

Problem

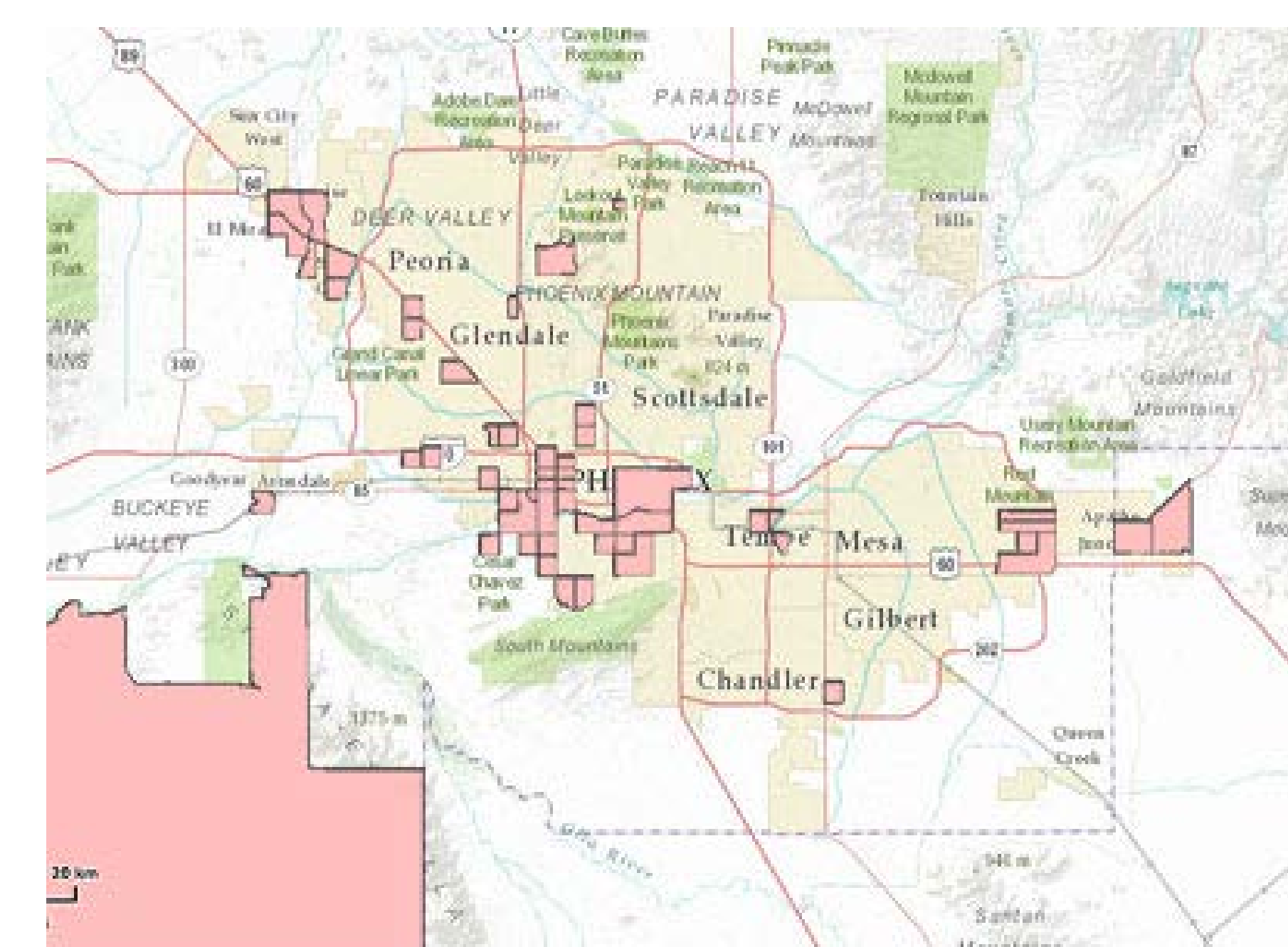


Figure 1. Food Deserts in Maricopa County Shown in Pink

- **Food deserts** are defined as a “low-access community” with at least 500 people and/or at least 33% of the census tract's population must reside more than **one mile** from a **supermarket** or large grocery store.¹
- Using the USDA food desert guidelines, Maricopa County was home to **55** food deserts in 2012.
- These 55 food deserts, and the associated food insecurity, impact over **700,000** Arizona residences.²

Approach

- The goal of this research is to investigate the viability of practicing vertical farming in inner-cities, abandoned warehouses, multi-use buildings, and rooftops to fill the need created by food deserts.
- Mesa Community College (MCC) is awaiting the installation (by the end of 2019) of an indoor vertical farm capable of growing healthy food with less water than traditional farming practices.
- In urban areas where traditional farming is not practical, vertical farms fill a vital role.

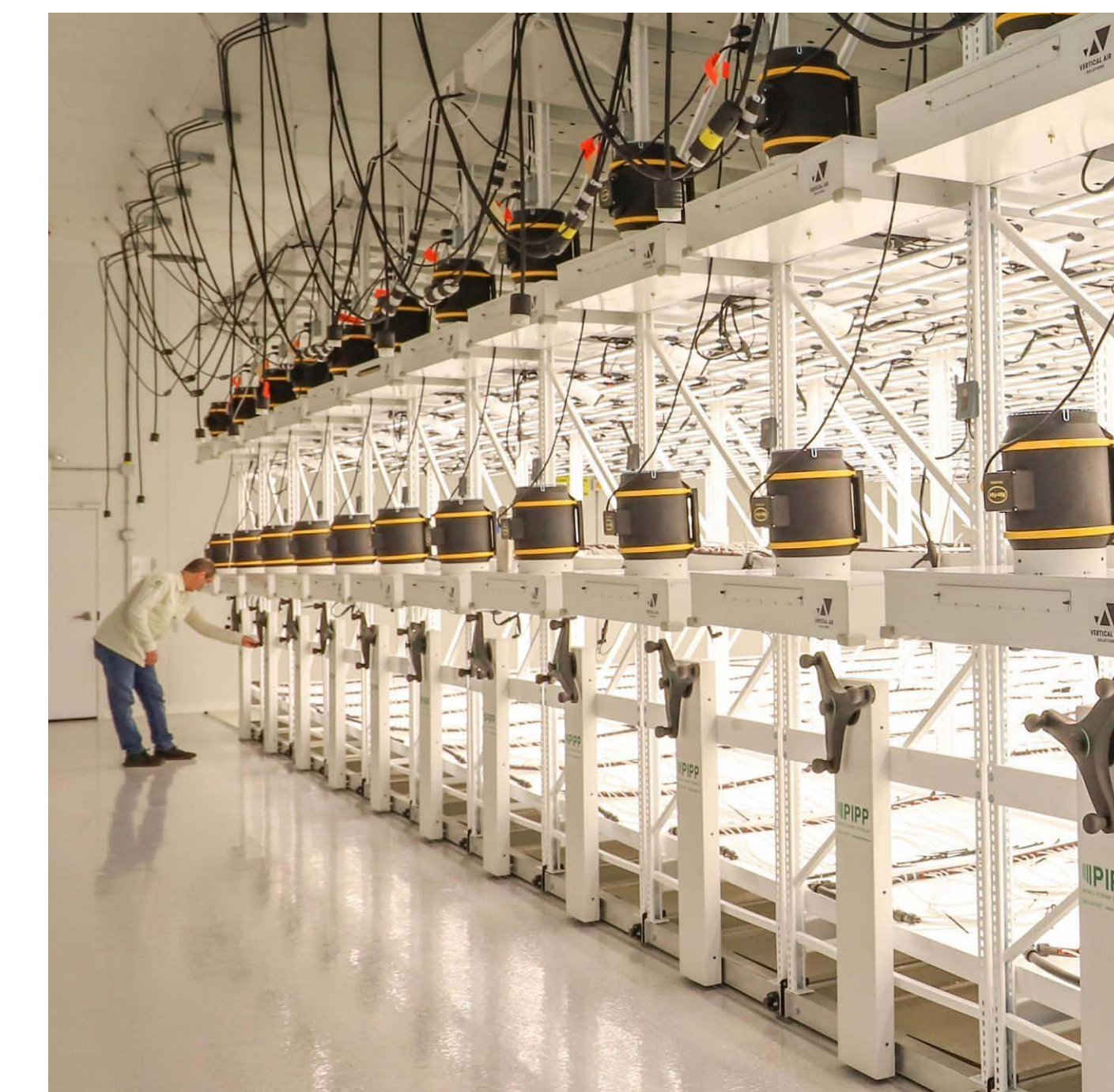


Figure 2. PIPP Horticulture Vertical Farm System

Results

- This system uses up to 95% less water and less than 50% of the fertilizer than an open-air organic farm would consume by delivering all of the necessary nutrients directly to its crop's roots and recycling the solution in a closed loop system. Vertical farming seeks to operate in unutilized warehouses and retail spaces, which will serve to control every aspect of the growing environment. This entails replacing sunlight with specially designed LED lights for horticulture applications, and an HVAC system that creates the perfect growing conditions for plants to transpire. All of these capabilities translate into vertical farming being able to grow consistently year-round, regardless of weather, and produce quality local vegetables 30% faster than a conventional farm.

- Arizona has a glut of underutilized space in many school districts in the form of both entirely vacant and underutilized facilities—over 1.4 million square feet of reported vacant or underused building space, and even more available capacity going unreported.⁴ This space could be used to grow nutritious, local food, and can be used as a learning opportunity for students and teachers alike.
- Vertical farms can utilize hydroponic, aeroponic, aquaponic, or soil based systems. A possible collaboration with another project being worked on to collect all food waste on campus and turn it into compost, would be to use a soil based system. One possible downside to this is lack of precision when delivering nutrients.



Figure 3. Traditional vs Vertical Farming Infographic

- The net operating income of a prototype designed in collaboration with the University of Arizona's Controlled Environmental Agriculture, is estimated to be 11.94%, with revenue in excess of \$5.7 million and the largest costs being the LED lights and electricity. There is potential for renewable energy sources to be used as affordable, environmentally responsible energy sources. “The Vertical Farm” has mitigated its potentially largest cost, labor, by streamlining all processes of production in addition to employing the use of high-tech materials handling robots to transport crops within the facility. The Vertical Farm's production facility is not designed with human comfortability in mind (aisles are only 3' wide), but instead maximizes floor space utilization in order to produce as many pounds of product as possible.
- Vertical farming produce can be grown for \$3.07 / lb.⁵, therefore, microgreens and greens show the most promise of being profitable for the weight of each unit or head.

Conclusions & Next Steps

- In conclusion, vertical farming is a viable alternative to conventional agriculture. It can serve as an intervention point to food insecurity and food deserts in underserved communities.
- Examples of successful businesses in the Phoenix area that use vertical farming are Bambox and AZ Microgreens.
- This is a burgeoning market that will only continue to become more profitable as land becomes more expensive and renewable energy comes down in price.

Funding

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¹Gallagher, M. (2011). USDA Defines Food Deserts. Retrieved October 8, 2019, from <http://americannutritionassociation.org/newsletter/usda-defines-food-deserts>.

²Fergus, Barrett, & Walter Cronkite School of Journalism. (2017, May 1). Retrieved October 8, 2019, from <https://repository.asu.edu/items/43747>.

³Nickerson, Michael Scott, Eaton, Kathryn, Schlacter, John, Department of Management Entrepreneurship, & Barrett, The Honors College. (2016). *The Economic Feasibility of Indoor Vertical Farming*.

⁴https://arizona-asu-primo.hosted.exlibrisgroup.com/permalink/01ASU_DR42751

⁵Empty Schools Full of Promise: Exploring the Benefits of District-Charter Co-location Partnerships in Arizona. (n.d.). Retrieved October 8, 2019, from <https://goldwaterinstitute.org/article/empty-schools-full-of-promise/>

⁶The Economics of Local Vertical and Greenhouse Farming Are Getting Competitive. (2019, August 16). Retrieved October 2019, from <https://agfundernews.com/the-economics-of-local-vertical-and-greenhouse-farming-are-getting-competitive.html>.