High Tunnels: High rewards for farms and farmers

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High Tunnels Growing into Local Food Systems

ABSTRACT:

High tunnels (HTs) constitute a growing, local level response to the globalization of our food. As semi-permanent greenhouses, HTs bring practical on-farm solutions to biophysical growing constraints; they extend the growing season and buffer delicate crops from extreme weather events. In 2009, the Natural Resource Conservation Service (NRCS) began subsidizing the construction of HTs with the documented goals of increasing environmental stewardship and the added benefit of promoting local foods. However, many questions remain about the impacts of HT’s. Who is benefiting from the NRCS HT program? Will farmers continue to adopt HTs in the absence of government subsidies? What is their production potential? This paper explores the impacts of the NRCS HT program and high tunnels on farms, consumers, and the local food movement. Preliminary results indicate that farms with high tunnels are expanding around areas with the greatest demand for local produce. The combined results from farmers who use high tunnels and the United States government who pays for the leads us to conclude that high tunnels are a growing part of the U.S. food system with the potential to increase access to local produce.

BACKGROUND:

Most of the farms that can grow produce year round are not near metropolitan areas like Chicago or New York for example. In areas like this where production seasons are limited by cold winters HTs can expand the production window for farmers who are near metropolitan areas, increasing the availability of local produce in regions as cold as the northeastern U.S.

Constructed from wooden frames and covered in clear plastic, high tunnels are relatively simple to construct and can be an economic boon to farmers. In 2014, an acre of corn is projected to net the average farmer $284/acre (or just $34/acre if the land is leased). In contrast, HTs can earn a farmer as much as $100,000/acre (Moss, 2014). Of course, the market must first be identified to ensure sales of HT produce (Orzolek, 2013). Despite growing competition from foreign markets, there is growing interest, especially in metropolitan areas, for extended-season, locally grown produce (Conner, 2009). It has even been confirmed that those who shop at farmer’s markets are willing to pay a premium price for extended season vegetables (Conner, 2009).

In 2008, HT acreage was between 4,666 and 5,027 acres (Carey, et al.) compared with 334 million acres of total fruit and vegetable crop production in the U.S. (ERS, 2007). While HTs represent a small proportion of U.S. fresh produce acreage, the popularity of high tunnels continues to grow, especially since the advent of USDA’S Seasonal High Tunnel (SHT) cost share initiative program in 2009. Under this program, a farm is eligible for a HT paid for by the NRCS (up to $3,500).

The USDA’s stated goals for the SHT initiative are to reduce erosion, pest pressures, and pesticide use, but HTs have the added benefit of promoting local foods. In 2011, USDA undersecretary Kathleen Merrigan stated that, “By capturing solar energy, seasonal high tunnels create favorable conditions enabling farmers to grow vegetables, berries and other specialty crops in climates and at times of the year in which it would not be impossible otherwise. Farmers who sell their high tunnel produce locally benefit from the extra income and the community benefits from the availability of fresh, locally grown food” (Kim, 2011). This project aims to test this combination of benefits to determine if
HTs really can increase local sales, plant health and the conservation value of the farm and food system. It is important to understand the mechanisms which provide the benefits Merrigan mentions. The income spurred by HT production also impacts the greater food system, which in turn affects production decisions, which have further environmental outcomes (Peters, 2008).

While HT adoption in the U.S. is just taking hold, protected vegetable production is very advanced in other parts of the world. In China, there were more than four million hectares of protected production in 2010 (Kang, 2013). In order for the U.S. to keep up with the global trend of protected cultivation and capitalize on the potential there is a need to better understand the potential for high tunnel production to grow and meet produce demand.

![Value of direct-to-consumer sales, by county, 2007](image)

**Figure 1** Areas in blue show the highest amount of direct sales. Areas in green show higher than average direct sales. Areas in yellow have an average number of direct sales. It is likely that most high tunnels are located within 100 miles of the blue areas.

There is potential for HTs to reduce pesticide use, increase plant health and yields. If HTs also increase the income of farms and the availability of locally grown product it may be possible to further justify their benefits to conservation. Furthermore, the local sales themselves may contribute to greater on-farm conservation efforts by the same reductions in pesticide use and increases in plant health and yield. Local sales can then too be justified as a conservational effort helping to preserve the integrity of the food and farm ecosystem.

The delicate nature of most high tunnel products limits their ship-ability (Orzolek, 2013) suggesting that they will remain in the local food-system and contribute to direct-to-consumer agricultural sales. However, many critics of the local food movement say that it is a luxury of the middle, often urban middle class (Patel, 2007) and recent analysis of agricultural statistics supports this presumption. Low and Vogel (2011) found that agricultural direct sales are highest in metropolitan areas, especially those on the West Coast and Northeastern United States (Figure 3) where incomes tend to be high. This leads to the possibility that the USDA SHT subsidies may be disproportionately benefiting high income urban consumers. The extent to which HTs may be benefiting farmers and increasing their incomes in the absence of subsidies is also largely unknown.
The purpose of this project is to measure the conservation value of high tunnels (HTs) using measures of plant health and the HT’s geospatial relation to metropolitan areas in the United States. Carey et al. (2008) have estimated total HT acreage to be between 4,665 and 5,026 acres versus the 408 million acres used for total vegetable production (ERS, 2007). While still only covering a small percentage of total vegetable acreage, high tunnels are growing in popularity and provide benefits to both producers and consumers. HTs give growers an opportunity to increase local food production and increase their direct sales (Conner, 2009) by providing out-of-season product to consumers during an otherwise limited selection season (early spring and late fall/winter).

After four years of government support, it is important to examine the impacts of the NRCS SHT program and to explore the potential of HTs to expand local food systems. In this paper, we will address the following questions related to HTs and their potential contributions to local food systems:

1) How has the NRCS cost-share program impacted HT adoption and distribution geographically?
2) What is the production capacity of HT’s in the local food system and are HT products marketed and directly?
3) Based on collected production capacity data and historical trends of adoption, what impacts can be predicted about the relationship between HT’s and the food system?

Identifying a significant correlation between high tunnel production, increased direct sales, and improved plant health, could lend useful insight to the benefits of incorporating conservation measures (like HTs) into specialty crop production. Conservation is an important part of sustainable agriculture economically, by minimizing costs through reduction of pesticide usage; environmentally, by promoting localized production thus reducing transportation based pollution; and socially, by ensuring societal value of good food.

HT production improves economic viability by allowing a farmer to increase his or her annual income by elongating the growing season. The production of high value crops during periods of season extension makes it possible to receive a significant return on a small land area. This increased profit margin during seasonally low production windows can make meaningful contributions to economic sustainability for farms and markets.

High tunnels can boost on-farm biodiversity by increasing the number of crops that can grow throughout the year, because they are no longer limited by traditional temperature restrictions. This project studies that competitive edge and will explore how it could be made most advantageous during the greatest portion of the year.
Figure 2. Shown above is combined data from 2009, 2010, 2011 and 2012 via NRCS. Counties in white had no high tunnels constructed over those four years. As the counties become bluer their high tunnel construction grows.

Finally, the rural areas that feed the metropolitan areas stand to benefit from the expansion of high tunnel production. High tunnels are most likely to be found on rural farms that market towards urban customers. They have been used in more urbanized production; however the preliminary geospatial data of high tunnel distribution indicates otherwise (Figure 2).

While each of these benefits on their own is valuable, it is the high tunnel’s unique ability to bring every one of those elements together that makes it worth studying further. While many studies have been conducted investigating high tunnel production efficiency, little has been done to investigate their impact on the food system overall. The potential to produce food during the otherwise off-season has broad appeal for many small to mid-sized farmers who depend on high value direct sales, as opposed to commodity markets. High tunnels have been cited by the NRCS to improve plant health, and increase farm income while also conserving the land. This project will examine how we use high tunnels to enhance farm stewardship and income, because both are needed for healthy and long lasting farm and food systems.

METHODS:

GIS Analysis

The following data will be compiled to better understand where HTs are being adopted, their contributions to local foods, and the communities where they are located:
1. The number of NRCS funded HTs/county.
2. A map of U.S. urban centers.
3. A map of the average household income/county.
4. USDA’s Economic Research Service (ERS) food access data including food deserts, farmers markets, and community supported agriculture (CSA) programs, and direct-to-consumer sales.

ArcGIS 10.2 will be used to determine whether NRCS HTs tend to be clustered around urban centers and what proportion of the HTs are within 100 miles of metropolitan areas. Their locations will also be used to determine any correlations with direct sales, farmers markets, and CSAs to infer contributions to local food systems. HT distributions will also be related to income levels and food deserts to infer potential contributions to the production community and economy.

**Farmer Surveys**

In coordination with Virginia’s Agricultural Cooperative and Extension Service, 60 HT owners in Virginia will be surveyed spring 2014 to collect the following data to better understand the types of farmers adopting HTs and how they are selling their produce:

1. Farmer demographics and farm characteristics
2. Sales method of the HT product (direct vs. indirect)
3. If farmers would adopt HTs without government subsidies
4. Average revenue generated by the farm’s HT(s)
5. The sales venue for their HT product(s)
6. The distance the typical HT product travels.

**Synthesis**

Data from the NRCS SHT program will also be used to determine the rate of HT adoption and production capacity. Assuming each tunnel is between 30 feet wide by 75-90 feet long, the total acreage of HT crops will be determined and used to calculate the potential production capacity of the HTs. Estimates will be compared to those cited by Carey et al. (2008) to predict future trends in high tunnel adoption and potential impacts on local foods.

**(Preliminary) RESULTS/DISCUSSION:**

Since 2010 5,778 HTs have been sponsored through the EQIP SHT via the NRCS (USDA, 2013) in 50 states. Combining the NRCS 2009-2012 HT numbers with 2008 data (Carey, 2008) with the most HTs seem to be in the Northeastern United States. This indicates that, that when HT production occurs near areas with large populations in appropriate climatic conditions (like the northeastern U.S.), the produce grown is likely to follow a source-sink relationship. Produce grown by small and mid-sized farmers will tend to travel from the HT to areas with greatest demand for the product (Low and Vogel, 2011).
Figure 3 Indicates that (n=30) surveyed farmers sell 75% or more of their high tunnel products within 50 miles of where it was grown (Foust-Meyer, unpublished).

Many critics of the local food movement say that it is a luxury of the middle, often urban middle class (Patel, 2007). This research will establish an opportunity for further insight into building local food systems that increase food security and sovereignty. While more local produce may be available to consumers because of HTs there is likely room to expand their benefits to a larger demographic. It is important to ensure that HTs, especially those subsidized by the federal government, contribute to all income levels of the local food movement.

Metropolitan areas exhibit great promise in encouraging the growth of robust local food systems, however; but the historically underserved and low income families may not share in the bounty without knowing where the produce reaches the plate and how. Before local produce can make it into all income brackets we must research how local produce, and therefore HT produce, travels through the food system and onto our plates.

Survey results (n = 30) indicate that most farms with high tunnels sell 75% or more of their product within 50 miles of where it was grown (Table 1). These results confirm the notion that high tunnel growers are most likely to sell their product locally, usually through direct sales venues (farmer’s markets, roadside stands, CSA programs, etc.).

Additionally those who have participated from the NRCS SHT initiative indicated that they were likely to purchase another high tunnel even without the subsidy (Figure 4). This can be attributed to the benefits high tunnels bring to growers, allowing them to grow and sell produce during times of the year when there is little opportunity to generate revenue.
Figure 4 indicates that 76% of respondents (n = 30) would forgo the NRCS funding and purchase additional high tunnels for their farms.

CONCLUSIONS

Food systems that are less dependent on imported produce require novel technologies that can usurp biophysical growing constraints. The results from this study indicate that high tunnels are a popular means of doing so, and the majority of farmers agree. High tunnels are poised to benefit farmers by bringing them greater opportunities to generate income, and their customers benefit from the increased availability of locally grown produce.

Further studies are needed to determine where all HTs, not just those funded by the NRCS cost-share program are. Knowing where these high tunnels are located will allow for deeper insight into the production capacity of local farms. Additional research into where the greatest benefits from HT production exists could boost the impact of the NRCS SHT initiative on local production.

High tunnels make it possible for farmers and consumers to benefit from local production, distribution and sale of fruits and vegetables. There is a mutual benefit to each as the ability of the farmer to grow food expands. It is our hope that this research helps increase our understanding of solutions to biophysical production constraints in local food system development and that it increases our insight into the efforts the NRCS and local farmers are going to, in order to help meet the growing demand for food grown close to home.
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