



Seed Saving and Exchange Networks

The Seed Library & Food System Resilience

Environmental Studies Senior Capstone Project

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Abstract:

In this research we examined the extent to which seed libraries have successfully contributed to maintaining regional crop species diversity that would allow food system resilience against drought, disease and other negative impacts of climate change. Using seed libraries as tokens of public seed saving and exchange networks, we surveyed seed library volunteer coordinators from around the country to examine the impact of their seed lending operations and activities on preserving heirloom or open-pollinated seed varieties, which contribute to regional crop diversity. We measured the proliferation of regionally adapted seeds by tallying the number of varieties in circulation, the number of seed saving participants, and other measures. The swell in seed libraries created just within the past 15 years demonstrates massive potential for regional food system impact going forward, as approximately 300 are dispersed across the United States today, up from 63 in 2013. We concluded that seed libraries are just a budding component of the alternative food movement as most libraries today are between 1-3 years old. However, they do play a major role in their regional communities by providing alternative sources to genetically modified seeds, enhancing biodiversity and genetic crop resilience, and reconnecting people with their food source.

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Seed Libraries, Seed Exchange Networks, and Food System Resilience

"We usually don't think about it when we sit down to eat our cereal in the morning or tuck the kids into their cotton sheets at night, but it all starts with seed. The seed we sow affects the quality, nutrition, cost, and environmental impact of all the food we eat and every fiber we wear,"

Seed Matters, 2015.

1. Introduction

It is true that most of us don't think about seeds in our everyday lives as the basis for our existence. Seeds are the building blocks for everything that we eat. They are the raw material that provides for the bounties that give form to cultural heritage and tradition. As the Seed Matters' Principle states, "People have saved, selected, and improved seed for thousands upon thousands of years. Seed is the repository for crop genetic diversity, and the foundation of agriculture and food security. It's a shared legacy" (Seed Matters, 2015). Whereas seed saving and exchange networks were once commonplace among U.S. farmers a few generations ago, a newfound ubiquity of public seed collections has taken root in schools and public libraries across the U.S. (Shrestha et al 2006). These "seed libraries" are one component of seed saving and exchange networks, which involve all entities that save and proliferate seeds: for-profit seed companies, non profit seed companies, seed saving farmers as well as the seed libraries. However, what makes seed libraries distinct from other exchange networks is that they provide the community with free access to regionally adapted, open-pollinated (self-pollinated "true-breeds"), non-genetically modified seed varieties. Seeds with these unique qualities are referred to as "heirloom varieties." At their impressive rate of creation, seed libraries have become key distributors of heirloom seed varieties and a phenomenal offshoot of the alternative food movement.

1.1 Purpose of the Research

Though seed libraries can be found all over the world, they have recently experienced an unprecedented rate of creation, particularly in the U.S. In 2013, there were only 60 seed libraries nationwide (Connors, 2014). Just one year later, researchers counted 163 libraries, and recent reports suggest that number has grown to over 300 today (Atalan-Helicke, 2015). The wider adaptation of seed conservation practices sends a clear message: resiliency of the North American food supply—the ability of the food system to deliver naturally nutrient-rich foods, withstand and evolve from inhospitable climate change disruptions like droughts, pests, extreme storms, inhospitable climate change, and ultimately countervail collapse—has become a visible priority in society (Gerald & Atalan-Helicke, 2015). Nevertheless, without knowing the nature of the motivations by individuals who have voluntarily assumed stakeholder roles in conserving seeds, it is difficult to know whether seed saving and exchange networks will continue to garner support, participation and relevance as an alternative to the standard commercial seed industry.

The purpose of this research is to examine the extent to which seed libraries have successfully contributed to maintaining their region's genetic crop diversity and food system resilience in the U.S. Using seed libraries as tokens of public seed saving and exchange networks, we surveyed the administrators of seed libraries around the country to assess the impact of their seed lending operations and activities on their regional food systems. We measured the proliferation of regionally adapted seeds by tallying the number of varieties in circulation, the number of participants saving seeds, and other measures. In assessing the activities that are facilitated in a representative sample of seed libraries across the country, we

were able to estimate the resilience of each major regional food system in the U.S. based on the financial and operational capacity of seed libraries maintained there.

2. Literature Review

2.1 “New Age” Agriculture: Monocultures and Genetically Modified Seeds

In 1994, the FLAVR SAVR tomato became the first genetically modified food to receive approval by the U.S. Food and Drug Administration (FDA) for commercial use (ISAAA.org). Although the FLAVR SAVR flopped on the market after meeting a myriad of consumer disdain, two billion hectares (almost 5 billion acres) of genetically modified seeds have since been planted around the world, a number which has seen exponential growth each year (ISAAA.org, 2016; Christy, 2012). The shift in the genetic makeup of commercially available food followed fundamental changes during the Green Revolution in the early 20th century (Grauerholz & Owens, 2015). The Green Revolution was a period of rapid agricultural innovation technologies that strived to assert better control over crop production by introducing pest and weed-fighting chemicals (Grauerholz & Owens, 2015). The new wave of agro-chemicals and fossil fuel-guzzling machinery expedited the cultivation process momentarily, but ultimately exacerbated drought-prone conditions of the American Heartland into a soil-eroded Dust Bowl in the 1930s (Cordova & Porter, 2015). Many crops also struggled to grow optimally with the agro-chemicals that were designed strong enough to kill weeds and insects. In the wake of degraded growing conditions, researchers turned to strengthen the crop themselves with new biotechnology innovations. The agriculture industry’s heavy reliance on a few genetically modified crops that were high-yielding and able to withstand certain pesticides and herbicides helped homogenize the global diet and consolidate the market for seeds (Nazarea 2005; Pautasso

et al. 2013). Soon, the food system shifted from small-scale localized system of production and consumption, to an industrialized system whose products were shipped worldwide (Grauerholz & Owens, 2015).

2.2 Alternative Food Movement

After the Green and Biotechnology Revolutions, food production continued on the trend towards becoming increasingly centralized and impersonal (Grauerholz & Owens, 2015). Community-based groups worked to reconnect people to sustainable agriculture in their region to supersede the standardized conventional agriculture market. To do this, heirloom seeds that possessed inherent value were carefully saved and re-incorporated into crop fields in the local regional. To decentralize the management of heirloom seeds, new community exchange networks, like seed libraries, were established to cultivate and support seed diversity, not merely the high yielding “cash crops” (Shrestha, 2006). The goal of seed saving and exchange networks was to bring about a viable public alternative seed breeding system (Atalan-Helicke, 2015). Civic engagement groups also worked on the advocacy level to promote education about food production, calling for reforms to food policies that incentivize GM crop domination.

The alternative food movement gained socio-political salience as part of the U.S. environmental movement and policy reforms of the late 1960s, early 1970s. Since then, numerous offshoots of the alternative food movement have sprung briefly into the consumer conscience. These can be summarized in buzzwords, ranging from “organic,” “superfoods” and “non-GMO” that preoccupy the healthy “conscious consumer.” However, certain demanders of an alternative food system have more at stake than just nutritional standards; in some rural areas, the seed industry defines the wellbeing of entire local economies.

2.3 Why Save Seeds?

Seeds are the carriers of genetic diversity, expressing traits, flavors and growing patterns that vary over time and space as products of evolution or human manipulation (Connor, 2014). For seed activist Cindy Connor, “whoever owns the seeds controls the food supply” provides reason enough to believe that seeds should be kept in the hands of people (Connor, 2014). Seed saving is a critical practice for promoting food security, local food economies, and biodiversity through conservation. Crop species diversity is one of many components that define the quality of ecosystem biodiversity, which has plummeted worldwide in parallel with the Industrial, Green and Biotech Revolutions (Smale, 2005). The global community lost 75 percent of its plant varieties just within the last century, and 93 percent has been lost in the U.S. alone (Seed Savers Exchange, 2016). The extreme reduction in biodiversity poses a threat to human welfare, as extinctions limit the ecological benefits that we can sustainably reap from the remaining at-risk varieties. To highlight the magnitude of biodiversity loss, the U.S. commercial market in 1983 offered twelve varieties of corn, one of which was the conventional “sweet yellow” variety. These remaining twelve varieties were a 96 percent decrease from 80 years prior, measuring from 1903. Research tells us that U.S. farmers previously grew 307 different corn varieties, some having yellow kernels, some with white kernels; some that grew taller, others shorter; some offered better protection against pests and diseases, while others were more drought and flood tolerant (FAO, 2014). Seed saving and exchange confronts the problem of crop diversity loss by contributing to their conservation, repopulation and distribution.

2.4 Farmers and the Seed Saving Tradition

For the human part in seeds’ genetic evolution, the keepers of seed gene pools have

historically been agrarians or farmers. In a scientific and social study carried out in Chile, farmers were regarded as the frontrunners of biodiversity conservation in the region (Fuentes; Bazile & Bhargava; Martínez, 2012). Farmers bear a significant decisionmaking role in the distribution and conservation of genetic resources; whether or not a farmer chooses to take part in the seed saving and distribution networks accessible to him may expose or buffer the local food system from changes in production yield, the physical environment, and the socio-economic situations of the livelihoods dependent on it (Fuentes; Bazile & Bhargava; Martínez, 2012). The effects of seed saving and “agro-ecosystems” extend beyond the field, as studies have proven that regions with richer genetic diversity tend to reap higher socio-ecological resilience to disturbances and unforeseen events (Pautasso et al, 2013; OSA, 2011). Now more than ever, maintaining hearty genetic seed arsenals are naturally protected to withstand severe climate anomalies that are quickly becoming normalized, especially in rendering nutrient inputs, pesticides, and herbicides redundant (Ingram & Liverman, 2010; Sgro, Carla, 2011; Hendrickson, 2015). In the Chilean case study, crops like quinoa are disappearing and being replaced by rice and wheat. However, families who have preserved their quinoa seeds have continued to grow and conserve quinoa (Fuentes; Bazile & Bhargava; Martínez, 2012). Today, quinoa enjoys increasingly high demand in the West as a result of being popularly advertised as a “superfood,” since the grains are packed with an essential “building block” macronutrient called protein (Anderson & Delcarmen, 2015). Were it not for the farmers who preserved this traditionally peasant foodstuff, this high-protein crop variety may have faced extinction instead of revitalization (Anderson & Delcarmen, 2015).

As more agricultural products are pumped into the global trade markets, government and

corporate stakeholders become increasingly involved in determining the cultivation and distribution strategies of farmers. For instance, “cash crops” are the biggest recipients of federal subsidies and crop insurance coverage, incentivizing agri-businesses to produce more acres of specific crops for the purpose of exporting to foreign markets. In an otherwise break-even industry, these federal incentives take away farmers’ agency as rational decision makers on behalf of their cropland and the consumers they serve (Shrestha; Subedi; Sthapit; Rijal; Gupta; Sthapit, 2006). Oftentimes, small-scale farmers are forced to migrate or become a human wrench in the agribusiness machine. Small-scale farmer displacement concerns more than just the farmers themselves, but also public health officials they contemplate the long-term health impacts of an industrialized food system (Fuentes; Bazile & Bhargava; Martínez, 2012). The organic farmers that remain in business are now burdened with righting the ambient environmental degradation and preparing for resilience in the face of climate change. These ecologically conscious farmers are charged with carefully selecting the appropriate seeds with which to address regional agronomic challenges, market needs, government-sanctioned stewardship requirements, and ultimately to promote optimal ecosystem function (Fuentes; Bazile & Bhargava; Martínez, 2012). To meet these needs, organic farmers require seeds bred under strict USDA Certified Organic conditions, and further to protect these cultivars from trait contamination from biotech seed cross-pollination. Farmers’ involvement in the selection and saving of seeds ought to be improved in order to sustain the ecological and cultural diversity of agriculture and food systems in this generation and in those to come (D Via, 2012).

Moreover, seed sovereignty is the natural right of people to maintain formal and informal modes of exchanging and conserving agricultural, social, and cultural diversity oftentimes

contained in heirloom seeds (Louis, 2011). Seed sovereignty operates as a dual social and environmental issue, since guaranteeing the right to preserve biodiversity preserves cultural and buffer mechanisms in the food system against environmental and economic shocks. Protecting the rights of the public to save seeds, with the sufficient quantity of food is not synonymous with providing sufficient access, nutritious, safe and culturally appropriate food (UN Food Summit, 1996).

2.5 U.S. Seed Libraries

The formalizing of seed exchange networks through the advent of modern seed exchange libraries is a recent development. Although farmers had exchanged seeds informally, the institutionalization of seed libraries has provided an array of benefits for farmers, regional food systems, and the surrounding communities. Seed libraries have broadened conversations about seed sovereignty and access to seeds, and emphasized the role of local farmers selecting and saving agrobiodiversity in the U.S. (Atalan-Helicke, 2015). In the words of the Roman philosopher: “If you have a garden and a library, you have everything you need” (Bentley, 2013).

2.6 The Commercial Seed Industry

In 2011, Mother Earth News surveyed hundreds of gardeners to glean the top fifteen favorite seed companies. The study found that hobby gardeners preferred to purchase their seeds from mail-order catalogues, versus seed racks at stores like the Home Depot or Lowe's (Mother Earth, 2011). Seed catalogue customers are more likely to be commercial farmers or avid gardeners who have a vested interest in the type of food they grow, having amassed seasons of cultivation experience and expectations (Mother Earth, 2011). Unlike seed libraries, mail-order seed catalogues are for-profit companies and lack community and mission-driven aspect of

promoting biodiversity.

2.6-1 Heirloom Seed Companies

2.6-1-1 The Hudson Valley Seed Library

The Hudson Valley Seed Library (HVSL), which was an informally assembled seed library in the Gardiner Public Library in Gardiner, New York in 2004, has since grown into a for-profit seed saving farm and exchange network with far reaching impact on agrobiodiversity and community seed knowledge (Hudson Valley Seed Library, 2014). Ken Greene founded HVSL as a way “to encourage and develop a network of regional seed savers and seed-producing farms throughout the Hudson Valley,” (Hudson Valley Seed Library, 2014). Since then, Greene has played a major role in promoting the “seed library model,” a means of engaging communities in participatory seed saving and knowledge exchange. Since its creation, the HVSL has blossomed into an “heirloom seed sanctuary,” producing the majority of its seeds on its Northeast Organic Farmers Association New York certified organic farm (Hudson Seed Library, 2014). The rest of the seeds are grown by gardeners in the region and sold in “library packs,” while “garden packs” are heirloom seeds bought from wholesalers (New York Times 2010; Atalan-Helicke, 2015).

The seed cultivation practices of the HVSL exemplifies how small-scale seed companies are best promoting heirloom diversity in their regions. The HVSL abides by Vandana Shiva’s Declaration of Seed Freedom, meaning that their seeds are produced by open pollination and natural hybridization (Hudson Seed Library, 2014). These techniques follow natural evolutionary forces to maintain the genetic health of the seed stock (Hudson Seed Library, 2014). Although their seeds are not certified organic, they follow organic practices that promote both

environmental and human health. As a signatory of the Safe Seed Pledge, the company also emphasizes local farmers rights in offering access to “safe” or non-genetically modified seeds. Overall, HVSL provides a regional alternative to the concentrated seed industry and connects seed purchasing to the global food sovereignty movement.

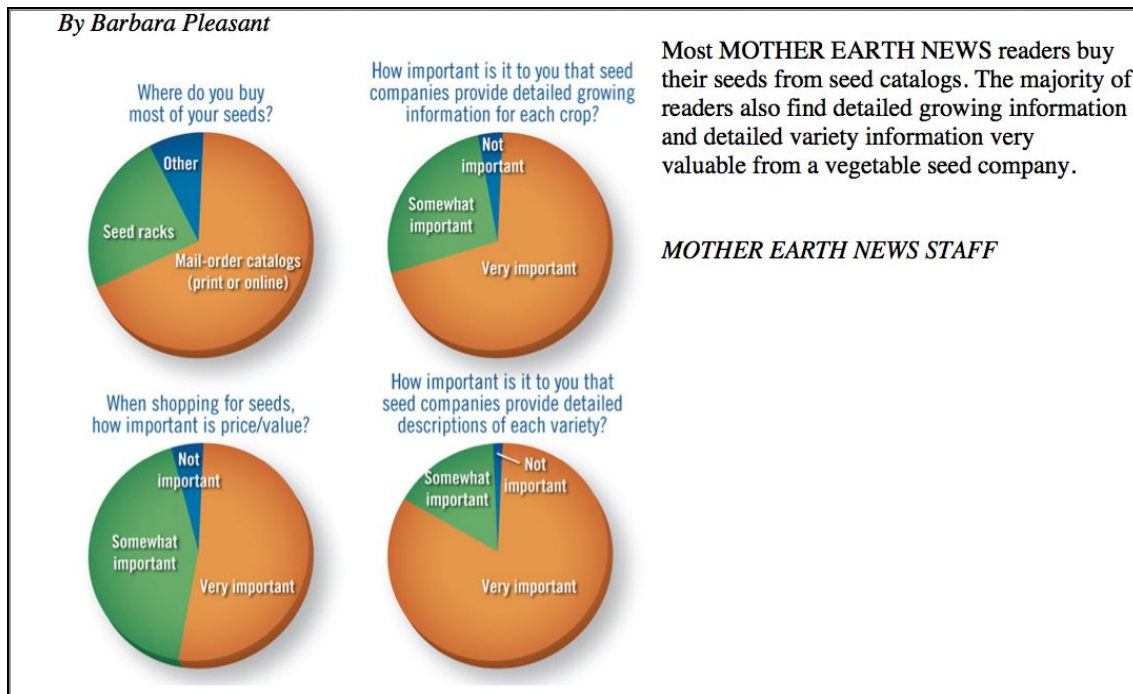
The HVSL has facilitated a well-connected seed exchange network for the Hudson Valley, having collaborated with the Organic Seed Alliance, Seeds on Wheels Truck, Poughkeepsie Farm Project, and other regional not-for-profits. Their network boasts multi stakeholder representation, including businesses, civil society organizations, and higher education, which is necessary to pool together NGO resources (Atalan-Helicke, 2015). That said, collaborations are not limited organization-a-organization; public-private partnerships are also essential to increasing implementation of heirloom seeds in the field. For instance, fostering connections between local farmers that plant and public programs that breed local heirlooms may enable the programs more responsive to farmers’ diverse needs and any emerging environmental challenges. We explored the nature of existing partnerships amongst seed savers in the region in semi-structured interviews with seed library administrators from all over the country.

2.6-1-1 Johnny’s Select Seeds

Johnny’s Selected Seeds is an employee-owned “Safe Seeds” company in Maine that offers heirloom and organic varieties. Research has found that Johnny’s was the favorite mail-order company among avid gardeners and farmers in 2011; indeed, our research confirmed that Johnny’s seeds were a popular donation item at many seed libraries (Mother Earth, 2011). Gardeners laud Johnny’s for providing accurate descriptions of seed species, while others cite having “never had a failed crop from their seed” (Catherine Dickson Hofman Seed Library,

2016; Mother Earth, 2011). Despite finding positive testimonies from interviews and prior literature, the belief that heirloom and organic varieties are less productive than hybrids was an emerging theme from employees at national seed supplying stores like Home Depot and Lowe's.

Figure 1: Mother Earth Survey 2011



3. Methods

A mixed-methods approach was used to collect our research data. Our qualitative research utilized written response surveys, online surveys and semi-structured interviews conducted over the phone. While the online survey focused on collecting data from seed libraries across the U.S., the semistructured phone interviews and written surveys were conducted with experienced individuals that are involved in seed saving, breeding, education, distribution, etc. Our research was guided by the following questions:

- What are the major concerns of the farmers, activists, and seed savers in seed exchange networks in the U.S.?
- How do seed saving and exchange networks accomplish their goals?
- At what stage of development are U.S. seed libraries contemporarily, according to the following measures: years active, extensive partnerships, received some form of funding, have a large number of active members, and have a large volume of seed varieties in circulation?
- How can food system resilience result from public exchange of heirloom seeds and seed saving knowledge?

3.1 Population and setting

Our research focuses on seed libraries as examples of seed saving and exchange networks in the U.S.. Stakeholders implicated in seed exchange networks include local seed companies and their consumers, seed banks, policymakers, and farmers. The Northeast covers nine states: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania (New World Encyclopedia, 2015). According to estimates made by the U.S. Census Bureau, the region's population was 56,152,333 in 2014. (U.S. Census Bureau, 2015). Detailed demographic information for the nine states are below (Table 1).

**Table 1: Demographic Information of Target Region
according to the latest statistics from the U.S. Census Bureau in 2014**

State	Land Area, in sq. mi. (2014)	Population (2014)	Median Household Income (2014)	Number of seed libraries* (2016)
NY	47,126	19,746,227	54,310	5
NH	8,953	1,326,813	73,397	0
MA	7,800	6,745,408	63,151	1
NJ	7,354	8,938,175	65,243	0
PA	44,743	12,787,209	55,173	0
CT	4,842	3,596,677	70,161	1
VT	9,217	626,562	60,708	4
ME	30,843	1,330,089	51,710	0
RI	1,034	1,055,173	58,633	0

** according to our findings*

3.2 Survey Instrumentation and Data Collection

Our first data collection site was located at the Northeast Sustainable Working Agriculture Group (NESWAG) Conference in Saratoga Springs, NY, where we distributed approximately 100 written surveys and garnered 60 respondents. The survey asked six questions using a variety of response structures, including multiple choice, short answer and yes or no questions. These questions were designed to gauge the concerns and awareness of conference participants regarding the functionality of the seed networks in the Northeast region. We explored the way respondents defined “regional seeds,” and where these seeds are ultimately grown. We also asked respondents to rank the major contemporary challenges, posited in a list of eight, that they perceive are most threatening to the seed sector in the U.S.. Overall, this survey sought to determine a general consensus from a population of concerned food systems

stakeholders regarding the current state and workability of seed networks in the Northeast region.

We conducted a second written response survey at the Northeastern Organic Farming Association of New York Conference (NOFA-NY), also in Saratoga Springs, NY. We distributed approximately 20 Surveys and garnered 10 responses. After assessing reactions from the first survey, we tuned the second survey to convey the questions in a more direct and unmistakable manner. To promote continuity among our data collection methods, the response structures stayed consistent between the two surveys.

In addition, we sent approximately 155 online surveys, using Qualtrics, and garnered 61 respondents. This survey targeted seed libraries in the U.S and focused on understanding how interactions and partnerships with public entities affects the success of seed libraries. At the end of both surveys, all respondents were given the option of supplying their contact information, allowing us to contact them for a more in depth interview over the phone.

3.3 Interview Instrumentation and Data Collection

Out of the written survey respondents who provided us with their contact information, we chose ten to interview over the phone who we felt, according to their stated role, were major stakeholders in their regional food systems. We also interviewed two garden center managers from the Home Depot and Lowe's Homegoods, both located in Wilton, NY, to gage the perspective of chain stores that market seeds to the local area. Finally, we spoke to two financiers of alternative food ventures, both of whom were identified attendees at the 2016 Food + Enterprise Summit held in Brooklyn, NY. In these semistructured phone interviews, we applied similar themes and questions framework to our data collection. The semi-structured interviews were addressed to employees of relevant NGOs, farmers/gardeners, seed companies, public

libraries and community members who are involved in the regional seed exchange networks. Interview of regional food system stakeholders were designed to glean the potential obstacles, growth ideas and opportunities, and general considerations for accomplishing their goals. For seed library administrators, the interview questions delved into the administrator's range of job descriptions, their knowledge acquisition on the job, knowledge transferred to library participants, means of financial subsistence, nature of local partnerships, prevalence of educational programs and personal motives for their roles in the regional seed system.

Table 2: Semi-Structured Interview Stakeholder List

State	Position	Organization
NJ	Self employed	Farm worker activist
MA	Assistant Librarian	Concord Seed Lending Library
CO	Associate Reference Librarian	Bud Werner Memorial Library Seed Library/Collection
WI	Adult Services Librarian	The Seven Hills Seed Library
VA	Volunteer Coordinator	Washington County Seed Library
CA	Manager of Potrero Branch	San Francisco Public Library
NY	Garden Manager	Lowe's Homegoods
NY	Garden Manager	The Home Depot
NY	Organizing Director	Food + Enterprise Summit Eco Practicum
NY	Managing Trustee	Veginvest Trust

To learn about other actors in the seed saving and exchange networks in the Northeastern U.S., and to triangulate our data from seed libraries administrators and conference attendees, we evaluated transcripts from semi-structured interviews with small-scale heirloom seed vendors. Such regional stakeholders included John Waldo, Turtle Tree Seed, Stone Barns Education Center and the Hudson Valley Seed Library. We included the contributions they make to seed

networks in the Northeast region in the literature review of this paper.

3.4 Data Analysis

The survey and interview data is exhibited using “thick” descriptive narratives, which most effectively display qualitative data (Creswell, 2007). The descriptive narratives permitted stakeholder surveyees to refer to their contemporary beliefs, aspirations, critiques, challenges, recollections, and level of emotional and physical involvement that are unique to their situations. To ensure the testimonies belonging to each stakeholder were secure and private, we coded the interview results and avoided referencing specific names in the data findings. Using the type 1 tabulation method, we isolated topics and categorized emerging themes that were most mentioned collectively by the interviewees (Silverman, 2006). We anticipated that most stakeholders would emphasize two themes in particular: concerns with lack of financial support and the dwindling genetic diversity in the seed industry. In our interviews, we gleaned insight into the social, economic and political obstacles the stakeholders face in implementing a multifunctional seed library. We also received recommendations and ideas that could potentially aid the process of implementation and sustainability of these public institutions.

3.5 Research Limitations

Limitations to our data collection through random surveys included having a limited amount of time and money. Due to a limited amount of money we were only able to attend two conferences and due to a limited amount of time we were only able to distribute and collect data during those two conferences. This limited the number and makeup of participants in our data collection. The diversity of our sample population was limited, as most of our participants were from food access advocates and thereby compelled to attend the conferences for similar reasons.

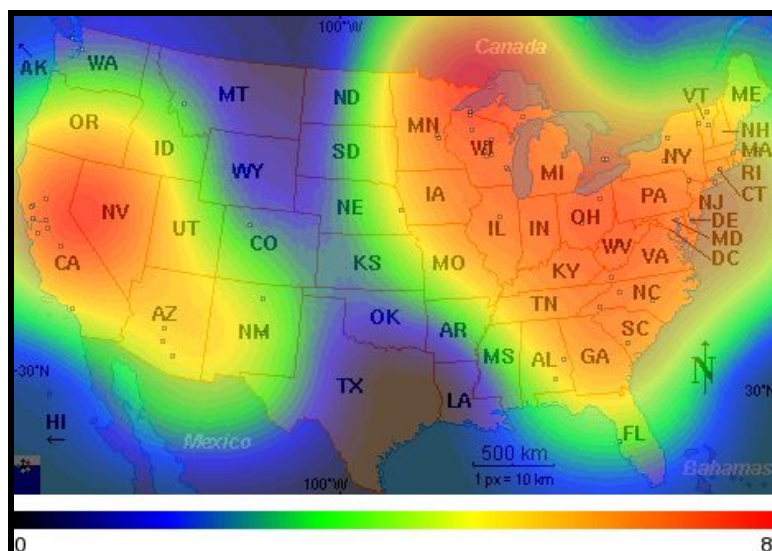
This limitation was accompanied by a lack of interest and hesitancy to participate from our targeted population. For instance, farmers and policymakers, both key stakeholder groups in seed networks, were underrepresented at the conferences. Overall, we strived to gather commensurate participation from each stakeholder group, but largely failed to garner a diverse sample. Additionally, we encountered a lack of general knowledge about challenges facing the seeds in the U.S. among Northeast food system conference attendees. Therefore, due to a combination of a lack of diversification and relevant knowledge in the sampled population of Northeast food system stakeholders, we broadened our focus to seed libraries and their comparative influences in the major U.S. regional food systems.

4. Results and Discussion

4.1 Seed Library Population

From the online survey of our triangulated data collection, we engaged with a sample population (N = 61) of seed libraries across the U.S. (Figure 1). Most of the seed libraries were located in clusters along the coasts more than the continental U.S. (Figure 1). In terms of seed library dispersal, we noticed a high concentration of seed libraries in Wisconsin and California.

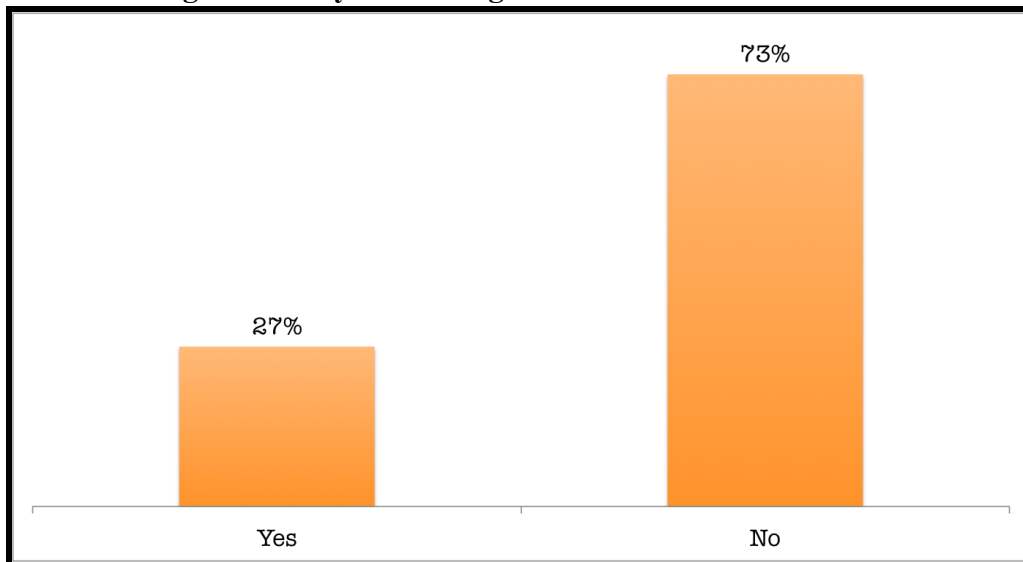
Figure 1: Location of Seed Library Respondents



4.2 Interconnectivity

Since the seed libraries were clustered, we assumed they would have some degree of connectivity and interaction with one another. However, we found the majority of the seed libraries do not exchange seeds or partner with each other as often as we assumed (Figure 2). Inter-exchange of seeds and knowledge is important because the more exchanges seed libraries exchange, the wider each heirloom species can be spread throughout the region. It also provides the opportunity to consolidate seed libraries' volunteer efforts and the small amounts of funding they receive. Pooled funding could enable joint collaboration on seed swapping events and educational programs to teach the community how to save seeds.

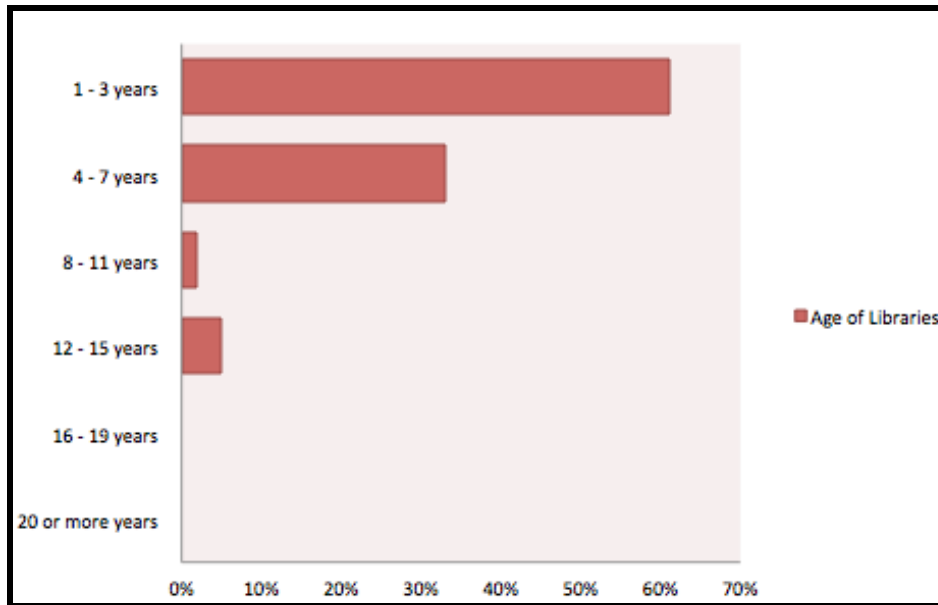
Figure: 2 Do you exchange seeds with other libraries?



We concluded that seed libraries are just a budding component of the alternative food movement. The reason they have not made a larger impact in the alternative food movement was made clear by the following data findings: 60 percent of the seed libraries we sampled have only been around for 1-3 years (Figure 3). The oldest seed libraries in our sample, three in total, have not existed more than 15 years. The swell in seed libraries created just within the past three years

confirms that the seed library phenomenon, where approximately 300 are dispersed across the U.S., is fairly new (Marten & Atalan-Helicke, 2015).

Figure 3: Budding Component of the Alternative Food Movement

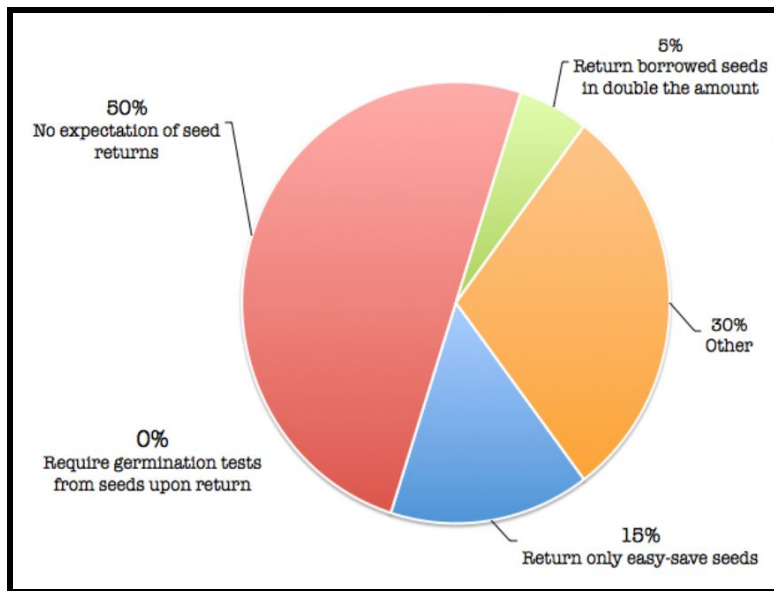


The online multiple choice questions examined common features among seed libraries, including their years active, active membership, partnerships, commercial farmer participants, membership access, and volume of seeds in circulation. According to the results, seed libraries average 120 active members, with a whopping standard deviation of 145 members. The statistical variance speaks to the significant number of seed libraries that are currently in the initial phases of development. The minimum number of members listed was 0, while 400 members was the maximum allowable value. However, one particular seed library, the Taos Exchange in New Mexico, answered the membership question using the space provided under a different question and claimed to have over 1,000 active members.

4.3 Seed Libraries: ‘The Open Source Alternative’

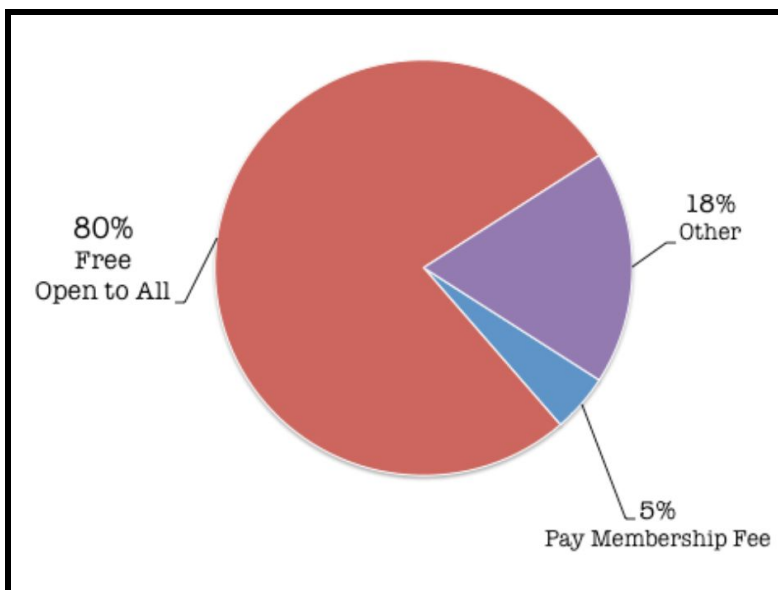
As alternative sources to the commercial seed industry, seed libraries are like the “open source” alternative. Survey results showed that the majority of seed libraries boasted free and open membership and a culture of easy-to-follow seed borrowing rules. For example, no seed library required lab germination tests upon return of the seeds to the library, which gauge the quality and growth viability of the seeds being returned (Figure 4; "The Germination Test", 2016). Though requiring germination tests would ensure that the heirlooms were pure most meticulously, it could also pose as a discouraging barrier for members strapped for time or money to do the test. As such, 50 percent of the seed libraries maintain no expectation that their seeds will be returned, while 30 percent have “other” seed return policies (Figure 4).

Figure 4: Seed Return Policy



While looking at the open accessibility of seed libraries across the sample, we found that the majority, 80 percent, are free and open to all, while a mere 5 percent limit membership to people living in a specific geographical area (Figure 5).

Figure 5: Membership



Qualitative Data Findings

4.4 Seed Libraries Priorities and Concerns for Heirloom Seeds

Seed libraries' challenges to structural and functional development were better understood after isolating emerging concerns and priorities from their mission statements. Surveys showed that the power of multinational seed corporations was mentioned most across seed library mission statements, particularly due to their distribution of genetically modified (GM) seeds (Table 3). One administrator stated that part of their mission is to provide alternatives to the genetically modified, processed foods industry by promoting self-grown food (Table 3). In contrast, we also found that addressing global climate change was repeatedly listed at the bottom of seed libraries' functional emphasis. Despite most seed library directors funneling most of their energies to bolstering access and availability of seeds, all have aided

regional food system resilience for reasons that may lie within the scope of the local town, the region, or the globe more broadly.

Table 3: “What is the mission of your seed library?”

Multinationals seed suppliers	Biodiversity	Heirloom seed accessibility	Education
<p>"To reclaim the power of owning our own seed stock and won't have to re-purchase seed every year or be dependent on outside companies."</p> <p>Eden Valley Seed Library, MN</p>	<p>"We seek to preserve genetic diversity, increase food security and food justice in our region, safeguard alternatives to GMOs."</p> <p>NE Seattle Seed Library, WA</p>	<p>"Access to various, region/climate-specific seed varieties as a means to promote community involvement."</p> <p>Bud Werner Memorial Library Seed Collection, CO</p>	<p>"To create a culture of learning, sharing, and community through sustainable seed saving that reclaims seeds as a public resource."</p> <p>Town of Clayton Seed Library, NY</p>
Empower to grow own food	Develop new interest in growing food	Access to regionally adapted seeds	Cultural revival
<p>"To have every household in Fairfield plant a garden at/in their home."</p> <p>Seed to Seed Library, CT</p>	<p>"To distribute seeds to the community with the hope of sparking an interest in gardening."</p> <p>SeedShare, CA</p>	<p>"Community seed libraries have collections of regionally adapted seeds with characteristics developed through many consistent years of being grown in the same Canadian soil and weather. Why would a broccoli seed grown in a mega-farm in Mexico produce a better crop than one that has been grown in the Greenbelt of Ontario for a generation?"</p> <p>Canadian Seed Library, Canada</p>	<p>"To bring back seed saving traditions of many ethnic groups."</p> <p>Mora Grows Seed Library, NM</p>

We found that the majority of administrators facilitate seed exchange on a volunteer basis, many in the confines of a local public library (Table 2). Stemming from the volunteer basis of their jobs, interviewees explained: (i) gaps in financial and community support for their seed library, (ii) challenges and obstacles for implementation, and (iii) effective methods for long-term success. A volunteer seed library coordinator in the state of Virginia expressed their concerns with entrusting the integrity and survival of heirloom seeds to inexperienced seed savers, but commended their operation for offering educational resources that help combat heirloom seed mismanagement:

“But we, any community-based seed library operating with volunteers- we’re not going to be able to guarantee the biological efficacy of every seed. On the other hand, I think we do pretty darn well because we educate people.” - (Personal communication, 2016.)

The coordinator also noted that another big constraint to the propagation and success rate of their seed library initiatives is time:

“Time constraints, and just the logistics of basically running a pretty functional program as a volunteer and not really having the connectedness that a full-time employee would have [is an obstacle].” (Personal communication, 2016.)

4.5 Assessment of Seed Library Development

We devised five measures to assess the relative resilience that seed libraries are contributing to their regions across the U.S.: years active, partnerships, membership, funding, and volume of seed varieties. Using the five measures, we isolated the major regions to glean developmental strengths and weaknesses between regions using the sample population of 61 seed libraries in our national data. We predicted that the most developed libraries would have been active the longest, established extensive partnerships, received some form of external funding,

maintain a large base of active seed saving members, and host a diverse seed collection. In the next few paragraphs, we present evidence to support or reject these assumptions.

4.5-1 External Partnerships and Funding

In their rarity, heirloom seeds make for expensive initial investments. On top of the cost to build the original seed arsenal, replenishing seed stocks requires stable sources of financial support. “You can’t run a seed program based only on donated seed,” reads a testimony from one administrator who heads one of the most community supported seed libraries (over 1,000 active members) in the country. Monetary donations are necessary tools to fill any gaps as the need arises, as opposed to addressing shortages by chance seed donations. We predicted that seed libraries boasting more extensive partnerships within their communities would also have more funding compared to seed libraries that are disconnected from other organizations in the surrounding region. Looking at our national seed library data, there is no clear trend that solidifies the relationship between community partnerships and financial assistance. But, 63% of libraries with at least one partner receive financial assistance in the form of seed and monetary donations. In comparison, there is a clear trend for the Northeast region. All seed libraries that have at least one community partner have received financial assistance and seed donations. On the other hand, in the Pacific region only about 43% of seed libraries with one or more partners receive financial assistance.

4.5-2 Active Membership and Seed Varieties in Circulation

Membership is at the core of a seed library’s functionality and relevance to the community. For many seed libraries, the most important community partners are “the folks who show up and make it run, [who] let their minds and hearts holds seeds” and make it their own, as

advocated by the seed sovereignty movement. To assess the true influence of membership size, we looked at the relationship between the number of active members and the number of seeds in circulation to determine a relative measure of resilience. The assumption was that seed libraries with most active memberships will also have the highest diversity of seeds in circulation. As a baseline assumption, we predicted that a robust base of 20 active members or more is likely to have more than 100 seed varieties in circulation. Nationwide, seed libraries boasting at least this level of active membership (20 members) and seed circulation volume only comprised over a quarter of the total seed libraries sampled. Interestingly, we found that the limiting factor that yielded only a quarter of the seed libraries to qualify was not the number of members they had, but the number of seed varieties. Raising the stakes to 50 or more members but decreasing the benchmark of seed varieties from 100 to at least 50, we found that the same percentage of libraries qualified (about a quarter). At the extremes, active membership seemed to bear a positive correlation to the breadth of seed diversity. For example, the library with the topmost active membership circulated more than 1,000 seeds, while the least utilized library with no active members possessed only 24 varieties in its seed arsenal. This correlation was not an anomaly; the libraries with the lowest active membership were often the same libraries that possessed the least diverse seed arsenals. Meanwhile the top five libraries with memberships exceeding 400 people had, on average, one hundred times more seed varieties in circulation (313 varieties) than the five seed libraries with the lowest membership levels (33 varieties). This trend was especially strong in the Northeast region, where we found that memberships of 100 or more also had over 100 seed varieties. This suggests that active community involvement in a given seed library increases the manifold of seed diversity in turn.

4.5-3 Years Active and Interconnectivity

Lastly, we investigated how years of being an active seed library influences the number of formal and informal connections one seed library may have with other libraries. Seed exchange among seed libraries magnifies the scope of opportunity for each heirloom variety to be saved, redistributed and replanted, which keeps the seeds in hardy condition. Exchange between seed libraries also promotes interconnectedness for other purposes, from exchanging best techniques and seed saving knowledge to collaborating on educational and seed swapping events. To assess the level of interconnectedness between seed libraries in the U.S., we cross-tabulated the number of years each seed library had been active and the frequency of inter-library seed exchanges (Figure 5). Out of the whole population of 61 seed libraries, a whopping 77 percent of them do not exchange seeds with other libraries. For the 33 remaining percent that have swapped seeds with other libraries, we found the highest level of interconnectivity were amongst libraries that have been active for 4-7 years. In this particular age bracket, seed libraries were more than three times as likely to exchange with other seed libraries compared to younger libraries aged 1-3 years (Figure 5). In addition to the increased likelihood of exchange, libraries aged 4-7 participated in double the frequency of those exchanges compared to their younger counterparts (Figure 5). Since interconnectedness tends to increase with age, it is logical that only about a quarter of seed libraries have exchanged with other seed libraries before, since the majority were just starting out (Figure 3). Contrary to our hypothesis that interconnectedness enhances with age, we found unexpectedly that only one out of the four oldest seed libraries we sampled has ever exchanged seeds with another library. Overall, most seed library administrators described these exchanges as informal or need-based only. As one

seed library administrator attested, “we have done so [exchanged seeds with other libraries]...but only occasionally and not in any highly organized manner.” “Yes, no formal plan, as the opportunity and need arises,” another said. We discovered dichotomous pattern between seed libraries that have experience organizing and hosting inter-library seed swap events and those that prefer to rely on the initiative of others.

Figure 8: Seed Library Interconnectivity Relative to Years Active

		Do you exchange seeds with other seed libraries?	
		Yes (If yes, how often and with how many seed libraries?)	No
For how long has your seed library been active?	1-3 years	4	28
	4-7 years	9	11
	8-11 years	1	0
	12-15 years	1	2
	16-19 years	0	0
	20 or more years	0	0

Table 4: Lacking Interconnectedness: Seed Libraries that Do Not Inter-Exchange

Years Active	Do Not Inter-Exchanged	Percent Total
1-3	5	87.5%
4-7	8	55%
8-11	1	0%
12-15	1	66%
All	46	75%

4.5-4 Case Study: *Wisconsin Seed Libraries & the Seed Savers Alliance*

We observed a unique concentration of nine seed libraries located across the state of Wisconsin (Figure 1). We investigated whether their close proximity has enabled a “strength in numbers” mechanism, meaning a more cohesive support network that facilitates functionality and longevity. We also wanted to know whether proximity has enhanced the efficacy of their programs and their interactions with community members in the region. We found the reason for the odd propagation of seed libraries was initiated in 2014 by a seed library network organization called the Seed Savers Alliance. To date, the Alliance is comprised of nine seed libraries that serve three northern Wisconsin counties and their immediate regions (Figure 2). We found that the majority of these Wisconsin seed libraries were 1-3 years old, a logical finding since the Seed Savers Alliance was only established two years ago. As one of nine budding new seed libraries in this region, the Seed Savers Alliance offers a starter package that includes, free of charge a free seed saving toolkit, as well as a one year membership to the Seed Savers Exchange (Figure 9; Figure 10). The Alliance also offers their Seed Savers Exchange members a chance to receive support for seed projects through their Community Seed Resource Program.

Figure 9: Map of the Seed Savers Alliance Seed Libraries Network

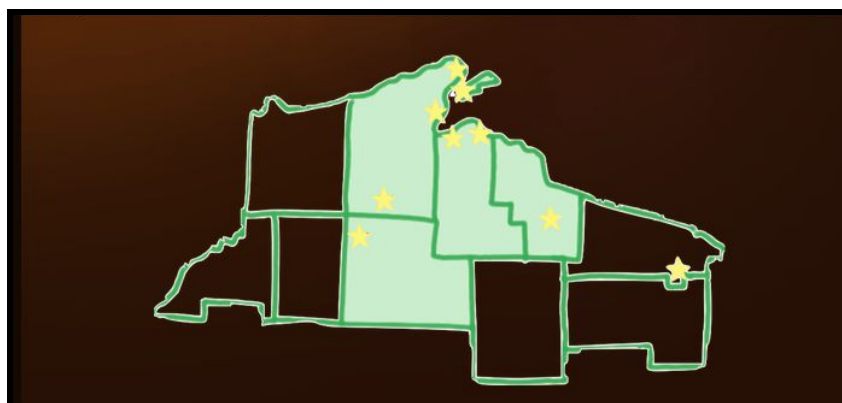


Figure 10: Seed Savers Alliance Starter Toolkit



4.6 Political Hurdles and Opportunities to Seed Saving

Many food system stakeholders attested that the public is not attuned to the threats that widespread standardization in the food industry present. One Food + Enterprise Summit attendee described the public as “an urbanized society” with a “serious, serious lack of knowledge about...the basics, like identifying what is edible and not edible.” By contrast, we would argue that data showed an acute public awareness to food issues and improved civic participation in the alternative food movement. For instance, representatives from Lowe’s and Home Depot approximated 15-20 percent of their home improvement shoppers are “afraid of genetically modified food” and “concerned with the amount of processed foods they consume.” However, theories suggest that if misinformation and fear is behind the popular pushback against GMOs, then public concern is likely to fall by the wayside.

4.6-1 “Non-GMO” Issue-Attention Cycle

According to the issue-attention cycle, the buzzword “GMOs” is destined to not keep public attention because the science behind biotechnology is complex and its problems have no

easy solution (Downs, 1972). For example, the fear that consuming GMOs is dangerous to human health cannot yet be scientifically proven through long term study. Reason being, the Flavr Savr was only introduced commercially about 20 years ago and has since been taken off the shelves (Feinberg, 2013). What has been scientifically proven, however, is the displacement of natural crop diversity in the food systems by these genetically uniform varieties. As mentioned previously, biodiversity loss has serious consequences on food system resilience and its natural ability to withstand environmental stressors. However, before enough data exists to assess GMOs' long-term impacts on the human health, GMOs will have likely fallen from public salience and the national political agenda (Downs, 1972). In order for seed networks to be more widespread, seed savers ought to know about the more scientifically concrete, arguably more threatening reasons to save seeds, such as conserving biodiversity, soil quality, and much more. Additionally, seed saving practices could be facilitated with several legislative and political changes, like reforms to ownership rights on patented seeds and heavy regulations on seed exchange activities. As such, we argue that the best method for protecting seed sovereignty would be if seed stakeholders refocused public attention towards political pressure to safeguard seed saving rights, and away from fear mongering rhetoric about GM "Frankenfoods."

In public seed saving forums, anti-GMO rhetoric is easy to find. Even the founder of the Baker Creek Heirloom Seed Company has outspokenly referred to GM seeds as "Frankenfood," (Mother Earth, 2011). This is not to say that the owner of Baker Creek Heirloom Seeds is riding the short-lived issue-attention cycle; it is likely that has additional reasons for selling heirloom seeds. Although "Frankenfood" beckons an emotional reaction, such disgust does little to shed

light on the root of the seed industry's problems. If the public is uneducated about the problems, then there will be no public pressure or sense of urgency to fix them.

4.6-2 The Power of Multinational Seed Companies

On the other hand, the fact that seed library administrators were overwhelmingly concerned by the power of multinationals suggests that administrators grasp the political obstacles threatening seed saving practices. Administrators are key seed network stakeholders, as many offer educational programming and enjoy direct communication with fellow seed savers. However, in their daily operations of the seed libraries, we learned that many administrators are careful not to affiliate themselves with any overtly political stances or activities. One administrator chose instead to “take the moral high ground,” opposite powerful agribusiness interests. “[By choosing not to be political, it keeps the lines of communications with you and all your seed savers open,” explained the administrator. Likewise, many felt that just by nature of saving their seeds and facilitating public forums for exchange, they are subverting community support away from the seed corporations. However, we would suggest that passive, indirect political action neither serves to educate community members on the dangers of a corporate-controlled seed industry, nor does it spark a sense of urgency to change it.

4.6-3 Barriers to Buying Heirloom in National Chain Stores

Although a review of the literature found that most avid gardeners and farmers purchased their seeds from mail-order catalogues, we visited three garden centers at national home improvement stores to observe seed selection availability for the casual gardener. Each of the employees at Home Depot and Lowe's had personally witnessed a new boom in garden shoppers in the last four to six years to “grow their own [food] and save money,” as one put it. Despite the

wider interest in self-grown food, producing a fruitful harvest was reportedly the prevailing objective of garden center shoppers. Seed companies at Lowe's and Home Depot marketed to this objective by guaranteeing a successful harvest with their biotechnology and advanced pesticide and herbicide products. As such, customer requests for heirloom varieties are little heard, according to the Lowe's garden center manager. In fact, customers generally do not seek help in selecting their seeds, suggesting that most are set in their choices between heirloom and hybrid. When we asked for their opinions about the relative productivity of hybrids and heirlooms, both garden center managers endorsed the hybrids without hesitation. Despite these resident experts' doubts about the practicality of growing heirloom varieties, seed savers cite having no issues with yields or pest control (Mother Earth News, 2014). Fundamentally, heirlooms are saved over generations in part because of their high germination rate and regional adaptability. However, once mass-produced and sold nationwide, heirlooms may not boast the same adaptability and robustness everywhere that they are sold, one of the great perks of saving regionally adapted varieties. Although the commercial seeds labeled "heirlooms" may be open-pollinated true breeds, regional adaptability seems an essential missing quality from these store-bought "heirlooms."

4.6-4 Patent Seed Ownership

Corporate seed ownership is a major impediment to the seed saving movement and, in this case, has barred the casual gardener's ability to participate in seed saving at all. National chain stores where seeds are sold have no say in determining the types of seeds they sell. Instead, the managers reported to interact with the seed companies through a pay-by-scan system, where they are furnished with seed display cases and paid for each seed packet sold. At the end of the

season, stores are reimbursed for the unsold merchandise, but are required to send back every seed they fail to sell. Seed companies are willing to pay for the unsold seeds in order to tightly track the seeds' distribution. Once in the customer's possession, consumers are also legally limited in methods of handling of the proprietary seeds. Legally, customers are not permitted to save seeds bought by corporate seed companies. In these ways, patent-wielding seed companies have assumed tight control over the usage and distribution of their intellectual property (the seeds). Recently, multinational seed companies have even strived to politically intervene in the public heirloom seed networks.

4.6-5 Liability Concerns from State Seed Acts

In the mid-1970's national seed exchange networks like Seed Savers Exchange attempted to stop corrupted seed distributors from selling low-quality seeds that typically contained seed-borne diseases that destroyed crops, and/or didn't germinate as advertised (SELC, 2016). As a result, seed laws were written, implemented and enforced by state governments in order to maintain a secure U.S. food supply (Kinkaid, 2016). Most state laws, like the Pennsylvania 2004 Seed Act, require seed distributors to be licensed annually and have their seeds both tested and properly labeled (SELC, 2016). The labeling requirements alone restrict lawful seed distributors to those who can label the seeds in English and pay an yearly fee of \$25 (in most states). As for the details required on the label, it is "unlawful to sell, offer for sale, expose for sale or transport any seed" without the following:

- (1) the name and address of the distributor who labeled the seed
- (2) a treatment statement as prescribed by the secretary in the regulations
- (3) the calendar month and year the germination test was completed

Certain states have even more stringent seed distribution laws than the norms listed above. For instance, the Pennsylvania 2004 Seed Act not only requires all seeds to be labeled, but also requires that specific types of seeds include specific information which can be found under the Act (See Figure 6). Along with Pennsylvania, Maryland, Nebraska and Minnesota have enforced its seed distribution regulations by making seed libraries the target of multiple violations, in some cases forcing seed libraries to close. We use Pennsylvania as a case study to examine how seed libraries in certain states have faced legal obstacles to saving and exchanging seeds in their stateside communities.

Figure 6: Agricultural Seed Labeling Requirements

- (1) For agricultural seeds except for cool season lawn and turf grass seed and mixtures and blends thereof as provided in paragraph (2):
- (i) Commonly accepted name of kind or kind and variety of each agricultural seed component in excess of 5% of the whole and the percentage by weight of each in the order of its predominance or as the secretary may direct. Where more than one component is required to be named, the word " mixture," "mix," "mixed" or "blend" shall be shown conspicuously on the label.
 - (ii) Lot number.
 - (iii) Country and state of origin of certified seed and agency responsible for its certification.
 - (iv) Country and state of origin of alfalfa, bird's-foot trefoil, red and white clovers and field corn except hybrid corn. If the origin is unknown, that fact shall be so stated.
 - (v) Percentage by weight of all weed seeds.
 - (vi) The name and number of restricted noxious weed seeds or number of bulblets per pound.
 - (vii) Percentage by weight of agricultural seeds, other than those required to be named on the label, which may be designated as crop seeds.
 - (viii) Percentage by weight of inert matter.
 - (ix) For each named agricultural seed:
 - (A) The percentage of germination, exclusive of hard seed.
 - (B) The percentage of hard seed, if present.
 - (C) The calendar month and year the test was completed to determine such percentages.The additional statement "total germination and hard seeds" may be stated after the foregoing, if desired.

Source: Pennsylvania 2004 Seed Act

4.6-6 Case Study: Pennsylvania State Department of Agriculture

The conflict between public rights to save seeds and corporate (or individual) rights to enforce seed patents has been instigated by particular state departments of agriculture. The Pennsylvania State Department of Agriculture (PA DOA) recently incited a public dispute regarding the redistribution of seeds that were allegedly labeled incorrectly. In 2014, the Cumberland County Library System launched a seed library together with the Cumberland County Commission for Women and the PA Agricultural Extension Services. The seed library opened on Earth Day with the not unusual goal of providing a space in the community where the public could swap heirloom seeds to celebrate cultural seed traditions in the region (Germanos, 2014). Yet four months later, with only sixty active participants, the PA DOA contacted the seed library to relay that they were in violation of the 2004 Seed Act. The PA DOA questioned the quality of the seed in circulation at the library, since they had neither undergone tests nor proper labeling in accordance with the Seed Act (Warburton, 2014). Barbara Cross, Mechanicsburg's County Commissioner, painted the seed library as a dangerous threat to the greater agricultural system (Warburton, 2014). "Agri-terrorism is a very, very real scenario," said she, fearing that the seed library's slack volunteer oversight could make them an easy target for deliberately introduced diseases, which could cause food insecurity and economic instability for the country at large (Warburton, 2014). With that testament, the Joseph T. Simpson Public Library was left with little choice but to shut down.

Patrons were fully aware that the seed library was not a licensed seed distributor in compliance with the Seed Act's test and labeling standards. In fact, what attracted them was the free and easy access to regionally adapted seed varieties, and a communal space in which to

forge personal connections with fellow seed savers in their community (Conner, 150). Fortunately, the PA DOA allowed the library to host “seed swap” events that final year, on the condition that the seeds exchanged could only be store bought (Creason, 2014). As such, since store bought seeds are protected from being saved by patent laws, the seed library was forever barred from accepting donated seeds saved by local patrons and small organizations.

It makes sense to require enterprising seed companies, which sell millions of seeds to the public, to conduct health safety tests on their seeds. However, seed saving advocates argue that seed libraries are not seed enterprises, and therefore should not be subject to enterprise-grade regulations (SELC, 2016). One seed library administrator from the same mid-Atlantic region made the following interpretation to the seed library shut-down:

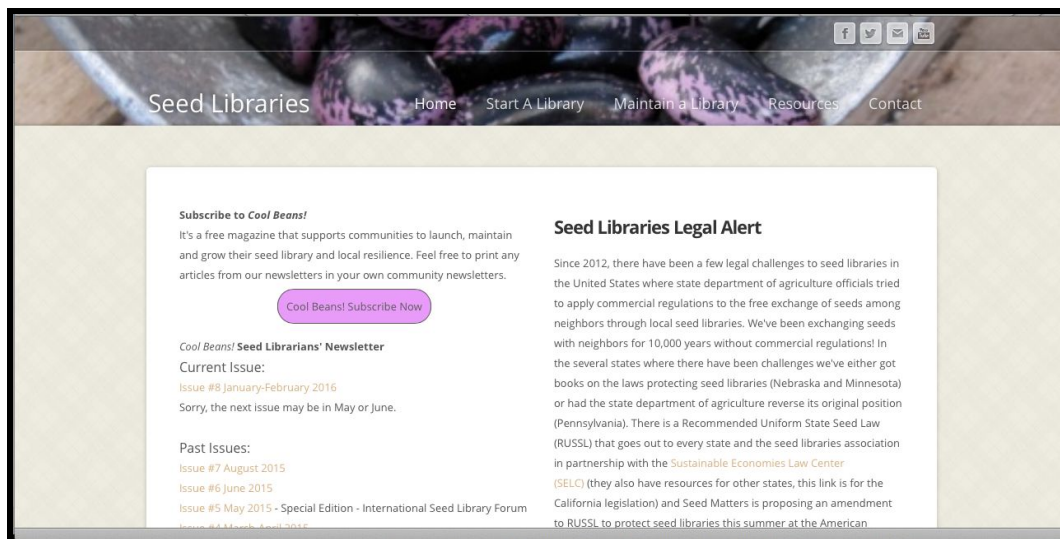
“I think the concern in Pennsylvania was if you come to our seed library and I give you seeds that say ‘sunsweet watermelon,’ and it’s not, I’m participating in some sort of business fraud, [that] I’m not guaranteeing the efficacy of our seeds. And my response to that is, we’re giving it away. We’re telling you if it’s a local donation. So to use the old latin phrase, let the buyer beware. We’re not selling you something that’s causing you to, you know, lose money if it’s not pure. We’re giving seed away in earnest hope that it is pure and to serve a greater purpose (personal correspondence, 2016).”

Whether the underlying concern was business fraud, agro-terrorism or unfair competition for corporate seed interests, these licensing and labeling standards are an expense barrier to the small-scale farmers, gardeners, and patrons who utilize seed libraries.

In 2012, Seed Matters circulated an online petition addressed to the 50 Directors of the U.S. Departments of Agriculture, asking them to issue a statement that would explicitly exclude seed libraries from restrictive seed laws. By April 2016, the petition had garnered 25,671 signatures of support, some of which were the seed library administrators we had interviewed (*Save Seed Sharing Petition*, 2016). Seed library activists are trying to find loopholes in seed

legislation that would allow seed libraries and other non-commercial exchanges to be legal (Kinkaid, 2015). Assisted by the Sustainable Economies Law Center, Seed Matters has already drafted the necessary language to “re-legalize” public seed saving and exchange across state seed acts (SELC 2016; Figure 7). A number of local organizations, including the Institute for Sustainable Future and Gardening Matters, have published letters of support for the suggested changes (Phillips Community, 2016). In addition, SELC has been helping activists educate people across the country by creating a documentary film called “SEEDS OF TIME,” which follows agriculture pioneer Cary Fowler on his race to protect and preserve seed diversity around the world (seedsoftimemovie, 2015). The level of public attention signalled in the case of this Pennsylvanian seed library means the following: the public’s rights to save seeds operates outside of any fear-mongering issue-attention cycle, because community support networks have demonstrated that they are willing to defend these rights by educating the masses and asserting political pressure to create change.

Figure 7: Seed Libraries Website Alerts Readers to Potential Changes in U.S. Seed Laws



5. Recommendations for Enhancing Food System Resilience

5.1 Public and Private Partnerships

Utilizing public support systems is an essential tool for starting up and maintaining seed libraries. Through our research we found public libraries are important partners of seed libraries because they host seed libraries. Public libraries, like seed libraries are a space where the community has free access to resources available for circulation. Libraries are known to preserve and maintain artifacts in good condition, which is just what heirloom seeds need. Therefore public libraries are a great hosting location for seed libraries because of their accessibility and their ubiquity in communities regardless of socio-economic background.

Another public entity that is willing to help communities start their local seed libraries is the Cooperative Extension Services. They are located in every state throughout the U.S., and offer non-formal education and learning activities, through programs such as the Extension Master Gardener Programs, to farmers and community members. Master Gardeners is a nationwide, volunteer-based program that provides individuals with horticulture training and plays a key role in the development and implementation of seed libraries (Conner 52). Even though their volunteers are not horticulture experts they tend to be involved with seed saving and are more likely to have a better understanding of horticulture than the average person (Conner 52). Having partnerships with programs like these can help seed libraries understand seed saving concerns and needs on both the local and global scale. It is important that public libraries are not just starting seed libraries but are also enlightening the community about the importance of protecting and preserving heirloom, organic, and open-pollinated seed varieties. Resources are there, use them

5.2 Educational Awareness

Campuses are microcosms of society; mandatory student service learning primes students for active civic engagement later in life, but also is the pinnacle of community development. Robust civil societies are the platform for democracy. The relationship between seed library and the college could improve.

“There’s a very positive vibe between Emory and Henry and our seed library, but...they’ve got their mission and focus and their community garden...and then we’ve got the seed library. And they get some of our seeds and we buy produce from them, and we sort of interact that way but, arguably, not as much as we should.”

Q: What would be the ideal relationship there?

A: I think more students, maybe, would familiarize themselves with what we do and be able to take it from an academic environment to actually putting seeds in the ground. To go from more of a- I would love to- I think Emory and Henry has the ideological mainspring...they have the foundation there on many fronts; we’re more of a: put the seeds in the ground. Go out and meet the little old ladies out in the country and see what kind of beans they have, and that kind of stuff. And it would be kinda need to see a kind of merger of those two. Last fall, we were conducting interviews, where we went out and interviewed seed savers, and taped them, literally collected oral histories, transcribed them; those were I think the class was “Environmental Sociology.” There’s an example of where we did merge the two.

How could entities that respect each other this way cross the awkward divide and work directly with one another? We recommend an app that connects demand with supply for organizing more coherent events and sharing of information and seeds. Login and has map of the U.S., input all the heirloom seed varieties by regional adaptivity, maybe their traits like germination rate, etc. Online marketplace that’s carried out in person (“Oh you have X? I want that! I’ll trade you for Y. Okay, see you at the exchange event.”).

We also recommend increasing educational programs in seed libraries to inform both the seed savers and community members about the importance of seed saving. Education is one of the major components in determining the success of seed exchange networks. In 2011 Seed Trust, a seed business based in Cornville, Arizona, whose mission is to build a vast networks of regional seed systems, partnered with Native Seeds/SEARCH and since then have been providing libraries and individuals with "Seed School." Seed School is a 1-day program that offers individuals educational programming on how to start seed initiatives like local seed libraries (Conner 67). The Rocky Mountain Seed Alliance, is a non-profit organization that aims to strengthen food and seed security in the U.S through education (Conner 68). They offer training to individuals on how to become community-based seed stewards who are able to grow, save, and share a diverse pool of seeds (Conner 68). Stewards play a crucial role in the development and continuity of seed libraries. All public libraries who have seed libraries should offer patrons books, magazines, websites, presentations, demonstrations, discussions, and workshops for community members as a way to provide them with the necessary skills to be a successful seed saver (Conner 83). Although heirloom seeds contribute genetic resiliency to the food system, the seeds themselves are delicate because they can be easily contaminated by cross-pollination, therefore it is important to have an educated person handling these varieties. Without the proper knowledge and skills, seed librarians will have a difficult time educating community members as well as carrying out and maintaining the seed libraries. All public libraries who have seed libraries should offer patrons books, magazines, websites, presentations, demonstrations, discussions, and workshops for community members as a way to provide them with the necessary skills to be a successful seed saver (Conner 83).

6. Conclusion

In a newfound popular demand within the past 15 years, the practice of saving an abundant variety of seeds has seen an exponential growth in the U.S.. The formalizing of seed exchange networks is a recent development. Although farmers have been exchanging seeds since the dawn of agriculture, the advent of modern seed exchange libraries has provided an array of benefits for farmers, ecosystems, and the surrounding communities. Today the number of seed libraries continues to grow throughout the U.S., all motivated by their own missions to conserve seeds and right the degrading quality of Earth's ecosystems. Seed libraries are just a budding offshoot of the alternative food movement, majority of the seed libraries we sampled in our research have only been around for 1-3 years. At this rate of seed library creation just within the past 15 years, the regional impact that these public entities will have going forward has massive potential.

The purpose of this research is to examine the extent to which seed saving and exchange networks contribute to enhancing biodiversity and the resiliency of crop systems. Using seed libraries as tokens of public seed saving and exchange networks, we surveyed the administrators of seed libraries around the country to assess the impact of their operations and activities on their regional food systems. We assessed the extent to which seed libraries contribute to regional food system resilience in the U.S..

Seed libraries are one component of seed saving and exchange networks, involving all entities that save and proliferate seeds: for-profit seed companies, not-for-profit seed companies, seed saving farmers and seed libraries. The purpose of exchange networks and seed saving is to conserve what little seed biodiversity we have left. Seed libraries, an example of seed exchange

networks, are often housed in public libraries and keep seeds that have been cultivated in the region for years in the hands of the public. Seed libraries provide an alternative to genetically modified seeds, they increase biodiversity and plant resilience, as well as reconnect local people with their food systems. Yet, being a public movement, having a robust volunteer base, financial stability and time to spare is a constant objective to maintain these important public seed networks.

Despite concerns about the quality of seeds exchanged in such networks, each organization fulfills an important mission role for maintaining crop diversity leading to multiple collaborations in the alternative food movement of the U.S.. Seed exchange networks are involved in educating the public and advocating for changing the food system. In addition, they also keep seeds in informal networks outside of conventional and genetically engineered commercial markets and provide access to a variety of seeds at public level.

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8. Appendix

How to start and maintain your own seed library:

- <http://seedlibraries.weebly.com/start-a-library.html>
- <http://seedlibraries.weebly.com/maintain-a-library.html>

Find a seed library near you!

- <http://seedlibraries.weebly.com/sister-libraries.html>

Information about State Seed Laws:

- <http://www.amseed.org/issues/state-federal/resources/>
- <https://hackpad.com/About-the-Seed-Law-Tool-Shed-tyGDxRK8uO3>
- http://www.theseic.org/seed_law_resources