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Demand for Local Produce from Passive Solar Greenhouses: Contributions to Sustainable Food Systems

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The length of the growing season can limit sales of locally grown foods despite increasing demand. Season-extension technologies such as passive solar greenhouses ("hoop houses") have potential to address this constraint. This paper reports findings from the first year of a project which measures the potential benefits of hoop houses to farm viability and sustainability in three Michigan regions. We begin to determine the potential market for hoop-house–grown produce and whether consumers will patronize extended-season farmers. Using results from four methods (dot poster surveys, written surveys, focus groups, and experimental auctions) conducted at three Michigan farmers markets, we find that consumers greatly value locally grown foods, are willing to patronize early- and late-season farmers markets, and report willingness to pay a premium for local produce. We explore the meaning and value of "local" from previous research and the contributions of hoop-house–grown produce at farmers markets to meeting demand for attributes associated with local produce. We conclude with observations on the role of season extension in the development of local sustainable food systems.

Many signs point to increased importance and demand for locally grown food, from popular culture to increasing numbers of farmers markets, community supported agriculture programs, and other direct-market outlets. This growing demand presents an important niche-marketing opportunity, particularly for small- and medium-scale farmers selling directly to consumers.

Increased sales of locally grown foods can bring a wide variety of benefits to communities as well, increasing the overall sustainability of food systems. Economically, local food sales support regional farmers. Farmers markets, a key outlet for local food, often serve as small-business incubators, bring additional shoppers to patronize downtown businesses, and serve important social functions for both customers and farmers (Hilchey, Lyson, and Gillespie 1995; Hunt 2007; Kezis et al. 1998). Local food production and consumption is a key component in civic agriculture, which is touted as having a host of community benefits (Lyson 2000). Finally, local food purchases can decrease the food miles traveled and concomitant fossil-fuel consumption, carbon footprint, and infrastructure wear.

According to recent studies, consumer perception of local food is seen as having three broad (potentially overlapping) dimensions: spatial proximity; food quality and freshness; and relationships between consumer and producer. These dimensions are described in one study as "place, taste and face to face" (Selfa and Qazi 2005). Other studies show these factors help drive demand for locally grown foods (Brown 2003; Darby et al. 2008; Zepeda and Leviten-Reid 2004). However, in a series of Wisconsin focus groups designed to understand consumer views on local food, only one consumer mentioned seasonality as a component of eating locally (Zepeda and Leviten-Reid 2004).

For much of the nation, including Michigan, seasonality poses a major constraint on the consumption of locally grown fresh produce. Much of Michigan is in USDA plant-hardiness zones four and five, implying no more than six frost-free months; this severely constrains farmers' ability to meet local food demand and contribute to agricultural sustainability. One possible solution is the use relatively low-cost passive solar greenhouses (aka, high tunnels or "hoop houses") for season extension.

This paper reports findings from a USDA-funded project which tests the potential contributions of hoop houses to farms' economic and environmental well-being. In other components of this project, we are conducting on-farm research to measure profitability and farmer-adoption experiences, and an embedded-energy study to compare local hoop-house versus imported vegetable production. This paper reports on the first phase of research conducted at farmers markets, which begins to measure consumer demand for hoop-house–grown produce. The key

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questions of this research are determining whether consumers will patronize extended-season markets, whether consumers will pay a premium for local produce, and what attributes and products consumers most value. This information will help farmers determine their marketing mix.

Methods

We used four complementary methods to gauge consumer demand, three of which were conducted entirely at and during three Michigan farmers markets: Ann Arbor Farmers Market, Sweetwater Local Foods Market (Muskegon, MI), and Sault Ste Marie (SSM) Farmers Market. From June to August 2007, the following methods were used to elicit information from market shoppers: dot poster surveys, written surveys, and focus groups (conducted only at Sweetwater and SSM, due to logistical difficulties at Ann Arbor). The fourth method involved a series of experimental auctions, which were conducted at the Sweetwater Market and in East Lansing, MI between March and June 2008. All protocols were approved by Michigan State University's Institutional Review Board for Human Subjects (IRB# X06-340)

The dot posters measured shoppers' actual and potential market attendance. Shoppers were asked to state the earliest month they attended the market in 2007 and the last month in 2006. Other posters asked the earliest and latest month shoppers would be willing to attend the market if fresh local produce was available. A total of 442 people participated

The written surveys (N = 195) counted shoppers' total visits to the market in 2006 and 2007 and their intended expenditure at the market during their current visit. Shoppers were then asked to consider the following hypothetical scenario:

> Suppose you are shopping for bag of fresh salad greens. You have the option of buying (1) produce that was grown outside of the state, or (2) produce that was produced by a local farmer in an unheated greenhouse (hoop house). The two items are the same in size, quality and appearance. Suppose item (1), the salad greens grown outside of the state, cost $2.00 per bag. What is the most you would pay for item (2), local hoop house produce?

Following this, the survey asked the consumer to consider the price they named above and asked them on what proportion of produce items they would pay that amount, choosing between these responses: only a few items I buy, many items I buy, most of the items I buy, all of the items I buy. Shoppers were then asked to choose from a list of vegetables they would particularly like or not like to buy. The final set of questions asks respondents to rate the importance of a set of attributes (on a 1–10 scale, 1 being not at all, 10 being very important): (i) grown within 20 miles of this market, (ii) grown within 100 miles of this market, (iii) grown in Michigan, (iv) I personally know the farmer who grew it, and (v) produce grown with organic methods.

Two focus groups (N = 16, eight at each session) were conducted in a meeting room near the market location in July and August 2007. The focus groups included a set of nine questions concerning the shoppers' attitudes, motivations, preferences, and behaviors at that market.

As a means of comparing the stated-choice willingness-to-pay measures from the survey, a set of three experimental auctions were conducted with 46 total participants. Subjects were recruited through the Sweetwater Market managers' newsletter, a university departmental listserv, and the newsletter of a local church. Participants were given a $25 stipend which they used to bid. At each session, two bags of organic salad greens, each approximately one-half pound, were auctioned; one was grown locally, one was not. A second-price English auction was used due to its incentive-compatible properties, with three rounds (to avoid wealth effects in bidding), the binding round determined by lot. The bids for each round were recorded and the means for each item compared by a paired-means T-test. At the end of the three rounds, participants completed an exit survey which asked them (i) to state the percentage of produce purchases for which they would pay their auction bid; (ii) to rate factors beyond local/not local which influenced their bid, including provenance, packaging, and mix of species; and (iii) to rate the same attributes included in the written survey.

Results

Results from the dot posters suggest that consumers would be willing to attend the farmers markets both earlier and later if fresh produce were avail-

able. While 23 percent actually attended markets in January or February, 69 percent indicted a willingness to do so. Similarly, 61 percent last attended in November or December, but 91 percent would be willing to do so.

Written surveys confirmed that shoppers attended the markets regularly. The mean and medium visits per shopper in 2006 and 2007 were 18.8 and 9.9, respectively. Shoppers spent or planned to spend an average of $20.51: 14 percent said they spent 0–$10, 47 percent said $10–$25, and 39 percent reported spending more than $25. Most shoppers also expressed willing to pay a premium for local produce (Figure 1); only nine percent would pay the same or less for local produce. Additionally, the majority would pay this premium for most or all the produce they buy (Figure 2).

The most desirable products to these shoppers are tomatoes (85 percent), lettuce (70 percent), and spinach (70 percent). Consumers are least likely to purchases radishes (26 percent). The most important attributes are grown in Michigan and grown with organic methods (Table 1).

The major themes of the focus groups are that the shoppers attend the farmers markets regularly, in many cases, buying most or all of their produce there when in season. Furthermore, these markets are the only locations where the shoppers can find the foods with the desired characteristics: pesticide-free produce and pasture-raised livestock products for Sweetwater shoppers and fresh, high-quality produce for SSM shoppers. Sweetwater shoppers in particular expressed great loyalty, saying they would shop there year round, buy most or all their food there and that only an ice storm would keep them away. These consumers also enjoy socializing with other shoppers and value trust-based relationships with farmers.

The experimental auction yielded similar WTP results as the written survey. On average, participants were willing to pay $2.96 for the one-half pound of local greens and $2.26 for the non-local greens, a $0.70 (31 percent) premium. The average bids for local and non-local are significantly dif-

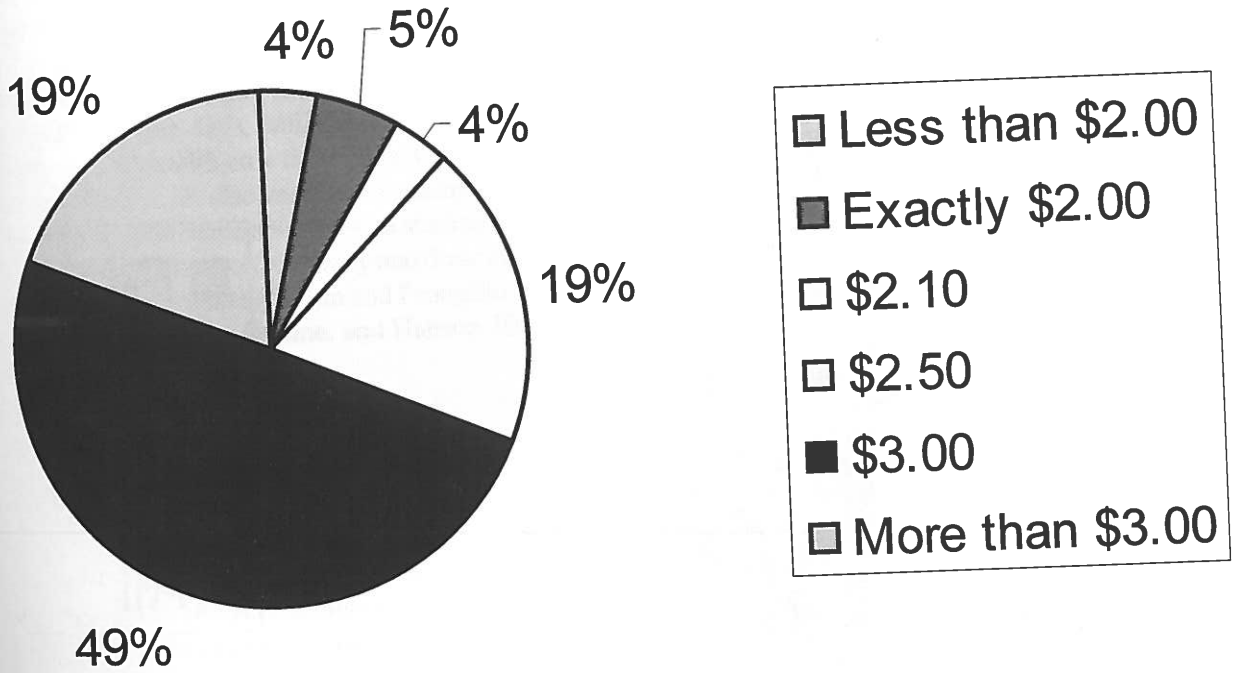

Figure 1. Willingess to Pay for Local Produce.

ferent, as measured by the paired-means T-test. On average, the auction participants said they would pay their bids on 63 percent of the produce they buy, with 11 percent willing to pay this price on all items. When asked about factors influencing their bids, the provenance of the produce was by far the most important attribute in the bids: 65 percent rated this as greatly important, whereas only nine percent rated it as not important. The mix of greens was also important to many: 39 percent and 33 percent rated it as greatly and moderately important, respectively. Packaging was only greatly important to a few (seven percent).

Grown in Michigan and grown with organic methods again had the highest ratings, although the auction participants rated organic highest. Overall, the auction participants had lower mean and median ratings on all attributes than did the farmers market shoppers (Table 1).

Discussion

Throughout the nation and Michigan, consumers are expressing greater interest in locally grown foods, creating niche-market opportunities for farmers. Season-extension technologies like hoop houses permit farmers to extend the availability of almost any crop and produce a number of cold-tolerant crops in the coldest months, thereby addressing seasonality, a major constraints of local food consumption. Before adopting this technology, it is important for farmers to understand the potential market for the products.

Our research measures consumer attitudes and demand for local food at three Michigan farmers markets where farmers growing in hoop houses sell their wares. Data from a combination of four research methods suggests a viable market for farmers using season extension. These shoppers indicated that fresh produce will draw them to late- and early-season farmers markets, and many are willing to pay a premium price for potentially large amounts of a wide variety of produce items. These premiums hold up under both stated- and revealed-choice methods.

While each of the three dimensions of local (spatial, quality, and social) found in previous studies (Selfa and Qazi 2005) creates some degree

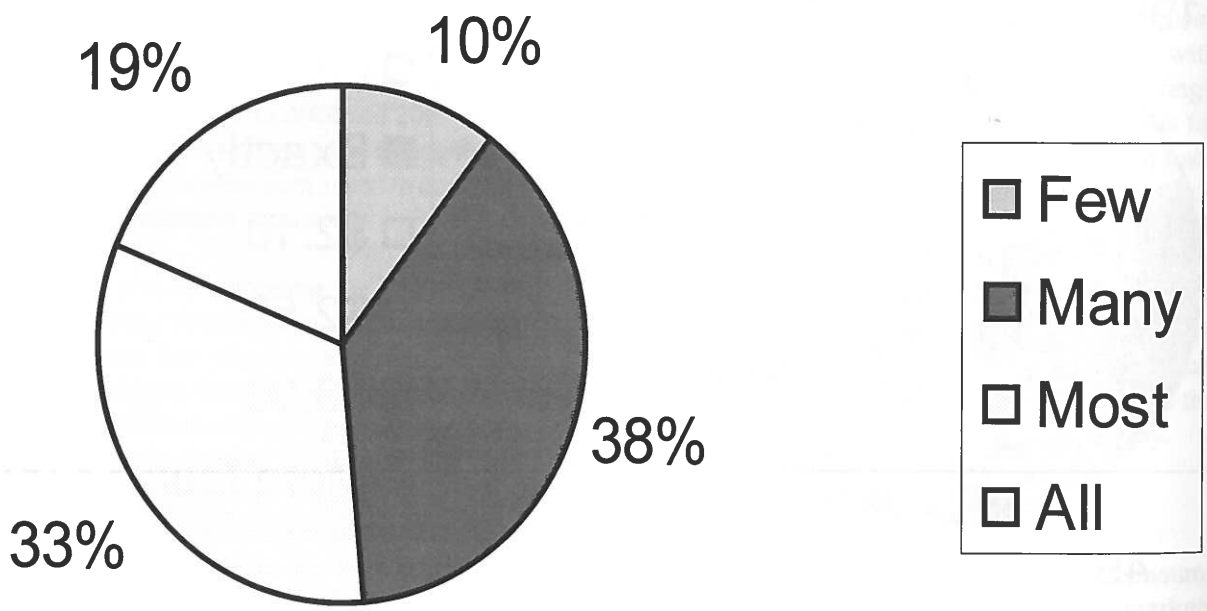

Figure 2. Proportion of Items WTP Premium.

Table 1. Mean and Median Rating of Selected Attributes (10-point scale).

Participant group	Attribute	Grown less than 20 miles away	Grown less than 100 miles away	Grown in Michigan	Knowing the farmer who grew it	Organic methods
Farmers market shoppers	Mean	6.62	6.59	7.88	4.79	7.39
	Median	8	8	10	5	9
Auction participants	Mean	5.11	5.65	6.89	5.22	7.17
	Median	5	7	7	5	8

of value, for these consumers geographic proximity, especially "grown in Michigan," appears to be a particularly important attribute, and would likely be a successful cornerstone of farmers' promotional efforts. Knowing the farmer was overall the least important attribute as rated by the farmers' market shoppers, despite the importance of trust-based relationships expressed by some focus-group participants. This result is consistent with Howard (2006), which found that consumers overwhelmingly prefer to get information (including "local") about food products from labels or brochures rather than through interaction with the seller. This may come as welcome news for farmers, who may feel freer to focus on selling rather than on socializing on busy markets days, while still perhaps making the time to chat with core customers. Growing with organic methods is also important to many consumers, which is not surprising: several studies suggest that organic growers add diversity and draw customers to farmers markets (Griffin and Frongillo 2003; Hunt 2007; Kremen, Greene, and Hanson 2004).

Conclusion

Although buying locally grown foods does not automatically enhance the sustainability of food systems (Bellows and Hamm 2001; Born and Purcell 2006), it is difficult to imagine sustainable food systems without farmers and consumers in close proximity. By fostering the viability of farms, enhancing relationships among actors, and decreasing food miles and their concomitant environmental impacts, local food purchases, and farmers markets in particular, have a wide array of potential benefits. The use of season-extension technologies such as hoop houses permits consumers to continue to buy from local farmers year-round, which increases the period and magnitude of cash flow, and may foster customer loyalty by keeping consumers in the habit of buying local.

Our research suggests a strong potential market for hoop-house–grown produce. Together with other components of the project, this can inform farmers' decisions to adopt this technology and guiding strategies which enhance chances of success. Nonetheless, this research has many limitations. First, the sample of consumers is limited to shoppers at these markets on particular days, and may not be representative of all the markets' shoppers, let alone of the state or region. The willingness to pay measures, while using both stated- and revealed-choice methods, do not measure consumers' repeated actions in an actual market setting.

Finally, many questions remain as we seek to understand the contributions of hoop houses to farm viability. Foremost is the durability and depth of demand. Specifically, even in light of farmers markets sustained growth, will large numbers of the general public attend extended-season markets? And how many hoop houses on how many farms can a given extended-season market support? While many questions remain, we hope this research stimulates interest in season-extension technology as a means to enhance the sustainability of local food systems.

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