefits, it is harder for smaller-scale food producers to remain competitive due to established food safety and provisioning infrastructures and large producers' market dominance. For many communities, this has contributed to the loss of traditional foods and production practices (Harvard Food Law and Food Policy Clinic, 2015).

Fermented foods have faced an incredibly challenging road within this regulatory, technological, and market landscape. While a recent turn to examining the existence of beneficial and harmful microbes exists, the science and practice of food safety has primarily been a Pasteurian approach, aimed at eliminating as much as possible all uncharacterized/ unanticipated/ microbial life. Consolidation of food production further solidified the food safety ecosystem into an ecosystem characterized by dominance over food and ordering food safety over people and nature (P. F. Baur, 2016; Law & Mol, 2008). This has been done using either scare tactics and more standardized forms such as Hazard Analysis and Critical Control Points (HACCP) (P. Baur et al., 2017). By the end of the twentieth century, food safety standards in the U.S. reflected a good vs. bad binary structure. Players that didn't conform to the safety protocols, that didn't adopt industrial operations and couldn't wage a "war on pathogens" - a term that describes a full-on investigation to criminalize the entity

responsible for a food-related illness (P. F. Baur, 2016; P. Baur et al., 2017) - were presented through the media to the public sphere as bad actors. The good players were the ones that followed standardized, industrial-scale safety protocols.

One market segment trying to bring traditional production approaches to a broader audience is cottage industries. Cottage industries are considered small food enterprises often produced in private homes or shared kitchen spaces, for commercial sale, with regulations determined at the state level of what foods are eligible for sale and how (Johnson, Nicholas & Endres, 2011; Mcdonald, 2019). Cottage industries provide a valuable option to ensure food access and economic security for marginalized communities (Condra, 2013). However, individual state laws provide a significant barrier to more traditional food producers (Condra, 2013; Mcdonald, 2019). Recent growth in cottage industries has been driven by consumers being more interested in the origin of foods and the interest in specialty foods (Feldman & Welsh, 1995) and marginal communities and especially women finding opportunities to create small businesses.

Despite recent gains made in allowing cottage industries access to markets, fermented foods are excluded from this legal food production realm. This is because states' definitions to identify what can and cannot be produced under their cottage food acts; many states limit producers to foods that are "not potentially hazardous" (Condra, 2013). While on the face, this makes perfect sense, this enforces a very narrow interpretation of safety in practice. Arizona's Cottage Food Production regulations exclude fermented and pickled products, identifying these as potentially hazardous foods. Instead, the regulations only allow foods that are considered safe and do not require time or temperature control for safety, such as Christy and her grandmother's bread. This essentially limits would-be producers to baked goods, jams and jellies. Arizona' approach is informed in part by the FSMA, which extended regulatory oversight

of the FDA to additionally focus on preventing transmission of harmful bacteria, parasites and viruses (P. F. Baur, 2016), with a goal of zero microbiological contamination (Thomé Da Cruz & Menasche, 2014). This further complicates small producers' ability to bring their traditional foods to market, given the testing costs for microbes and the lack of available, affordable tools to assess microbial contamination. These standards disproportionately impact cottage industries as well as small-scale, traditional and Indigenous producers (Hassanein, 2011; Mcdonald, 2019; Williams & Holt-Giménez, 2017), especially women (Boys & Fraser, 2018; Low et al., 2015; Ribera & Knutson, 2011). We do not argue against food safety, but wish to highlight the limitations of the current regulations that limit a more expansive and diverse food system.

Food regulations are not new; the code of Hammurabi (1700 B.C), for example, governed food. Other codes, often based on religious beliefs, have shaped what is considered healthful as well as lawful for centuries (Gallagher & McKevitt, 2019). These regulations have been essential to ensure the health and safety of communities. However, in the U.S. in the 19th century, a growing understanding of Pasteurian concepts on microbes, in tandem with the advent of the progressive era, led to food safety and morals being intertwined in a new way. The human body, rather than being conceptualized as prone to ritual impurity, became something vulnerable to pathogens (Goodwin, 1999). Current food safety regulations are built, in part, on the advent of germ theory embedded in Pasteurian concepts of contamination. But these new, scientifically-informed regulatory systems are not without their social trappings: even as these systems seek to remove biological, chemical, and physical contaminants from foods, they are also seeking to maintain specific social processes and relationships (Latour, 1993). They also reinforce the power structures that enable larger-scale and mechanized industries to play a larger role in shaping regulations (P. F. Baur, 2016).

With this preparatory work complete, we now follow three fermented foods produced by diverse communities in Arizona. As we examine these different foods within Arizona's food safety ecosystem, we seek to highlight what social processes and relationships exist in these potentially alternative approaches to making safe foods. We do this to extend conversations about the characteristics of alternative paths capable of going beyond sustainable to produce regenerative systems (Thompson & Scoones, 2009).

Inoculating or Backslopping Bacteria

Desirable fermentation requires the presence of beneficial bacteria. In industrial production, these bacteria are specifically selected and standardized, while in more traditional methods, the bacteria may come from the environment. This could include *Lactobacilli* that natively exist on vegetables or human hands. This could also include the purposeful addition of a small portion of a previous ferment, called backslopping. Sara's grandma's yogurt used a backslop, where she kept a couple of spoonsful of the old yogurt to inoculate the new batch; similarly, Christy's grandmother kept her sourdough starter alive by saving a bit from each batch to use to start the next. Following the backslopping pattern, in this section we introduce the fermented foods we followed in Arizona to set in place or inoculate our ideas for the rest of the paper. These are all traditional products of different communities, products with a special connection to a people and/or a place, with a gastronomic heritage and particular sensory properties, that has endured over generations, at least 30 years (Balogh, Békési, Gorton, Popp, & Lengyel, 2016).

Gundruk

Gundruk is a sun-dried, fermented, and re-sun-dried mix of leafy greens produced and consumed by Nepali families in and around Maricopa county. Sometimes *gundruk* is made in Nepali's homes, sometimes it is brought back from family visits in Nepal, sometimes smuggled in, and some introduced through their restaurants. *Gundruk* is traditionally made by women, using the leaves of vegetables such as cauliflower and mustard green, staples of farms in the Himalayas. It produces a light lactic acid fermentation through an anaerobic process, with an acid-like smell (Farag et al., 2020). It is often the main ingredient in creating hearty soups and salads (Interview 1 and 3, 2019) that are low-calorie, low protein, high in dietary fiber, ascorbic acid and carotene (Ranjan Swain et al., 2014). The recipes produced include gundruk *sandheko* or ko *achar,* a salad, or *Bhatamas*. The knowledge of preparing *gundruk,* including how to ensure the product is safe, is based on tacit knowledge (Fonte, 2018) that has been passed down. The people we interviewed have tuned their bodies to detect when it's gone off, just one step in a larger array of strict cultural rules implemented to avoid contamination. Illustrating how intergenerational tacit knowledge is an important cultural method of ensuring the quality of fermented foods.

Figure 3: Nepali couple making *gundruk* in Tempe, Arizona, in their backyard.

Saguaro Syrups and More

The Saguaro cactus is sacred to Indigenous communities of the Sonoran Desert, such as the Tohono O'odham and the Akimel O'odham (Pima) people. Until the 20th century, most tribes had half of their diet from wild foods. This included Saguaro fruit, mesquite pods, cholla buds, and others (Rea, 1997). The Saguaro harvest is usually in midsummer, with its rich sweet pulp filled with seeds and rich in protein. Today parties of families will go out using a tool known as a *ku'ipad*, as seen in figure 4, to knock down the saguaro cactus fruit. The fruit is transformed into a thick syrup by cleaning it, thumping it to remove the seeds, and then extracting the pulp and cooking until it reduces. The syrup can then be used as a flavoring for drinks or sauce on meats, salads, and stews. Saguaro syrup can be fermented into a wine. This beverage plays a vital role in a ceremony intended to bring rain. Many O'odham people prefer not to talk about the Saguaro wine. This silence is a form of ethnographic resistance, and grows out of an

experience where western people and academics have discussed the wine out of context; one interviewee told us this decentralizes its sacred value for O'odham folk (Rea, 1997, Interview 7, 2020). Fermentation, when implemented, not only changes the syrup into wine, it also changes the syrup from something that could potentially freely circulate out into larger economic systems to something kept close to home. To many Indigenous communities, being aware and respectful of recurring patterns such as annual rainfall, is connected to their sense of stewardship and caretaking. This is exemplified by honoring the land, foods, and organisms through renewed ceremony (Whyte et al., 2016).

Figure 4: Tohono O'odham woman harvesting a Saguaro fruit using *ku'ipad* (Malloy, 2020).

Yogurt/soft cheese (Dairy)

Middle Easterners consume a variety of fermented dairy, including *laban rayeb or laban khad,* lightly fermented buttermilk, which can be transformed into *karish* cheese, which in Egypt is subsequently converted into *mish* (El-Gendy, 1983; Mahgoub, 2018). Yogurt or *zabady* is also commonly produced at home using acid-producing bacteria (Trachoo, 2002). In Jordan and Lebanon, yogurt is transformed to *labneh*, by removing the liquid and adding salt, and is further transformed into *gemed* (Figure 5), sun-dried dry balls of cheese (Interview 15, 2021). Like *gemed, kishk* can be stored for a year, and is made from cow or buffalo milk that is fermented and dried and grain added to it. Fermentation of dairy is believed to be widespread in the Middle East due to the widespread nomadic cattle culture and the need to process the milk (Mahgoub, 2018)[2]. These products play a significant role in Middle Eastern culture and continue to be produced and consumed amongst Middle Easterners, even those in the global diaspora.

Arizona is home to approximately 60,000 people from the Middle East (https://yallacountmein.org/states/arizona). This group, composed of Egyptians, Libyans, Jordanians, Lebanese, Palestinians, Iraqi and Iranians, continues to value fermented dairy products like *mish, labneh, gemed,* and *kishk*. Most fermented products consumed by Muslim Arabs has little alcohol content, as alcohol is considered *haram (*non-halal). However, naturally fermented foods containing less than 1% alcohol content, such as vinegars, are allowed (Alzeer & Abou Hadeed, 2016). Many Middle Eastern immigrants, Christian and Muslim, maintain their food traditions. These

2 Rock drawings in the Libyan desert as far back as 9000BC and Sumerian drawings of 6000 BC show different aspects of milk production and fermentation (Edward, 2008) Many processes include transformations by salting, drying or forming balls in olive oil (Tamime & O'connor, 1995) . Each country has its slight variations, for example a form of *kishk* is produced across the region, however in Egypt it is produced in claypots, in a special room where the beneficial lactic acid bacteria accumulate from one production cycle to the next (Mahgoub, 2018), while in Lebanon its formed from *labneh*.

traditions are especially prevalent during holidays: For Muslims, Ramadan marks the month where many traditions are maintained, such as breaking the fast with a date and some fermented dairy. This process of transforming raw foods to preserve them for long periods of time, is not only an important gastronomic tradition, but enables food to be preserved for longer periods while enhancing their nutritional value.

Figure 5: Jordanian soft chesses in Tempe: Women in Arizona making *labneh* (left) with both strainer and traditional cloth and the finished product of *gemed* in olive oil (right)

Backslopping Regeneration into the Food System

These three fermented foods provide the starting point for considering how to inoculate the starter culture to create a more regenerative food system in Arizona. Like beneficial bacteria added to milk, saguaro syrup, or greens, these foods highlight a rich connection to land and heritage. The intergenerational knowledge embodied in the production of *gundruk* creates a final product that is safe to eat and of good quality. The

renewed rain ceremony using Saguaro wine, is a reminder to its people of the earth's cycles and the need to continue to be caretakers and give offerings to the earth. Middle Easterners' age-old techniques of transforming dairy have ensured the creation of tasty, durable, and nutritious foods. If allowed to be produced, the system would be characterized by emphasizing traditional preservation and conservation techniques, enabling relationality between people and their food, honoring the cycles of the earth, increasing the diversity of foods, in particular ones with health benefits, and enabling a continuation of intergenerational learning through a method of enabling translocality, all principles of a regenerative food system (El-Sayed, Cloutier unpublished). However, for the inoculation to be successful, how it is fed, meaning the particular circumstances they exist, is equally important, as discussed in the next section.

Feeding and Fermenting

Depending on the product, as fermentation begins, the product might need to be left in a cool, dry place, or burped, to allow the gases to be released. It is essential that you care for your ferment, care is used since you are nurturing living things and creating a relationship (Fournier, 2020). Caring, Puig de la Bellacasa (2017) states, "is a relational practice that engages ways of knowing" (p.146), in our case, that involves feeding, monitoring the fermentative process, and checking what the ferment's needs are, after all these are live organisms at work. Sara's Nonna would tell her to be careful with the "fermenti lattici," which translates to probiotics, they are the essential element that gives the health benefits, so we need to care for them. We both have experience improperly caring for our ferments; Sara opened up some jars of kimchi that were left in a place that was too hot and released a strong pungent and unpleasant smell that

made her kitchen unusable for two days, while Christy once over fermented a ginger-turmeric beer that acted like champagne when opened, spraying turmeric all over the kitchen ceiling and walls. When things go wrong, we know that one might need to start again or add some missing element. Like other people who ferment, we have learned that success is about attunement to place, understanding what the specific circumstances need, and adapting to them. This section explores the challenging context that these fermented foods are found in and how other external factors shape them.

Gundruk and Food Safety

Many traditional foods never reach commercial markets. The production processes used in creating many of these foods do not adhere to food safety regulations, and fail to follow the principles of Hazard Analysis and Critical Control Point (HACCP) set by the FDA (Lee, Hwang, & Mustapha, 2014). Due to *gundruk's* current lack of known safety protocols and the cultural aspect associated with care and being typically produced through tight-knit connections with friends and family, it is the probable cause for it not being found in supermarkets across the USA. *Gundruk* is often obtained from family members or close friends, to ensure its quality, since it is a time-consuming process with many potentially hazardous steps. Nonetheless, these foods do inherently have their own cultural safety protocols. For *gundruk,* these include a series of established steps of producing a safe product and following a concept of cleanliness known as *Gotho (*Interview 5 and 6, 2019*)*. *Gundruk* is traditionally produced by women, who are expected to have very clean hands, and shouldn't make *gundruk* when they are menstruating; lastly, there should not be any animals during production.

To make *gundruk,* cultural safety guidelines are set into place—these work to ensure that only beneficial bacteria such as lactic acid microbes are introduced. Surplus leaves of mustard, cauliflower cabbage, or radish are washed and wilted in the sun to remove excess moisture (Tamang & Tamang, 2010). This discourages the growth of mold. The wilted leaves are chopped and squeezed to extract the remaining moisture. The leaves are then tightly packed in containers, traditionally earthenware, to allow little to no oxygen flow (necessary for anaerobic reaction) for fermentation to occur (Tamang & Tamang, 2010) Emission of an 'acidic' smell in three to four days confirms fermentation, and the process continues between 15-22 days. The fermentation step is observed carefully, however no metal object, or bare fingers are allowed to touch the *gundruk* at this stage. Three interviewees told us that only dry wooden items could be used (Interview 1, 2, and 6). Once fermentation is complete, *gundruk* is sun-dried for 2-44 days, shrinking its volume considerably. It is now ready to be cooked or stored (often for months).

While simple, each of these steps demonstrates how producers navigate a type of microbiopolitics unique to their culture and social conditions, while ensuring the safety of the product. *Gundruk* brought back many sentimental feelings to all those interviewed, some mentioned how they hope their kids can grow up to enjoy *gundruk,* but aren't sure if they can continue producing it or finding it. Another challenge, and microbiopotical entanglement faced when bringing back *gundruk* from overseas, was how customs officers treated them as if they were bringing in illegal drugs. Gundruk appeared to be mistaken for dry marijuana (Interview 6, 2019). Paxson (2019) points out that food safety regulations are unevenly enacted at U.S ports of entry, where some products are perceived as adulterations and contaminations, while others aren't. A

mixture of hindering regulatory structures, a lack of trustworthy networks, and a lack of time to produce this time-consuming product, may mean that Nepali families may not continue to enjoy *gundruk* in Arizona in second or third-generation families.

Saguaro and Food Sovereignty

For the O'odham people, the relationship to the Saguaro is related to their food sovereignty, embedded in their right to their own culturally defined food ("Nyéléni 2007 Forum for Food Sovereignty," 2007). Food sovereignty to Indigenous people is a process of reclaiming, a movement among many tribes, and not a goal per se (Hoover & Mihesuah, 2019). Food sovereignty scholar Elizabeth Hoover (2019) explains that amongst Indigenous communities, food sovereignty is not just about rights, it is about relations towards each other and towards the living world. Framed this way, food sovereignty includes preserving cultural heritage, maintaining health, and making a living—food sovereignty is economics and much more. It is seen by many as defining what food is, but having the means to have control over one's food, which translates into a form of independence. For this reason, foods that are considered sacred are kept close, and not made available to a wider public.

Making wine from saguaro fruit, but keeping it from entering larger markets, is a practice of claiming food sovereignty. In an interview (Interviewee 7) with a Tohono O'odham producer, he stated, "some foods we produce we are happy to sell in markets, but others we don't, they are considered sacred." These include the saguaro wine used in rain ceremonies. These foods have a strong association to land, and it is embedded in the regenerative connection they have with the land. Saguaro cacti are not meant to be cut down or harvested except by Indigenous people, thus solidifying the linkage of food sovereignty and land reclamation and regeneration against the colonial settler (Whyte,

2016). Caring for saguaro wine, then, is primarily a process of keeping the ferment isolated from larger economic circulatory structures, rather embedding its production and circulation in relationships of kinship and trust defined in part by encounters with settler colonialism and contemporary extractive impulses exerted by Western society.

Despite the clear desire to protect the sovereignty of their foods and lands, tribal communities don't always have the ability to protect their foods and care for them as they wish. Firstly, foods can become commodified and commercialized. Several small businesses are rising across Arizona that are producing and commercializing Saguaro and prickly pear juices, syrups, etc. A white woman interviewed in Southern Arizona has a whole line of products from the prickly pear cactus, another plant traditionally used in Indigenous cuisine in the Arizona region, and markets it based on its traditional medicinal properties. Even though this woman is collaborating with Tohono O'odham people in the production, she remains the owner, and as this business grows, what limits are present to stop her efforts from eventually excluding her original collaborators? This question reflects a common challenge faced by fermenters who rely on backslopping or non-standardized cultures-—sometimes the balance between different microbial strains tips in one direction or another, and in the process, impacts the entire production. This example raises questions about how non-Indigenous folks who have made their home in the region relate to the land and its earlier inhabitants.

Secondly, incorporating traditional foods in tribal feeding programs has long been requested by many tribal nations, however, this comes with stipulations. A document titled *Tribal farm bill recommendations* (Farm bill 4033-year 2014) explicates that "Traditional foods were defined in the provision to include: wild game meat; fish; seafood; marine mammals; plants; and berries." However, it is required that FDA and USDA approval take place (Hipp & Duren, 2017). This requirement removes

agency from the tribes. These two examples showcase how the commodification of foods, as well as requiring they exist within FDA regulatory structures, removes agency and sovereignty from Indigenous communities. In time, many authentic foods become viewed as exotic foods and become culturally appropriated, commercialized, and transformed to fit within regulatory frameworks. In that process, cultural values and religious beliefs often get effaced; all that remains is a product (Alkon & Vang, 2020).Therefore, the question remains: how to care for foods while caring for the people's values of sacredness producing them?

Dairy and Translocal Identity

Fermented Middle Eastern dairy products are sold in mini-markets across the greater Phoenix area. Most commercial brands come from the Middle East and follow US safety standards. "We work with distributors in LA (Los Angeles) or Chicago, and we choose the brands that most of our customers are familiar with," one Libyan store owner told us (Interview 14, 2021). Some products are home-made, often by the market's owners or friends and family, as well as families who are maintaining their cultural traditions alive (Interview 17, 2021). These products and practices constitute an important sense of identity and reconnection to the homeland, while allowing them to create a sense of community prevalent with many immigrant communities (Parasecoli, 2014). Hayes-Conroy and Martin (2010) argue that immigrants' bodies carry with them food-tastes developed and experienced in their homeland, and bring them into the new location. In an interview, a Jordanian mother mentioned that despite all her children and grandchildren now living in the USA and specifically Arizona, "they still always ask me for our traditional foods, like *mansaf* and *gemed,* and I am keen on having them maintain their cultural heritage" (interview 15, 2021). In her paper, Valiente-Neighbours

shows how Philipino immigrants never truly become "native," they have brought their food with them, and although they are in San Diego, they see their native food, as local food. This showcases a type of "immigrant identity-based localism" (2012, p. 539), accentuating Delind's concept that these migrants carry in their bodies their foods (Delind, 2006).

However, Middle Easterners also enjoy other cuisines, including American food, possibly in an effort to assimilate. The Middle Eastern store owner stated that the first 5-10 years when the immigrant families arrive, they are connected to their food heritage, but as the second generation comes to age, they begin to move towards more western food and fast food (Interview 14, 2021). This hybridization is part of what scholars refer to as translocal identities (Alkon & Vang, 2020; Brickell & Datta, 2011). Translocal identities describe a phenomenon related to mobility and migration while having some spatial interconnectedness, meaning not limited to national boundaries, and being from more than one location at the same time (Greiner & Sakdapolrak, 2013). "My nieces," one Jordanian interviewee (Interview 16) said, "like grandma's traditional food, and engage in our traditional dances and customs, but it's not a deep understanding of our culture, it's shallow." Translocal expands on the familiar concepts of local food, which denotes good, healthful, and sustainable productions produced within 30-50 miles, suggesting that with a growing migrant community, it's essential to acknowledge and purchase translocal foods (Valiente-Neighbours, 2012). There are around 17 Middle Eastern stores/restaurants in the greater Phoenix area. Many act as both a mini-market for Arab products, including dairy, but they are also a place to gather, have a warm meal, and have cumbersome desserts. These places often become a hub for the Middle Eastern community, where people may order halal meats, or lamb on special occasions or have

significant catered events (Interview 13 and 14, 2021). Parasecoli (2014) states that many food-related communities will coalesce around the same desire to defend an often imagined past that is perceived as threatened with extinction and claim roots that are antagonized continuously or negated by the surrounding environment. A Jordanian interviewee (Interview 15) stated that it would be great if our foods were more accessible, not just the commercial items found in Middle Eastern stores, but rather that our communities were engaged in producing them, as we have back home. These translocal identities and foods are often placed in the margins and not considered part of a local food ecosystem, thus furthering the racial divide that may exist. A constant renegotiation is needed at the local level with the growth and expansion of migrant communities such as the Middle Eastern one, this lends itself as an opportunity.

Feeding Diversity, not the Divide

The interconnectedness of the three products to their communities illustrates the intricate relation of care towards food, and highlights the complexity of creating a regenerative food system. Feeding and caring for the diversity of ways to interact with food is no easy task. *Gundruk's* traditions invite opening up the dialogue on what constitutes a safe fermented product, what traditional mechanisms exist and are passed down through generations and may enable us to continue to ensure the safety of products beyond the standardized regulatory standards. *Saguaro wine* invites non-Indigenous folks to be more cognizant that relationships to foods differ between communities, and that some products have a more profound and spiritual value to people, and their commercialization might harm both the food sovereignty of the people, as well as have potential adverse effects on the environment. The food's sacredness represents, to the Tohono O'odham folks who talked with us, a larger ecosystem where

the Saguaro plant itself is endangered. The Middle Eastern connection to dairy invites the realization that immigrant communities are in flux, and with this flux, a need for more flexible systems that allow for a local food system that is evolving that is translocal may enable more diversity. These are just a few elements of what following some ferments have highlighted, however as with regenerative food systems, adapting and making adjustments is part of the evolution and growth of such. The next section illustrates some of the proposed adjustments.

Sensing and Making Adjustments

To ensure the quality of a fermented product, some sensing or testing needs to occur. The sensing process might be observing bubbles in a sourdough starter, or floating a spoonful of the starter in some water, or conducting a smell test such as with *gundruk* to ensure it's not foul and that the ferment didn't go bad. Alternatively, a device such as a hydrometer may be used to test the alcohol content. Based on the various tests, you might then choose to make adjustments, decreasing the time of fermentation or adding an ingredient. Fermented dairy producers in Egypt will evaluate whether to add or reduce dried artemisia leaves and chili depending on the milk's fat content. This section discusses how to tackle and address some of the microbiopolitical entanglements fermented foods raise and create a more inclusive food environment that enables traditional productions to exist and flourish. Similar to Spackman's (2018) discussion on microbiological citizenship, which illustrated the tension found between producers and consumers of kombucha, a fermented tea, the fermenters we talked about seek to preserve their relations with microbial life in the face of different regulatory, cultural, and economic challenges. We illustrate how a need to navigate these entanglements is

necessary, since many marginal communities encourage and welcome a relation between foods and microbes. We suggest promoting a regenerative food system that addresses the issues raised about food safety, food sovereignty, and identity. We do this by exploring tools that empower communities using alternative labeling systems, pushing for more education and awareness-raising, and facilitating the availability of cheap and accessible testing methods.

Encouraging a Regenerative Food System

Many traditional and Indigenous communities encourage regenerative food systems. Namely, the whole systems approach to place-based food (Jackson & Jensen, 2018; Mang & Reed, 2012), while integrating agroecological (M. A. Altieri et al., 2011), and nature-inspired solutions (Rhodes, 2017), and being engaged civically and economically (Hintz, 2015a; Trauger, 2017). It is a system that produces flavorful and culturally appropriate food, such as fermentation (Fontefrancesco, 2018). Regenerative food systems seek to be ecologically net positive (Hes & Du Plessis, 2015; Pedersen Zari, 2018b), while striving to achieve intergenerational and interspecies justice (K. A. Dahlberg, 2009; Paxson, 2008). Fermented foods exemplify this complexity and call for a constant renegotiation of what constitutes as eligible food.

In the natural world, where regenerative systems take inspiration, it's not about getting rid of the rogue or harmful substance, but rather it's about creating balance (Interview 8, 2020). It is about sensing the feedback loop, making small adjustments, incorporating diversity, and enabling the system to reach a new equilibrium. The ecosystem of twentieth-century food safety has created sets of regulations and standards that don't enable this equilibrium to be established. Rather it ostracizes different players

and labels them in binaries as good and bad. A regenerative approach is needed to ensure a safe, holistic and inclusive food environment. One that doesn't disenfranchise the small scale and traditional producers, but instead includes them and learns from them. Making traditional microbial foods offers opportunities to interact in microbiopolitics and engage with organisms we can't see but can smell, touch, and feel. This provides an opportunity to further cultivate relations with other organisms. By inviting these microbes into our bodies, we nurture our ecosystem inside and out (P. F. Baur, 2016).

Alternative Labels and Ways of Organizing

One way of protecting traditional and Indigenous foods that have been successful in Europe is labeling. For example, geographic Indication (GI) labels are given to a product from a specific geography with particular qualities and production processes of the product (2015 WIPO). Given the following definition, only the Saguaro product could be attributed as a possible GI, however before following through with just adding a label, respecting the community's requirement of honoring sacredness needs to be taken into account. Commercializing might destroy the preexisting social dynamics (Parasecoli, 2017b). The global popularity of products that celebrate an authentic, artisanal production method, or a connection to a geographically limited area, can also operate to disrupt traditional ways of life and destroy the underlying attributes that make a traditional product unique and popular in the first place (Gallagher & McKevitt, 2019). Another form of labeling and organizing is a system developed by Slow Food International known as Presidia[3]. This is a system based on consensus amongst

3 Slow Food Presidium, a trademarked designation that indicates a collective of producers that sustain the quality production of a crop, variety, food process, or product that is at risk of extinction. The Slow Food Presidia provide a global umbrella to allow for the recovery of

producers to establish production standards through an agreed-upon protocol. In the USA, one known presidium has been the Navajo Churro sheep found in the four corners, whereby the traditional production and preservation of this sheep is protected Parasecoli, 2017b). This protocol then means that if someone wants to reproduce this product, they need to follow this protocol and receive technical assistance from the presidium members (Fontefrancesco, 2018). Unlike GI, this system is based on community consensus and is not necessarily geographically bound, but highlights people and their customs and is meant to create trust and standardization beyond the more industrialized HACCP model.

These community-based labeling systems sometimes stem from a religious or cultural belief. Middle Easterners categorize foods as *haram*, forbidden in Islam or *halal*, meaning lawful, *Tayib*, foods that considered clean. Today halal foods have an actual certification, which was not the case before the 1970s (Billah, Rahman, & Hossain, 2020). Therefore, even culturally relevant labels such as this could be translated into Indigenous applications such as sacred or marketable, but belonging to an Indigenous community. This, however, would need to happen in a way that continues to limit how a product is produced and circulates. Some things, still, are not meant to travel into economic circuits.

Food Education and Better Ways of Testing

Linked to creating more inclusive labels is a need for more education across the spectrum, elders who teach the younger generation, or the larger community understanding the pleasure in having more diverse foods, and regulators who are stuck in their systems. "I want my grandchildren to take pride in their Jordanian food

traditional processes and the safeguarding of native breeds, local varieties, and unique ecosystems.

heritage," (Interview 15, 2021). She then continued that despite teaching their culture norms at various centers, it's watered down due to fear of not assimilating. As governance structures strive to be more inclusive of different foods, more public education and awareness is needed. Consumers need to be made aware of the biodiversity of foods that exist. However, there has also been a critique towards this idea of returning to traditions. As this paper has shown, new food ecologies are being created. In Arizona, where migrant communities are growing, and Indigenous communities rediscover and redefine their food traditions, a new local is being created, embedded with Indigenous and translocal. It is not just about foods produced locally, because this is what has culturally been produced, as some gastronomes have proposed, but also that local foods are being reinvented with the people who inhabit these new locales. According to Valiente-Neighbors (2012), the localist rhetoric often sidelines the food choices and practices of immigrants, migrants, and refugees, who see themselves as trans-local, meaning multiple locations, but who still create their own community-based local food.

Increased Cheap and Accessible Technology

Communities and food producers need to be empowered with cheap and accessible technology. One of the challenges in traditional fermented foods is truly identifying what makes this food special, what are the microbial communities involved in its production. Today there are technological tools that can enhance this process. Technology can track microbial communities found in fermented products such as sourdough, kombucha, kefir, etc., using high-throughput sequencing processes (Bokulich, Lewis, Boundy-Mills, & Mills, 2016). Thus, using science to bolster the traditional value of these foods. These tools remain expensive, but are being rolled out as

potential ways of assessing microbial communities. The technology could be developed through a collective decision-making process to make specific production steps easier. In making *laban khad,* the lining of a goat's stomach is used as a balloon and then boxed and agitated by women for up to 45min, a machine that creates the same motion but is lined with the goat's stomach, would facilitate the process and ensure it continues to be produced. Facilitating access to such technologies can also enable communities to better communicate with their audience the quality of such products.

As with fermented foods that need this constant toggling and self-regulating whether they are ready, tasty, and safe, we envision a regenerative food system that can self-regulate and introduce new elements to make it more resilient and adaptable.

Coming together and sharing

Whether sitting around Sara's Nonna's table with yogurt, breads, home-made passata or with her Egyptian family at a Ramadan feast that included fermented dairy and pickles, or sitting at the breakfast table with Christy's family to eat sourdough waffles, food is about coming together and sharing. To conclude this paper, we invite you to keep an open mind to expanding our existing food system. We have learned that *gundruk* can accompany salads or soups, *Saguaro* syrup can be added to lightly sweetened foods, *gemed,* and *kishk* can be rehydrated and served with eggs most importantly, these foods are shared. This paper has expanded on the concepts of microbiopolitical entanglements related to less familiar fermented foods that belong to different communities living in Arizona. We have invited you to expand on the potentials of a food system by following both these ferments and the process itself of fermentation, which is a bubbling, messy, yet flavorful and fulfilling process. We illustrate how these foods live within complex

local contexts of food safety regulations, structured for more industrialized food systems. These foods are part of a complex socio-ecological construct of meanings related to some people's food sovereignty. The relations some have with their food are in flux based on how their own identities are evolving. We have proposed making adjustments to the current system to make themes more inclusive and diverse by encouraging more regenerative ways, expanding on alternative labeling notions, and encouraging more education, while expanding on the tools to support valuing these fermented foods. This is not an attempt to replace the structured industrialized food system, which will continue to exist, but to create more space for alternatives and enable diversity to have both an equitable and safe space to flourish.

CHAPTER 4

INTERROGATING FOOD SYSTEM SUSTAINABILITY: A GOOD FOOD JOURNEY

Introduction

I have been pursuing good food for the past decade. In this time, I have created several enterprises to valorize traditional small-scale productions, working closely with small-scale farmers, renowned chefs and women – fierce guardians of family meals, health and traditions. As an active member of the Slow Food (SF) movement, I have ardently searched for good food and sought to promote it, although, through my ancestors, it was always brewing in my body.

When I began my doctoral program at Arizona State University (ASU), I knew I wanted to learn from its land and people, but I was not cognizant of Arizona's sacredness and its relationship to my own country, Egypt. Like Egypt, Arizona is arid. As well, it bears many historical and contemporary similarities; both stewarded by ancient civilizations who mastered the art of water management and agriculture and continue to innovate and create agricultural bounty. I was drawn to Arizona small-scale farmers and producers – primarily the indigenous and the migrants – and their regenerative practices. For the Indigenous communities I interacted with, regeneration is much deeper than what we call sustainability. Regeneration is a strong connection to the land and the living and the non-living worlds, creating balance and healthier foods based on strong relations. I wanted to learn from these approaches and the land's wisdom to cultivate regenerative food systems.

I understand a regenerative food system to be one that is holistic and beyond sustainable, where the objective is to create ecologically net-positive systems while enhancing the livelihoods of people and other species across generations. Up to this point, my dissertation has examined how regenerative food systems are carving a space

against the backdrop of neo-liberal and industrialized food systems, doing so by maintaining Indigenous traditions often inspired by nature. I have represented this framework as a spiral (Ch. 2) – a recurring pattern in nature – seen in flowers and shells, and an Indigenous philosophy in which "the spiral shows how we are all related, from the shape of the galaxies to our fingerprints (Bioneers, 2014)." Using the metaphor of traditional fermentation, I have demonstrated how messy may be these biological entanglements between regulations, producers and consumers (Wakefield-Rann, Fam, & Stewart, 2019).

Ultimately, fermentation can produce delicious and nutritious foods and, as a model, guide more inclusive governance structures encompassing traditional and Indigenous regenerative practices. The outcome could be frameworks and approaches to enhance food system sustainability. Yet, more inclusive means of knowledge creation within sustainability and food system sustainability must be made possible to shift toward a regenerative future.

Scholars of food system sustainability argue the field is normative, meaning it has a desirable state of ensuring food security for all humans at all times (Hodbod & Eakin, 2015); the field is also interdisciplinary (Hatt et al., 2016; Thompson & Scoones, 2009). Wiek et al. (2011) define normative approaches to sustainability as assessing the sustainability of a current or future socio-ecological system and crafting a sustainable vision by negotiating sustainability values, principles, goals and targets. Simply, interdisciplinarity suggests multi-perspective food system sustainability scholarship, including diverse methods and ontologies to address sustainability's wicked problems. In reality, the field does not always negotiate various worldviews and ontologies, and struggles to be inclusive when following a Western scientific paradigm (Papenfuss, 2019) and associated quantitative and qualitative approaches.

Some scholars have pushed to hybridize sustainability science (Benessia et al., 2012) to include more sensorial research, such as journaling or self-reflective activities (Evangelos, Hockey, & Littledyke, 2013), to understand (un)sustainable practices – much of this has occurred primarily in sustainability education, however, and not the field at large (Pretorius & Cutri, 2019; Reed, Dagli, & Hambly Odame, 2020). I assert that a deeper form of sustainability (Hill, 1998) – knowledge generation – would include various forms of knowledge systems and methodologies, such as Traditional Ecological Knowledge (TEK) and diverse qualitative methods (Reed et al., 2020), such as autoethnography or arts-based methods (Leavy, 2017).

This autoethnographic chapter recounts my efforts to investigate and explore good food. It tells my story to better understand and embody sustainability and how this journey helped center my values, questions, frameworks and the decisions that supported good food choices for myself and my family. Using the arts, specifically podcasting, I explore ways to better represent the voices at the forefront of regenerative practices and examine how I encourage and influence those around me on this path. Using a self-reflective process of analytical autoethnography (B. Anderson & Mcfarlane, 2011), I examine my individual role as a sustainability scholar, practitioner, activist and consumer, and I postulate that, working as sustainability scholar-practitioners, we should uphold our values while questioning our role through a reflexive process of our behaviors (B. Anderson & Mcfarlane, 2011). I follow an indigenous spiral temporality (Brooks, 2012; Whyte, 2018), where lessons are repeated from the past in the form of values and questions, transformed into the present as lessons applied, and passed on as wisdom to the future.

On this journey toward regenerative practices, I acknowledge the values of tradition, land appreciation and acknowledgement, and nature-reconnection. I frame the

chapter through the lenses of indigenous knowledge, biomimicry, regenerative food systems, microbiopolitics, ecofeminism and arts-based methods (Figure 6).

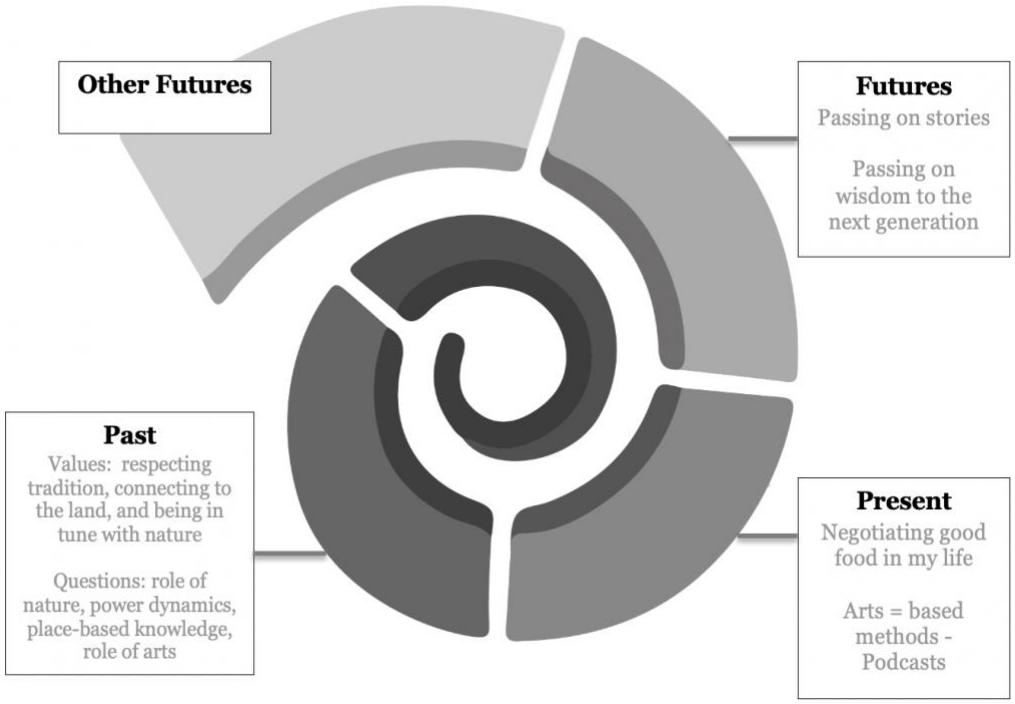

Figure 6. Spiral diagram for past, present and future: representing my food journey through time and its influence on my path toward regenerative practices.

Methods

Autoethnography

Examination of food lends itself well in an autoethnographic form; it facilitates the incorporation of more sensorial forms of ethnographic research (Pink, 2009), and showcases how food system sustainability can diversify its communication methods. Autoethnography is a form of naturalistic inquiry, a well-established qualitative tool in exploratory research in the social sciences (Armstrong, 2010; Lincolin & Guba, 1985). It is grounded in a postmodern philosophy, drawing on lived experiences, to understand

social contexts with the intent of acknowledging the link between the personal and the cultural, using non-traditional forms of inquiry (Alkhaled, 2016; Méndez, 2013) while cultivating reciprocity from the reader (S. H. Jones, Adams, & Ellis, 2013).

Written in narrative form, autoethnography allows researchers to question internal emotional conditions and external environmental conditions and to explore a temporal dimension of past, present and future (Méndez, 2013). As a feminist scholar, I acknowledge my positionality and subjectivity; therefore, autoethnography enables me to critically examine my personal experiences within a cultural construct while contributing to existing research (S. H. Jones et al., 2013). According to Ellis, Adams, and Bochner, "autoethnography is an approach to research and writing that seeks to describe and systematically analyze (graphy) personal experience (auto) in order to understand cultural experience (ethno) (2011, p. 273)."

I rely on analytic autoethnography (L. Anderson, 2006; Ellis et al., 2011) to explore my role in changing behaviors toward regenerative solutions while seeking good food. Analytic refers to ethnographic work where the researcher is a member of the group being studied – where reflexivity and narrative are present – and links to the field's theoretical understanding (L. Anderson, 2006). I take this further, bringing in evocative autoethnography elements, using podcasts as a creative tool (Bartleet, 2013; Ellis et al., 2011). Such analytic tools are commonly used in education (Reed et al., 2020), and when Indigenous scholars challenge the paradigms within which they work. Indigenous scholars acknowledge the value of autoethnographies because they enable one to talk about self without the sharp separation of the subject, while also placing value on storytelling as a tool (McIvor, 2010).

Data Collection

A rigorous autoethnography requires diverse datasets. I compiled data in various forms across three years, including gratitude notes, journal entries, photos, transcripts from meetings and interviews, memos, classroom notes and a short survey for one podcast episode. The gratitude journal began in March 2018 and was a couple of daily appreciation sentences for the things I had in life. Later, in November 2018, the notes turned into full-on journal entries documenting my journey toward regenerative practices. The journal entries were weekly or biweekly entries that I supplemented with pictures or drawings. These entries were imported into MAXQDA, where I wrote memos to reflect further, analyze what I had written (Charmaz & Belgrave, 2019), and reach potential epiphanies (Ellis et al., 2011; Jevic & Springgay, 2019). I also kept weekly transcripts from meetings held with undergraduate students engaged in producing the podcast series. In my analysis, I would search keywords of essential concepts and reference them with notes from workshops attended and interviews conducted. I supported these efforts with peer-reviewed literature on themes and concepts that emerged. I also developed and executed a short survey for listeners of one podcast episode to assess the content's impact. Through an iterative and simultaneous data collection and analysis process (Charmaz, 1983), I revisited my lived experiences of producing and consuming food and painted a picture of my journey toward regeneration. I followed my art-making process from sensory experience to deep listening to creating an embodied experience, culminating in a podcast.

Now begins the spiraling autoethnography of past, present and future. I borrow from the Anishnaabe concept of *aanikoobijigan*, an expression that refers to ancestor and descendent at the same time (Whyte, 2018). This intergenerational expression is embedded in a concept of “spiraling temporality” (Whyte, 2018, p. 229), where

narratives unfold through our interaction with them, responding to and reflecting on the actual or potential actions and viewpoints of our ancestors and descendants, as they associate to place (Brooks, 2012; De Vos, 2020). This temporal cycle of past, present and future, is influenced both by Indigenous scholarship that acknowledges intergenerational knowledge spanning seven generations (Kimmerer, 2002; Winter, 2019), as well as ethnographic work that follows a cyclical ontology in tune with nature's cycles, where knowledge is cumulatively acquired (Gonzalez, 2000). My process takes three stages, past – values from my ancestors and my teachers' questions; present – how I have negotiated and embodied lessons into my life; and future – how to be a good ancestor to my offspring (Whyte, 2018) and pass on wisdom. In each section, I highlight my learnings and reflect on the shortcomings, setting the opportunity for these ideas and questions to spiral forward.

Past: Values from My Ancestors and Questions from my Teachers

Attuning to my ancestors' wisdom has shaped my values, and listening to my teachers has opened up questions on my path toward regeneration. In both native philosophy and my Muslim upbringing, it is essential to acknowledge our dependency on others, including the non-human, plants, animals and ancestors, and reciprocating by giving thanks (Kimmerer, 2018). In Arabic, *Alhamdulillah* means "thanks to God," while in Anishnaabe traditions, the concept of the Seventh fire acknowledges that to move forward, one must walk on the trail of one's ancestors and pick up what was left behind in terms of land, stories, seeds and values. Such an approach enables one to be more regenerative (Kimmerer, 2018). Such values and lessons are passed down through seeds, prayers, stories, or even visions.

In this section, I highlight with gratitude the values passed down by my ancestors on respecting tradition, connecting to the land and being in tune with nature. I raise core questions inspired by my teachers that have deepened my understanding of sustainability. I ask, can inspiration from nature be disconnected from social aspects? Does sustainability perpetuate colonial attitudes? Can sustainability exist without place-based knowledge and diverse knowledge systems? Should we move beyond sustainability being measured by metrics? Why should we explore boundary spaces and intersectionality? How can the arts offer more nuanced embodied and sensory experiences?

Ancestors

Appreciating traditional knowledge. Bubbling in a cauldron-like pot are kilos of San Marzano tomatoes, a kitchen transformed into a month-long sauce-making operation. This is how I remember my grandma, Nonna Rosa. My Italian Nonna passed many years ago, but her voice still guides me to explore a passion for traditional foods. Nonna Rosa expressed her love for others by daily creating nutritious and tasty lunches and dinners, weekly making fresh pasta, bread, yogurt and the yearly tomato preserve. Together in my summers, we made all the above and collected fruits such as figs. Nonna taught me to be frugal and not wasteful, and to recycle all materials, including learning recipes to reuse food. These are sustainability values I continue to hold dear. Her connection to her Calabrese land, and the value attributed to home productions of cheese and preserved meats, was passed on to me and instilled in my passion for traditional things.

Value: The time with Nonna taught me to appreciate and forefront traditions. I learned to value time-tested practices of small-scale farming, home-cooking, preservation, fermentation and more, many of which have been scientifically proven healthier for humans, other species and the land.

Connecting to place-based knowledge. "You look exactly like your father, your strong character and hard-headedness reflect him," people who knew Ali El-Sayed tell me. I didn't know my father; I was barely two when he died of a heart attack, but he is within me.

In a visualization activity conducted in 2011 in Tucson, Arizona, I connected with my deceased father, who guided me in his diplomatic ex-Minister of Housing ways. The visualization became very graphic and bloody, with many people shot in the head and beaten by sticks; although the picture was morbid, it was strangely hopeful. Next, my father and I began flying across Egypt, seeing growing pockets of green with green buildings and rooftop gardens. This vision profoundly influenced my life, especially given that, two days after this visualization activity, I landed in Egypt, oblivious that a call for a peoples' revolt had just been set in motion. Hours later, millions of Egyptians and I witnessed Egypt's transformation, now known as the Arab Spring. The images in my vision became a reality; yes, bloodshed and death, but with a renewed sense of hope to change our land.

Despite the current optics, a transformation has happened over the past decade, and I played my part in creating these green pockets. I co-created Nawaya, a social enterprise that works with small-scale producers in Cairo's outskirts to valorize our traditional lands and foods in sustainable ways. My father had a deep connection to his land and a deep appreciation for Egypt; he was a humble man who was grateful for his

life of simple beginnings to great prestige, praying five times a day and never forgetting his blessings.

Value: This vision solidified my connection to Egypt, and land in general, wanting to always be of humble service to my homeland in the process. Appreciation for land and its teachings has traveled with me wherever I go, as I am always keen to learn from the land and its people through their place-based knowledge.

Attuning to nature. Mostafa learned tracking from the *Bishari* tribe in Southern Egypt. The camel prints in the sand indicate the identity, size, sex, age and the tribe of the camel. Although not directly an ancestor, Mostafa was a person I was promised to marry who died in his mid-twenties – way too young – but his spirit continues to follow me and teach me lessons through the songs he wrote and sang.

"May you build a ladder to the stars

And climb on every rung,

May you stay forever young."

– *Bob Dylan*

Mostafa lived a nomadic lifestyle among the *Bishari, Wahi* and other Egyptian Indigenous communities, learning from them and appreciating nature. This awe of nature was infectious; as a biologist, I appreciated nature, but he taught me to be more attuned and to trust nature. I began walking barefoot in the hot desert sand, staying late at night to hear the sounds of insects, using only my ears to visualize my surroundings and be present for the birth of camels. My relationship with Mostafa helped me attune to nature, which flowered into a master's degree in biomimicry and a passion for learning more about nature-inspired design.

Value: Mostafa planted within me a deep respect, awe and appreciation for the natural world. While my respect for nature translated into pursuing a biomimicry degree, it made me keenly aware that nature teaches us to be more attuned, beyond sustainable and toward regenerative.

Teachers

My ancestors' voices have inspired my path, and I carry their values with me. My teachers along the way opened up many questions, which indirectly taught and continue to teach me lessons on my path to more regenerative practices.

Nature reconnection is not enough. "If you get accepted to a Ph.D. at ASU, I can offer you a fellowship at the Biomimicry Center," Dayna Baumeister (senior sustainability scholar and co-founder and director of ASU's Biomimicry Center) told me in 2016. One year later, I was studying sustainability as a Ph.D. student at ASU. Dayna, a longtime mentor, also led the visualization activity years back when I embarked on my biomimicry journey – we were connected. Learning from nature's strategies, being inspired by it, and emulating sustainable design (Benyus, 1997) is what I have been continuously learning from Dayna. Biomimicry expanded my knowledge horizons in how nature functions, bringing me closer to the natural world and those who steward it and are adept at creating more regenerative systems.

"Action on behalf of life transforms. Because the relationship between self and the world is reciprocal, it is not a question of first getting enlightened or saved and then acting. As we work to heal the earth, the earth heals us."

– Robin Wall Kimmerer

Biomimicry's framework, Life Principles (LPs)[4] (Baumeister, 2017), is the backbone of what I use to define a regenerative food system. Embarking on that process, however, made me question if nature-inspired design was enough. As Kimmerer says, I feel we should also learn from the self-sustaining communities who grow in symbiosis with nature.

Biomimicry also led me to start another company Dayma, where thousands of students have been led on nature journeys of (re)connection with Egypt's nature and understanding nature's ethos. I (co)founded Nawaya and Dayma to focus on different ways of changing behaviors and living more sustainably. Yet as I conducted my training and research, I began to question the enterprises true sustainability, as well. Indeed, they focus on the three pillars of sustainability – social, environmental and economic (Kajikawa, 2008; World Commission on Environment and Development, 1987). However, I realized that I had inadvertently adopted a colonial and savior mindset of preaching from a high horse to educate and change people and their behaviors, despite actively working to promote sustainability through a regenerative framework.

Decolonial scholars state that research should be based on mutualism rather than charity (Buzinde, Manuel-Navarrete, & Swanson, 2020). My early sustainability work was founded on charity, and failed to recognize existing power structures – something I share with many other sustainability efforts (Raj Patel, 2009; Wolford, McCarthy, Walsh-Dilley, Wolford, & McCarthy, 2016). Thus, as I thought more deeply about the power dynamics at play in my own sustainability work, I began to actively question my approach.

[4] The Life Principles are a set of 26 principles, ubiquitous patterns extrapolated from the natural world (Baumeister et.al, 2013). The principles were developed over the course of 20 years by Dayna Baumesiter and Janine Benyus at Biomimicry3.8.

Questions: Studying biomimicry brought me closer to nature and encouraged me to ask, "Can we solve sustainability issues that are divorced from social values and impact?" In pursuing my biomimicry degree and through my journey in both Dayma and Nawaya, where nature-inspired designs have been practiced either in youth reconnecting to nature or small-scale farmers adopting nature-inspired methods, I now question: "As sustainability experts, are we perpetuating colonial and savior attitudes?"

Contextualizing food through place and diverse knowledge systems.

My love for the natural world flourished with Mostafa and matured with biomimicry, but it was instigated by my Mamma Minuccia. We would sit on our balcony, I as a youngster, overlooking the Nile River and observe birds migrating north and south. Mamma Minuccia, like my father, has a deep love for Egypt. Despite being a foreigner, she explored with me the many cultural aspects of Egypt. Like Nonna, she also instilled my reconnection with food and my passion for making delicious homemade meals. She led me on the path of learning about Slow Food (SF).

"Carlo Petrini (founder of International Slow Food Movement) is revolutionary," my mother would say, "reach out to (him) and bring SF to Egypt." Eventually, I brought SF to Egypt and helped start its first Convivia, Presidia, market, Ark of Taste products and many more activities[5]. SF allowed me to integrate my passions for nature, the environment, people, traditions and food. The values learned from my ancestors were

[5] Slow Food is an international organization with chapters in 150 countries, promoting "Good, Clean and Fair Food for All". Founded by Petrini in 1986, its activities consist of 1) Convivia, local chapters that practice Slow Food's philosophy through various events such as shared meals, tasting and conferences or festivals organized in local communities;2) Presidia is an organizational set up that sustains quality production where risk of extinction or unique regions and ecosystems require sustainable intervention and methods, recovers traditional processing methods, and safeguards native breeds and local plant varieties; and 3) Ark of Taste is a catalogue of small-scale quality productions that belong to the cultures, history and traditions, and the collective heritage of fruits, vegetables, animal breeds, cheeses, breads, sweets and cured meats around the world.

becoming my practices. SF gave me a framework and a set of values to work with small-scale rural farmers effectively. Although criticized for being an elite organization focused on gourmet food, I see SF as a constantly evolving movement centered on positive development (Birkeland, 2008) rather than a negative, deterministic one.

"Slow Food unites the pleasure of food with

responsibility, sustainability, and harmony with nature."

- Carlo Petrini

When I moved to Arizona, I immediately joined the local SF chapter to become more entrenched in local activities. ASU did not provide opportunities to learn about the local history and its people; only through discussion with Joni Adamson (Director of the Environmental Humanities Initiative at ASU's Julie Ann Wrigley Global Institute of Sustainability) did I learn about the 22 indigenous tribal communities and their food sovereignty. I was hopeful SF would connect me more meaningfully, and I was invited to join the movement's Phoenix board. Cognizant of SF USA's "wine and cheese" focus, I wanted to ensure I challenged and realigned the chapter over time, transforming it into more inclusive and diverse body. The experiences I was gaining in a leading, well-respected sustainability program at ASU and a SF chapter made me question if true sustainability could be represented when neither the program nor the movement had taken into account and interacted with diverse indigenous communities.

Eventually, drawing on Slow Food USA's networks, I began connecting with Indigenous food producers, learning about their extensive food heritage and regenerative practices. I discovered many foods to forage – from edible mesquite pods that make flour to Palo Verde legumes to Nopales from cacti and saguaro fruits that make jams and syrups. The most intense experience took place when Clayton Brascoupe of the Traditional Native Farmers Association (TNFA) and Louie Hena, a Tesuque Pueblo

elder, invited me to attend the Indigenous Sustainable Food Systems Design Course in the summer of 2019. I learned about TEK, Pueblo food culture, the interconnectedness of foods and spirituality, diverse foodways – like foraging for sumac – and Zuni water-capturing traditions and natural building. The experience helped me understand regeneration in more depth, not in terms of agriculture systems that mimic prairies and grasslands to create more restorative grasses and animal productions (Rhodes, 2015; Savory & Duncan, 2016), but in terms of a holistic system that looks at mind, body, spirit and culture. I began to see how nature, social elements and diverse knowledge systems can weave together toward more regenerative practices.

Question: Getting involved in the local food system in Arizona and discovering that there was little connection to Indigenous knowledge invited me to question the limits of sustainability programs at SF Phoenix and ASU. Can we learn about sustainable food systems without learning about the land we live on, and without including diverse knowledge systems, such as TEK?

Moving beyond the boundaries through intersectional feminism, and microbiopolitics. "Let me help you with that" is my recurring offer in the interviews conducted for my Southwest Arizona research; it is hard for me to put on the researcher hat without getting actively involved with harvesting or some post-harvest activity. "I see myself as both a practitioner and an academic," I responded once to Scott Cloutier (senior sustainability scientist, assistant professor, ASU College of Global Futures), who had asked me if I saw myself as an academic. Before starting my doctorate in 2017, I did research but didn't identify as an academic; instead, I felt I was a practitioner – a serial entrepreneur – working to valorize traditional Egyptian foods and place-based

experiential learning for young adults. As a practitioner working with small-scale producers, I related to farmers and small-scale producers in the USA, whose challenges are similar. The deeper connection I felt to them brought me closer to being an insider, despite coming from a different country. I have accepted the role of duality and plurality I play, and I acknowledge its importance in changing behaviors.

Initially, my research focused on women working in regenerative food systems, since I had worked with rural Egyptian women to modernize and make their traditional farming practices sustainable. ASU's Joni Adamson recommended I lean into ecofeminism and its intersectional space. Ecofeminist approaches encourage in-depth understanding of place and argue that we are multispecies focusing on deconstructing dualisms (Dooren, Kirksey, & Munster, 2016; DuPuis & Goodman, 2005; Hintz, 2015b). When coupled with an intersectional understanding — the sum of injustices from race, sex and class (Cooper, 2016) — ecofeminism offers sustainability a more profound process to understand root problems in the inequities and injustices that are systemic in today's industrial food system (Merchant, 1996; Trauger, 2017).

I play a role in the normative aspect of sustainability by crafting a sustainable future and creating a desired space of sufficient food for all people at all times. Thus, I strive to be aware of how I shape sustainability conversations and practices and what methods and values I uphold. I acknowledge my positionality and privilege. I am a biracial, able-bodied, highly educated woman from an upper middle-class family from Egypt. My background enabled me to pursue higher education and gain access to exclusive spaces with Egyptian funders and politicians. Yet, I have also been unjustly treated by border patrols worldwide, given my name and religion. As Abu-Lughod (2012) refers to it, I am a hybrid of mixed Egyptian/Italian culture; this hybridity has given me the ability to live and work between cultures and transcend hierarchies to navigate and

bridge different worlds. Through self-reflection, I strive to create a democratic culture beyond dualism, to be intersectional, decolonial, mutualistic and centered on care (Haraway, 2008; Plumwood, 1993).

The quest for intersectionality and ecofeminism led to TEK. Through this interest, I have met migrant and small-scale farmers and producers in Arizona. I have worked with indigenous food producers in Arizona from the Tohono O'odham, Salt River Pima-Maricopa, Gila River Indian, Navajo, Hopi, Havasupai, and White Mountain Apache nations, as well as Pueblos in New Mexico. My entrance to these communities started at the Rocky Mountain Seed Alliance grain workshop. Talking with Cristal Franco an Indigenous there resulted in an invitation to the course led by Pueblo leaders Brascoupe and Hena mentioned earlier. Cristal gave me constructive advice as I navigated the Indigenous ways of knowing, ensuring I was respectful. The ways of knowing differ across the tribes but share a deep connection to the earth, one where we treat the plants, animals, rocks, water as kin to care for and not objects to exploit. The ways can open a deeper understanding of concepts of care, such as the one exemplified in an honorable harvest. Kimmerer (2018) says gather from the heart with good intentions, introduce ourselves to the plants, ask permission and listen, take only what we need and use it all, and always reciprocate back with a gift or offering. Learning from indigenous knowledge, I realized sustainability is not just a set of metrics but rather a relational exchange based on mutual care for other humans and also other beings. I continued to explore different ways of knowing, including ones not seen by the eye.

"At the heart of sustainable farming and food production

is a feminine energy of fertility, rebirth, and nurturing.

It is this regenerative power,

that is inspiring the process of social change."

- Claire Hope Cummings

In 2019 I took a microbial geographies course with Christy Spackman, assistant professor in ASU's School for the Future of Innovation in Society. We were required to create a fermented ginger beer, bring it to class and share it with others. Interestingly, I was happy to try the ginger beer by some students. Others, however, I refused – some smelled foul, but it had more to do with the social dynamics of interacting with some of the students. This underlying political tension of unclear boundaries is known as biopolitics (Foucault, 2008).

Exploring this biopolitical tension and the diversity that occurs at boundaries became pivotal to my work. Within nature, the edges, such as ecotones where two ecosystems meet, are where the most biodiversity exists. It is the interface of two systems coming together. I began exploring microbes by inviting effective microorganisms into my compost to break down organic matter. I also started producing fermented foods alongside my husband, Ahmed. Fermented foods are "made through desired microbial growth and enzymatic conversions of food components (Marco et al., 2021, p. 196)." Ahmed makes beer, and I make kefir water, kefir milk and vinegar, sourdough loaves of bread, pickles and lots more. I have had successful and failed attempts (Figure 7).

I began adding fermented foods to my diet, as research shows that lactic acids have health benefits because they add probiotics to help your microbiome. They also improve shelf life and the nutritional value of foods (Ranjan Swain et al., 2014). I deepened my understanding of fermentation by learning from people and attending workshops hosted by fermentation expert Sandor Katz and his partner Mara King in 2018 and another featuring Baker Don Guerra in Tucson. Interacting at these boundaries allowed me to "visualize" an unseen world, but one that was significant in creating

regenerative food and living a deeper sustainable life. The interactions with microbes also opened me to a more creative self.

"Since my early 20s, I have always heavily opposed antibiotics, as the step-daughter of a gastroenterologist, antibiotics were the answer for serious illness. I always resisted it, it was a gut feeling, the treatment always seemed so aggressive. I have a distinct memory of having super intense diarrhea and vomiting and discovering I had giardia, so I had to take an antibiotic course, which left me super debilitated. I didn't want this to be the way I treated my body. Despite not knowing the science (Fieldwork Journal, December 9, 2019, Pos. 211)."

Figure 7 Different fermentation attempts. (Top left) The best attempt of sourdough bread, sourdough burger bun, homemade beer. (Bottom left) Worst sourdough attempt, various date vinegars, crumb.

I identify fermentation and other preservation techniques as pivotal methods and characteristics of regenerative food systems; it is caring for microbes that makes fermented foods healthful, flavorful and reflective of diverse cultures.

The space of traditional fermented foods opened up questions of boundaries, of what is considered clean, healthy and good food? My research led me to explore hybrid spaces that create more diversity (Hinchliffe, 2007; Law & Mol, 2008) and invite non-human companion species (Haraway, 2003). This helps unravel the power dynamics at play at the biological level, the biopolitics (Latour, 1993) as well as the microbiopolitics, meaning the dynamics of living with microscopic non-humans at the bacterial and fungal level (Paxson, 2008). I discovered the complexity of the microbial world and how there are many more beneficial communities interplaying than previously assumed; also, given the ubiquity of microbes, how impossible it is to delineate where one boundary ends, where a new one begins.

Unraveling these concepts and valorizing rather than stigmatizing microbes is particularly important as our world is ravaged by the deadly virus SARS-CoV-2. This pandemic highlights our need to expand our understanding of the microbiopolitical entanglements rather than focusing on creating the illusion of pristine and clean spaces to avoid diseases (De Wilde, Koopman, & Mol, 2020). In this process of making spaces free of contamination, have we unintentionally set in place a future characterized by intensified super-bugs and pandemics? Both Indigenous knowledge and nature-inspired design encourage finding balance with physical surroundings rather than eliminating entire groups of organisms. Through traditional fermentation techniques whose processes are not as standardized as other food production processes, I learned to incorporate more mistakes and enable a more creative flow.

Questions: Exploring the boundaries, learning about valuing and caring for microbial biodiversity showed me the complexity of regenerative systems and made me question whether we should move beyond sustainability as merely a set of metrics? Can we quantify such things as care and reciprocity, or are these nurtured in us in different ways? In deciding what is good food, are the boundaries created by science and regulatory bodies correct? Should we be eliminating microbes as contaminants, or should we be negotiating these microbiopolitics? Do we eliminate traditional productions and intersectional know-how when we define foods as good and bad?

Fermentation and other artistic expressions. Fermentation enabled me to experiment with different flavorful and healthful foods. Despite growing research on the importance of engaging both the mind and body in cognitive and imaginative ways to represent complex issues and facilitate "collective deliberation, learning, and transformation (Lineberry & Wiek, 2016, p. 312)," many mainstream sustainability approaches lack creative and an artistic presence. In academia, the rhetoric is that stories can misrepresent science (Blastland et al., 2020). Some scholars state that an academic should inform rather than persuade and that "there is a continuum from 'informing' to 'persuading' — and researchers should choose their position on it consciously (Blastland et al., 2020, p. 364)." However, credible science communication and storytelling do not need to be mutually exclusive. The Intergovernmental Panel on Climate Change (IPCC) has begun to use narrative as an approach for better communication, while maintaining neutrality, understanding the power that arts and compelling storytelling can provide (Ettinger, Friedreike, & Schipper, 2021; Olson, 2016). My focus on traditional and community definitions of good food also means representing a community's perspectives

and ensuring a more sensory and embodied experience. The arts can play a significant role in portraying this.

The qualitative methods I had been trained in seemed to fall short of my goal of analyzing and presenting food issues more regeneratively. To showcase the complexity of diverse knowledge systems and the relationality in producing and consuming good food, I turned to the arts. I started using theater tools for social change and subsequently attended ASU classes with professors Liz Lerman and Michael Rohd at the School of Music, Dance and Theater, and Peter Byck at the Cronkite School of Journalism. I was taught that to understand social phenomena and create behavior changes, we can begin with deep listening and embodied work. I became equipped with a variety of tools to engage people in data collection. A walk-and-talk approach during interviews made the answers flow better, with more nuances, such as tapping into childhood stories or even dreams the producers had. Visualization activities tapped into artistic talent and painted a bigger picture of food production. I also became more equipped to present my findings using more creative formats, using storytelling to reach a wider audience while engaging the senses (Pink, Phil, O'Neil, & Alan, 2010) and bodies (Bartleet, 2013; Leavy, 2017). Storytelling or, in my case, using documentary filmmaking, supported me in giving a voice to regenerative practitioners without being obscured by my interpretation and analysis. I took documentary filmmaking and sustainability coursework, which gave me the skills of storytelling and interviewing, filming and editing.

"I've been taking Peter Byck's class on filmmaking for two months, and I'm excited to be learning, since I hope that I can use film in the making of my dissertation, but it's a frustrating process (Fieldwork Journal, November 6th, 2019)."

In the end, I settled for another form of storytelling, podcasting. Logistically, the pandemic meant I couldn't visit the practitioners; artistically, I discovered the power of the voice and sound; and culturally, my Arab heritage is famous for the importance its places on oral storytelling, using poetry and song. These tools enabled me to analyze my research using more decolonial methods of reciprocity and allowed the speakers' voices to be heard by a wider audience.

Questions: My art and media teachers brought me to question the mixed methods of discovery commonly used in sustainability research. Are the methods used in food system sustainability sufficient to express the nuances of regenerative food productions? Can we better communicate these topics to a larger audience to create the needed transformation toward more regenerative practices through arts-based methods?

The above values and questions guided the next step of my journey, the present, the practice. How do I incorporate these values into my life, and what must I negotiate to enable me to walk the talk?

Present: Negotiating a Path to Regenerative Practices through Good Food and Producing a Podcast

Sustainability research that investigates individuals' behavioral changes holds that sustainability practices in one aspect of life spill over to others. For example, energy efficiency can spill into sustainable food choices, eventually facilitating adoption of a sustainable lifestyle (Barr, Shaw, Coles, & Prillwitz, 2010). Unfortunately, in sustainable food systems, many foundational research frameworks perpetuate a system with too many unintended consequences. Many scholars note that industrial approaches modeled on overproduction, monocultures and the heavy use of pesticides and chemicals have

destroyed ecosystems and livelihoods of smaller-scale producers and their communities (Holt-giménez & Altieri, 2013; Patel, 2012; Patel & Moore, 2017; Rhodes, 2012; Shiva, 2014c) It is, therefore, essential to understand how to perpetuate regenerative practices that are beyond sustainable.

This section reflects how I have implemented these values and questions from ancestors and teachers into my family and others around me. I see it as the difference between shallow sustainability, which focuses on making systems efficient, and deep sustainability, which looks at re-evaluating values and goals (Hill, 1998). Deep sustainability built on deep ecology states that the ultimate cause of environmental problems is the anthropocentric nature of Western development (Jacob, 1994). However, I aspire to the ecofeminist approach to a deeper sustainability, one that does not accept this duality of human/nature, but tries to encourage plurality (Plumwood, 1993). This narrative of the present – like growing a garden that needs constant tending, revisiting and making adjustments – highlights my continuous state of back-and-forth in making decisions for good food, as well as the constant negotiations that take place to produce a podcast on regenerative food systems.

Negotiating Good Food in My Life

I displaced my family, husband and eldest stepson to move to Arizona (Later, my other two stepsons joined.); together, we explored how to navigate our sustainable pathways, including eating good food, given its importance in our lives. My journal entries highlight the struggle of finding appropriate, healthy and flavorful foods for my family while on a tight budget. Living on my student income with one parent, my husband Ahmed, not eligible to work in the USA, posed many challenges for us to walk the talk. Our food journey is one of constant negotiations. Still, it has resulted in our

trying farmers' markets, volunteering in order to receive Community Supported Agriculture (CSA) boxes, ordering through online delivery services, growing our own food, supporting local businesses during the pandemic, applying for the Pandemic Electronic Benefits Transfer (P-EBT) cards for the kids, applying for the Women, Infants and Children (WIC) card for me as a pregnant mother, and lots more.

In this section, I evaluate how I made these choices and whether I truly walked the path of being regenerative, with the caveat that I had already been raised understanding what "good food" was, both in terms of nutrition and flavor.

It took several months to find foods that were nutrient-dense and would satiate us. Initially, without a car, we used the closest stores – Food City, Safeway and occasionally Costco. Eventually, through various negotiations, but trying to stick to our values, we found ways to be on a budget and eat better. We wanted to support small-scale Black, Indigenous, People of Color (BIPOC) producers to get fresh produce; instead, we joined a CSA program called Bountiful Basket. We didn't know the producers but received fresh vegetables and fruits once a week. Still, without a car, we eventually discontinued the program and instead participated in the Borderland Produce on Wheels. The borderland program supplied 70lbs. of non-organic produce at $12. However, often, the produce needed to be consumed within a day, so eventually, we discontinued. We were not eligible for the Supplemental Nutrition Assistance Program (SNAP) and could not participate in the double-up food bucks that would enable us to purchase fresh produce at a reduced price, including from BIPOC producers at farmers' markets.

Instead, I could maintain some fresh produce by volunteering at different gardens and getting access to fresh produce and eggs. Ahmed and I volunteered where opportunities allowed – Escalante community garden, Scott Cloutier's project in Don

Carlos, and the Clark Park farmers' market coordinated by Juliann Vitullo. Through this reciprocal process, my family could access some fresh produce and support the local gardeners. We also were encouraging regenerative farming practices of polycultures using local seeds and varieties and improving the soil with compost, microbes, mulches and cover crops.

To ensure we had a good sustainable meat source that was not from Concentrated Animal Feeding Operations (CAFOs), from animals treated inhumanely and from operations harmful to the environment, we signed up for an online delivery service called Crowd Cow. Initially, we were delighted. The website offered information on each farm, where and how animals were raised, whether they were grass-fed or grass-finished, and what breeds were used. The membership enabled you to share a cow with others, and once the shares were distributed, we received our delivery. Although we received our meat three weeks out, we were supporting small-scale and sustainable ranchers. Two years into the service, the company became commercial, the sharing concept disappeared and more premium cuts appeared; although always about meat appreciation and gastronomy, it lost the community and ecological aspect.

"Recently, we started hearing problems they are facing with the ranchers supplying meat for them. And their whole focus shifted to Wagyu steak and prime cuts that didn't feel right for us (Fieldwork Journal, March 20th, 2020 Pos. 299)."

We next discovered a local butcher, Arcadia Meat Market, that supports family farmers who raise animals humanely and focus on Arizona's regenerative farming practices. I understand that consuming meat has adverse impacts on the environment.

Still, I value the ranchers and animal raisers who support regenerative agriculture practices, and I find it essential to support smaller producers while decreasing our meat consumption. We didn't give up finding alternatives, since finding regenerative ranchers was an important value for us.

My biggest accomplishment has been "guerrilla gardening" at my apartment complex, where technically I am not allowed to grow, yet I have created a sizable seven-by-five-foot garden. My original intention was to learn how to grow in this environment. I started slowly and collaboratively with my neighbor, who has since left.

It's been a central "boundary object" in allowing me to become friends with my neighbors (Fieldwork Journal, November 30th, 2019, Pos. 208)."

It has also been an educational component for our community: "*Kids get curious about certain insects, especially since my youngest has moved in here. He loves to play with the garden, check out the spiders and praying mantises, and then show them to the other kids. Kids will come over, and he will give them mini-lessons on gardening (Fieldwork Journal, November 30th, 2019, Pos. 208)."*

I have rotated between rosemary, mint, basil, tomatoes, rucola, swiss chard, eggplants, peppers, potatoes, carrots, peas and kale. I have also created a small desert garden that mimics the Sonoran landscape, with prickly pear (Nopales), agave and other cacti (Figure 8). I have grown products to familiarize myself with local Indigenous practices, including Hopi corn and amaranth from workshops attended on local grains and Indigenous growing practices. I have also learned from many Indigenous Tohono O'odham, Hopi and Pueblo people. This garden has provided small amounts of delicious foods, many that have been processed into fermented foods to improve their digestibility

and health. For example, I get bloated eating cabbage, but never do if I eat kimchi or sauerkraut. The garden has inspired neighbors to ask questions about growing or taking plant cuttings. Gardening allows me to wear my practitioner and academic hats. It enables community building, albeit small, and has allowed me to practice and embody sustainability by teaching and being taught by others how to attune to nature.

Figuring out how to create a balance between healthy foods, sourcing regeneratively and having the time to make our food is a constant dance, since the infrastructure of this city isn't set up to easily access nutritious food. In March 2020, when COVID-19 restrictions were in force and we were in lock-down, we took the opportunity as a family to produce delicious home-cooked meals, especially from our Egyptian heritage; when restaurants opened again, we supported local businesses as a treat. In trying to get pregnant, Ahmed and I focused on our food to ensure a successful pregnancy; Ahmed stopped drinking alcohol, and I focused on eating wholesome foods with no junk. I must say, it was easier to access cheap fruits and vegetables in Egypt, compared to Arizona.

Lessons: I often think if my family and I were being measured, what metric would we fall into? Would we be considered food insecure (FAO, 2011), since we use some state services such as WIC and P-EBT. Are my family and I unsustainable (T. Allen, Prosperi, Cogill, Padilla, & Peri, 2019), since we purchase food items from stores like Food City, foods that are not locally sourced? Despite our strong commitment to regenerative foods, there are strong power dynamics that play a role with people like us. Limited budget and a small local network – these include state policies, regulations and lack of accessibility – hinder us from accessing the foods we prefer. These various factors showcase that simply

assessing metrics such as the nutritional value of food insecurity or unsustainability fails to paint a comprehensive picture of our food experience.

Figure 8 Diagram of plants in garden: plants already in garden or sown in Aug 2018 (Testing Hopi corn)

Regenerative Practices through Podcasting

In trying to connect to a deeper form of sustainability, I decided to create mini-films. The pre-COVID plan was to film food system (Ericksen, 2008) regenerative practices in the Southwest while engaging in various art games such as walk and talks and visualizations. These films would enable me to communicate the multiplicity of voices doing regenerative work and bring to life in a sensory and experiential manner their teachings. The films would feature dryland farming practices, including rain-fed polycultures with locally adapted seeds, regenerative soil rehabilitation practices using microbial inoculations, and products processed using drying and fermentation practices.

I felt prepared to create a film after taking Peter Byck's class, learning how to script, film and edit a short documentary (I co-produced "Hiding in Plain Sight" about women living in homelessness). However, the pandemic meant I needed to pivot, and the podcast was the best alternative storytelling tool to reach the intended goal.

Podcasts have revolutionized communication, modernizing storytelling, one of the oldest forms of communication. Since the earliest humans, we have told stories, written and sung songs, and shared anecdotes around a fire. According to National Public Radio (NPR), about 50% of the population has listened to at least one podcast in the USA. I took an online course offered by NPR Senior Editorial Director Tamar Charney, and I began to realize the power of storytelling and recording for the ear. It's both an intimate moment and a public one that can reach millions. It enables the speaker to tell their own story while creating a world where the listener can wander inside their imagination and creativity in a way that video can't. Since sustainability is about creating a particular narrative and imagining a future to better adapt to our environment, it is a narrative that we co-create using science and technology, while understanding the social, cultural and geopolitical contexts; but it remains at its heart a story. I used audio storytelling to learn how to tell the stories of the unheard voices, to expand the narrative toward more regenerative food systems.

The podcast brought me closer to food makers and allowed them to recount their intersectional experiences instead of writing about them. The narratives told were by small-scale producers, people of color, women and Indigenous people. These are voices I and others acknowledge need to be amplified. To achieve this, I recruited speakers in tune with nature, where they may talk on their behalf or acknowledge the necessity to collaborate with natural systems, including plants, animals and even microbes.

"What inspires me to do the permaculture stuff is the joy in watching nature and how it works. The life that is in it from the microorganisms in the soil to the plants and insects and birds and everything that creates life. To me, it's trying to understand how nature works and how I can be of service to it, makes me feel closer to nature, and it feeds my soul in a very deep way (Transcript from episode one, Roxanne Swentzl)."

My practice of choosing the speakers, and the pieces of their narratives to present, were all part of my goal to showcase aspects beyond sustainability and the efficiency narrative; to present a non-Western paradigm that is often nuanced with a spiritual and holistic connection to food.

How can we negotiate sustainability values if the smaller voices in the food system, which are more sustainable and regenerative, are not in the narrative? I recognize the paradox that I am the one editing the messages that are finally broadcast. As noted above, when reflecting on my work in Egypt, I realize I brought a colonial savior attitude to my work (Smith, 1999), despite efforts to be collaborative and decolonial. The farmers I worked with understood me as the wealthier and better-connected person who could secure new opportunities for them. Today, these power dynamics remain with me as I complete my doctorate and become a "sustainability expert." Through my work I question how, as sustainability scholars, we can indeed solve wicked problems and change behavior if we do not examine our power structures. How do we decolonize our minds? In producing the podcasts, I consciously sought to veer away from the colonial

savior. The speakers were free to talk, including at times in a non-linear fashion; I didn't try to help, as I had during my in-field interviews; I told my own stories to ensure a reciprocal conversation, although these sound bites were edited out.

I was also intentional in selecting speakers who were intersectional and representative of the less-heard voices across the food system. They represented Indigenous people from Turtle Island and Africa, different genders, African Americans, Asians, Arabs, educators, small-scale producers, chefs, people working on advocacy and people working in tribal government, or a youth caucus in the United Nations. The podcasts allowed me to level the playing field and the people to express themselves and their own stories, even as I am still tasked with shaping the collaborative narrative toward our joint goal. I continue to be critical and self-reflective.

Lessons in Applying the Wisdom

In practicing sustainability to produce, consume, research and present good food, I have learned that deeper sustainability is not about abandoning a Western paradigm for sustainability, but it's about embracing a paradigm of regeneration. However, we must find more inclusive ways of assessing that are not based on metrics that miss the nuances of the consumer's choices. For my food choices, I needed to constantly negotiate the pragmatic life of a family of five living off of a student salary in a city that doesn't prioritize sustainability; balance those realities with my values of being more regenerative. I have been impacted by power dynamics, and it is important that I acknowledge my own such dynamic as I communicate regenerative practices, understanding how significant power dynamics are in shaping the narrative of sustainability. I must pay attention to my power in the narrative and address it.

Future: Passing on the Wisdom

A robust sustainability narrative acknowledges how wisdom is passed on, how it thrives and evolves to the next generations. Telling stories, sharing recipes, songs and mentoring enables the coming generation to embody such practices. A common sustainability narrative is of a dystopian post-apocalyptic future, in which our mistreatment of our planet leads to catastrophe; our own demise, quite possibly. (Methmann & Rothe, 2012; Whyte, 2018).

I do not aspire to this narrative, instead I seek to promote a regenerative narrative inspired by a positive development framework (Birkeland, 2008) informed by the belief that our role is to think about net-positivity and give back to nature and society more than taking from it. Some Indigenous scholars also support this argument, stating that they have been in these supposed-apocalyptic moments before, such as in the 19th century when colonialism forced their relocation and caused destruction to their culture and ecosystems (Whyte, 2018). Others reflect that this is an ongoing crisis, and the answer is resilience and survivance – an active sense of presence, not a simple reaction (Vizenor, 1994) –by moving forward regeneratively. In my life's work, food and its stories have provided this positive perspective, whereby we play a role in creating a positive future, and we intentionally work to "become good ancestors ourselves (Whyte, 2018, p. 229)."

I have organized this section into two parts, passing on the stories through the narration of a podcast series emphasizing the choices we made and how I am passing on the wisdom to my offspring.

"The work I do as well is inspired by being a good ancestor, by working to create a world for my children and my grandchildren and the future generations that are going to allow them to express themselves, and be able to live and have the best chance to succeed but to thrive and flourish (Transcript episode two, Lilian Hill)."

Passing on the Stories

I onboarded four undergraduate students, of which three are Barrett Honors students, and one is an intern from ASU's Sustainability Undergraduate Research Experience (SURE) to produce the podcasts. Following an ASU public announcement about the project, and through the screening process of applicants, I selected those students most enthusiastic about the topic and podcasting. A reciprocal process was developed among all participants to benefit my podcasts' production and enable the student subjects to gain exposure in producing podcasts and learning about regeneration. Although I took the lead in managing the workflow, task distribution, training on research methods, getting Institutional Review Board (IRB) approvals, conducting interviews and using podcasting software (zencastr and audacity), the students were quickly learning by doing. Not only did their understanding of regenerative food systems deepen, but eventually, in the last two episodes, their acknowledgement of the existing power dynamics; they took the lead in both directing the episodes toward their specific interest, as well as interviewing and editing, making it a co-created process.

We co-produced four episodes on regenerative food systems from various angles. The first two episodes were produced in collaboration with Slow Food International's

biannual event "Terra Madre[6]", enabling us to tap into the thousands of people in the Slow Food Youth podcast network." We also published two blogs that accompanied the audio files. For each episode, we made a list of potential global names representing small-scale and traditional productions, then reached out to determine their availability. Episodes No. 3 and No. 4 (https://anchor.fm/sara-el-sayed5) had a local Arizona target, intending to educate people on regenerative practices in the state and how to be involved in advocacy. These episodes were distributed through the ASU School of Sustainability network, given the hunger of the younger generation for accessible information on sustainability issues. We searched for speakers who could represent a range of topics on farming and advocacy, as well as being intersectional. Our aim was to produce episodes that modeled more interdisciplinary conversations, as well as to present an inclusive normative view of sustainability.

Episode No. 1, called "Arid Lands and Regenerative Preservation Practices," presented a global overview on practices such as preservation, fermentation and seed saving techniques. Ultimately, we included in our interviews a solar drying expert from Egypt, a Jordanian permaculture expert, a tinkerer living in Australia and experimenting with all things fermentation and soil, a fermentation chef originally from Hong Kong residing in Colorado, and an Indigenous seed saver from New Mexico. This episode allowed us to get an overview on diverse concepts of regeneration but also get our feet wet in producing an episode from scratch. The whole process took one month, involving transcription, logging, creating narratives, editing, adding voice-overs, sound effects and music. We worked on creating a narrative that was emotional and that would transport

[6] Terra Madre is a biannual live event that happens in Turin, Italy, but due to the pandemic it transformed into a six-month online platform to promote food biodiversity. In previous years Terra Madre brought together millions of global food producers, farmers, chefs and activists to participate in various talks, workshops and live demonstrations.

the audience into each speaker's meaning of regenerative practices, and inspire the listener to follow in their footsteps.

Episode No. 2, called "Resilience of Indigenous Communities Through Food in the Face of COVID-19," focused on Indigenous communities' various resilience strategies during the pandemic and how food was used as a way of reclaiming their sovereignty. We interviewed a young Indigenous Kenyan activist and pastoralist, a Seneca leader and health expert, the founder of a Hopi permaculture center, and a Pueblo artist and gardener.

"For us, going back to our original diet, made it so that we were eating what our bodies understood for more than 20 generations. Our bodies immediately went into a balanced state and became healthier and happier. All of us, no matter where we are from, are Indigenous to this planet somewhere. I always want to encourage people to go look back at your history, about where you're from, and see what kind of foods fit you (Transcript episode No. 2, Roxanne Swentzl)."

This second episode unpacked the complexity of living found in Indigenous communities, where the residents struggle between maintaining their resilient food sovereignty, and fighting against external pressures that have forced them out of their traditional practices – be it through war, boarding schools, relocations or changing their food production practices.

We chose to edit the episode using sparklines technique (sparkol.com) of taking the audience on an emotional journey. This included explaining the problems and the community-based solutions, intensifying the complexities with even bigger problems –

COVID-19, for example – then ending on a hopeful note that Indigenous people and their beliefs can pave the way to better balance with nature. We intentionally chose the hopeful, solution-driven ending, as this reflected the desires of the speakers and reflected the overall message of survivance (Vizenor, 1994) or perseverance of Indigenous communities, pushing a positive development narrative (Birkeland, 2008), which I champion.

Episode No. 3 focused on local regenerative solutions. We interviewed a Black farmer working on transitioning her community toward healthier, regenerative practices.

"Minimizing in life, I think that's the way that the young generation should be mindful about, it's not going out and getting all the things that we need. It's about the necessities in life and sharing them among the ones we love and being connected … Feeling our pleasures, and getting back rooted to the feeling of life, and that earth does that and nature does that and just to get backgrounded to that, and that's what project roots are pointing towards (Transcript episode No. 3, Bridget Pettis)."

Compared to White farmers, there aren't many Black farmers, especially Black-owned farms in Arizona, for this reason we focused on one Black female producer. The aim of the episode was to enable local people to find ways to tap into the local regenerative food space, and to feel like they too can have an impact. Indirectly, the episode enabled us to dig deeper into issues of injustice, without the need to spell them out. Like autoethnographic documentaries, podcasts have the ability to tell several layers of stories simultaneously (Bartleet, 2013).

Episode No. 4 featured an interview with a person working on food advocacy, and it provided an understanding of how food policy is tackled at the state scale and how the

public could participate. Our guest, a healthy communities programs manager shared his hopes: "*I would love to see that we have preserved the heritage of agriculture in our state. I would love to see more land being used for pro food. I would love to see farmers not have to worry about how they're going to make ends meet, or getting water to grow. I would also love to see consumers more tuned into what our state has to offer, and are purchasing locally. This doesn't come from behavior change; it comes from policy change at various levels. I would like for policy makers not to think of this as a fad, but something really important, that will ensure that families are fed, and that they have an opportunity to be healthy (Transcript episode No. 4, Kenneth Steel).*" In both episodes No. 3 and No. 4, students were the presenters, representing their own interpretations and questions about how to be more involved in regenerative practices. The purpose was to make the episodes more accessible to an audience that is not necessarily aware about how to become more sustainable. These episodes were intended to be relational and not extractive, and as intersectional as possible, while illustrating diverse knowledge systems that may exist across the food system.

The episodes' impact was not just on the audience listening, but on those of us producing it. Meeting minutes illustrate the amount of learning that the undergraduate students gained from researching, writing interview questions, interviewing and then editing the episodes. The production of these episodes enabled us to further understand intersectionality; for example, how difficult it is for a Black woman to be recognized as a respected producer. Our work enabled us to understand how some producers collaborate with non-living organisms such as microbes, or how food production is not just about calories, but about spirituality.

The first episode was launched on December 5, 2020, and by February 23, 2021, it had been downloaded 179 times. We also created a survey (results in appendix J) to

assess the impact of this episode. Fourteen people responded, 70% of those were female and from Arizona. Sixty-four percent of the respondents found it useful and impactful to them for the future. Some of the comments centered on the value of the lessons provided, e.g., "*(to)best care for seeds/plants and food preservation methods*." Another announced that the respondent would *"likely incorporate local foods in their daily habits."* Some comments praised the encouragement provided to consume and even make fermented foods. While the survey sample is small, and I cannot generalize the podcast's impact, I suggest that podcasts can affect people, leave a lasting impact through storytelling while sharing wisdom. In the end, it allowed me to express and share my work through a creative outlet and make my research more publicly available.

Passing the Wisdom to the Next Generation

As a sustainability scholar and a practitioner, I think about how I'm passing on my knowledge on regenerative food to my children. As a stepmother, I continue to model, prepare and showcase what good food is. Yes, we make use of federal programs such as the P-EBT and WIC. However, we are still focused on ensuring we purchase healthy and wholesome foods, support local CSA's grow and harvest some of our own, volunteer with small local growers and eat culturally appropriate foods. My husband and I cook our meals with a lot of love, believing in an Arab concept of *nafas,* meaning soul and breath, signifying that each person brings their soul and their breath to make food taste good. Scientifically, I explain *nafas* as an individual microbial signature that is added to food. Similarly, Landis et al. (2021) uncovered unique microbial populations found in the sourdough starters of 500 bakers worldwide, determined not by their geography but rather how the starter was made and how it changed over time, signifying

that each baker had their signature. We rotate food we make weekly, so we have a wide variety of nutritious foods.

Good food, to us, is about getting closer to our food, and learning how to turn it into delicious meals. Since the start of the pandemic our children have been cooking with us. We rotate between having garden-based vegetable stir-fries, freshly made pasta with local grains, one meat day sourced from local Arizona ranchers, one sustainably sourced fish day, other Arab vegetable dishes, and then on Sundays we make a homemade pizza or homemade burgers (Figure 9 children making food). On Saturdays we support small local businesses that have been hit by the pandemic, and in so doing we have discovered Black-owned, Middle Eastern and many small Asian restaurants. The Arizona Restaurant Association has said that at the peak of the pandemic, Arizona restaurants lost roughly $29 million a day (Leoni & Merrigan, 2020), and although there has been a strong coalition led by Slow Food Phoenix to pass the Restaurants Act that would provide small restaurants, food trucks and caterers $120 billion in funds, these calls have fallen on deaf ears. In this process, our children have learned about different cuisines, issues of struggling businesses, and how to find sustainable food sources.

Figure 9 Images of my children's home cooking during the pandemic. Making home-made pasta, pizza and stuffed vine leaves (*warak enab*).

After many failed attempts, I am currently pregnant and reflect on what I am leaving this child, what nourishment I am getting that will give them the best chance of success in his early stages. Expecting mothers often stop smoking, refrain from drinking coffee and alcohol, and are more attentive to their medications. Others actively think of healthier foods to add to their bodies, understanding the value of wholesome foods such as grains, beneficial fats like nuts, and calcium-dense products such as whole dairy. Also, these conscientious mothers-to-be are understanding the importance of fermented foods to bring probiotics into the body. It doesn't end with food and exercise, which I'm doing a fair amount of.

In the process of birthing, if a baby is delivered naturally, they are inoculated with their first bacterial colony that will determine the microbiota community they eventually possess (Collen, 2015). Therefore, like many other mothers before me, I hope to give this child their best chance. Mothers throughout history have thought about their bodies as providing a sanctuary for the next generation, but not all are as lucky. Hoover illustrates (2017) how women and midwives have been in an upward battle to remove the contamination of PCBs from streams and rivers. These recognized pollutants have a catastrophic impact on fisheries, one of our most important sources of low-fat, high-quality protein; these nutrients are critical to the health of both mother-to-be and the baby on its way. I have been blessed to have built a network of resources that enables me to, despite our current finances, have access to good, wholesome, nutritious and diverse foods — hoping that being aware of good food will positively impact the chances of this child.

Gratitude: I am grateful that in searching for good food, I have gotten closer to more regenerative practices, extended my network, learned and eaten from diverse producers, expanded my skills and creativity, worked collaboratively with students and deepened my sustainability experience. Although I cannot call my practices regenerative, navigating and negotiating both my values and questions has gotten me closer. The podcasts enabled me to hear and present the diverse voices of regenerative food practitioners, as well as enabled me to make healthy choices that influence my children. My spiral journey added layers of complexity in the practice and scholarship of sustainability, with the intention that it inspires a deeper understanding. I hope to be a good ancestor to my offspring. I give thanks to those who have mentored me and have taught me to be more attuned to nature and be appreciative and able to access good food.

Offering for Food System Sustainability

This autoethnography is not a linear story. Rather, it is a spiral inspired by indigenous models (Brooks, 2012; Whyte, 2018) of traveling in the past in order to move forward, and it illustrates the interconnectedness of being a sustainability scholar while walking the talk of making good food choices, and the challenges and negotiations associated with it.

The chapter begins to unravel the need to bring in diverse knowledge systems for a deeper form of food system sustainability, as well as showcase its complex interdisciplinarity and the difficulty of changing behaviors. In my past, my ancestors passed on the values of honoring traditions, respecting land and caring for nature. My teachers guided questions that have led the way toward integrating diverse ways of knowing, acknowledging my plurality, learning from TEK, being cognizant of colonial dynamics, accepting the entanglements that exist in boundaries that include unseen microbial organisms, and inviting more arts into my practice. I have applied these teachings in my present experience in Arizona, through a negotiation in accessing good food for myself and my family as well as researching and presenting regenerative practices by others through a series of podcasts. Finally, looking at the future and trying to be a good ancestor I leave podcast stories representing intersectional voices and how they view and live regenerative practices as well as passing on lessons and food decisions to my offspring.

With respect to food sustainability, I believe that we need to be decolonial, inclusive, cooperative and reflective in our work; decolonial by deconstructing power dynamics and being intersectional (Smith, 1999) to diversify our food system. We should be conscious and critical of the power structures at play, be they infrastructural issues played by a state, or personal issues where as a colonizer you perpetuate colonial savior

world views. We should be conscious of the impact of intersectionality; for example, what it's like to be a BIPOC female producer? We must be inclusive of other knowledge systems, such as TEK, that may aspire to a more positive vision of the future and – through intergenerational memory –have paved a path toward food sovereignty. We must further explore and understand methods of art that give voice to diverse people while tapping into both cognitive and emotive aspects. And, we need to be cooperative, creating a culture of care in the building of ecosystems that are regenerative, and we should be collaborative with non-human organisms (Haraway, 2008; Paxson, 2008), such as microbes and plants to deepen our system's overall sustainability. Also, collaborating together to amplify the voices of people stewarding the work in sustainability, and making choices that empower rather than disempowering them is critical to future success. Finally, it is important we reflect on the influence we have as individuals in shaping sustainability, being aware of our own power structures, how we walk the talk of good food, and continuously learn from those around us.

In the end, this journey has made me see good food as a constant renegotiation, based on size of family, income, access and values. Good food is also about the narratives that influence us, which stories are told or untold. However, as I continue to navigate, I will strive to volunteer my time and source sustainably. I will seek healthy ingredients that are grown in soils stewarded by people connected to nature and are caretakers of the earth; soils that have been nourished by microorganisms, and plants grown in collaborative polycultures. I will consume animals in moderation and only from ranchers that ethically raise them, with one bad day.

Final Lesson: Good food comes from stewardship from seeds you save, sow, grow and plant, you harvest or forage.

Good food is produced in collaboration with other companion species such as microbes that improve flavor, digestibility or nutritional value.

Good food comes from smaller-scale, decentralized productions, with knowledge passed down through traditions, intuitions and prayers.

Good food is prepared with care and *nafas*.

Good food is sacred and is made with loved ones with shared stories – good and bad, equally.

Good food supports local food economies, amplifying and supporting the voices of the small producers, farmers, ranchers and others who make up the fabric of our food system.

CHAPTER 5

CONCLUSION

Sustainability uses classical quantitative and qualitative methods, but capturing the experiences of good food producers and regenerative practices across the food system requires adopting a toolkit of more nuanced ways of gathering and representing data. This research demonstrates that regenerative food systems offer a path forward; this is a path that travels beyond sustainability, includes diverse knowledge systems and methods, and produces good food. As shown, including Traditional Ecological Knowledge (TEK) can facilitate sustainability scholars' and practitioners' efforts to conceptualize more sustainable food systems; as such, I invite readers to use these insights to expand on what research in this space can entail. Making regenerative food systems invites adopting humility, learning from indigenous knowledge systems, and in the process seeking to create net-positive ecosystems that preserve cultural traditions and respect social, intergenerational and interspecies justice (Ch. 2). I offer a path forward to create more inclusive governance structures modeled on the production of traditional fermented foods (Ch. 3). I demonstrate the need to include more embodied arts-based methods in sustainability research (Ch. 4), modeling how using more artistic elements in data collection paints a more detailed picture by using storytelling tools such as podcasting. This enables sustainability scholars and practitioners to better understand the complexity of people working in regenerative spaces.

A foundational argument is that being a sustainability scholar should require us to be more self-reflective. In other words, our behaviors cannot be divorced from the change we hope to see in others: sustainability's normativity runs both ways. I self-reflected on my process of trying to walk the talk toward regenerative practices. In so doing, I addressed the three gaps identified in the introduction: lack of diverse

knowledge systems in food system sustainability, lack of regulatory structures inclusive of small-scale and traditional productions, and lack of embodied forms of knowledge in the field.

Throughout the dissertation, I use the metaphor of a spiral, nested in complexity. On one level, the spiral represents the physical form of growth from simple to complex; on another level – an Indigenous perspective – it means changes over generations, with responsibilities toward the ancestors and those not yet born, while stewarding one's current place (Brooks, 2012; De Vos, 2020). I view the spiral as representative of constant growth and evolution: adding more elements increases complexity. In my case, these elements are the various knowledge systems: nature's inspiration, traditional knowledge and the arts. This dissertation models a nested spiral, the personal narrative being one spiral, nested within a regulatory system as a second spiral, and finally nested into a larger system of regenerative food systems, a larger spiral.

The first spiral, in Ch. 4, recounted my personal narrative and the path toward regenerative practices, how it was informed by values I received from my ancestors, and questions prodded by my teachers. Along the journey, I practiced finding good foods for myself and my family in Arizona, a state that does not prioritize sustainability or accessibility of good food to people without the means. I also found ways to amplify the voices working in regenerative practices using storytelling, namely podcasting. In this journey, I had a few epiphanies: that sustainability scholars should actively embrace a decolonial approach, and not have a savior attitude; they should be inclusive of diverse ways of knowing; cooperative toward both marginal communities and other organisms such as microbes; and, finally, be self-reflective in their work, given how we impact sustainability.

Nested on the personal spiral is the regulatory spiral illustrated in Ch. 3. In Ch. 3, I unpacked the complexity of regulations for small-scale and traditional productions and showcased how the nature of traditional fermented products makes them fit uneasily within regulatory structures that are based on rigid standards. These regulatory structures have evolved over the past 100 years to protect consumer health but have inadvertently sidelined and even at times eliminated — the ability of traditional food producers to make, circulate and market their products in mainstream economic circuits. I suggested in Ch. 3 ways forward that make the system more inclusive by enabling these fermented products to exist to expand the space of regenerative food systems. This can happen through more food education, increased diversified labeling systems, cheaper and more accessible ways to test safety, and more accessible technologies. Ensuring these traditional good foods' ability to co-exist in our food system requires a more flexible and expansive understanding of regulations.

Finally, the regulatory structure is nested within a larger understanding of a food system, defined and characterized in Ch. 2 as a regenerative food system. This chapter showed what a regenerative food system looks like, with examples from arid regions building on Dahlberg's (1993) definition. I did this by weaving together two disciplines: TEK and biomimicry. I defined a regenerative system as one that adds to the net-positivity of an ecosystem through merging nature-inspired design with practices that promote its people civically and economically and ensures justice across generations of humans and non-humans. I characterized a regenerative food system through 13 principles of being attuned to place, cooperative, leveraging the earth's cycles, reciprocal, based on nested components, resource-efficient and cyclical. With time the system then grows to be adaptable, diversified, endures through survivance, incorporates self-renewal, replicates strategies that work and eventually evolves through the generations.

This spiral is not finished: instead, it invites integrating further growth and development. For example, building on my learning experience, I propose modeling a formal learning journey for students to gain expertise in regenerative food systems. The program's philosophy is built on the premise that to experience a regenerative food system, students need to explore various skills, knowledge sets and sensory experiences of good food. As a start, I envision a multi-year program at Arizona State University, housed at the Swette Center for Sustainable Food Systems, harnessing its network, access and partnerships. The program would enable students to become attuned to their local place and understand how to leverage an alternative food system in an arid region of the Southwestern U.S. The program would include four spiraling components: (1) several core classes where students learn systems thinking and the leverage points of the diverse food systems. In these classes, they would be exposed to various knowledge systems such as Indigenous and nature-inspired ones; (2) one or two in-depth courses on the regulatory, economic, political, cultural, agronomic and gastronomic aspects of the food specific to a local environment; (3) courses in diverse research methods, from classical quantitative to arts-based methods. These classes would enable students to learn how to use specific metrics in assessing sustainability and to understand the nuances that exist in forms of art that allow deeper listening and sensory explorations; and (4) internship experience for two semesters, leveraging local food networks. The internship would teach students place-based knowledge related to food and provide hands-on experience in many aspects of a sustainable food system. Such aspects would include farming, processing, production/cooking, advocacy/policy and waste management. Such an internship fulfills ASU's community embeddedness charter through student support of local sustainable food system organizations. Designing such

an educational program might enable students to explore their niche and add complexity to the proposed nested spirals of regenerative food systems.

This dissertation sets in place a path toward more regenerative practices. This process of expanding the field while being self-reflective invites sustainability scholars and professionals to question our paradigms and seek wisdom from diverse spaces that may range from intuitions and dreams from our ancestors to attuning and learning from microbes. I invite us all to search for good food by inviting diverse ideas and organisms and their cultures and histories into our conversations and practices.

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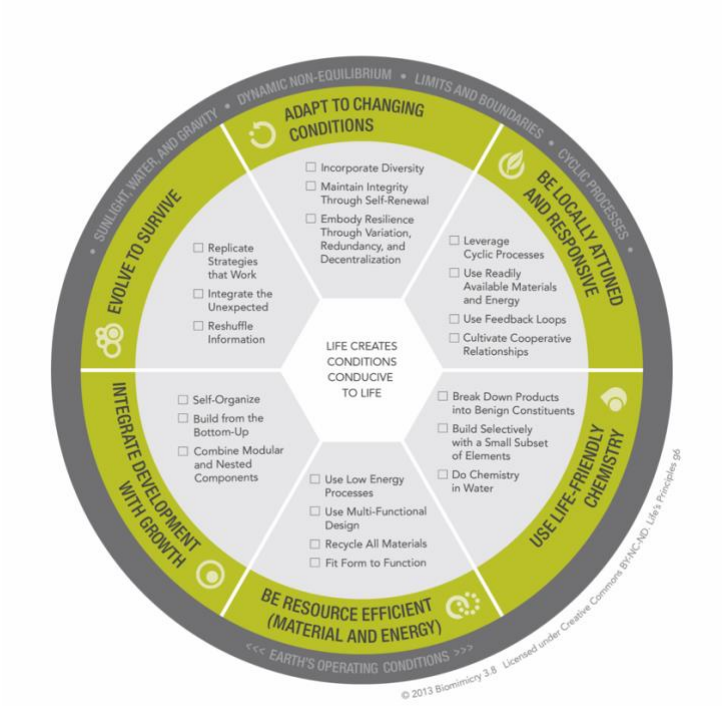
APPENDIX A

LIFE PRINCIPLES AND TRADITIONAL ECOLOGICAL KNOWLEDGE FRAMEWORK


SUNLIGHT, WATER, AND GRAVITY • DYNAMIC NON-EQUILIBRIUM • LIMITS AND BOUNDARIES • CYCLIC PROCESSES •
ADAPT TO CHANGING CONDITIONS
Incorporate Diversity
Maintain Integrity Through Self-Renewal
Embody Resilience Through Variation, Redundancy, and Decentralization
BE LOCALLY ATTUNED AND RESPONSIVE
Leverage Cyclic Processes
Use Readily Available Materials and Energy
Use Feedback Loops
Cultivate Cooperative Relationships
USE LIFE-FRIENDLY CHEMISTRY
Break Down Products into Benign Constituents
Build Selectively with a Small Subset of Elements
Do Chemistry in Water
BE RESOURCE EFFICIENT (MATERIAL AND ENERGY)
Use Low Energy Processes
Use Multi-Functional Design
Recycle All Materials
Fit Form to Function
INTEGRATE DEVELOPMENT WITH GROWTH
Self-Organize
Build from the Bottom-Up
Combine Modular and Nested Components
EVOLVE TO SURVIVE
Replicate Strategies that Work
Integrate the Unexpected
Reshuffle Information
LIFE CREATES CONDITIONS CONDUCIVE TO LIFE
<<< EARTH'S OPERATING CONDITIONS >>>
© 2013 Biomimicry 3.8 Licensed under Creative Commons BY-NC-ND Life's Principles 96

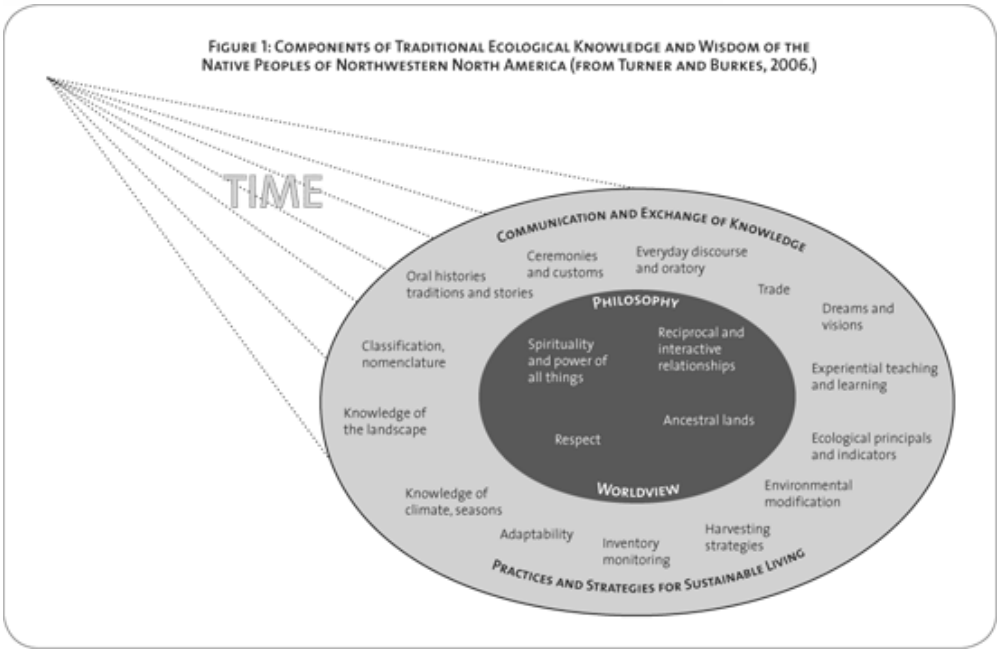


FIGURE 1: COMPONENTS OF TRADITIONAL ECOLOGICAL KNOWLEDGE AND WISDOM OF THE NATIVE PEOPLES OF NORTHWESTERN NORTH AMERICA (FROM TURNER AND BURKES, 2006.)
TIME
COMMUNICATION AND EXCHANGE OF KNOWLEDGE
Ceremonies and customs
Everyday discourse and oratory
Oral histories traditions and stories
Trade
Dreams and visions
PHILOSOPHY
Spirituality and power of all things
Reciprocal and interactive relationships
Classification, nomenclature
Experiential teaching and learning
Knowledge of the landscape
Ancestral lands
Respect
Ecological principals and indicators
WORLDVIEW
Environmental modification
Knowledge of climate, seasons
Adaptability
Inventory monitoring
Harvesting strategies
PRACTICES AND STRATEGIES FOR SUSTAINABLE LIVING

APPENDIX B

WORKSHOPS ATTENDED

Workshop name	Location	Participants	Date	Comments
Reclaiming Native Truth	Slow food nations, Denver, CO	Michael Roberts, Ian McFaul, Denisa Livingston, Roy Kady	July 19th 2019	Video was shown. Reclaiming Native Truth is a national effort to foster cultural, social and policy change by empowering Native Americans to counter discrimination, invisibility and the dominant narratives that limit Native opportunity, access to justice, health and self-determination. Reclaiming Native Truth's goal is to move hearts and minds toward greater respect, inclusion and social justice for Native Americans.
The Art of Fermentation	Slow food nations, Denver, CO	Sandor Katz, Mara King	July 20th 2019	Fermentation is everywhere, always. It is an everyday miracle, the path of least resistance. " – Sandor Katz Workshop with fermentation revivalist Sandor Katz and Mara King of Ozuke. Sandor has taught hundreds of fermentation workshops around the globe and has helped to catalyze a broad revival of the fermentation arts. Through hands-on demonstration and instruction, you'll explore the possibilities of vegetable fermentation. Learn the simple concepts underlying sauerkraut, kimchi, pickles, and all fermented vegetables.
Indigenous Sustainable Communities Design course	Santa Fe, NM	Clayton Brasquope, Louie Hena, Lilian Hill, Roxanne Swentzl	July 21st - July 26th 2019	The 20th Annual Indigenous Sustainable Food Systems Design Course is a two week intensive training in ecological design, natural farming and earth restoration, natural healing both human and Mother Earth. These strategies and objectives compliment the Permaculture methodology, which is: the conscious, holistic design and maintenance of biologically productive ecosystems that have the diversity, stability, balance and resilience of natural ecosystems
Wisdom of Indigenous Foodways	Skysong, Scottsdale, AZ	Bryan Brayboy, Paula Daniels (Native Hawaiian), Janie Hipp (Chickasaw), Chef	January 22nd, 2020	The Wisdom of Indigenous Foodways" that will surely stimulate critical discussions on food sovereignty and justice, biodiversity,

		Sean Sherman (Oglala Lakota), Twila Cassadore (San Carlos Apache), Terrol Dew Johnson (Tohono O'odham), Michael Johnson (Hopi)		landraces, and more.
Rights of Nature and the Food System	Skysong, Scottsdale, AZ	Kathleen Merrigan, Janie Hipp, Paula, Daniels Denisse, Córdova Montes, Shannon Biggs, Melissa Nelson	January 23rd, 2020	Workshop with different indigenous scholars and practitioners.

APPENDIX C

BASELINE TABLE FOR REGENERATIVE FOOD SYSTEM PRINCIPLES

Comparing Regenerative Agriculture, Agroecology, Permaculture, Food System Sustainability and Food sovereigty.					
	Regenerative Agriculture	**Agroecology (Altieri 2002) (Gliessman 2007)**	**Permaculture (Mollison, 1988), holmgren)**	**Food System Sustainability (Eakin, etal, 2017)**	**Food Sovereignty - Radical collectivism (Trauger)**
Definition	To embraceregenerative development, by adopting measures that drive the regeneration of soils, forests, watercourses and the atmosphere (Rhodes, 2017)	The holistic study of agroecosystems, that includes environmental and human elements, with a focus on form, dynamics and functions of their interrelationships and the processes in which they are involved (Altieri, 2002)	Dervived from permanent agriculture, or culture and describes a low impact method which uses perennial cultivation methods to produce food crops, working via principles that are in harmony with nature.	Achieves and maintains food security under uncertain and dynamic social-ecological conditions, through respecting and supporting the context-specific cultural values and decision-processes that give food social meaning, and the integrity of the social- ecological processes necessary for food provisioning today and future generations	Food sovereignty is 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. (Nyéléni Declaration 2007)
Goal	To increase soil quality and biodiversity in farmland while producing nourishing farm products profitably (LaCanne, Lundgren, 2018)	Provide basic ecological principles for how to study, design and manage agroecosystems that are both productive and natural resource conserving, and that are also culturally sensitive, socially just and economically viable (Altieri, 1995)	To develop sustainable human settlements and self-maintained agricultural systems modelled from natural ecosystems (Rhodes, 2017)	To ensure food security as well as social justice.	To put the aspirations and needs of those who produce, distribute and consume food at the heart of food systems rather than at the demands of corporations. Prioritize local and national economies and markets and empower peasant and family farmer-driven agriculture, and artisanal food production, distribution and consumption based on environmental, social and economic sustainability (Nyéléni Declaration 2007).
Principles	1. Activitly build soil fertility and avoid tillage, 2. Foster plant diversity on the farm, 3. integrating livestock and cropping operations on the land 4. Integrate diversity in terms of polycultures and perrenials	1. Resilient systems that cope with disturbances 2. Species and genetic diversification in space and time 3. Enhancing soil biotic activity for plant growth 4. Sociocultural relations of collective forms of organization 5. Increased soil cover for (microclimate management) 6. Balancing nutrient cycle and recycling of biomass 7. Optimization of the whole farm not one crop.	1. Use and value diversity, 2. Obtain a yield 3. Creatively use and respond to change. 4. Apply self-regulation and accept feedback. 5. Use and value renewable resources and services. 6. Use edges and value the marginal. 7. Design from patterns to detail 8. Integrate rather than segregate 9. Use small and slow solutions. 10. Catch and store energy, 11. Produce no waste	1. Innovation 2. Diversity in terms of crops, diet, and practices 3. Congruence is about fit. 4. Transparency. 5. Modularity.	1. The Right of people to self-governance and democracy 2. Local production, food coops, solidarity economies, local processing 3. Mutualisms and alternative econmic models 4. Based on agroecological principles 5. Access to local and communal resources, seeds varieities, water, land 6. Social justice and self governance

APPENDIX D

INTERVIEW QUESTIONS REGENERATIVE FOOD SYSTEMS

Title: Regenerative Food Systems that honor small-scale producers' good food, in Arid Regions. Study Interview Questions:

- Semi-structured series of interviews 1 hour each approx. (all participants, Southwest and Egypt)
- In person visit (to the local Southwest only) 4-5 hours of shadowing, participant observation and facilitated discussions. These will be in their place of work, given their approval.
- The final questions are being reviewed by my committee and I will thus apply for modifications if changes are made, but these are the main questions.

Semi-structured interviews will have the following broad questions:

- Please introduce yourself and what is your interest in food? how do you approach food issues in your location? (open ended questions) these will be voice recorded and typed up.
- What are the most significant practices and traditions that you have adopted over the years, how did you learn them and what do they mean to you?
- How do you define good food?
- Have you worked with traditional foods, such as fermented foods, explain their value to you and to the communities you have worked with? What fermented foods are the most meaningful and elaborate on why?
- On a piece of paper draw out in your own diagrams and words what an important practice in your work (could be a certain type of garden, or planned grazing, or making a specific fermented food) explain your drawing
- Can you share any anecdotes in your experiences that value traditional foods? which has more value and why?
- How would you describe x practice (I will list different practices based on above conversation) to a person who has never seen or heard of this?
- How do you envision the future of food for your region? who are the people involved? what do the relationships created look like?
- What is the value of geographic indication, or terroir or artisanal other such term in your work?
- Is there a relationship between traditional foods and aridity? can we learn something about them.

In person visits questions: (general outline)

- Broad questions about the different practices of the woman.
- Using several arts-based techniques in data gathering, that include:
    - "walk and talk" as the person is working, walk and talk, or work and talk. Could be on the field or in a kitchen. In this case I will either be carrying a camera to film, or if funds allow there will be someone else filming
    - Mirroring exercises – where I ask the participant to recount a typical day and then I repeat again to her what I saw, ensuring I have captured the emotions and the meanings of her words.

- Tableau – making images that capture the essence of her work, but as still shots. We will create these tableau's together. It is in essence like a staged photoshoot, that tells a story. Three-four shots (images) that tell a story.
- Vocal daily reflections and recording sound bites.

APPENDIX E

PREVIOUSLY PUBLISHED MATERIAL AND CO-AUTHORSHIP PERMISSION

Chapter 2
Is being peer-reviewed by Journal of Agriculture and Food Systems and Community Development

I declare that I have obtained permission from Scott Cloutier to use material in this dissertation.

Acknowledgement: The authors wish to acknowledge the small-scale and traditional producers that accepted interviews and field visits, The Biomimicry Center, Ahmed Barakat for the design of graphics and Dr. Melissa Nelson (Anishinaabe/Métis/Norwegian) for her edits and recommendations.

Funding: This research was partially funded by the Neely Foundation Food and Agriculture Sustainability grant, an Internal Arizona State University Grant.

Chapter 3
Is in preparation for submission to the journal Gastronomica

I declare that I have obtained permission from Christy Spackman to use material in this dissertation.

Funding: This research was partially funded by Lattie and Elva Coor Building Great Communities Fellowship

Chapter 4
Is in preparation for submission to a journal such as Sustainability Education.

APPENDIX F

INTERVIEW QUESTIONS FOLLOW THE FERMENT

Interview Questions:

- What's your name, profession and preferred method of contact?
- Tell me about yourself as a food producer.
- What food production practices are central to your values, ethics, and/or traditions?
- How would you describe x practice (I will list different practices based on above conversation) to a person who has never seen or heard of this?
- In what ways does producing food in this region enable your efforts to produce in alignment with your values? Can you share any anecdotes in your experiences that value traditional foods? which has more value and why?
- How would you describe x practice (I will list different practices based on above conversation) to a person who has never seen or heard of this?
- What things are getting in the way of you producing food that aligns with your values, ethics, and/or traditions?
- How do you know when the product you have produced is of good quality?
- Are you able to practice making these foods? Explain.
- What are some challenges you have faced in the last six months in making these foods? Explain.
- How do you envision the future of food for your region?
- What is the value of geographic indication, or terroir or artisanal other such term in your work?
- How has the current pandemic of COVID-19 impacted your work? What modifications have you had to make?
- Which regulatory, permitting structures or executive orders have you taken advantage of, if any? Explain how?
- What rules or regulations do you think would have helped you and your business during the stay-at-home orders?

Below are some arts-based methods I have also employed: (we may choose to select one or two of these methods)

- Walk and talk: this technique has the researchers walk and talk or work and talk alongside the people we are interviewing. This approach can happen in the field or in production kitchen. When permission is granted, audio or video recordings of the interview will be made.
- Mirroring exercises: this technique has researchers ask the participant to recount a typical day and then repeat back to the interviewee what we saw or heard, ensuring we have captured the emotions and the meanings of their words.
- Tableau: this collaborative practice involves having researchers and interviewees make images that capture the essence of the interviewees work, but as still shots. We will create these tableau's together. It is in essence like a staged photoshoot, that tells a story. Three-four shots (images) that tell a story.
- Drawings: this technique invites interviewees to outline the steps and or illustrate items they use in producing foods, followed by a verbal explanation of the drawing. Photographs of drawings will be taken, and the original left with the producer.
- Vocal daily reflections and recording sound bites.

APPENDIX G

INITIAL CODING FOR REGENERATIVE FOOD SYSTEM ON MAXQDA

Code System	Memo
Traditional	
plant based	Foods that are vegetarian that have origins in plants and dont have meat products in them.
Low tech	Technology that doesn't require high-level technology, considered simple technology, that can easily be operated and may be produced using simple tools, materials as well as cost.
natural flavors	flavor or taste is the perceptual impression of food or other substances and is determined by the chemical senses of the gustatory and olfactory system, natural flavors are ones that are based on natural materials.
sustainable food	Is one that achieves and maintains food security under uncertain and dynamic social-ecological conditions, through respecting and supporting the context-specific cultural values and decision-processes that give food social meaning, and the integrity of the social- ecological processes necessary for food provisioning today and for future generations (Eakin, et.al, 2017).
intersectionality of food	Food that is considered at the intersection either between cultures, or as a way of bridging cultures.
Cosmology	" The food gods are watching"
Holistic	
Nativore	Eating native plants and foods, lots of plants, berries and hunted and fished animals. Defined by Lois Ellen-Frank. seems very similar to ancestral food.
Permaculture	
fermentation	is a metabolic process that is based on chemical changes in organic substrates through the action of enzymes. The presence of microorganisms brings this change in foodstuffs and beverages such as cheeses, pickles, drinks like beer and kombucha.
Arid region practices	
creating a microclimate	
seed saving	
using beneficial microorganisms	many regenerative systems use beneficial microorganisms in producing fermentations for improving the quality or flavor of food, as well as in the soil to increase the biodiversity and fertility of the soil.

native plants	Naturally growing plants in one ecosystem. Often the most resilient ones, the focus is on the beneficial or edible plants. plants that are indigenous or native to a certain geography and are most probably associated with certain traditions and costumes of using it.
dryland farming	practices of farming in arid and desert regions.
Traditional Ecological knowledge	
place-based knowledge	is a focus on the local resources and attuning to them over generations of knowledge through tradition and experience (Houde, 2007).
ancestral food	Food that has a value in the culture, and is traced back generations
Relationality/relationship	A central principle and value in indigenous knowledge, built on interrelationships and interconnections among humans, non-humans beings, spiritual entities, and landscapes. Most indigenous communities will introduce themselves by their name, their grandparents and state their origins, they are orienting the audience to who they are and why they are here (wilson, 2008). These relations carry responsibility as well.
Cycles of the earth	Seasonality and leveraging the cycles is part of indigenous knowledge in the practices, as well as ceremonies. It is also exemplified in the importance that cosmology and moon cycles play on culture. There are many cultural foods that are connected to recurring rituals, ceremonies and festivals, such as rites of passage or harvest ceremonies.
reciprocity/care	Indigenous culture cherish reciprocity between humans and non-humans, that for the Earth to stay in balance, for the gifts to continue to flow, we must give back in equal measure for what we take (Kimmerer, 2013)
love	
management systems	-Indigenous knowledge is based on a deep understanding of both the local and readily available resources, as well as how to cycle energy locally (Houde, 2007) .
preservation/conservation	Practices of food storage and ensuring food for times of stress. Using techniques that use low and avaiable energy sources
Adaptive management	Also known as resilent co-habitation, whereby the biosphere provides the rules, and they are subject to change we require constant adaptive practices to respond to the socio-ecological systerm (Pena, 2019)
Diversification	- Traditional systems use more varieties, species, and landscape patches, as well as integrate rotation of crops and successions (Berkes, 2000), and create companion growths (Pena, 2019)

	rebirth/renewal	- Spiritual ceremonies to create rebirth experiences. Smoke ceremonies for cleansing and detoxification.
	Survivance	Active sense of presence, the continuance of native stories, and livelihoods. Also seen as the renewal and continuity into the future (Whyte, 2018).
	nested communities	Coevolution is interpreted as a trial-and-error process of self-organization through mutual feedback, (Berkes, 2000' Colding and Folke 1997.) Growth is based on nested elements and is from the bottom up.
	intergenerational learning	Intergenerational learning, takes place across generations through storytelling (Kealiikanakaoleohaililani, Giardini, 2016),where the ancestors, the living and future generations are part of a recurrent spiral of time and being-in-place (Winter, 2019) that are kept through nuances in languages expressed in song and poetry (Kimmerer, 2002).
	generating/validating	Traditional knowledge represents an intellectual tradition of generating (replicate strategies that work), validating, and interpreting information about relationships in the natural world (Kimmerer, 2002)
	Healthy food	Food that has health benefits, either because its nutritional value has been assessed by laboratory procedures, or through community-based understanding of the food.
	Taboo contamination	contamination of food based on traditions and what is considered taboo from a religious perspective
	Contamination	Food that has had infilteration from an external body making it bad to eat. It might be visible or invisible such as harmful bacteria
	food is medicine	Food in many indigenous communities is also seen for its curative properties. Food has healing properties and often there are specific members of the community, often women who hold the knowledge of the healing properties and which foods act as what kinds of medicines.
Sensorial engagement		
	Eating together	
	singing	
Lifes Principles		
	locally attuned and responsive	Fit into and integrated into the surrounding environment. Supporting a local production of food, that can modify and create a microclimate, executed in collaboration with native vegetation (Mollison, 1988)
	cultivating cooperative relations	- Mutualism and synergistic effects through win-win interactions, between species are sought out, either by growing crops together, companion plants or foods that are

		eaten together (Gliessman, 2007)
	leverage cyclical processes	Take advantage of phenomena that repeat themselves, such as Agriculture and how its based on seasonality and leveraging seasons, what crops to grow and harvest.
	Feedback loops	engaging in cyclic information, applying self-regulation and accepting feedback (Holmgren, 2007).
	Use readily available resources and cycling	use materials and energy sources that are easily available and ensure the cycling of them. In Permaculture principle that states to use and value renewable resources and services, and use edges and value the marginal (Holmgren, 2007). Plan for scales of design to maximize energy use (Mollison, 1988)
	low energy processes	Minimize energy consumption by reducing requisite temperatures, pressures and/or time for reactions
	adapt to changing conditions	Responding to dynamic contexts, its about Congruence and fit, among resource institutions and local conditions is thought to enhance their capacity for persistence over time (Eakin et.al., 2017) Produce foods that are adaptable to changes in climate, more drought resistant etc...
	Incoporate diversity	multiple forms, processes, or systems, such as species and genetic diversification in time and space (Altieri, 2002)
	self renewal	Maintaing integrity through self renewal, such as increasing the genetic pool by creating new breeds and crosses, increase hybrid vigor of plants/animals.
	Embody Resilience	Through variation, decentralization and redundancy. Resilient food system enhances food security and is able to minimize, withstand and anticipate environmental and economic disturbances at different temporal and spatial leve having a lhigher capacity of the system to cope with perturbation (Prosperi, et.al., 2016)
	Integrate development with growth	Invest optimally in strategies that promote both development and growth -Design from pattern to detail (Holmgren, 2007) and include self-organizing mechanisms.
	evolve to survive	Continually incorporate and embody information to ensure enduring performance - such as new research and findings into ways to continue to be selected for as a species. Transitioning into perennials rather than annuals for the staple crops, such as the work at the Land Institute (Jackson & Jensen, 2018
	replicate strategies that work	Repeat successful approaches, by observe the strategies and patterns that work in nature and replicate them (Mollison, 1988)

APPENDIX H

INSTITUTIONAL REVIEW BOARD EXEMPTION LETTERS

Weaving Disciplines Paper and Autoethnographic research:

EXEMPTION GRANTED

Scott Cloutier
CGF-SOS: Faculty & Researchers
-
Scott.Cloutier@asu.edu

Dear Scott Cloutier:

On 10/30/2020 the ASU IRB reviewed the following protocol:

Type of Review:	Modification / Update
Title:	Regenerative Food Systems that Honor Small-scale Producers' Good Food, in Arid Regions
Investigator:	Scott Cloutier
IRB ID:	STUDY00009793
Funding:	Name: Sustainability, Julie Ann Wrigley Global Institute of (GIOS)
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Consent form for podcast , Category: Consent Form; • IRB form modification/podcast, Category: IRB Protocol;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 10/30/2020.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

If any changes are made to the study, the IRB must be notified at research.integrity@asu.edu to determine if additional reviews/approvals are required. Changes may include but not limited to revisions to data collection, survey and/or interview questions, and vulnerable populations, etc.

Sincerely,

IRB Administrator
cc: Sara Aly El Sayed
Scott Cloutier
Sara Aly El Sayed
Anna Elovitz
Jordan Sene
Madison Harris
Katherine Blessington

Follow the Ferment focus group and interviews:

ASU Knowledge Enterprise Development

EXEMPTION GRANTED

Christy Spackman
SFIS: Future of Innovation in Society, School for the
-
Christy.Spackman@asu.edu

Dear Christy Spackman:

On 12/4/2019 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Governing Food in a Post-Pasteurian World: Exploring food safety culture among ethnic and traditional food producers.
Investigator:	Christy Spackman
IRB ID:	STUDY00011075
Funding:	Name: ASU: Sustainability Consortium
Grant Title:	
Grant ID:	
Documents Reviewed:	• Consent Form, Category: Consent Form; • Interview questions, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Introductory Email, Category: Recruitment Materials; • IRB food governance, Category: IRB Protocol; • Swette Center Grant, Category: Sponsor Attachment;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 on 12/4/2019.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator
cc: Sara Aly El Sayed
Nalini Chhetri
Christy Spackman

APPENDIX I

ARTICLES ACCOMPANYING PODCASTS

Regenerative Preservation Practices Episode One: Article on Slow Food Website

SFYN Podcast: Meet our guests from our Regenerative Preservation practices episode

13 JANUARY 2021 SARA EL SAYED AND JORDAN SENE

An arid climate or landscape has little to no rain and is considered too dry and barren to support vegetation. We interviewed four guests from arid or semi-arid regions around the world including New Mexico, Egypt, Australia, and Colorado.

Listen the podcast here!

Growing food and preserving it is possible in desert-like environments and our guests share their regenerative practices with us including permaculture techniques, seed saving, drying, and fermentation in this episode.

Roxanne Swentzl, a Pueblo woman from Santa Clara, New Mexico who co-founded the Flowering Tree Permaculture Institute. She is passionate about learning from her ancestors and finding ways where her children, grandchildren, and future generations continue their ancestral knowledge forward. Roxanne is a seed saver and protector of her place-based indigenous knowledge which led her to share these customs by publishing the Pueblo Food Experience.

Menar Meebed is a grandmother and owner of Minnies Dried Fruit and Vegetables, in Cairo, Egypt. Her dedication to ensuring her grandchildren had access to healthy food meant she transformed an age-old technique of drying to make delicious and nutritious products for many more. She uses a German technology of solar drying to dry local fruits such as strawberries and mangoes as well as vegetables that create healthy and convenient soup mixes.

Regenerative Preservation Practices Episode: Article on Slow Food Website Continued

Salah Hammad, a permaculture consultant, and educator who lives in Sydney, Australia – originally from Jordan. His passion for ensuring regenerative systems has meant that when there is a surplus of food, it needs to be preserved. He works on fermentations such as sourdough, labneh, and others. He explains how these fermented processes can help the soil remain healthy – showing how microbes help us through soil health, the processing of food, and the well-being of our bodies.

Mara King is a fermentation chef and one of the co-founders of Ozuke. Originally from Hong Kong, she currently works at Fresh Times Eatery in Boulder, Colorado. Her passion for all things fermented has made her travel around the world in the discovery of different foods like Nato made in China. However, her passion lies in teaching others to explore their own journey of fermentation as a way of producing more organic foods.

Elena Escaño is a young agroecological pig farmer in Andalucia, Spain. At her family's farm, Finca Montefrio, they breed the local pig race Iberico. The pigs eat mainly acorns and the animal density is very low. This and other sustainable practices prevent soil erosion at the farm.

Thank you for taking the time to listen to our guests and learn about arid preservation practices. Please consider taking this survey to help with our research.

Find the SFYN Podcast on all the podcasting platforms:

- **Spotify**
- **Apple Podcasts**
- **Google Podcasts**
- **Online**

Resilience of Indigenous Communities Episode Two (Unpublished)
By: Katherine Blessington, Sara El-Sayed

The goal of this episode is to broaden our understanding of a regenerative food system within the context of an indigenous community, and to shed light on the age-old agricultural practices that keep our communities strong. We learn about the multi-faceted challenges indigenous communities face, in the past, present, and future, and the solutions and growth that agriculture can provide. **Amidst the trying times of the Covid-19 pandemic, we are humbled by new perspectives. The voices of our interviewees give us a strong reminder to step outside of ourselves and to understand not only how different communities are affected, but to learn from others.**
In doing so, we hear from experts around the world - people that have gained years of insight through study, implementation, and experimentation. Carson Kiburo represents his indigenous Kenyan community on the global stage; Roxanne Swentzl educates fellow members of the Santa Clara Pueblo in northern New Mexico on health and balance within ourselves; health scientist and CEO Dean Seneca advocates for the underdogs; and Lilian Hill shares with her community on the Hopi reservation different ways of saving food and building their own food systems. Through these different perspectives prevails a common message: what we grow and how we grow it is an extension of our cultural identity. **To hear indigenous community members speak on the resiliency and unification that comes from their food is not just a call to action. Rather, it is encouragement to reconnect with our food, and a reassurance that sometimes**
we have to look to the past in order to move forward.

Photo courtesy of Lilian Hill

Photo courtesy of Lilian Hill

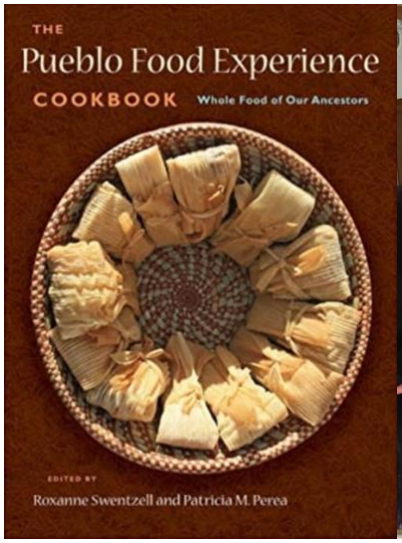


Photo courtesy of Roxanne Swentzl

Photo courtesy of Carson Kiburo

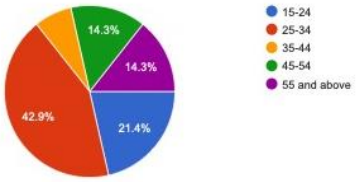
Thank you to Lyla June for the music. Lyla June is a nationally and internationally renowned public speaker, poet, hip-hop artist and acoustic singer-songwriter of Diné (Navajo) and Tsétsêhéstâhese (Cheyenne) lineages. Her music can be found here: soundcloud.com/lylajune

APPENDIX J

SURVEY RESULTS FOR EPISODE ONE: REGENERATIVE SYSTEMS PODCAST

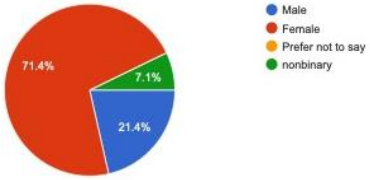
Age

14 responses



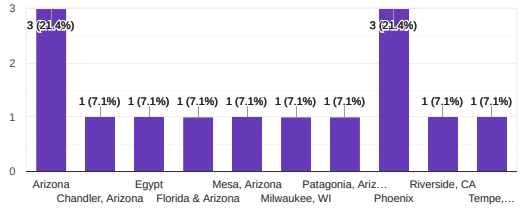
Sex

14 responses



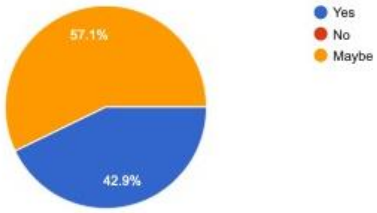
Location (where are you located)

14 responses



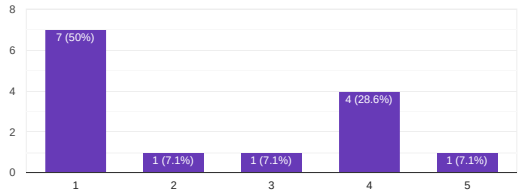
Do you think you will use any of the advice given?

14 responses



Was the episode useful?

14 responses



If you answered yes above, in what way?

10 responses

I understood it more as something inspirational, and as a spirit of agriculture practices than as something to give advices

Be more conscious of my food choices

I liked the discussion on fermentation.

Drying healthy food instead of gravitating towards junk food! Also want to learn more about traditional gardening methods in areas with little water.

Thinking about how to best care for seeds/plants, food preservation methods

I'll likely try to better incorporate local foods into my daily food habits, and design future infrastructure systems in support of a regenerative, local food systems. I'll also look into more traditional sustainability practices and see if they can be applied to my food consumption and design matrix. :) Thank you!

I really liked the piece about seed saving and how part of that work is also planting it

BIOGRAPHICAL SKETCH

I see myself as mycelia, the vegetative part of fungi, diffusing, and absorbing knowledge with the people surrounding me - like fungi in a forest I hope to create a mesh of connections. My Ph.D. is in food system sustainability from Arizona State University, focusing on regenerative food practices in arid regions. I have worked as a researcher and lecturer at The Biomimicry Centre, focusing on Life Principles, as well as a researcher at the School for the Future of Innovation and society, focusing on Food ecologies. I am co-founder of several social enterprises in Egypt. Nawaya, a social enterprise working to catalyze and transition small scale farmer communities in Egypt into more sustainable ones through education and research. Dayma is an LLC responsible for outdoor Environmental Education, teaching young adults about Biomimicry and local Egyptian communities. Clayola is an LLC that produces low-tech irrigation systems for household units. I am an avid traveler, nature lover, and enjoy tasting foods, cooking and interacting with people through food experiences. I sit on the Slow Food Phoenix board, heading the policy and advocacy committee and previously was the North African international councilor for Slow Food International, a movement whose aim is to safeguard local food cultures and traditions and does so by promoting Good, Clean, and Fair food for all.

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