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Perspective

The potential of fenced community gardens to mitigate the negative impacts of white-tailed deer on food gardening in Canada

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Abstract

Household food insecurity describes insufficient or unreliable access to food due to financial constraints. Food gardening is practiced throughout the world as a means of addressing household food insecurity. Although food gardening is not a viable standalone solution to food insecurity in Canada, it is a useful practice for providing households with fresh and nutritious food. Gardeners are faced with numerous challenges and barriers to growing food, including lack of gardening knowledge, availability of space, and lack of financial resources to purchase supplies. Community gardens, where members of a local community cooperatively manage an area of land to produce food, can be useful in helping individuals overcome many of the challenges and barriers to food gardening. A benefit of community gardens is the shared protection that fencing infrastructure can provide against wildlife. In this article, I highlight how fencing can help overcome the potential challenges posed to food gardening by a herbivore: the white-tailed deer (*Odocoileus virginianus*). White-tailed deer can negatively influence the potential of food gardening to support household food security by causing significant damage to garden plants. Fencing is an effective way of reducing these impacts, and this intervention can be highly useful for community gardens where users benefit from shared infrastructure. In landscapes with high abundances of deer, governmental and grassroots support of deer fencing for new and existing community gardens could be a useful action in increasing the potential of food gardening to ease household food insecurity.

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Household food insecurity in Canada

Household food insecurity is defined as insufficient or unreliable access to food due to financial constraints and is increasingly recognized as a serious population health problem in Canada (Jessiman-Perreault & McIntyre, 2017). Based on a survey of 103,500 Canadian households conducted from 2017 to 2018, approximately 12.7 percent of respondents had experienced some level of household food insecurity within the past 12 months (Tarasuk & Mitchell, 2020). The occurrence and severity of household food insecurity does not affect all equally but is influenced by numerous socioeconomic factors including employment status, income level, receipt of social assistance, and immigration status. Household food insecurity is disproportionately experienced by households of colour: the most recent survey of Canadian food insecurity found 28.9 and 28.2 percent of Black and Indigenous households respectively experienced some level of food insecurity compared to 11.1 percent of white households (Tarasuk & Mitchell, 2020).

Numerous social interventions have been implemented to address food insecurity in Canada. At a federal level, the Government of Canada's Universal Child Care Benefit from 2006 to 2016 provided families $100 per month for each child under six years of age; this policy yielded a 25 percent decrease in food insecurity among families that received the benefit (Ionescu-Ittu et al., 2015). Provincial policies have also been effective in addressing household food security. For example, in Newfoundland and Labrador, a collection of poverty reduction policies that included increasing the minimum wage and reducing income tax among the lowest earning households reduced household food insecurity from 59.9 percent in 2007 to 33.5 percent in 2012 among families receiving social assistance (Loopstra et al., 2015). One of the most widely practiced interventions for addressing food security across Canada is the establishment and management of food banks, where charitable food donations are made by the public, and collection and redistribution of surplus food can be freely accessed by those in need. While food bank use has been shown to improve household food security in the short-term, food banks do not address the underlying causes of food insecurity and are not considered as a sustainable long-term solution (Tarasuk et al., 2014).

Food gardening as an approach to supporting household food security

A potential pathway to help alleviate household food insecurity is the self-provisioning of food produced via food gardening in home and community gardens.

More than 600 million people living in urban areas worldwide are estimated to grow food for their own personal consumption within community gardens, vacant lots, private gardens, and on balconies (Petts, 2005).

The practice of food gardening is widespread in Canada, but food grown in this manner generally represents a small proportion of the food consumed within a household across the full calendar year. A study based in Guelph, ON asked 50 gardeners to keep a garden diary and record harvest weights and inputs (time and resources); They found that an average home garden produced 256 servings of fruits and vegetables on an annual basis, which could provide a family of four with sufficient fruits and vegetables for approximately ten days (CoDyre et al., 2015). While the productivity of these gardens may not be sufficient for alleviating food security across the entire year, food gardening can be highly productive at certain times of the year. A recent demographically representative survey of 1,023 Canadians revealed that during 2020, 51 percent of respondents reported growing at least one fruit or vegetable at home (Mullins et al., 2021) and that during peak harvest season, 53 percent of experienced gardeners reported that 25 percent or more of their household fruit and vegetables were supplied via food gardening. Despite the recognized limitations of food gardening for alleviating overall food insecurity, among food insecure gardeners, self-grown produce is highly desired for its social and nutritional value (Kortright & Wakefield, 2011).

Multiple factors influence the ability of individuals to participate in food gardening. A study based in Ohio, U.S., found that individuals with lower socioeconomic status were less likely to participate in home gardening. Through surveys, individuals with lower socioeconomic status were found to have less knowledge of food production practices, fewer financial resources for purchasing supplies, and lack of access to gardening space (Schupp et al., 2016). An effective means of addressing these concerns are - community gardens areas that are cooperatively managed by members of a local community where food or flowers are cultivated (Drake & Lawson, 2015). Community gardens can be a solution to a lack of gardening space, lack of gardening knowledge, and reducing capital costs—while also supporting a number of other benefits to users (Drake & Lawson, 2015), which are described below.

An overview of the benefits of community gardens

Community gardens are effective in removing financial barriers to participating in food gardening. Many community gardens are established specifically for the purpose of engaging people of lower socioeconomic status in the process of food gardening, with memberships that are either free or priced at a relatively nominal cost. Along with access to land, users of community gardens regularly benefit from access to plant material such as seeds and transplants (Pearsall et al., 2017), use of gardening tools, access to a water source (Petrovic et al., 2019), and use of composting facilities (Drake & Lawson, 2015).

While individuals participating in community garden initiatives are largely driven by intrinsic motivations such as learning from others, numerous studies have also shown the benefits of participation to dimensions of health and wellbeing (Hale et al., 2011). Many of these benefits are related to diet; for instance, a study based in Twin Cities, MN, U.S. found a 22 percent increase in daily vegetable consumption among Karen and Bhutanese refugees who participated in a community gardening program (Hartwig & Mason, 2016). In a second study exploring the health benefits of community gardens, a case-control study of 165 gardeners in Tokyo, Japan, found that participants involved in community garden projects self-reported significantly better mental and physical health, and fewer numbers of subjective health complaints as compared to a control group (Soga et al., 2017). A third study, that used case-control approach to compare individuals participating in a community gardening initiative to same-sex siblings and neighbours, found community gardening was associated with lower body mass index and reduced odds of obesity (Zick et al., 2013).

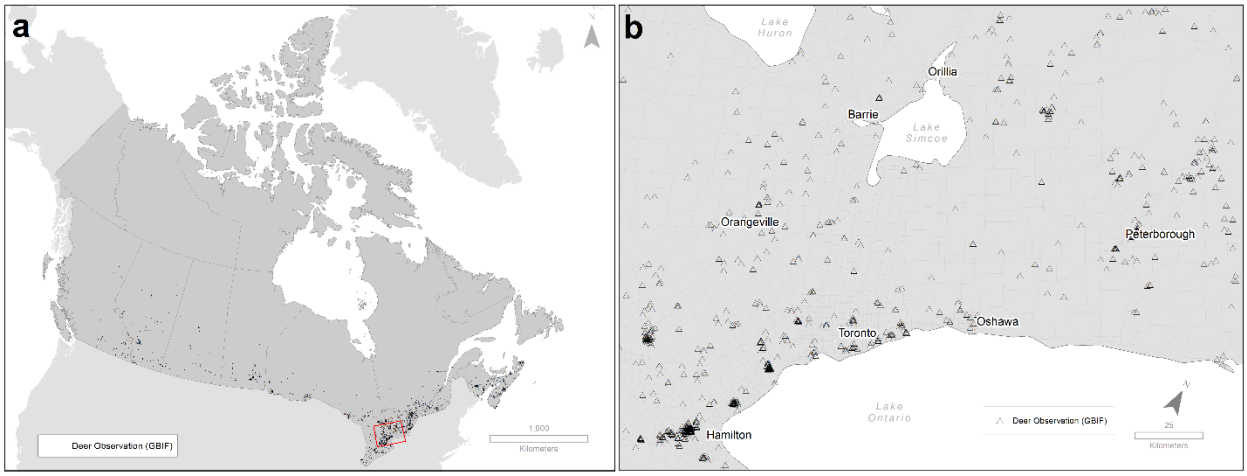
Community gardens are a physical space that facilitate knowledge sharing through formal education programs and conversation. In a survey of 445 community garden organizations across the U.S. and Canada, 96.7 percent reported "education specifically about gardening" as a benefit provided by their organization (Drake & Lawson, 2015). Within community gardens, this sharing can take place through workshops or classes (Booth et al., 2018), and through organic social connections, such as conversations with fellow gardeners (Rogge et al., 2020).

White-tailed deer and food gardening

Individuals growing their own food within community gardens must contend with various production challenges including soil fertility, irrigation, and insect pests. Food gardeners must also deal with wildlife that can cause significant food losses, that may require special attention. Some examples of wildlife in Canada that thrive in human-dominated landscapes and may cause large food losses from gardens include rabbits, hares, groundhogs, birds, and raccoons. One species of wildlife that poses a particular challenge for food gardeners throughout many parts of Canada is the white-tailed deer.

The white-tailed deer (*Odocoileus virginianus*) is a medium-sized ungulate that is variable in size. Males usually weigh between 34 and 73 kg and females typically weigh between 28 and 66 kg (Sauer, 1984). White-tailed deer are generalist herbivores that can adapt to a wide variety of habitats and feed on a wide range of native and non-native plants (Weckerly & Nelson, 1990). Deer typically consume between 1 to 4 percent of their bodyweight in plants each day, representing approximately 1.0 to 1.2 kg of dry plant material (Berry et al., 2019). White-tailed deer are found across Canada east of the Rocky Mountains (Figure 1a) and can be commonly observed in human-dominated landscapes such as the Greater Toronto Area (Figure 1b).

Figure 1: Observations of white-tailed deer across Canada (a) and the Greater Toronto Area (b).



Each point represents a georeferenced observation of a white-tailed deer, either through direct observation or indicators of deer activity (e.g., fecal pellets, hoof prints). White-tailed deer data provided by Global Biodiversity Information Facility (GBIF.org, 2021).

The past century has seen exponential growth in the abundance of white-tailed deer. Population estimates of white-tailed deer in the U.S. and Canada expanded from 100,000 individuals in the early 1900s to more than 30 million today (Adams and Hamilton, 2011). The rapid growth of the white-tailed deer population has largely been attributed to factors associated with living in urbanized areas, including release from predation, longer lifespans, tolerance to humans and human activities, and widely available food resources (Adams and Hamilton, 2011). White-tailed deer readily habituate to human contact (Schuttler et al., 2017), and when living in suburban areas without the pressure of hunting, can reach densities as high as 80 individuals per km^2 (Williams et al., 2013).

In many human-dominated landscapes, high densities of white-tailed deer bring challenges that include more frequent deer-vehicle collisions, damage to landscape plants, and the spread of zoonotic diseases. An underappreciated impact that deer have to humans, however, is the consumption of food plants in community and home gardens. Although many plants grown for human consumption are nonpalatable to deer such as members of the Allium family, including chives, onions, garlic (Nitzsche et al., n.d.), the wide dietary breadth of deer means that many crops can be lost to deer browsing.

Studies of conventional agricultural systems have shown that browsing by white-tailed deer may cause significant losses of agricultural productivity. For example, in a study of soybean (*Glycine max*) plants browsed by white-tailed deer yielded 74 percent less seed than plants protected from deer by cages (Begley-Miller & Cady, 2015). Even so, the severity of these losses is highly variable and does not necessarily correspond to deer density.

A series of field studies by Matthews (2019) determined that crop damage by white-tailed deer varied from 0 to 538 kg/ha for soybean, and from 0 to 1002 kg/ha for corn, but that deer density did not explain appreciable variation in crop losses.

Though no published estimates are available, damage by white-tailed deer is likely exacerbated in many home and community gardens, specifically during periods of drought. Under drought conditions, white-tailed deer shift foraging preferences and become more selective about the plants they consume (Lashley & Harper, 2012). Irrigated gardens may be particularly attractive to browsing deer because of the increased palatability of irrigated plants relative to other plants in the landscape. To this end, because home and community gardens are small relative to most commercial agricultural operations, a concentrated browsing effort by deer will have a larger overall effect on crop productivity.

Fenced community gardens can help mitigate the impacts of white-tailed deer on food gardening

Because of the challenges associated with living amongst high-density deer populations, numerous products and practices have been tested to prevent conflict between deer and humans. For example, to keep deer from damaging landscape plantings many fear-based approaches have been used ranging from the use of auditory deterrents like propane cannons, to olfactory deterrents that include bobcat urine or pig blood (Vantassel & Groepper, 2016). Deer tend to acclimate to these cues over time, and as such these fear-based interventions are typically not effective over prolonged periods—particularly when deer are living in predator-free landscapes (Champagne et al., 2017).

The intervention which has shown the most promise for preventing deer damage is fencing. Fencing is widely used as an effective intervention for reforestation efforts in landscapes with high deer densities (Sweeney & Dow, 2019), and when used in conjunction with crossing structures is highly effective in preventing deer-vehicle collisions (Huijser et al., 2016). A wide range of fencing styles have been tested for their efficacy in excluding deer, with fence height generally proving to be the most important attribute for preventing deer damage. In a study by Stull et al. (2011), a fence height of 2.4 m prevented any deer from crossing into the other side of a fenced pen–even when startled by the researchers. The study also explored a range of lower fence heights, between 1.2 and 2.1 m, finding that as height decreased fence crossings became more frequent. Fences 1.2 m in height have been effective in preventing deer damage in 100m^2 forest plots (Sweeney & Dow, 2019), however given that deer can easily leap over low fences (Huijser et al., 2016), the effectiveness of such fencing is likely dependent on the fenced-off area being of similar forage quality as the surrounding landscape—which is typically not the case for food gardens.

In landscapes where white-tailed deer browsing pressure is high, deer-proofing gardens through fencing may be necessary in preventing food losses.

The costs and challenges of building and or maintaining these fences represent another significant barrier to individuals growing their own food. Adjusted for inflation, VerCauteren et al. (2006) estimated the cost of deer-proof fencing with 90 to 99 percent efficacy ranged between $16.4 to $32.7 per m. This cost would be prohibitive to many individuals, particularly those who were opting to grow their own food for the purpose of alleviating food insecurity. Beyond the barrier of initial capital to build and install the fencing, the economic benefit of fencing for protecting against food losses must outweigh the cost. This becomes more likely for community gardens where users share a larger fenced area. This is partially because users can share the full cost across the membership, and partially due to the mathematical relationship between area and perimeter: where when considering areas of consistent shape, the ratio of fencing cost to area protected decreases as area increases.

Along with the other widespread benefits to health and wellbeing, users of community gardens can collectively benefit from the use of shared fencing infrastructure. Fencing may also provide additional benefits to users, such as providing protection against food theft, and acting as structural supports for climbing food plants like cucumber (*Cucumis sativus*). Governmental and grassroots support of deer fencing for new and existing community gardens could be a useful action in realizing the potential of food gardening in addressing household food insecurity in areas with significant deer-human conflict.

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