Food Gardeners' Productivity in Laramie, Wyoming: More Than a Hobby

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Objectives. We quantified the productivity of food gardens in Laramie, Wyoming, over 3 growing seasons.

Methods. From 2012 to 2014, 33 participating gardening households weighed and recorded each harvest. Academic partners measured plot sizes and converted reported harvest weights to volume in cups.

Results. The yield of the average 253-square-foot plot was enough to supply an adult with the daily US Department of Agriculture–recommended amount of vegetables for 9 months.

Conclusions. Gardeners produced nutritionally meaningful quantities of food; thus, food gardening offers promise as an effective public health intervention for improving food security and nutritional health. (*Am J Public Health.* 2016;106:854–856. doi:10.2105/AJPH.2016.303108)

In the United States, major public health nutrition problems include low vegetable consumption, high food insecurity and obesity rates, and lack of access to a local grocery store.[1–3] Growing vegetables in home and community gardens offers a promising strategy for improving these issues. A large body of observational research suggests that home and community food gardening yields a wide range of health benefits, including improved fruit and vegetable consumption, activity levels, and mental health.[4–7]

However, only a handful of studies have documented how much food gardens yield (Table A, available as a supplement to the online version of this article at http://www.ajph.org), and none have quantified these harvests in terms of vegetable servings provided. We have added to this emerging literature by (1) quantifying harvest results in a climate zone that is more challenging for growing than are the locations of previous studies, (2) quantifying results over 3 growing seasons, (3) calculating harvest values in nutritional terms as servings of vegetables yielded, and (4) quantifying how gardeners used their harvests, whether eaten immediately, stored, or shared.

METHODS

Our study was part of a larger, multistate community food system action research project called Food Dignity, which includes the community-based organization Feeding Laramie Valley and academic partners at the University of Wyoming (UW). Five expert gardeners recruited by Feeding Laramie Valley codesigned the study protocol with UW and then implemented it in their 9 plots during the 2012 pilot year. They also named the project Team GROW (Gardener Researchers of Wyoming). We expanded in 2013 to more diverse participants, both in gardening experience and demographics, with 31 gardeners measuring harvests from 33 plots. In the 2014 season, 12 of these gardeners participated again. With the exception of 1 rural garden, all plots in this study were within Laramie, Wyoming, a city of about 31 000 people on windswept and semiarid high plains at 7200 feet.

Each season, Team GROW participants weighed and recorded each produce harvest from their garden plots, and the UW team visited each garden plot to measure the area in production, excluding nongrowing areas such as stepping stones. Each household received a scale, $100, and midseason soil tests. The data we requested for each harvest included date, crop type, weight, immediate use (eaten, stored, or shared), and any notes. Gardeners shared their harvest logs with the UW team (Appendix A, available as a supplement to the online version of this article at http://www.ajph.org).

The UW team analyzed each season's data from each plot and across plots to calculate garden productivity by weight, monetary value, and number of vegetable servings. We also examined the use of harvests, number of crop types grown, and yield variation between years and converted harvest measures into rates. These rates enabled comparability across Team GROW plots and years while aiding interpretation and extrapolation to other gardening contexts.

Our base measure was total harvest weight with conversions to per plot and per area rates. To estimate the nutritional relevance of the yields from Team GROW plots, we first converted total harvest weights for each crop type into volume (in cups) by weighing 1 cup of each harvested crop type. We then calculated how many daily recommended vegetable servings the harvested quantities provided (on the basis of the US Department of Agriculture recommendation to consume 2.5 cups each day or, for raw leafy greens, 5.0 cups).[8] For example, we found that a cup of roughly chopped raw spinach weighs 0.95 ounces.

Using that conversion weight, a garden yield of 10 pounds (4.54 kg) of spinach would represent 168 cups, enough for 34 days of

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vegetables for 1 person. Using weight-to-volume conversion rates (Table B, available as a supplement to the online version of this article at http://www.ajph.org), we estimated the vegetable serving yield from the average plot for each Team GROW season. To allow comparability across years, we expressed serving yields as standardized to the average plot size (253 sq ft) over the 3 seasons combined.

We assessed crop diversity using the number of unique crop type entries gardeners made in their harvest logs. Participants defined crop types. Because many gardeners used generic terms (e.g., "lettuce" vs "red leaf lettuce" and "romaine lettuce"), actual variety is likely underestimated.

Finally, participants noted how they used each recorded harvest by either checking the appropriate column or providing weights or percentages in the use columns of the harvest log. We have presented these reported uses as percentage of harvest by weight.

RESULTS

Over the 3 growing seasons, the average garden plot size was 253 square feet, which yielded 128 pounds of produce (0.51 lb/sq ft) worth $422 at the local farmers market. The average plot yielded 17 gardener-defined crop types and was enough to supply the US Department of Agriculture–recommended amount of daily vegetables for an adult for approximately 9 months. On average, by weight, gardeners ate 39% of their harvest, stored 31%, and gave away the remaining 30%.

Individual results varied greatly between plots and, to a much lesser extent, within repeat plots between years. For example, 2013 saw both the lowest harvest rate for a plot (0.01 lb/sq ft) and the highest (2.06 lb/sq ft). Of 12 plots that were a part of the study for more than 1 year, intraplot yield rates varied an average of 39% from year to year. However, average vegetable serving yield rates (adjusted for plot size) were very similar each year. Table 1 summarizes the results from each year.

DISCUSSION

Team GROW results have at least 3 public health implications. First, they suggest that gardening can yield a nutritionally meaningful portion of a household's vegetable

TABLE 1—Team GROW Garden Harvest Results: Laramie, Wyoming, 2012–2014

Variable	2012	2013	2014
Participant households, no. (no. repeating from previous year)	5	31 (3)	12 (12)
Participant retention rate,[a] %	100	94	86
Plots, no.[b]	9	33	14
Average plot size, sq ft; range (SD)	317; 120–890 (262)	262; 58–1006 (256)	191; 45–534 (144)
Total plot area, sq ft	2853	8649	2676
Average harvest days during season; range (SD)[c]	100; 44–170 (39)	103; 212–167 (36)	118; 54–239 (50)
Average number of crop types/garden; range (SD)	18; 11–28 (6)	17; 4–39 (10)	17; 9–41 (9)
Average harvest, lb/plot; range (SD)	141; 43–342 (102)	137; 4–656 (146)	99; 10–486 (134)
Use of harvested food,[d] %			
Eaten	51	36	39
Stored	19	30	45
Shared	30	34	17
Average value of harvest/plot, $; range (SD)	459; 151–914 (311)	447; 28–2599 (513)	401; 28–2102 (580)
Average value/lb, $; range (SD)[e]	3.27; 2.36–4.67 (0.60)	3.54; 2.12–7.74 (1.56)	4.06; 2.48–5.94 (1.10)
Average value/sq ft, $; range (SD)	1.45; 0.69–6.69 (1.94)	1.85; 0.03–6.64 (1.32)	2.10; 0.19–5.03 (1.29)
Yield, lb/sq ft; range (SD)	0.44; 0.16–2.06 (0.60)	0.52; 0.01–1.68 (0.38)	0.52; 0.12–1.16 (0.29)
Annual vegetable servings/average plot, %[f]	94	75	59
Annual vegetable servings/253 sq ft, %[g]	72	75	78

Note. GROW = Gardener Researchers of Wyoming.

[a]Team GROW attrition rate measured from the starting base of gardeners who had submitted at least 1 data sheet to the University of Wyoming team, at which time they received the $100 household participation stipend.

[b]Number of gardens exceeded number of participants each year because some participants had 2 plots (1 community and 1 home plot).

[c]We calculated harvest days using average first and last harvest date recorded by participants.

[d]In 2013 we added "lost" and "sold" options, but amounts reported were negligible and are not reported here.

[e]At local farmer's market prices or, when items were unavailable, organic grocery prices; spot checks each season indicated little change, so these calculations used 2012 prices.

[f]Percentage of the year that the average plot supplied 1 adult with the recommended 2.5 cups (or 5.0 cups of leafy greens) of vegetable servings.

[g]Percentage if standardized to the average 3-year plot size of 253 sq ft.

needs. The average garden plot yielded enough vegetables for 1 adult for 9 months or for 2 adults over an extended growing season of 4.5 months. The most productive half of plots in Team GROW—those yielding more than the median of 0.41 pounds per square foot—averaged a yield rate of 0.74 pounds per square foot. This is higher than that of commercial vegetable farms in more favorable climates, which yield approximately 0.67 pounds per square foot.[9,10]

Second, gardeners grew a wide variety of vegetables—an average of at least 17 types and as many as 41. Previous research has noted the ecological benefits of such diversity, and such variety likely also offers nutritional advantages.[8,11]

Third, benefits of gardening accrued not only to gardeners. Gardeners gave away an average of 30% of their harvests each year to friends, neighbors, and produce-sharing programs. This kind of sharing spreads nutritional benefits and might be a mechanism by which gardens build the social capital reported in other studies.

In addition, viewed through the wider lenses of ecological sustainability and climate change, distributing food production and production skills via household gardening offers a promising resilience strategy. Viewed through the democracy and equity lenses of food justice and sovereignty, producing food at household and community scales is essential.

The United States already has some infrastructure for supporting gardening (e.g., community-based organizations, schools, local government programs, and cooperative extension agencies) and a Supplemental Nutrition Assistance Program policy that allows seed and seedling purchases. The current body of evidence, including the results of our study, suggests that our nation should invest in expanding and integrating such gardening support to help tackle some of our most serious public health and nutrition problems. AJPH

CONTRIBUTORS

S. J. Conk collated and analyzed the harvest data that was collected by Gardener Researchers of Wyoming. C. M. Porter conceptualized and originally designed the study with the gardener–researchers and supervised the study. Both authors designed the data analysis, wrote the article, and approved the final version.

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HUMAN PARTICIPANT PROTECTION

This study received approval from the University of Wyoming institutional review board. All study participants gave written informed consent.

REFERENCES

1. Centers for Disease Control and Prevention. Overweight and obesity. 2014. Available at: http://www.cdc.gov/obesity/index.html. Accessed November 12, 2015.

2. US Department of Agriculture. Household food security in the United States in 2014. 2015. Available at: http://www.ers.usda.gov/media/1896841/err194.pdf. Accessed November 12, 2015.

3. Centers for Disease Control and Prevention. Progress on children eating more fruit, not vegetables. 2014. Available at: http://www.cdc.gov/vitalsigns/fruit-vegetables. Accessed November 12, 2015.

4. Brown KH, Jameton AL. Public health implications of urban agriculture. *J Public Health Policy*. 2000;21(1):20–39.

5. Draper C, Freedman D. Review and analysis of the benefits, purposes, and motivations associated with community gardening in the United States. *J Community Pract*. 2010;18(4):458–492.

6. Alaimo K, Packnett E, Miles RA, Kruger DJ. Fruit and vegetable intake among urban community gardeners. *J Nutr Educ Behav*. 2008;40(2):94–101.

7. Wakefield S, Yeudall F, Taron C, Reynolds J, Skinner A. Growing urban health: community gardening in South-East Toronto. *Health Promot Int*. 2007;22(2):92–101.

8. US Department of Agriculture. All about the vegetable group. 2015. Available at: http://www.choosemyplate.gov/vegetables. Accessed November 12, 2015.

9. Seufert V, Ramankutty N, Foley JA. Comparing the yields of organic and conventional agriculture. *Nature*. 2012;485(7397):229–232.

10. US Department of Agriculture. Plant hardiness zone map. 2012. Available at: http://planthardiness.ars.usda.gov/PHZMWeb. Accessed November 12, 2015.

11. Letourneau DK, Armbrecht I, Rivera BS, et al. Does plant diversity benefit agroecosystems? A synthetic review. *Ecol Appl*. 2011;21(1):9–21.