A FEASIBILITY STUDY OF HYDROPONIC SHIPPING CONTAINER FARMS IN BUSINESSES AND SCHOOLS: IDENTIFYING THE INFLUENTIAL FACTORS, BENEFITS, AND CHALLENGES

by

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DEDICATION

This thesis is dedicated to my family. My parents, Manuel E. Juarez and Mary Sue Galindo, my brother and sister, Juanita Andrea Juarez and Manuel E. Juarez Jr., and my grandparents Jose Roberto Juarez, Maria Antonia Juarez, Lydia Galindo, and Pedro Galindo. I could not have completed this journey without your unconditional love and support. You all have been my biggest inspiration and motivation. This one is for us.

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ABSTRACT

Agriculture is one of the largest and most profitable industries in the United States. It generated $992 billion in 2015 (Glaser, 2016). However, studies have identified that the agriculture sector has become increasingly more difficult for farmers to enter (Reid, 2013). Additionally, concern over the long-term sustainability of modern agriculture has arisen due to climate change, as well as economic, ecological, and social concerns (Gold, 2001). As a result, sustainable agriculture has become more popular as an alternative to traditional agriculture (Kirschenmann, 2004) and created a niche market for produce grown sustainably.

Shipping container farms are one of the most recent agricultural innovations entering the market. This innovative method of production is promoted as efficient, profitable, and sustainable food production that can be utilized almost anywhere year-round (Freight Farms, 2017). However, there is limited data available on this new method of production, and the majority of that data come from hydroponic shipping container farm (HSCF) vendors. In this study the researcher sought to provide objective data on HSCF performance in businesses and schools by conducting a mixed method study.

The following research objectives were used to fulfill the purpose of this study: (1) discover the influential factors for selecting a hydroponic system inside of a insulated shipping container for businesses and schools, (2) identify the benefits and challenges of HSCF in business and schools, and (3) describe the experiences of businesses and schools utilizing varying HSCF designs concerning their expectations, use and overall satisfaction.

Results for the research indicated that all schools are satisfied by utilizing a HSCF on campus. Specifically, they experience the benefits of traditional school gardens while overcoming typical barriers that result in short term use of the soil-based garden on campus. Business owners of HSCF however, are not totally satisfied by utilizing a HSCF and their experiences varied based on the HSCF manufacturer they selected. Most importantly, the research identified why schools and business are selecting this innovative method of production, the benefits and challenges when utilizing a container farm, and described user experience to provide a real-world picture of HSCF performance in schools and businesses.

I. INTRODUCTION

This mixed method study examines the influential factors, benefits, challenges, and user experience of producers and educators utilizing hydroponic shipping container farms (HSCF), a new method of agricultural production. The study examines how schools have implemented shipping container farms as a part of food production and as an educational resource, and how HSCF businesses are performing in relation to producers' expectations and overall production and profitability. The study draws upon scholarship in multiple fields: production and resource use of conventional agriculture, hydroponic greenhouse production, and shipping container farm production, the history of school gardens, and the benefits and challenges of utilization of school gardens.

Problem Statement

Agriculture is one of the largest and most profitable industries in the United States. It generated $992 billion in 2015 (Glaser, 2016). Fruit and vegetable sales in 2015 alone were valued at over $1.3 billion (USDA, 2017). However, the agriculture sector has become increasingly more difficult for farmers to enter. Studies have identified the largest barriers encountered by beginning farmers as 1) capital acquisition, 2) finding land, and 3) understanding farm business (Reid, 2013).

Additionally, concern over the long-term sustainability of modern agriculture has arisen due to climate change, as well as economic, ecological, and social concerns (Gold, 2001). As a result, sustainable agriculture has become more popular as an alternative to traditional agriculture (Kirschenmann, 2004) and created a demand for produce grown sustainably, resulting in a niche market. Shipping container farms are one of the most recent agricultural innovations entering the market. Shipping container farms are recycled insulated shipping containers whose interior has been repurposed with a hydroponic or aquaponic growing system.

Hydroponics, a soilless growing system often done indoors, uses ‘nutrient rich water’ in place of soil to grow plants (Wasserman, 2012) and uses 90% less water than traditional agriculture (Freight Farms, 2017). Plant roots sit in this nutrient rich solution opposed to soil as their growing medium.

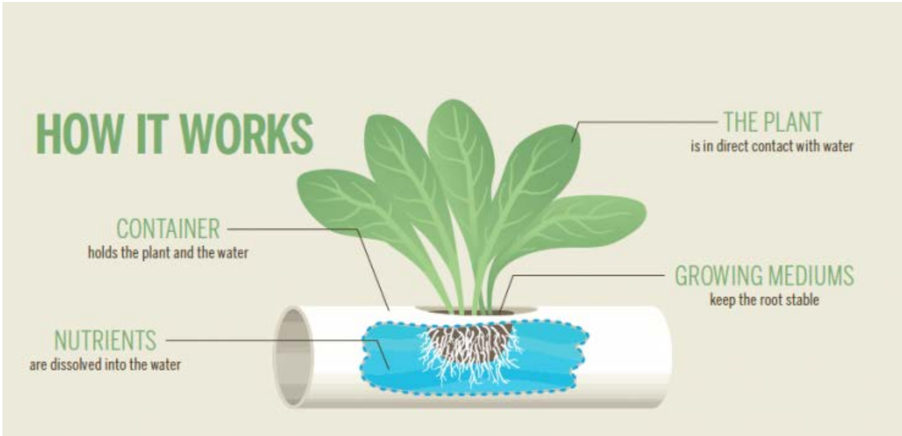

Figure 1. *Hydroponics Infograph* (Gentry, 2015).

Aquaponics is also a soilless growing system often done indoors. The growing concept similarly utilizes nutrient rich water, but nutrients consumed by plants are obtained from fish waste. Fish and plants are raised in a symbiotic relationship as the water is recycled through the system reducing water usage as compared to traditional agriculture. This results in a significant reduction in water as conventional agriculture uses 70% of the globe’s freshwater supply (National Geographic, 2017).

By utilizing these more sustainable methods of production, a controlled environment, and technology, shipping container farms seem to be making efficient, local, sustainable production possible, and profitable (Freight Farms, 2017). The containers have caught the attention of the media and investors such as Kimbal Musk.

Shipping container farms are being produced by multiple companies from around the world, such as, Growtainer, Crop Box, Urban Farm Unit, Freight Farms, Alesca Life, Modular Farms, and GrowTech. Shipping container farms are a growing industry that are attracting farmers for multiple reasons. They promote higher yields in shorter amounts of time, provide local production almost anywhere, and promote sustainable production year-round (Freight Farms, 2017). However, there is little objective data available on resource use, production, and ease of use of shipping these container farms.

Shipping container farms have also been incorporated into the educational system. From the university, to high school, to the middle school level, shipping container farms are being used as an ‘updated’ school garden to feed and educate students. By investigating the feasibility of shipping container farms, in businesses and in schools, we can identify the motivations behind choosing this new method of agricultural production, as well as its benefits and challenges. Moreover, by examining the motivations of schools and producers who utilize shipping container farms, we can examine food sociologically from the producers’ and educators’ perspective, as opposed to the consumers’ perspective, which has traditionally been the focus of most sociological research (Beardsworth, Keil 1996). Additionally, we can examine how shipping container farms are responding and performing in reaction to the recent changes in consumers’ demand.

Purpose of the Study

The purpose of this study is to identify the influential factors, benefits, challenges, and user experience of producers and educators utilizing hydroponic shipping container farms.

Research Objectives

1. Discover the influential factors for selecting a hydroponic system inside an insulated shipping container for both businesses and schools.
2. Identify the benefits and challenges of hydroponic shipping container farms in businesses and schools.
3. Describe the user experience of businesses and schools utilizing varying hydroponic shipping container designs concerning their expectations, use, and overall satisfaction.

Significance

Hydroponic shipping container farms have the potential to provide a safe, locally produced food option that uses less resources, such as land and water, and has a smaller negative impact on the environment than traditional agriculture. (Freight Farms, 2017; Growtainer, 2017). Shipping container farms could be used to produce food in areas food production is not possible, and be a more accessible method of production for producers. HSCF could be productive in areas where there is growing conditions are not ideal such as, areas affected by drought, poor weather conditions, and food deserts. Moreover, HSCF could be used to teach students science, technology, engineering, and math (STEM), food ecology, and nutrition in a more hands on approach (Wesserman, 2012). By surveying and interviewing businesses and schools who are utilizing this new method of agricultural production, we can contribute new perspectives in the sociological study of the production of food and provide objective data on shipping container farms for future users.

Keywords

For the purpose of the study, the following terms are defined:

Sustainable Agriculture: The production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare (GRACE Communications Foundation, 2010).

Conventional Agriculture: Farming systems which include the use of synthetic chemical fertilizer, pesticides, herbicides, genetically modified organisms, heavy irrigation, intensive tillage, or concentrated monoculture production (Appropedia, 2016).

Hydroponic Shipping Container Farm (HSCF): Recycled insulated shipping container that has been repurposed to house an agricultural growing system (Freight Farms, 2017; Growtainer 2017).

Hydroponics: Method of growing plants without soil, using nutrient rich water solution as a medium to feed the plants.

Aquaponics: A soilless growing method, utilizes natural fertilizer supplied by the fish, which are being raised along with the plants, to provide nutrient for growth.

Vertical Farming: Involves growing crops in controlled indoor environments, with precise light, nutrients, and temperatures. In vertical farming, growing plants are stacked in layers that may reach several stories tall (Birkby, 2016).

Nutrient Film Technique (NFT): Hydroponic growing technique where plants are placed in a trough, pvc pipe, tube, or similar equipment. Roots sit inside tubing where a shallow stream (film) of nutrient solution constantly flows over the bare roots within the pipes providing nutrient rich water for growth (Kaiser, 2012).

Theoretical Framework

The sociological developmental approach will be utilized as the guiding theory for this study. The developmental approach primarily focuses on social change, while examining the origins and the process of the occurring change (Beardsworth, Keil 1996). By utilizing the developmental approach, we can examine the interconnectedness of the various components of the food systems, producers, or businesses, and schools, instead of focusing on consumers, as most research is inclined. The developmental approach allows us to examine multiple facets of HSCF. Using the developmental approach, the researcher can identify reasons for a rise in the popularity of shipping container farms, how businesses and schools are utilizing these containers, and reasons for choosing shipping container farms for agricultural production. Lastly, by utilizing the sociological developmental approach, the researcher can assess how HSCFs are currently functioning and developing in the business and school settings.

Research Limitations

As HSCFs are still in their infancy, having only been available on the market for less than 10 years, the population size was limited. Additionally, schools and businesses were primarily found online via articles and social media so any possible participants without an online presence were excluded. Furthermore, only schools and businesses that responded to the primary inquiry were contacted again which further reduced the population size. Participants who responded to the initial inquiry experienced a certain degree of success. Several businesses who were contacted were no longer in operation.

Regardless, the responding population came from various locations and backgrounds, and had an array of goals. Most importantly, all participants had firsthand experience implementing, operating, and maintaining a HSCF.

II. LITERATURE REVIEW

The focus of this study is to identify the influential factors, benefits, challenges, and the overall satisfaction of businesses and schools utilizing shipping container farms, a new method of agricultural production. A detailed understanding of traditional agriculture and issues faced is included to show why new methods of agricultural production are being explored. In addition, shipping container farms are defined, and a brief history is included to provide insight into how this concept has developed and impacted the market. This background information provides insight about how the concept was created and the growth of the market. Local and sustainable markets that shipping container grown products can enter are also explored. Perceived motivations and challenges faced by producers are also discussed since this is a critical aspect explored throughout this study. School garden history, and the benefits and challenges of implementing school gardens, are also described in the exploration of shipping container farms in schools.

Traditional Agriculture and Issues Faced

Agriculture is an industry that affects us all; however, there is uncertainty about what modern agriculture and sustainable agriculture are. As defined by the USDA, conventional agriculture operations, “vary from farm to farm and from country to country. However, they share many characteristics: rapid technological innovation; large capital investments in order to apply production and management technology; large-scale farms; single crops/row crops grown continuously over many seasons; uniform high-yield hybrid crops; extensive use of pesticides, fertilizers, and external energy inputs; high labor efficiency; and dependency on agribusiness” (Gold, 2001).

Modern agriculture has evolved and become more efficient over time through the adaptation of technology. According to the World Bank (2017), the utilization of technology by conventional agriculture, rather than greater acreage under cultivation, has accounted for an estimated 70-90 % of the worldwide food production increase that has been seen over the past 50 years (Gold, 2001). However, decline in soil productivity, and an increase in water pollution, and water scarcity, are associated with conventional agriculture. Due to these areas of concern and climate change, the sustainable agriculture concept has been attracting many in the agriculturalist community who question the longevity of our agricultural system (Gold, 2001).

While the alternative agriculture movement has been around since the start of the application of chemical fertilizers in the 18th century, the resurgence today, involves a growing awareness of how our food is produced, where it is produced, and who is producing it, which has not been experienced since the Victory Gardens of WWII (Ridenour, 2014).

As identified by Ridenour (2014), the growing concerns can be seen through the rise of 'locavores', people who strive to eat food that has been grown locally, by the increased number of farmer's markets, and in the growing success and popularization of "Buy Local" labels. This surge in the concerns over where our food is produced, who is producing it, and more importantly how it is being produced, can be explained by examining the sociological value that food holds.

As Beardsworth and Keil (1996) noted, people eat with the mind as much as with the mouth and connect their personal identify to their food. Through food choices we often demonstrate our personal beliefs and ethics. When individuals center their food selections predominantly on their ethics (for example, political reasoning, ecological concerns, social matters, and animal welfare/right issues), opposed to basing them on taste or health benefits, sociologist consider these individuals to have a moral menu (Beardsworth, Keil, 1996). As a result, the growing apprehensions over the current food system have led to a demand in organic, sustainable, and ‘green’ alternatives which is illustrated through the expanding number of farmer’s markets and sales to meet the needs of consumers’ moral menus (Ridenour, 2014).

Shipping Container Farms

Shipping container farms, like those produced by companies such as Growtainer, Crop Box, Urban Farm Unit, GrowTech, and Freight Farms, are recycled insulated shipping containers, whose interior has been repurposed with a hydroponic or aquaponic growing system. They claim to solve many of the problems that agriculturalists face by drastically reducing inputs and increasing profitability.

Hydroponics, a soilless growing system often done indoors, uses nutrient rich water in place of soil to grow plants (Wasserman, 2012) and uses 90% less water than conventional agriculture (Freight Farm, 2017). Multiple crops such as kale, basil, endive, and many other leafy green crops can be grown in hydroponic systems. According to Freight Farms (2017), 1000+ heads of lettuce can be produced weekly in the Leafy Green Machine (LGM). The LGM is Freight Farm’s shipping container farm that includes a vertical hydroponic system. This more effective and efficient use of water and nutrients, combined with controlled and easily maintained growing systems, makes shipping container farms an attractive alternative. Additionally, shipping container farms provide producers with the ability to grow many crops regardless of season, and almost anywhere, regardless of location.

Aquaponics, also a soilless growing method similar to hydroponics, incorporates fish that are raised symbiotically with plants. Fish provide nutrients for the plants through the excrement, and the plants filter the water for the fish habitat (Maucieri, 2018). Aquaponic systems are also utilized in shipping container farm designs such as those produced by Urban Farm Unit. Aquaponic systems recycle water between the fish and the plants, and drastically reduce the amount of water needed to grow produce (Maucieri, 2018). Aquaponic farming drastically reduces the amount of water needed to grow crops as it reduces the rate of application, evaporation, and runoff when compared to soil based agriculture. The need for synthetic inputs, such as fertilizer, herbicides, and pesticides, is reduced by aquaponics because the method of production is naturally self-fertilizing and reduces the occurrence of weeds.

According to shipping container farm vendors such as Freight Farms (2017) shipping container farming requires less resources such as land, water, labor, herbicide, pesticide, making farming more accessible. Additionally, shipping container farms can be productive year-round, and in areas where food production is not typical. For example, production can be in areas where arable land and water are scarce, as well as areas with extreme weather, creating new markets, and providing local and sustainable produce.

Shipping container farms all have key features and make similar claims. They employ hydroponic or aquaponic growing systems, use controlled agriculture environment technology such as LED lighting, temperature regulators, humidity controls, and software to monitor growing conditions and maximize production (Michael, 2017).

Furthermore, shipping container farm producers, such as PodPonics, Freight Farms, Growtainer, CropBox, Urban Farm Unit and GrowTech, promote higher yields in a shorter amount of time than conventional agriculture; year-round production of a variety of crops; water conservation; reduction of environmental impact,; and reduced labor requirements for their users (Freight Farm, 2017; Growtainer, 2017).

Shipping Container Farm History

Shipping container farming is an agricultural production method still in its infancy. It entered the global market in 2010 through vendors such as Freight Farm (Boston, Massachusetts), Urban Farm Unit (Paris, France), and PodPonics (Atlanta, Georgia). Since 2010, more producers of shipping container farms have emerged. Due to market growth, there are now shipping container farms and producers around the world, continually improving their designs.

While the shipping container farming concept hit the market in 2010, it was developed years prior. In 2008, Ben Greene, the designer behind CropBox, repurposed an insulated shipping container for agricultural production as a part of his master's thesis at North Carolina State University. Greene used his creativity and previous experience as an artist and a designer to minimize farmers' risks while "making small farming feasible by making a system that could be rented instead of bought" (Williamson Greenhouses, 2015). This unique renting option and design was implemented as a way to eliminate barriers faced by beginning farmers, such as capital acquisition, land, and farming knowledge. While origins of CropBox date to 2008, it was not until 2014 that the company launched promoting their affordable prices, scalability, precision growing, and controlled environment agriculture. Over the years, technology has been more incorporated in the shipping container farm's design. CropBox now offers an app which monitors a farm from a smartphone. They have also included upgrades such as new LED lighting, windows, and instillation of personal logos, which producers may opt to add onto their units later.

Freight Farms was one of the first three companies that emerged on the market in 2010. Inspiration for Freight Farms resulted from founders Jon Friedman and Brad McNamara's frustration while attending a rooftop greenhouse training. McNamara stated, "We realized there was a much larger opportunity to empower more people in different spaces than just unused roof space and hoped that this concept would cut down the number of miles it took to get greens from farm to table, and so you can grow local food anywhere" (NPR, 2015). Freight Farms was one of the first companies to emerge in the market and is still in production today. They offer support, training, network opportunities, and an app to assist producers with running their system. Freight Farms has attracted investors such as Kimbal Musk, and continues to improve their design, now advertising future incorporation of solar panels.

Damien Chivialle, a French industrial designer, designed Urban Farm Unit in 2010 as a part of the master's program at Ecole Nationale Superieure de Ceramique Indstrielle (ENSCI) École Nationale Supérieure de Céramique Industrielle (ENSCI), a graduate level industrial design school located in Paris (Chivialle, 2010). Urban Farm Unit combines a recycled shipping container with an aquaponic system and a greenhouse that sits on top of the shipping container. According to Chivialle (2010), the design was created in hopes of reducing the number of miles that food must travel to the consumer, by growing fresh produce in the street, and providing for downtown cities. Farmers collaborate with Urban Farm Unit and units are custom built for their needs. Prospective farmers utilizing Urban Farm Units can become a part of their online farming community. This community connects farmers, provides support and, creates a forum for all initiatives and experiments (Chivialle, 2010).

In Atlanta, PodPonics emerged inherent in 2010. PodPonics utilized its unique design coupled with energy efficient technology to fulfill the growing demand for local and sustainable food. By 2012, it was named one of the most innovative technology companies in Georgia by the Technology Association of Georgia but filed for bankruptcy in 2016 (Karkaria, 2016). PodPonics began by growing and selling produce to local restaurants using a shipping container farm they designed. They then provided ready to eat salad mixes for grocery chains throughout the Southeast. Eventually, PodPonics became a farm vendor – selling their shipping container design, watering systems, lighting systems, and software used for production (Karkaria, 2016). PodPonics raised money from investors and went to Dubai in 2014 to start a ‘proof of concept farm’, but the company eventually went under before mass production. After filing for bankruptcy PodPonics reorganized under Agrinamic in 2016, and now focuses on developing technology for precision agriculture (Karkaria, 2016).

In 2012 Growtainer was founded and joined Freight Farms, Urban Farm Unit, and PodPonics in the market. Growtainer, who has offices in New York and Dallas, offers shipping containers for agricultural, horticultural and floricultural production. They offer customizable designs based on crop choice, work with Texas A&M University for research, and emphasize affordable prices (Growtainer, 2017).

By 2015, Alesca Life emerged out of Beijing, China. Alesca Life was co-founded by CEO Young Ha, who quit his job at Dell to start designing smart urban farm containers (Yoo, 2015). Through software integration, Alesca Life seeks to help address China's food security issues by providing fresh produce in urban areas and fulfill the growing demand for more health-conscious food as China's middle class grows. Alesca Life developed an app enabling direct consumer sales. Consumers can view container farms nearby, order online, and go directly to the grower to pick up their produce. Alesca Life strives to break the notion that farming is just for farmers and has announced development of container farm models for individual production at home.

Today more companies are joining the shipping container farm industry, such as GrowTech in Buffalo, New York which entered the market in 2016. Modular Farms, out in Ontario, Canada was founded in 2015 and announced release of their model in 2017 (Modular Farms, 2016). Modular Farms' design was intended to position Modular Farms as a leader in the indoor agriculture trend and function in the north of Canada to address food security problems in the region. Growframe, developed in 2016 in London, designed a collapsible hydroponics system for production inside of shipping containers without any modification to the container itself (Narcross, 2016).

Growframe was designed by Phillipe Hohlfeld, an imperial design engineering student, who sought to utilize the empty space within shipping containers traveling back to Asia from North American. Hohlfeld viewed the journey back of empty shipping containers on cargo ships as an opportunity to grow produce. Utilizing his collapsible model, spinach, bean sprouts, and a variety of lettuces are grown during the voyage from North America to Asia, and are ready for consumption upon arrival. Growframe's intention is to be as compact as possible, and use mushrooms to control CO_2 levels to eliminate need for technology while providing China with access to fresh food.

As more container farm manufacturers and vendors continue to enter the market, the more affordable shipping container farms will become. In order to thrive in this market, container farm vendors are looking to appeal to a niche producer and make their design unique, more appealing, and more productive. Shipping container farms have evolved, and companies have offered unique features to differentiate themselves. Features include custom apps to help monitor and operate the growing process from remote locations, ‘upgrades’ available for the container, support, training, and networking opportunities (Growtainer, 2017; Freight Farms, 2017).

Shipping Container Farm Markets

Shipping container farm vendors are advertising their method of production to individuals who are looking to produce locally and sustainably. This is apparent through their promotion of water conservation techniques, hyper local production capability, and appeal to the urban farm movement (Growtainer, 2017; Freight Farms, 2017). Shipping container farm vendors market their products and the produce grown within their units to the local and sustainable ‘niche markets’ and the producers who are trying to fulfill the growing demand from concerned consumers. The growing demand for alternative agriculture has been noted in the recent decades by the presence of alternative food networks. Bruce (2016) stated that these alternative food networks have been created to reconnect growers and consumers and are a result of food based social movements that have been seen during the past four decades. Shipping container farm vendors, such as Freight Farms, promote the use of their shipping container farm to individuals as an easier way to enter the agriculture industry, but more importantly, a way to become a part of the alternative food network that has recently risen in popularity.

Sustainable agriculture has become a more popular and common practice as environmental limitations, industry need, and consumer preferences are shifting towards ‘green’ and organic markets. The result is a niche market that is beginning to be filled. The organic market has continued to grow since 1990 at a rate of approximately 20% per year (Economics and Social Dimensions of the Sustainability of Farming Practices and Approaches, 2010). The hydroponic industry has also experienced growth the past five years in the United States at an annual rate of 3.6% (Pilloni, 2014) and revenue is projected to grow globally over the next five years. Demand for organic and green markets has risen as farmers are producing for those concerned with the environmental impacts of conventional agriculture, and are not well served by supermarket chains.

Sustainable and local agriculture meet the needs of customers who are looking for an alternative to industrialization, and “niche marketing gives farmers an opportunity to get off the industrial treadmill of the past to sustain profits over time” (Ikerd, 2017). The industrial agriculture treadmill was not designed to sustain profits. It heavily relies on technology to make operations more efficient and reduce cost per unit; only those who adapt this technology early on (and can afford to) create profit opportunities. As Ikerd points out “…as more farmers adopted the new technologies, total production increased, prices dropped, and profits were erased”. Shipping container farms, who also heavily rely on technology, could be susceptible to the same cycle. However, because of the unique design and method of production, shipping container farms primarily focus on marketing themselves to these growing local and sustainable niche markets.

While niche marketing provides a great alternative for local producers to compete in, they are also susceptible to dramatic changes in supply and demand, as well as consumer income (Economics and Social Dimensions of the Sustainability of Farming Practices and Approaches, 2010). Industrialization ignores the needs and wants of consumers and offers an impersonal system. Niche marketing offers the consumer alternatives to this impersonal system and options. The key to success in niche markets is offering a unique, high value product while "getting the right product to the right person at the right time" (Ikerd, 2017).

To be successful, niche producers must offer high-quality and unique products to consumers that cannot be purchased at the super market, while focusing on value and avoiding competition with mass marketers (Ikerd, 2017). The success of this value-trait marketing lies in the difference in quality, i.e. fresh, local, sustainable produce (Ikerd, 2017). While fresh fruits and vegetables have been the most successful market, there is still potential for growth in new niche markets as concern for food and health safety has grown (Ikerd, 2017).

Growing niche markets appears to be the key to making sustainable agriculture economically feasible. Shipping container farms and their producers aim to provide local, high value produce to consumers, year-round, and in a more sustainable and efficient manner. Niche markets have made it possible for ecologically responsible farming and socially sound farming to be economically viable (Ikerd, 2017). However, niche markets are often hard to enter and are continually changing.

Motivations for Producers to Purchase Shipping Container Farms

There are many reasons why a farmer may choose a shipping container farm opposed to traditional farming or greenhouse production methods. Shipping container farms promote a sustainable model that can bring fresh, local produce to consumers with higher yields in less time, and endorse almost immediate production, less labor requirements, offer support, training, and sophisticated technology.

When compared to traditional agricultural production, shipping container farms, through a controlled environment and hydroponic system, report numbers of higher yields and shorter growing periods (Storey, 2017). Modular Farms endorses immediate production noting "We've designed a scalable, modular, portable and self-contained indoor farming system that literally gets delivered on a truck and plugged in to start growing, with yields twice as high as any other farming system we've seen to date." To a producer, the promise of higher productivity in a shorter amount of time is appealing and can affect the choice to use a shipping container farm as opposed to building a greenhouse or obtaining and/or preparing land for traditional agricultural production.

Shipping container farms also advertise their ability to produce year around (Storey, 2017). Due to the controlled environment aspect of shipping container farms, farmers are able to produce a variety of crops regardless of season. Therefore, farmers can offer more specialized high value crops to consumers year-round (Fright Farms, 2017, Growtainer, 2017). By being productive year-round, farmers are able to increase the number of harvests and have a more consistent monthly income (Michael, 2017).

In addition, the controlled environment aspect of shipping container farms allows producers to provide to the local community regardless of location or climate. Shipping container farms have enabled production of local food in areas that never before had that option, such as areas of extreme weather, non-arable land, or dense urban development (Freight Farms, 2017, Urban Farm Unit, 2010).

Furthermore, shipping container farms appeal to farmers who are looking to produce sustainably. Through the employment of their hydroponic or aquaponic growing system, the amount of water is reduced by 90%, application of fertilizers, pesticides, and herbicides is also reduced up to 80%, and the overall environmental impact is lessened (Growtainer, 2017). Aside from environmental benefits, producers who utilize sustainable growing methods correspondingly fulfill the growing demand for sustainable food. Shipping container farms also promote a drastic reduction in labor requirements. Alesca Life states that due to their incorporation of technology, producers can run the system with only two individuals (Bischoff, 2014) and Freight Farms (2017) estimates 20-25 hours needed to run their system per week.

Through atomization, technology, support, and training, shipping container farms seek to make farming more user friendly, and appeal to individuals who have no previous experience with agriculture. They appear to minimize typical barriers faced by beginning farmers and make entry more accessible. This is enabling production by individuals, and in locations, that never had the ability to do so before. While there appear to be numerous benefits to utilizing a container farm, possible motivations for producers to select this method of production has yet to be researched.

These possible influential factors for producer to select a container farm are speculative and can widely vary. Though sociological insight has been used to examine and explain the motivations of consumers' and their desire for alternative food systems, producers are rarely surveyed, and their motivations are largely unknown (Beardsworth, Keil 1996). By reaching out to producers utilizing shipping container farms we can examine their motivations and gain new sociological understanding as to why producers are choosing this innovative method of sustainable agricultural production and choosing to become a part of the alternative food systems. While motivations for producers to utilize this production vary, there are many appealing aspects to these container farms. However, container farms do not come without drawbacks.

Challenges faced by Producers Utilizing Shipping Container Farms

Shipping container farms sound like a great alternative to traditional farming for producers; however, they are not as simple and instant as companies can make them seem. Producers utilizing shipping container farms must overcome many obstacles before becoming productive. Bright Agrotech, who designs and produces vertical farming equipment, noted that over the last five years many new shipping container farms have started only to be shut down shortly afterward (Michael, 2017). They equate this to unrealistic expectations perpetuated by shipping container farm vendors regarding smart farm technology, yields, and labor requirements. Bright Agrotech argues that “misguided metrics are hurting the indoor ag industry and the farmer” (Storey, 2017).

Farmers go in with expectations of instant production, high yields, and profitability, but encounter the following challenges with high electrical demands and user knowledge. Shipping container farms highlight their reduced use of inputs and ability to provide fresh produce sustainably; however, as with most indoor agriculture operations, they use a substantial amount of electricity. While controlled environment agriculture systems, such as greenhouses and shipping container farms, produce ‘yields up to 10 to 20 times higher than the same crop grown outdoors', they are energy intensive and expensive (Royte, 2015). Energy requirement costs, depending on location, can even negate profits for the producers (Royte, 2015).

Shipping container farms, through their use of hydroponics, controlled environment, and precision agriculture technology, require user knowledge of these sophisticated and often complex systems. As co-founder of Alesca Life Oda noted "Soil is incredibly forgiving. With our technology, the margin of error is incredibly small." (Yoo, 2015). A producer must either select an automatized container farm that can make adjustments as needed or be knowledgeable on how to create the optimal environment and maintain it. Regardless of choice, a learning curve must be expected when utilizing a shipping container farm before it can become productive.

Shipping Container Farms as an Educational Tool

While shipping container farms focus on appealing to producers to purchase their product, there is also outreach towards schools to use containers to feed and educate students. Growtainer advertises their system as a mobile classroom that can teach students of "controlled environment technology-based production, sustainability, and provide fresh healthy veggies" (Growtainer, 2017). Freight Farms publicizes schools that have incorporated their model as a means of food production and for educational purposes. How these 'updated school gardens' have been incorporated and their effectiveness have not yet been studied. There have been numerous studies, however, of the positive effects of gardens in schools and the barriers that prevent them from being implemented.

School Garden History

As a part of ‘education according to nature” movement (Klein, 2012), gardens have been recognized as vital educational tools by educational philosophers such as John Amos Comenuis (1592-1670) and Maria Montessori (1870-1952). In the 19th century school gardens were introduced in Europe and the United States (Childs, 2011). In 1891, the first school garden was implemented in the United States in Massachusetts (Klein, 2012). By the year 1918, school gardens had become a national movement and could be found in every state (Murakami, 2015). This trend only continued during both world wars as schools implemented victory gardens as a way to do their part during the war effort (Childs, 2011). School gardens steadily rose in popularity but eventually died out after the war around 1944 (Klein, 2012). It was not until the 1960’s and 1970’s that the push to incorporate gardens returned to schools as a part of the environmental movement of the time and the “war on poverty” (Murakami, 2015). In the 1980’s, however, the conservatism of the time weakened the platform for gardens in the school system and there was a decrease. By the 1990’s, educational trends, such as experiential learning, strengthened the resurgence of the school gardening movement. Organizations such as The American Horticultural Society even held a symposium to encourage the use of gardens in schools (Murakami, 2015). By 1997, 3.6 million youth in the United States had been involved with school gardens (Klein, 2012). Today the school garden movement is still strong. There are various organizations such as the Edible Schoolyard, California School Garden Network, and the Boston Schoolyard, just to name a few, that organize and help surrounding schools implement gardens (Klein, 2012).

School gardens have been proven to be a powerful learning tool and greatly benefit students academically, emotionally, and socially (Childs, 2011, Klein, 2012, Murakami, 2015). However, due to challenges such as lack of time, funding, support, and resources, many schools are unsuccessful in properly implementing, utilizing, and maintaining their school gardens (Poole, 2016). Due to the reduced use of resources, along with the controlled environment that enables year-round production, shipping container farms seek to alleviate many of the challenges that schools face when implementing, utilizing, and maintaining school gardens. To date, there is little data regarding shipping container farms in schools.

School Garden Benefits

The long-term success and resilience of gardens in schools is no coincidence. It is because of the numerous benefits, such as improved STEM grades, attitudes, and social skills that school gardens have been deemed a powerful learning tool (Poole 2016, Kelin, 2012, Childs, 2011). Murakami (2015) investigated schools with gardens and those without. She noted that schools that had a garden had increased test scores and improved academic achievement. Klein's (2012) research identified different ways that students benefit from school gardens. Her research found that students were more motivated to learn and improved academically overall as abstract learning was transformed into real life experiences. Students also had an increase in attention span and a higher retention rate. "Garden based learning (GBL) provides motivation for learning; improves attitude towards learning, improves ability to problem solve; increases attention span; and builds confidence in learning" (Klein, 2012).

School gardens allow for new curriculum and subject matter to be taught to students in a more approachable manner. GBL, formerly known as “education by nature”, incorporates the use of school gardens in the classroom. Klein’s research, found that GBL leads to improved attitude and behavior of the students overall, as well as improved attitudes towards the environment and school. Klein found that through GBL there was an increase in students’ nutrition awareness, sensory awareness, imagination, compassion, patience, self-discipline, retention rate, motivation, academic achievement, teamwork skills, positive behavior, attention span, pride of accomplishments, and sense of place.

School gardens also endorse experiential learning or learning by doing. Experiential learning has been proven to be more effective for students than traditional methods as noted by Murakumi (2015). Through their work with the garden, students were also found to learn life skills such as teamwork and self-understanding. School gardens impart life skills, academic, emotional, and social benefits in students that cannot be replicated. (Murakumi, 2015; Child, 2012; Klein, 2012).

Just as student learning was able to expand effortlessly through the use of school gardens, so is this the case for content curriculum. Through her research, Childs (2012) identified the many benefits noted by teachers who used school gardens in their classroom. The utilization of their school garden as a teaching tool led to increased scores in science and allowed for new subjects to be taught. Nutrition education became a part of the curriculum through school gardens, and was used as a tool to combat obesity and teach agriculture education. Klein (2012) found that by using the school garden, students learned about food system ecology and developed higher environmental values as they now had experience with these concepts. School gardens efficiently allow for multiple subjects to be introduced; biology, nutrition, environmental education, food ecology, agriculture, etc., are related to the garden. Furthermore, school gardens can also be applied to subjects that most would not think, e.g. English, history, business, and art as noted by Carver and Wesserman, who implemented hydroponic gardens in the classroom (2012).

Barriers to School Gardens

Though the benefits of having a school garden have been researched, there are barriers that prevent schools from implementing, utilizing, and maintaining them. Several studies have been conducted to identify these barriers. The most important elements that lead to successful utilization of a school garden were identified as funding, motivated teachers, and administrative support (Klein, 2012; Muarkami, 2015).

Klein (2012) identified "one of the main issues with GBL (being implemented in schools) is the lack of funding". Funds must be allocated for materials to start the garden as well as to maintain it. Murakami (2015) noted that lack of interest and support was a factor in school gardens not being implemented.

In Murakami's research, when asked why they, schools without a garden, did not utilize one, the most common responses were 1) lack of funding; 2) little to no knowledge about gardening; and 3) lack of garden supplies and time constraints. The last area - the barriers that schools encounter with gardens - which Murakami examined through her research was perhaps one of the most telling. Specifically, teachers felt there was a lack of time, experience, and training in the garden to properly utilize it as a learning tool.

After a school has successfully implemented a school garden, proper utilization is challenging. Lancey (2012) found that even when a school had a garden already implemented, there were teachers who were often hesitant to make use of it as they had no interest, experience, or time. Teachers who were hesitant to utilize the garden as a learning tool often had no prior experience, knowledge, or garden training. They cited lack of training and experience, as well as the lack curricular materials that meet academic standards, and the lack of time (Poole, 2016).

Maintenance of school gardens is labor intensive and requires dedicated time--that most teachers feel they do not have. Lancey (2012) found that once a school has implemented a school garden, it is lack of organization that often leads to it going unused. Organization of goals, time management, and scheduling proved to be the most challenging barriers faced by teachers who had access to their school's garden. Poole (2016), who sought to identify the challenges that come with school gardens, noted that teachers often found that the school day schedule, logistics, coordinating with other teachers, and designing curriculum for the garden to be problematic. Though lack of organization and experience can cause teachers to hesitate and shy away from using the school garden, it was lack of time that was the number one response as to why teachers do not/cannot use school gardens as a part of their curriculum.

Shipping container farms look to address many of these issues. Utilization of shipping container farms could mean long term use and success of a school garden that can feed and educate students year-round. By identifying how schools have already implemented shipping container farms, we are able to rate their degree of success in schools and how they are being utilized.

Comparing Production Methods: Conventional Agriculture vs Shipping Container Farms vs Greenhouse Production

When examining production methods, comparisons were drawn from one model of shipping container farm production, 1) the Leafy Green Machine (LGM) produced by Freight Farms, to one acre of traditional agricultural production and 2) hydroponic greenhouse lettuce production. To compare traditional agriculture to the Leafy Green Machine (LGM), a shipping container farm equipped with a vertical hydroponic growing system, and hydroponic greenhouse production, we examine resources utilized by each production method. To make comparisons between these systems, lettuce production in each system is the focus. Data was collected on energy and water use, labor hours, land use, and production. Data on conventional agricultural practices was collected from the University of California - Davis and Washington State University (Freight Farms, 2017). LGM data came from Freight Farms. Data on greenhouse production was collected from the University of Kentucky. According to Freight Farms, one LGM produced marketable yielded the equivalent of 2 acres. However, to make this comparison we focused on 1 LGM, 1 acre of land, and 1 greenhouse. For the greenhouse comparison of lettuce production, a 3000 sq. ft. quonset greenhouse utilizing a hydroponic nutrient film technique (NFT) design was used.

It is paramount to note that when these numbers were compared, the main aspect to be considered is that the LGM, due to the controlled environment, had the ability to produce year-round, and, as a result, was harvested up to 12 times a year compared to conventional agriculture's average of one harvest per year. Greenhouse production averaged eight harvests per year (Kaiser, 2012).

Space required. When comparing conventional farming to the LGM, the following dimensions were compared: 1 acre for traditional production, 40' x 8' x 9.6' for the LGM, and 3,000 square feet for the greenhouse.

Production annual yields. When comparing lettuce production, traditional agriculture had 30 rows with 1,056 heads of lettuce per row. The field was harvested once, totaling 31,680 heads of lettuce. The LGM with 256 towers and 17 mini heads per tower, produced 4,352 heads of lettuce per harvest. However, the focus is the marketable percentage yields. Marketable yields was based on high-quality produce offered for sale, i.e. no disease present, minimal pest damage, and marketable size. LGM farms reported 93% of their crop yield is typically marketable (Freight Farms, 2017).

Because the LGM was harvested 12 times in a year, 52,224 heads of lettuce were produced annually. On average, traditional agriculture marketed of 75% of the crop (Freight Farms, 2017). Examining marketable yields annually, conventional agriculture produced 23,760 mini heads of lettuce and the LGM produced 48,568 mini heads of lettuce. Greenhouse production, with 8 harvests per year, estimated 5,900 marketable heads per growing season. 5,900 heads of lettuce multiplied by the 8 harvests per year produced an average of 47,200 heads of marketable lettuce (Kaiser, 2012).

Electricity. The LGM run on electricity and used an average of 100kWh per day. Annually LGM used 30,000kWh. When comparing hydroponic greenhouse production and conventional agriculture, hydroponic greenhouse production required 82 ± 11more energy per kilogram produced than the conventional production of lettuce (Barbosa at el., 2015). Hydroponic greenhouse production included the following energy demands: "supplemental artificial lighting, water pumps, and heating and cooling loads" (Barbosa at el., 2015). Total hydroponic greenhouse energy equaled 90,000 ±11,000 kJ/kg/y. Conventional agriculture's total energy use equaled 1100 ± 75 kJ/kg/y, and came from fuel usage and groundwater irrigation (Barbosa at el., 2015).

Water. Conventional farming required 48 acre-inch of water to grow an acre of lettuce, which equated to 27,154 gallons of water. Therefore, 1,303,392 gallons of water were used to produce one-acre worth of lettuce. The LGM, which employs hydroponics and a vertical growing method, used about only 5-10 gallons of water per day. The 5-gallon figure was reached by utilization of a dehumidifier system which pulled the excess moisture out of the air and filtered it back into the reservoir system. Annually, the LGM used about 3,650 gallons of water (Freight Farms 2016). Hydroponic greenhouse lettuce production 'had an estimated water demand of 20 ± 3.8 L/kg/y' (Barbosa at el., 2015).

Labor. Total number of hours of labor for conventional agriculture, both labor that required machinery and labor that did not require machinery, was 37.67 hours per acre. (UC Davis, 2017). LGM reduced the amount of time needed to run a farm through design, incorporation of technology, and automation. The LGM system required minimal user labor requirements of 20-25 labor hours per week for seeding, transplanting, and harvesting, resulting in annual labor requirements of 1,300 hours. Labor requirements for the greenhouse production were approximately 140 hours for production and 1,500 hours for harvesting/packing/marketing (Kaiser, 2014), totaling 1,640 hours of labor annually.

Data collected from Freight Farms resulted from their own research of LGM. Usage from beginning producers has not been collected. There is a need for objective research to quantify resource use, yields, and labor requirements of users and producers of shipping container farms and bring forth new, unbiased data.

III. METHODOLOGY

The purpose of this research was to learn more about the factors that influence both schools' and businesses' utilization of hydroponic shipping container farms (HSCF) as an educational resource and method of agricultural production. Also discover the benefits and challenges of utilizing a HSCF while describing user experience. Hence, the focus of this research revolved around several key questions: "1) Why are producers and educators selecting this method of production opposed to others? 2) How are these farms being utilized by schools and businesses? 3) How are these farms performing? 4) Are user expectations being met and are users satisfied?"

My hypothesis was that these factors would vary on a case by case basis, being affected by the overall goals of the organization they are affiliated with, be it educational or business oriented. This would ultimately affect what is being produced in the container, why it is being produced, who it is being produced for, and how the produce will be utilized.

To achieve the objectives of this research, an exploratory study design was proposed. The study utilizes qualitative and quantitative data to survey the primary factors in producers' and educators' decision to use hydroponic shipping container farms. An unbiased representation of user experience, from implementation to successful use of hydroponic shipping container farms in schools and businesses, was the goal of this research. Furthermore, the research would provide an improved understanding of the use of HSCF in business and schools and insight for future users of HSCF. The research objectives addressed included:

1. Discover the influential factors for selecting a hydroponic system inside an insulated shipping container for both businesses and schools.
2. Identify the benefits and challenges of hydroponic shipping container farms in businesses and schools.
3. Describe the experiences of businesses and schools utilizing varying hydroponic shipping container designs concerning their expectations, use, and overall satisfaction.

Population and Sample

Users of hydroponic shipping container farms in both businesses and schools was the targeted population in this mixed method study. Due to hydroponic shipping container farms being a novel method of production, the population was limited. Participants were found online via research and through social media sites such as Facebook and Twitter. Participants were found to be operating a hydroponic shipping container farm as a part of their organization, be it business or educational, and were assumed to have the furthermost familiarity with hydroponic shipping container farms. Twelve businesses participated in this survey as well as six schools. Participants were asked online via the survey if they would be willing to participate in a phone interview.

School population. Schools (6) included a private secondary school (1), a public secondary school (2), a state university (3), a private university (4), and land grant universities (5-6). Each school operated one hydroponic shipping container on their campus. School student enrollment ranged from 340 students to 29,500. Grade levels of schools ranged from pre-kindergarten to university. The *School Snapshot A* Figure 2 includes a snapshot of the demographics of each school and their hydroponic shipping container farm.

School	Student Population	Grade Level	Type of School
A	340	PK-8	Private Secondary School
B	1100	9-12	Public Secondary School
C	20,000	4-year University	State University
D	3,300	4-year University	Private University
E	29,500	4-year University	Land Grant University
F	27,000	4-year University	Land Grant University

Figure 2. School Snapshot A

Business population. Business participants utilized a variety of hydroponic shipping container farm models. Additionally, participants ranged in age and background. Age of business owners ranged from 33 years of age to 71. Participants came from a variety of background experiences. Five participants came from an agricultural background (e.g. farming, gardening, hydroponics, etc.). Seven participants had no previous agricultural experience and came from backgrounds such as engineering and business. Figure 3 includes key demographic information about each business owner and their business operation.

Business	**Title/Position**	**Age**	**Background**	**Years of Operation**
A	CEO	35	Industrial Design	5+ years
B	President	71	Entrepreneur	2 years
C	VP Operations	36	Bachelor's Degree in Biology	Within 1 year
D	Owner Sole Member	33	Agriculture, farming, gardening	2 years
E	Owner Founder	38	No previous agricultural experience	2 years
F	Owner Operator	50	No previous agricultural experience (Pastor)	Within 1 year
G	Owner	63	Agriculture, farming, greenhouse, gardening	Within 1 year
H	Owner	44	No previous agricultural experience	2 years
I	Owner Operator	58	Gardening	2 years
J	Founder Farmer	60	Hydroponics, Manufacturing	Within 1 year
K	Owner	42	No previous agricultural experience	2 years
L	Owner	34	Agriculture, farming, greenhouse, aquaponics, gardening	Within 1 year

Figure 3. Business Snapshot A

All participants have firsthand experience operating and/or implementing hydroponic shipping container farms within a school setting or as a business and were considered knowledgeable users.

Instrumentation

Two online surveys were administered, one for businesses and one for schools after the researcher attained institutional review boards (IRB) approval from the university. Surveys were submitted to The Graduate College for review along with a description of the research to be conducted and the overall purpose. Upon approval, possible participants were contacted via email and asked if they would be willing to partake in an online survey. Participants were sent consent letters detailing the purpose of the research and a link to the online survey in the initial email. Via Qualtrics, two distinct online surveys were created, one for schools and one for businesses. Participants that agreed were then sent a link via email to the survey appropriate for them. Businesses and schools were treated as two separate groups. Only participants who consented to the research clicked on the link and completed the survey. Each online survey was generated and distributed via Qualtrics (Qualtrics.com) and took approximately 15 minutes to complete. Participants were sent an anonymous link via email that could be accessed at any time. Soft deadlines were given to participants to encourage the completion of the survey. Participants who failed to meet those deadlines were contacted again via email and the link resent with a new deadline. Participants were generally asked to complete the survey in about two weeks.

Participants that agreed to a phone interview as a part of the online survey were contacted, and follow up phone interviews were conducted. Phone interviews were conducted with the purpose of creating a deeper understanding of their online responses and overall hydroponic shipping container farm use. Interviews were conducted by phone, recorded using the Voice Recorder app, and transcribed. Responses were then examined, and common themes found in school interviews and business interviews. Interviews served to acquire valuable qualitative data about hydroponics shipping container farms in schools and businesses and a means to reinforce the validity of the survey instrumentation. Expectations were that participants' responses would be similar to their initial survey responses online. Nevertheless, interviews provided further understanding that could not have been gathered from survey data alone.

Surveys created for schools and businesses, though different, were similar. Surveys were adapted from a combination from 4 different sources: a school garden survey; an educators' perspectives associated with school gardens programs survey (Tamauri, 2015); the factors that influence teachers' use of school gardens survey (Poole, 2016); and a usefulness, satisfaction, and ease of use survey found online. The combinations of surveys were used to encompass the various aspects of hydroponic shipping container farms including influential factors, benefits, challenges, expectations, and overall satisfaction. Participants were asked to indicate the level of influence each factor had when selecting a hydroponic shipping container farm. Influential factors included price of container, design, and growing capability. Additionally, participants were asked to indicate the level of agreement they shared with the statements about their HSCF (e.g. use of a hydroponic shipping container farm: has enabled sustainable production, given me the ability to produce locally, and is user friendly). Furthermore, participants were asked to rate their level of agreement that the HSCF met their expectations in the following areas: efficiency, production, ease of use, and profitability. In addition, the level of difficulty encountered with various factors, such as startup costs, lack of user knowledge, and finding your market, was discussed. Moreover, each participant was invited to answer open ended questions and include any other influencing factors, benefits, and challenges encountered when utilizing his/her hydroponic shipping container farm. Discussion included any unexpected issues, and the most negative and positive aspects of utilizing a hydroponic shipping container farm.

Phone interviews. The primary motivation for conducting phone interviews with participants was to attain valuable qualitative data to reveal a profound understanding of how hydroponic shipping container farms were performing, the influencing factors into an educator's or producer's decision to use a hydroponic shipping container farm, their goals, and overall satisfaction/experience. Interviews were formatted in a semi-constructed manner wherein the researcher asked each participant the same questions but could ask follow up questions to gain further insight to responses participants gave to the initial questions. Phone interviews were conducted at the convenience of participants. In the initial online survey participants were asked if they conceded to a phone interview and what time worked best for them to conduct the interview (e.g. Mondays at 2pm). Participants who agreed to a phone interview were asked a list of designed open-ended questions as well as follow up questions at the discretion of the researcher. The purpose was to gain insight into the three research objectives in a more meaningful manner than can be captured from the surveys alone. Interviews ranged in time from 15 minutes to one hour depending on the number of people who were participating (ex: a single participant, or multiple participants such as an administrator and a teacher, or business partners). The phone interviews enabled a deeper understanding and provided insight into data gathered via the online survey that ordinarily could not be gathered from surveys where respondents can only rate pre-determined answers.

Interview questions.

1. Background
2. How did you become familiar with HSCF and why did you choose to use one?
3. Why did you choose that particular model?
4. What were your goals/motivations?
5. Have those goals/expectations been met? Why or why not?
6. Who runs the HSCF?
7. How do you feel about HSCF?
8. Do you plan to continue to use your HSCF? Why or why not?
9. What do you think the future look like for HSCF? For producers/ in schools?
10. What have you done to be successful?
11. What does it take to be profitable? (Businesses only).

Data Collection

On January 22, 2018, the researcher sent the initial survey to all possible participants, 58 customers of HSCF (46 business and 12 schools) found online. After there was no response, the researcher proceeded to call possible school and business population participants on February 23. Not all businesses on the initial list of participants were still in business, and phone numbers found online were no longer in service. Additionally, faculty that were working with the HSCF on campus had moved and a new individual put in charge of operation. The researcher called each school to find the main operator of the HSCF and their contact information for the email to be sent to directly. Furthermore, each business was contacted via phone to see if there were still in operation. On February 27, emails were sent to the refined list of all possible participants. Online data collection ended on April 20 with a total of twelve business and six schools able and willing to participate. Phone interviews were then conducted with willing participants. Phone interview data collection ended on June 19, 2018. Phone interviews were then transcribed and analyzed in search of reoccurring themes.

Data Analysis Overview

The researcher used SPSS 24.0 for Windows software to analyze the data. Descriptive statistics were used to familiarize the reader with the demographics of the school population and business population. Frequencies, percentages, means, and standard deviation were calculated to fully describe the data that was collected by the researcher for influential factors, benefits, challenges, expectations, and overall satisfaction.

After inputting all the information into the SPSS software, the demographics of each organization of HSCF was put into different snapshot tables including school type, school population, and grade level for schools, plus the years of operation, background, and age for the business population. The frequencies and percentages were calculated for gender, race/ethnicity, and overall satisfaction. Means, standard deviations, and frequencies were calculated for influential factors, benefits and challenges experienced, and expectations. Results for each area of examination were gathered and reported for the business sample and school sample.

IV. FINDINGS AND DISCUSSION

Results are organized based on the study's primary objectives to: 1) Discover the influential factors for selecting hydroponic shipping container farms as perceived by both business and schools, 2) Identify the benefits and challenges of hydroponic shipping container farms in schools and businesses, and 3) Describe the experiences of producers and schools utilizing various hydroponic shipping container farm designs regarding their expectations, use, and overall satisfaction. The online survey was analyzed through examination of the frequencies and descriptive statistics of questions asked pertaining to demographics, influential factors, benefits, challenges, expectations, and overall satisfaction. Results were reported using means and standard deviations of each individual factor surveyed. A phone interview was conducted and responses were recorded. Common themes were then noted and organized in correspondence with the study's primary objectives. Phone interview responses and responses to open ended questions on the online survey can be found in the *Discussion of Interview Results* section for each objective.

A description of the demographics of the participants was deemed essential to fully describe the responding population. School participants and business participants were treated as two separate groups. Responses and results gathered from each population were also were reported as two distinct groups.

An overview of each school was deemed essential to convey the student population, grade level of students interacting with the HSCF, and the type of school. This data can be found in the School Snapshot A Figure 4 below.

School	Student Population	Grade Level	Type of School	Satisfaction
A	340	PK-8	Private Secondary School	S
B	1100	9-12	Public Secondary School	VS
C	20,000	4-year University	State University	S
D	3,300	4-year University	Private University	VS
E	29,500	4-year University	Land Grant University	S
F	27,000	4-year University	Land Grant University	VS
Satisfaction: VS = “Very Satisfied” S = “Satisfied” N = “Neutral” DS = “Dissatisfied” VDS = “Very Dissatisfied”				

Figure 4. School Snapshot A: Results

School types were varied and included private secondary schools, public secondary schools, state universities, private universities, and land grant universities. Furthermore, student populations of participating schools ranged from 340 students to 29,500 students from grade levels pre-kindergarten to collegiate.

Table 1 shows the gender of the participants who were involved with hydroponic shipping container farms in school. Gender reported by participants involved with hydroponic shipping container farms in schools were as follows: school participant respondents were one-half male (*n* = 3; 50%) and one-half female (*n* = 3; 50%), as shown in Table 1 below.

Table 1

Gender of Faculty Utilizing Hydroponic Shipping Container Farm(s) on Campus

Gender			
Male		**Female**	
n	**(%)**	**n**	**(%)**
3	50.0	3	50.0

The school population of participants involved with hydroponic shipping container farms in schools consisted of Caucasians and African Americans. Table 2 illustrates the ethnicity of the school participant population. Over half of the participants where White (*n* = 4; 66.7%) and the remainder was an African American participant (*n* = 1; 16.7%). One participant chose not to share their ethnicity.

Table 2

Ethnicity of Faculty Utilizing Hydroponic Shipping Container Farm(s) in Schools

Race/Ethnicity									
White/Caucasian		**Hispanic/Latino**		**African-American**		**Native American/Alaskan**		**Other**	
n	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**
4	66.7	0	0	1	16.7	0	0	0	0

An overview of each business was deemed essential to convey the position of the individual surveyed, their age, background experience, and the total years their HSCF has been in operation. This data can be found in the Business Snapshot A Figure 5 below.

Business	Title/Position	Age	Background	Years of Operation	Satisfaction
A	CEO	35	Industrial Design	5+ years	VS
B	President	71	Entrepreneur	2 years	S
C	VP Operations	36	Bachelor's Degree in Biology	Within 1 year	S
D	Owner Sole Member	33	Agriculture, farming, gardening	2 years	N
E	Owner Founder	38	No previous agricultural experience	2 years	S

Figure 5. Continued

Business	Title/Position	Age	Background	Years of Operation	Satisfaction
F	Owner Operator	50	No previous agricultural experience (Pastor)	Within 1 year	S
G	Owner	63	Agriculture, farming, greenhouse, gardening	Within 1 year	DS
H	Owner	44	No previous agricultural experience	2 years	S
I	Owner Operator	58	Gardening	2 years	S
J	Founder Farmer	60	Hydroponics, Manufacturing	Within 1 year	S
K	Owner	42	No previous agricultural experience	2 years	DS
L	Owner	34	Agriculture, farming, greenhouse, aquaponics, gardening	Within 1 year	S
Satisfaction: VS = "Very Satisfied" S = "Satisfied" N = "Neutral" DS = "Dissatisfied" VDS = "Very Dissatisfied"					

Figure 5. Business Snapshot A: Results

Table 3 represents the gender of business owners operating hydroponic shipping container farm(s). The gender of responding business owners consisted of primarily male (*n* = 10; 83.3%) participants with a few female participants (*n* = 2; 16.7%). This data suggests that hydroponic shipping container farms are a male dominated field of agricultural production.

Table 3

Gender of Business Owners of Hydroponic Shipping Container Farms

Gender			
Male		**Female**	
n	**(%)**	**n**	**(%)**
10	83.3	2	16.7

Table 4 showcases the ethnicity of hydroponic shipping container business owners. The ethnicity of the business population was made up of predominately White (*n* = 11; 91.7%) participants and one African American (*n* = 1; 8.3%) participant.

Table 4

Ethnicity of Business Owners of Hydroponic Shipping Container Farms

Race/Ethnicity									
White/Caucasian		**Hispanic/Latino**		**African-American**		**Native American/Alaskan**		**Other**	
n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
11	91.7	0	0	1	8.3	0	0	0	0

Findings Related to Objective 1: Influential Factors

The first objective of the research was to discover the influential factors for selecting a HSCF for both businesses and schools. Table 5 displays the influential factors when purchasing a hydroponic shipping container farm for school campuses. The least influential factors included: *cut costs* (*M* = 1.40*; SD* = .55), *extracurricular activity* (*M* = 1.80*; SD* = .84), *academic instruction* (*M* =2.60*; SD* = 1.82), and *subject matter reinforcement* (*M* = 2.60*; SD* = 1.52). The most influential factors included *sustainable food production* (*M* = 4.83*; SD* = .41), *local food production* (*M* = 4.83*; SD* = .41) and *demonstrate commitment to sustainability* (*M* = 4.67*; SD* = .82).

Table 5

Influential Factors When Selecting a Hydroponic Shipping Container Farm(s) for School Campuses.

Scale	**Rating**											
	Not Influential		**Slightly Influential**		**Somewhat Influential**		**Moderately Influential**		**Very Influential**			
	1		**2**		**3**		**4**		**5**			
Factors:	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Local Food Production	0	0.0	0	0.0	0	0.0	1	16.7	5	83.3	**4.83**	**.41**
Sustainable Food Production	0	0.0	0	0.0	0	0.0	1	16.7	5	83.3	**4.83**	**.41**
Demonstrate Commitment to Sustainability	0	0.0	0	0.0	1	16.7	0	0.0	5	83.3	**4.67**	**.82**
Sustainable Education	0	0.0	0	0.0	2	33.3	0	0.0	4	66.7	**4.33**	**1.03**
Efficient Food Production	1	16.7	0	0.0	0	0.0	0	0.0	5	83.3	**4.33**	**.41**
Nutrition Education	0	0.0	1	16.7	1	16.7	0	0.0	3	50.0	**4.00**	**1.41**
Promote nutrition, health, and wellness	1	16.7	0	0.0	1	16.7	1	16.7	3	50.0	**3.83**	**1.60**
Advocate for innovative technology and creativity	1	16.7	1	16.7	0	0.0	1	16.7	3	50.0	**3.67**	**1.75**
Experiential Learning	2	33.3	0	0.0	0	0.0	0	0.0	0	0.0	**1.40**	**.55**
Academic Lab	2	33.3	0	0.0	0	0.0	1	16.7	3	50.0	**3.50**	**1.98**
Encouragement from Administrators	2	33.3	0	0.0	1	16.7	1	16.7	3	50.0	**3.50**	**1.98**
Space Efficiency	2	33.3	0	0.0	1	16.7	0	0.0	3	50.0	**3.33**	**1.67**

Table 5. Continued

Scale	Rating											
	Not Influential		**Slightly Influential**		**Somewhat Influential**		**Moderately Influential**		**Very Influential**			
	1		**2**		**3**		**4**		**5**			
Factors:	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Academic Instruction	2	33.3	0	0.0	0	0.0	1	16.7	3	50.0	**3.50**	**1.98**
Subject Matter Reinforcement	2	33.3	0	0.0	1	16.7	0	0.0	2	33.3	**3.00**	**2.00**
Extracurricular Activity	2	33.3	2	33.3	1	16.7	1	16.7	1	16.7	**2.60**	**1.82**
Cut Costs	3	50.0	2	33.3	0	0.0	2	33.3	0	0.0	**2.60**	**1.52**

Table 6 characterizes the most influential and least influential factors when business owners were selecting a hydroponic shipping container farm to purchase. *Design* (*M* = 4.58*; SD* = .67) was the most influential factor closely followed by *growing capability* (*M* = 4.42*; SD* = 1.24). The *location of company* (*M* = 1.92*; SD* = 1.56) proved to be the least influential factor overall. However, two companies found the location of company to be very influential.

Table 6

Influential Factors When Selecting a Hydroponic Shipping Container Farm(s) for Business Owners

Scale	**Not Influential**		**Slightly Influential**		**Somewhat Influential**		**Moderately Influential**		**Very Influential**			
	1		**2**		**3**		**4**		**5**			
Factors:	**n**	***(%)***	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**M**	**SD**
Design.	0	0.0	0	0.0	1	8.3	3	25.0	8	66.7	**4.58**	**.67**
Growing Capability.	1	8.3	0	0.0	1	8.3	1	8.3	9	75.0	**4.42**	**1.24**
Price of Container.	0	0.0	1	8.3	4	33.3	1	8.3	6	50.0	**4.0**	**1.13**
Location of Company.	8	66.7	1	8.3	1	8.3	0	0.0	2	16.7	**1.92**	**1.56**

Discussion of interview results: influential factors. Additional influential factors for the implementation of a HSCF in schools were identified both through the open-ended questions on the survey and qualitative data collected via phone interviews. A key influential factor for one school proved to be the school district's push to incorporate science, technology, engineering, art, and math (STEAM) and utilize technology to solve problems and encourage students to think like engineers. Due to the district's push, the superintendent was prompted to lead and apply for a grant and make the school's goal of the purchase, and incorporate a hydroponic shipping container farm to meet the objectives of the sponsor. A public secondary campus stated that their incorporation of a HSCF on campus was in direct response to a student lead initiative for local and sustainable food practices for campus dining. The implementation of the HSCF was used to demonstrate to students that the campus was socially aware and accountable for the food and the culture on campus. Lastly, several schools chose to utilize a hydroponic shipping container farm on campus as a part of the Real Food Challenge, a student led initiative to have campuses commit to purchase and serve more ‘real food’.

Common themes identified through the open-ended questions on the survey and phone interviews by business owners of hydroponic shipping container farms included: working for myself, additional income, supplemental retirement income, and working with family. Business owners of HSCF’s reported that they opted to explore an alternative source of income that enabled them to be their own boss and have independence. Moreover, one business owner saw the utilization of a HSCF to take more direct control over their life as they witnessed seven rounds of layoffs at work. Other producers chose to utilize a HSCF because they desired to work with their family, which ultimately cut labor costs and allowed them to spend time with their family. Furthermore, producers used HSCFs as a means to supplement their income, a spouse’s income, or retirement income.

Other influential factors identified by producers included: enabling young farmers to enter the market and be successful by demonstrating that HSCFs are profitable and feasible using their own unit and not needing to purchase land because of the technology and design of HSCF. Other producers noted they chose to implement a HSCF to utilize a novel, turn-key, concept to be profitable and productive year-round while addressing several food issues such as the aging farmer population, reduction in resource use, and food security. Lastly, business owners noted that having a positive impact on their local communities was influential in their decision. Producers aimed to connect with their community and offer educational opportunities through their HSCF. Business owners of HSCFs aimed to provide their community with the option of a fresh, healthy, local, high quality produce, while demonstrating sustainable market acceptance, and creating food awareness in their community. Above all else, while influential factors varied from producer to producer, one of the more experienced producers stated, though there may be various influential factors and goals when using a HSCF, such as wanting to be sustainable and help your community, but in order to accomplish these goals and experience the benefits, this innovative method of production must be profitable, and that profitability was ultimately their influential factor.

Findings Related to Objective 2: Benefits and Challenges

The second objective of this research was to identify the benefits and challenges of hydroponic shipping container farms in schools and businesses. Table 7 reveals the level of agreement school participants had with statements regarding hydroponic shipping container farms on their campus. School participants most agreed that the hydroponic shipping container farm: *has allowed access to fresh produce* (*M* = 4.83; *SD* = .41), is *user friendly* (*M* = 4.50; *SD* = .55) and *has facilitated experiential learning* (*M* = 4.17; *SD* = 1.33). Schools most disagreed that the shipping container farm: *has reduced dining costs* (*M* = 2.50; *SD* = 1.23).

Table 7

Level of Agreement Regarding the Benefits Experienced by Utilizing Hydroponics Shipping Container Farm(s) on Campus

Scale	**Strongly Disagree 1**		**Disagree 2**		**Neutral 3**		**Agree 4**		**Strongly Agree 5**			
The shipping container farm(s):	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Has allowed access to fresh produce.	0	0.0	0	0.0	0	0.0	1	16.7	5	83.3	**4.83**	**.41**
Is user friendly.	0	0.0	0	0.0	0	0.0	3	50.0	3	50.0	**4.50**	**.55**
Has facilitated experiential learning.	0	0.0	1	16.7	1	16.7	0	0.0	4	66.7	**4.17**	**1.33**
Is a beneficial educational resource.	0	0.0	0	0.0	3	50.0	1	16.7	2	33.3	**3.83**	**.98**
Helps teachers be more effective.	0	0.0	0	0.0	3	50.0	2	33.3	1	16.7	**3.67**	**.82**
Is beneficial in teaching STEM education.	0	0.0	1	16.7	2	33.3	1	16.7	2	33.3	**3.67**	**1.21**
Works well. You would purchase another shipping container farm(s).	1	16.7	0	0.0	2	33.3	1	16.7	2	33.3	**3.50**	**1.52**
Has improved student attitudes towards STEM areas.	1	16.7	0	0.0	4	66.7	0	0.0	1	16.7	**3.00**	**1.27**

Table 7. Continued

Scale	Rating											
	Strongly Disagree		**Disagree**		**Neutral**		**Agree**		**Strongly Agree**			
The shipping container farm(s):	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Has improved student test scores.	1	16.7	0	0.0	5	83.3	0	0.0	0	0.0	**2.67**	**.82**
Has reduced dinning costs.	2	33.3	0	0.0	3	50.0	1	16.7	0	0.0	**2.50**	**1.23**

Table 8 indicates the level of agreement business owners had with the following statements regarding their hydroponic shipping container farms. Business owners agreed most that the HSCF: *has given me the ability to produce locally* (*M* = 4.50*; SD* = .67*),* *has enabled sustainable production* (*M* = 4.33*; SD* =.78), and *has given me the ability to produce in new areas* (*M* = 4.17*; SD* = .94). Business owners least agreed that the shipping container farm(s): *allows me to quickly recover from mistakes* (*M* = 3.25; *SD* =1.14), *is user friendly* (*M* = 3.42*; SD* = .90) and *does everything I would expect it to* (*M* = 3.50*; SD* = 1.17).

Table 8

Level of Agreement Regarding the Benefits Experienced by Operating a Hydroponic Shipping Container Farm(s) as a Business

	Rating											
Scale	**Strongly Disagree**		**Neutral**		**Agree**		**Strongly Agree**					
	1		**2**		**3**		**4**		**5**			
The shipping container farm:	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Has given me the ability to produce locally.	0	0.0	0	0.0	1	8.3	4	33.3	7	58.3	**4.50**	**.67**
Has enabled sustainable production.	0	0.0	0	0.0	2	16.7	4	33.3	6	50.0	**4.33**	**.78**
Has given me the ability to produce in new areas.	0	0.0	0	0.0	4	33.3	2	16.7	6	50.0	**4.17**	**.94**
Helps the farm operation be more productive.	0	0.0	0	0.0	3	25.0	5	41.7	4	33.3	**4.08**	**.79**
Works well. I would purchase another shipping container farm.	1	8.3	0	0.0	3	25.0	4	33.3	4	33.3	**3.83**	**1.19**
Is profitable.	0	0.0	1	8.3	4	33.3	3	25.0	4	33.3	**3.83**	**1.03**
Is efficient.	0	0.0	2	16.7	1	8.3	6	50.0	3	25.0	**3.83**	**1.03**
Meets my needs.	0	0.0	3	25.0	0	0.0	7	58.3	2	16.7	**3.67**	**1.07**

Table 8. Continued

Scale	Strongly Disagree 1		Disagree 2		Neutral 3		Agree 4		Strongly Agree 5			
The shipping container farm:	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Does everything I would expect it to.	1	8.3	2	16.7	0	0.0	8	66.7	1	8.3	**3.50**	**1.17**
Is user friendly.	0	0.0	2	16.7	4	33.3	5	41.7	1	8.3	**3.42**	**.90**
Allows me to quickly recover from mistakes.	1	8.3	2	16.7	3	25.0	5	41.7	1	8.3	**3.25**	**1.14**

Discussion of interview results: benefits. Schools identified additional benefits experienced by their campus due to the implementation of the HSCF. Benefits of the implementation of a HSCF experienced by schools ranged from additional courses and concepts being taught at their campus, to a new nontraditional source of funding, and notoriety. A public secondary school noted use of their HSCF on campus has enabled community building and new partnerships with the local food bank, which in turn resulted in a “buzz of enthusiasm in the school community”, and the school being placed on the map as innovators. Furthermore, multiple schools stated the HSCF has enabled them to provide an opportunity for students to run a business in real time and have a nontraditional funding stream. Moreover, a public school stated that the notoriety gained by their successful incorporation of a HSCF has made them the recipients of additional grants and fueled the district’s STEAM movement. Likewise, due to the efficient, local food production within a small space, schools have brought hyper-local, healthy, production and produce to their campus and, more importantly, their students. Schools described students as excited and eager participants. This is in part a result of how HSCFs are managed on campus. Most campus container farms are student run. Schools are providing students with opportunities to work and volunteer in the HSCF. Several schools even offer, paid and unpaid internships to students.

Public schools utilizing HSCF shared that students from all backgrounds and life skills, work in the container. A participant even used the HSCF as an incentive to connect and engage with kids with behavior issues. Lastly, schools are using their HSCF as a recruiting component, to directly respond to students' desire to be more conscious about where their food is coming from and employ technology to solve real world problems. Not only have schools identified their HSCF as a recruiting incentive, but as a platform that has allowed campuses to engage with students in a new way as it creates dialogue about sustainability and the future of food production.

Schools were given an opportunity to provide a list of additional courses/concepts taught in their schools using the HSCF on campus via an open-ended question on the online survey. Additional courses/concepts taught using the HSCF were considered beneficial and were included in the benefits portion of research objectives as courses and concepts taught through a traditional school garden were considered beneficial (Klein, 2012). The courses seen in Additional Courses/Concepts Taught in Schools Incorporating the HSCF on Campus Figure 6, were listed by schools as subjects that incorporated the HSCF on campus as an educational resource.

Additional Courses/Concepts Taught in Schools Incorporating The HSCF On Campus			
Concept	**Courses**		
Agriculture	Food Systems	Food Justice	Food Ecology
Environmental Sustainability	Conservation and Ecology	Environmental Risk Management	Sustainability Courses
Social	Social Purpose	Non-profit Business Operations	Community and Economic Development
Nutrition	Public Health	Nutrition	-
Miscellaneous	Horticulture	Hydroponics	Healthy Lifestyle
Miscellaneous: Free Evening Classes Offered to the School Community Members Grade 6 and Up			

Figure 6. Additional Courses/Concepts Taught in Schools Using the HSCF on Campus

Producers were also provided with the opportunity to include any additional benefits experienced while using their HSCF via open-ended questions in the online survey and during the phone interview. Common themes identified by business owners of HSCF included the quantity of high quality produce grown in a short amount of time in an environmentally friendly manner with a smaller carbon footprint. Producers also commented on HSCF being affordable and enabling comfortable, year-round farming, making HSCF more feasible than traditional farming. Furthermore, producers remarked that the ease of use and flexibility allows for less (work) hours needed, making the container self-manageable which greatly reduced labor costs and allowed for farms to be run with fewer employees. Producers viewed the implementation of technology in the HSCF instrumental in providing farmers with independence and the ability to provide custom cropping for chefs and education on farming.

Table 9 illustrates the level of difficulty encountered by school participants pertaining to implementing HSCF. While the mean score of all factors included in the survey did not prove to be more than slightly difficult, participants found *funding* (*M* = 2.15*; SD* = .98) most difficult, followed by *relating the shipping container farm(s) to the curriculum* (*M* = 2.00*; SD* = 1.67). Overall, the least difficult factors were *availability of supplies* (*M* = 1.17*; SD* = .41)*, availability of water* (M = 1.17; SD = .41), and *overall lack of interest of school community* (*M* = 1.17*; SD* = .41).

Table 9

Level of Difficulty the Following Factors Posed When Implementing a Hydroponic Shipping Container Farm(s) on Campus.

Scale	**Rating**											
	Not Difficult		**Slightly Difficult**		**Somewhat Difficult**		**Moderately Difficult**		**Very Difficult**			
	1		**2**		**3**		**4**		**5**			
Factors:	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Funding	1	16.7	4	66.7	0	0.0	1	16.7	0	0.0	**2.15**	**.98**
Relating the shipping container farm(s) to the curriculum.	4	66.7	0	0.0	1	16.7	0	0.0	1	16.7	**2.00**	**1.67**
Teacher Support	4	66.7	1	16.7	0	0.0	0	0.0	1	16.7	**1.83**	**1.60**
Adequate Space	4	66.7	0	0.0	1	16.7	1	16.7	0	0.0	**1.83**	**1.33**
Leadership to sustain a shipping container farm(s).	3	50.0	2	33.3	1	16.7	0	0.0	0	0.0	**1.67**	**.82**
Lack of Resources.	4	66.7	1	16.7	1	16.7	0	0.0	0	0.0	**1.50**	**.84**

Table 9. Continued

Scale	Rating: Not Difficult 1		Slightly Difficult 2		Somewhat Difficult 3		Moderately Difficult 4		Very Difficult 5			
Factors:	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Lack of teacher training.	4	66.7	1	16.7	1	16.7	0	0.0	0	0.0	**1.50**	**.84**
People to maintain the shipping container farm(s) during the school year.	4	66.7	2	33.3	0	0.0	0	0.0	0	0.0	**1.33**	**.52**
Administration Support	4	66.7	2	33.3	0	0.0	0	0.0	0	0.0	**1.33**	**.52**
Overall lack of interest of school community.	5	83.3	1	16.7	0	0.0	0	0.0	0	0.0	**1.17**	**.41**
Availability of Water	5	83.3	1	16.7	0	0.0	0	0.0	0	0.0	**1.17**	**.41**
Availability of Supplies	5	83.3	1	16.7	0	0.0	0	0.0	0	0.0	**1.17**	**.41**

Table 10 illustrates difficulty encountered by business owners when implementing a HSCF. While the mean score of each factor included in Table 10 did not rate more than somewhat difficult, business owners rated *power usage* (*M* = 3.27*; SD* = 1.56) as the most difficult, followed by *startup costs* (*M*= 3.17*; SD* = 1.19). The least difficult factors ranked were *finding labor* (*M* = 1.83*; SD* = 1.27) and *finding your* *market* (*M* = 2.83*; SD* = 1.12).

Table 10

Level of Difficulty the Following Factors Posed When Implementing a Hydroponic Shipping Container Farm(s) As a Business.

Scale	**Rating**											
	Not Difficult		**Slightly Difficult**		**Somewhat Difficult**		**Moderately Difficult**		**Very Difficult**			
	1		**2**		**3**		**4**		**5**			
Factors:	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Power usage	2	16.7	2	16.7	1	8.3	3	25.0	3	25.0	**3.27**	**1.56**
Startup costs	1	8.3	3	25.0	2	16.7	5	41.1	1	8.3	**3.17**	**1.19**
Lack of user knowledge	2	1.67	1	8.3	4	33.3	2	16.7	2	16.7	**3.09**	**1.38**
Operational Costs	1	8.3	3	25.0	4	33.3	2	16.7	2	16.7	**3.08**	**1.24**
Finding your market	2	16.7	2	16.7	4	33.3	4	33.3	0	0.0	**2.83**	**1.12**
Finding labor	7	58.3	2	16.7	2	16.7	0	0.0	1	8.3	**1.83**	**1.27**

Discussion of interview results: challenges. Schools shared additional challenges faced by their school when utilizing a HSCF. The implementation of a HSCF proved difficult for some schools as there were issues of getting the correct permits for the container, getting it sited and approved for use, and finding a place for it on campus, which in turn led to a loss in parking spaces for one campus. Additionally, a campus found managing the system to be a challenge as well. Several schools commented on finding the right talent to manage the unit as a major challenge, including setting protocols and logistics the first year and trouble shooting. Furthermore, campuses remarked on the learning curve as being a challenge, noting that the basics of the farm are easy but learning the nuances can be tricky, and getting a consistent, smooth operation proved difficult. Moreover, several schools experienced issues with the HVAC system and crop damage due to utilities shut off during the winter break. Other issues included monetizing the production of the HSCF on campus for inclusion in the Real Food Challenge data which was one of the driving factors for campuses to purchase a container. Though schools experienced difficulty in the implementation of the HSCF, namely, attaining the proper permits, managing the system appeared to be more difficult since this response was more common from schools.

Business owners also encountered challenges when implementing HSCF including city regulations and zoning, access to clean water, and keeping the container precisely level. Additional challenges encountered by producers when utilizing a HSCF included cramped work space, cleaning, pest management, and the learning curve required for consistent production. While several producers noted a benefit of the HSCF as comfortable farming, others found working in a confined work space as difficult, especially when harvesting produce. Producers noted that they experienced damage to their crops when harvesting due to the tight quarters. Other business owners noted that cleaning and pest management were problematic as these issues were addressed during the training they attended after purchasing their HSCF. These producers even went so far as to mention that when attending the training held by the HSCF manufacturer, the employee running the training stated that issues with pests and cleaning would not be encountered when using their unit. Producers identified several issues with the technology incorporated in the HSCF. Issues with technology included rural Internet that was too slow to run the unit, too many technological components that break, and not enough people who know how to work on them. Lastly, a producer stated that their unit requires better technology to run it as the rapid technology advancement required constant refinement. Other challenges identified by producers steamed from misinformation presented by the HSCF manufacturer. Issues encountered were the ‘turn-key system’ was not plug-and-play, a single HSCF was not a sole income generator; and that running the unit was much more time consuming than anticipated. Unexpected issues faced by producers included hurricanes that led to the destroyed infrastructure of their container, unavailability of clean water, and power outages. A business owner who encountered several of these unexpected issues commented that due to the controlled environment agriculture aspect of HSCF, you can overlook that the environment outside of your container will affect your unit. Lastly, most producers noted a major challenge they faced was the lack of customer support from the one HSCF manufacturer. This lack of support led several producers to switch to a second HSCF manufacturer and a new design. Issues with HSCF manufacturers proved a common theme as most producers discussed issues such as misinformation, lack of farming support and knowledge, and lack of response from some manufacturers.

Findings Related to Objective 3: Expectations, Use, and Satisfaction

The third objective of this research aimed to describe the experiences of producers and schools utilizing a HSCF(s) regarding their expectations, use, and overall satisfaction. Description of user experience was deemed necessary to capture a realistic description of utilization of HSCF. This section is broken into three main subcategories: expectations, use and satisfaction.

Expectations. Schools were asked to share their expectations of HSCF in the online survey. Table 11 illustrates the level of agreement schools had regarding expectations of their hydroponic shipping container farm. Hydroponic shipping container farms met educators' expectations in *efficiency* (*M* = 4.17*; SD* = .41), *production* (*M* = 4.17*; SD* = 1.17) and *incorporation of technology* (*M* = 4.17*; SD* = .75). However, *profitability* (*M* = 3.17*; SD* = .41) was the area where expectations were least met with a mean score that fell between neutral and agree.

Table 11

Level of Agreement of Schools That Hydroponic Shipping Container Farm(s) Met Their Expectations.

Scale	**Rating**											
	Strongly Disagree		**Disagree**		**Neutral**		**Agree**		**Strongly Agree**			
	1		**2**		**3**		**4**		**5**			
The shipping container farm met my expectation in:	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Production.	0	0.0	1	16.7	0	0.0	2	33.3	3	50.0	**4.17**	**1.17**
Incorporation of technology.	0	0.0	0	0.0	1	16.7	3	50.0	2	33.3	**4.17**	**.75**
Efficiency.	0	0.0	0	0.0	0	0.0	5	83.3	1	16.7	**4.17**	**.41**
Ease of use.	0	0.0	1	16.7	0	0.0	3	50.0	2	33.3	**4.00**	**1.10**
Reduced resource use.	0	0.0	1	16.7	2	33.3	2	33.3	1	16.7	**3.50**	**1.05**
Profitability.	0	0.0	0	0.0	5	83.3	1	16.7	0	0.0	**3.17**	**.41**

Business owners of HSCF were also asked on the online survey to share their expectations of HSCFs. Some HSCF manufacturers provide numbers for the expected number of plants grown per cycle, per year, and their value to calculate a dollar number of what producers can expect to generate per year. Because of the numbers presented by manufacturers, business owners of HSCF were asked if their expectations had been met in areas such as profitability and production. Table 12 explains the level of agreement business owners had regarding their expectations of hydroponic shipping container farms. Business owners agreed that their expectations had been most met in the following areas the hydroponic shipping container farm's: *incorporation of technology* (*M* = 3.92*; SD* = .67), *reduced resource use* (*M* = 3.75*; SD* = .87), and *efficiency* (*M* = 3.50*; SD* = 1.0). However, the business owners' expectations were least met in the following areas: *profitability* (*M* = 2.67*; SD* = 1.23) and *production* (*M* = 3.25*; SD* = 1.22).

Table 12

Level of Agreement of Business Owners that Hydroponic Shipping Container Farm(s) Met Their Expectations.

Scale	**Strongly Disagree 1**		**Disagree 2**		**Neutral 3**		**Agree 4**		**Strongly Agree 5**			
The shipping container farm met my expectation in:	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***M***	***SD***
Incorporation of technology	0	0.0	1	8.3	0	0.0	1	83.3	1	8.3	**3.92**	**.67**
Reduced resource use	0	0.0	1	8.3	3	25.0	6	50.0	2	16.7	**3.75**	**.87**
Efficiency	0	0.0	3	25.0	1	8.3	7	58.3	1	8.3	**3.50**	**1.0**
Ease of use	0	0.0	2	16.7	4	33.3	5	41.7	1	8.3	**3.42**	**.90**
Production	1	8.3	3	25.0	1	8.3	6	50.0	1	8.3	**3.25**	**1.22**
Profitability	2	16.7	4	33.3	3	25.0	2	16.7	1	8.3	**2.67**	**1.23**

Discussion of interview results*:* expectations. During the phone interview portion of data collection, schools and businesses were asked what their initial goals were when they purchased a HSCF. Both the initial goals and whether those goals were met, are reported below as a further indication of the experience of schools and businesses utilizing a HSCF.

Schools shared their goals for the HSCF on their campus. Goals included: provide hyper local food, grown by students, for students on campus and in dining halls. Schools also aimed to provide produce free of pesticides or insecticides in response to student led initiatives. Goals for the incorporation of a HSCF additionally acted as a response to the school district's initiative to emphasize STEAM in their schools and utilize technology to solve real world problems.

All schools agreed that their goals were met by their HSCF in some way. Several schools commented that their goals were exceeded. A school noted that the incorporation of a HSCF on campus led to a new agriculture program taking off in a new direction, emphasizing sustainable agriculture and the incorporation of technology to address real world problems. Utilization of HSCFs met one campus's goals and even allowed for the creation of a retail concept on campus built around the hydroponic farm. All of the money made goes back into the HSCF. Other campuses met their goals of showcasing that sustainable and urban farming is useful, important, and possible, while providing a new platform in which the school can engage their students. Though several schools stated that their goal of using their HSCF for the Real Food Challenge was not met, all other expectations were. Reports from the school population were unanimous in that HSCF on campus met their expectations or exceeded them.

Producers were also asked what their initial goals were when they purchased a HSCF for production. Their initial goals, as well as whether those goals were met, are reported below. Producers had various goals when using a HSCF. Several producers noted that their goals were ultimately to be profitable, fill a demand, create supplemental income/retirement, and be self-managing. Other producers' goals included providing the community fresh, local food year-round, and utilizing a HSCF as a demonstration of sustainability to the community while doing something valuable in the long term (combating food issues such as the aging farmer population, a growing population, and demand for local/sustainable food).

While a couple of producers said that their goals were 'definitely met', others shared that their goals have been mostly met though there were many obstacles that made it difficult. Obstacles identified and overcome by producers included a steeper learning curve than anticipated, higher operating prices, and lower yields than expected. These obstacles in particular can again be attributed to the misinformation surrounding the HSCF and presented by manufacturers to potential customers. Another producer noted that because of these issues, which arise from misinformation presented to producers, that their income that has not yet met their goals. Lastly, several producers noted that while their goals have not yet been reached, there are signs of success, economic viability and sustainably, although a clear conclusion cannot yet be made by the producer. This can be attributed to the HSCF still being in their infancy and the limited years of experience that producers have**.**

Use. To further create a realistic idea of the experience that schools, and businesses have had operating a HSCF, operators were asked questions regarding their use of HSCF in their organization. Schools were asked the purpose of their HSCF, how produce is utilized, and how often students work with the container. Results can be seen in the *School Snapshot B* Figure 7.

School	Investment Funding Source	Years of Operation	Purpose of HSCF	How Produce is Utilized	How Often Students Work with HSCF	Number of Employees	Sufficient Number of Employees
A	$186,000 Donation **	Within the last year	3	4,5,6: CSA Shares	At least once a week	1 FT 2 PT	Yes
B	$100,000 Local Share Account Grant **	Within the last year	3	3,4	Daily	1 PT 4 Students	Yes
C	$85,000 Departmental Spending	2 years	3	2	At least once a week	1 PT	No
D	$75,000 Sodexo Grant **	3 years	3	1, 2, 3, 5, 6	Daily	1 FT 1 Intern 3-4 PT Dining Services	Yes
E	$94,000 Dining Services Budget	Within the last year	2	1, 6: Catering and retail operations	Never	1PT	Yes
F	$100,000 Dinning Funds	2 years	3	1, 2, 3, 5	At least once a week	5 PT	Yes

Investment/Funding Source: ** = Outside Funding Received by School for implementation of HSCF
Purpose of HSCF: 1= "Educational Resource" 2= "Food Production" 3= "Combination of educational resource and food production"
How Produce was Utilized: 1= "School Meals" 2= "Salad Bar" 3= "Donated" 4= "Classroom Activities" 5= "Students or community member take it home" 6= "Other"
# of Employees/Sufficient: Indicates the number of employees, full time (FT) and part time (PT) working on the HSCF on campus.

Figure 7. School Snapshot B

Additionally, courses and concepts taught incorporating the HSCF can be seen in the Benefits section under *Findings Related to Objective 2*. During phone interviews, however, participants were asked what they have done to be successful in the implementation, utilization, and management of their HSCF on campus. Such questions were deemed essential as most schools utilizing a traditional garden often struggle to successfully implement, utilize, and manage school gardens (Poole, 2016; Murakami, 2015). School participants reported the following areas to be key to their successful utilization of HSCF. A majority of schools found that support was the key to their continued success. Namely support from administration and students. Other responses key to the successful utilization of HSCF on campuses included: hiring the right people and putting them in the right places, managing the unit well, asking questions (to the manufacture), and utilizing all resources available to them

Businesses were asked similar questions regarding the use of their HSCF such as, the number of container farms in operation, the number of employees, and their primary customer base, to capture a representation of their business operation. Such responses can be found in the Business Snapshot B Figure 8.

Business	**Number of Containers**	**Number of Employees**	**Primary Customer**	**Labels Used on Produce**	**Container Model**	**Location**
A	2	1	Other	1, 3	Modular Farms	Durham, North Carolina
B	2	4	Restaurants	1, 6: Grown by local Vet	Freight Farm Modular Farms	Springdale, Arkansas
C	2	0	Restaurants	1	Modular Farms	Subudry, Ontario
D	2	1 part-time	Restaurants	6: Fresh	Freight Farm	Guyton, Georgia

Figure 8. Continued

Business	Number of Containers	Number of Employees	Primary Customer	Labels Used on Produce	Container Model	Location
E	1	3	Restaurants	1,2	CropBox	St. Thomas, U. S. Virgin Islands
F	1	None	Other: Produce Aggregator	1,2,3	Freight Farm CropBox	Calgary, Alberta
G	1	1	Restaurants	1,2	Freight Farm	Monkton, Maryland
H	1	1	Individuals	1	Freight Farms	Casper, Wyoming
I	1	3 part-time	Restaurants	1,2,6: Certified Naturally Grown	CropBox	Raleigh, North Carolina
J	1	Self	Restaurants	1, 2,4,6: Year Round Fresh, Michigan	Freight Farm	Grand Rapids, Michigan
K	4	3	Other: Self	1	Freight Farm	Crested Butte, Colorado
L	2	1	Restaurants	1,2,3,4	Self - Designed	Reedville, Texas
Labels Used on Produce: 1 = “Local” 2 = “Sustainable” 3 = “Organic” 4 = “Green” 5 = “None of the Above” 6 = “Other”						

Figure 8. Business Snapshot B

Benefits and challenges have been identified and can be found in the *Findings Related to Objective 2* section. To understand their experience, producers were also asked what they have done to be successful and profitable. Success and profitability were treated as two separate questions as not all businesses had yet become profitable.

Success. While conducting the phone interview portion of data collection, producers were asked what they have done to be successful. Common responses included marketing, knowing your community, riding the wave of local enterprise, local food, and capitalizing on the strong food culture. Producers were adamant in emphasizing working in and with the community as key to their success. Producers noted that if the community is not behind them, then it will not be successful no matter what your method of production. Several producers mentioned that riding the 'local' wave was the key to their success, and knowing how to market yourself to align with these trends is vital. One producer went on to note that while their business can thrive in their community, due to the presence of a strong food culture; however, if they were to operate in the neighboring rural community, they would not be as successful. The producer stated that the food culture, demand for local, organic, or high-quality produce, was simply not present in the neighboring community. Other business owners of HSCF added that understanding the power of the story of what you are doing and sharing that story with others was key to their marketing strategy, and ultimately their success. Similarly, producers indicated that it was by bringing something new to the community and educating their community on this novel approach to agriculture led to their success. Producers noted that by educating the surrounding community, a farmer is building relationships, marketing, and showcasing and adding value to their product. Furthermore, producers noted that finding the right product to grow was instrumental to the success of their business. Finding the right product to grow resulted from knowing the surrounding community, building relationships, and talking to customers, as noted by several producers. Lastly, producers stated that living close to their farm, working with their family (eliminating the need for hired hands), and their persistence in finding customers (and demonstrating the value of their product) has enabled them to stay in business.

Profitability. During the phone interview producers were asked what they have done to be profitable. This was deemed relevant as many producers who purchased a HSCF were unsuccessful in managing the unit and creating a viable business (Michael, 2017). The following were common answers from producers in response to questions of profitability. Producers attributed their profitability to having a consistent product and ensuring that their customers know what to expect in terms of quality of produce grown. Other producers stated that they were able to achieve profitability by managing finances carefully and paying attention to details. One such producer went on to note that they were able to drastically reduce their marketing costs by labeling products themselves. Additionally, several producers attributed their profitability to them treating a HSCF like a real job, including dedicating time, effort, and money into the operation. Other factors producers credited to being profitable included understanding your market and the value proposition that you bring to that market, offering something that no one else can offer, and listening to customers. Furthermore, producers pointed out that to be profitable you must develop and sell your product, have consistency in your sales pitch, ask for the price you deserve, and network and get people to taste your produce. These are some of the more common themes identified by producers when asked what they have done to become profitable.

Satisfaction. Schools were asked to share their satisfaction level of the utilization of the HSCF on their campus during the online survey. Table 13 signifies the overall satisfaction of schools utilizing a hydroponic shipping container farm. All schools utilizing a hydroponic shipping container farm on their campuses were either *satisfied* (50%) or *very satisfied* (50%). Schools were additionally asked questions during the phone interview portion of data collection in relation to their overall satisfaction of their HSCF.

Table 13

Overall Satisfaction of Schools Utilizing Hydroponic Shipping Container Farm(s)

Satisfaction Level	***n***	**%**
Very Satisfied	3	50.0
Satisfied	3	50.0
Total	6	100.0

Businesses were also asked to share their overall satisfaction in the online survey and question during the phone interview that relate to their satisfaction of the use of their HSCF. Table 14 denotes the overall satisfaction of businesses utilizing hydroponic shipping container farm. While most producers utilizing a hydroponic shipping container farm were *very satisfied* (8.3%) and *satisfied* (66.7%), several users were *dissatisfied* (16.7%) with their unit.

Table 14

Overall Satisfaction of Business Owners Utilizing Hydroponic Shipping Container Farms(s)

Satisfaction Level	**n**	**%**
Very Satisfied	1	8.3
Satisfied	8	66.7
Neutral	1	8.3
Dissatisfied	2	16.7
Total	12	100.0

While a majority of business owners reported they were either *very satisfied* (8.3%) or *satisfied* (66.7%), we do not see the unanimous satisfaction as in the school population. A small portion of producers reported being *neutral* (8.3%) and the remainder were *dissatisfied* (16.7%). Possible reasoning for such reporting will be explored in the Discussion Section.

Discussion of interview results: satisfaction. During the phone interview, schools and businesses were asked how they feel about HSCF from their experience, whether they plan to continue to utilize a HSCF on their campus or business model, and what they believe the future of HSCF holds in schools and businesses. Such questions were asked to better encompass the overall satisfaction of users.

All schools felt very positive about their experience with HSCF and some even said "they are great for college campuses" because of the efficient use of space, and that "they should be standard operation equipment for every institution, not just college campuses but high schools, middle schools, and elementary schools, specifically in inner cities". Schools praised the ease of use of HSCF stating, "If they are well managed they are excellent. However, if they are not managed well, a lot can go wrong," and "Considering that the average person who has no real experience can just go in and run a farm is quiet astounding and amazing". Additionally, educators commented on the platform HSCFs provide, and the conversation and new interaction with students generated through their use in schools.

Businesses were asked during the phone interview how they felt about their experience utilizing a HSCF. Common themes shared by producers included, that the HSCF have their place in farming however, it depends on the farmer's objectives and the application, as producers have found that the HSCF work incredibly well in very specific applications. Others felt that HSCF were a good compromise, though there are some tradeoffs being in a box, such as a confined work space and limited scalability. Most producers felt HSCF are a great opportunity to enter the field of agriculture, a tremendous leap in agriculture, and something for which we will see more that, as there will be a push for fresh food and fresh water. Finally, producers added the HSCFs were more challenging than expected but they were glad that they purchased one.

Schools and businesses participating in the phone interview portion of data collection were asked if they planned to continue to use their HSCF in their organization. This was deemed essential in conveying their overall satisfaction. Their responses follow.

All schools reported that they plan to continue to utilize a HSCF on campus. Several schools included possible expansion in the years to come due to their success with their first container. Possible expansion ideas included an experimental unit for student research, production for profit, and an operational unit to teach students how to work and develop their soft skills.

While schools again unanimously agreed that they planned to continue to utilize the HSCF on campus, business owners' responses varied. When asked if producers planned to continue using a HSCF for production, there was an array of responses. Several producers agreed that they would continue to use their HSCF since it was currently fulfilling their needs. These producers remarked that HSCFs are a marketable approach to agriculture that drove people's interest in where their food originates. However, other producers stated that they would no longer utilize a HSCF and instead opt for a larger scale of production, either a greenhouse or warehouse hydroponics system. However, producers who were not going to continue to utilize a HSCF noted that by using their HSCF, they were able to become familiar with hydroponics, learn the market, and that a HSCF was the step needed before they made the decision to scale up.

Given their first-hand experience, schools and businesses were asked to share their opinion regarding what they thought the future of HSCF may be for schools and businesses. Their responses are reported below.

Schools unanimously agreed that campuses should incorporate a HSCF for many different reasons including the educational opportunities gained, food safety and security, and lastly improvement of food services on campus. Thus, many schools reported that HSCF are a great resource for schools and felt that more schools would incorporate them over the long term.

Producers' responses again varied but most agreed that the HSCF would become more prevalent as we see technology advance and demand for local and sustainable produce continues to grow. Responses by producers regarding what the future of HSCF might look like included: HSCFs are a viable business model that would work in most places in the United States with a minimum population of 50,000-55,000, HSCFs make sense if strategically placed on low value real estate to provide hyper local produce, and HSCFs have a future in northern communities and communities with limited access to fresh water. Moreover, producers felt that HSCFs are a niche market, stating that producers with more money will likely invest in larger scale operations such as warehouses or greenhouse, and the HSCFs would be more common among producers who are looking to supplement their income. Lastly, producers noted that the biggest barrier of HSCF is the startup cost, but as design improves and more companies begin manufacturing new models, the units will become more affordable and we will continue to see more HSCF. Producers forecast partnerships between solar companies, battery companies, and HSCF manufacturers as design improves and prices become more affordable.

V. SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

The purpose of this study is to identify the influential factors, benefits, and challenges of producers and educators utilizing hydroponic shipping container farms while describing user experience.

The following objectives were identified to fulfill the purpose of this study:

1. Discover the influential factors for selecting a hydroponic shipping container farms for both businesses and schools.
2. Identify the benefits and challenges of hydroponic shipping container farms in schools and businesses.
3. Describe the experiences of producers and schools utilizing HSCF regarding users' expectations, operation of the unit, and overall satisfaction.

The exploratory study utilized both qualitative and quantitative research methods. Quantitative data was collected via the online surveys sent to schools and business utilizing a HSCF as a part of their organization. Utilization of the survey data collection method proved useful when collecting numerical data to identify influential factors, benefits, challenges, expectations, and overall levels of satisfaction of users of HSCF. Phone interviews were conducted with willing participants to gather qualitative data to provide further insight into core areas of examination, such as the experience of users of HSCF in terms of overall expectations, use, and satisfaction.

Possible participants were found online via social media, new articles, and official organization websites.

Conclusions

Conclusions related to objective one: influential factors. Research objective one sought to identify key influential factors for selecting HSCF production for both business and schools. Participants were surveyed to identify key influential factors including promotion of nutrition, health, and wellness, experiential learning, and sustainable education for schools, and location of company, price of container, and growing capability, for businesses. Schools identified top influential factors as *local food production* (M = 4.83; SD = .41), *sustainable food production* (M = 4.83; SD = .41) and *demonstrate commitment to sustainability* (M = 4.67; SD = 4.82). Due to these findings, the researcher concluded that schools are primarily influenced to incorporate HSCF to improve food production and, secondarily to educate students. Additional influential factors were identified by schools and businesses via the open-ended questions on the online survey and phone interviews. Schools remarked that additional influential factors for purchasing and implementing a HSCF were to utilize the produce grown in the HSCF as a part of the Real Food Challenge, and as a direct response to a student led initiative for local and sustainable food practices. Such responses support the conclusion that food production, namely local and sustainable food production, was more influential to schools than the educational opportunity of HSCF.

Key influential factors identified by business owners of HSCF via the online survey were found to be the *design* (M = 4.58; SD = .67) and *growing capability* (M = 4.42; SD = 1.24) of the container. These reports led the researcher to conclude that producers are primarily concerned with and influenced by yields, production, and profit. These results are reinforced by the qualitative data gathered via phone interview. During the phone interview, many of the business owners of HSCF remarked that additional income, profitability, and working for themselves are key influential factors when deciding to purchase and implement a HSCF.

Conclusions related to objective two: benefits and challenges. Research objective two sought to identify the benefits and challenges of HSCF in schools and businesses**.** Based on the results from the online survey and participant responses during the phone interview, it is apparent that users of HSCF experience benefits in both the school and business setting. However, barriers were also identified that limited participants from using their HSCF to a greater potential.

Benefits. Schools found the following areas to be most beneficial through the online survey. Schools most agreed that use of their HSCF on campus *has allowed access to fresh produce* (M = 4.83; SD = .41)*, is user friendly* (M = 4.50; SD = .55) and *has facilitated experiential learning* (M = 4.17; SD = 1.33). Survey results led the researcher to conclude that while dining production may have been the key influential factor for schools choosing to operate a HSCF on campus, benefits of HSCF are experienced in areas outside of the dining facilities.

Based on the survey results, the researcher concluded that schools utilizing a HSCF can operate them successfully, allowing access to fresh produce. The researcher further concluded that schools can operate the unit due to the turn key components in the container design which makes HSCF 'user friendly'. Furthermore, the researcher can conclude from results that HSCF in schools has facilitated hands on learning opportunities to students, or experiential learning, like that of traditional gardens, even if providing learning opportunities for students was not an influential factor or initial goal.

Experiential learning, as noted by Murakumi (2015), is one of the most impactful methods to educate students. This hands-on approach to teaching has been proven to be more effective than traditional methods, as students become active participants rather than passive learners, and is a benefit customarily experienced by schools utilizing traditional school gardens. This result led the researcher to conclude that HSCF can provide schools with similar benefits of traditional school gardens, such as experiential learning and access to fresh produce.

Additional benefits of HSCF on campuses as noted by schools through the open-ended questions of the online survey and phone interviews include: enabled community building, recognition of the campus as innovators, the school being awarded additional grant money due to the gained notoriety, and enthusiastic students. Finally, schools noted a wide variety of subjects that were being taught using their HSCF on campus. Courses incorporating the HSCF as an educational resource was viewed as a benefit experienced by the campus as found by Klein (2012). Schools reported the following courses had incorporated the HSCF on campus: nutrition and public health, non-profit business operation, social and environmental justice, conservation and ecology courses, and food systems just to name a few. This lead the researcher to conclude that benefits of using traditional school gardens, as identified by multiple studies (Childs, 2012; Klein, 2012; Carver, 2012) such as the expansion of curriculum, facilitated experiential learning, and implementation of an 'edible education' were also being seen by schools utilizing a HSCF.

Benefits most experienced by business owners of HSCF as identified through the online survey included: the ability to *produce locally* (*M* = 4.50; *SD* = .67), *enabled* *sustainable production* (*M* = 4.33; *SD* =.78), and *the ability to produce in new areas* (*M* = 4.17; *SD* = .94). The researcher concluded that the method and location of production enabled by a HSCF was most beneficial to producers. Such results are comparable to the reports set forth by Freight Farms (2017), which promote HSCF as a method of agricultural production that enables users to produce locally, sustainably, and in new areas, such as areas where weather conditions are not ideal for crop production.

Additional benefits experienced by business owners of HSCF identified through the open-ended questions on the online survey and via the phone interviews included various areas pertaining to production methods and location, which further reinforced the researcher's conclusion. Qualitative results gathered regarding benefits experienced included the quantity and quality of produce being grown in a short amount of time, a smaller carbon footprint, and the reduced need for inputs. The researcher can conclude from the responses gathered through the survey and phone interviews that businesses are benefiting most from the method of production in HSCF. The hydroponic system within the container is allowing producers to grow more sustainably. Moreover, the mobile aspect of the shipping container is enabling producers to grow locally and become productive in new areas. The ability to produce in new areas, as described by producers utilizing HSCF, are enabling producers to overcome one of the barriers faced by beginning farmers as identified by Reid (2013), the ability to find and acquire land. Because of the hydroponics system within the mobile shipping container, producers can place the containers on land more accessible to them, have a need for less land, and can purchase land that ordinarily would not be conducive for crop production. Furthermore, the ability to produce locally and sustainably, as reported by producers, allows growers to enter the growing niche market described by Ikerd (2017) whose overall success relies on value-trait marketing i.e. fresh, local, and sustainable produce.

Challenges. The following challenges were experienced by school and businesses respectively. Barriers were primarily associated with acquiring funding to purchase and implement the HSCF and relating the HSCF to the curriculum for schools. Through the online survey, schools identified *funding* (M = 2.15; SD = .98) and *relating the shipping container farm(s) to the curriculum* (M = 2.00; SD = 1.67) as the most difficult. These results align with previous research conducted by Klein (2012) who found funding as a crucial factor for gardens not being implemented in schools. Furthermore, Poole (2016) identified designing curriculum for the garden to be one of the critical barriers faced by teachers that affect traditional school garden use as teachers reported lack of time to research and develop lessons geared towards the garden that also align with standards.

Conversely, schools reported the *availability of supplies* ($M = 1.17; SD = .41$), and *availability of water* (M = 1.17; SD = .41), as the least difficult factors when using a HSCF on campus. Murakami (2015) found that lack of funding, lack of gardening knowledge, and lack of garden supplies and time constraints as the largest barriers schools faced when utilizing a garden and key reasons why schools often do not implement gardens. The result from the study demonstrate that HSCF can in fact overcome some of the barriers faced by schools when using a traditional garden, as identified by Murakami (2015) and Poole (2016). Furthermore, the results from the benefits and challenges identified by schools led the researcher to conclude that benefits experienced by schools utilizing traditional school gardens (i.e. expanded curriculum and experiential learning) are being seen in schools utilizing HSCF. Moreover, schools utilizing HSCF on campus are overcoming obstacles typically faced by schools using traditional school gardens (the availability of supplies) (Murakami, 2015). This leads to the conclusion that HSCF are imparting the benefits of conventional school gardens while overcoming common barriers that often lead to short term use of traditional gardens in schools.

Challenges faced by business owners operating HSCF, as identified through the online survey were: *power usage* (M = *3.27;* SD = *1.56*) when operating the unit and the high *startup costs* (M= *3.17;* SD = *1.19*) when purchasing and implementing the container farm. Such findings aligned with the identification of the largest barriers faced by beginning farmers, namely capital acquisition and startup costs Reid's (2013) and the report by Brite AgroTech (2017) on why so many HSCF companies start up only to be shut down shortly after (Michael, 2017). Brite AgroTech attributed this trend to the substantial amount of electricity it takes to run a unit and how depending on location, the energy requirement costs, can negate profits for producers (Royte, 2015). Perhaps more telling however, were the responses shared by business owners during the phone interviews and open-ended questions on the online survey. Business owners stated that they ran into more issues than anticipated. Producers identified challenges experienced in implementation, utilization, and customer support. Several issues faced during implementation of their unit included: city regulations and zoning, access to clean water, and keeping the container precisely level. Based on the frequency of challenges that were reported by business owners, the researcher can conclude that certain manufacturers are providing misinformation to producers and are overlooking key aspects of operation. These results again parallel Bright AgroTech's report on why HSCF often do not last

(Michaels, 2017), which they equated to unrealistic expectations perpetuated by shipping container farm vendors of smart farm technology, yields, and labor requirements. Reports shared by several producers who stated that manufacturers of HSCF do not understand the growing process further reinforce this conclusion. Producers were adamant that certain manufactures do not understand how to grow produce for profit or do not 'think like a farmer' which made operating, communicating, and the overall grower experience difficult for users trying to create a viable business.

Conclusions related to objective three: expectations, use, and satisfaction. Research objective three aimed to describe the experiences of producers and schools utilizing HSCF(s) concerning users' expectations, operation, and overall satisfaction. Description of user experience was deemed necessary to capture a realistic portrayal of HSCF utilization in businesses and schools. This section is broken into three main subcategories: expectations, use and satisfaction.

Expectations. Schools and businesses were asked to share their expectations of HSCF in the online survey. Certain HSCF manufacturers provided figures representing the expected number of plants grown per cycle, per year, and their value to calculate a dollar number of what producers can expect to generate annually by using their HSCF model. Due to the figures presented by key manufacturers, users of HSCF were asked if their expectations had been met in areas such as profitability and production. During the phone interview portion of the data collection process schools and businesses were asked what their initial goals were when they purchased a HSCF. Both the initial goals and if those goals were met were reported as a further indication of the experience of schools and businesses utilizing HSCF and their overall expectations.

HSCF met educators' expectations in *efficiency* (*M* = 4.17*; SD* = .41), *production* (*M* = 4.17*; SD* = 1.17) and *incorporation of technology* (*M* = 4.17*; SD* = .75). However, *profitability* (*M* = 3.17*; SD* = .41) was the area where expectations were least met. These reports, along with the qualitative data collected, led the researcher to conclude that campuses utilizing HSCF to supplement dining production, can do so due to the incorporation of technology which in turn enables efficient production, as expected by educators. Furthermore, the researcher concluded that schools' expectations were not met in profitability as the HSCF incorporated on campus were primarily meant for supplemental food production and produce grown in the container was not intended to be sold but instead used by the school. Data collected from the school population was consistent in that HSCF on campuses met educator's overall expectations or exceeded them. This trend however, was not seen in the business population.

Business owners of HSCF most agreed that their expectations had been met in the following areas: *incorporation of technology* (*M* = 3.92*; SD* = .67), *reduced resource use* (*M* = 3.75*; SD* = .87), and *efficiency* (*M* = 3.50*; SD* = 1.0). However, the business owners' expectations were least met in the following areas: *profitability* (*M* = 2.67*; SD* = 1.23) and *production* (*M* = 3.25*; SD* = 1.22). The researcher can conclude from the gathered data that HSCF are providing a method of agricultural production that incorporates technology to make the unit more user friendly, and significantly reduces the need for additional resources, making production efficient. However, the researcher can also conclude that HSCF are not meeting producers' expectations in production or profitability, which were key influential factors for producers to select this method of production. Furthermore, the researcher can conclude that some HSCF models are not as productive or profitable as advertised. While business owners' of HSCF report that HSCF are efficient in production, the units were still not as productive and profitable as they were led to believe. The data gathered online and through the phone interviews reinforce the researcher's conclusion and align with the article shared by Bright AgroTech wherein they identified the misinformation and unrealistic expectations set forth by shipping container vendors as a culprit for why so many HSCF farms close shortly after startup (Michael, 2017).

When examining the varying reports by schools and producers regarding if their expectations were met when utilizing a HSCF the researcher can conclude that the goals and influential factors of each respective organization were crucial when examining the overall level to which their expectations were met for the two populations. Producers, who were most influenced by profitability and production, and whose livelihood is dependent on the productivity of their units, were more critical when looking at total output of HSCF. Schools, who are using the container farms as supplemental to their dining facilities and as an educational resource, and are typically not selling their produce, were less concerned and critical about the total production and profitability of their HSCF. Furthermore, this data led the researcher to conclude that because producers were more concerned with and influenced by profitability and production, they were more able to identify that their units were not as productive as advertised when their units were unable to perform as described as it directly affected their livelihood. Thus, when a producer's unit was not generating the numbers provided by the manufacture their initial expectations were not met which is reflected in their reported expectations levels.

Meanwhile, schools', who were looking to supplement their dinning production and provide a local and sustainable food option, expectations were met or exceeded as they were able to not only grow and provide any produce, whether it matched the figured presented by the manufacture or not and provide a unique educational opportunity.

Use. Descriptions into how the HSCF was utilized on campus can be seen in the School Snap Shot Figure 7 to provide further insight into how schools are using a HSCF on campus. Information included describes the purpose of the HSCF, how the produce grown is utilized, how often students work with the container, as well as the number of employees operating the container. Descriptions into how the HSCF was utilized by businesses can be seen in the Business Snap Shot B Figure 5 Information includes the number of containers, number of employees, primary customers and labels used on produce. To further describe the experience that schools, and businesses have had operating a HSCF, participants were asked questions regarding use of the HSCF in their organization, namely what they have done to be successful in the use of their container. This question was deemed essential as Bright AgroTech reported on the high number of HSCF being purchased only to stop operation shortly after (Michael, 2017) and significant to others looking to implement a HSCF to provide insight into successful operation both the school and business setting.

School participants reported the following areas to be crucial to their successful utilization of HSCF. Schools described support as the key to their overall success, namely support from administration and students. This report was in line with findings of Murakami (2015) when examining the most important elements that lead to successful utilization of schools’ gardens which included: funding, motivated teachers, and administrative support. Other factors identified by the school population through the open-ended questions on the online survey and phone interviews as significant to the successful utilization of HSCF on campuses included: hiring the right people and putting them in the right places, managing the unit well, asking questions (to the manufacturer), and utilizing all resources available to them. While the key influential factors identified by schools for the implementation of a HSCF were primarily for food production, as can be seen by the School Snap Shot B Figure 5, the majority of schools are utilizing HSCF as an educational resource and for food production. Furthermore, a description of how schools are utilizing the produce grown in the HSCF is reported below and can also be seen in the School Snapshot B Figure 5. By asking schools who have been operating a HSCF what they have done to be successful, insight is provided and can be compared to studies done on traditional schools' gardens.

Producers were all utilizing HSCF to generate income whether primary or supplemental and operating the container as a business. Producers were asked during the phone interview what they have done to be successful and profitable to encapsulate their experience using a HSCF. Success and profitability were treated as two separate questions as not all businesses had yet become profitable.

Producers provided a range of answers when sharing what they have done to be successful in operating their HSCF as a business. More common responses were: marketing and working with the local community. Regarding marketing, responses from business owners lead the researcher to conclude that when utilizing a method of agricultural production as unique as a HSCF, sharing your method of production and 'your story', as one producer put it, is key to making your product stand out and entice customers, creating or filling a niche. These results parallel research that state that, niche producers, such as the producers using a HSCF, must offer high-quality and unique products to consumers that cannot be purchased at the super market, while focusing on value and avoiding competition with mass marketers to be successful in niche markets (Ikerd, 2017). The researcher recommends showcasing the HSCF and having a consistent sales pitch where you capture the interest of your customer by selling your product, method of production, but more importantly, why your product is valuable. One farmer stated, “It is not just growing lettuce – it is changing society and people like that”. The same producer went on to state that they had over 200 people come and visit the farm to create interest and a connection with their local community. Moreover, producers additionally attributed their success to creating working partnerships with their community. Producers attribute the successful, and in some cases profitable, implementation of their HSCF by identifying that there was a need, demand, or established market for locally and sustainably grown produce before bringing a HSCF to the local marketplace. Some producers noticed the ‘wave of local enterprise’ and decided to become a part of that movement by utilizing a HSCF, while others provided a product that no one else could provide based on location and environmental conditions and secured the market. Based on the data collected, the researcher can conclude that the placement and marketing of a HSCF is essential to the overall success of the unit as a business. Furthermore, the researcher can conclude that producers utilizing a HSCF are in fact targeting niche markets to sell their produce as can be seen by the labels that are used on their produce to market themselves to customers.

During the phone interview, producers were asked what they have done to be profitable. This again was deemed relevant as many producers who purchase a HSCF are unsuccessful in managing the unit and creating a viable business as identified by Bright AgroTech (Michael, 2017) and as a way to provide insight to individuals looking to purchase, implement, and operating a HSCF as a business. While not all producers who were interviewed had become profitable yet, those who had, shared what they had done to become profitable. Producers attributed profitability of their HSCF to their dedication and attention to detail. Producers commented that consitency, from their product to their sales ptich, was essential. Furthermore, they attributed their profitability to them treating their HSCF like a real job and dedicating the time, effort, and money into their operation.

Based on the reports of business owners, the researcher can conclude that HSCF are not as turn-key, user-friendly, or profitable as they can be made to seem. These producers experienced first-hand, the additional amount of time, effort, and money, required to be put into a HSCF to become profitable. One producer commented, “The unit is ultimatly a tool that must be operated by the individual. You can purchase the newest and most sophisticated model available, but if you don’t know how to use and don’t put in the time and effort, it’s not going to work for you”. The researcher can also conclude that HSCF can be profitable based on the individual utilizing the unit and the time, effort, and money, willingly to be investing into the unit. Lastly, the reseracher can conclude that producers utilizing HSCF are able to be profitable and successful by appealing to niche markets and empahsizing their unique growting method and product. These results support that niche markets have made it possible for ecologically responsible farming and socially sound farming to be economically viable (Ikerd, 2017) and that HSCF can be successful in these markets.

Satisfaction. Schools and business were asked via the online survey to share their overall level of satisfaction with their HSCF. Schools were unanimous in reporting that they were either *very satisfied* (50%) or *satisfied* (50%) with their HSCF. The reporter can conclude that satisfaction levels reported were related to the influential factors and goals set by schools when purchasing a unit for campus. The key influential factors identified for schools were primarily local and sustainable food production, however, the benefits of HSCF in schools identified were experienced inside and outside of the dining facilities. Thus, HSCF surpassed initial expectations of educators by not only enabling local and sustainable food production but by being used as an educational resource, resulting in the high levels of satisfaction as reported by schools.

Overall satisfaction levels reported by business owners of HSCF however, differed in response. While most business owners reported they were *satisfied* (66.7%), the same unanimous satisfaction seen from the school population was not seen from the business population. A small portion of producers reported being *very satisfied* (8.3%) or *neutral* (8.3%), while the remainder of producers reported that they were *dissatisfied* (16.7%) after utilizing a HSCF. These reports lead the researcher to conclude that producers' who were neutral or dissatisfied felt that way due to their initial expectations of profitability and production that were unmet. When examining the influential factors for producers opting to utilize a HSCF, the key influential factors identified were the growing capability and design (i.e. production). Due to the misinformation as described by several producers, who later went on to switch HSCF manufacturers, the researcher can conclude that producers are unsatisfied when they were unable to match the numbers of production and profitability presented by manufactures. Moreover, producers reported unexpected challenges that required an additional investment of money and time spent on the HSCF. Producers described a general lack of customer support from certain manufacturers as they faced unanticipated challenges when utilizing their container farm. Producers who described experiencing lack of customer support from their manufacture attributed the absence of customer support to a lack of user experience and knowledge, stating that *"the employees who are hired to assist users with growing problems, have never grown produce hydroponically or in the unit before, and are unable to help."* Such findings lead the researcher to further conclude that producers are not as satisfied with their HSCF as their expectations were not met in production, profitability, ease of use, or customer support as described by certain HSCF manufactures. Furthermore, the researcher can conclude that the variations of satisfaction levels between producers utilizing HSCF reported can be attributed to the selection of manufacture and HSCF model being employed. Such discrepancies in satisfaction levels among producers can be further attributed to the producer's location and goals for their HSCF (e.g. whether it is being used to supplemental income, or as a sole income generator). The researcher recommends vetting all possible HSCF vendors before purchasing a unit and asking questions ahead of time regarding growing and operating procedures to gauge the responsiveness of the manufacturer.

The researcher attributes the digression in the overall satisfaction levels between the school population and the business population to the influential factors, goals, and expectations of each organization. While schools were influenced by supplemental dining production they experienced benefits in various areas including gained notoriety, additional grant funding due to said notoriety, facilitated experiential learning, and a nontraditional stream of funding.

Businesses however, expected a profitable and turnkey approach to an efficient and effective method of agricultural production that did not meet their expectations in ease of use, profit, or production due to the unexpected challenges faced by producers including city zoning and regulations, a steeper learning curve than anticipated, and lack of customer support.

During the phone interviews schools and businesses were asked: how they felt about HSCF from their experience, if they planned to continue to utilize a HSCF on their campus or business model, and what they believed the future of HSCF looks like in schools and businesses. These questions were asked to better encompass the overall satisfaction levels of users. The qualitative data gathered from the phone interviews with businesses and school reinforced the researcher’s conclusions as to why there was a discrepancy between the overall satisfaction levels of schools and businesses utilizing HSCF.

Schools again unanimously responded positively to all questions asked during the phone interview. Schools commented that: HSCF should be standard operating equipment and incorporated in every institution, that their school planned to continue to use their unit on campus, and some even went on to describe what possible future expansion might look like (e.g. purchasing another HSCF for their school). Lastly, the school population stated that HSCF are a great resource for schools and that more schools will incorporate them over the long term. Responses from the business population again varied when asked the same questions. When asked how they felt about HSCF after their experience operating one, producers agreed that HSCF have their place in farming but work best in specific application and depend on the farmer’s objectives. Other producers went on to state that while HSCF were more challenging than expected they were glad that they purchased one.

Additionally, when asked if they planned to continue to operate a HSCF not all producers agreed that they would. Several producers commented that they would be scaling up from a HSCF to a hydroponic warehouse or greenhouse operation. Though other producers stated that they would continue to utilize their unit as it was currently filling their needs, or as they would continue working with the unit to see if they could become profitable. Producers who decided to no longer utilize a HSCF and scale up, shared that operating the HSCF was the experience they needed before deciding to purchase a larger facility as they were able to become familiar with hydroponics, farming, and the market. Lastly, when asked what the future of HSCF might look like, producers’ responses again varied but most agreed that HSCF would become more prevalent as technology advances and the demand for local and sustainable produce continue to grow claiming that HSCF will be a niche market. These comments made by producers’ compliment reports that state there is still potential for growth in new niche markets as concern for food and health safety has grown (Ikerd, 2017). Responses from producers reinforce the researcher’s conclusion that variance in overall satisfaction levels between the business population and school population are related to manufacture and container design choice and the influential factors, goals and objectives, and the overall expectations of each organization.

Recommendations for Further Study

Based on the results and conclusions of this study, future research is needed in the following areas:

1) The researcher recommends a further study to identify the resource use and production outputs of varying models of HSCF and a comparison of the results. This will provide insight and objective data on real world grower's resource use to figures presented by HSCF vendors. Additionally, by examining the resource use and total output of various HSCF this will provide guidance to growers looking to select a model that will meet their needs in terms of sustainability and production.

2) An investigating of the demographics of the user of HSCF is recommended by the researcher. This study would identify who is utilizing HSCF. The study should examine areas such as age, gender, level of education, experience in agriculture, and influential factors for entering the field of agriculture and selecting this method of agricultural production. This study would be significant as the average age of farmers is increasing and there is a need for younger farmers (Reid, 2017).

3) An investigating of the demographics of the students with access to a HSCF is recommended by the researcher. This study would identify the students utilizing HSCF. The study should survey areas such as age, gender, ethnicity, level of education, and, experience in agriculture. Studies have identified an underrepresentation of ethnic minorities in STEM fields (Mark, et al., 2013). This study would be would provide insight into the demographics of students interacting with HSCFs.

4) The researcher recommends conducting a study of comparison between the experience of hydroponic greenhouse growers and HSCF in areas of production, profitability, and

resource use.

5) The researcher recommends examining the long-term benefits of schools utilizing HSCF. The core areas of examination should be derived from long-term benefits experience by schools who utilize traditional gardens i.e. nutritional awareness, social skills, emotional benefits, and academic benefits (Poole, 2016; Kilen, 2012; Childs, 2011). This would provide a further comparison of HSCF performance in schools and further reveal if HSCF provide schools, and students, with the same benefits experienced through traditional gardens.

6) The researcher recommends examination of HSCF and STEM benefits. This study should examine the effectiveness of HSCF in imparting STEM benefits similar to those of traditional school gardens, i.e. such as improved STEM grades, attitudes, and social skills that school gardens have been deemed a powerful learning tool (Poole, 2016, Kelin, 2012, Childs, 2011).

7) Lastly, the researcher recommends a recreation and extension of this study for a greater population size to gather new data and provide further insight.

Recommendations for Practice

General. Before purchasing a HSCF, growers should identify key influential factors and goals of their operations. Ensure that the HSCF manufacturer and unit model being selected will serve their needs. Furthermore, ensure they are prepared, learning all requirements (i.e. city and zoning regulation), finding an appropriate location to house your unit, and a plan of operation.

Schools. After identifying the purpose of the container and selecting a manufacture, ensure that a key individual is appointed to overlook and operate the unit.

This individual could be a teacher, someone from the dining facilities, or even a registered dietitian on staff (as was the case for schools involved in the survey) and does not need a background in agriculture of any sort. Typically, most HSCF vendors offer training on how to operate their equipment and or customer service. Depending on how the HSCF will be utilized, ensure that curriculum is in place that can be applied to the unit or create curriculum. Hiring a key individual and having support are key to overall success.

Producers. After speaking to producers utilizing HSCF the researcher can recommend that anyone who is interested in purchasing and implementing a HSCF as a business should research and speak directly with multiple manufacturers. Moreover, potential future producers should speak with farmers who are currently using the technology if possible and search for objective data, such as this study, to provide further insight into what is to be expected before purchasing a unit. Prior to implementation, it is advisable to have a business plan and select a manufacturer that will be beneficial in reaching the initial goals of production and customer support, as well as to know your community, and scout for potential partners and markets to work with. Once your container has been implemented it is important to understand how to market the product being produced by the HSCF, the unique method of production, and highlight the difference of quality. As one producer stated, "Sell your story". Allow for potential partners and customers to visit your operation and buy into what you are trying to accomplish with this unique growing method. Additionally, use social media websites to promote their operation and their produce. By empahsizing the HSCF producers can move beyond relying on buzz words such as local and sustainble to entice customers.

Promote transparancy and a connection between the farmers and the customer by allowing people to visit your farm or by posting online and become a part of the alternative food networks (Brue, 2016). Empahsizing the uniqueness of your operation is key to enter and thrive in niche markets as identified by Ikerd (2017) attributed the success of this value-trait marketing in the difference in quality, i.e. fresh, local, sustainable produce (Ikerd, 2017). Lastly, as a producer looking to operate a successful HSCF selection of a crop that works best for your method of production and customers is vital. Producers reported growing a variety of crops and being successful. While some chose to grow one crop and grow it well (e.g. kale), other choose to experiement with a variety of crops and relied on the input from their customers to select which crop works best for them.

Manufacturers. After conducting this study, the researcher has the following recommendations for HSCF vendors and manufacturers. Manufacturers must ensure that any figures presented to customers are attainable and support provided can help individuals operate the unit to attain those numbers consistently. HSCF vendors must hire qualified individuals who understand the growing process and can provide support to customers who are struggling with the growing process. Additionally, if HSCF vendors are offering customer service, be sure that it is consistent whether assisting a school or a producer. When reporting use, the school population expressed customer support as beneficial while producers felt that they were ignored when asked for customer support from the same manufacturer. Furthermore, the researcher recommends the creation of an online forum by manufacturers for users of their product to help one another. By creating an online forum this will provide a platform to identify issues experienced by operators.

Regarding customer support and improvement of overall design, the researcher recommends that HSCF manufacturers and vendors listen to farmers and understand what they need and what issues they are dealing with, i.e. issues with lighting, damaged crops due to harvesting procedures, micro-climates, etc. Moreover, manufactures should aim to provide a unit that runs the system off renewable energy to supplement the energy required to run the unit and combat the costs of power usage. Lastly, manufacturers aiming to ensure the long-term operation of their product should provide a sample business plan for producers or curriculum for schools.

APPENDIX SECTION

APPENDIX A: INSTRUMENTATION

Business Survey

Q1 What is the name of your business?

____

Q2 What is your current position/title in the company?

____

Q3 How long have you been employed with this company?

____

Q4 Please indicate your gender

- O Male (1)
- O Female (2)

Q5 Please indicate your age

____

Q6 Please indicate your ethnicity

- O African American/Black (1)
- O Hispanic/Latino (2)
- O Asian (3)
- O White/Caucasian (4)
- O American Indian/Alaska Native (5)
- O Other Race (6)

Q7 What was your initial cost/investment for your shipping container farm:

____

Q8 How many different shipping container farm(s) companies did you investigate before purchasing your shipping container farm(s)?

____

Q9 Please indicate which shipping container farm design(s) you utilize. Check all that apply

- ▢ Freight Farms (1)
- ▢ Growtainer (2)
- ▢ CropBox (3)
- ▢ Modular Farms (4)
- ▢ Urban Farm Unit (5)
- ▢ GrowTech (6)
- ▢ Self Designed (7)
- ▢ Other (8) ____

Q10 How was your shipping container farm funded?

____

Q11 How many shipping container farm(s) do you currently operate?

____

Q12 How long have your shipping container farm(s) been operational?

- Within the last year (1)
- 2 years (2)
- 3 years (3)
- 4 years (4)
- 5+ years (5)

Q13 Please list all of the crops that are grown in your shipping container farm.

____

Q14 Do you use any of the following on your labels? Check all that apply.

- Local (1)
- Sustainable (2)
- Organic (3)
- Green (4)
- None of the above (5)
- Other (6) ____

Q15 Please select all areas of previous background experience prior to purchasing your shipping container farm.

- ▢ Agriculture (1)
- ▢ Farming (2)
- ▢ Greenhouse (3)
- ▢ Hydroponics (4)
- ▢ Aquaponics (5)
- ▢ Gardening (6)
- ▢ Other (7) ____
- ▢ No previous experience (8)

Q17 How many people do you currently employ?

____

Q18 Is this a sufficient number of employees to run the unit at full capacity?

- O Yes (1)
- O No (2)

Q19 Please indicate the level of influence each factor had on selecting a shipping container farm for your needs

	Not Influential (1)	Slightly Influential (2)	Somewhat influential (3)	Moderately Influential (4)	Very Influential (5)
Price of Container (1)	O	O	O	O	O
Design (2)	O	O	O	O	O
Location of Company (3)	O	O	O	O	O
Growing Capability (4)	O	O	O	O	O

Q20 Please indicate any other influential factors when selecting your shipping container farm. If none, please leave blank.

____

Q21 Please indicate the level to which you agree with each statement about your shipping container farm.

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
The shipping container farm helps the farm operation be more productive (1)	o	o	o	o	o
The shipping container farm meets my needs (2)	o	o	o	o	o
The shipping container farm does everything I would expect it to do (3)	o	o	o	o	o
The shipping container farm is user friendly (4)	o	o	o	o	o
I can recover from mistakes quickly and easily when I use the shipping container farm (5)	o	o	o	o	o
The shipping container farm has given me the ability to produce locally. (6)	o	o	o	o	o

The shipping container farm has given me the ability to produce in new areas. (7)	O	O	O	O	O
The shipping container farm has enabled sustainable production. (8)	O	O	O	O	O
The shipping container farm is efficient. (9)	O	O	O	O	O
The shipping container farm is profitable. (10)	O	O	O	O	O
I would purchase another shipping container farm (11)	O	O	O	O	O

Q22 Please list any other benefits that you have experienced through the use of your shipping container farm(s). If none, please leave blank.

____

Q23 Please indicate the degree of difficulty each factor had on your business when using a shipping container farm.

	Not Difficult (1)	Slightly Difficult (2)	Somewhat difficult (3)	Moderately Difficult (4)	Very Difficult (5)
Start Up Costs (1)	O	O	O	O	O
Operational Costs (2)	O	O	O	O	O
Lack of User Knowledge (3)	O	O	O	O	O
Finding Your Market (4)	O	O	O	O	O
Finding Labor (5)	O	O	O	O	O
Power Usage (6)	O	O	O	O	O

Q24 Please indicate any other difficulties your business encountered when using your shipping container farm(s). If none, please leave blank.

Q25 Please indicate the level to which you agree that you shipping container farm(s) have met you expectations in the following areas.

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
The shipping container farm met my expectation in efficiency (1)	O	O	O	O	O
The shipping container farm met my expectation in production (2)	O	O	O	O	O
The shipping container farm met my expectation in its reduced resource use (3)	O	O	O	O	O
The shipping container farm met my expectation in ease of use (4)	O	O	O	O	O
The shipping container farm met my expectation in its incorporation of technology (5)	O	O	O	O	O
The shipping container farm met my profit expectation. (6)	O	O	O	O	O

Q26 Please list any unexpected problems your business faced through utilization of a shipping container farm. If none, please leave blank.

____

Q27 Who is your primary customer?

- O Individuals (1)
- O Restaurants (2)
- O Other (3) ____

Q28 Please list the most POSITIVE aspect(s) of utilizing a shipping container farm:

____

Q29 Please list the most NEGATIVE aspect(s) of utilizing a shipping container farm:

____

Q30 Please rate your overall satisfaction with your shipping container farm

- O Very Satisfied (1)
- O Satisfied (2)
- O Neutral (3)
- O Dissatisfied (4)
- O Very Dissatisfied (5)

Q31 Are you willing to participate in a phone interview?

- O Yes (1)
- O No (2)

Display This Question:

If Are you willing to participate in a phone interview? = Yes

Q46 What time is best to reach you? Please give a general date and time. Ex: Mondays at 2.

____

School Survey

Q1 What is the name of your school?

____

Q46 Did your school receive funding to purchase the shipping container farm?

- O Yes (1)
- O No (2)

Q45 Please indicate what your school classified as.

- O State University (1)
- O Land Grant University (2)
- O Private University (3)
- O Public Secondary School (4)
- O Private Secondary School (5)
- O Other (6)

Q44 What is the student population of your school?

____

Q2 What is your current position/title at your school?

____

Q3 Please indicate your gender

- Male (1)
- Female (2)

Q4 Please indicate your age:

____

Q5 Please indicate your race/ethnicity

- African American/Black (1)
- Hispanic/Latino (2)
- Asian (3)
- American Indian/Alaska Native (4)
- Native Hawaiian/Other Pacific Islander (5)
- White/Caucasian (6)
- Other (7)

Q6 What was your initial cost/investment for a shipping container farm(s)?

____

Q7 How many different shipping container farm companies did you investigate before purchasing your shipping container farm(s)?

____

Q8 Please indicate which shipping container farm design(s) you utilize. (Check all that apply.)

- ▢ Freight Farms (1)
- ▢ Growtainer (2)
- ▢ CropBox (3)
- ▢ Modular Farms (4)
- ▢ Urban Farm Unit (5)
- ▢ GrowTech (6)
- ▢ Self Designed (7)
- ▢ Other (8) ____

Q9 How was your shipping container farm(s) funded?

____

Q10 How many shipping container farm(s) do you currently operate on campus?

____

Q11 How long have your shipping container farm(s) been fully operational?

- O Within the last year (1)
- O 2 years (2)
- O 3 years (3)
- O 4 years (4)
- O 5+ years (5)

Q12 How are your shipping container farm(s) primarily used on your campus?

- O Educational Resource (1)
- O Food Production (2)
- O Combination of educational resource and food production (3)
- O Other (4) ____

Q13 How is the produce from the school's shipping container farm used? (Check all that apply)

- ▢ School Meals (1)
- ▢ Salad Bar (2)
- ▢ Donated (3)
- ▢ Classroom Activities (4)
- ▢ Students or community members take it home (5)
- ▢ Other (6) ____

Q14 Please indicate the likelihood of the following courses and/or concepts being taught through the use of the shipping container farm(s) on your campus:

	Very Unlikely (1)	Unlikely (2)	Neutral (3)	Likely (4)	Very likely (5)
Science Courses/Concepts (1)	O	O	O	O	O
Technology Courses/Concepts (2)	O	O	O	O	O
Engineering Courses/Concepts (3)	O	O	O	O	O
Math Courses/Concepts (4)	O	O	O	O	O
Agricultural Courses/Concepts (5)	O	O	O	O	O
Business Courses/Concepts (6)	O	O	O	O	O

Q15 Please indicate any other courses/concepts that are being taught through the use of the shipping container farm on your campus. (If none please leave blank)

____

Q16 How often do students work with the shipping container farm?

- O Daily (1)
- O At least once a week (2)
- O Every other week (3)
- O Once a month (4)
- O Never (5)

Q18 Please list all crops grown in your shipping container farm(s).

____

____

____

____

____

Q19 How many employees currently work with the shipping container farm(s) full time?

____

Q20 How many employees currently work with the shipping container farm(s) part time?

____

Q21 Is this a sufficient number of employees to run the shipping container farm(s) at full capacity?

- O Yes (1)
- O No (2)

Q22 Please indicate the level of influence each factor played in purchasing a shipping container farm(s) for your school.

	Not Influential (1)	Slightly Influential (2)	Somewhat Influential (3)	Moderately Influential (4)	Very Influential (5)
STEM Education (1)	O	O	O	O	O
Dinning Hall Production (2)	O	O	O	O	O
Sustainable Education (3)	O	O	O	O	O
Academic Lab (4)	O	O	O	O	O
Academic Instruction (5)	O	O	O	O	O
Subject Matter Reinforcement (6)	O	O	O	O	O
Extracurricular Activity (7)	O	O	O	O	O
Nutrition Education (8)	O	O	O	O	O
Experiential Learning (9)	O	O	O	O	O
Encouragement from Administrators (10)	O	O	O	O	O
Efficient Food Production (11)	O	O	O	O	O
Sustainable Food Production (12)	O	O	O	O	O
Local Food Production (13)	O	O	O	O	O

Space Efficiency (14)	O	O	O	O	O
Demonstrate commitment to sustainability (15)	O	O	O	O	O
Actively promote nutrition, health, and wellness (16)	O	O	O	O	O
Be an advocate for innovative technology and creativity. (17)	O	O	O	O	O
Cut costs (18)	O	O	O	O	O

Q23 Please indicate any other influential factors in deciding to purchase a shipping container farm(s). If none, please leave blank.

____

Q24 Please indicate the level to which you agree with each statement about the shipping container farm(s) on your campus.

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
The shipping container farm(s) helps teachers be more effective. (1)	O	O	O	O	O
The shipping container farm(s) is beneficial in teaching STEM education (2)	O	O	O	O	O
The shipping container farm(s) is a beneficial educational resource. (3)	O	O	O	O	O
The shipping container farm(s) has reduced dinning costs. (4)	O	O	O	O	O
The shipping container farm(s) has facilitated experiential learning. (5)	O	O	O	O	O
The shipping container farm(s) has improved student attitudes towards STEM areas. (6)	O	O	O	O	O

The shipping container farm(s) has improved student tests scores. (7)	O	O	O	O	O
The shipping container farm(s) has allowed access to fresh produce. (8)	O	O	O	O	O
The shipping container farm(s) is user friendly. (9)	O	O	O	O	O
Your school would purchase another shipping container farm(s) (10)	O	O	O	O	O

Q25 Please indicate any other benefits your school has encountered through the use of the shipping container farm(s). If none, please leave blank.

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Q26 Please indicate the level of difficulty each factor played in the implementation of the shipping container farm(s) at your school.

	Not Difficult (1)	Slightly Difficult (2)	Somewhat Difficult (3)	Moderately Difficult (4)	Very Difficult (5)
Funding (1)	O	O	O	O	O
Distance from School Building (2)	O	O	O	O	O
Administration Support (3)	O	O	O	O	O
Teacher Support (4)	O	O	O	O	O
Availability of Supplies (5)	O	O	O	O	O
Availability of Water (6)	O	O	O	O	O
People to maintain the shipping container farm(s) during the school year (7)	O	O	O	O	O
People to maintain the shipping container farm(s) during the summer (8)	O	O	O	O	O
Leadership to sustain a shipping container farm(s) (9)	O	O	O	O	O

Overall lack of interest of school community (10)	O	O	O	O	O
Lack of Resources (11)	O	O	O	O	O
Lack of teacher training (12)	O	O	O	O	O
Relating the shipping container farm(s) to the curriculum (13)	O	O	O	O	O
Adequate Space (14)	O	O	O	O	O

Q27 Please indicate below any additional difficulties encountered when implementing a shipping container farm in your school. If none, please leave blank.

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Q28 Please indicate to which level you agree that your shipping container farm(s) have met your expectations in the following areas.

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
The shipping container farm met my expectation in efficiency (1)	O	O	O	O	O
The shipping container farm met my expectation in production (2)	O	O	O	O	O
The shipping container farm met my expectation in its reduced resource use (3)	O	O	O	O	O
The shipping container farm met my expectation in ease of use (4)	O	O	O	O	O
The shipping container farm met my expectation in its incorporation of technology (5)	O	O	O	O	O
The shipping container farm met my expectation in profitability (6)	O	O	O	O	O

Q29 Please list any unexpected problems your school faced through utilization of a shipping container farm. If none, please leave blank.

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Q30 Please list the most POSITIVE aspect(s) of utilizing a shipping container farm in your school.

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Q31 Please list the most NEGATIVE aspect(s) of utilizing a shipping container farm in your school.

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Q32 Please rate your overall satisfaction with your shipping container farm(s)

- O Very Satisfied (1)
- O Satisfied (2)
- O Neutral (3)
- O Dissatisfied (4)
- O Very Dissatisfied (5)

Q33 Are you willing to participate in a phone interview?

- O Yes (1)
- O No (2)

Display This Question:

If Are you willing to participate in a phone interview? = Yes

Q47 What time is best to reach you? Please give a general date and time. Ex: Mondays at 2.

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APPENDIX B: COVER LETTER

Marcella Juarez, a graduate student at Texas State University, is conducting a research study to identify the motivations, benefits, and challenges of shipping container farms. You are being asked to complete this survey because you utilize a shipping container farm as a part of your school or business.

Participation is voluntary. The survey will take no more than 15 minutes to complete. You must be at least 18 years old to take this survey.

This study involves no foreseeable serious risks. We ask that you try to answer all questions; however, if there are any items that make you uncomfortable or that you would prefer to skip, please leave the answer blank. Your responses are anonymous.

If you have any questions or concerns, feel free to contact Marcella Juarez

Marcella Juarez, graduate student
Agriculture Department
(956) 754-9330
Mij1@texasstate.edu

This project 2018104 was approved by the Texas State IRB on November 1, 2017. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to the IRB chair, Dr. Jon Lasser 512-245-3413 – (lasser@txstate.edu) or to Monica Gonzales, IRB Regulatory Manager 512-245-2334 - (meg201@txstate.edu).

If you would prefer not to participate, please do not fill out a survey.

If you consent to participate, please complete the survey.

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