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# Indicators of Land Insecurity for Urban Farms: Institutional Affiliation, Investment, and Location

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**Abstract:** As urban agriculture (UA) continues to expand in the United States, many practitioners question its continuation in cities with high property values and increased economic incentives for development. Frequently, these pressures make urban farmers anxious about investing resources, time, and energy in land suitable for food production if tenure is insecure. Despite these concerns, UA continues to persist in areas experiencing increased property values and rent-seeking. Based on surveys with over 56 urban farm managers in California, we identify possible indicators of land tenure insecurity for urban farms. Our analysis finds that urban farms with greater land security have more financial and institutional support, and are located in census tracts with higher economic opportunity.

**Keywords:** urban agriculture; security of tenure; California

## 1. Introduction

Urban populations account for 80% of the population in the United States, and they continue to increase at a steady pace [1,2]. At the same time, participation in urban farming and gardening has risen by 34% in the United States between 2007 and 2011. In 2012, the American Gardening Association reported over 8500 urban farms and gardens in 38 cities throughout the United States; this number is now estimated to be over 10,000 [3]. These urban farms and gardens are critical components of alternative food systems and bulwarks against urban food insecurity.

Researchers have reacted to the growth of urban agriculture (UA) with interest, regularly advocating its benefits ecologically, socially, and economically. Policy makers and city planners have taken interest as well by reversing restrictive zoning ordinances, passing legislation incentivizing UA, publishing guides for inclusion of UA in community planning, and helping urban farmers get their harvest to markets [4]. Despite these efforts, UA is still often regarded as a transitory land-use activity, a phase in the ever-changing urban environment [5].

Fundamental challenges faced by urban food producers include political and economic issues affecting security of tenure and access to land [6,7]. It is estimated that over 79% of urban farmers do not own the property that they farm [3]. Urban agriculture often exists with only short-term, usufruct or de facto rights agreements with landowners to protect farms. Insecure tenure incentivizes rent-seeking behavior, leaving urban farms vulnerable to developments considered "highest and best use" [8,9]. These tenuous conditions lend to a sense of temporariness, where urban food producers perceive UA sites as interim land uses, further reinforced by a legacy of intermittent support for UA during economic depressions and periods of global conflict that diminish once socioeconomic conditions stabilized [9,10].

### *1.1. Urban Agriculture Persists*

Despite competitive property markets, complex legal, policy, zoning, and ad hoc agreements between landowners, institutions, and local municipalities, UA continues to exist in various forms as market, residential, kitchen, guerilla, and school gardens; soil-less farms; urban orchards; and often include the keeping of chickens, bees, goats, and other livestock [4,9,11]. These farms operate with different organizational patterns and structures, including farms that are collectively managed and harvests equitably distributed; allotment style farms where each farmer has their own plot; production-based operations; or a hybrid of these schemas. Operations are often dependent on outside funding as sales commonly do not generate enough income to be self-sufficient [12]. With little funding and support, UA is expected to meet ambitious social goals while being financially sustainable [13]. Urban agriculture projects often compensate for lower profits by focusing on education and food security initiatives through donations from non-profit organizations, non-governmental agencies, and local governments.

Given the prevalence, persistence, and growth of urban agriculture, extension agents and researchers have adopted a variety of assessment tools that look for indicators of sustainability or resilience in UA [14,15]. Mirroring traditional institutional extension initiatives, these efforts tend to concentrate on farming practices or ecological conditions, directly addressing problems such as pest outbreaks and soil quality. While previous work has assessed some place-based factors of UA [16,17], the authors know of no study that tracks explicitly urban agriculture in the context of land-use change or security of tenure, or assesses factors of risk in UA through a social, political, and economic lens. Most assessments do not adequately encompass the full complexity of UA. Urban farms are places of human creation and are impacted and shaped by the unique characteristics of the built environment. There is a need for more social-ecological analysis to better understand the capacity of UA to persist temporally. Without secure land tenure, it is unlikely that urban farmers will implement best-practices that lead to ecologically resilient systems, which take years to establish.

### *1.2. Purpose of Our Analysis*

Given UA's consistent resurgence and continued interest among underserved communities, researchers, local governments, and city and regional planners, we examine UA as a resilient social structure and question whether the assumption of temporariness in UA is valid by exploring social-economic factors as potential indicators of risk for urban farms. Specifically, we question: (1) whether characteristics of urban farms (Table 1) are indicators of insecure tenure; (2) whether farms that identify as tenure insecure differ as a population; and (3) what factors most likely predict secure tenure in measured farms. Analyzing urban farms and gardens from this perspective may give insight into characteristics of UA that lead to their persistence, alert us to risk-factors, and inform future urban agriculture policymaking.

**Table 1.** Assessed characteristics of urban farms.

| Category | Indicator | Measure or Levels |
|---|---|---|
| Economic support | Farm managers | Paid, part-time/full-time |
| | Irrigation | Municipal water rates |
| | Harvest sold to market | Percentage of harvest |
| Social support | School affiliated | Yes/No |
| | Harvest provided to community | Percentage of harvest |
| | Food security focus | Yes/No |
| Location-based | Property value | Median property value per sq. ft. |
| | Walk score | Index score: 1–100 |
| | ROI–economic | Low quartiles–high quartiles |
| | ROI–housing | Low quartiles–high quartiles |
| | ROI–place-based opportunity | Low quartiles–high quartiles |

## 2. Materials and Methods

Three survey periods were conducted between 2016 and 2018 in two high-cost coastal regions of California known for their preponderance of urban agriculture: the San Francisco Bay Area and Los Angeles County. Several respondents came from outside of these target areas, specifically in Humboldt and Riverside counties. Online surveys were created using Qualtric survey tools (Appendix A). Surveys were anonymous with the exception of location in the form of nearest cross streets. Locations were "ground-proofed" through Google Earth Pro, and through site visits to farms in the S.F. Bay Area.

Farms were separated into two populations based on tenure status—high-security and low-security—and related to sixteen predictor variables (Table 1). Tenure status is a complicated issue, we have allowed for some simplification for the sake of analysis. This methodology may fail to capture the nuance of unique regional, local, and social and economic drivers that affect urban agriculture sites. Our methodology depended on legal land status and perception of farm managers regarding tenure insecurity (Figure 1). In some cases, farms that are owned by producers may still have insecure tenure status, but this sample did not identify any tenure insecure farms that had legal land ownership. In two instances, favorable farm manager perception combined with a memorandum of understanding (MOU) determined tenure status as secure. Both populations are equally represented within the sample: $n = 27$ (low security) and $n = 29$ (high security).

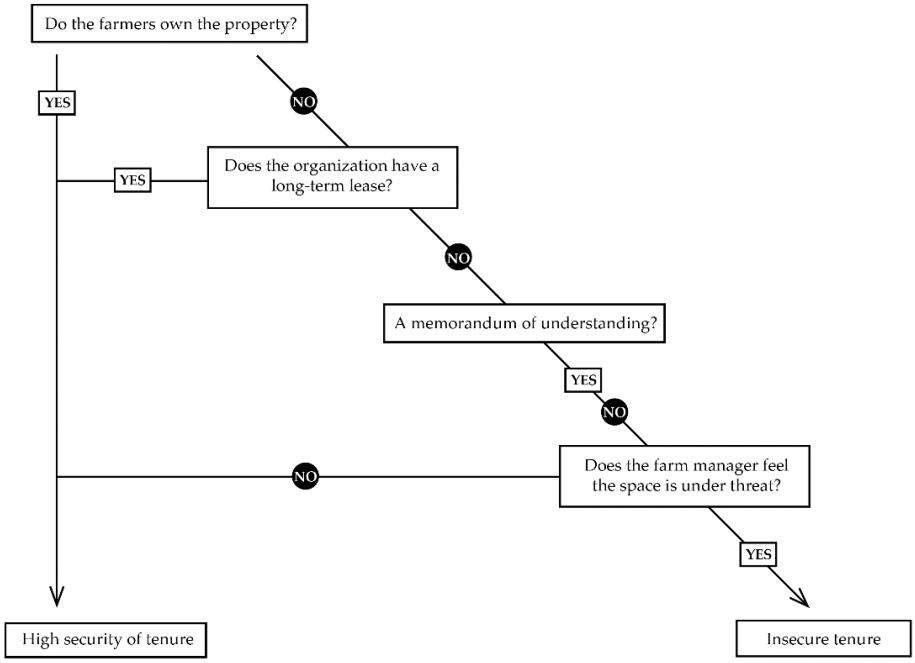


**Figure 1.** Tenure status decision process.

Census tract data in the form of median home value per area (Zillow Home Value Index and Walk score) were used to assess farms for place-based criteria [18]. Regional Opportunity Index (ROI) data from the University of California, Davis Center for Regional Change, were collected for housing opportunity, economic opportunity, and overall place-based opportunity (Table 2). Index data were scored (lowest, low, medium, high, and highest), and further subdivided into two categories (low + lowest, and high + highest index scores); this Likert-like index data were compared using a $\chi^2$ goodness-of-fit test and Fisher's exact test to determine if tenure status populations differed.

Previous survey work demonstrated that obtaining quantitative levels of economic and organizational support is challenging. Questions about financial resources and funding for UA can be perceived as invasive by respondents. Our inquiry concentrated on characteristics indicative of increased economic support: whether UA projects have a paid full-time or part-time manager,

their ability to pay for irrigation requirements, and their capacity to produce profits through sales. Social and economic support survey responses were compared using Fisher's exact test of independence. Findings from preliminary analysis encouraged further investigation through binomial logistic regression and regression tree analysis using R (Version 3.4.4) [19]. Regression tree analysis was completed using the "tree" package (Version 1.0-39) [20].

**Table 2.** ROI index categories.

| Regional Opportunity Index—UC Davis Center for Regional Change | |
|---|---|
| Housing Opportunity-People | Percentage of households in which residents own their own home (and) percentage of homeowners and renters for whom housing is less than 30% of household income. |
| Economic Opportunity-People | Number of jobs per 1000 people, within a 5-mile radius, percentage 1-year change in the number of jobs, within a 5-mile radii, percentage of high-paying jobs, within a 5-mile radius, number of banks and credit unions per 1000 people, within a 5-mile |
| Regional Opportunity-Place | The Regional Opportunity Index (ROI): Place is a relative measure of an area's assets in education, the economy, housing, mobility/transportation, health/environment, and civic life. |

Our analysis focuses on the unique social, political, economic, and land-use contexts of California. This analysis explicitly recorded responses from farm managers to obtain more accurate results during sampling periods and to reduce the possibility of double counting. Including manager status as a variable while also only recording data from farm managers may have introduced some bias into our sample, but the benefits outweigh the potential problems. Respondents were able to share the online survey with other urban farms, which may have generated some sampling bias. However, targeted outreach by researchers was comprehensive enough to eliminate these concerns.

## 3. Results

Comparing populations of secure and insecure tenure farms indicated differences regarding financial support and location. More tenure secure farms were able to pay for irrigation and full-time managers. Place-based differences show greater numbers of insecure tenure farms occurring in census tracts with lower economic opportunity as measured by the ROI. Only 25% of sampled farms own their property.

### *3.1. Comparison of Tenure Status Populations*

Comparison of the tenure status in sample populations was completed using Fisher's exact test. Differences in four categories were detected: census tract median home value (low–high, $p$-value = 0.03); housing opportunity (low–high, $p$-value = 0.006), paying for irrigation ($p$-value = 0.03), and full-time farm managers ($p$-value = 0.04). More urban farms occur in areas with lower property values and housing opportunity, as measured by lower rates of homeownership and increased rent burden. Tenure insecure farms are less likely to pay for their own irrigation or have a full-time farm manager.

### *3.2. Binomial Regression Models*

Supporting the previous population comparisons, regression analysis indicator categories for irrigation and full-time manager were significant. Paying for irrigation was one of our most robust indicators ($z$-value −2.054, Pr(>|$z$|) 0.04), with over 70% of tenure secure farms indicating that they are financially able to pay for irrigation at municipal rates. Full-time farm manager was correlated with secure tenure farms ($z$-value −1.916, Pr(>|$z$|) 0.05), and 44% of tenure secure farms were able to pay for a full-time manager. Only fifteen of the sampled farms had a production focus, indicating little income from market-based activities. However, regression analysis did show that mixed distribution of harvests, with some produce sold at market was significant at increased confidence levels ($z$-value 1.793,

Pr(>|z|) 0.07). Of the 29 secure tenure farms/gardens sampled, over 50% of them were affiliated with educational institutions (z-value −1.897, Pr(>|z|) 0.05).

Only one place-based indicator was significant: economic opportunity as measured by census tracts with a higher number of jobs per 1000 people; higher percentage 1-year change in the number of jobs; more high-paying jobs; and more banks and credit unions within a 5-mile radius (z-value 2.094, Pr(>|z|) 0.03).

### *3.3. Regression and Classification Tree Analysis*

Differentiating groups using a classification and regression tree (Figure 2) confirms findings from previous analysis and helps us understand what factors most likely predict secure tenure in measured farms. At each "branch" of the tree, a decision based on binomial (0,1) regression modeling is made, creating a hierarchical structure that maximizes the reduction in impurity. When the criteria are not met (0) the regression tree branches to the readers left, and when the condition is met (1), to the right. Ability to pay for irrigation, a proxy of economic support, was the most important factor in this analysis followed by school affiliation and the economic opportunity index "high" category.

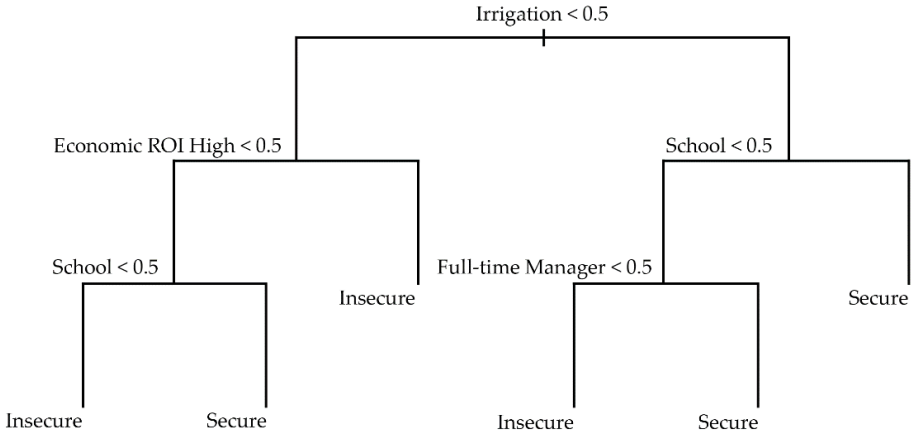


**Figure 2.** Regression and Classification Tree.

Secure tenure farms: When urban farms are able to pay for their own irrigation, and they are affiliated with a school, they are more likely to have secure tenure status. If not school affiliated, having a full-time, paid farm manager is a strong indicator of secure tenure. Conversely, secure tenure farms that do not pay for their own water and are located in areas of lower economic opportunity must be affiliated with a school to be considered tenure secure.

Tenure insecure farms: When farms are unable to pay for their irrigation (less financial support) and occur in areas of higher economic opportunity, they are more likely to be insecure, while farms in underserved neighborhoods rely on school affiliation to remain secure. Farms that show indicators of financial support, but lack full-time farm managers and school affiliation are also likely to be insecure.

## 4. Discussion

It is not uncommon for people engaged in urban agriculture to have witnessed the loss of an urban farm. In the 1990s, the city of New York bulldozed hundreds of gardens in vacant lots that had been developed by community members [10]. In Los Angeles, the razing of the South Central Farm in 2006 was well publicized [21]. When urban farms are well-established and provide valuable resources to the community their loss can significantly impact those that rely on them. Concerns of the long-term viability of these community resources frequently occur in the absence of data, leading to conjecture about the persistence of urban farms over time, or identification of underlying causes of UA loss.

Our analysis suggests that the tenure security of urban farms is related to specific characteristics (Table 1). Traits that best predicted tenure status in UA are financial support, location, and affiliation with an educational entity (Figure 2). Urban farms in areas of higher economic opportunity that receive more financial support appear to be more insulated from unexpected land-use changes over time. Measures of financial support, including the ability to pay for irrigation and hire a full-time manager, occurred more frequently in tenure secure farms. Irrigation and labor costs are often the most costly expenditures for urban farms. One acre-foot (approximately 1233 $m^3$) of water costs farmers around $2200 from the East Bay Municipal Water District in the S.F. Bay Area [22]. There are no agricultural rates currently in effect for urban farms in the sample area. Cheaper non-potable water would be beneficial for UA, but the infrastructure required to deliver to urban farms and gardens is often inadequate.

Our analysis finds that association with a school was especially important indicator of social support for UA sites in more impoverished neighborhoods. School affiliation may act as a de facto subsidy in the context of irrigation and labor costs and may reduce pressures driving land-use changes in cities. An emphasis on education and food security is prevalent for both tenure secure and tenure insecure farms. Only 20% of farms have a production focus. Approximately 80% of food grown on non-production farms is distributed to the community who works on or lives near the farm. Previous survey work in the Bay Area recorded high yielding production systems that provides further evidence for the important contributions of urban farms to local food security [23]. Many UA organizations dedicated to educational and food security objectives are also deeply tied to food justice initiatives, reflecting associations to important regional social movements [10–12].

Place-based indicators show that more successful UA initiatives may occur in areas with greater economic opportunity as measured by the ROI, raising concerns regarding how space and resources to incentivize UA are allocated at the state and local level. Resources and programming are often concentrated in more affluent communities. In the Los Angeles region in 2003, only "10 of the more than 60 official community gardens were located in underprivileged areas" [21].

Economic incentives, such as advantageous tax assessment for landowners who allow urban agriculture on their property, have become one policy mechanism to direct financial resources toward UA [4,24]. Yet, these tax-incentive schemes target landowners themselves who may not suffer from food insecurity or even be present at the site. Moreover, these tax-exemption schemes contribute to the sense of temporariness. In California, only a minimum commitment of five years is required from the property owner to claim the tax incentive [24], a short period to fully realize the full productive potential of urban farms.

## 5. Conclusions

Our findings call attention to the importance of equity in financial and institutional support for urban farms. Disproportionate financial support to urban agriculture projects in areas with high property values or incentives to property owners in more affluent census tracts may be counterproductive to achieve resilient and productive urban farms that serve communities with the greatest food need. Only supporting farms in areas with more favorable tenure status may perpetuate existing inequalities. We encourage future studies to contextualize these findings within the scope of existing literature in the fields of urban political ecology [25], critical geography, and environmental justice.

If in fact the capacity for UA to persist is greater in more affluent areas, previous findings that indicate gardens increase nearby property values over time, especially properties in impoverished neighborhoods is problematic [26], suggesting that the establishment of UA on unused land makes neighborhoods more attractive and increases real estate prices, increasing potential for UA to act as a mechanism for de facto environmental gentrification, economically dispossessing residents of the spaces they created through hard work and social organizing. These radical acts of reclaiming space for food sovereignty may inadvertently contribute to and perpetuate existing inequalities [11,27–30].

Relationships with strong social institutions such as schools and direct financial support may be the best policy mechanisms to help UA persist over time in urban areas. Seattle runs the largest municipally managed community gardening program in the United States and is an example of successful direct financial support for irrigation costs and paid farm managers. Through bonds and matching community grants, the city provides staff and logistical support for approximately ninety permanently protected community gardens on a variety of public lands. These "P-Patches" were initially considered as provisional land uses. However, community members and social movements catalyzed successful partnerships, and the overall number of gardens has grown exponentially over four decades. Seattleites even operate two functioning, profitable market gardens [4,31].

Our analysis points to important characteristics associated with the persistence of urban farms across different social-economic and political circumstances. Urban agriculture persists in adversarial policy, political, and economic climates, but urban farms that are well resourced and in more affluent areas may be able to respond to disturbance and/or resist involuntary land-use changes more effectively than farms that are less resourced and in areas of lower economic opportunity. We encourage advocates and planners to concentrate financial resources directly to farms that are more likely to be tenure insecure.

**Author Contributions:** For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, J.A.; Methodology, J.A., P.R.; Software, J.A., P.R.; Validation, J.A., P.R.; Formal Analysis, J.A., P.R.; Investigation, J.A.; Resources, J.A.; Data Curation, J.A.; Writing-Original Draft Preparation, J.A.; Writing-Review & Editing, J.A., P.R.; Visualization, J.A.; Supervision, J.A., P.R.; Project Administration, J.A.; please turn to the CRediT taxonomy for the term explanation. Authorship must be limited to those who have contributed substantially to the work reported.

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## Appendix A

| | **Survey Questions** |
|---|---|
| 1. | Are you a manager at the farm or garden? |
| 2. | If yes, are you part-time or full-time? |
| 3. | Are you paid for your work? |
| 4. | What is the goal or focus of the farm/garden? (Food Security, Production, Education)—pick all that apply |
| 5. | Is the farm or garden owned by the organization/people that operate the farm? |
| 6. | Does the farm/garden have a long-term or short-term lease? |
| 7. | Does the farm/garden have memorandum of understanding (MOU) with the property owner? |
| 8. | Is the farm/garden located on public land? (Example: park land) |
| 9. | Do you feel like the farm or garden is under threat of development or conversion to other non-farm/garden uses? If yes, please provide a brief description. |
| 10. | Does the farm or garden pay for water/irrigation? |
| 11. | Where does this water come from? |
| 12. | Does the farm or garden have a water catchment system to capture and store rainwater? |

| | |
|---|---|
| 13. | Where does the farm/gardens harvest go? Who receives the food grown there? (please total to 100%)—Local community/people who work on farm, Market (farmers market, farm stand, etc.), Donated to local organizations (food pantry, senior housing, Meals on wheels, etc.), Other (please explain) |
| 14. | Is the farm or garden affiliated with a school (located at a school or students use it for educational purposes?) |
| 15. | Is the farm or garden affiliated/sponsored/co-managed with a non-profit organization, 501(C) (3)? |
| 16. | If not affiliated with a non-profit, is the farm part of a larger organization dedicated to education, food-security/sovereignty or similar? If yes, please describe. |
| 17. | Have any of the below policies benefited or affected your farm/gardens operations since enacted? |
| 18. | If yes, can you briefly explain how one of these ordinances has affected your operations? |
| 19. | How does the farm/garden function: people rent spaces and typically only work/harvest those plots (allotment style), or is the farm/garden worked collectively and harvests are distributed to those who work/volunteer? Is it a mix of these two styles? |
| 20. | How long has the farm/garden been established at its current site? |

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