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Risk Mitigation Practices in Urban Gardening: A Case of Small Minority Producers in Maryland

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ABSTRACT: *Urban gardening (UG) serves to increase the production and consumption of fresh produce in urban and semi-urban areas. A project was implemented in 2022 to enhance the technical, allocative, and economic efficiency of small, socially disadvantaged minority farmers engaged in UG. Data were collected from 22 of the project's participating producers. The findings revealed that farmers operated rationally, and cultivated diversified specialty and ethnic crops and medicinal herbs, with an average of 20 crops on 1.2 acres. As rational producers, based on data-driven evidence, farmers practiced integrated alley and mixed cropping systems (crops such as leafy, root, climbers, cash, herbs, and fruits), adopted a rainwater harvesting technique, expanded compost-making, maintained high cropping diversity, and introduced a tier system of production to mitigate production, marketing, and financial risks. Besides the socio-economic and health benefits, an increase in the production of vegetables locally will eventually help to lower the carbon footprint.*

KEYWORDS: community economic development, data-driven farm planning, extension education, minority producers, risk diversification

INTRODUCTION

Small, socially disadvantaged, and minority (SSDM) farmers across the U.S. have been at the crossroads of survival. They have been faced with ever-increasing challenges while striving to obtain supplemental household income from farming, in this case, urban gardening (UG). According to GICA (2011), the trend of abandoning inherited and owned farms in Maryland has been increasing in the past 40 years. As a chain effect, the loss of small farms adversely affects local employment. Moreover, due to the influence of brokers, high transaction costs, and a lack of direct access to market outlets, the farmers' share of the retail food dollar has been steadily decreasing, with farmers receiving only about $0.20 out of each food dollar spent by consumers, which was $0.41 in 1950, and $0.31 in 1980.

This paper examines the scope and opportunity of urban gardening to revitalize the economies of small, socially disadvantaged, minorities (SSDM), and beginning farmers in Maryland. Specifically, the information in this paper comes from a study conducted in 2022 to understand Maryland farmers' practices for risk mitigation, crop diversity, and rational reasons for urban gardening. UG embodies a large social, economic, environmental, and civic scope of expansion across the community that could be a backyard, side yard, rooftop, community garden, kitchen garden, or any other space where farmers can produce some greens. UG is being increasingly adopted by small, urban, and semi-urban, historically underserved and minority farmers with culturally based festivities and strong ethnic food habits. Their cultural practices encourage them to sustain UG, which will underpin small-farm sustainability.

Naturally, urban gardeners must be very creative and efficient to get the maximum production from limited space. Possible production technologies to maximize space include tower/vertical gardening, container gardening, tree guild design, rooftop gardening, community gardening, growing dual-purpose plants, square foot gardening, and dense and companion planting. Moreover, urban gardening is not limited to food grown and sold within city limits but also includes the supply of the produced foods to the community markets. SPUR (2012) stated that urban agriculture is a strategy to increase food and health literacy as many urban and peri-urban inhabitants are becoming increasingly concerned about eating more greens in every meal.

CFSC (2003) reported that community gardening programs provide employment, education, and entrepreneurship opportunities for a wide variety of people, including students, recent immigrants, and homeless people. Moreover, gardeners save significant amounts of money on produce in their households. According to Hlubik et al. (1994), "Community gardeners saved between $75 and $380 in food costs every season."

In lieu of the many benefits, evidence suggests there is a need for a larger and more intensive intervention to facilitate UG as the trend of urban migration continues to grow. The United Nations Development Program estimates that 15% of food worldwide is grown in cities (Smit, Ratta, and Nasr, 1996). Per the American Planning Association, urban agriculture continues to grow as a priority, with several cities and counties including local food elements and urban agriculture in their comprehensive plans (Hodgson, 2012). In addition, a growing number of state land grant universities and their cooperative extension systems are directing and allotting resources toward research in urban agriculture (Hendrickson and Porth, 2012; Reynolds, 2011). Urban agriculture provides a medium for learning experiences, educational programs, and youth development opportunities, which have been a successful strategy for improving food access in food insecure areas (Armstrong, 2000; Balmer et al., 2005; Corrigan, 2011; Larsen and Gilliland, 2009).

Conceptual Model

Farmers are rational producers who seek to maximize profit. Technically, a rational producer strives to optimize farm profit and this can be obtained in the second stage of production function. This stage is known as the stage of diminishing returns, which is the rational stage of production for all factors of

production employed, where farmers obtain a maximum total product. At this stage, the marginal product of each variable factor yields positive (Figure 1). In general, farmers must always make decisions under risky conditions, as there are many factors associated with production that are beyond their control, such as weather conditions, price of products, shortage of labor, disease and pest infestation, increasing input costs, etc. The return of their decisions may be either positive or negative, however, they rationally choose a preferred combination of activities to make a profit.

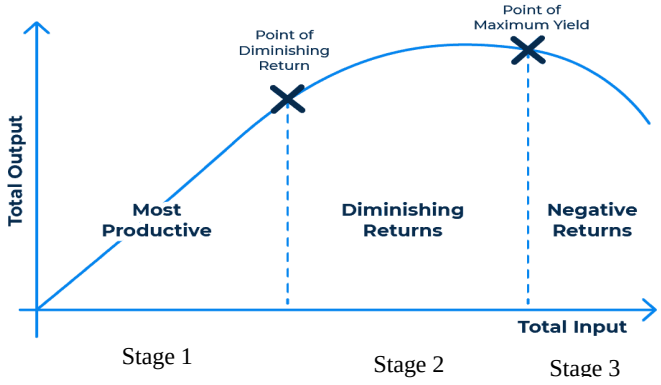

Figure 1: The law of diminishing marginal returns.

Small-scale farmers are often categorized as risk-averse because their financial survival is at stake. As a result, they are compelled to undertake lower-risk and lower-yield agricultural practices that provide them with little or no profit. Based on the nature of farm activities, risks can be broadly categorized as production, marketing, finance, human resource, and legal. Each of these is equally important to urban gardeners, although their scale of production is very small. However, small farmers will not continue gardening with a possible negative economic output despite its health and environmental benefits.

LITERATURE REVIEW

Socially disadvantaged, minority, small-scale, limited-resource, veteran, and beginning farmers are often forced to adopt unhealthy eating habits and sedentary lifestyles due to several of the challenges outlined in the preceding sections. Regrettably, these farmers rely heavily on imported produce such as vegetables, fruits, and other farm products. In the United States, “food travels an average of 1300 miles from farm to fork, changes hands half a dozen times, and consumes 10 calories of fossil-fuel energy to produce a single calorie of modern supermarket food.” (Cited in Gardening Matters, 2012; Kloppenburg, Hendrickson, and Stevenson, 1996; Pollan, 2008). According to CFSC (2003), fruits and vegetables sold in supermarkets spend as many as 7 to 14 days in transit. During this time, almost 50% of the transported food is lost due to spoilage. Moreover, imported produce is gradually becoming unaffordable due to continually rising prices and declining household incomes. These problems have multi-faceted impacts influencing the health and social well-being of struggling households.

Farmers who produce multiple outputs mitigate risks or adverse outcomes through their input choices

(Mango et al. 2018; Tveterås, Flaten, and Lien 2011. Mango et al. (2018) further reported that crop diversification strategies used by farmers are meant to reduce agricultural production risks. Moreover, producers reduce their farm output risks through the use of institutional and managerial tools (Heshmati and Haouas 2011; Khayyat and Heshmati 2014). For example, producers can reduce risk levels by changing the level of different inputs used in the production process.

Decisions to undertake new activities and/or adopt new technologies are crucial for farm success (Blandford and Hill 2006). Chavas (2004) considers production, market, technological, and institutional risks as inherent properties of agriculture, as farmers are often risk averse. The level of risk associated with a lack of knowledge and experience is one of the key determinants of the adoption of technology (Karni 2006; Marra et al. 2003). For instance, decision makers with a higher risk aversion tend to adopt new technology at smaller scales (Liu 2013; Trujillo-Barrera et al. 2016; van Winsen et al. 2016). Incentives to postpone a managerial decision, such as the adoption of technology, may exist regardless of the attitude toward risk (Dixit and Pindyck 1994). Spiegel et al. (2018) demonstrated that in the risk-neutral context, reducing or eliminating a risk might lead to earlier adoption of technology at a lower scale. Regarding the effect of risk aversion on the scale of new technologies, the literature indicates that higher risk aversion tends to reduce the scale (Liu 2013; Trujillo-Barrera et al. 2016; van Winsen et al. 2016). This implies that new technologies are perceived as riskier than those currently in use.

Karki et al. (2017), in a study of 59 small-scale producers in Alabama, reported five types of risks, of which, financial risk ranked highest at 51%, followed by marketing (34%), production (32%), human resources (17%), and legal (3%). Findings from a similar study reported on the risk-taking behavior of small-scale limited resource producers (Karki et al. 2020). The study found that 28% of them were risk averse, while 44%, 20%, and 8% of them stated average, above average, and substantial amounts of risk-taking behavior, respectively.

Community gardens have been shown to increase property values in the immediate area where they are located. In Milwaukee, properties within 250 feet of a garden experienced a $24.77 increase in value per foot, and the average garden was estimated to add approximately $9,000 per year to the city's tax revenue (Bremer, Jenkins, and Kanter 2003; Sherer 2006). Similarly, Voicu and Been (2008) revealed that the presence of a garden raised property values by as much as 9.4% within five years of being established. CFSC (2003) found that developing and maintaining garden space is less expensive than parkland area, in part because gardens require little land and 80% of their cost is in labor. In addition, locally grown food will help reduce or eliminate the transit time, thus greatly reducing the waste of fresh fruits and vegetables. In addition, gardening encourages exercise and motivates people to stay active longer than other activities. Community gardens and urban farms create safe spaces to recreate and improve the physical space of the neighborhood. Research has found that gardens and farms beautify neighborhoods and employ and benefit residents, which in turn creates more local pride and attachment to the space (Bradley and Galt, 2013; Ober Allen, Alaimo, Elam, and Perry, 2008).

Some literature reviews have discussed evidence that urban agriculture increases fruit and vegetable consumption among participants (Brown and Jameton, 2000; McCormack et al., 2010). Research shows that "people who participate or have family members that participate in community gardens were 3.5 times more likely to consume fruits and vegetables at least 5 times per day than people without a gardening household member" (Alaimo et al., 2008:97). Similarly, Ober Allen et al. (2008) mentioned that youth involved in community garden programs discussed eating more fruits and vegetables and less junk food as a result of their participation. Liu (2008) and Voicu & Been (2008) correlated urban farms and community gardens to increased home values and household income.

METHODOLOGICAL APPROACH

CASE STUDY

The University of Maryland Eastern Shore (UMES) Extension carried out an exploratory case study in 2021. The project initially recruited 14 farmers. As a snowball effect of the project intervention, the number of farmers gradually increased to 22 in five Maryland counties: Anne Arundel, Baltimore City, Baltimore, Somerset, and Wicomico. These participating farmers were identified as urban and semi-urban gardeners who produced primarily in the backyard for home consumption.

Baseline Survey

A semi-structured needs assessment survey was administered to the participating farmers at the beginning of the project to obtain baseline information. The survey broadly covered farm size, farming experience, scale of farming, reasons for farming, major problems, preferred training and educational materials, and demographic information. In addition, an in-person interactive workshop, e-mail and telephone communication, and farm-field visits were also organized to triangulate the information. The project provided production inputs such as manure and fertilizer, seeds and seedlings, garden soil, rainwater harvesting tanks, plant feed, insecticides, pesticides, and herbicides as token support. Farm tools and equipment (hand tiller, hoe, rake, shovel, hedge cutter, wheelbarrow, weed cutter) were provided to the group for individual use as needed. This was followed by capacity building activities on farm management practices, data recording, compost making, peer-to-peer interactions, farm visits, one-to-one and one-to-many counseling and consultations, and marketing initiatives.

End of the Project Survey

The project administered an end-of-the-project survey to the 22 participating farmers after one year. The main objective of the survey was to assess the impact of the project intervention as perceived by the farmers in terms of production and productivity, change in farming practices, and tools and techniques used to mitigate risk factors.

Data Collection and Analysis

Data were collected through the baseline and end-of-project survey, farm recording, a market survey, a crop biodiversity survey, and market observation. Various activities such as organization of training events, providing support services, monitoring and farm visits, group meetings, peer-to-peer interactions and farm visits, telephone, and email communications, one-on-one and one-to-many counseling, and

consultations were conducted to support farmers and gather necessary data. The data were analyzed using Excel and SPSS software. Given the exploratory in nature of the study, the focus at this stage was primarily on descriptive findings. The relevant findings are described below.

RESULTS AND DISCUSSIONS

Farmers' Demographics

Initially, 14 conveniently identified farmers participated in the project. A large majority of them were from Baltimore City and Baltimore County (42.8%), followed by Somerset County (36%), Anne Arundel (14.3%), and Wicomico County (7.1%). These farmers belonged to a diverse group of ethnic minorities that included Hispanic/Latino (7%), White/Caucasian (7.1%), Non-Hispanic/Latino (7.1%), African American (14.3%), and Asian (64.3%). Of the total participants, 35.7% were female and 64.3% were male. The ages of these urban gardeners ranged from 26 to over 60 years. Categorically, 50% of them were under 44 years of age, followed by 42.8% under 60 years and 7.1% over 60 years of age. The average farm size was only 1.20 acres (with a median size of 0.38 acres), ranging from 0.06 acres to a maximum of 11 acres.

Farmers' Type and Farming Experience

Nearly 86% reported that they were seasonal farmers, with only 14% reporting that they were part-time farmers (Table 1). Most of them operated backyard kitchen gardens (86%) and the remaining 14% were engaged in or volunteered to produce in community gardens. Fifty percent of them had <10 years and 50% had >10 years of farming experience. Regarding their characteristics, 71.4% of the farmers reported that they did not keep any farm records. This implies that they did not practice systematic and data-based farm planning and budgeting.

Table 1: Types of farmers and their farming experiences (n=14).

Characteristics	Percent
Type of involvement type	
Part-time	14.3
Seasonal	85.7
Farming experience	
1-5 years	35.7
6-10 years	14.3
More than 10 years	50.0
Type of farming	
Backyard kitchen garden	85.7
Community garden	14.3
Practice of keeping farm records	
Yes	28.6
No	71.4

Farm Commodities

A large majority (93%) of these participating farmers reported growing vegetables. Many of them grew more than one commodity. Nearly 36% of them reported producing fruits, followed by medicinal herbs (28.6%), flowers (14.3%), poultry (14.3%), and 7.1% reported producing peacocks, ducks, oysters, and mussels (Table 2).

Table 2: Type of commodity grown in the farm (n=14).

Farm commodity	Percent
Vegetables	92.9
Fruits	35.7
Medicinal herbs	28.6
Poultry	14.3
Flowers	14.3
Peacock	7.1
Ducks	7.1
Oysters and mussels	7.1

Reasons for Urban Gardening

The results showed that nearly 79% of the project farmers reported that their primary reasons for farming (urban gardening) were to produce for family consumption and to health enjoy the outdoors and engage in physical activity (78% each). Additionally, 57% reported that farming supplemented household income by providing fresh vegetables to the kitchen for seven months (late spring, summer, and fall of 2022) of the project period.

Table 3: Primary Reasons for Farming (n=14).

Primary Reasons	Percent
1. Outdoor and physical activity	78.6
2. Produce for family consumption	78.6
3. Supplemental income	57.1
4. Passing Time	50.0
5. Educational purpose	14.3
6. Tax benefits	7.1

Fifty percent of participating farmers described gardening as an excellent way to pass time for retired family members. Sharing the educational experience year-round with family, especially with children at the dinner table as garden produce germinates, grows, is harvested, and makes its way to the kitchen was reported by 14% of the farmers. Children learned how to protect plants from insects and diseases; give them water, require manure and fertilizer to help them grow; and how to get fresh food to their doorstep for every meal. It also gave farmers an avenue for receiving tax benefits as declared by 7% of the participants. The findings were consistent with Caspersen et al. (1991) that participants spent significantly

more time gardening (225 minutes/week) than doing other leading forms of exercise, such as walking (160 minutes/week) and cycling (170 minutes/week).

Risk Mitigating Practices

It is commonly found in the literature that small farmers are not rational producers. However, many have stated that small farmers are more efficient and rational than medium and large farmers. Comparatively, small farmers tend to be more risk averse than medium and large farmers due to lack of access to necessary production resources, lack of knowledge, and entrepreneurial skills. Apparently, risk-averse behavior limits their frontier production, leading to a reduction in potential for productivity. However, there is evidence that smallholders are both rational and employ various means or tools to manage or mitigate risks. Harwood et al. (1999) defined risk management as the selection of the appropriate mix of alternative tools to mitigate the impact of risks within a farm's activities, to transfer risk or to strengthen a farm's capacity to bear risks. According to Harwood et al. (1999), small farmers choose an appropriate mix of alternative tools to minimize or mitigate the impacts of potential risks envisaged within the farm to diversify or transfer of risk and/or to strengthen a farm's capacity to bear risks.

Strategies for Risk Mitigation

Project farmers indicated that they adopted crop diversification, mixed cropping, rainwater harvesting, composting, two-tier production system, container gardening, and marketing to mitigate potential production, marketing, and financial risks. All the participating farmers confirmed that their involvement in the project was either extremely useful (47.6%) or very useful (52.4%) in mitigating the envisaged risks associated with small-scale urban gardening.

Crop Diversification

A crop diversity survey administered to the participating farmers (n=16) in 2022 shows that they cultivated up to 50 different specialty and ethnic crops (vegetables, fruits, medicinal herbs, pulses, and cereals) in their backyards: 33 vegetables, 10 fruits, 5 medicinal herbs, 3 pulses, and 2 cereals. Of the vegetables grown, chili, cucumber, pumpkin, and tomatoes were cultivated by 93.8% of the project farmers. These common vegetables were followed by eggplant (87.5%) and okra, beans, spinach, and bitter gourd/melon, each by 81.3% of the farmers. Among fruits, banana was reported by 43.8% of the farmers, and peach and apple by 25% each. They also reported medicinal herbs like Tibetan/Himalayan spice (*Zanthoxylum armatum)*, gurjo/heart-leaved moonseed/guduchi/giloy (*Tinospora cordifolia)*, burflower-tree (*Neolamarckia cadamba), and* Night-flowering jasmine (*Nyctanthes arbor-tristis)*. In addition, farmers reported rice bean (a type of legume/bean) (*Vigna umbellata),* and corn and buckwheat as cereals.

Farmers reported growing a minimum of 7 to a maximum of 43 different crops, with an average of 20. Nearly 44% of the farmers reported growing 10-19 crops, followed by 37.5% of them growing 20-29 crops, and 12.5% growing 30 or more crops on a single piece of land (Table 4). The results provided clear evidence that these small urban gardeners practiced a rich crop diversity that minimized potential production, marketing, and financial risks.

Table 4: Crop diversity practiced by the farmers (n=16).

Number of crops	Farmers (%)
Below 10	6.3
10 to 19	43.8
20 to 29	37.5
30 and above	12.5
Total crops	50

Mixed Cropping

Monocropping has displaced mixed farming systems and associated local crop diversity worldwide (King et al., 2014). This is more common in developed countries, such as the USA, and has serious implications for food security and climate resilience. King and colleagues further emphasize that the application of mixed cropping or intercropping not only helps improve food security but also makes farming more lucrative as well as climate resilient. The project promoted mixed farming as one of the tools to mitigate risk in small-scale production. The results demonstrated that the farmers already practiced mixed cropping systems that followed several ethnic and specialty vegetables and flowers. The commonly cultivated ethnic vegetables in the mixed production system were stinging nettle, red-hot and long chili, tomatoes, slippery gourd, eggplant, pumpkin, yams, chayote, mustard greens, Indian rape (narrow leaf), beans, amaranth, and banana. While the mixed farming approach encourages farmers to produce multiple crops in their gardens, the system also increases the supply and consumption possibilities of a variety of culturally preferred fresh products in the kitchen. The participating farmers reported that mixed farming helped them diversify potential risks.

Rainwater Harvesting

To meet the water demand of the growing plants in the garden, while lowering production costs by reducing the water bill, the project promoted the practice of rainwater harvesting, which was already being used by some of the farmers. As a pilot case study, the project distributed ten 1000-gallon rainwater harvesting tanks to the ten most dedicated urban gardeners (46%); the number of project farmers increased from an initial 14 to 21 as a snowball effect of the project intervention. The distribution of tanks was far below the demand due to a lack of budget. The high demand for tanks was a reflection of their willingness to sustain urban gardening by bringing production costs down.

Compost Making

The project placed a strong emphasis on compost-making among the project farmers to minimize or replace the use of chemical fertilizers. It was also believed that the production of compost in the gardens would improve soil health, increase productivity, conserve moisture, and lower production costs. However, the project has yet to introduce scientific tips to expedite the composting process and maintain good soil health in order to completely replace chemical fertilizers and sustain urban gardening.

Two-Tier Vegetable Production System

In a two-tier vegetable production system, farmers grew leafy vegetables such as mustard greens, chili, eggplant, okra, parsley, coriander, broccoli, and cauliflower on the ground, and climbers such as pumpkin, cucumber, bitter gourd/melon, sponge gourd, etc. on the first tier (open wire-net roof) to maximize production, and productivity by using the limited space.

Container Gardening

A farmer or a family who wants to produce fresh vegetables for home consumption does not need to own a piece of land. A landless person can grow their family's preferred ethnic vegetables in containers that can be placed around the house, shed, driveway, or fence line. One can produce enough for home consumption, to share with friends and family, and even to supply markets when it yields a bumper harvest. Thus, the project encouraged urban gardeners to use containers to produce fresh ethnic vegetables, fruits, and flowers when other methods were not possible. The technique of producing in the containers will not inflate the water or fertilizer bill as it follows a precision agricultural practice. The kitchen waste and chopped grass could be regular sources for making compost, and harvesting rainwater often suffices to lower production costs. We found that the participating farmers were excited to practice container gardening on their homesteads.

Marketing Urban Garden-Fresh Produce

The general assumption is that farmers produce in the garden for home consumption and for sharing with friends and relatives during cultural festivities and special occasions. However, the results of the needs assessment survey revealed a 3.9 index value out of five for the importance of marketing, indicating that the farmers also wanted to sell some of their surplus and generate income. Marketing was specified by 100% of the farmers as one of the thematic problems inhibiting their ability to sustain urban gardening, as indicated by 100% producers. Thus, the project introduced the concept of an economic agent to help them operate the farm as rational producers. The project helped them sell and market surplus produce to increase supplemental household income and build capacity to manage production, marketing, and potential financial risks. The project intervention was in line with Harwood et al. (1999), who described the marketing of surplus produce as another strategy adopted by rational farmers to mitigate or minimize risk in farming. It is believed that linking farmers to sell their surplus will enable them to sustain urban gardening. Accordingly, the project connected them with the following marketing outlets as price takers rather than price makers.

1. Niche marketing of ethnic vegetables, 2. Direct marketing of the garden products: selling directly to the retail stores, setting up a roadside market, entering into farmers' markets, inviting consumers to harvest their own purchases, advertising to initiate community-supported greens production, selling at the farm gate, connecting to the seasonal markets, collecting produce, and selling from a common stall, 3. Connecting to local festivals, 4. Peer-to-peer networking, 5. Labeling of their products, and 6. disseminating product information.

Crop Biodiversity

The crop biodiversity survey administered to the participating farmers (n=16) shows that the farmers cultivated 50 different specialty and ethnic crops in their fields. Specifically, chili, cucumber, pumpkin,

and tomato were cultivated by most of the farmers (93.8%), followed by eggplant (87.5%) and okra, beans, spinach, and bitter gourd, each 81.3%. Among fruits, banana was reported by 43.8% of the farmers, followed by peach and apple (25% each). On average, a farmer reported growing 20 different crops, with a minimum of 7 and a maximum of 43. Forty-four percent of the farmers reported that they cultivated 10-19 crops, followed by 38% of them growing 20-29 crops, 13% of them growing 30 or more crops, and 6% of them fewer than 10 crops.

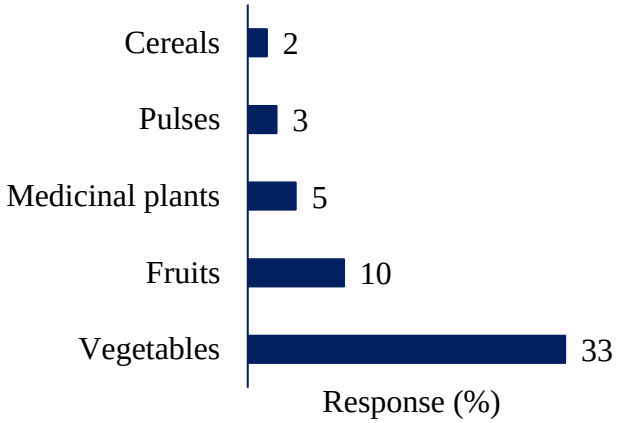

Figure 2. Types of crops cultivated by the project farmers (n=16).

Household Supplemental Income

The findings confirmed that project farmers benefited socio-economically and technically from urban gardening and marketing initiatives. Farmers practiced various market outlets listed above and were partially successful in lowering planned production, marketing, and financial risks. Among the participating farmers, five collectively reported $1,700 in sales, primarily through direct marketing during the summer and fall of 2022. In addition, 20 project farmers reported an increase in fresh vegetable intake by 25% (15 farmers) and 15% (5 farmers), respectively, which was equivalent to $12,500 during the project period (2022). Thus, the direct and indirect economic benefit from the vegetable sales due to the project intervention was $14,200.

CONCLUSION

The findings of the exploratory case study revealed that urban gardeners
operated a garden for six primary reasons i) outdoor and physical activity, ii) increasing fresh food consumption, iii) supplementing household income, iv) passing the time, v) engaging children and family members on how food is produced, and vi) using the tax benefit as applicable. Farmers integrated specialty and ethnic vegetables, fruits, and medicinal herbs with an average of 20 (minimum 7 to a maximum of 43) different types of crops on 1.2 acres (on average).

Urban gardeners applied various techniques or practices to lower production costs and increase supplemental household income. For example, they practiced intensive crop diversification, mixed cropping, rainwater harvesting, compost making, two-tier production systems, container gardening, and marketing to mitigate potential production, marketing, and financial risks.

From a research perspective, the project aimed to enhance the technical and economic efficiency of socially disadvantaged, small, and minority farmers by strengthening their knowledge and skills to make informed decisions, develop data-based farm plans, and adopt economically sustainable practices to optimize farm income. Accordingly, the project strengthened the technical and economic efficiency of the farmers by (i) enhancing their capacity to allocate limited resources efficiently and make informed decisions; (ii) strengthening their knowledge and skills to record farm data and monitor farm performance such as production, consumption, and marketing; (iii) strengthening their capacity to prepare a data-driven farm business plan; iv) increasing cropping intensity and crop biodiversity; v) encouraging them to install rainwater harvesting technology; vi) educating and expanding compost making; and vii) linking them to market outlets to sell their marketable surplus.

From an extension standpoint, the post-evaluation findings confirmed that farmers' participation in the project was useful for building and enhancing entrepreneurial skills, developing data-driven planning, managing limited resources efficiently, and reducing the cost of production. Similarly, improving farm production and increasing consumption of fresh products; maximizing farm revenue; increasing household income; securing socio-economic and technical benefits; and changing behaviors, actions, attitudes, and enthusiasm for selling produce on the market helped mitigate possible production, marketing, and financial risks. The benefits of the project intervention to the farmers in terms of improved knowledge, skills and experiences will encourage them to continue urban gardening in the future.

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