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Barriers to urban agriculture in Sub-Saharan Africa

Julia Davies [a,*], Corrie Hannah [a], Zack Guido [b,c], Andrew Zimmer [a], Laura McCann [a], Jane Battersby [d], Tom Evans [a]

[a] School of Geography, Development & Environment, University of Arizona, 1064 E. Lowell Street, Tucson, AZ 85719, USA
[b] Arizona Institutes for Resilience: Solutions for Environment and Society, University of Arizona, 1064 E. Lowell Street, Tucson, AZ, 85719, USA
[c] School of Natural Resources and Environment, University of Arizona, 1064 E. Lowell Street, Tucson, AZ 85719, USA
[d] African Centre for Cities, University of Cape Town, Private Bag x3, Rondebosch 7701, South Africa

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ABSTRACT

Trends in urbanization and urban food insecurity in sub-Saharan Africa (SSA) have stimulated critical debates around the potential benefits of urban agriculture (UA) to urban livelihoods. Some scholars suggest that UA can contribute to the food quantity, food quality and income needs of urban households. However, much of the evidence cited comes from single case studies, with particular attention paid to large cities and high-income countries. There is a resulting gap in understanding regarding what role UA plays in the food security of households in smaller African cities and towns. These smaller urban areas are likely to house a large fraction of SSA's urban population in future and are important sites for early intervention by policymakers. Our analysis is based on survey data collected from 2,687 low- and low-middle income households in 18 urban areas with populations of less than 200,000 across Zambia and Kenya. We perform statistical analyses to investigate the association between UA and household food security and assess which types of households are engaged in UA. We found that 33% of households in our sample are engaged in UA and there was limited statistical significance in terms of the relationship between UA and household food security. Our results reveal three key barriers to UA, namely settlement formality, property rights, and distance from food retailers. These barriers imply the need for urban planners and policymakers to revisit how decisions are made about issues such as residential development, land tenure, transport infrastructure, and the use of space in cities, as these affect the ability of households to produce, sell, and access food. Policy and planning mechanisms should further recognize the embeddedness of UA within African urban food systems, in which traditional markets, informal trading, and modern food retail also play an integral role.

1. Introduction

Rapid urbanization has caused the locus of food insecurity to shift and expand from rural areas to cities and towns (Crush and Frayne, 2011; Poulsen et al., 2015). Whether Urban Agriculture (UA) can improve urban livelihoods has become the subject of critical debate among those concerned with these co-emerging trends of rapid urbanization and urban food insecurity (de Zeeuw et al., 2011; Frayne et al., 2014, 2016; Prain and Lee-Smith, 2010; Zezza and Tasciotti, 2010).

UA and *peri*-urban agriculture are terms that are often used interchangeably to refer to food production in and around cities (Opitz et al., 2016; Padgham et al., 2015; Thornton, 2008). However, we define UA as growing crops and raising small livestock on land within the urban boundaries of cities and towns (e.g. home gardens, vacant lots, roadsides, and balconies) for household consumption or sale in urban markets (Poulsen et al., 2015). On the one hand, UA is often regarded as a solution to some of the social, economic and environmental challenges in cities (Miccoli et al., 2016; Mkwambisi et al., 2011; Nkrumah, 2018; Thornbush, 2015). On the other, critics have highlighted the barriers to UA, citing many cases where UA has proven to be an ineffective livelihood strategy for lower-income urban households who depend predominantly on a cash income to support their basic needs (Crush et al., 2011; White and Hamm, 2014).

Scholarship on UA has largely been shaped by perspectives from the Global North, but there is an increasing geographic focus on UA in sub-Saharan Africa (SSA). Today, an estimated 350 million people live in urban SSA and this figure is expected to triple to 1 billion by 2050 (UN-DESA, 2014). Since the colonial period, much of SSA's urban growth has

* Corresponding author.
E-mail address: juliadavies@email.arizona.edu (J. Davies).

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been centered around large, primary cities (Fox 2012; Rondinelli 1983). However, secondary and tertiary urban areas are expanding rapidly, playing an increasingly important role in national and regional urban development (Roberts, 2016; Roberts and Hohmann, 2014; Zimmer et al., 2020).

Despite the growing significance of smaller urban areas, much of the existing research on UA and urban food security more generally has been case study-based and has focused on large metropolitan areas (e.g. Berger and van Helvoirt, 2018; Malan, 2015; Simatele and Binns, 2008). A bias toward primary cities overlooks the significant challenges being faced in secondary and tertiary urban areas, where poverty rates are typically higher relative to larger cities due to fewer opportunities for employment (Thornton, 2008). Small but rapidly transitioning cities and towns provide important opportunities for early intervention by policymakers (Joos-Vandewalle et al., 2018), and may therefore be well positioned to adopt viable food policies that support UA and which ensure urban food security in future (Filippini et al., 2019; Haysom and Fuseini, 2019; Martellozzo et al., 2014). However, under-resourced municipal governments in smaller urban areas also often need more support to assist their populations to adapt to social and environmental change (Roberts, 2016; Roberts and Hohmann, 2014).

Amid an array of pressing urban planning and development challenges (Hove et al., 2013), city governments in SSA have tended to view food insecurity as being outside of their mandate (Battersby et al., 2016; Crush and Frayne, 2010). In part, this is because of a perception of food insecurity as a rural, production-based problem (Battersby, 2017a; Haysom and Tawodzera, 2018). This perception is further sustained by the fact that food security is largely absent from urban development planning and policy in many SSA countries (Battersby and Watson, 2019). Although historically the development of policies, programmes and infrastructure to provide food to urban populations was central to national food policy (Smale and Jayne, 2003), national food policies now tend to focus on increasing rural agricultural output (Battersby et al., 2016; Crush and Frayne, 2010).

The challenge of urban food insecurity in SSA speaks directly to the United Nations Sustainable Development Goal (SDG) on 'zero hunger' (SDG 2), and is tied closely to others such as SDG 1 on 'no poverty' and SDG 11 on 'sustainable cities and communities' (Perez-Escamilla, 2017; United Nations, 2015). Padgham et al. (2015: 184) argue that achieving these global sustainability goals "will depend to a large extent on how developing-country cities are planned, managed and governed." Identifying policy solutions that could reduce food insecurity in rapidly-growing cities and towns across the SSA region is thus critical, and there are important considerations around the role of UA in this regard.

Leveraging the potential food security benefits of UA will require policy and planning mechanisms that enable urban food production and exchange, but which also recognize the embeddedness of UA within urban food systems, which themselves are shaped by broader socio-political and ecological contexts (White and Hamm, 2017). This implies the need to revisit how decisions are made across governance scales about issues such as residential development, land tenure, transport infrastructure, and the use of space in cities, including where food cultivation is permitted and where urban markets are located. These urban development dilemmas may be directly or indirectly related to UA and urban food security, but can nonetheless affect the ability of urban households to produce, sell, and access food and should therefore be considered in urban food security policies and planning agendas (Filippini et al., 2019).

In this paper, we assess the extent to which low- and low-middle income households in 18 urban areas with populations of less than 200,000 in Zambia and Kenya are engaged in UA, and investigate the association between UA and household food security. Specifically, we answer three questions: (1) what role does UA play in household food security? (2) what types of households are engaged in UA? and (3) what are the barriers to UA for low- and low-middle income households in a SSA context?

We hypothesize that barriers such as a lack of space, time, resources, and property rights mean that low- and low-middle income households would likely have less ability to produce food at a large enough scale to meet both the household's consumption and nutrition needs. Middle-income households therefore may be most likely to engage in UA relative to lower- and higher-income households (Fig. 1).

In Section 2 we provide an overview of the urban food security context in SSA and discuss the role of UA as a response to food insecurity in cities, highlighting some of the potential benefits of and barriers to UA that have been observed in the literature. In Section 3, we describe how we collected, organized, and analyzed the data using logistic and linear regressions. In Sections 4 and 5, we present and discuss our main results that identify the key barriers to UA for low- and low-middle income households, including settlement formality, property rights, and distance from food retailers. In conclusion, we argue that while UA contributes marginally to household food security, its potential benefits as a primary urban food security strategy should not be overstated. Rather, urban and agricultural policy and planning should recognize UA as one aspect of African urban food systems, in which traditional markets, street food vending and modern food retail also play an integral role to urban food security.

2. Literature

2.1. Urban food security in African cities

The Food and Agriculture Organization (FAO) defines food security as the condition whereby "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 2009: 1). Despite the integrated understanding of food security advocated in this definition, food security in the African context is still largely framed from the perspective of availability of staple foods. Other critical dimensions of food security - including access, utilization, and stability - have thus been overlooked. Where food access for urban residents has been considered in policies, it has often been conflated with ensuring availability of staple crops at low prices (Battersby and Watson, 2019).

With increased agricultural production and rural development remaining priority areas for food security interventions, African governments have been slow to recognize how the food security problem is manifesting in growing urban areas (Crush and Riley, 2019; Frayne et al., 2010). Rather than being caused only by insufficient food supply, urban food insecurity is strongly related to high levels of household poverty and unemployment (Crush et al., 2012; Prain and Lee-Smith, 2010; Siegner et al., 2018). This problem is worsened in times of financial stress, as was seen during the 2007/8 global financial crisis that resulted in a food security crisis (Cohen and Garrett, 2010; Ruel et al., 2010; Verpoorten et al., 2013).

The failure to address urban food insecurity in SSA is perpetuated, in part, through idealist visions of the 'modern' African city. This modernity is seen as desirable and favors the formal food retail sector in urban planning, whilst positioning informality as inadmissible for reasons such as congestion, hygiene, and illegality (Battersby, 2017b; Battersby and Watson, 2018; 2019). Governments and investors argue that these formal food retail outlets contribute to local economic development, job creation and economies of scale (Skinner, 2016). However, the quantities and prices of food offered in supermarkets often make it accessible only to middle- and higher-income urban residents who are able to pay more money at once for bulk goods, as opposed to a smaller quantity that has been portioned out and sold by an informal vendor (Peyton et al., 2015). Moreover, lower-income residents predominantly use supermarkets for non-perishable foods, and supermarket shopping therefore contributes to higher consumption of processed foods (Battersby, 2019; Battersby and Peyton, 2016; Demmler et al., 2017). In terms of food access among the urban poor, research in SSA cities highlights the minor role of supermarkets relative to traditional open-air markets and

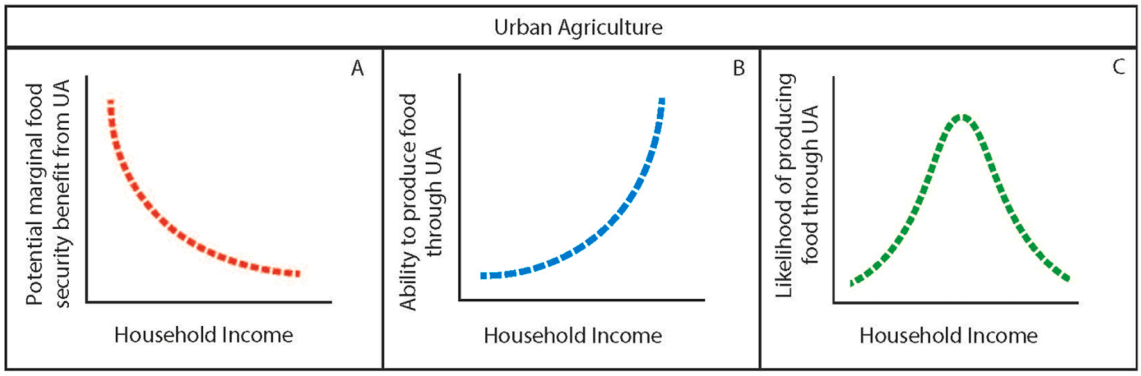

Fig. 1. Prospective relationships between household income and urban agriculture: (A) Potential marginal food security benefit of UA by household income; (B) Ability to produce food from UA by household income; (C) Likelihood of producing food from UA by household income.

street vendors (Crush and Frayne, 2011).

Although there has been increasing attention paid to UA and *peri*-urban agriculture in food security policy contexts, UA has largely been an afterthought, if not actively discouraged in urban planning in SSA (Padgham et al. 2015; Halloran and Magid, 2013; Redwood, 2012). The lack of consistent policy, planning and support for UA in SSA cities has been informed, in part, by a modernization discourse. However, this is layered on a much longer-term antipathy towards urban food production. Under structural adjustment, UA was often repressed out of concern that it would reduce demand for agricultural products, when agriculture was viewed as a crucial engine of economic growth. David Maxwell argues that local governments only became more open to UA in response to structural adjustment-related price shocks, in an effort to retard social protest (Maxwell, 1999). This history of repression followed by acceptance provides an entry point for understanding the contradictory engagements of local governments with UA. For example, In the development of an Urban Agriculture Policy for Ndola in Zambia, RUAF identified a critical challenge to the policy being conflicting pieces of legislation across sectors (RUAF/MDP, undated). Similarly, in neighboring Kitwe, agriculture is not officially recognized as an urban land use and common agricultural practices, such as small livestock and poultry rearing are illegal. However, Zambia's Department of Community Development, as part of its Food Security Pack programme, provides loans to women's groups, many of which it recognizes are being used to conduct livestock and poultry farming (Battersby, 2018). These regulatory ambivalences make urban food production a precarious livelihood with farmers beholden to the political will of local government officials and politicians (Battersby, 2018).

2.2. Urban agriculture as a response to urban food insecurity

The contribution of UA to urban food security is contestable (Poulsen et al., 2015; Siegner et al., 2018; Zezza and Tasciotti, 2010). One position in recent UA research suggests that UA is not an effective food security strategy in African cities (Frayne et al., 2016). For instance, results from a survey of 11 SSA cities found that only 22% of households engage in UA (Crush et al., 2011). Most of this UA practice occurs on a small scale and does not contribute significantly to either the food or cash income needs of poor urban households (Frayne et al., 2014).

The second position on UA evident in the literature endorses UA as a solution to multiple urban challenges, including urban food insecurity, poverty (Lee-Smith 2010; Nkrumah 2018), and urban greening (Thornbush, 2015). Much of the empirical work supporting UA is from the Global North and is often linked to ideas of social and environmental justice, food sovereignty, and the localization of food systems (e.g. Alkon and Agyeman, 2011; Leitgeb et al., 2016; McClintock, 2012). These framings are not always applicable in the SSA context, where national food economies rely substantially on transnational food imports and exports (Bren d'Amour and Anderson, 2020); while at the local scale people's experiences of food insecurity are shaped by household characteristics and a complex mix of market and non-market food sources and formal and informal food systems (Battersby and Crush, 2014; Tefft et al., 2017). However, as argued in Winklerprins (2017) and by Gray et al. (2020), it is no longer entirely accurate to dichotomize UA according to a Global North - South divide, as the differences in how and why UA plays out are becoming less marked. This can be seen in additional scholarly work that has found similar evidence of the benefits of UA in both Global North and South contexts. For example, Battersby and Marshak (2013) and Olivier (2019) found that in Cape Town, South Africa, UA contributes to social wellbeing at the individual and community scales. Similarly, Parece and Campbell (2017) note the social benefits of community gardens in the United States, which in some cities are viewed as "a catalyst for neighborhood and community development" (p.44). Arguments have also been made for the important role that UA can play in household food security in times of crisis in SSA (e.g. Smart et al. 2015; Toriro, 2019) and South America (Hammelman, 2017), as well as in Europe (Seguí et al., 2017) and North America (Chan et al., 2017).

2.3. Barriers to urban agriculture

Beyond scholarly review of UA, the international development community has advocated for the expansion of UA in rapidly urbanizing regions (Crush et al., 2011; RUAF, undated; UNDP, 1996). However, empirical evidence indicates that the effectiveness of UA is limited in SSA, and the food security benefit is likely to be more in terms of dietary diversity than the amount of food consumed (Badami and Ramankutty, 2015; Warren et al., 2015). Part of the problem is that many of the people who could benefit from UA live in dense, overcrowded settlements, where they do not have the land on which to grow food (Badami and Ramankutty, 2015; Battersby, 2013; Crush et al., 2010; White and Hamm, 2014). Households living in situations of tenure insecurity are also less able - or less inclined - to invest in UA. In some cases, people have made use of public open spaces to produce food, but they too face barriers such as pollution from traffic, dumping of waste, and a lack of nearby water access (Crush et al., 2011; Simatele and Binns, 2008; Bryld, 2003).

From a policy perspective in SSA, there has also been some push-back on promoting UA among city governments concerned with hygiene and the use of space in cities, and officials have placed an outright prohibition on agriculture in some urban areas (Simatele and Binns, 2008; Toriro, 2019). In fact, Bryld (2003) notes that in almost all developing countries, UA is de jure and/or de facto illegal. Additionally, as discussed above, the historical repression and then permitting of UA in SSA as a result of structural adjustment policies has led to policy and planning inconsistencies, which leave UA practitioners vulnerable to

changes in political will and with inconsistent support (Battersby, 2018).

The changing demographics of an urbanizing SSA population also play into the realities of UA as a livelihood strategy. Some poor residents in SSA cities are migrants who have come to urban areas in search of a cash income. Although migrants from rural agricultural regions may already have the knowledge and skills to produce food, many of these migrant household members are working long hours at multiple jobs and often do not have the time or resources required to engage in UA (Crush, 2012; Joubert et al., 2018). On the other hand, perceptions of agriculture as an activity suited only to those living in the countryside can be a barrier to community acceptance and uptake of UA (Thornton, 2008). The length of time that a household has lived in an urban area or community can further influence whether or not they engage in UA. Households that have resided in an area for many years are more likely to seize available land and grow food, versus newcomers who may be met with gatekeeping from established community members (Bryld, 2003).

3. Methodology

3.1. Study sites

Household survey data collection was conducted in a set of 18 secondary and tertiary urban areas in Kenya and Zambia. Zambia is a landlocked country in the south-central African region with a population of approximately 18 million (World Bank, 2018). Although the majority of the population lives in sparsely populated rural regions, close to 45% of Zambian people currently reside in urban areas (World Bank, 2018). Our household survey was conducted in the following 14 urban areas in Zambia: Batoka, Choma, Chongwe, Itezhi-Tezhi, Kapiri Mposhi, Maamba, Mazabuka, Mbabala, Mkushi, Mpongwe, Namwala, Nyimba, Pemba and Petauke. These urban areas spanned the Southern, Central, Eastern, and Copperbelt Provinces.

Kenya is a coastal country in Eastern Africa that spans the equator. Kenya has a population of roughly 52 million, with approximately 27% living in urban areas (World Bank, 2018). We included the 4 urban areas of Nanyuki, Karatina, Timau, and Naro Moru in our Kenyan sample. Fig. 2 shows the location of Zambia and Kenya in SSA (panel B), the approximate locations of the sampled urban areas in Kenya (panel C) and Zambia (panel D) and a map depicting the spatial distribution of household sampling within one individual urban place (panel A, Choma, Zambia).

3.2. Sampling design

Our data collection approach consisted of a household survey conducted in 18 urban areas across Zambia (n = 14) and Kenya (n = 4) from May to August 2019 (Fig. 2). Enumerators were recruited through our in-country partners, which include the Zambia Agriculture Research Institute in Zambia and Mpala Research Centre in Kenya. We obtained Institutional Review Board approval from our research institution to conduct human subjects-based research according to our data collection protocols and ethical research standards. Additionally, we liaised with administrative and municipal-level authorities in Zambia and Kenya throughout the research process to gain permissions to conduct our

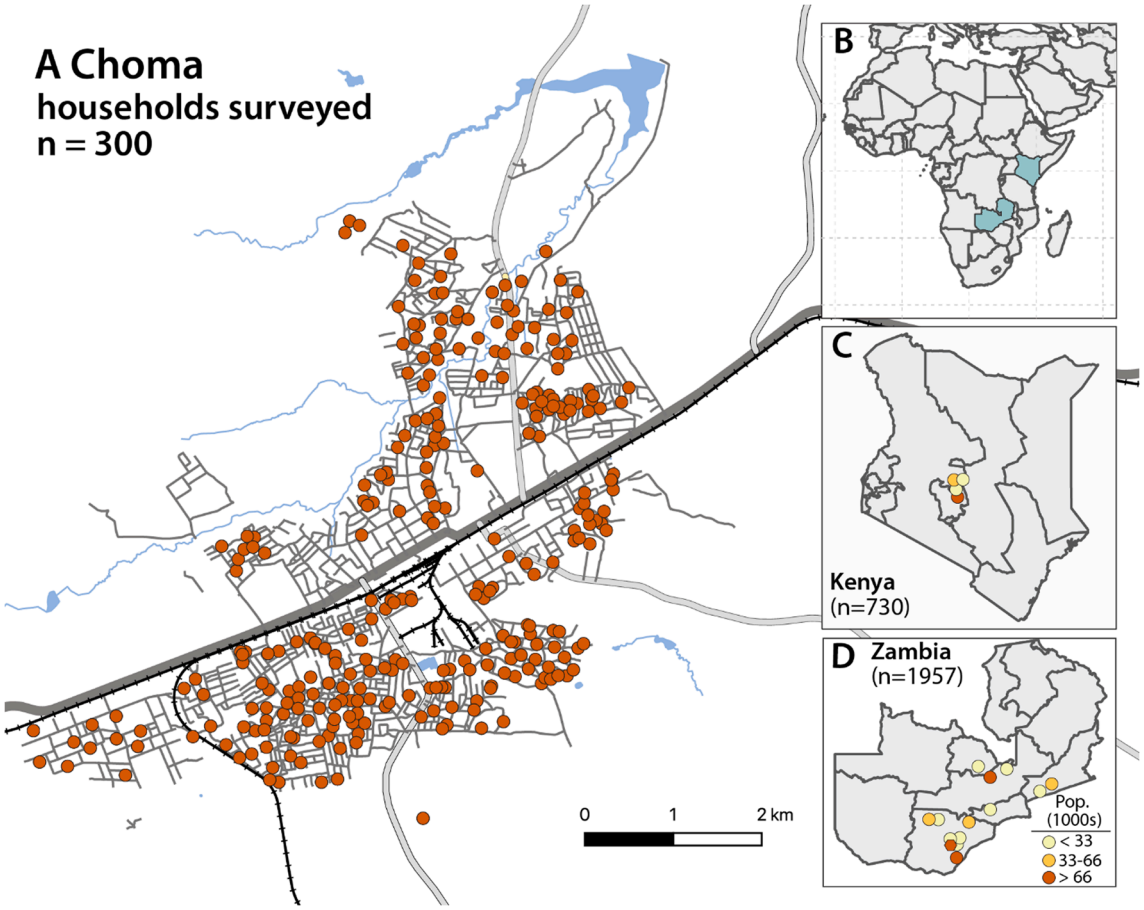

Fig. 2. (A) locations of households interviewed in Choma, Zambia; (B) locations of Kenya and Zambia in Africa; (C) location of the 4 urban areas surveyed in Kenya; D: location of the 14 urban areas surveyed in Zambia (hexagon denotes the location of Choma). The number of households surveyed in Kenya, Zambia, and Choma and the population range for each town is noted.

research activities in each urban area. Enumerators fluent in local Zambian and Kenyan languages conducted the household surveys. Respondents included one individual from each household who was over the age of 18, and knowledgeable about the household's characteristics and food purchasing patterns.

Following a purposive sampling approach to target smaller urban areas, we first selected urban areas with total population sizes ranging from 5,000 to 200,000 (Fig. 2) based on the Global Human Settlement Population dataset (European Commission, 2020) or the most recent national census. Then, in each of the 18 urban areas, we conducted a systematic random sample of households within identified low and low-middle income residential neighborhoods. Small urban areas did not have designated high-income residential neighborhoods in the manner of larger metropolitan areas, and so our sample in these small urban areas included their entire spatial extent. Moderate-sized urban areas (100,000+) exhibited some differential in household income across stratification of residential neighborhoods, but these neighborhoods constituted a small proportion of the total population. The number of households surveyed in each urban area varied by total population with larger samples selected in towns with larger populations. The households in our sample had monthly per capita incomes ranging from USD 0.00 - USD 490.20. We concentrated our data collection in low and low-middle income residential areas, because lower-income households would be most likely to reap the most food security benefits from UA relative to middle- and higher-income households who could spend more money on food purchases (Frayne et al., 2014).

We surveyed 2,687 households, including 1,957 from 14 urban areas in Zambia and 730 from 4 urban areas in Kenya. In each residential neighborhood, enumerators began at a central starting point chosen by visual inspection of a satellite image. Enumerators interviewed household respondents following roads extending from central points, skipping 3–5 homes after each interview. The number of households skipped depended on the size of the residential neighborhood, with a targeted sampling of 15–30 households within each residential neighborhood. This systematic sampling approach of skipping households was taken to ensure a representative spatial distribution of the households within each residential neighborhood (Fig. 2). For apartment complexes, which were predominantly located in the central business districts in Kenyan urban areas, we estimated the number of households living in one complex, chose a random starting point and then proceeded by skipping every 3–5 apartments. If an enumerator approached a house or apartment with no available survey participants, the enumerator proceeded to each successive household until a survey was conducted, and then continued to follow the procedure of skipping 3–5 households.

3.3. Analysis

We use three regression models to assess (1) the role that UA plays in household food security, (2) the types of households that are engaged in UA, and (3) the association between household characteristics and the area of cultivation among the subset of households engaged in UA. Each of these analyses provide insight on the barriers to UA. The regression models include mixed-scale explanatory variables that are theoretically influential on the dependent variable (see Appendix A for descriptive statistics of all variables used in the models).

First, to understand the role that UA plays in household food security, we use three linear models with the following standardized metrics for the dependent variable: the Household Food Insecurity Access Scale (HFIAS), the Food Consumption Score (FCS), and the Reduced Coping Strategy Index (RCSI). We summarize each of these in Table 1. We analyzed three food security metrics because no single indicator adequately measures food security (Blekking et al., 2020; Wambogo et al., 2018). Negative binomial regressions are used in the case of the HFIAS and RCSI due to the skewed distribution of these scores. We used ordinary least squares regression for the normally-distributed FCS scores. We include town identity as a control variable in each of these linear regression models and present the model results with robust standard errors to account for heteroskedasticity.

Second, to analyze the types of households that engage in UA we use a binary logistic regression model. Logistic regression is preferred in these models because we assume that the errors follow a standard logistic distribution. We control for confounding effects at the town level by including town identity in each model. Third, to study the effect of household characteristics on the area of cultivation among the subset of households that are engaged in UA, we use an ordered logistic regression model. The 'size of area cultivated' variable that we use as the dependent variable specifies the area used for UA on an ordinal scale, with 5 equal-interval categories that range from < 6 m^2 to > 30 m^2. We again include town identity to control for confounding effects at the town level.

4. Results

4.1. The extent and characteristics of urban agriculture in Zambia and Kenya

Across all study sites, UA was present in only 33% of sampled households. There was a slightly higher prevalence of UA engagement among sampled households in Zambia, at 35%, compared to 28% in Kenya. A large majority of UA-engaged households in both countries (86% in Kenya and 79% in Zambia) grew food in a garden at their residence, as opposed to in pots or sacks, or cultivating a remote location such as a community garden.

Within our sample, 17% of UA-engaged households in Zambia and 23% in Kenya used small areas of < 6 m^2 for UA cultivation. In both countries, the majority of UA-engaged residents cultivated UA on areas between 6 and 12 m^2, and households in both Kenya and Zambia exhibited a similar decreasing frequency in UA plot sizes until the final, largest category (Fig. 3). In Kenya, slightly more than 30% of the sample had UA plots greater than 30 m^2, a substantial difference from Zambia

Table 1
Summary and descriptive statistics of food security metrics used in this study (Zam = Zambia, Ken = Kenya).

Food security metric	Mean		Stand. Dev.		Min.		Max.		Description and interpretation
	Zam	Ken	Zam	Ken	Zam	Ken	Zam	Ken	
HFIAS	9.10	7.30	6.70	7.24	0	0	27	27	Composite score measuring household **access to food** over a 30-day recall period. Scores range from 0 to 27 with a higher score indicating more severe levels of food insecurity.
FCS	44.54	57.74	16.00	20.50	0	2	102	110.5	Composite score measuring household **food consumption and dietary diversity** over a 7-day recall period. Scores range from 0 to 112 with a lower score indicating more severe levels of food insecurity. FCS levels can also be interpreted according to the following thresholds: 0–21 poor; 21.5–35 borderline; > 35 acceptable.
RCSI	11.38	7.32	12.21	10.60	0	0	56	56	Composite score measuring the **severity of coping strategies** used by individuals or households in the last 7 days to cope with food insecurity. Scores range from 0 to 56 with a higher score indicating more severe levels of food insecurity. RCSI scores can also be interpreted according to the following thresholds: 0–3 no or low coping; 4–9 medium coping; RCSI ≥ 10 high coping.

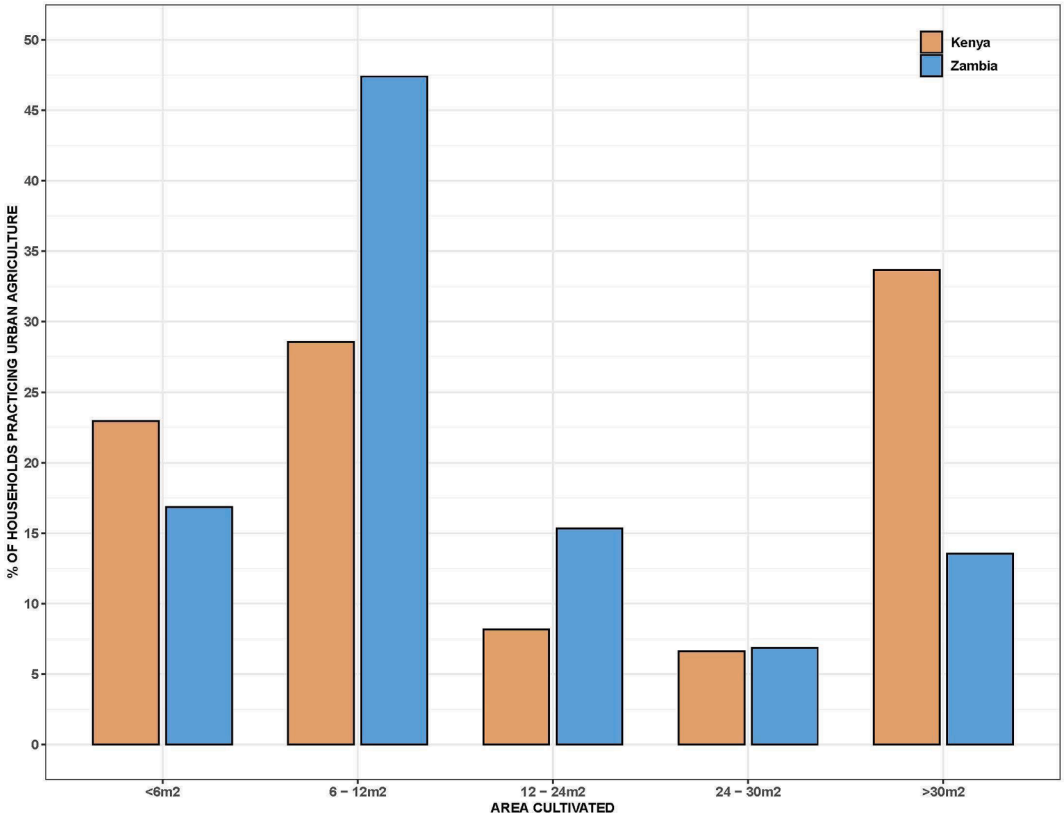

Fig. 3. Size of area cultivated for UA in all households that engage in some form of UA in Kenya (n = 200) and Zambia (n = 684).

which may reflect comparatively less dense housing clusters or generally larger urban residential spaces. About 44% of households in Kenya and 69% of households in Zambia that engage in UA were growing just one or two types of crops. In both countries, the most common crops grown were dark green leafy vegetables and maize.

4.2. Relationships between food security and urban agriculture

While only about one third of our sample practiced UA, those households that grew crops or raised animals perceived these activities to be important for their food security. Forty four percent of Kenyans and 32% of Zambians in our sample who were engaged in UA thought that the contribution of their UA activity to their households' food security was either extremely important or very important. We therefore assessed the relationship between UA and food security using the three metrics outlined in Table 1. The values and standard deviations are similar between the two countries, but the metrics show Zambian households to be more food insecure on average.

Measuring food access using the HFIAS metric, we find that the average scores in Zambia and Kenya were 9.10 and 7.30, respectively. These scores fall into the lower third of the HFIAS scale (which ranges from 0 – 27), suggesting that the households included in our sample are not severely food insecure. For the FCS metric that measures food consumption and dietary diversity, we find that 1325 households from our Zambian sample (68%) and 602 households from our Kenyan sample (82%) have "acceptable" levels of food security. For the RCSI metric, which measures the severity of coping strategies that a household employs to deal with situations of food insecurity, we find that 25% of Kenyan households and 43% of Zambian households in our sample had scores greater than or equal to 10, which indicates "high coping." Fig. 4 shows the mean values of the food security metrics by use of UA for each country.

Next, we conducted regression analyses to evaluate the relationships of each food security metric to the presence of UA, as well as the relationships of these three metrics to the size of the area cultivated for UA in each country (Tables 2 and 3), while controlling for household, community, and country-level factors (see supplemental material). The regression results show a limited association between UA and food security. We only found a statistically significant association with UA engagement for FCS scores in Kenya. While the regression coefficients for the food security metrics show consistent patterns in directionality within each country, the directionality of these food security coefficients are opposite when comparing across countries. In Kenya, households engaging in UA were prone to being more food insecure across all three food security metrics, while in Zambia it was the opposite - households engaging in UA were prone to being less food insecure (Fig. 4).

We do not seek to identify causal directions in the relationship between UA and food security, however, our results suggest that UA can relate to food security in different ways. Low- and low-middle income households in Kenya may engage in UA as a strategy to cope with existing food insecurity or to mitigate against more severe levels of food insecurity. On the other hand, UA may also improve food security, which could explain why Zambian households engaging in UA are more food secure.

4.3. Barriers to urban agriculture in Kenya and Zambia

We investigated barriers to UA engagement by performing regressions to assess the association of a suite of independent variables with: (1) whether or not the household is engaged in UA, and (2) the size of the area cultivated for UA. The size of the area cultivated is omitted in the first model because those who do not engage in UA would not have an urban food garden or other type of urban cultivation area. We chose to assess the size of the area cultivated to understand barriers to UA because this variable can provide insight into the amount of food that a household might be able to produce. We assume that a larger cultivation

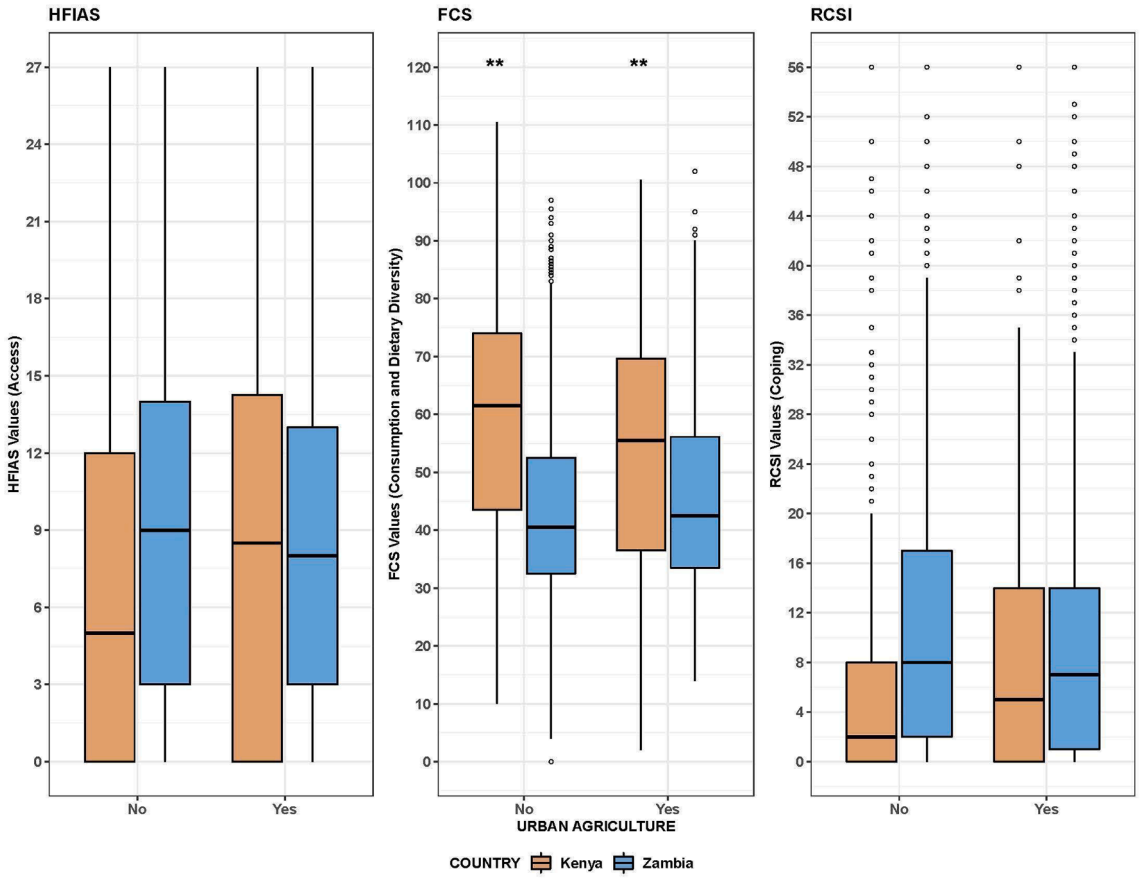

Fig. 4. Mean HFIAS, FCS and RCSI scores by urban agriculture engagement in Zambia (total n = 1849; n of UA-engaged households = 684) and Kenya (total n = 703; n of UA-engaged households = 200). ** = P < 0.05.

Table 2
Relationships between urban agriculture and food security in Kenya (*** p < 0.01; ** p < 0.05; *p < 0.1).

	OLS	Negative Binomial	
	FCS	HFIAS	RCSI
	(2)	(3)	(4)
Urban agriculture engagement	−7.087**	−0.102	−0.114
	(3.067)	(0.165)	(0.208)
Size of area cultivated	1.341*	−0.004	0.015
	(0.774)	(0.041)	(0.056)
Covariates	Yes	Yes	Yes
Constant	13.075**	4.193***	4.561***
	(5.212)	(0.295)	(0.397)
/lnalpha		0.161*	0.670***
		(0.085)	(0.078)
N	703	703	703
R^2	0.0442	0.039	0.044

Table 3
Relationships between urban agriculture and food security in Zambia (*** p < 0.01; ** p < 0.05; *p < 0.1).

	OLS	Negative Binomial	
	FCS	HFIAS	RCSI
	(2)	(3)	(4)
Urban agriculture engagement	−0.719	0.041	0.126
	(1.379)	(0.067)	(0.109)
Size of area cultivated	0.565	−0.018	−0.066*
	(0.469)	(0.022)	(0.036)
Covariates	Yes	Yes	Yes
Constant	29.672***	2.887***	3.479***
	(2.381)	(0.108)	(0.166)
/lnalpha		−0.623***	0.150***
		(0.053)	(0.045)
N	1849	1848	1849
R^2	0.212	0.030	0.032

area would enable a household to produce more food and perhaps a greater variety of food types. We organize this section around three main results that had statistically significant associations across the two regressions with UA as the dependent variable (Table 4), and which are also relevant from an urban planning and policy perspective, namely: settlement formality, property rights, and distance from food retailers.

4.3.1. *Settlement formality*

The majority of households included in our sample are located in planned (formal) settlements (66% in Zambia and 85% in Kenya), rather than unplanned (informal) settlements. We define planned settlements as neighborhoods comprising households that have a plot number or house number allocated by the municipal council. Typically, households located in planned settlements have better access to formal housing and basic infrastructure and services, such as water and electricity, which are also key determinants of food security (Frayne and McCordic, 2015; Rice and Rice, 2009). Our logistic regression results indicate that, in both Zambia and Kenya, households that are located in planned settlements are less likely to engage in UA. They are also likely to use smaller areas of land for UA cultivation (Table 4).

4.3.2. *Property rights*

We found that most households in our Kenyan sample rent their dwellings (72%) as opposed to having a formal title deed or occupancy certificate, whereas in Zambia only 35% of sampled households are renting. In both Kenya and Zambia, households that were renting their

Table 4
Binary logistic and ordered logistic regressions with urban agriculture engagement and size of area cultivated as the dependent variables for Kenya and Zambia. We do not present the control variables for town identity, although these were included in the model.

	Urban Agriculture Engagement (Binary Logistic Regression)				Size of Area Cultivated (Ordered Logistic Regression)[1]			
	Kenya		Zambia		Kenya		Zambia	
	β	p	β	p	β	p	β	p
Planned settlement	−1.005**	0.011	−0.114	0.359	−1.067***	0.002	−0.086	0.486
	(0.394)		(0.125)		(0.349)		(0.123)	
Separate house	1.624***	0.000	0.199	0.141	1.401***	0.000	0.225*	0.084
	(0.393)		(0.135)		(0.321)		(0.130)	
Rent	−1.086***	0.007	−0.611***	0.000	−1.296***	0.000	−0.644***	0.000
	(0.401)		(0.126)		(0.327)		(0.121)	
Private water source	−0.087	0.767	0.363***	0.002	0.049	0.853	0.334***	0.003
	(0.294)		(0.115)		(0.265)		(0.113)	
Electric grid	−0.466	0.175	−0.044	0.727	−0.306	0.317	−0.037	0.760
	(0.343)		(0.125)		(0.305)		(0.120)	
Flooding in area	0.390	0.135	−0.088	0.453	0.400*	0.073	−0.209*	0.066
	(0.261)		(0.118)		(0.223)		(0.113)	
Distance to bus stop	0.011	0.126	−0.009**	0.019	0.007	0.276	−0.011***	0.002
	(0.007)		(0.004)		(0.006)		(0.004)	
Distance to food source	0.014**	0.041	0.008***	0.008	0.017***	0.009	0.008***	0.003
	(0.007)		(0.003)		(0.007)		(0.003)	
Household size	−0.015	0.818	0.036	0.160	−0.011	0.825	0.036	0.148
	(0.064)		(0.026)		(0.052)		(0.025)	
No. rooms in HH	0.297**	0.017	0.115***	0.008	0.180*	0.073	0.092**	0.023
	(0.125)		(0.043)		(0.100)		(0.040)	
Male-headed HH	−0.045	0.870	0.075	0.540	−0.176	0.443	0.094	0.423
	(0.275)		(0.122)		(0.230)		(0.117)	
Household income	0.000	0.975	−0.001	0.413	−0.000	0.755	−0.001	0.185
	(0.002)		(0.001)		(0.002)		(0.001)	
No. days worked	0.005	0.735	0.009	0.129	0.015	0.193	0.006	0.299
	(0.014)		(0.006)		(0.012)		(0.006)	
Education level	0.041	0.633	0.103***	0.005	−0.012	0.855	0.067**	0.049
	(0.086)		(0.037)		(0.065)		(0.034)	
Food help	−0.076	0.353	0.056	0.249	−0.087	0.212	0.070	0.128
	(0.081)		(0.049)		(0.070)		(0.046)	
N	703		1849		703		1849	
Pseudo R^2	0.376		0.089		0.212		0.046	
χ^2	219.28		179.96		289.23		189.97	
Pseudo Log-likelihood	−257.13		−1090.35		−536.42		−1975.27	

Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
[1] Ordinal Variables (1–5); Indicates the size of area cultivated for UA on an ordinal scale (0 = <6 m^2; 1 = 6–12 m^2; 2 = 12–24m^2; 3 = 24–30 m^2; 5 = > 30 m^2).

properties were significantly less likely to engage in UA. Of the subset of households engaged in UA, those that were renting were likely to have smaller cultivation areas than those not renting (Table 4). This difference in cultivation area was marginal in our Kenya sample, where both renting and non-renting households had a mean cultivation area of 12–24 m^2. In our Zambia sample, the mean size of the area cultivated for UA was more distinguishable: 12–24 m^2 in non-renting households compared to 6–12 m^2 in renting households.

4.3.3. Distance from food retailers

Our results show that as the distance between households and food retailers increases, so too does the likelihood that these households will engage in UA. In Zambian urban areas, we found that the households in our sample were, on average, a 23-minute walk from the location where they predominantly purchase their food items. 77% of these Zambian households are buying food most frequently from an open-air market, and households that were located farther away from their main place of food purchase were more likely to engage in UA and to use larger areas of land for UA cultivation (Table 4).

In our Kenya sample, we found that households most commonly purchase their food from roadside vendors or kiosks (30%), although open-air markets (24%), supermarkets (24%), and local retail shops (19%) were also frequented more than other food retailers such as wholesale markets or prepared street food vendors. The Kenyan households in our sample are located an average of 14 minutes walking from their main food purchasing location. As in Zambia, our regression results (Table 4) suggest that the farther away from this location that a Kenyan household is, the more likely it is to engage in UA and the larger the size of the area cultivated for UA.

5. Discussion and policy implications

5.1. The challenge of measuring urban food security

Our results highlight that households in our Kenya and Zambia study sites are not engaged in UA as widely nor is it as strongly related to food security as has been depicted in some of the scholarly literature and NGO- or development-related work (e.g. Lee-Smith, 2010; RUAF, undated; UNDP, 1996). However, it is important to consider the food security results in context. First, the three metrics that we used were developed to assess food security conditions in rural contexts. As such, they may not capture the nuances of urban food security, for example the fact that low-income urban dwellers tend to have poorer health outcomes than their rural counterparts, which in turn affects their ability to produce, access and utilize food (Haysom and Tawodzera, 2018; Rice and Rice, 2009). Second, there are important dimensions of food security that these metrics do not adequately address, including dietary diversity over a period of time longer than 7 days, as well as more subtle cultural differences in a household's behavior and experiences with regard to food security (Deitchler et al., 2010).

New methods for urban food security are worth exploring to complement the three metrics that we used. Indeed, Battersby (2012) suggests that efforts to measure urban food security may benefit from the use of a more diverse set of indicators that capture the complexity of the

problem, while Haysom and Tawodzera (2018) call for more in-depth, city-scale assessments that capture the nuances present in different urban contexts. In this way, both the breadth and depth of food security measurements can be improved, making them better positioned to inform national and local-level policies concerned with urban food security.

5.2. Barriers to urban agriculture are interrelated

Notwithstanding the statistically insignificant association between UA and food security, we find that a household's ability to engage in UA, and thus the potential of UA to contribute to food security, depend on settlement formality, property rights, and the location of a household in relation to food retailers. These characteristics can be barriers to UA, and they raise concerns around the equity of food access from a spatial and economic perspective.

One way that these barriers manifest is through an interplay between land use planning, informal settlements and food security. For example, a lack of holistic, multi-sector planning can result in the development of informal settlements in marginal areas that are vulnerable to flooding or other hazards (Douglas, 2018; Kironde, 2006). Typically, these settlements are home to relatively lower-income households who are also likely to have higher levels of food insecurity (Frayne and McCordic, 2015; Tacoli, 2017). We find that households in informal settlements are more likely to engage in UA, and UA may serve more as a food security coping strategy in these areas given the potentially limited options that these households have in terms of being able to obtain food through other means. In this context, UA has the potential to benefit households in informal settlements, provided that these households have the legal, logistical, and financial means and capacities to engage in UA. For example, insights from Gallaher et al. (2013) demonstrate how collective engagement in a UA intervention program in Nairobi's informal Kibera settlement had a positive impact on the dietary diversity and coping mechanisms of households faced with food shortages.

However, not all lower-income households located in informal settlements have access to these opportunities to engage in UA, as demonstrated in a study by Crush et al. (2011) who observed strikingly low rates of UA engagement in informal settlements in southern African cities. Horst et al. (2017) explain that without appropriate planning and a focus on food justice, UA programmes can emphasize societal inequities by contributing to the displacement of lower-income households who lack land and tenure security, while benefiting the wealthier and propertied class. In SSA, this often manifests as the reinforcement of colonial-era planning (McConnachie and Shackleton, 2010; Watson, 2009).

We need to recognize how the lack of property rights could make households reluctant or simply unable to invest in UA due to the uncertainty surrounding the stability of their living arrangements (Rice and Rice, 2009). Households that rent (as opposed to own) their properties are less likely to depend on food production, and they may have insufficient permission to grow crops or keep animals on a rented property (Crush et al., 2011; Bryld, 2003). Both space limitations and property rights may compel individuals to engage in UA on roadside verges or public open spaces. However, doing so might cause clashes with government officials over the permitted use of space in cities (Drechsel and Dongus, 2010; Smart et al. 2015; White and Hamm, 2014). These feedbacks between property rights, settlement formality, and food security highlight the need for planners to better address how marginalized populations can be incorporated in urban development and planning, a point that is also made by Du Toit et al. (2018).

Strengthening property rights through settlement formalization and certification, and integrating UA into urban plans and policies, could improve household and community investment in UA and bolster its contribution to urban food security (Holden and Otsuka, 2014; Robineau, 2015; Siegner et al., 2018). Tacoli (2017) also highlights how access to social welfare benefits (e.g. cash or food rations), financial services like loans, and targeted poverty reduction programmes often require official land tenure documents that show proof of a legal address in the city. Prioritizing settlement formalization and property rights in urban policies may therefore also lead to food security gains that go beyond the ability of urban dwellers to engage in UA.

5.3. Variability in food sourcing and access

Our findings further indicate that although some households engage in UA, most people rely more on purchased food from a variety of sources to meet their household food needs, with roadside vendors and open-air markets serving as important sources in both countries. The sources of food raise concerns about displacement and access, as land is often provided to the retail food sector in cities where urbanization occurs without adequate long-term land use planning. Unplanned urban growth can further lead to the encroachment of urban areas on *peri*-urban agricultural land, making it increasingly important to understand and manage the complex linkages between different elements of the urban food system that affect food sourcing and access for the urban poor (Hatab et al., 2019).

In considering the land use policies affecting food access in cities, it is important to distinguish between the distinct land uses with different food retailing. Supermarkets are developed by private investors with large financial investments that go through a formal permitting process. Traditional open-air markets may be formal or informal, but are large enough in scale that they are under some degree of authority from municipal governments (Smit, 2019). Street vendors that opportunistically occupy small available areas may be formally permitted in large municipalities that have the government resources to oversee these actors. However, they are often entirely unregulated in smaller urban areas and in many SSA cities these informal traders operate under hostile regulatory conditions (Skinner, 2019). Food retail also tends to congregate around transit stations, which are often sites of regulated trade in which market practices are rendered formal (Battersby and Muwowo, 2019). Due to their size and scope, supermarkets and open-air markets require more consideration in land use planning, particularly as cities and towns continue to expand. As White and Hamm (2017) note, open-air markets play an especially central role in the economic, social and cultural dimensions of urban life in SSA. The design and location of these markets should therefore be carefully considered by policymakers, as these factors affect strongly who can use and benefit from them.

Our results that households are more likely to engage in UA if they are located further away from food retailers raises important insights concerning urban food accessibility and appropriate land use planning. Namely, lower-income urban residents in SSA typically rely on walking and public transportation such as buses or minibus taxis, which often present a high expenditure burden (in terms of both money and time) (Olvera et al., 2013, 2008). When households are overburdened to obtain food from distant food retailers, they face a greater need to rely on alternative food sources. For the households in our study sites, engaging in UA appears to be one possible coping strategy to overcome these food accessibility challenges. This finding emphasizes the need for cities to consider policies affecting transportation, infrastructure and zoning in support of locating affordable retail options in closer proximity to residential areas. Yet, for cities in SSA, this approach to urban planning may be a challenge for residents lacking land tenure rights. If there is a perceived gap in food access, residential areas that lack space for food retail would require land to be reallocated to retail, and, where rezoning does occur, residents in informal settlements are at risk of displacement because of their lack of secure property rights (Holden and Otsuka, 2014; Siegner et al., 2018).

We also recognize that urban residents in SSA rely on a variety of food sourcing options beyond the food retail sector as a food security strategy (Berger and van Helvoirt, 2018; Crush and Frayne, 2011; Skinner, 2019). For example, rural to urban food transfers are an important source of food for many people, particularly migrant

households (Frayne, 2004). These transfers can contribute significantly to household food security and play a key role in the food provisioning strategies of urban residents (Frayne et al., 2017; Owuor, 2006).

However, these additional complexities in the urban food system remain largely unacknowledged by urban policy makers and planners. Decisions that shape the urban food retail environment are typically made without consideration of the food system or food security impact of policies and planning decisions. More often, decisions are determined by normative views of an idealized 'modern' city in which supermarkets are a symbol of development, but also a means to generate more revenues in the form of rates and levies for often cash-strapped local governments (Berger and van Helvoirt, 2018; Battersby, 2017b). It is widely assumed by policy makers and planners that supermarkets improve access to food for urban populations. However, evidence from both Kenya and Zambia indicates that this is not the case (Battersby, 2019; Demmler et al., 2017).

Municipal planning decisions around traditional markets are also subject to (mainly donor-funded) modernization plans which include market upgrading and market relocation. These plans are often poorly conceived of and ill-tuned to local market, producer or consumer needs (Asante, 2020; Asante and Helbrecht, 2020; Battersby and Muwowo, 2019). Furthermore, street vendors are often moved from central trading areas in the interest of sanitizing the street and making the city more attractive to investors (Battersby and Muwowo, 2019; Hansen, 2010; Skinner, 2019).

The limited attention paid to traditional markets and street vendors as vital components of the urban food system in SSA means that decisions taken around their governance have not considered the food security consequences of governance and planning decisions. Decisions to relocate markets, as has happened in both Zambia and Kenya, have failed to consider supply chain logistics, and may therefore make access to markets for urban food producers more challenging. Efforts to remove street traders from central locations further limits potential market access for urban producers. While many cities are relaxing historic anti-urban agriculture by-laws and allowing urban food production, their wider governance and planning agenda is limiting the viability of this production through hindering market access. Furthermore, the legalization of UA in the absence of proper spatial planning, service provision and facilitation means that the problems that city authorities often associate with UA (such as public health hazards, waste management issues and the illegal use of land that has been allocated for other urban development priorities) could overshadow the potential benefits of UA (Bryld, 2003).

5.4. Urban agriculture and transitions in urban policy

Although some country-level policies in Kenya and Zambia concern topics related to UA like land tenure and agricultural production, national policies on UA itself do not exist in these countries, and are scarce across SSA in general. To our knowledge, policies specific to UA have been developed in recent years at the city-level rather than at the country-level (Gore, 2018). Typically, these policies have been introduced in large, primary cities. For example, the Nairobi City County Urban Agriculture Promotion and Regulation Act (2015) ensures that UA is included in deliberations regarding urban planning, food policy, and market infrastructure. These types of city-level policies allow UA activities to be integrated into broader discussions on urban food systems governance and planning that specifically reflect a city's unique social, economic, and environmental contexts. They also demonstrate the important role that municipal governments can play in initiating policy development and change (Gore, 2018).

There are fewer instances where UA policies have been developed in secondary or tertiary cities, although one exception is the Urban Agriculture Policy for Ndola in Zambia (RUAF/MDP, undated). However, as discussed earlier, the inconsistencies in policy and planning in this case have meant that UA practitioners in Ndola experience variable support and are vulnerable to fluxes in political will (Battersby, 2018).

Without proactive planning, smaller cities may face significant challenges in the future as their populations expand and the pressure to ensure reliable food access for urban residents increases. As such, decision makers in both smaller urban areas and at the country-level in SSA have an opportunity to learn from the approaches taken toward UA by those larger cities that have already identified and developed mechanisms to incorporate UA into the broader food system. Realizing the potential benefits and opportunities that might arise through the development and implementation of UA policies will, however, require that UA policy initiatives remain consistent with broader urban policy objectives. For example, our empirical findings identify some of the key barriers to UA that many low-income and marginalized urban households face, which further demonstrates the need for policy initiatives to recognize and address the underlying drivers and interactions between property rights, settlement formality, and food security (Du Toit et al., 2018).

Moreover, our findings show that UA is not a panacea for urban food insecurity. Rather, policy and planning discourses should recognize UA as one element of SSA's complex urban food systems, where the management of urban land and water resources for UA require integrated and cross-sectoral coordination to support marginalized urban populations (Padgham et al., 2015). Yet, as much as these hybrid policy approaches are championed, we also recognize that urban cities in the Global South, such as those in our study site, face weak governance and coordination challenges in managing tradeoffs to promote green infrastructure initiatives, like UA, and overall urban development (Du Toit et al., 2018). Thus, policy approaches that address and incorporate UA need to recognize the diversity of financial resources and incentive structures that can drive urban planning in secondary and tertiary African cities (Goodfellow, 2013). In doing so, policymakers and planners should embrace certain social and cultural dynamics that make African cities unique, rather than striving for normative western ideals that perhaps do not transfer well to the African urban context, where informality is a dominant feature and where social networks are often critical to survival (Harrison, 2006).

6. Conclusion

In this paper we set out to answer three questions: (1) what role does UA play in household food security? (2) what types of households are engaged in UA? and (3) what are the barriers to UA for low- and low-middle income households in a SSA context? Although we found that UA contributed only modestly to household-level food security relative to purchased food, we recognize that UA could still have a role to play in the food and nutritional security strategies of lower-income urban residents. Policies that are prohibitive of UA, or which inadvertently create disconnects between urban food producers and markets, introduce constraints that limit potential food security support in some residential areas. Moreover, city-level UA policies which contradict or are misaligned with broader urban or national-scale policy objectives can result in inconsistent political buy-in and support for UA activities, and this should be considered when developing policies or plans for UA. At the same time, it is important to understand that only a subset of households are in a position to engage in UA. As such, programs promoting UA should also promote additional mechanisms to support food security beyond UA in order to benefit the widest spectrum of households.

Effectively leveraging the potential of UA as a food security strategy requires an improved understanding of the barriers to UA. We found that households in unplanned (informal) areas, households that rent their dwellings, and households that are located closer to food retailers are less likely to engage in UA. We therefore identified settlement formality, property rights, and the location of a household in relation to food retailers to be key barriers to UA. These barriers should be considered not only in UA policies, but in urban planning activities and in urban policies that may not be related directly to UA or food security. For example,

how decisions are made around issues like residential development, land tenure, transport infrastructure, and the location of urban retailers can impact the ability of households to produce, sell, and access food.

Urban policies and planning agendas in SSA can adopt an integrated approach to ensuring food security in cities, taking into account the realities of how the urban poor navigate urban food systems in which UA, traditional markets, informal trading and modern food retail all play an integral role. Smaller urban areas, which are often fast growing and changing rapidly, constitute an important part of urbanization in SSA and need to develop more integrated urban food systems, just as is the case with large metropolitan areas. Municipal governments, with their mandate to address urban planning and development needs at the city scale, have a key role to play in this regard but need to develop the knowledge, skills and resources required to deliberately mainstream contextually-relevant support for food security into urban planning procedures.

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CRediT authorship contribution statement

Julia Davies: Investigation, Data curation, Formal analysis, Software, Writing - original draft, Writing - review & editing. **Corrie Hannah:** Formal analysis, Investigation, Methodology, Writing - original draft, Writing - review & editing. **Zack Guido:** Methodology, Validation, Visualization, Writing - original draft, Writing - review & editing. **Andrew Zimmer:** Investigation, Visualization, Writing - original draft, Writing - review & editing. **Laura McCann:** Formal analysis, Methodology, Validation. **Jane Battersby:** Writing - original draft, Writing - review & editing. **Tom Evans:** Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Writing - review & editing.

Appendix A. Descriptive statistics of variables used in the regressions.

Variable name	Mean		Stand. Dev.		Min.		Max.		Variable description
	Zambia	Kenya	Zambia	Kenya	Zambia	Kenya	Zambia	Kenya	
Urban agriculture engagement	0.35	0.27	0.48	0.45	0	0	1	1	Describes whether the household is engaged in urban agriculture or not (1 = yes)
Size of area cultivated	0.87	0.80	1.40	1.57	0	5	0	5	Indicates the size of area cultivated for UA on an ordinal scale (0 = <6m^2; 1 = 6–12 m^2; 2 = 12–24 m^2; 3 = 24–30 m^2; 5 = > 30 m^2).
Planned settlement	0.66	0.85	0.47	0.36	0	0	1	1	Describes whether the household is located in a planned or unplanned settlement (1 = planned settlement)
Separate house	0.76	0.29	0.43	0.45	0	0	1	1	Describes whether the dwelling is a separate house or not (1 = yes)
Rent	0.35	0.72	0.48	0.45	0	0	1	1	Describes whether the household is renting the property or not (1 = yes)
Private water source	0.57	0.54	0.49	0.50	0	0	1	1	Describes whether the household has access to a private water source on the property (1 = yes)
Electric grid	0.46	0.85	0.50	0.35	0	0	1	1	Describes whether the household is connected to the municipal electric grid or not (1 = yes)
Flooding in area	0.27	0.23	0.44	0.42	0	0	1	1	Describes whether flooding occurs regularly within the immediate vicinity of the household (1 = yes)
Distance to bus stop	21.31	16.68	16.43	15.12	0	1	180	180	Distance from the household to the nearest bus stop, measured in minutes walking
Distance to food source	23.10	13.84	20.02	14.20	0	0	300	180	Distance from the household to the location where food is most often purchased, measured in minutes walking
Household size	5.29	3.86	2.25	1.87	1	1	12	12	Measures household size by the number of people living in the household
No. rooms in household	3.25	2.11	1.48	1.15	1	0	12	7	Number of rooms in the household (excluding kitchens and bathrooms)
Male-headed household	0.74	0.72	0.44	0.45	0	0	1	1	Describes whether the household is male-headed or not (1 = yes)
Household income	36.80	61.12	53.57	83.14	0	0	461.54	490.20	Household monthly income in USD per capita
No. days worked	19.61	22.47	9.09	7.97	0	0	30	30	The number of days that the respondent worked within the last 30 days
Education level	3.93	4.60	1.67	1.84	1	1	7	7	The level of education of the household head (7 = Completed Post-Secondary, 6 = Some Post-Secondary, 5 = Completed Secondary, 4 = Some Secondary, 3 = Completed Primary, 2 = Some Primary, 1 = None, NA = Unknown)
Food help	3.33	3.16	1.08	1.45	1	1	5	5	Describes responses to the question: "If someone in my household didn't have enough food, I could count on my neighbors to help me." (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree)

Total N = 2,687 households; Zambia N = 1,957; Kenya N = 730 households.

Appendix B. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodpol.2020.101999.

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