

Cross-Location Analysis of the Impact of Household Socioeconomic Status on Participation in Urban and Peri-Urban Agriculture in West Africa

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Abstract This study explores the relation between household socioeconomic status (SES) and participation in urban and periurban agriculture (UPA) in three West African cities. We used a structured questionnaire to survey 700 randomly selected households: 250 in Kano, Nigeria, 250 in Bobo Dioulasso, Burkina Faso, and 200 in Sikasso, Mali. Multiple correspondence analysis was applied on household asset variables to create an index of assets which was used as a proxy for household SES. The results showed no significant differences in households' rate of participation in UPA across socioeconomic groups. Participation in UPA was rather significantly ($P < 0.001$) and positively related to household size. Interestingly, the analysis revealed that field crop cultivation and gardening were more common among households in the low and medium SES groups while those in the high SES group were more likely to keep livestock.

Keywords Determinants · Field crop cultivation · Gardening · Livestock keeping · Urban dwellers · West Africa

Introduction

Urban and peri-urban agriculture (UPA), which has been defined as the cultivation of crops and rearing of animals for food and other uses within and around cities (Mougeot 2000), is widely practiced in sub-Saharan Africa (Rakodi 1988; Kironde 1992) and its socioeconomic importance continues to rise (Drechsel and Dongus 2010). The edited collection “Feeding African Cities” (Guyer 1987a) is one of the most important and detailed studies on the social history of food systems in African urban centers. Drawing upon cases studies in Dar es Salaam (Tanzania), Harare (Zimbabwe), Kano (Nigeria), and Yaoundé (Cameroun), it examines the urban food supply, including local production, the imports, the markets, institutions and the policy responses in the colonial and post-colonial eras. The general conclusion drawn from these case studies is that many urban dwellers were also farmers. There is a wealth of literature that describes the social roles of UPA, its economic functions and its potentials to sustain the livelihoods of urban dwellers in African countries, along with its environmental benefits and problems (Memon and Lee-Smith 1993; Smit *et al.* 1996; Birley and Lock 1998; Maxwell *et al.* 1998; McMichael 2000; Asomani-Boateng 2002; Danso *et al.* 2002; Cissé *et al.* 2005; Graefe *et al.* 2008; De Bon *et al.* 2010; Diogo *et al.* 2010, Predotova *et al.* 2010). It has also been widely argued in the general UPA literature and in several case studies that urban farmers are among the poorest of poor urban dwellers who have no other livelihood alternatives (Lado 1990; Rogerson 1993; Enete and Achike 2008). While these claims seem largely unsubstantiated, some studies provide a more complex picture. For instance, May and Rogerson (1995) and Webb (1998) found that middle- and higher-income households were more involved than marginalized households in urban

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farming in South Africa, while van Averbek (2007) reported sharply contrasting results. In Dar es Salaam (Tanzania), Sawio (1994) found that urban farmers included better-off urban dwellers and civil servants. Similarly, Foeken and Owuor (2008) observed that the poor households in Nakuru, Kenya, were much less likely to participate in urban agriculture than the well-off and were therefore underrepresented among urban farmers. These findings however suffer from the lack of a clear distinction between poor and rich. For instance, the wealth indicator used in the South African (Averbek 2007) and Kenyan (Foeken and Owuor 2008) case studies was the gross monthly cash income, for which the data were collected through questionnaires. No detailed calculation of household income was undertaken in either study. In addition, data on household income based on self-reported information are frequently unreliable (Montgomery *et al.* 2000; Jäckle *et al.* 2004; McKenzie 2005; Kolenikov and Angeles 2009) and they also fail to capture all aspects of well-being (Falkingham and Namazie 2002). Similarly, reliable quantitative information from West Africa is very limited.

Based on the assumption that the assets owned by households and the quality of their housing are good indicators of their wealth status, Filmer and Pritchett (2001) developed Principal Components Analysis to create an index of household assets and housing quality for measuring household socioeconomic status (SES). While debate about the reliability of their results continues (Howe *et al.* 2008; Kolenikov and Angeles 2009), asset-based indices are increasingly being used in the area of welfare studies as proxies for living standards in developing countries (Filmer and Pritchett 2001; Ruel and Menon 2002; Houweling *et al.* 2003; Schellenberg *et al.* 2003; Doctor 2004; Filmer 2005; Vyas and Kumaranayake 2006; Gwatkin *et al.* 2007). Since as it has proven very difficult to obtain accurate information on household income and expenditures in sub-Saharan Africa (Benin and Randriamamonjy 2008), such an asset-based index might be a useful alternative tool to identify differences in socioeconomic conditions among urban households. Against this background, the main purpose of the current study was to examine how proxies for SES of urban households in West Africa relate to their participation in UPA in general and to their choice of a specific UPA activity in particular.

Materials and Methods

Study Locations

The study was carried out between August and December 2008 in the West African cities of Kano in Nigeria, Bobo Dioulasso in Burkina Faso and Sikasso in Mali (Fig. 1).

With a population estimated at 3.140.000 in 2007 (UNUP 2009), Kano is the second largest city in Nigeria after Lagos. Located in the northern part of the country, it covers a total area of 55.000 ha (Tiffen 2001). Bobo Dioulasso is located in the south-west of Burkina Faso and with an estimated population of 400.000 inhabitants in 2007 is the second largest city in the country after the capital Ouagadougou, covering 13,678 ha (Commune de Bobo Dioulasso 2007). Sikasso, in the south of Mali, is the third largest city of the country after Bamako and Segou, covering 3,745 ha (Ministère de l'Habitat et de l'Urbanisme 2005) and with an estimated population close to 200,000 inhabitants.

Sampling

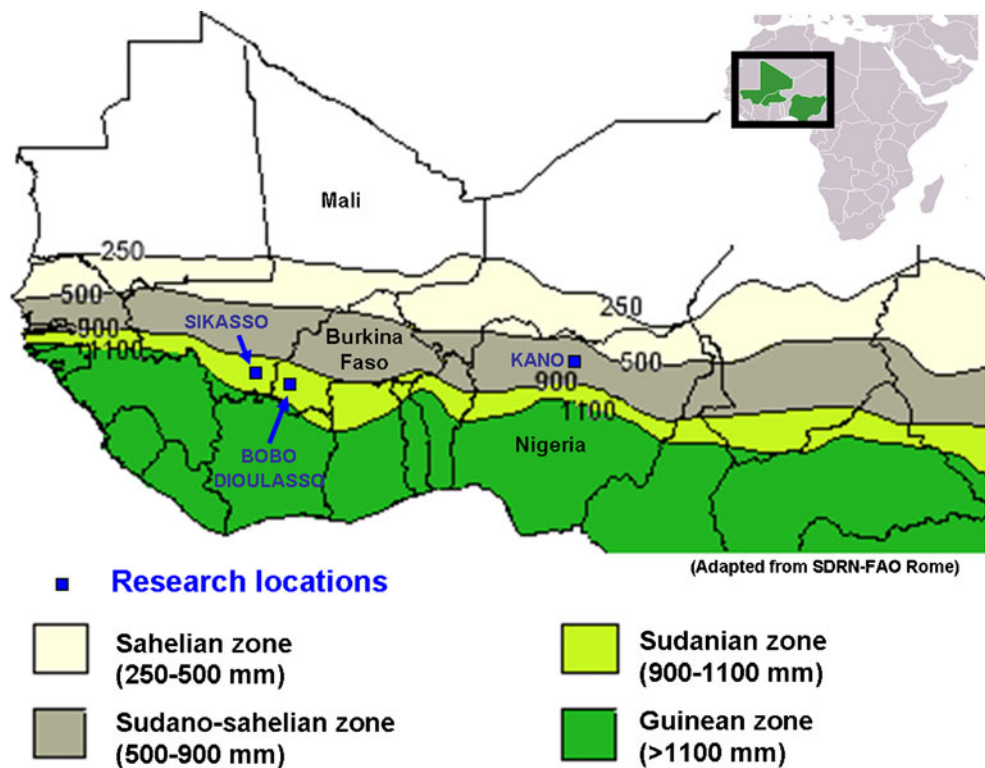
Households (HH) were randomly selected using a skip-interval sampling method (Amedeo *et al.* 2009; Brewer and Gregoire 2009). First, the subdivisions (quarters or local governments) of the city that were to be part of the sample were identified from the city maps. In each subdivision, two major roads, two secondary roads and two back-roads were identified. Then, along each of the identified roads, the first dwelling was blindly chosen and visited. Subsequently every 4th dwelling was visited. In case two or more households were living in the dwelling, only one randomly chosen household was approached. Upon agreement to participate in the survey, the head of household or his/her representative was interviewed (see below) by a trained enumerator.

A total of 700 randomly selected HH were surveyed; 250 in Kano, 250 in Bobo Dioulasso and 200 in Sikasso. In Kano, the sample covered the six local government areas representative of the city: Municipal (26 HH), Gwale (22 HH), Dala (49 HH), Tarauni (76 HH), Nassarawa (37 HH) and Fagge (50 HH). In Bobo Dioulasso, 10 HH were surveyed in each of the 25 quarters of the city. In Sikasso, 13 HH were surveyed in each of the 15 old quarters of the city and 5 HH in the hamlet of Bougoula village located 10 km to the east of the city center.

Data Collection and Computation

Using a structured questionnaire, information was collected from heads of households or their representative on the age, formal education level, and migration status of the head of household, on household size and structure, sources of income, assets, housing quality, and participation in different UPA-related activities. Additionally, each respondent was asked to rate the wealth profile of his/her household as poor, well-off or rich (self-classification). The questionnaire was pre-tested on 10 households in each city and the questions were adapted to local conditions

Fig. 1 Research locations and agro-ecological zones (average annual rainfall in mm) in West Africa



without affecting the comparability of information across locations.

An asset index was generated from the variables indicating a household's assets (Table 1) and was used as measure of a household's SES. As all these variables were categorical and did not fulfill the required assumptions for Principal Components Analysis (PCA), we employed Multiple Correspondence Analysis (MCA) to construct the asset index. To account for socioeconomic differences, the MCA was performed separately for each city. The results obtained from the first dimension were then used to develop the asset index according to a widely used methodology (Cortinovis *et al.* 1993; Filmer and Pritchett 2001; Howe *et al.* 2008; Booyesen

et al. 2008). Each household asset was assigned a score generated through the MCA. The resulting asset scores were standardized in relation to a standard normal distribution with a mean of zero and a standard deviation of one. These standardized scores were summed by household, ranked and recoded into a tercile variable (Ruel and Menon 2002), which was then used as measure of the household's SES (low, medium or high).

Statistical Analysis

Chi-square analyses were used to compare ownership of each asset and housing quality across the derived SES

Table 1 Variables describing household assets and housing quality used to construct the asset index for 250, 250 and 200 households (HH) in the cities of Kano, Bobo Dioulasso and Sikasso, respectively

Variables	Levels of measurement
Ownership of house	1 = yes, 2 = no
Does household share compound with other households?	1 = yes, 2 = no
Material of housing construction	1 = brick, 2 = else
Presence of electricity	1 = yes, 2 = no
Presence of piped water	1 = yes, 2 = no
Use of gas for cooking	1 = yes, 2 = no
Presence of air conditioner	1 = yes, 2 = no
Presence of conventional telephone	1 = yes, 2 = no
Possession of car	1 = yes, 2 = no
Possession of motorbike	1 = yes, 2 = no
Possession of color TV	1 = yes, 2 = no
Possession of refrigerator	1 = yes, 2 = no

groups. To check the validity of the classification, membership in an SES group was compared to the household's self-classification as poor, well-off or rich. The association between the asset-based and self-reported wealth categories was estimated by the Spearman's rank (ρ) correlation coefficient. Cohen's Kappa statistics was performed to assess the degree of agreement between the two approaches using the following cut-offs (Viera and Garrett 2005): < 0 , less than chance agreement; 0.01–0.2, slight agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, substantial agreement; 0.81–0.99, almost perfect agreement. Univariate analyses of the continuous variables were performed using the non-parametric Mann–Whitney U test. Associations between categorical variables were assessed with the chi-square test. A P -value ≤ 0.05 was considered to indicate statistical significance. To determine the combinations of variables that best predicted household participation in UPA, Stepwise Logistic Regression analysis with backward elimination of predictors (Hair *et al.* 2006) was performed, whereby only the variables that showed significant association with a household's participation in UPA in the univariate analyses were used as covariables in the logistic regression. The positive or negative sign of the coefficient β indicates the direction of the relationship between a given independent variable and the dependent variable, while the odds ratio (e^β) gives the magnitude of the change in the odds of having the dependent variable event for a one unit change in the given independent variable. The fit of the final model was assessed by the model chi-square (Model χ^2) and the goodness-of-fit test of Hosmer and Lemeshow (Hosmer *et al.* 1997). Well-fitting models show significance ($P \leq 0.05$) on the Model χ^2 and non significance ($P > 0.05$) on the goodness-of-fit test of Hosmer and Lemeshow. All statistical analyses were performed separately for each city using SPSS/PASW 18.0 (SPSS Inc. 2010).

Results

Scoring Factors, Asset Index and Households' SES

The results for the first dimension from the MCA of the households' asset variables (Table 2) showed that higher positive scores were assigned to variables that were more likely to be associated with high SES and low values were more likely to be associated with low SES. Assets owned by almost all households received a very low weight and therefore contributed very little to the households' overall asset score. The lowest tercile was considered as a proxy for households of lowest SES and was therefore referred to as low SES (Table 3). The highest tercile was representing households of highest SES and was referred to as high SES.

In terms of the distribution of assets and housing quality marked differences were observed across the three SES groups (Table 4). Regardless of the city, households in the low SES group possessed no car. Piped water was present in only very few households in the low SES group whereas it was present in more than 75% of households of high SES. Inequalities across cities were observed regarding access to electricity. Almost all households in Kano, regardless of their SES, reported the use of electricity for lighting. In contrast, more than 95% of households in the low SES group in Bobo Dioulasso and Sikasso had no access to electricity, whereas almost all households in the high SES group reported electricity as source of lighting at both locations.

Overall, there was a significant ($P < 0.001$) positive correlation (Spearman's $\rho = 0.58, 0.66$ and 0.60 for Kano, Bobo Dioulasso, and Sikasso, respectively) between the self-reported wealth categories and the asset-based proxy wealth index. The Kappa agreements were significantly ($P < 0.001$) low with values of 0.35, 0.37 and 0.38 for Kano, Bobo Dioulasso, and Sikasso, respectively. In each city, more than 70% of households that self-classified as poor fell into the low SES group (Table 5). Similarly, more than 80% of self-classified rich households were allotted to the high SES group. In contrast, more than half of the respondents (56.9% in Kano; 58.6% in Bobo Dioulasso, and 54.2% in Sikasso) who classified their households as well-off did under- or over-estimate their household's SES (respondents with under- and over-estimation: 21% and 35.9% in Kano; 39.3% and 19.3% in Bobo Dioulasso; 26.1% and 28.1% in Sikasso).

Socioeconomic Characteristics of Households and Participation in UPA

In each city, no differences were observed across SES groups with respect to participation in UPA (Table 6). The proportion of households participating in UPA varied across cities and was significantly ($P < 0.001$) higher in Bobo Dioulasso (87.6%) and Sikasso (62.5%) than in Kano (41.6%). Regardless of the city, households that were participating in UPA had a significantly ($P < 0.05$) larger household size and a greater number of active members than non-participating households. In Sikasso, the average age of heads of households participating in UPA was significantly ($P < 0.05$) higher than that of non-participating heads of households, while in Bobo Dioulasso a household's participation in UPA was significantly and negatively related to the formal educational level of its head.

UPA was reported as main occupation and main source of income by a significantly ($P < 0.05$) higher proportion of heads of households in Bobo Dioulasso (39%) than in

Table 2 Scores of the asset and housing quality variables on the first principal component from Multiple Correspondence Analysis for households in the cities of Kano ($n=250$), Bobo Dioulasso ($n=250$) and Sikasso ($n=200$)

Variable description	Kano	Bobo Dioulasso	Sikasso
Ownership of house	0.255	0.001	0.063
Does household share compound with other households?	0.366	0.026	0.000
Material of housing construction	0.177	0.572	0.309
Presence of air conditioner	0.016	0.198	0.188
Presence of electricity	0.138	0.687	0.512
Presence of piped water	0.406	0.288	0.396
Use of gas for cooking	0.144	0.527	0.201
Possession of car	0.556	0.378	0.438
Possession of motorbike	0.000	0.429	0.203
Possession of color TV	0.332	0.621	0.364
Possession of refrigerator	0.583	0.563	0.461
Possession of conventional phone	0.069	0.494	0.326
Eigen value	3.043	4.783	3.461
Proportion variance explained (%)	25.40	39.90	28.80
Cronbach Alpha	0.732	0.863	0.776

Sikasso (14%) and Kano (5%). Regardless of the city, gardening was the least common and livestock keeping the most popular UPA activity among households (Fig. 2). The proportions of households involved in gardening and in crop farming were significantly ($P<0.05$) higher in Sikasso (15.2% and 62.4%, respectively) and in Bobo Dioulasso (11.8% and 51.6%, respectively) than in Kano (4.8% and 29.8%, respectively), whereas significantly ($P<0.001$) more households were involved in livestock keeping in Kano (90.4%) and Bobo Dioulasso (87.7%) than in Sikasso (72.0%).

The results of the logistic regression analyses showed that regardless of the city, the Model χ^2 was significant ($P<0.05$) while the goodness-of-fit test of Hosmer and Lemeshow was not significant ($P>0.05$), suggesting that the models adequately fitted the data for the respective cities and that at least one of the predictors is significantly related to participation in UPA (Table 7).

The results confirmed household size as the only predictor that had a significant ($P<0.05$) influence on a household's participation in UPA in Kano, where large households were 1.057 times more likely than small households to participate in UPA. Household size was also confirmed as the most significant predictor of a household's participation in UPA in Bobo Dioulasso and the odds of large size households being involved in UPA were 1.197 times greater than the odds of small-sized ones. In contrast, the logistic regression model identified age of head of household as the only variable having an independent and significant contribution to the prediction of household participation in UPA in Sikasso. The older the head of a household in Sikasso, the more likely the household was involved in UPA.

Among households participating in UPA, those of low SES were significantly ($P<0.05$) more likely to be involved

in field crop cultivation in Kano and Bobo Dioulasso than households of medium and high SES (Table 8). A similar tendency was observed in all cities for participation in gardening, although the differences were not statistically significant. In contrast, households of high and medium SES were more likely to be involved in livestock keeping and tended to keep larger (standardized¹) numbers of livestock than those of low SES. The differences were statistically significant in Bobo Dioulasso ($P<0.001$) and Sikasso ($P<0.05$) but not in Kano.

Average number of years of households' experience in gardening was 16.4 ± 9.3 , 17.5 ± 10.8 and 7.6 ± 7.9 in Kano, Bobo Dioulasso and Sikasso, respectively. For livestock keeping, it was 13.6 ± 11.3 in Kano, 12.2 ± 10.4 in Bobo Dioulasso and 11.3 ± 11.7 in Sikasso, and for crop cultivation it was 17.7 ± 15.5 in Kano, 12.8 ± 10.2 in Bobo Dioulasso and 13.5 ± 12.3 in Sikasso.

Discussion

Self-Perceived Wealth and Asset-Based Index Proxy for Wealth

The households' self-perceived wealth status was correlated with the SES derived from the asset-based index but the Kappa agreements were only fair. As shown in Table 5, many participants were inclined to rate their household's wealth status below the estimated SES level. In contrast to the asset-based index approach, asking respondents to rate

¹ For standardization, livestock species were converted to Tropical Livestock Units (TLU) as follows: cattle=0.80, sheep and goats=0.10, donkey=0.50; pigs=0.20, poultry and rabbit=0.01.

Table 3 Mean asset score by socioeconomic status (SES) groups of households in the cities of Kano ($n=250$), Bobo Dioulasso ($n=250$) and Sikasso ($n=200$)

	SES								
	Low			Medium			High		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Kano	82	-1.06	0.37	83	-0.14	0.24	85	1.16	0.54
Bobo Dioulasso	83	-1.20	0.62	81	0.17	0.38	86	0.99	0.14
Sikasso	65	-1.05	0.37	68	-0.98	0.23	67	1.13	0.68

the wealth status of their households did not provide an objective criterion with which the accuracy of the respondents' answers could be tested, and many respondents tended to provide the interviewer with biased perceptions, mainly because, although the purpose of the research was explicitly explained, some of them were still worried about potential future uses of such information. Van Bodegom *et al.* (2009) reported similar bias towards under-estimation of household wealth status by respondents, and assumed that this occurred because respondents thought it would make them more eligible for developmental programs. Our results support the hypothesis that the asset-based index approach produces more reliable results than self-assessment. We therefore argue that this approach might be a very useful and trustworthy proxy measurement of wealth, particularly in locations where people are reluctant to talk about their

prosperity in a face-to-face interview. However, as stressed by Filmer and Pritchett (2001) and Sahn and Stifel (2003), the asset-based index only provides a good relative analysis of welfare but not of absolute poverty.

Socioeconomic Status and Participation in UPA

In this study we found no consistent evidence of association between the SES of a household and its participation in UPA. Our finding is in agreement with contentions that not only the urban poor, but all socioeconomic groups are represented among urban agriculturalists (Egziabher *et al.* 1994; Maxwell 1995; May and Rogerson 1995; Mkwambisi *et al.* 2010; De Bon *et al.* 2010). In addition, we did not find any significant difference in the rate of participation of poorer and richer socioeconomic groups in UPA, which was

Table 4 Distribution of assets and housing quality among households of different socioeconomic status (SES) groups in the cities of Kano, Bobo Dioulasso and Sikasso

Variable description	Kano ($n=250$)				Bobo Dioulasso ($n=250$)				Sikasso ($n=200$)			
	SES			P-Value ^a	SES			P-value	SES			P-Value
	Low	Medium	High		Low	Medium	High		Low	Medium	High	
	Percent ^b of HH				Percent of HH				Percent of HH			
Ownership of house (yes)	29.3	80.7	90.6	**	86.0	90.1	84.3	n.s.	55.4	57.4	85.1	**
Does household share compound with other households? (no)	17.1	54.2	89.4	**	83.7	60.5	54.2	**	73.8	64.7	73.1	n.s.
Material of housing construction (brick)	59.8	75.9	97.6	**	3.9	21.4	74.8	**	32.3	77.9	95.5	**
Presence of air conditioner (yes)	0.0	0.0	1.2	n.a.	0.0	0.0	9.8	n.a.	0.0	1.5	10.6	n.a.
Presence of electricity (yes)	81.7	100.0	100.0	n.a.	0.0	46.9	100	n.a.	4.6	51.5	93.9	**
Presence of piped water (yes)	6.1	33.7	77.6	**	20.9	44.4	79.5	**	10.8	50.0	89.4	**
Use of gas for cooking (yes)	0.0	1.2	10.6	n.a.	3.5	40.7	91.5	**	4.6	17.6	42.4	**
Possession of car (yes)	0.0	6.0	63.5	n.a.	0.0	3.7	32.5	n.a.	0.0	8.8	56.7	n.a.
Possession of motorbike (yes)	41.5	53.0	50.6	n.s.	20.9	80.2	98.8	**	58.5	88.2	98.5	**
Possession of colour TV (yes)	39.0	84.3	100.0	n.a.	0.0	60.5	98.8	n.a.	41.5	97.1	100.0	**
Possession of refrigerator (yes)	1.2	18.1	88.2	**	0.0	2.5	61.4	n.a.	1.5	4.4	55.2	**
Possession of conventional phone (yes)	0.0	0.0	4.7	n.a.	0.0	0.0	37.3	n.a.	0.0	1.5	28.8	n.a.

^a P-value, Chi-square test: ** $P \leq 0.01$; n.s. = differences not significant; n.a. = not applicable

^b Sums of columns exceed 100% because households within a given SES group in each city reported ownership of many different assets and multiple housing quality indicators

Table 5 Congruency (%) between self-classification and asset index-based classification (socioeconomic status, SES) of households in the cities of Kano, Bobo Dioulasso and Kano

Wealth groups based on self-classification ^a	SES		
	Low	Medium	High
Kano			
Poor (<i>n</i> =23)	82.6	17.4	0.0
Well-off (<i>n</i> =167)	35.9	43.1	21.0
Rich (<i>n</i> =60)	5.0	11.7	83.3
Bobo Dioulasso			
Poor (<i>n</i> =78)	74.4	25.6	0.0
Well-off (<i>n</i> =145)	19.3	41.4	39.3
Rich (<i>n</i> =27)	0.0	3.7	96.3
Sikasso			
Poor (<i>n</i> =28)	89.3	7.1	3.6
Well-off (<i>n</i> =142)	28.1	45.8	26.1
Rich (<i>n</i> =29)	0.0	3.4	96.6

^a The number of households per wealth group and city is set to 100%

also observed by Foeken and Owuor (2008), and Zezza and Tasciotti (2010). According to Guyer (1987b), the practice of

urban and peri-urban agriculture was already common in the nineteenth century among wealthy African urban dwellers. As Watts (1987) posited for the city of Kano, the urban aristocracy dominated even the urban food production and supply, drawing upon servile labour. However, it has been shown that the main motivations for engaging in urban agriculture vary greatly across different socioeconomic groups. The participation of poorest and low-income households is mainly driven by cash income generation and improving their nutritional status (Gbadegesin 1991; Maxwell 1995; Mwangi and Foeken 1996; Cissé *et al.* 2005; Simatele and Binns 2008) whereas for the middle and higher income groups UPA represents a significant source of savings on food expenses but also an opportunity to diversify their sources of income (May and Rogerson 1995; Smit *et al.* 1996; Binns and Lynch 1998; Smith 2001; Page 2002; McClintock 2010). It is evident that the introduction of structural adjustment programs in the mid-1980s coupled with recurrent economic crises in West African countries has drastically affected all socioeconomic groups (Ekpo 1992; Ezenwe 1997). As argued by Castillo (2003), the resulting sharp declines in real incomes, employment opportunities and purchasing power and the rises of food prices have

Table 6 Differences in some socioeconomic characteristics between urban households (HH) participating (UPA) and those not participating (NUPA) in activities of urban and peri-urban agriculture in the cities of Kano, Bobo Dioulasso and Sikasso

Variables	Kano				Bobo Dioulasso				Sikasso			
	n	UPA (%)	NUPA	P-value [#]	n	UPA (%)	NUPA	P-value	n	UPA (%)	NUPA	P-value
Gender of HH head				n.a.				*				n.s.
Male	248	41.9	58.1		226	89.4	10.6		193	63.7	36.3	
Female	2	0.0	100.0		24	70.8	29.2		7	28.6	71.4	
Migration status of HH head				n.s.				n.s.				n.s.
Immigrant	100	45.0	55.0		144	85.4	14.6		110	58.2	41.8	
Native	150	39.3	60.7		106	90.6	9.4		90	67.8	32.2	
SES of HH				n.s.				n.s.				n.s.
Low	82	41.5	58.5		83	88.4	11.6		65	56.9	43.1	
Medium	83	45.8	54.2		81	90.1	9.9		68	67.6	32.4	
High	85	37.6	62.4		86	84.3	15.7		67	62.7	37.3	
Formal educational level of HH head				n.s.				*				n.s.
None	126	46.0	54.0		134	91.0	9.0		87	60.9	39.1	
Primary	39	41.0	59.0		60	90.0	10.0		55	63.6	36.4	
Secondary	62	38.7	61.3		39	76.9	23.1		31	54.8	45.2	
University	23	26.1	73.9		17	76.5	23.5		27	74.1	25.9	
Means±SD												
	(<i>n</i> =104)	(<i>n</i> =146)			(<i>n</i> =219)	(<i>n</i> =31)			(<i>n</i> =125)	(<i>n</i> =75)		
HH size	10.1 ^a ±6.1	8.5 ^b ±5.0			8.3 ^a ±4.9	5.8 ^b ±3.0			11.8 ^a ±7.4	9.3 ^b ±6.0		
Age of HH head (years)	45.4±12.6	42.3±11.3			47.9±13.7	50.5±12.8			51.1 ^a ±10.0	44.8 ^b ±11.3		

[#] P-value, Chi-square test: * $P \leq 0.05$; n.s. = differences not significant; n.a. = not applicable

^{abc} Within cities, row means with different superscripts differ significantly (Mann-Whitney *U* test, $P \leq 0.05$)

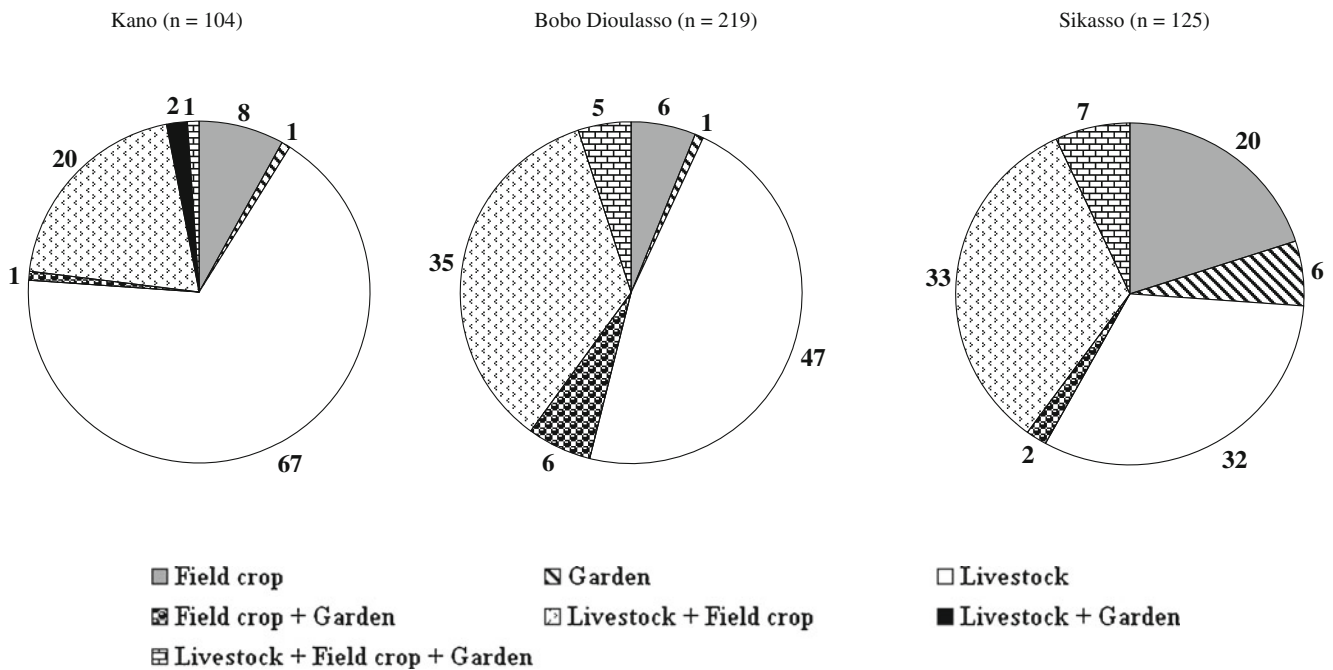


Fig. 2 Distribution of different UPA activities (values in %) among households (250, 250 and 200 respectively) in the West African cities of Kano (Nigeria), Bobo Dioulasso (Burkina Faso) and Sikasso (Mali)

forced many urban households of various SES groups to develop a range of coping strategies, including urban agriculture, to ensure their food security.

Interestingly, the average size of households participating in UPA in the three cities was significantly larger than that of non-participating households and the logistic regression models confirmed household size as the household's socioeconomic characteristic that had the most significant contribution to the prediction of its participation in UPA in Kano and Bobo Dioulasso. It has been shown that the larger the household, the greater the demand and expenditures for food and the higher the tendency to substitute high-value food by low-value and basic foods (Savadogo and Brandt 1988; Deaton and Praxson 1998). Rose and Charlton (2002) also observed that food insecurity rates increased with increasing household size. Regardless of the SES group, involvement in urban agriculture for home consumption helps larger-size households save on the amount spent on food and thus constitutes a significant source of fungible, invisible income (Maxwell 1995). Similar to our finding, Altman *et al.* (2009) observed a positive relationship between participation in UPA and increased household size; they argued that increased household size and the associated demand for more food requires the household's engagement in subsistence production as a way of feeding a larger group of dependants.

Our data also show that people from all educational levels were represented among the urban agriculturalists, which supports similar results from Accra (Danso *et al.*

2002). In contrast to the argument that urban and peri-urban farmers are generally people who have migrated from rural areas where they were involved in agricultural activities, our study revealed that there was no significant difference between UPA and non UPA households with respect to their migration status. This is in line with studies from Accra in Ghana (Maxwell and Armar-Klemesu 1998), Ouagadougou in Burkina-Faso (Thys *et al.* 2005) and from many Eastern African cities (Egziabher *et al.* 1994), which reported that new migrants were only poorly represented among the urban and peri-urban agriculturalists. Tacoli (1998) argued that the steady rise of urban and peri-urban agriculture in sub-Saharan Africa is not due to rural–urban migration but rather to the declines of the formal urban economies. The observed differences between cities in terms of participation rates in UPA and prevalence of different UPA activities reflect variations in socioeconomic conditions across West African countries and cities. The negative relationship between population density and prevalence of urban and peri-urban agriculture is worth noting. Kano has the highest population density (~57 inhabitants/ha) and has the lowest rate of households involved in UPA, whereas Bobo Dioulasso has the lowest population density (~30 inhabitants/ha) and the highest proportion of UPA households. The lower UPA involvement of households in Kano therefore seems to be related to the city's higher degree of urbanization and industrialization even if the proportion of UPA households in Kano is relatively higher than the average national rate of 32% reported for Nigeria in 2004

Table 7 Summary of the logistic regression analysis for variables predicting households' (HH) participation in urban and peri-urban agriculture in the cities of Kano, Bobo Dioulasso and Sikasso

Predictor	β	$SE \beta$	Wald's χ^2	df	p	e^{β} (odds ratio)
Kano ($n=250$)						
Constant	- 0.850	0.258	10.857	1	0.001	0.427
HH size	0.055	0.024	5.269	1	0.022	1.057
<i>Test</i>			χ^2	df	p	
Overall model evaluation (Model χ^2)			5.514	1	0.019	
Goodness-of-fit test (Hosmer & Lemeshow)			6.380	8	0.605	
Bobo Dioulasso ($n=250$)						
Constant	-1.232	0.888	1.927	1	0.165	0.292
HH Size	0.180	0.070	6.592	1	0.010	1.197
Gender HH head (1 = male, 0 = female)	1.388	0.552	6.317	1	0.012	4.009
Formal educational level HH head			6.910	3	0.075	
EDU (1 = none, 0 = else)	1.193	0.690	2.991	1	0.084	3.298
EDU (2 = primary, 0 = else)	0.883	0.744	1.410	1	0.235	2.419
EDU (3 = secondary, 0 = else)	0.001	0.724	0.000	1	0.998	1.001
<i>Test</i>			χ^2	df	p	
Overall model evaluation (Model χ^2)			22.156	3	0.000	
Goodness-of-fit test (Hosmer & Lemeshow)			3.984	8	0.859	
Sikasso ($n=200$)						
Constant	- 2.270	0.717	10.030	1	0.002	0.103
Age of HH head	0.058	0.015	15.223	1	0.000	1.059
<i>Test</i>			χ^2	df	p	
Overall model evaluation (Model χ^2)			16.768	1	0.000	
Goodness-of-fit test (Hosmer & Lemeshow)			8.828	8	0.357	

(Zezza and Tasciotti 2010). Similarly, the proportion of UPA households obtained for Bobo Dioulasso is almost two times the rate of 36% estimated by Smit *et al.* (1996) and that of 44% reported for Ouagadougou (Thys *et al.* 2005).

The lower rate of participation in UPA in Kano compared to the two other cities can further be explained by the fact that Kano offers better opportunities for income diversification through jobs in the industrial and service sectors, and has better infrastructure (market facilities, paved roads, electricity). Income diversification can be defined as a household's strategy of combining sequentially or/and in parallel activities that contribute to the accumulation of wealth and preservation of long-term livelihood security (Adams *et al.* 1998). Yet, urbanization and industrialization are important drivers of income diversification, offering many new job opportunities in the formal and informal sectors (Tacoli 2009). It has been noted that increasing opportunities for income diversification through non-farm activities lowers the rate of participation in farm activities (Lanjouw *et al.* 2001). Our results suggest that this depicts the situation in the urban and peri-urban areas of Kano which, compared to the two other cities, are

characterized by higher rates of urbanization and industrialization (Pourtier 1995; Damon and Igue 2003).

About 60% of all household heads participating in UPA were less than 50 years old and their average period of involvement in UPA was less than 20 years, regardless of the major agricultural activity. These high rates of participation in UPA, which are all above the estimations of 10% to 25% made by Guyer (1987b) for the early 1980s, seem to reflect the considerable and still growing importance of this informal activity among urban dwellers in sub-Saharan Africa in general (Altman *et al.* 2009) and in West Africa in particular.

The variation among different socioeconomic groups regarding their involvement in a specific type of UPA activity is interesting: regardless of the city, households of low SES were more likely involved in crop farming and gardening while wealthier households were more likely to keep livestock. Field crop farming mainly targeted at home-consumption while gardening was mainly market oriented, and the types of garden crops and vegetables varied across cities depending on local food habits and market demand. With the exception of monogastric livestock, such as local

Table 8 Percentage of households (HH) involved in gardening, livestock keeping and field crop cultivation by socioeconomic status (SES) group in Kano, Bobo Dioulasso and Sikasso

SES	Gardening	Livestock keeping	Field crop cultivation
	HH involved (%) ^b		
Kano			
Low (n=34)	5.9	85.3	47.1
Medium (n=38)	5.3	92.1	26.3
High (n=32)	3.1	93.8	15.6
P-value ^a	n.s.	n.s.	*
Bobo Dioulasso			
Low (n=76)	65.4	76.3	78.9
Medium (n=73)	34.6	90.4	46.6
High (n=70)	0.0	97.1	27.1
P-value	n.a.	**	**
Sikasso			
Low (n=37)	18.9	56.8	64.9
Medium (n=46)	19.6	67.4	58.7
High (n=42)	7.1	90.5	69.0
P-value	n.s.	*	n.s.

^a P-value, Chi-square test: ** $P \leq 0.01$; * $P \leq 0.05$; n.s. = differences not significant; n.a. = not applicable

^b Note that many households in a given SES category in a city were involved in more than one UPA activity. Hence, sums of percentages in rows exceed 100%

types of poultry (chicken, duck, pigeon and guinea fowl) as well as rabbit that were mainly raised across all SES categories for self-consumption, livestock keeping was a commercial activity. While these discrepancies between socioeconomic groups were statistically significant for all three UPA activities in Bobo Dioulasso, they were only significant for field crop cultivation in Kano and for livestock keeping in Sikasso. These findings are in accordance with those of previous investigations in Ouagadougou, Burkina Faso (Thys *et al.* 2005) and in Ibadan, Nigeria (Yusuf *et al.* 2008). The latter authors reported 50% of households engaged in field cropping against only 17% of those involved in livestock keeping were poor, when households had been classified into poor and non-poor groups based on their total expenditures on food and non-food items. Thys *et al.* (2005) explained the preference of wealthier urban people for livestock activities by the fact that urban livestock provides higher returns to investment than crop production. Our study does not provide sufficient data to support this claim; however, one reason for the phenomenon might be that crop cultivation and gardening activities require a greater allocation of time and are more labour intensive than livestock keeping. Although Guyer's (1987a) work hardly addressed the production and marketing of livestock and livestock products, it highlighted the

strong linkages between urban food production in general, and land, capital and labour resources. Gockowski *et al.* (2003) identified low capital requirement for crop farming and vegetable gardening as one of the most important reasons for the high level of participation of the poorest households in these activities in Buea, Cameroon. Livestock keeping on the other hand requires comparatively greater expense for investments in animals and holding pens, and is also characterized by high variable costs for feed and healthcare; its practice is hence skewed in favour of wealthier urban dwellers. As feed availability and costs are the major constraints for West African urban livestock production systems (Diogo *et al.* 2010), poor urban people might lack the financial resources needed to buy commercial feeds and to hire labour for collection of roadside forage or regularly herd their animals at the city fringes (Schiere and van der Hoek 2001). Bah *et al.* (2003) reported that across many sub-Saharan African countries most land around cities that could be used for grazing is owned by wealthier urban residents. It is also worth noting that the three cities investigated in our study represent three major centres for ruminant livestock trade in West Africa. We therefore agree with Lee-Smith and Memon (1994) that wealthier urban dwellers consider livestock keeping as a store of wealth, an investment of capital and an opportunity to take advantage of growing urban markets for high value and import-substituting livestock products. For poorer households who keep relatively lower numbers of animals, livestock keeping may be a means of consolidating household well-being. Urban livestock keeping might also be associated with spiritual and mystical beliefs in order to obtain protection, wealth and power (Fall *et al.* 2005). Yet, the choice of livestock species might be influenced by several factors, including agro-ecological zone and feed resources, land availability, religion, culture, food preferences and market demand. Small ruminants such as sheep and goats predominated in Kano, while the proportion of households keeping cattle was significantly higher in Bobo Dioulasso than in Sikasso and Kano. Regardless of the city, the wealthier households in our sample were mostly headed by public/civil servants, traders and self-employed people. Similarly, in Dar es Salaam, Tanzania, most urban livestock keepers were senior government officials who had the necessary money to buy feed and pay for veterinary services (Mlozi 1997). Probably due to the better socioeconomic conditions and associated status of the urban livestock keepers, the city council of Dar es Salaam was lax in enforcing the existing by-laws prohibiting/limiting livestock keeping in town (Mlozi 1997). This argument might also be true for Bobo Dioulasso where, despite the official ban of livestock activities in the urban area (Assemblée Nationale du Burkina Faso 2005), this UPA activity is still popular and flourishing.

Conclusions

Our cross location study confirms that urban agriculture is neither the survival strategy of the poorest urban households nor that of recent migrants with a rural background. It rather shows that urban agriculture constitutes a livelihood strategy across all socioeconomic groups of a city. The high proportion of households involved in UPA suggests that this informal activity is still on the rise in West Africa. Therefore there needs to be adequate technical and institutional support to help it fulfil its role in urban food supply and income generation, while operating at the same time in an ecologically sound and socially acceptable way. This is especially important since a high number of people are directly affected by environmental and health impacts of urban agricultural activities. The observed high socioeconomic diversity among urban agriculturalists needs to be recognised and adequately considered in the development of technologies and policies that cope with their problems, needs and capacities.

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