Land Use Policy 70 (2018) 182–197

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

Mapping and characterising the urban agricultural landscape of two intermediate-sized Ghanaian cities

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ARTICLE INFO

Keywords:
Urban agriculture types
Tamale
Techiman
Staple foods
Urban food
Urban land use

ABSTRACT

Extending beyond previous research biases towards large cities or analyses based largely on one type of urban agriculture (UA) (such as market gardening, or home gardening), this research aimed to investigate all forms of UA within two intermediate-sized Ghanaian cities (Techiman and Tamale). Where was being farmed? For whom, and why? The paper considers how findings compare to Ghana's larger cities, and possible implications for theory and for planning. Methods included remote sensing, field mapping, interviews and a 1000-household per city questionnaire. The most common reason for farming was food supplementation. This was often via staple foods, particularly maize, rather than the leafy vegetables common in larger cities' market gardening. Farming was predominantly via home gardening, particularly for the better off. The larger city of Tamale also sustained organised irrigated-vegetable market gardens.

Findings suggest a picture not dissimilar to Ghana's larger cities but with greater prevalence of home gardening, and a dominance of staple foods rather than perishable or high value crops. A compelling finding, which has received less attention in the literature, is the extent of, and roles played by, what this study refers to as 'institutional land. Both Ghanaian Ministry of Food and Agriculture's policy framing, and market crisis theorising, of the drivers and role of UA were not found to be an accurate reflection of Techiman and Tamale's UA. Rather than being a localised survival activity of the poor or marginalised, of recent migrants, or of predominantly women, these cities contained a large scale and diverse spatiality of UA mainly for non-poor and non-migrants' supplementation of their staple food larder. Results emphasise the context-specific nature of a city's urban agriculture, and underline the need for researchers and UA advocates to be specific about the form of UA under the microscope when making claims for 'an urban agriculture'.

1. Introduction

Urban agriculture (UA) is claimed to have grown in scale and importance since the 1970s (Hampwaye, 2013; Mougeot, Chapter 1 in Egziabeher et al. (1994)), though not without debate (Hamilton et al., 2014). Attempts at global assessment of *urban* cropland estimated 67.4 Mha or 5.9% of the world's irrigated and rain fed croplands to be within urban areas (Thebo et al., 2014). Hamilton et al.'s (2014) review of developing country UA estimates 266 million households engaged in some way in urban *crop* production (29 million households in Africa). Such figures suggest a not insignificant UA activity, but both the Hamilton and Thebo papers acknowledge their resolution of spatial analysis excludes home gardens or "small, spatially dispersed areas of urban croplands" (ibid, p8), as well as excluding animal-husbandry. They both call for comprehensive local surveys to contextualise UA's extent and role. In addition to this need to understand the scale of UA locally, changing demographic trends (Maxwell, 1999), as well as the effects of the 2007–08 food price riots and global financial crisis (Bush, 2010; Prain et al., 2010), may have rendered studies from the 1990s/early 2000s out-dated. Additionally, much of the research undertaken on urban or *peri*-urban agriculture has focused on capitals and large cities–a "metro-bias" (Thornton, 2008) or on a single type of UA (such as only investigating market gardening of high-value vegetables; or only home gardening). Such exclusionary focus on just one UA form, or on larger cities, may unintentionally misrepresent UA. Research in larger cities may also be less pertinent given that the greatest development pressure in coming decades is predicted to be in secondary cities (Cohen, 2004; De Bon et al., 2010; Satterthwaite et al., 2010). Indeed such secondary or intermediate-sized cities (defined in this research as roughly 100,000–500,000 inhabitants) are thought to be more representative of where the world's urban population actually lives (Satterthwaite et al., 2010). In terms of theory, until relatively recently the urban agriculture literature tended to bifurcate across two schools of thought when attempting to explain why farming within cities occurs

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http://dx.doi.org/10.1016/j.landusepol.2017.10.031
Received 16 June 2017; Received in revised form 17 October 2017; Accepted 19 October 2017

and persists (described in more detail in Section 1.1). One set of framing viewed UA as an expression of market failures or livelihood crisis. The other, in contrast, presented UA as arising from opportunities offered by the proximate urban market. Recent research has become more nuanced but see Ellis and Sumberg (1998), Battersby (2013), Masvaure (2016), and Frayne et al. (2016) for analysis of this difference in theorising urban agriculture.

This paper began its' journey with readings from both sides of this debate, and a concern than neither type of theory framing could be well-applied to a range of UA in a particular place, while being aware that this may be neither possible nor desirable. This limitation in the UA research, I feel, is partly because studies tend to exclusively zoom-in on only one or two types of UA (e.g. home gardens, or market gardening), or in one particular location (public open spaces), or for one particular group of people (farmer associations, or households), and to focus mainly upon capital cities with large and growing populations. I admit however that I was probably more influenced, at the start of this research, by understandings of UA as a survival strategy of the poor. My overall research questions are thus informed by this theoretical debate and designed to allow reflection on the implications of these city-specific findings for theory. My approach is more inductive rather than deductive (Lincoln et al., 2011) as I aimed to investigate the broadest spectrum of urban agriculture possible with the mix of methods used, in the specific social context of these two smaller Ghanaian cities. Such a research approach avoids the large-city bias, and exclusionary practitioner, single land type or farm system foci. In line with this research approach, perhaps more common to qualitative research (Lincoln et al., 2011), I therefore did not firmly pre-determine a theoretical "side" but rather grounded my research question in what could be found in my study sites: the observations, people's descriptions of their activities and motivations. Thus my research questions were simply: where is agriculture being practiced in these smaller cities? Who is farming these sites, and why? I do not claim the study nor its findings to be statistically replicable (Sandelowski, 1995; Lincoln et al., 2011) to all intermediate cities of Ghana, or of Sub-Saharan Africa, though the method, analysis and resulting insights may have transferable implications (Morse et al., 2002) for other sites where the relations around land, urban life, food and farming might be similar.

The next section of the paper provides a brief overview of urban agricultural research and theorising. The specificities of the Ghanaian context are then described and the characteristics of UA in Ghana's largest two cities are outlined. This is followed by a description of the materials and methods. My mixed methodology of remote-sensing of urban land, in-field survey, semi-structured interviews with urban farmers and key respondents, and a questionnaire survey of 2047 urban households (both farm and non-farm households) was complementary. The remote-sensing and in-field survey allowed identification of the institutional lands under agriculture in these cities, which the household survey alone would not have picked up. The mapping component alone could not have addressed the questions of who or why. Analysis and discussion are structured by the research questions around the characteristics of the farmed land found, and the function of the urban agriculture (for whom and why). In the discussion I consider how the findings from the specific social context of these two intermediate cities compare to studies of urban agriculture in Ghana's larger cities of Kumasi and Accra. I also return to reflect briefly on possible implications for theory and for urban planning. The compelling finding of the extent of, and diverse roles played by, institutional land is discussed and deserves follow-up investigation. At the end of the paper I conclude that Techiman and Tamale's patterns and functions of urban agriculture are not so dissimilar to Ghana's larger cities, but seem to contain a greater prevalence of home gardening, a dominance of rain fed staple crop production, and are most commonly motivated by household food supplementation, rather than survivalist, concerns.

1.1. Urban agriculture

It is necessary to describe and define urban agriculture since there has been imprecision or disagreement regarding what constitutes UA, and a lack of consensus regarding its role (Dubbeling et al., 2010; Zezza and Tasciotti, 2010; van Veenhuizen and Danso, 2007). It is not possible to cover this debate in detail. Suffice to say that lack of consistency of definition leads to difficulty assessing the true scale, and hinders comparability of studies (Thebo et al., 2014). For this research, practicality of definition was of concern i.e., what could be mapped and identified remotely and from in-field survey. Thus aspects related to the post-harvest food supply chain such as processing, distribution, or marketing were excluded. Urban agriculture, in this study therefore, (following Quon, 1999) refers to: the growth of food crops (including staple crops, fruit and vegetables), or cash crops (such as coffee, tea, sugarcane) or other agricultural products (such as textile, rope, fuelwood), or the practice of animal husbandry (including for meat, milk, fish, poultry), at all levels from subsistence to commercial, within the city area.[1] It may be illegal or legal, planned or unplanned, on public or private land, and the produce may remain in the city or be transported outside.

Urban agriculture has been documented around the world (Egziabher et al., 1994; De Bon et al., 2010; Taylor and Lovell 2012) and indeed is not a new phenomenon (Hampwaye, 2013). The significance for food security, income generation, nutritional intake or business opportunity is debated however, and very context-dependent (Zezza and Tasciotti, 2010; Hovrorka 2004; Frayne et al., 2014). UA in the African city context, although it is a source of food production, is also a way of overcoming the accessibility, affordability barriers to food and nutrition security (de Zeeuw and Drechsel, 2015). UA is purported to contribute to better nutritional and health status (Dixon et al., 2007), though this is debated. Families with access to food through UA have been found, in some studies, to have better nutritional diversity (Maxwell et al., 2000; Prain 2010; Zezza and Tasciotti, 2010). Studies of urban African households documented between 20 and 50% being involved in UA, depending on country (Orsini et al., 2013). Two sister projects to this research, also in intermediate-sized cities, found 16 and 22% of urban households in Tamale and Techiman (Ghana) respectively (Ayerakwa 2017), and 17% of Kenyan households in Thika and Kisumu involved in UA (Omondi et al., 2017).

The practice of urban agriculture has been theorised by Marxists and political economists as being a result of market failures to provide food and employment for urban inhabitants (Maxwell 1999; McClintock 2010). When UA first attracted research interest it was often portrayed in this way (motivated by survival needs) or as a transitory expression of rural behaviours prior to immigrant assimilation into appropriate city living (Drakakis-Smith et al., 1995, Mougeot, 2006; Drechsel and Dongus, 2010) but this is still claimed in some contexts (Masvaure, 2016; Bryld, 2003; Smart et al., 2015). Agriculture in African cities has been read by some as a sign of poverty: a 2010 analysis of urban households that practiced agriculture (regardless of farm location) across 15 countries concluded that agriculture "is an activity in which the poor are disproportionately represented", most significantly in Africa (Zezza and Tasciotti, 2010, p. 271). Other types and motivations for UA encompassing an accumulative potential for wealthier urbanites, and a "means of consolidation" (Bryld, 2003, p80) for the better off may be recognised by these framings. Nevertheless, it was commonly concluded that the majority of urban farmers were "engaged in cultivation as a means of survival" (ibid) further pinpointing practitioners as poor and/or marginalised.

Other research, however, has tended to focus more upon the market gardening type of urban farming. Such studies posit that city food

[1] "land which is administratively and legally zoned for urban uses" (Mbiba in Quon, 1999, p63).

production reflects innate opportunities for business (Drechsel and Dongus, 2010; Armar-Klemesu & Maxwell *in* Bakker et al., 2000; Hovrorka, 2004). Commercially oriented vegetable production is a feature of many African (Accra, Dar es Salaam, Kampala, Nairobi), South American (Lima, La Paz), or Western (London, New York, Oakland) cities (Tinker in Egziabher et al., 1994; Niñez 1985; McClintock, 2014; Bakker et al., 2000). Notable is that these are mostly capitals, or significantly populated regions (Thornton (2008)Thornton's (2008) metro-bias). It is recognised that such practitioners are not necessarily poor (Armar-Klemesu & Maxwell Accra case study in Bakker et al., 2000) and in fact the poorest may be excluded due to lack of capital or land (ibid; Mbiba, 2001). Such framing contrasts with market crisis theorising. As noted in the introduction, more recent work recognises that a city's UA may be a simultaneous mix of both (see Masvaure (2016) and Battersby (2013) for excellent overviews of various theoretical conceptualisations of, and holistic approaches to, urban agriculture). Claims that urban agriculture can combat urban food insecurity need to be treated with caution and specificity as Haysom and Battersby (2016) and Frayne et al. (2014) also purport.

1.2. Ghanaian UA context

Ghana, with a population of 28 million people (World Population Review, 2016), and urban areas growing faster than rural, is an example of rapid urban growth trends (FAO, 2012). Poverty has been falling since the 1990s (Cooke et al., 2016). Accra, the capital, however, saw those below the poverty line almost doubling between 1998 and 2005 (Agbeko and Akpakli, 2010): a spatial shift in deprivation towards the urban is suggested (FAO, 2012). Cooke et al. (2016), however, dispute this at the aggregate level, claiming that overall rural poverty remains four times worse than urban poverty. Despite claims of poverty reduction, estimations that up to 23% of Accra's children under 5-years are stunted due to a lack of adequate nutrition (Agbeko and Akpakli, 2010; Prain et al., 2010) remain of concern. Agriculture, with a dominance of smallholders (World Bank, 2017), remains relevant in economic and livelihood terms, accounting for 21% of GDP in 2015 (ibid). In 2010 the share of the population employed in agriculture was 41.5% (Ghana Data Portal, 2014). Ghana has been considered one of the darlings of African peaceful democratic rule and a "global poster child of economic liberalization" (Otiso and Owusu 2008, p153). It has been a middle-income country since 2011 (IFAD, 2013).

Ghana has seen increasing official acceptance of UA since the 1970s due to growing elite involvement (Obosu-Mensah 2002), especially since 2008′s financial crisis and food price hikes (Dubbeling et al., 2010; Smart et al., 2015). UA was included for the first time in the Ghanaian Ministry of Food and Agriculture (MOFA)'s 2007 "Food and Agriculture Sector Development Policy". The practice, however, was framed as a crisis alleviation strategy in this policy formulation, in line with market crisis theorists, with UA described as offering "a sustainable alternative means of livelihood for poor migrants engaged in it" (MOFA, 2007, p27).

Accra's UA activities (city population: 2.1 million in 2010 (GeoHive, 2016)) are well-documented by local stakeholders, and diverse. Though now dated, a 1997/98 interview study of 87 UA practitioners (home-gardening, open-space farm and market gardeners) characterised Accra's farmers as predominantly male, between 15 and 45 years-old, with 47% having a primary education and 37% having secondary or post-secondary education (Asomani-Boateng, 2002). Only 18% had no education at all (ibid). This study makes claims for UA as a migrant activity, yet this claim appears based on records of ethnic group affiliation of farmers, *not* how long they had lived in the city nor recent migratory behaviour. This survey found almost 60% of UA practitioners farmed on a part-time basis, and a diverse range of occupational profiles were represented from skilled workers to civil servants, teachers and police officers (ibid).

High-value irrigated vegetable production for market seems to dominate Accra's UA with estimates that 80% of the city's lettuce, cabbage, spring onions, cucumber, green pepper and cauliflower come from urban farms, providing a good income for 1000 farmers from 100 ha of spatially distinct open space and public land (RUAF-CFF, 2008). A further 50–70 ha of private land was thought to be being farmed commercially (ibid). Estimating the proportion of households engaged in backyard gardening in Accra has proved more difficult and range from 15% (Maxwell et al., 2000) to a high 60% (RUAF-CFF, 2008). Much of this household involvement in backyard gardening actually consisted of keeping a few poultry/livestock as "a form of liquefiable assets, not for subsistence consumption" (Maxwell et al., 2000, p30) and such UA engaged both men and women (ibid). The majority of other UA, however, were found to be male-dominated (ibid). Other studies estimate average Accra farm sizes at 0.02 ha, and providing an above-average monthly income equal to US$27-50/per capita (Cofie et al., 2005; FAO, 2012).

Kumasi, Ghana's second largest city (population 2 million, GeoHive, 2016) had well-developed market gardening (around 200 farms), largely spatially concentrated into specific shared areas, or in surrounding low-lying valleys (Cofie et al., 2003). Farmers earned a reasonable salary of US$800 per annum (FAO, 2012). This UA supplied cabbage, lettuce and spring onions amounting to 90% of urban leafy vegetable demand according to Cofie et al. (2003). Thousands of farmers in the Kumasi *peri*-urban zone also switch from staple crop production to irrigated vegetables during the dry season (ibid). These farms were male-dominated (Cofie et al., 2003). Research on Kumasi's *peri*-urban agriculture covered a wide geographic area extending 40 km in radius from the city centre, thus encompassing a number of different kinds of farming systems (Brook and Dávila, 2000). Home gardening in Kumasi was described as being mainly undertaken by women and was considered common: 33–57% of households (Brook and Dávila, 2000; Cofie et al., 2003). Health and environmental concerns have proven valid by studies of microbiological contamination (FAO, 2012; Amoah 2009).

Studies within these cities are hard to find after the mid-2000s. This may be partly due to funding reprioritisations within RUAF, who had been a key player in investigating UA in Ghana (interview finding). Consequently, how valid these studies continue to be is less easy to assess. Published studies of the MOFA-claimed relationship between migrants and UA in Accra and Kumasi are also difficult to come across.

Techiman and Tamale were the sites for this research. Techiman is the smaller city (population approximately 97,000) located within one of the country's most agriculturally dynamic zones. It is an important agrarian market town and trading centre with a history dating from colonial times (Dennis and Peprah, 1995). Techiman serves as a conduit for surrounding rural agricultural produce. Tamale is the larger city (261,000 population) and an important regional capital and hub for Northern Ghana, established in colonial times (see Fuseini et al. (2017) for an excellent historical-geographical analysis of Tamale's socio-spatial evolution). It is located in agricultural hinterland where agrarian activity is less productive and the ecological zone more marginal. Local urban demand for food has, however, powered a significant year-round irrigated market-gardening activity (Fuseini et al., 2017). Despite its relatively small population in global terms, it is the third largest urban area in the country (Fuseini et al., 2017). Tamale has experienced strong infrastructural and economic growth since structural adjustments programmes of the 1980s (ibid), though 81% of the population are still thought to pursue informal sector livelihoods (ibid).

2. Materials and methods

2.1. Data collection

This paper is based on a remote sensing and field-survey of UA sites conducted during a five week country visit in July 2013. Semi-structured interviews with 22 urban farmers (14 in Techiman, 8 in Tamale), and with four key respondents were also conducted. Key respondents

Table 1
Characteristics of UA Practitioner Interviewees (June-July 2013).

Interview	City	Age Group*	Gender	Level of Education Achieved	Employment Situation	Occupation
1	Techiman	Young adult	Male	Secondary	Full-time, professional	Poultry Farm Manager
2	Techiman	Mature adult	Male	Not asked	Full-time, unskilled job	Undiscussed
3	Techiman	Mature adult	Male	Not asked	Full-time, informal	Tro tro (minibus taxis) station master
4	Techiman	Mature adult	Male	Primary	Full-time, informal	Cattle farmer
5	Techiman	Mature adult	Male	Tertiary	Full-time, professional	Environmentalist
6	Techiman	Mature adult	Male	Tertiary	Full-time, professional	Anaesthetist
7	Techiman	Elderly	Female	No education	Unknown	Undiscussed
8	Techiman	Mature adult	Male	Not asked	Informal	Driver
9	Techiman	Mature adult	Male	Primary	Full-time, unskilled job	Cattle farmer
10	Techiman	Youth	Male	Secondary	Teenager in school; mother, whose garden it was, worked full-time	Undiscussed
11	Techiman	Mature adult	Male	Not asked	Full-time, unskilled job	Undiscussed
12	Techiman	Mature adult	Female	Not asked	Full-time	Undiscussed
13	Techiman	Young adult	Male	Primary	Unemployed	Car Electrician
14	Techiman	Mature adult	Male	Not asked	Full-time	Electrician
15	Tamale	Elderly	Male	No education	Informal	Unskilled/menial
16	Tamale	Young adult	Male	Not asked	Not asked	Not asked
17	Tamale	Mature adult	Male	Not asked	Unemployed	Unskilled/menial
18	Tamale	Mature adult	Male	Not asked	Informal	Not asked
19	Tamale	Mature adult	Male	Tertiary	Informal	Not asked
20	Tamale	Young adult	Female	Tertiary	Full-time	Skilled
21	Tamale	Mature adult	Male	Not asked	Informal	Not asked
22	Tamale	Elderly	Female	No education	Part-time	Unskilled/menial

*Youth (approx. 16–25 years), Young Adult (approx. 26–40 years), Mature Adult (approx. 41–65 years), Elderly (> than 65 years).

included a senior municipal planning officer, and the agricultural extension officer (AEO) who accompanied the fieldwork, in each city. The study additionally draws on a household questionnaire conducted with 2047 households during October 2013. The study cities of Techiman and Tamale were purposively chosen by the project team, including researchers from the University of Ghana, based on city size and agricultural characteristics. The cities were chosen to represent intermediate-sized cities (population approximately 100,000–500,000, reflecting the urban profile of the country) that are facing development pressure. Techiman is located in Ghana's agricultural breadbasket zone but had unknown levels of UA activity. Tamale was selected because it had a slightly larger population and known market gardening activity but its other UA types have been less studied.

The mapping component followed the methodological guidelines of Weckenbrock et al. (2008). Similar mapping methodology was undertaken by Drechsel and Dongus (2010) in Tanzania. A study testing the efficacy of remote-sensing UA also provides methodological support and attained high accuracy (Taylor and Lovell, 2012). Due to time limitations the mapping focused on the main urban area: in Techiman this amounted to a 40 km^2 area (a radius of 5 km from city centre), in Tamale 80 km^2 (6 km radius from centre). Mapping used newly purchased 0.5 m resolution satellite imagery. The Tamale image was taken on 24 Dec 2012 from the Geo-Eye-1 satellite and the Techiman image was from the Pleiades satellite, taken on 15 March 2013. Both images were thus taken in the dry season, not the rainy season. Time of year of imagery can obviously influence what cropping activity can be identified. Using dry season imagery likely prevented over estimations.

The images were surveyed remotely and sites that looked as though they contained UA (suspected plough lines, expanses of green, suspected field boundaries or agricultural structures) were identified for in-field verification (36 each city). These "training sets" (Weckenbrock et al., 2008) were then checked by ground survey. Animal husbandry was recorded when found but this dimension is likely underrepresented due to difficulty identifying from satellite imagery. Further UA sites were added, if found, during field survey.

In both cities, in order to investigate the remotely sensed areas that turned out to be institutional land required permission (except for the public hospital grounds in each city). Thus all secondary schools, church lands, college, university or research institute sites involved an introductory meeting with the head teacher, or senior staff member or site manager following correct local protocol. Although these meetings did not comprise any formal interview, the discussion provided valuable information on the site situation, the institution's activities, the land usage, and the kinds of agricultural production undertaken (the who and why dimensions of the research questions). In most instances, a staff member then gave us a guided tour. This information was recorded in ethnographic-style field notes and this data has informed the depiction of the agriculture on institutional lands given in this paper. In addition, two practitioner interviews came from the Techiman Hospital site (one a medical doctor and one a man affiliated to the hospital who was passionate about gardening and trying to establish a demonstration plot). Another in Tamale was with a local community resident who had usufruct farming rights to a part of the Tamale Hospital land.

Sampling of interviewees occurred in an opportunistic manner primarily by encountering people farming during the field survey and requesting an interview. Interviewees thus were people who had the time to farm during the day and in early evening as surveying did not occur after dark. Two interviews in Tamale however, were pre-arranged by the AEO with whom we were working: these were the head of the one of the market gardening farmer cooperatives in the city, and the female head of the women's group of the same cooperative. These interviews were conducted directly by the author in English, as were a number of the other interviews. A student assistant worked with the author in both cities to provide translation support when necessary. In Tamale it was necessary during a couple of interviews to rely on our local contact for translation. Interviews asked how far the place they farmed was from their residence, what crops/livestock they farmed, the tenure of the land, and their reasons for farming. In addition, the interview enquired about their farming history and experience, whether they farmed other lands within the city or outside it, and whether they had experienced any land conflict. Finally, interviews probed about the challenges and opportunities of farming within the city, and their opinions on trends over time. Table 1 provides a summary of the interviewees.

For the 2013 household questionnaire, the cities were proportionately stratified from sub-community population sizes with the help of local planners in order to be representative. Random systematic sampling was then employed to survey every third household over 10 days

Table 2
Characteristics of All Surveyed Households (HHs) (October 2013).

	Techiman	Tamale
DEMOGRAPHICS	N of HHs = 1034	N of HHs = 1013
Mean age of household (HH) members	23.5	25.8
Mean household size	4.5	4.9
Total individuals	4688	5028
GENDER COMPOSITION	N (%)	N (%)
Male (adults and children) in households	2165 (46.2)	2382 (48.9)
Female (adults and children) in households	2509 (53.5)	2472 (50.7)
HOUSEHOLD STRUCTURE	N (%)	N (%)
Single-parent households (no partner) [72% of these were female-headed in Techiman, 56% in Tamale]	374 (36)	190 (19)
Multiple adults present in the HH (includes nuclear and extended families, with or without children)	649 (63)	814 (80)
SOCIO-ECONOMIC STATUS		
EMPLOYMENT STATUS (adults 18 years and above)	N = 2456 valid data	N = 2915 valid data
Working full-time (paid employment)	1326 (54)	1339 (46)
Working part-time/casual	109 (4)	306 (10)
Unemployed and looking for work	245 (10)	412 (14)
Unemployment but not looking for work	679 (28)	827 (28)
Refused or Missing	97 (4)	31 (1)
GROSS MONTHLY INCOME (all sources including agricultural sales and cash equivalent estimates of any in-kind remittances or aid)	N = 852 HHs valid data	N = 938 HHs valid data
Mean gross monthly HH income in Ghanaian Cedis (US$)	629 (140)	758 (168)
Mode gross monthly HH income in Ghanaian Cedis (US$)	100 (22)	300 (67)
HOUSEHOLD DIETARY DIVERSITY SCORE (HDDS)	Mean Score	Mean Score
Mean HDDS (min of 0 means eaten nothing the preceding 24-h, max. of 12 means HH had eaten from the maximum of 12 food groups in the previous 24-h)	6.11	5.2
HOUSEHOLD FOOD INSECURITY ACCESS SCALED SCORE (HFIASS)	Mean Score	Mean Score
Mean HFIASS (0 = food secure; maximum of 27 = very severely food insecure)	3.95	3.62

using a team of 20 enumerators who had received two days training. The questionnaire asked about each georeferenced household's socio-economic characteristics and livelihood strategies, as well as household farming activities, location, motivation, product usage and how important they deemed farming to be. Table 2 provides an overview of the survey sample, describing household demographic and socio-economic characteristics whereby 10% of the adults in Techiman and 14% in Tamale were unemployed and looking for work. The mean household dietary diversity score (HDDS) and mean household food insecurity access scaled score (HFIASS) indicate the sample having medium (Tamale) and high (Techiman) dietary diversity and both cities having a low experience of food insecurity (Table 2).[2]

2.2. Data analysis

The mapping component enabled measurement of the areal extents, and number of surveyed sites, using a Geographic Information System (GIS) where sites were drawn as polygons (refer to Figs. 1 and 2). Note that the category designated as 'No Urban Agriculture' denotes sites that were selected from the remote sensing as looking as though they could contain urban agriculture but which, upon field survey, were found not to be under any form of agriculture. They are retained in the maps because they are a relevant aspect of the methodology, and because they also allow reflection upon the accuracy of remote sensing for picking out certain forms of UA. In this study, an 82% accuracy (that is 82% of the sites selected remotely as being possible UA proved to contain UA upon field survey) was attained in Techiman, 80% in Tamale. Greater contextual familiarity would further improve this accuracy. For example, there were a number of sites visible in the satellite imagery that were initially thought to contain pen-like structures for animals and were thus highlighted as possible UA. Upon field survey these turned out to be the internal walls of unroofed, under construction housing. In a future remote sensing exercise I would thus be less likely to suspect such features of being agricultural.

A typology of UA was constructed, inspired by previous research, from a combination of all data sources (see findings). The location and scale of UA was assessed via practitioner and plot size estimates from the household questionnaire and from the interviews. The characteristics of the farmed land were assessed from the combined analysis all data sources (survey, interviews, questionnaire). The function and motivation of UA was described by analysing interview and questionnaire responses regarding the location of the farmed land, the types of produce, the use of that produce, the form of the farming, and the distance to the farm site. The characteristics of the UA households could also be analysed from the questionnaire data, along with stated product usage. An insight into official views from the town planning and agricultural extension offices were provided by the key respondent interviews.

3. Findings

3.1. Where was UA occurring?

3.1.1. Land types

Table 3 provides a summary of the main findings from the mix of methods employed. The table summarises the findings regarding the main kinds of UA practitioners found on each type of UA and the main purpose of the farming (further described in Sections 3.3 and 3.4). The land types found under UA were grouped into four main types of land (this was informed by other studies' classifications and the form of data available). These comprised: i) gardens and undeveloped plots, ii) open

[2] These are internationally recognised scores of calorific and nutritional food security. HDDS provides a measure of the diet diversity (Swindale and Bilinsky, 2006), assessed using 24-h recall of 12 food groups. The groups were: 1) cereals/grains 2) roots and tubers 3) vegetables 4) fruit 5) meat or meat products, includes poultry, game 6) eggs 7) fish, shellfish, fish products 8) legumes, nuts, seeds 9) milk or other dairy 10) oil, fat, butter 11) sugar, honey, sweeteners 12) condiments, spice, tea, coffee. HDDS runs from a minimum of 0 (nothing consumed the previous day) to a maximum of 12 if they had eaten from all groups. HDDS may be further classified as low (≤3), medium (4–5), and high (≥6) in accordance with FAO guidelines (FAO, 2012). HFIASS is a continuous scaled measure of the occurrence of insecure food access over the preceding 4-weeks and runs from 0 (no food insecurity) to 27 (extreme food insecurity) (Coates et al., 2007).

Table 3
Summary of Urban Agriculture found in Techiman and Tamale in 2013.

Land Type	Land Owner	Main (usufruct) practitioner	Farming system(s)	Main purpose or motivation for the UA	Techiman		Tamale	
					Sites	Area[1] (ha)	Sites	Area (ha)[1]
Data sources: remote-sensing, field survey, city plans, interviews	Data sources: Key respondent and UA practitioner interviews; field notes from institutional sites; in-field verification (where possible); household questionnaire (asked about agricultural activities of household members during preceding year i.e. Oct 2012-Oct 2014)				Data sources: remote sensing/field survey. Areal calculations in GIS			
Gardens and undeveloped plots	Private (largely residential areas). Some undeveloped plots may still be owned by the council but are zoned for residential development.	The land owner or tenant but may also be family members, neighbours, or people unknown to the owner	Maize/plantain common; Diverse vegetables; Occasional fruit trees; Occasional poultry/livestock	Predominantly for household food supplementation Some produce may be sold Occasional commercial enterprises	55	127	53	300
Open space: Institutional land	Largely public institutions (hospitals, schools) but also private schools/ hospitals, church lands; or non-profit or private organisations	The institution itself	Largely rain fed; Maize common; Cashew or teak; Staff had diverse vegetable gardens	For institution it can be income generating or to supplement feeding. May also be for land management purposes.	25	323	19	590
		Institution's employees		Largely household food supplementation for individuals, though some produce may be sold				
		Individuals not connected to the institution						
Open space: Other	Largely public (includes parks and urban forests), but may also be private.	Farmer groups & cooperatives Individuals Local government	Rain fed plantations; Farmer groups: year-round irrigated vegetable market gardens; but also staples and grazing	Plantations may be for sale Market gardens predominantly for sale (this UA form found only in Tamale) Market gardens also consumed a portion, but primary motive was sales	4	136	4	180
Utility land	Public (rubbish, dumps, along power lines, roads, railways, canals or waterways)	Individuals	Generally rain fed staple crops such as maize. Possible grazing areas	Household food supplementation Some produce may be sold	11	67	1	2
TOTALS					95	653	77	1072

[1] Area of the polygons, which generally included buildings, paths and some non-agricultural areas. These acreages, therefore, are not equivocal to area under productive agriculture but rather represent maximum extents of sites that were selected from the satellite imagery on the basis of being suspected agriculture (refer to methodology).

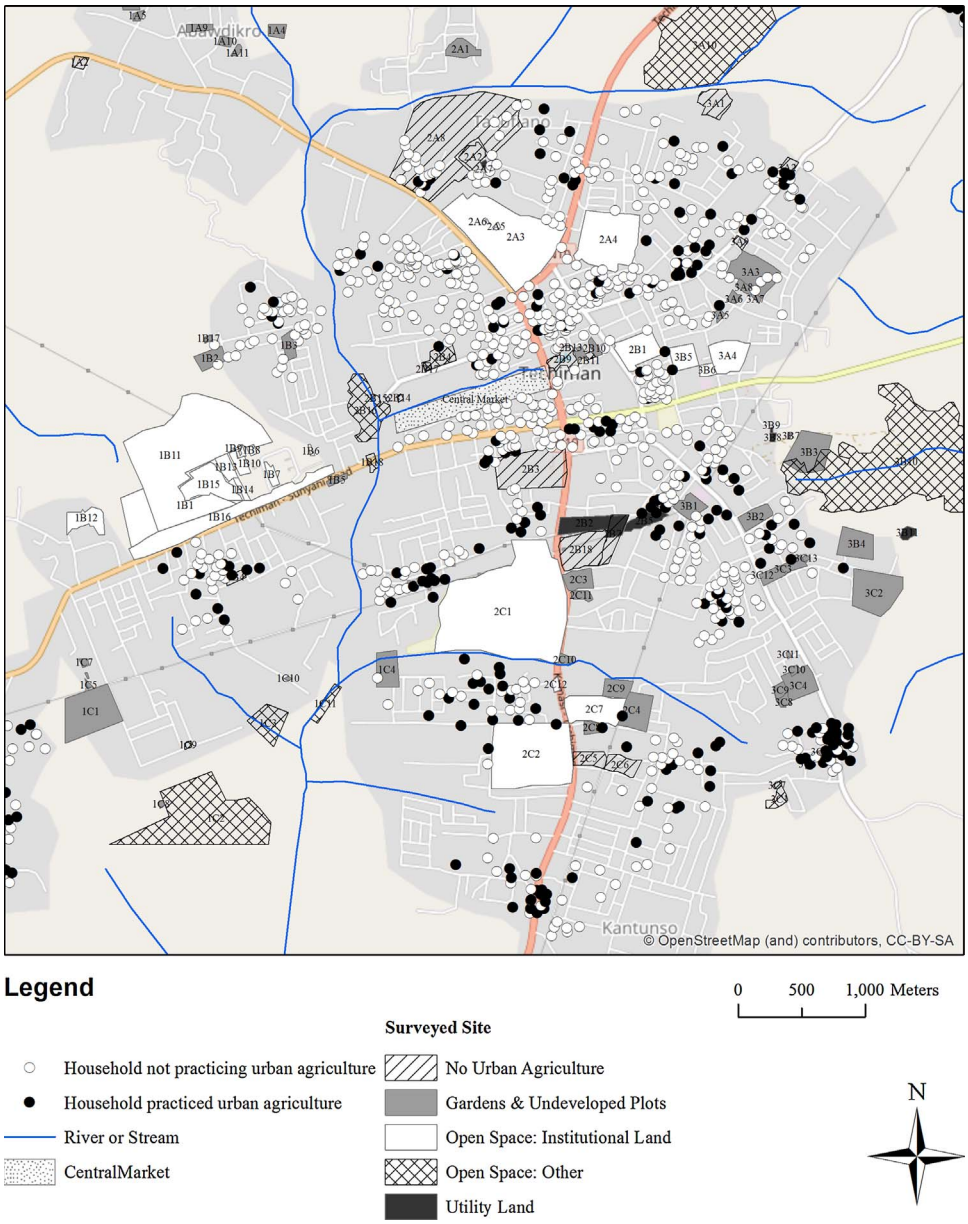

Fig. 1. Types and Spatial Distribution of Urban Agriculture in Techiman, 2013.
Note: 'No Urban agriculture' denotes sites that were picked out from the remote sensing as looking as though they could contain urban agriculture but which, upon field survey, were found not to be under any form of agriculture (see 2.2 Data Analysis).
Source: Created by the author using survey data, satellite imagery and Open Street Maps data

space: institutional land, iii) open space: other and iv) utility land. Figs. 1 and 2 present the results cartographically.

Gardens and undeveloped plots (Table 3) were largely in residential areas and predominantly privately owned (not necessarily by the person farming the site). Undeveloped plots were sites predominantly in residential zoned areas that were not yet built upon, or the urban fringe. Some were already owned by a private person, others still by the local authority. These sites were farmed until the owner begins construction (interview findings). The two AEOs and two interviewees described this practice as quite common. Such a farming arrangement could be a mutually beneficial relationship as land owners would rather someone farm there than risk the land being used as a dumpsite, or for illegal construction (interview findings). An agreed rent could be paid, or a proportion of the harvest shared but this was not always the case (interview data). These undeveloped plots tended to be distributed around the periphery of the cities (see also Section 3.1.3 and Figs. 1 and 2).

'Open space: other' (Table 3) refers largely to public land and includes parks and urban forests, but it could also be privately owned. Such open space land may be farmed by the local government, by individuals or by farmer groups. Cooperatively managed year-round irrigated market gardening, largely of high-value crops for sale to the urban market, was found only in Tamale and is included within the open space category. Tamale's market gardens produced a wide variety of crops but common was lettuce, cabbage, red peppers, carrots, onions for local and regional markets (Tables 3 and 4). The market gardens were an important feature of the agricultural cityscape in Tamale but not in Techiman. These market gardens were a complex mix of tenure from city land, to community land to chiefs that claimed ownership (interview finding). Permission for farming had usually been negotiated (interviews and field notes). These sites in Tamale have been well documented by NGOs such as the International Water Management Institute (IWMI) and Resource Centres on Urban Agriculture and Food Security (RUAF): they generally had year-round water access and were well organised. There has been a history of conflict over land tenure and access rights to these market gardens in Tamale (interview findings). Gumbihene (polygon 2B1, Fig. 2) had security of tenure for the Forestry and Water Departments after winning a court case proving usage rights (interview findings). The Waterworks area (2A4 to the north of the city centre, Fig. 2) had also experienced conflict. Builpela

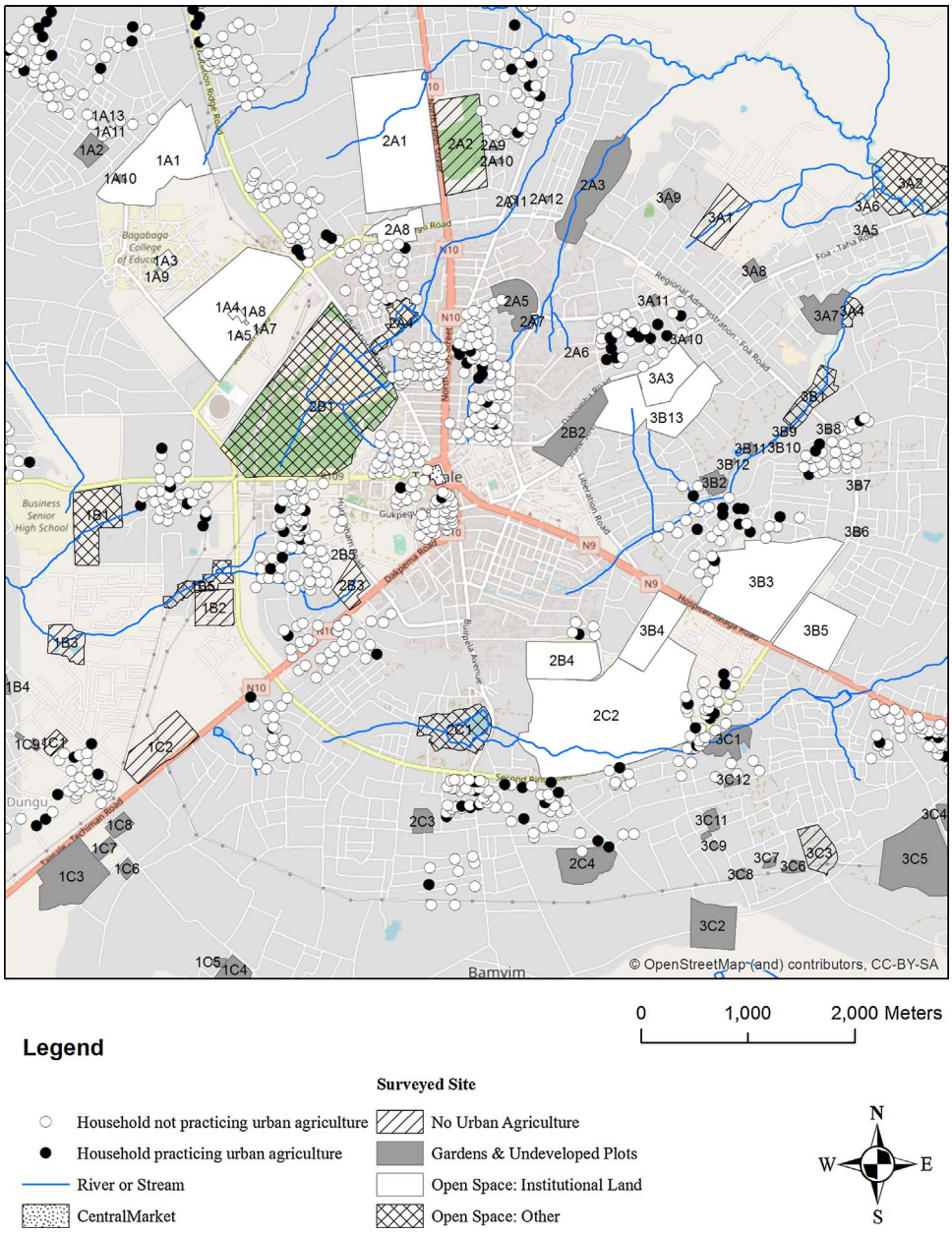

Fig. 2. Types and Spatial Distribution of Urban Agriculture in Tamale, 2013.
Note: 'No Urban agriculture' denotes sites that were picked out from the remote sensing as looking as though they could contain urban agriculture but which, upon field survey, were found not to be under any form of agriculture (see 2.2 Data Analysis).
Source: Created by the author using survey data, satellite imagery and Open Street Maps data

(2C1 towards the south of the city, Fig. 2) is experiencing urban encroachment.

'Open space: Institutional land' (Table 3), refers to land belonging to, or managed by, an institution (referred to throughout the paper from here on simply as 'institutional land'). By 'institutional' this study means land belonging to government schools, government hospitals, government research facilities and government offices. It also includes land owned or managed by non-profit or charitable organisations such as the various churches, church schools and church hospitals (especially the Catholic Church), but some institutional sites may even be privately run. This study finds institutional lands to be a significant feature of the urban agricultural cityscapes of these two intermediate-sized cities. Who farms these institutional lands, and their characteristics, are returned to in Sections 3.3 and 3.4, below.

The final category of utility land (Table 3) refers to predominantly public land in use as dumpsites, industrial sites or beneath electrical power lines, roads, railways, canals or other water channels or infrastructural usage. Some such sites may also be owned or run by a corporation or private entrepreneur.

3.1.2. Prevalence and acreage of land types

Table 3 additionally shows the number of surveyed sites in each category (total of 95 in Techiman, 77 in Tamale) and the surveyed polygon acreages (calculated in the GIS: 653 ha in Techiman, 1072 ha in Tamale). As is highlighted in Table 3, these acreages do not equate to farmed area but rather to the extent of the surveyed sites, of which a proportion was under agricultural usage.

The most common type of UA land were the gardens and undeveloped plots of the residential areas, comprising 58% of Techiman's surveyed sites, and 69% of Tamales (55 out of 95 sites in Techiman and 53 out of 77 sites in Tamale, refer to Table 3). UA within these sites predominantly consisted of gardening-types of UA.

As already noted, a key finding of this paper is the scale of, and roles played by, institutional land UA, in both cities. Institutional sites were the second most frequent type of UA found, comprising approximately 25% of the number of surveyed UA sites in each city (25 sites out of a total of 95 in Techiman and 19 sites out of 77 in Tamale, see Table 3). Institutional land also amounted to the greatest maximum acreages (323 ha in Techiman, and 590 ha in Tamale, Table 3 [note again this is

Table 4
Summary of Semi-Structured Interview Findings.

Int.	Land Type	Distance to home (metres)	Approx. area (m2)	Tenure	What are you farming here?	Why are you farming? Main motivation?	Why this particular site?	Water source & system	Produce distribution	Level of income if selling?	Other income sources	Always here or varied?	Area
1	Residential	5000	> 1000	They are the land owner	Poultry & eggs	Sole livelihood to earn a living	Available land	Irrigation from a well	Sell locally & distant & via intermediaries	Excellent	No	Constant location	Jama Tinporim
2	Garden	10	11–100	Traditional arrangement	Cassava	Food supplementation and income supplementation	Available land	Rain	Sell locally only	Not Discussed	Yes	Location has varied	Timber Market
3	Garden	10	11–100	Traditional arrangement	Cassava, maize, sweet potatoes	Food supplementation and income supplementation	Available land	Rain	Sell locally only	Not Discussed	Yes	Location has varied	New Krobo
4	Undeveloped Plot	10	11–100	Private rental	Poultry & eggs; small ruminants, cattle	Connection to the land & traditional way of life; Also only livelihood	Available land	Cattle drink from riverside	Sell locally only	Not Discussed	Yes	Location has varied	No data
5	Institutional	10	> 100–500	Rent from institution	Cabbage, okra, pepper, poultry, eggs	Environmental beliefs	Available land	Rain & various water systems	Sell locally only	Not Discussed	No	Location has varied	Holy Hospital
6	Institutional	40	11–100	Rent from institution	Cassava, maize, plantain, pepper, vegetables, yam	Hobby	Available land	Rain	Give to family	Not Discussed	Yes	Location varied	Holy Hospital
7	Open space	3	11–100	Traditional arrangement	Cassava, maize, plantain, yam, vegetables	Food supplementation	No choice	Rain	Not discussed	Not Discussed	No	Constant location	Kenten
8	Garden	10	11–100	They are the land owner	Cocoa seedlings; cocoyam, plantain, fruit trees & plants; poultry; pigs	Sole livelihood to earn a living	Available land	Rain & manually from own well	Other form of sales	Good	No	Constant location	Ahenfi
9	Open space	10	11–100	Traditional arrangement	Cattle	Connection to the land & a traditional way of life	Available land; Accessibility	Cattle drink from riverside	Sell locally & distant & via intermediaries	Medium	No	Constant location	Central Techiman
10	Undeveloped Plot	200	11–100	Rent from institution	Cassava, maize, plantain, yam, vegetables, fruit plants/trees; rabbits	Food supplementation	Available land	Rain	Give to family	Not Discussed	Yes	Constant location	Blue Cross
11	Garden	100	> 500–1000	They are the land owner	Maize, plantain, cocoyam, sweet potatoes, vegetables, fruit plants/trees; oil palm; sugarcane	Food supplementation and income supplementation	Available land	Rain and manual	Give to family	Good	Yes	Constant location	VRA
12	Utility site	10	11–100	Rent from public body	Plantain; fruit trees	Food supplementation	Available land	Rain	Not discussed	Not Discussed	Yes	Constant location	No data
13	Undeveloped Plot	10	11–100	Semi-legal	Maize, cassava	Food supplementation and income supplementation	Available land	Rain	Give or sell to friends and neighbours	Not Discussed	Yes	Location has varied	Bamiri
14	Undeveloped Plot	20	> 100–500	They are the land owner	Watermelon, fruit plants	Sole livelihood to earn a living	Available land	Manual	Sell via an intermediary	Not Discussed	No	Constant location	Ahenfi
15	Institutional	10	11–100	Rent from institution	Maize	Food supplementation	Available land	Rain	Give to family, Sell to friends or neighbours	Not applicable	No	Location has varied	Tamale Polytechnic
16	Home Garden	10	501–1000	Traditional arrangement	Maize, a few vegetables	Sole livelihood to earn a living	Easy and convenient access to markets	Rain	Sell locally, Give to family	Not applicable	No	Constant location	Bamvim Dohini
17	Undeveloped Plot	1000	101–500	Traditional arrangement	Maize, Oil palm	Food supplementation	Available land	Rain	Give to family, Sell to friends or neighbours	Not applicable	Yes	Constant location	Techiman Road

(*continued on next page*)

Table 4 (*continued*)

Int.	Land Type	Distance to home (metres)	Approx. area (m2)	Tenure	What are you farming here?	Why are you farming? Main motivation?	Why this particular site?	Water source & system	Produce distribution	Level of income if selling?	Other income sources	Always here or varied?	Area
18	Market Garden (Open-space)	Not asked	No data	Farmer coop. arrangement	Lettuce, Cabbage, Pepper, Alefu	Sole livelihood to earn a living	Available land	Manual (watering can)	Sell locally, Sell to an intermediary	Not asked	Not asked	Constant location	Waterworks
19	Market Garden (Open-space)	2000	> 1000	Farmer coop. arrangement	Maize, Lettuce, Cabbage, Pepper, Carrots,Fruit plants, Fruit trees, Goats, Cattle	Sole livelihood to earn a living	Available land	Irrigation system from a well	Sell locally, Sell to an intermediary, Sell in Kumasi market	Good	No	Constant location	Gumbihene
20	Market Garden (Open-space)	Not asked	Not asked	Farmer coop. arrangement	Cabbage, Sweet Potato, Garden Eggs, Ayoyo, Fruit Plants, Fruit Trees	Food supplementation and sole livelihood	Available land	Manual (watering can)	Sell locally, to intermediary, & to friends/neighbours	Excellent	Not asked	Constant location	Builpela
21	Institutional	2000	32,000	Arrangement with institution	Maize, Ayoyo, Bra, Guinea Fowl, Eggs	Food supplementation and sole livelihood	Available land	Rain	Sell to an intermediary	Good	No	Constant location	Tamale Teaching Hospital
22	Home Garden	500	101–500	Traditional arrangement	Maize, Oil Pal, Poultry, Eggs, Pigs	Food supplementation and income supplementation	Available land	Rain	Sell locally only	Good	Yes	Constant location	Kakpagyili

polygon areas, not total area being farmed). Institutions thus contained and controlled large stretches of the urban landscape (refer to Figs. 1 and 2). In terms of agricultural usage of these lands, the majority of Tamale's institutional land that was visited tended to be planted to one crop, usually maize (Tables 3 and 4). In Techiman cashew nut trees and teak plantations were also a cash crop on institutional land, providing budgetary support (field notes). The utility land category constituted the fewest number of sites and the smallest acreages in both cities (Table 3, Figs. 1 and 2).

3.1.3. City scale spatial distribution

Urban agriculture was found to be dispersed throughout the cities rather than clearly concentrated in specific areas (refer to the maps in Figs. 1 and 2). Road infrastructure did not seem to be a strong influence on the spatial expression of UA, in terms of following transport corridors or arterial routes (Figs. 1 and 2). Focusing only on the irrigated year-round market gardens in Tamale, however, it is noted that such UA were all located within 2 km of the central market (main customer source) and alongside water sources (natural, or man-made channels or dams) (Fig. 2). This accords with water supply being a problem in the northern city, and of course being essential for irrigated year-round production. Dams were not found in Techiman.

There was an absence of UA in the city centres. This is not surprising given the density of use and high land prices. Nevertheless, Techiman had a large cattle corral with approximately 100 cattle and riverside grazing within a few metres of the central marketplace (2B16, Fig. 1). Tamale also had a large area (approximately 1.5 km^2 or 151 ha) of irrigated market gardening just 1 km from the central market (2B1, Fig. 2). The market traders (often women in Ghana) were important purchasers of the produce and proximity to the central food market was thus advantageous (interviews with Tamale market gardeners and Techiman's cattle herders).

UA occurring on institutional land tended to be located on the periphery of the old town area, but the cities have grown around them, leaving them now quite within the urban boundary (Figs. 1 and 2).

A visual presentation of the location of the urban farming households (2013 questionnaire) is are also shown in Figs. 1 and 2 as black circles (the white circles are households that either did not farm at all, or who farmed a rural area, or that farmed in both urban and rural areas). A visual analysis of the locations and distribution of these UA households does not suggest particularly strong spatial associations. Further spatial analyses are planned but are not a part of this paper.

3.1.4. Farming close to homes

The semi-structured interviews asked about the distance from their home to the urban farm site: in Techiman this amounted to a mean of 388 m (calculated from data in Table 4). Yet if I exclude the poultry farm manager who travelled a further distance to his place of work, the other UA practitioners in Techiman farmed on average just 34 m from their homes. In Tamale the mean distance to the farm was 920 m (Table 4). This suggests that farmers of institutional sites and open space sites (a greater proportion of this city's interviewees) travel further to get to the farm site.

Although the questionnaire did not ask about distances, it did ask about where, that is what kind of land, the household farmed within the city. Table 5 presents the findings, indicating a dominance of UA sites within the residential area: of the Techiman HHs, 28% were either farming their own housing plot (regardless of whether they owned or rented the house) and 42% of Tamale HHs (Table 5); or within the residential area but outside their own plot (17% Techiman HHs and 23% Tamale). This latter is largely the undeveloped plots, but crop farming and free grazing can also be seen on streets, and within neighbours or friends' gardens (field notes and interview finding). In total, 45% of Techiman's surveyed UA households and 65% of Tamale's practiced UA in residential neighbourhoods (totals of own plot and within residential, Table 5). People in Techiman and Tamale were

Table 5
Location of urban food production (questionnaire).

		Techiman (N = 268) N (%) of UA HHs	Tamale (N = 150) N (%) of UA HHs
Where does the household produce these food crops?*	On own housing plot	74 (28)	63 (42)
	Within residential area, but outside own plot	45 (17)	35 (23)
	In an urban forest	102 (38)	12 (8)
	Hanging garden; in sacks or in a patio garden	0	8 (5)
	By roadside	11 (4)	6 (4)
	By side of a river, stream, or other water source	1 (0)	2 (1)
	On an industrial site	1 (0)	0
	On other urban land	39 (15)	17 (11)

* Note: multiple responses were possible so totals greater than 100%.

Table 6
Agricultural Involvement of Households (questionnaire).

City	Techiman		Tamale	
Area where agriculture practiced	Number of HHs	% of Total	Number of HHs	% of Total
Do not practice any agriculture	535	51.7	505	49.9
Rural area agriculture only	159	15.4	199	19.6
Urban area agriculture only	268	25.9	150	14.8
Both rural and urban area agriculture	24	2.3	142	14
Refused or missing data	48	4.6	17	1.7
Total	1034	100	1013	100

generally not travelling great distances to farm in the city, with UA being most common in residential areas.

3.2. Characteristics of the UA

3.2.1. Insights into scale: numbers of practitioners

Allowing insight into scale in terms of the number of urban agricultural practitioners, Table 6 shows the number of households from the 2013 questionnaire claiming involvement in UA (crops or livestock). In Techiman there were 268 HHs (25.9% of those surveyed) engaged in urban agriculture, and 150 HHs (14.8% of survey) in Tamale. Table 6 also suggests that the number of households engaging in UA was broadly similar to those farming in rural areas. Overall, these data indicate that around half of the 1034 Techiman and 1013 Tamale urban-based households surveyed were involved in agriculture (either urban agriculture, rural agriculture, or both, Table 6).

3.2.2. Insights into scale: plot sizes

In terms of aerial coverage, 16.5% of Techiman's 40 km^2, and 13.4% of Tamale's 80 km^2, urban area was found to contain UA.[3] This was using a methodology that sampled sites suspected of being agricultural. The total surveyed land area that contained some form of UA (including buildings, paths, roads however, as noted in Section 3.1 and Table 3) amounted to 653 ha in Techiman and 1072 ha in Tamale.

Mean plot size estimates per farming household can be calculated from the questionnaire data, which specifically asked urban farming households what size of plot they had farmed between Oct 2012 and Oct 2013. This amounted to a mean UA plot size per household of 2.07 ha in Techiman and 2.15 ha in Tamale (note these figures are based on just 167 UA HHs with valid data in Techiman and 146 in Tamale since not all respondents estimated sizes. We should also remain a little cautious of self-reported plot size data).

[3] Figures calculated using Table 3's 6.53 km^2 of UA in Techiman divided by 40 km^2 area, and 10.72 km^2 UA in Tamale divided by 80 km^2 extent of the satellite image.

From the interview data, 10 out of the 19 interviewees (53%) who could give plot size estimations fell into the 11–100 m^2 (0.001-0.01 ha) category of farmed plot (Table 4). These were predominantly gardens/undeveloped plots, but included one or two utility or institutional sites. The three who stated farm sizes greater than 1000m^2 (0.1 ha) consisted of the owner/manager of the large poultry farm in Techiman, and one market gardener in Tamale, and one man who farmed 3.2 ha of institutional land belonging to Tamale teaching hospital (Table 4). For all three, farming was their sole livelihood (note that the market gardener was a member of a farming cooperative and I believe he may have been reporting here on the site farmed by the group as a whole, not his portion but the data is unspecified).

Such scales can be referenced against estimates of irrigated market garden acreages in Accra with an average farm size of 0.02 ha (200m^2) (Cofie et al., 2005). Although not directly comparable, a 2015 study established Tamale open space average *field sizes* of 0.31 ha (3000m^2) and urban garden *field size* of 0.11 ha (1100m^2) (Bellwood-Howard et al., 2015, p7). Such figures illustrate the potential significance of UA.

3.3. Who was farming?

The mean household size is larger for urban agricultural HHs than for non-farming households, amounting to 5.1 members in Techiman and 5.4 in Tamale (Table 7) (compare to 4.5 and 4.9 respectively in Table 2). The questionnaire data also suggests that the urban farming households, in both cities, have higher mean gross monthly incomes than the rural farming and non-agricultural HHs (Fig. 3). Analysis of mean household dietary diversity levels and mean household food insecurity scores suggests that UA HHs in these cities were slightly more food secure (3.61 Techiman and 2.99 Tamale, Table 7) than the entire sample of households (compare to Table 2) and had a marginally higher mean dietary diversity score (6.13 Techiman and 5.36 Tamale, Table 7).

Regarding the institutional lands under UA: the institution's employees (such as teachers, civil servants, police) were able to farm these lands for food supplementation purposes (field notes; interview finding). In other cases the institution was farming for its own use, either to contribute to meals thus reducing the food bill (commonly maize), or to grow produce for sale such as cashew nuts, teak, or even, in St. Charles Catholic Secondary School's case in Tamale, pigs (field notes). Urban teak plantations were also noted in parts of Tamale (for example, polygon 2A1, Fig. 2). This site was also being used as a rubbish dump (see image, Fig. 4). Some institutions, notably Tamale Teaching Hospital (polygon 2C2 in Fig. 2), allowed individuals (not necessarily employees) to farm their land as a deliberate land management strategy and to prevent illegal encroachment (interviewee 21 is an example of this, Table 4). Findings from Techiman's institutional land visits also mention the positive role of allowing farming in order to demarcate boundaries and discourage illegal land grabbing (field notes). Monetary rent was not usually paid in these circumstances.

In summary, there was little to suggest that urban agriculture is

Table 7
Household size, dietary diversity and food security of UA households (questionnaire).

City of Residence		N	Min	Max	Mean	Std. Deviation
Techiman	Number of People in the Household	268	1	17	5.14	2.33
	Household Dietary Diversity Score	268	0	12	6.13	2.29
	Household Food Insecure Access Scaled Score	266	0	23	3.61	4.89
Tamale	Number of People in the Household	150	1	13	5.41	2.30
	Household Dietary Diversity Score	150	1	11	5.36	2.38
	Household Food Insecure Access Scaled Score	148	0	18	2.99	4.3

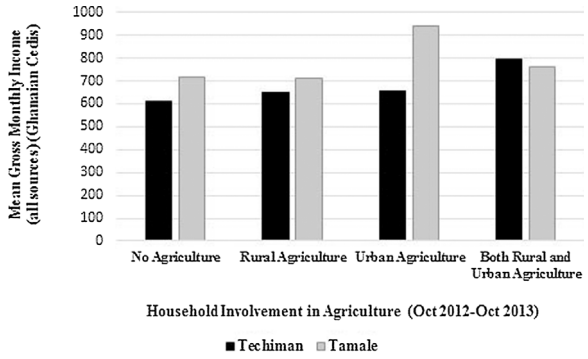

Fig. 3. Variation in mean gross monthly income by agricultural involvement of the household.
Note: Number of households in Techiman was 1034 and Tamale was 1013.

Fig. 4. A teak plantation within Tamale, also used as a rubbish dump.
Image: Author.

more practiced by poorer or more disadvantaged individuals or households. Rather this data suggest that UA is practiced by larger households, by households that have higher gross monthly incomes, and those that are more food secure. None of this says anything about causality: further analytical models could be informative.

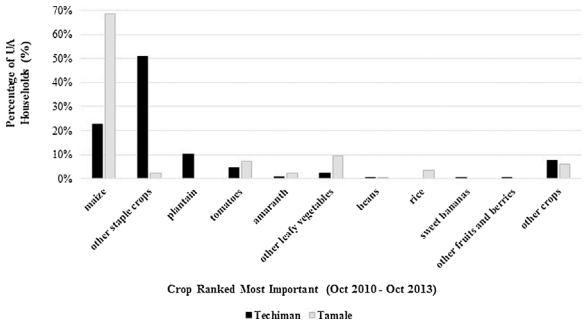

Fig. 5. Ranking of most important urban crop, Oct 2012-Oct 2013 (questionnaire).
Note: The indicator of 'importance' was subjective to each respondent and is thus variable. It was not defined by the project in terms of monetary value, nor of food contribution. The ranking of 'the most important' was thus according to each respondents' perception.
Note: Number of UA-practicing households with valid data was 267 in Techiman and 179 in Tamale.

3.4. Why engage in urban farming?

The household questionnaire data contributes to understanding of the kinds of produce being farmed in the urban areas, and the use to which produce was put. The questionnaire asked UA households what kind of crops they most commonly grew–the strong dominance of maize and other staple food crops is clear: Fig. 5 shows that 23% of Techiman's urban crop-growing households (N = 267), and 68% of Tamale's (N = 179) cited maize as most important to them. The indicator of 'importance' was subjective to each respondent and is thus variable. It was not defined by the project in terms of monetary value, nor of food contribution. The ranking of 'the most important crop' was thus according to each respondents' perception. Overall, when both cities are taken together, 41% of urban-growing households stated maize as most important to them. This was followed by 31% describing other staple crops as being deemed most important. Other types of crops grown in the cities were ranked most important by only 7% or fewer households. Regarding this staple food dominance, interviews with farmers and with the AEOs suggested that risk aversion to protect from food spoilage effects (due to lack of cold storage options) and/or market price fluctuations meant that most people avoided growing perishable produce such as tomatoes, melons, lettuce etc.

The presence of Tamale's cooperative market gardening of leafy vegetables is also evident in Fig. 5 in the slightly higher percentage of households (7.3% compared to Techiman's 1.9%) citing these as most important.

Regarding animal farming 118 HHs or 44% of the UA HHs from the questionnaire survey in Techiman kept poultry and 95 HHs (63%) in Tamale (data not shown). Keeping small ruminants such as sheep and goats within town was more common in Tamale than Techiman. Very few households said they kept cattle. Table 8 shows clearly that almost 100% of the HHs said they consumed their urban produce, whilst 55% of Tamale's UA HHs, 56% of Techiman's, said they also sold a portion (Table 8). Many also gave away some of their produce to friends and relatives (Table 8). Food supplementation for the family was clearly a strong motivation for UA activity.

Table 8
Use of Urban-Produced Products (questionnaire).

		Techiman (N = 268 UA HHs) N (%)	Tamale (N = 150 UA HHs) N (%)
How do you use the food which this household produces in the URBAN area?*	Eat some	261 (97)	148 (99)
	Sell some	150 (56)	82 (55)
	Give some away to friends/relatives	183 (68)	66 (44)
	Feed some to livestock (including chickens)	36 (13)	20 (13)

*Note: multiple responses were possible so totals greater than 100%.

The mapping component could not assess reasons for farming the city. Supporting the questionnaire findings, shown in Table 8, are the interview findings summarised in Table 4. This data shows 12 of the 22 (54%) interviewees stating they farmed for food supplementation purposes (Table 4). Four in Techiman and one in Tamale additionally mentioned income supplementation as a motivator. Nine interviewees in total (four from Techiman and five from Tamale) said farming was their sole source of income (sole livelihood to earn a living, Table 4). All these, except one, had a specialised market-oriented type of agriculture. In Techiman these were the poultry farmer, a cattle farmer, a man selling cocoa seedlings from his garden to the government, and a man who had planted an undeveloped plot with watermelon for sale. In Tamale, three of the five were irrigated market gardeners, another farmed a large plot of hospital land in an entrepreneurial and diverse manner, and only one was farming a home garden and this was predominantly under maize (Table 4).

Of those selling their produce as their main livelihood, the majority sold directly to the local market traders (often women in Ghana), though some sold to intermediaries (Table 4). These farmers claimed that sales provided a good-to-excellent level of income (Table 4) and such UA practitioners saw farming as a viable and even desirable livelihood strategy:

"People can educate their children. It's a good livelihood. Close to the market. It's good for the market women" (Interview with a male market gardener, Gumbihene, Tamale)

"*At first it was difficult to survive but now it is a good income. Become more profitable because the price is higher for vegetables since there are less farmers"* (Interview with female market gardener, Builpela, Tamale)

4. Discussion

4.1. Main findings and considerations

This mixed-method study of the geography of urban agriculture in two intermediate-sized Ghanaian cities suggests relations between the spatial location of the farmed site in the city, the tenurial arrangement and the type of farming occurring there (also found by Asomani-Boateng, 2002) (refer to Tables 2 and 4 and Figs. 1 and 2). More urban fringe, larger land areas, or areas specifically designated for agriculture (with formal tenure agreements), for example, tended to show more entrepreneurial and market-oriented characteristics (David et al. [Chapter 6 in Prain, Kranja and Lee-Smith, 2010] found similar associations around Kampala). However, UA for home consumption was common and scattered throughout the cities, but especially in neighbourhoods with gardens and undeveloped plots (refer to Tables 2 and 4 and Figs. 1 and 2). UA seemed to be less common in areas locally-termed 'slums', or more densely packed housing areas, and more common in peripheral newly developing housing areas where land was fast being converted to homes with gardens, where plots were farmed until built upon. The data presented in Section 3.2.1 showing that 15% of Tamale households and 26% of Techiman households practice urban agriculture via gardening for food supplement (Tables 3 and 4) suggests that these intermediate-sized cities retain strong connections to farming. My findings from a similar survey of two Ugandan intermediate-sized cities presents similar results (Mackay, 2016, forthcoming).

Staple food crops were common even within home gardening UA (findings by Florence et al. (2001) and Bellwood-Howard (2015) support this) (Fig. 5 and Table 4). The security of tenure associated with private gardens, however, did not translate to a primarily market-oriented farming (Table 4), suggesting tenure security alone is not a sufficient motivator. Flynn-Dapaah's writings (2002a and 2002b) highlight the importance of social networks and relationships, as well as (particularly for some institutional lands) the need to cultivate continually to prevent encroachment or usurpation.

The stronger influence on spatial expression, and to some degree scale, of UA in both cities was simply land availability and access (Table 4): land was generally more important than water since rain-fed farming was more common (Table 4), supporting Bellwood-Howard et al.'s (2015) Tamale findings. The irrigated market garden sites on open space land in Tamale are an exception since such UA, by default, requires year-round water sources. Fig. 2 shows the proximity of the open space UA to streams or dams. Techiman has two rainy seasons and Tamale one, influencing the number of harvests possible without irrigation (interviewees and key respondents confirmed this). The importance of land availability/access in dictating the pattern and type of UA is also evidenced visibly in Figs. 1 and 2 where the sharp-edged boundaries of institutional UA highlight a distinct tenure change.

The significant role of institutional land found in the UA landscape of these cities, in proximity to the urban heart, is a compelling finding, which may bring new understanding of the spatiality and role of UA. It may be an aspect of UA stronger in smaller cities that do not yet experience the same development pressure of larger cities. Institutional land's produce may be either for the benefit of the institution, or of the employees, or of local residents depending upon the needs and capabilities of the institution (see also Allen et al. (2014) and Flynn-Dapaah (2002a). Further in-depth qualitative and quantitative research on the role of institutional land within the UA landscape is desirable. Bellwood-Howard et al.'s (2015) study acknowledged surprise at the scale and persistence of institutional UA in Tamale and in Ouagadougou, Burkina Faso, even without necessarily secure tenure: "Despite farmers' concerns about insecure land-tenure arrangements, our survey found a surprisingly large persistence of UPA in both cities, and sites around government institutions such as power-generation facilities and schools owned by the state" (Bellwood-Howard et al., 2015, p7).

The reasonably large scale of UA found (in terms of practitioners, acreages [particularly of institutional land], and plot sizes) is supported by other literature (for example David et al.'s 2010 investigation of UA in Uganda [in Prain, Kranja and Lee-Smith 2010]; Ayerakwa 2017 in Ghana; Omondi 2017 in Kenya). This suggests that intermediate-sized cities can provide land (Thebo et al., 2014; Hamilton et al., 2014) that may play some role for household food security (de Zeeuw et al., 2011; Hampwaye, 2013) and calorific contribution (Florence et al., 2001). This should not be dismissed. However, looking at the whole UA cityscape of Techiman and Tamale, which consisted mainly of staple crop production for home consumption purposes, suggests this is less likely to impact diet quality, diversity or micronutrient status (Turner and Jirström, 2014; Schönfeldt et al., 2013).

Whilst the staple crop maize was clearly a dominant UA product (in rain fed home gardens, or institutional sites) a number of interviewees, and the institutional land managers, claimed that maize was generally not sold for cash income (supported by Armar-Klemesu and Maxwell's findings from Accra *in* Bakker et al. (2000) and Smart et al. (2015) in Zambia). Maize rather provides energy-dense food to the household/

institution (field notes). It does represent a financial saving to the household, or institution (some interviewees claimed self-sufficiency in maize) and can be considered as non-cash income (an expense alleviation) (Prain et al., 2010). Maize is easy to grow, has a fast growth cycle, can tolerate contaminated land, can be stored for long periods, can be processed into a dried powder, can feed animals and is widely used in many local dishes (supporting findings by Florence et al., 2001; Turner and Jirström 2014). This perhaps makes it a particularly suitable crop for urban areas. The predominance of maize is likely due to a combination of these tenure, risk aversion, ease of growth and storage, and food security characteristics.

4.2. How intermediate-city findings compare to Ghana's larger cities

Studies of Ghana's largest two cities (Accra and Kumasi), as described in Section 1.2, have tended to focus on the significant market-gardening that contributes considerably to Kumasi and Accra's leafy vegetable food system, with some consideration of home gardening. This paper suggests that the role of institutional land in urban agriculture is an under-studied area. Arguably, home-gardening and the farming of institutional land, may be more significant at the intermediate-city scale than the larger city scale, perhaps due to land availability dynamics, planning histories, and lower development pressure. Another difference of intermediate-sized cities from Accra and Kumasi may be the dominance of food supplementation of staples, rather than the irrigated vegetable market gardening prominent in larger cities, though Tamale presents some of these features.

The fact that the larger of the two study cities (Tamale) had similar market gardening UA characteristics to Kumasi and Accra is interesting. It is possible to speculate that there may exist a critical size of city (either population size or spatial spread i.e. distance from the urban centre to rural agriculture) beyond which market gardening becomes more feasible and attractive. De Bon et al. (2010) in their review of UA do suggest that development pressures tend to squeeze out home production but facilitate market gardening.

The Ministry of Food and Agriculture (MOFA) in Ghana employs local agricultural extension officers (AEOs) to advise and train farmers, and open-space urban farmers fall within their remit, though backyard farming would not (Drechsel, 2017). Their framing of UA practitioners as poor and migrant, or the market crisis literature's framing of urban farmers (discussed in Section 1.1) as a survivalist strategy of last resort for the dispossessed and marginalised seems to be strongly influenced by research on Accra's open space market gardening (see for example, Obosu-Mensah 2002, Allen et al., 2014, Obuobie and Hope, 2014, and Danso et al., 2014), or other much larger city contexts. The profile of UA practitioners found in these intermediate-sized cities: that they tend to be wealthier, more food secure home owners or renters, are supported by other studies (for example Frayne et al., 2014), and seem out of step with such theorising.

Overall, the city differences (between Techiman and Tamale, as well as between the intermediate-sized and the larger cities) could also be a function of one or a combination of population size, proximity to rural agriculture, climatic influences, agricultural zone, local dietary preferences and cultural attitude or local enabling factors.

4.3. Implications for theorising UA

It has been suggested that UA (specifically market gardening) functions as a "particularly successful farming system driven by market opportunities" (Mougeot, p12 in Egziabher et al., 1994) and a growing phenomenon in Africa's cities (FAO, 2012). The findings of this paper are somewhat split. Whilst there was little evidence of this in Techiman (the smaller city within an agriculturally productive zone) the findings from Tamale, the larger city where there was a strong financial driver (a good income could be earned from market gardening), lend support to this view.

Findings from these intermediate-sized cities did not strongly support framings of UA as an activity of the poorest, or of recent migrants. Of course, different theoretical framings may apply to different UA types. Market crisis theorising might predict greater UA presence in poorer neighbourhoods or households but this study did not find evidence of this. Aspects of market crisis-oriented theorising may possibly be employed to explain some of the impetus for the prevalent home gardening of staples to supplement the food basket. However, the commonness of home gardening in these cities could equally be theorised as an opportunistic strategy of asset savings (livestock or poultry for example) and expense alleviation (less expenditure on staple foods). Tamale's market gardening UA (and Accra and Kumasi's) can thus be thought of as more neatly responding to market-opportunities.

The prevalence of home gardening could possibly also be framed as UA subsiding failings in the dominant economic systems by filling gaps from a strained employment sector and a reduced social infrastructure, as Nathan McClintock suggests when he claims UA can "unintentionally bolster the neoliberalisation of cities" (McClintock, 2014, p10). Yet the findings presented here suggest that UA is simply a common risk avoidance strategy for those with land access. Critical Marxist theorising applied to some UA movements of the Global North (see Tornaghi 2014; McClintock, 2010, 2014) do not resonate strongly with this paper's findings. Certainly, the profile of urban farmers found here does not fit well with the market crisis and Ghanaian MOFA's framing of UA. This research suggests rather (in contrast to studies from some larger cities, see reviews by De Bon et al., 2010; Orsini et al., 2013; Hamilton et al., 2014) that UA is practiced by long-term residents (in support of de Zeeuw et al., 2011) and better-off households, with both male and female participation.

The important finding revealed in this research of the scale of, and roles played by, institutional land could, like that of home gardening, be described in market crisis terms if considering the use of such land by poorer residents who otherwise lacked access. Yet simultaneously the institution (here largely the public hospitals) were making use of otherwise under-utilised land in an opportunistic and common-sense way. They gain in terms of land management, as well as protection from urban encroachment (Flynn-Dapaah, 2002a). Furthermore, those institutions that were farming for food supplementation of their pupils, or to generate cash to support their activities, may be postulated as operating not out of crisis but out of practical thriftiness in a climate of tight resources. Further research should investigate this UA dimension in more detail, probing whether this is a phenomenon unique to Ghana, or to smaller cities; and investigating who gains most from farmed produce on institutional lands: employees, middle-class professionals, landless urban dwellers, or the institution itself.

Overall, the empirical and descriptive findings from this study suggest that, for these two cities in this national context (a country with stable political systems, strong economic growth and good poverty reduction indicators), during this time period (2012–2013), urban agriculture is better theorised as an expense alleviation and/or opportunistic accumulation or food supplementation strategy (even for institutional land), rather than a livelihood/market crisis response.

4.4. Planning and policy implications

Town planners confirmed that there was little officially defined or planned out regarding UA (key respondent interviews). While the practice was not specifically enabled, little was officially banned. Tamale had a slightly higher level of formalisation regarding UA than Techiman but both cities' planners said their difficulties would lie in enforcement of any official strategy due to resource constraints. Both planners held positive views of UA, particularly from an environmental and food security perspective. There was a desire to be more enabling but pressures from rapid urban development and lack of secure tenure were hindrances. One obstacle to local government having a more proactive role in supporting UA was that the government actually owns

very little of the land. The majority lies in the hands of chiefs as custodians (Bellwood-Howard et al., 2015). Problems have arisen, however, when chiefs' actions run counter to tradition and land becomes sold on the open market (ibid, and interview findings). Government usually does not have the resources to purchase land. Planners in both cities viewed UA as a declining practice except perhaps within home gardens. Their view was that farming tended to move to *peri*-urban areas as the city develops and land prices rise.

Land, even in the form of gardens (whether rented or owned) will probably continue to be farmed, small-scale, in this intermediate-city Ghanaian context. Future urban design may be more proactive or creative with this knowledge. The same could be said of urban planning with regard to the role of institutions, where participatory engagement could stimulate new strategies for urban food systems. Findings from Tamale suggest a strong influence of water only for the irrigated market-gardening activities found on open space land. Future planning may more strategically engage with such resources, and would benefit from forward-thinking consideration of pollution concerns. Agriculture occurs, in these Ghanaian contexts, on land zoned officially as urban residential or urban industrial, and thus becomes invisible on plans and maps. Should planning for the future move away from such rigid zoning regimes of colonial heritages, to better reflect the multi-dimensional African daily practicality (Myers 2011; Flynn-Dapaah, 2002b)? In reality, planners in these contexts are often under-resourced to enable such. Planners need to consider what kind of housing stock the city wants for the future. Continuing the colonial heritage of bungalow-style house-with-garden built environments may not be desirable or sustainable from a land-use, infrastructure provision or urban-sprawl perspective. This planning heritage likely contributes to the prevalence of home gardening however. Findings from this research prompt reflection on the urban morphological conditions that may support or hinder UA (David et al. in Prain et al., 2010).

5. Conclusion

This paper positioned itself to contribute to noted research gaps assessing the local scale, characteristics and motivation of urban agriculture. It focused on two smaller Ghanaian cities facing development pressure rather than duplicating research from large cities. It provides a recent assessment of the multiple types and roles of UA found in these cities and offers insights into reasons for, and persistence of, the activity. Findings indicate that UA practice was quite common, was practiced in residential areas (especially slightly better off areas with gardens) and on institutional land, and practiced by better-off individuals and households. Most common usage was as food supplementation (often maize) via home gardening. However, urban agriculture can be the main livelihood for those, often better-off residents, running a market gardening business, or other entrepreneurial UA. Findings suggest a picture not so dissimilar to Ghana's larger cities but with greater prevalence of home gardening, and a dominance of staple crops rather than leafy vegetables (particularly in Techiman). A compelling finding deserving further, qualitative as well as quantitative, investigation is the extent of, and multiple roles played by, institutional land. Ghanaian policy and market crisis theorising of the drivers of UA were not found to be a very accurate reflection of the UA patterns and functions found within these two intermediate-sized cities of Ghana. Rather than being a localised survival activity of the poor, or marginalised, of recent migrants, or of predominantly women, these cities contained a large scale and diverse spatiality of UA mainly for non-poor, non-migrants, supplementation of their staple food basket. Results emphasise the context-specific nature of a city's urban agriculture, and underline the need for researchers and UA advocates to be specific about the form of UA under the microscope when making claims for 'an urban agriculture'.

Source of funding

This work was supported by:

- Swedish International Development Cooperation (Sida), Minor Field Studies Grant.
- Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas), Grant number: < gn2 > 250-2014-1227 < /gn2 > .
- Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas; Grant: < gn3 > 225-2012-609 < / gn3 >).
- Swedish International Development Cooperation Agency (Sida Grant: SWE-2011-028).

Acknowledgements

I thank AFSUN for their permission to use the AFSUN Household Food Security Baseline Survey instrument as part of this research. I would also like to thank Christopher Turner for survey support during the mapping component of this research, and to Eunice Dadzie and Daisy Prempeh, research assistants. I am grateful also to the two anonymous reviewers who gave considered and constructive advice.

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