An Agroecological Survey of Urban Agriculture in the East Bay Area of California

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Introduction

In the face of food insecurity and in an effort to reconnect with the food system, many low-income urban residents have turned to urban agriculture to meet food and nutrition needs. In the East Bay of California, urban agriculture sites have proliferated, but little research has been conducted on how much these farms produce, the effectiveness of urban farming methods used, benefits to the community, or the unique challenges farmers face while farming the city. Over the 2014-15 summers, we conducted a survey assessing the state of urban agriculture in the East Bay area. Working from an agroecological perspective, we surveyed twenty-four sites to determine practices, challenges, and impacts of these urban farms.

Methods

Urban farms were surveyed to obtain qualitative data on the socio-cultural and ecological aspects of urban farming: genetic and species diversity; history of the land; mission of the farm or garden; legal land status/security of tenure; labor; access for community; acquisition of implements, seeds, and inputs; crop planning, incorporation of animals; pest control; weed and disease problems; soil building practices; diversification practices such as intercropping and rotations; yield levels and how the harvest is distributed.

We also measured nine on-farm features or factors: total farm size; area of non-production space (i.e. surrounding infrastructure and non-crop habitat); off-farm landscape matrix; orchard space; soil infiltration capacity, bulk density, and nutrient levels; crop species and genetic diversity; as well as productivity levels. We also developed a framework for farmers to assess best practices and ecological resiliency in their own urban farms.

Results

Yield and Productivity

The methodology used to estimate the average potential yields per square meter are based on prior work in urban agriculture (Colasanti, Litjens, & Hamm, 2010; Gittleman, Jordan, & Brelsford, 2012) Estimated yields on a per plant basis for each crop species were calculated based on *How to Grow More Vegetables* (Jeavons, 2012). These estimates are limited by little data on per plant yields. With data derived from one-meter square quadrat counts, total farm production space and estimates, we determined that sampled urban farms were producing ~7.2 kg of food per m^2 of production space (Table 1). Productivity estimates were correlated and matched well with farms that self-recorded yields by weight. Taking into account that the Bay Area can have two strong growing seasons we expect this productivity can be doubled on a year basis.

Cultivar and crop diversity

We found crop diversity to be relatively high, five species/m^2 or ~9.5 species per eight meter transect. However, we detected low varietal diversity (1.3 cultivars/m2) indicating low genetic diversity in crop plants (Table 1). Most farmers in the area acquire starts from distributors, which may limit access to more diversity of vegetable varieties.

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Water/Irrigation

Only twenty percent of farms are paying for irrigation directly; irrigation costs are often paid by parent organizations or owners of the land (i.e. the city). Only three farms had the infrastructure for rainwater harvesting. Many farms were conscious of water conservation methods such as increasing organic matter to enhance water storage in soil or mulching to decrease evaporation.

Pests

Most farmers (>95%) did not use pesticides prohibited for organic production and indicated that they adhered to organic pest control practices. Forty percent of farmers use homemade or OMRI listed pesticides to combat pest outbreaks. Forty percent of farms acknowledged that wiping or washing pests off plants by hand was the most efficient practice albeit labor intensive and difficult to accomplish at scale. Farmers identified aphids, slugs, and snails as the most troublesome pests attacking their crops and twenty percent mentioned aphid/ant mutualism as being particularly problematic to manage. Twenty-five percent of farmers indicated that they had planted flowers or other non-crop vegetation to create habitat to encourage beneficial insects and enhance biological control.

Weeds

Many farmers struggled with weeds. However, the majority of farmers mentioned that methods used to control or prevent weeds were “generally effective.” Some farmers can establish their crops weed-free before the period of critical competition, but most allow presence and growth of aggressive weeds such as amaranth or grasses to levels that can reduce crop yields. Percent cover of weeds in each quadrat also varied by farm. Most farms, at the time of sampling, exhibited average weed cover of 8-10% in production areas, but in others, weeds reached high presence and undesirable cover levels. Over half of the quadrats sampled were in raised beds; our observations suggest that raised beds typically exhibited lower weed densities. Broadleaf weeds were prevalent in the quadrats, but combinations of broadleaf weeds and grasses were not uncommon. Many weed species identified in this study were edible such as purslane, lambs quarters, malva, and amaranth.

Soil Fertility/Analysis

We found high levels of nutrients in gardens beds tested - specifically raised beds - indicating heavy use of amendments by urban farms. Soil fertility and trace metal content were sampled at ten farms. On each farm, three areas were sampled: areas of concern, production beds, and pathways. In each farm, composite samples were taken in triplicate by combining four subsamples into one sample. Fertility analysis including micronutrients was conducted by UMASS Soil and Plant Tissue Testing Laboratory (Amherst, MA); California Title 22 (CAM 17) metal analysis was completed by Curtis and Tompkins Laboratory (Berkeley, CA). Nine out of ten sites had high soil fertility and exhibited good soil quality indicators. No samples contained elevated levels of total trace metals. Most gardeners surveyed followed agroecological practices to maintain soil fertility and quality. Seventy-five percent of farms are composting on-site, with the remaining twenty-five percent citing labor restrictions for not composting. Most farms rely on municipal compost as a soil amendment.

Disposition of harvest

Aggregate data of 2014/2015 indicates that harvests are distributed in the following proportions: Sixty-nine percent of harvests go to the farmers’ families or the community surrounding the farm who are affiliated or familiar with the farm operations, suggesting surveyed urban farms are contributing to food security at a local scale. Twenty-one percent of harvests go to farmers markets or Community Supported Agriculture (CSAs) supporting the organizations (or members) economically. Ten percent of the harvest goes to organizations that are directly helping vulnerable populations (i.e. shelters and community kitchens).

Legal land status/security of tenure

Twenty-three percent of farms surveyed have long-term leases with property owners indicating security of tenure. About one-third of farms also have memorandums of understanding (MOU's) or short-term leases with property owners. However, almost half of our survey population experienced insecure tenure without leases or MOU's protecting them from displacement. In fact, insecure land tenure is high for all farms – with none owning the land they farm. As of this publication one farm has been lost to development, two farms have had to move, and one farm's tenure is threatened.

Conclusions

The vast majority of urban farms surveyed are using aspects of agroecological best practices including practices such as intercropping, rotating crops and using cover crops during the fallow season. Moreover, all urban farms surveyed were committed to using organic growing practices, biological controls, and expressed much interest in diversifying further to build resiliency, increase yields and develop the land into a more biologically diverse space. The surveys provided us with a better understanding of the features, function, and practices of urban farms. However, much research needs to be done to better assess their contribution to local food security, and how to maximize their production potential.

Our survey identified several issues that can be addressed through best practices. Our survey identified low cultivar diversity and reliance on local distributors for access to seedlings. Local seed banks, seed saving and access to greenhouse space may be a way to increase genetic diversity at the farm scale. Soil analysis and testing also indicate that current practices are working well, and farmers may be able to reduce inputs from season to season – an opportunity for potential savings for small-scale farms either focused on production or education. Many problems were identified with access to affordable irrigation, security of tenure and access to extension services. Much more needs to be done to encourage rainwater harvesting and to explore mechanisms to secure land tenure.

The overall goal of our project to build and amplify knowledge of agroecology and to support the rapid dissemination of agroecological approaches among Bay Area urban farmers. The survey provided us with information about the problems and challenges facing urban farmers, which informs of the need to promote an agroecological training program complemented by on-farm participatory research experiments. The expected outcome is that the training program and participatory research process will train a key number of UA farmers on agroecological methods so that they serve as trainers of others farmers via a farmer-to-farmer horizontal exchange of innovations and information. To facilitate this process, we will establish a system of Urban Farmer Field Schools that will build the capacity of urban farmers to generate and disseminate useful agroecological knowledge and build community relationships for community-driven food security.

References

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Table 1
Average species diversity and yields in selected East Bay urban farms

Farm	Total production space m	Garden- bed level species diversity	Garden- bed level genetic diversity	Productivity
		Average spp./m^2	Average cultivar/m^2	Average estimated yield kg/m^2
1	101.7	1.5	1.25	17.16
2	138.6	2.93	1.05	5.6
3	299.7	2.21	2.76	5.3
4	440.1	1.68	1.15	11.8
5	56	2.88	1.05	5.37
6	136.3	2.24	1	7.38
7	36.8	3.17	1	9.92
8	96.5	2.88	1.13	5.94
9	10.6	5.1	1.16	7.97
10	8016	3.12	1	5.78
11	31.3	5.3	1.13	6.4
12	123.1	2.43	1.42	4.43
13	24.1	4.3	1	8
14	178.8	1.93	2.05	4.84
15	495.3	2.27	1.13	5.77
16	*	2.44	1.21	5.47
17	*	3.66	3.4	9.75
18	179.4	2	1	4.34
19	565.5	2	1	3.43
20	*	1	1	5.05
21	348	2.3	1	8.27
22	24.7	2.8	1	9.6
		2.733636364	1.313181818	7.162272727
*Production area needs reassessment				