Rearing livestock on the edge of secondary cities: examining small ruminant production on the fringes of Wa, Ghana

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ARTICLE INFO

Keywords:
Developing countries
Ghana
Small ruminants
Urban fringe
Wa

ABSTRACT

Rapid urbanization exerts pressure on urban fringe resources in most cities in the global south. The resultant effect of this pressure is the rapid conversion of natural reserves and farmlands into residential and non-residential developments that affects crucial rural livelihoods including the production of small ruminants. However, scientific studies on the production of small ruminants on the fringes of cities in Ghana are limited. This study draws evidence from seven communities in Wa, Ghana to examine how urban fringe development influences the production of small ruminants, the challenges the farmers encounter, and the coping strategies adopted. The study adopted a mixed-methods research design involving 329 respondents to compare small ruminant production in 2009 and 2019. Data were also elicited from community and institutional level participants. A questionnaire-based survey, in-depth interviews, focused group discussions and observation were used to gather both quantitative and qualitative data. The findings revealed that the effects of weedicide use, frequent theft and vehicular downing adversely affected production resulting in a decrease in the number of small ruminants over the study period. Those who adopted the semi-intensive system of rearing were confronted with feeding, housing and security challenges. The study concludes that urban fringe development is detrimental to the production of small ruminants. To sustain production, it is recommended that the city’s Livestock Division of the Department of Agriculture support local farmers in constructing low-cost housing using local materials such as thatch, mud bricks and cow-dung and the preparation of low-cost feed using crop residues.

1. Introduction

Livestock keeping is an important risk reduction strategy for people living in poverty and vulnerable communities such as those within the fringes of African cities (Thornton, 2010). Some studies (e.g. Weyori et al., 2019; Wilson, 2018) show that livestock keeping in urban and urban fringe areas contribute to ensuring households’ food security and poverty reduction. Wilson (2018) argues that livestock keeping helps households to diversify their livelihood activities and income generating opportunities. Adams et al. (2021) and Mendes et al. (2021) state that livestock keeping provides an easy channel of ready income to meet household expenditure on children’s education and serves as medium-term savings and financial security against earning deficit. In the case of farming households, livestock keeping protects them against the consequences of crop failure, provides a means to diversify investment, and provides them the ability to perform their social and cultural responsibilities at festivals, funerals, naming ceremonies, and marriages (Mendes et al., 2021; Weyori et al., 2019). At the national level, livestock contributes between 30% and 80% of agriculture's share to GDP of African economies (African Union Commission, 2015).

It is estimated that the global cattle population will increase from 1.5 billion to 2.6 billion between 2000 and 2050, while the population of sheep and goats will grow from 1.7 billion to 2.7 billion over the same period (Robinson et al., 2011). Correspondingly, the annual global demand for meat is projected to increase by between six and 23 kg per person across the world by 2050, however; sub-Saharan Africa’s meat demand will only double over the same period (Robinson et al., 2011). Studies show that the demand for livestock products, including meat, is driven by population growth, urbanization and increasing incomes, especially in the Global South (Robinson and Pozzi, 2011; Thornton, 2010). Thus, livestock production, especially small ruminants, presents an opportunity to meet animal protein needs of the growing urban population. Therefore, there is the need to strengthen the relationship between local farmers on the fringes and urban food (animal protein) supplies. This is especially so in secondary cities, which have become centres of population growth (Carey and James, 2018; Roberts, 2014).
Roberts (2014) describes secondary cities as the second-tier level of a hierarchy of cities with a population threshold of 100,000 inhabitants or less. Even though secondary cities do not receive the needed investment and policy attention, they provide critical support functions for governance, transportation and production services, according to Roberts (2014).

Suffice to say, the urbanisation projections for Africa and Asia in particular present challenges for livestock keeping in the urban fringe communities around secondary cities. The global population hovered around 7.7 billion in 2019, and it is estimated that by 2030, it will reach 8.6 billion with more than 55% of the people living in urban areas (United Nations Department of Economic and Social Affairs, Population Division (UN DESA), 2019). The urban population is projected to continue to grow, and much of the future growth is expected to occur in sub-Saharan Africa and Asia (UN DESA, 2019).

The increasing urban population, urbanisation and uncontrolled urban land consumption rates to meet the residential and commercial needs of the urban population has mostly resulted in the conversion of previously agricultural lands into permanent uses on the fringes of cities (UN-Habitat, 2020). The dynamic area that lies between the boundaries of an established urban centre and the rural hinterland constitutes what is known as the urban fringe (Wang et al., 2021). Consequently, urban fringe areas are characterised by rapid land conversion from agriculture to urban uses, which tends to degrade the natural resource base and limits its ability to provide food and water for both humans and animals (Heymans et al., 2019; Nickayin et al., 2021).

Nowhere is the need to strengthen the relationship between local farmers on the fringes and urban food (animal protein) supplies greater than in the secondary cities, which have become the new face of urbanising economies (Carey and James, 2018; Roberts, 2014). Secondary cities are categorised based on a population size of less than 100,000. Studies on secondary cities are critical because they have the potential to create opportunities for the diversification of both the national and local economies and create jobs for residents, including those on the fringes. Nonetheless, secondary cities face urban-development and growth-management challenges, which have led to lost economic opportunities and increasing poverty, especially in the urban fringes (Roberts, 2014).

Due to their rapidly emerging importance in sustainable development discourse, urban fringe areas have become the focus of critical scientific research in the Global South (Adu-Gyamfi, 2021; Masereka and Wadembere, 2019). However, the focus of these researches is on food crop production, land commodification, natural resources, and general livelihoods, and sanitation and solid waste management (Abdulai et al., 2021; Bonye et al., 2021; Onyebueke et al., 2020). Urban-development and growth-management challenges have led to lost economic opportunities and increasing poverty in secondary cities, especially in their fringe regions (Roberts, 2014).

Notwithstanding the importance to the urban population of farming in the fringes of secondary cities, little is known about the production of small ruminants in these areas despite it being a source of cash income for subsistent farmers and for meeting their socio-cultural needs (Adam et al., 2010). Therefore, this study seeks to examine the realities of small ruminant production within the urban fringes in relation to urbanisation discourse in secondary cities in the Global South where the demand for the animal products is predicted to increase. The study anticipates that any insights gleaned will be helpful in planning actions, and infrastructure and investment decisions that are required to strengthen production systems to meet the projected high demand for animal products in developing countries.

Eledi and Kuusaana (2014) argue that urban land consumption in the urban fringes affects agriculture and related activities; however, urban studies about Wa (e.g. Abdulai et al., 2021; Ahmed et al., 2020; Bonye et al., 2021) have not focused on the impact of urbanisation on livestock keeping in the urban fringes notwithstanding the fact that livestock production could serve as an important livelihood activity that could compensate for the loss of farmlands. To fill this knowledge gap, this study intends to examine the impact of urban fringe development on small ruminant production in the secondary city of Wa. The study used 2009 as the reference point to measure the change in flock size of the respondents because earlier researchers (Eledi and Kuusaana, 2014) have argued that Wa started experiencing significant physical expansion in 2005. However, an average of ten years is long enough to measure urban change and its impact on land conversion and rural livelihoods (Korah et al., 2018; Osumanu et al., 2019). On this premise, 2009 and 2019 were chosen to measure the impact of urbanisation and the consequent urban fringe development on small ruminant production in Wa.

Specifically, the study sought answers to the following research questions: (1) How does urban fringe development influence small ruminant production? (2) What challenges affect the keeping of small ruminants in peri-urban communities? (3) How do small ruminant holders cope with the rapid peri-urbanisation and its associated consequences? The paper comprises six sections. In the section after the introduction, I present a brief literature review of urban fringe development and livestock production, and provide some context from related studies on Wa, the study area. This is followed by the methodology and results in sections three and four, respectively. The study separated the discussion and presented it as the fifth section, and ended with the conclusions, and policy recommendations.

2. Literature review

This section of the paper is dedicated to discussing conceptual issues and empirical studies that centre on livestock production in urban fringes in developing countries. Specifically, the section centres on urbanisation, urban fringe development and livestock production. A brief history of urbanisation and urban fringe development in Wa is also presented in this section.

2.1. Urbanisation, urban fringe development and livestock production in developing countries

Urbanisation has been studied variously in an attempt to understand its impact on livelihoods of urban fringe inhabitants (Budiyantini and Pratiwi, 2016; Korah et al., 2018; Eledi and Kuusaana, 2014; Pribadi and Pauleit, 2015). McGranahan and Satterthwaite (2014) describe urbanization as the combined outcome of rural-urban net migration, the spatial expansion of urban boundaries, and new urban centres. Thus, in their view, urbanization is driven by a composite of socio-economic processes that transform the urban built environment alongside the spatial redistribution of a population from rural to urban areas as emphasized by UN DESA (2019). UN DESA (2019) adds that urbanization brings about changes in the way of life and occupations of the people within both the urban centre and those at the fringes. Similarly, urbanization, from the perspective of Kuddus et al. (2020), involves the relocation of people from rural to urban settings and the consequent changes to the urban built environment, and the socio-economic structure of both urban and the adjoining communities. Urbanization also leads to transforming former rural areas (urban fringes) into urban areas and the spatial expansion of old urban areas (McGranahan and Satterthwaite, 2014). According to UN DESA (2019), the effects of urbanization include urban population growth, increased urban land consumption, decreased rural population and settlement size, urban sprawl and environmental degradation. It also affects the natural resource base of urban fringe areas through the introduction of artificial structures (houses, infrastructure and other activities). Consequently, this denies people’s access to ecosystem services such as food, water, and other environmental resources (McPearson et al., 2016). It is critical to note that these challenges are more pronounced in developing countries, including those in sub-Saharan Africa, than in other parts of the world.

Despite these challenges, urbanization and the associated development tend to make cities the heart of technological development,
employment opportunities, economic growth and overall progress of many nations (Kudus et al., 2020). Nevertheless, if not well managed, urbanisation could erode the associated benefits (Anarfi et al., 2020). The discussion highlights the need for countries in the Global South to hasten the implementation of the New Urban Agenda to facilitate the achievement of the Sustainable Development Goal (SDG) on urbanization. The New Urban Agenda (NUA), which seeks to lessen the human, cultural, economic and environmental footprints on urban spaces, become a critical pathway towards achieving safe, inclusive, resilient and sustainable cities. The NUA recognizes that population growth, economic activities, socio-cultural, and environmental impacts are increasingly being concentrated in cities and their surrounding communities and, as such, pose significant sustainability challenges including housing, food security, basic services and natural resources (United Nations, 2017), particularly in secondary cities in the Global South.

Globally, the urban areas (cities) are projected to increase in all regions, but much more is expected in Africa and Asia. In this respect, McGranahan and Satterthwaite (2014) posit that urbanisation in sub-Saharan Africa will be faster than in Asia, and this suggests that agricultural land conversion in the urban fringes will likewise increase, leading to a decline in available land for agriculture activities for residents. According to Li et al. (2018), urban fringes, which lie between the built-up city and surrounding rural areas, are crucial for urbanisation because they offer relatively easy access to land for the extension of urban areas, leading to the transformation of the built environment and the socioeconomic structure of these areas. In their view, the changes in the urban fringes result in the emergence of a series of phenomena such as the rapid agricultural land conversion, complexities of land rights and land use rights, and various income and land-resource allocations. Nonetheless, as noted by Abdulai et al. (2021), urban fringes offer opportunities for local residents to engage in urban-based activities and agriculture activities, including livestock (small ruminants) production. The evident physical and socioeconomic changes occasioned by urbanisation provide the necessary data for empirical scientific research.

According to Delgado (2005), the livestock subsector is one of the fastest growing in developing countries as its share of agricultural GDP is already 33%. This growth is driven by the increasing demand for livestock products such as meat, milk and dairy products for domestic consumption (Delgado, 2005) resulting from population growth, urbanization and increasing incomes in developing countries. Rapid expansion of urban areas presents an opportunity for livestock keepers to take advantage of the growing demand for their products and to increase production (Thorton, 2010). However, Thornton (2010) admits that the expansion of agricultural production needs to take place in a way that allows the less well-off to benefit from increased demand while moderating its impact on the environment.

Small ruminant production is reported to be a lucrative enterprise in Nairobi, Kenya. According to Mwasi et al. (2017), goat production dominates in peri-urban Nairobi because farmers earn enough money from it. However, the farmers do not have access to extension services to maximize production (Mwasi et al., 2017). This study by Mwasi et al. (2017) is critical to the academic community although it does not address the measures the small ruminant holders adopted in response to rapid development in the urban fringes.

2.2. Brief history of urbanisation and urban fringe development in Wa

In Ghana, the urban population growth has outpaced the rural population growth, with more than 51% residing in urban centres (World Bank, 2014). The urban population grew from 4 million in 1894 to 14 million in 2013 and is still growing. The World Bank (2014) indicates that urban population growth in secondary cities such as Wa is higher than the larger ones. Wa reflects the rapid urbanisation trend in Ghana. The population of Wa has been increasing since the 1970s. In 1970, the population of Wa was 13,740, and by 1984, it had reached 36,067. From 66,644 in 2000 to 71,051 in 2010, it climbed even further (Ghana Statistical Service, 2014). The results of the population projection for Wa indicate that 88,813 people resided in the city in 2020. The increasing urban population has resulted in the extension of the city into the surrounding communities, which has led to agricultural land conversion. Studies (Ahmed et al., 2020; Korah et al., 2018; Osumanu et al., 2019) have shown that Wa has witnessed significant physical extension since the 1980s. The extension of urban Wa into the fringe communities and the consequent land consumption has led to a competition for land between agriculture and urban uses. Eledi and Kuusaana (2014) argue that urban land consumption in the urban fringes affects agriculture and related activities. However, studies in Wa have not paid attention to the impact of urban fringe development on small ruminant keeping. The dearth in knowledge in this area makes a study of this nature critical to gaining a deeper understanding of the nuances of small ruminant production so as to inform the formulation of the appropriate policy interventions that could facilitate production while also reducing the challenges in urban fringe communities.

3. Methodology

3.1. Description of the study area

Figure 1 shows the location of the study area. Located in the Northwestern part of Ghana, Wa plays a dual role as the capital of the municipality and the Upper West Region. The municipality shares boundaries with Nadowli and Wa East Districts to the East and Wa West District to the West. The municipality lies within latitudes 1°40′ N to 2°45′N and longitudes 9°32′W to 10°20′W. According to the Ghana Statistical Service (2014), 107,214 people resided in Wa Municipality as of 2010, and 50.6% of them were females while the rest were males. The municipality is relatively urban, with about 66% of its residents in urban Wa, while the rest resided in rural localities. A majority of the people were engaged in the services sector, followed by those in agriculture. The rest of the population were engaged in craft and trade-related activities. Most of the households involved in agriculture were engaged in food crop farming and livestock keeping (Ghana Statistical Service, 2014).

Wa Municipality is located within the northern savannah agro-ecological area of Ghana, which is conducive to livestock rearing. The area is characterized by a rainfall regime that occurs from April to October, while the dry season follows from November to March. The average annual rainfall received in the area ranges from mean annual rainfall of 840 mm–1400 mm, according to the Ghana Statistical Service (2014). Nonetheless, June and September are the wettest months but very high rainfall figures could be recorded in a few rainy days in these months (Ghana Statistical Service, 2014). The vegetation is generally guinea savannah grassland type characterized by economic drought-resistant trees such as dawadawa, shea, neem, baobab, and a few mahogany trees can be found in the area (Ghana Statistical Service, 2014). These general characteristics of the area make it favourable for livestock keeping in general and small ruminants in particular.

3.2. Research design

The study adopted a mixed method approach that involves combining quantitative and qualitative approaches in data gathering and analysis (Schoonenboom and Johnson, 2017). Specifically, the study used the sequential explanatory mixed methods design. Quantitative data were first collected and analysed with the results used to design an interview guide for qualitative data collection (Liern, 2018; Subedi, 2016). The design helped in gathering data on flock size in 2009 and 2019 and to create a demographic profile of the respondents for analysis. After the analysis of the quantitative data, the issues that emerged unexplained were then used to formulate questions to elicit qualitative data that complemented the quantitative data. Thus, community level qualitative data gathered related to the reasons for keeping small ruminants, the production systems, and the challenges encountered by the farmers.
3.3. Sample size determination and sampling procedures

Sample size determination is an important step in planning a statistical study because it determines the usefulness of the findings (Biau et al., 2008). This section discusses how the sample size was computed and the sampling procedures adopted to select the respondents for the household survey, interviews and focus group discussions. The study was conducted in seven (Danko, Bamahu, Kompala, Nakori, Kpongu, Mangu and Sombo) out of the 16 urban fringe communities in Wa. The total numbers of households of the seven sampled urban fringe communities were 3,375. The total of 3,375 households was used to calculate the sample size for the study. The sample size was obtained via the formula; $n = N/(1 + N(e)^2)$, where “n” is the sample size, “N” is the population size, and “e” is the confidence level (Yamane, 1967). Therefore, $n = 3,375/(1 + 3,375 (0.05)^2)$ yielded 358. The 358 was apportioned to the sampled communities based on their total households.

The study used stratified sampling, simple random sampling and purposive sampling techniques. There are 16 peri-urban communities in Wa. The 16 communities were stratified into three strata based on proximity to each other. A simple random sampling technique via the fish-bowl method was then applied to select seven communities (Danko, Bamahu, Kompala, Nakori, Kpongu, Mangu and Sombo) to participate in the study. In furtherance, the lists of the households in each of the sampled communities were obtained from the Community Health Planning Services (CHPS) compounds, and used. The simple random sampling technique without replacement, via the fish-bowl method, was then used to select the participating households for the survey. The purposive sampling was also used to select 24 community-level participants - family heads, women leaders, Tindaana, Chiefs, and elders - for interviews and focus group discussions. An official from the Livestock Division of the Department of Agriculture in Wa Municipality was also purposively sampled to participate in the study. All these respondents were selected to participate in the study because they were presumed to have in-depth knowledge and experiences in small ruminant production in the urban fringes that they could share.

Issues of ethical consideration in conducting scientific research involving human participants are crucial. It is, therefore, important that an approval be obtained before data collection commences (Fleming and Zegwaard, 2018). Before the commencement of the field data collection, the researcher submitted the data collection instruments (i.e., the questionnaire) to the Institutional Review Board of the University of Cape Coast, Ghana for vetting and approval. The review report and approval letter was obtained after three months. Also, informed consent was sought from each of the respondents after the purpose of the study was explained to him or her. Before the questionnaire was administered to them, respondents were informed that their participation in the study was voluntary and that they could withdraw from the survey at any moment they feel uncomfortable with the line of questioning. The literate respondents were given the questionnaire to self-administer, while those who could not read nor write were assisted by trained research assistants who read and explained the questions in the indigenous language (Waale) to the respondents. A written informed consent was sent to Livestock Division of the Department of Wa Municipality with the researcher being able to conduct the interview with the official after three weeks of receipt of the permission request. With respect to community level interviews, the informed consent was sought through the Assemblypersons who explain the objectives and purpose of the study stated in the letter to the selected family heads, chief, Tindaanba and women leaders.

3.4. Data collection tools and analytical procedures

The study employed a questionnaire to elicit primary quantitative data from the households, and interview guides and discussion guide to elicit qualitative data from the key informants and focus groups, respectively. Observation, with the aid of a camera, was used to validate the participants’ claims. The questionnaire was developed in English language translated into the indigenous language of the interviewee and then translated back to English. This was to ensure that the questionnaire captured the actual meaning of the items. The questionnaire was pre-tested with similar respondents in two urban fringe communities that are not included in the study. The pre-testing of the questionnaire was to find out whether respondents understood the questions and to identify possible sources of confusion the actual participants may encounter.

$N(\bar{e})^2$
During the pre-testing of the questionnaire, translation ambiguities and inappropriate construction of some questions were identified. The questions were subsequently reconstructed to ensure that they were clear and precise before the actual data collection. The actual data were collected from August 2019 to March 2020. The questionnaire contained both closed-ended and open-ended items. Some of the questions were: (1) Have you observed changes in your community since 2009? (2) How many goats did you have in 2009? (3) How many sheep did you have in 2009? (4) How many goats do you have now (2019)? (5) How many sheep do you have now (2019)? (6) Do the new developments in your community affect goats and sheep keeping? (7) What specific challenges do the new developments pose to the keeping of goats and sheep? (8) What measures have you taken to continue rearing?

The quantitative data were entered into SPSS version 28 and processed for analysis. Descriptive statistics and the paired sample t-test were applied to the quantitative data. The paired-sample test was used to determine the differences between the number of goats and sheep kept by households in 2009 and 2019 at 5% significance level. Community level interviews (with family heads, women leaders, Tindaana, chiefs, and elders) and group discussions were conducted in the indigenous language. Concerning the focused groups, the number of participants ranged between 8 and 12 for each. The focused group discussions were held with family heads, women leaders, chief, and elders. In all, four focused group discussions and three in-depth interviews were conducted. Each interview and discussion lasted approximately 45 min, and was tape recorded with the permission of the participants. However, English was used to interview the official from the Livestock Division of the Department of Agriculture. The interview lasted for 45 min. The interviews and discussions were transcribed and analysed using NVivo (version 20) software. Based on the analysis, the study identified themes (reasons for keeping small ruminants, challenges with housing systems, and feeding) and drew clear conclusions from them.

4. Results

4.1. Background characteristics of respondents

Out of the 358 questionnaires sent out, only 329 were returned with valid data. The 329 represents a response rate of 91.9%, which falls within the acceptable survey rate of 60% or more (Fincham, 2008). As a result, all the quantitative analysis was based on 329 respondents. The demographic characteristics examined are age, sex, level of educational attainment, household size and marital status. For age, the results show that the average age of the respondents was 49 years ±11.7 (SD). Males formed 62.9% of the respondents. Respondents attainted various levels of formal education, but the majority (60.3%) had no formal education, with just 5.1% of them attaining tertiary level. Concerning marital status and household size, most (85.3%) of the respondents were married and the average household size was seven ±3.6 (SD). The study also found that 78% of respondents were full-time farmers, while the rest engaged in petty trading, craft, and services. An understanding of the demographic profile of the respondents is critical because issues of age, sex, educational attainment, marital status and occupation could influence the decision to keep small ruminants, challenges encountered and the coping strategies.

4.2. Urban fringe development and its influence on small ruminants’ production

The household survey showed that almost all (97.8%) of the respondents had observed some changes to their physical environment from 2009 to 2019. The study identified increased population, increased residential accommodation, and increased urban population, presence of electricity, and improved road and water infrastructure (Table 1) as the observed changes. Interviews with family heads, women leaders, chiefs and elders revealed that the fringe communities had witnessed significant physical, economic and social transformations between 2009 and 2019. The physical changes manifested in the rapid conversion of former farmlands into residential accommodation as urban residents entered the urban fringe communities to meet their housing needs, consequently leading to the city’s physical expansion. On the other hand, the economic changes found expression in the increased availability of non-farm income generation opportunities while changes in life style and social relationships constituted a social transformation.

Interviews with family heads showed that the sampled communities were small comprising an average of five large compound houses. However, the entering of former urban residents and newcomers in search of land for residential accommodation has led to an increase in land demand in the communities. This development had changed the physical, social and economic character of the communities. An interview with a Tindaana reported the following:

*It emerged that there were many wild animals around the community and local people could hunt game in the area lying between the community (Nakori community) and Kpaguri Tanga (a suburb of Wa). However, people cannot hunt there anymore because all the animals had disappeared because of human activities such as housing and infrastructure construction (Interview with Tindaana from Nakori, 5th January 2020).*

This except illustrates that the springing up of residential accommodation has led to land consumption and the disappearance of the game, which hitherto was a livelihood activity of the people.

Moreover, 77.5% of the respondents mentioned that the springing up of residential houses has affected the keeping of small ruminants via inappropriate human activities (use of non-selective weedicides), theft of the animals, straying, vehicular knockdown and reduced available of pastural land for grazing (Table 2). Essentially, the intense use of non-selective weedicides (49.5%) and theft (45.3%) accounted for the reduction in the production of small ruminants in fringe communities as they lead to frequent death and loss of the animals.

Interviews with the small ruminant holders revealed that most people use “condemn” (a non-selective weedicide) to spray their backyards to kill the weeds and this poses a threat to the health of small ruminants. This is because when the animals feed on such grass/pasture, they fall sick (diarrhoea) and eventually die. The activities of criminals have also contributed to the reduction of the flock size of the farmers over the ten-year period. Because of the frequent stealing of the animals by criminals, the small ruminant holders expressed their unwillingness to continue to

| Table 1. Perceptions of the manifestation of urban fringe development (N = 329). |
| --- |
| Manifestation | N | % |
| Residential accommodation | 159 | 48.3 |
| Increase in population | 147 | 44.7 |
| Presence of electricity | 115 | 35.0 |
| Increased infrastructure | 115 | 35.0 |
| Increased economic activities | 93 | 28.3 |
| Increased social amenities | 34 | 10.3 |

Note: The total responses are more than the sample size due to multiple responses.

| Table 2. Effects of urban fringe development on small ruminant production (N = 329). |
| --- |
| Reasons | N | % |
| Weedicide use | 163 | 49.5 |
| Theft/straying away | 149 | 45.3 |
| Vehicular knockdown | 60 | 18.2 |
| Reduced land for pasture | 37 | 11.2 |

Note: The total responses are more than the sample size due to multiple responses.
keep them and this adversely affected the population of the ruminants. An interview with a family head revealed the following excerpt:

Now the land and the grasses are all polluted. People do not use hoes and cutlasses to weed their backyards anymore. Rather, everyone depends on weedicides to kill the grasses. However, when the animals eat them, they either die or fall sick. Last year, I lost a lot of goats and sheep because they are grasses sprayed with “condemn” weedicides (Interview with family head from Danko, 12th September 2019).

In this excerpt, the interviewee showed that the development in the urban fringe communities has led to the adoption of harmful backyard management practices that are detrimental to small ruminant production. An official from the Livestock Division of the Department of Agriculture also stated that:

The use of weedicide around the backyard adversely affects the health of livestock in general and small ruminants in particular (Interview with an official from Livestock Division of the Department of Agriculture, 19th November 2019).

The official explained that when the animals feed on weedicide-infested grasses they suffer from diarrhoea, which can lead to death in some cases. According to the official, even if the animal does not die, a huge sum of money had to be spent on the treatment, which most of the holders cannot afford.

The impact of urban fringe development and the associated increase in population could be seen in the decline in numbers of small ruminants kept over the ten-year period. All respondents (100%) kept both goat and sheep in 2009, while only 56% of them keep both goats and sheep in 2019. The results showed that 23% and 21% kept goat and sheep, respectively. Although the majority of the households still keep small ruminants, there had been a reduction in the number of holders by 44% over the period. The results also revealed that there had been a decline in the number of small ruminants kept by the individual households in 2019 than in 2009. In terms of flock size, the results show that the maximum number of small ruminants kept in 2009 was higher than in 2019 (Table 3). With respect to sheep, the maximum number was 65 in 2009, while the minimum was one, while in 2019 the maximum number kept was 56. The results revealed a similar trend for goats, which reduced from 79 in 2009 to 65 in 2019, demonstrating that the number of goats and sheep kept by the holders had reduced over the ten-year period. The means for both sheep and goats had likewise decreased (Table 3).

Paired-sample t-test results revealed a significant difference in the number of goats and sheep kept by local households over the ten-year period. There has been a significant decline in the number of goats kept between 2009 (M = 14.37, SD = 11.45) and 2019 (M = 7.8, SD = 7.1); t (271) = 8.7, p-value = 0.000. Similarly, there has been a significant decline in the number of sheep kept between 2009 (M = 16.9, SD = 12.4) and 2019 (M = 9.0, SD = 6.9); t (170) = 7.9, p-value = 0.000.

Both local and exotic breeds of small ruminants were kept in 2009 and 2019. However, a slight majority (51.1%) kept only local breed of goats in 2009, while a shift towards the keeping of both local and exotic in 2019 could be observed. In addition, a large proportion of the respondents kept both local and exotic breeds of sheep in 2009 and 2019, even though the proportion was higher for 2019 (Table 4). Interviews and group discussions with family heads, women leaders and Tindaamba revealed that the preference for the local breed of sheep was based on their ability to resist common diseases and pests, and to adapt to the conditions of the local environment.

The small ruminants were kept for economic, social (funerals, marriages, and naming ceremonies) and religious (festivals) considerations. The economic reason revolves around the ability to turn them into ready cash for investment in small businesses to supplement household income. Socially, the animals were slaughtered to prepare food for guests during funerals, marriages and naming ceremonies, and cash income in times of emergencies. The animals also served religious purposes, often being slaughtered as a sacrifice to thank God for a plentiful harvest and during Islamic festivals. In an interview, a family head reported that:

I don’t keep the animals for commercial purposes. I keep the animals for two reasons. I use some of them for sacrifice during the Eid celebrations and for Quranic recitation before the commencement of the farming season so that God blesses us with good harvest. I also slaughter some of them to prepare food during naming ceremonies, marriages and funerals (Interview with family head from Bamahu, 10th March 2020).

The quotation illustrates that small ruminants were kept to meet the social, cultural and religious needs and obligations of the holders.

4.3. Small ruminant production challenges under urban change

Urban fringes communities encounter three challenges in small ruminant production, namely the difficulty obtaining feed; poor housing conditions; and inadequate security for the animals. Interviews and group discussions with family heads, chiefs and elders and an official from the Livestock Division of the Department of Agriculture revealed that obtaining feed for the animals was a major challenge especially during the dry season. It emerged that the small ruminant holders could not prepare forage in the raining season because of the high cost involved. They explained that the preparation of forage entails several stages and each stage comes with a cost that was beyond their financial capacity. The cost areas included labour, transportation and storage of forage. Again, the scarcity of pasture during the dry season emanates from the annual ritual of bush burning in and around the communities. As such, access to feed became limited. During an interview a women’s leader lamented that:

It is a big challenge to obtain or prepare forage these days especially during the dry season. I have to hire people and a motor king (Tricycle) to go the surrounding villages to cut grasses and gather crop residues to prepare forage and I spend not less than GH $50.00 on labour and transportation every week just to feed the animals. Because of high cost involved in preparing forage a lot of the holders here don’t prepare it which makes it difficult for them to obtain feed during the dry season (Interview with women’s leader from Mangu, 10th February 2020).

The study found that small ruminants were kept in makeshift structures (See Plates 1 and 2) that expose them to the vagaries of the weather and theft. The animals were also kept in uncompleted rooms or

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### Table 3. Flock sizes owned by farmers in 2009 and 2019.

| Ruminant | Minimum | Mean | Median | Standard Deviation |
|----------|---------|------|--------|-------------------|
| Sheep    | *65 (***56) | *17 (**9.5) | *15 (**8) | *12.6 (**7.7) |
| Goat     | *79 (***65) | *14 (**7.8) | *12 (**6) | *11.2 (**7.1) |

Note: * is for 2009, while ** represent figures for 2019.

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### Table 4. Breeds of small ruminants currently kept by households.

| Breed | Goats | Sheep |
|-------|-------|-------|
|       | 2009  | 2019  | 2009  | 2019  |
| Local | 168 (51.1%) | 127 (38.6%) | 167 (50.8%) | 209 (63.5%) |
| Exotic | 63 (19.1%) | 62 (18.9%) | 54 (16.4%) | 61 (18.5%) |
| Both (local & exotic) | 98 (29.8%) | 140 (42.5%) | 108 (32.8%) | 59 (18.0%) |

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2 At the time of the study $1 was equivalent to GH 5.69.
undeveloped portions of lands. Despite this housing arrangement not guaranteeing the health and safety of the animals, the farmers had no option but to keep them close by due to fears that if the animals are relocated outside or are separated from the house, they could be stolen or stray away.

The small ruminant holders indicated that security and safety of the animals were challenges they face in keeping the animals in the midst of rapidly increasing population in the area. According to the research participants, the poor housing structures and inadequate space to house the animals makes them vulnerable to theft and/or straying. According to the study, the adoption of the makeshift structures was due to the inability of the holders to raise the needed finance to construct and provide proper housing which is conducive to good health, comfort and protection of the animals from the activities of criminals. The following except taken from a focus group discussion illustrates the point:

> Even though the small ruminant holders acknowledged that the animals could be safe under a well-secured housing arrangement, they could not raise the need funds to finance the construction of a secure and large place for the sheep and goats. As a result, the animals were vulnerable to the activities of criminals, straying and the bad effect of the weather as they went out to fend for themselves and only came home only in the evening. This practice makes the animals vulnerable to theft and straying (Focus group discussion with family heads from Sombo, 27th November 2019).

This illustrates that animals are allowed to go out and feed on natural pasture and only come home in the evening. As a result, the animals are exposed to theft, straying away and poisoning.

### 4.4. Coping strategies for small ruminant production under urban fringe development

Given the challenges associated with small ruminant production in the urban fringe communities, it was crucial to interrogate the keeping arrangement adopted by the farmers in the midst of the urban change. A significant proportion of respondents (47.3%) used a semi-intensive system, while 21.6% adopted the free-range system for keeping livestock (Table 5). The data were disaggregated based on the educational level of the respondents and the results showed that most (70.3%) of those who attained primary and Junior High School education practiced the semi-intensive system. A chi-square test of independence showed a significant association between sex of respondent and type of supplementary feed provided to the animals. The interviews and focus group discussions showed that the lack of funds, familiarity, and availability of land accounted for the adoption of the semi-intensive system for the keeping of the small ruminants. According to the study, the semi-intensive system of livestock keeping was relatively less expensive compared to the intensive system and as such, farmers were motivated to adopt and practice it. An official from the Livestock Division of the Department of Agriculture in the Municipality corroborated the assertion and intimated that “we advise the farmers to adopt the intensive system but because of the high cost involved in running it, the farmers cannot afford it”. Thus, the relatively low-cost semi-intensive system was preferred to the costly intensive system of keeping small ruminants.

Small ruminants were housed in makeshift structures (Plates 1 and 2) that expose them to insects, theft and the vagaries of the weather. Interviews with family heads showed that the poor housing conditions under the makeshift structure system breeds insects that bite the animals, resulting in sicknesses. The following except taken from the field notes illustrates the point: “there are some pests in the animals’ pen and I have sprayed them with chemicals on several occasions but they are still disturbing the animals” (Interview with a family from Danko 10th November 2019). The quotation underscores the fact that poor housing conditions do not only expose the small ruminants to theft, but also makes them vulnerable to pests and laden diseases.

Generally, the sheep and goats harvest feed themselves by going out and eating grasses or legumes that grow in natural pasture. However, as shown in Table 6, the feed from natural pasture is supplemented with brans from cereals (52.3%) and forage (31%) and feed additives (see Table 6). The forage included crop residues (bush hay, soybean hay and groundnut hay). The provision of forage is critical because it is a major source of the fibre and protein that sheep and goats need to stay healthy. The holders also provided the animals with feed additives such as amino acids, vitamins, and minerals. The feed additives were provided to the animals to increase dry pasture consumption, to improve health growth rates, fertility, and meat production. Nonetheless, a variation existed in terms of the provision of supplementary feed for men and women as the result of the cross-tabulation showed that more men (65.1%) than women (34.9) provide brans from cereals as supplementary feed to the small ruminants. A similar trend could also be observed for the provision of forage and feed additives to small ruminants as supplementary feed (see Table 6). However, a chi-square test of independence showed no significant association between sex of respondent and type of supplementary feed provided to the animals.

The common diseases among the goats and sheep were mange, anorexia, pneumonia, enteritis wounds, keta, helminthiasis, and diarrhoea. The animals also suffered from starvation. Other afflictions were

| Educational Status | Rearing system | Intensive | Extensive | Free-range | Semi-intensive |
|--------------------|----------------|-----------|-----------|------------|---------------|
| No formal          |                | 33 (16.4%)| 27 (13.4%)| 56 (27.9%)| 85 (42.3%)    |
| Non-formal         |                | 2 (10.0%) | 7 (35.0%) | 6 (30.0%)  | 5 (25.0%)     |
| Primary            |                | 3 (8.1%)  | 4 (10.8%) | 4 (10.8%)  | 26 (70.3%)    |
| Junior High        |                | 7 (18.9%) | 2 (5.4%)  | 2 (5.4%)   | 26 (70.3%)    |
| Secondary          |                | 7 (36.8%) | 0 (0.0%)  | 1 (5.3%)   | 11 (57.9%)    |
| Tertiary           |                | 6 (40.0%) | 3 (20.0%) | 2 (13.3%)  | 4 (26.7%)     |

N = 329, Chi-square ($\chi^2$) = 49.94, df = 15 – p-value = 0.000

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3 Semi-intensive system keeping arrangement is one in which the animals are allowed to go out and feed and only come back to be housed in the evening.

4 Free range system is one in which the animals roam freely to feed themselves and find shelter in and around the owners residence in the evenings.

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Plate 1. Small ruminants pen.
miscarriages and neonatal deaths, ticks and tick-borne diseases and lameness. However, the majority (92.3%) of the respondents do not regularly vaccinate their small ruminants to protect them from diseases. It emerged from the interviews and group discussions that regular vaccination of the small ruminants was considered as an expensive exercise and, as such, many of the small ruminant holders could not afford it. The holders indicated that the animals were only vaccinated when they fell sick or whenever there was an outbreak of disease.

5. Discussion

The study set out to examine how urban fringe development facilitates or inhibits small ruminant production. Largely, urban fringe development has adversely affected small ruminant production due to inappropriate human activities, as a result the holders encountered housing, feeding and security challenges. In response, the farmers adopted the semi-intensive system of livestock keeping characterised by poor housing conditions, inadequate feed and lack of security for the animals. According to the study, the new developments (springing up of residential accommodation, infrastructure and amenities) observed in the urban fringe communities were driven by the combination of factors, namely increased urban population, immigration, the intensification of the nuclear family system, and the accompanying high demand for land to satisfy residential needs. Consequently, there was a decline in the land holding of households. This is consistent with the findings of previous studies (Abdulai et al., 2021; Bonye et al., 2021) that urban fringe development leads to the loss of land for farming. Unlike previous studies (Abdulai et al., 2021; Bonye et al., 2021; Coolibaly and Li, 2020), the shrinking of agricultural land resulting from increased residential housing, population and social and economic infrastructure does not appear to have as great a negative effect on small ruminant production as other land-based livelihoods such as food crop farming. This is because there were still large parcels of land available for pasture where the animals could go and harvest grasses for themselves. Instead, the indiscriminate use of weedicides (non-selective) in the backyards in the urban fringe communities threatens small ruminant production. This is because when the animals consume grasses sprayed with weedicide they fall sick and may eventually die. The death of animals becomes a big blow to the households especially those living in poverty because they stand the chance of losing the socio-cultural and cash income benefits (Mwasi et al., 2017; Thornton, 2010). The findings also reflect a potential decline in the contribution of the livestock subsector to the GDP of the Ghanaian economy as opposed to the assertion that livestock production including small ruminants could contribute to the growth of the economy of developing countries (Robinson and Pozzi, 2011).

The findings also showed that the sustainability of small ruminant production in urban fringes was being challenged by several factors including inadequate funds, difficulty in obtaining feed during the dry season, poor housing conditions and insufficient security for the animals. It emerged that the small ruminant holders could not prepare forage in the raining season in anticipation of the shortage of feed in the dry season because of the high cost involved. The inadequacy of funds manifested in the lack of preparation of forage. The preparation of forage comes with a cost that was beyond the holders’ financial capacity, according to the study. These findings are consistent with the findings reported in previous research (Katongole et al., 2011, 2012) that livestock holders in Uganda were confronted with feeding challenges especially in the dry season. Relatedly, many of the small ruminant holders found it difficult to provide adequate feed during the dry season due to the drying up of pasture and annual bush fires (Baah et al., 2012). According to the study, the annual bush fires that occur in the area leads to the burning and damaging of the vegetation that the animals depend on for pasture. Apart from this, adequate housing was not provided for the animals, which is the first step towards the adoption of the intensive system that protects the animals from poisoning, theft and vehicular knockdown (Adam et al., 2010; Mwasi et al., 2017) as well as guarantees an increase in production of small ruminants. The provision of suitable housing insulates the animals from the effects of bad weather conditions and provides an environment that is conducive to reproductive efficiency and higher small ruminant productivity (Llonch et al., 2017).

Unlike urban areas where the intensive system is adopted for livestock keeping (Dossa et al., 2015; Mwasi et al., 2017), the current study showed that small ruminant holders adopted the semi-intensive system of rearing. The semi-intensive system of livestock keeping was adopted because it required low managerial expertise and was relatively less expensive compared to the intensive system. However, the system poses challenges to the productive and reproductive efficiency, health and safety of animals (Okere et al., 2011; Rafeeq et al., 2010). As the semi-intensive system allows the animals to come into contact with others they are susceptible to disease contraction and transmission (Hatab et al., 2019). The holders’ inability to raise funds served as a barrier to adopting the intensive systems of small ruminant production that may increase production by improving the health and the safety of the animals (Baah et al., 2012; Katongole et al., 2012). This is happening amidst the rapid urban fringe land consumption that threatens the practice of the semi-intensive system and small ruminant production in general (Dossa et al., 2015). Although small ruminants are highly susceptible to zoonotic diseases (Mutua et al., 2019) the holders did not provide regular vaccination to the animals as it was considered expensive and not affordable for the majority of them. According to homewood et al. (2006), irregular vaccination of the animals exposes them to viruses and increases the risk of high mortality. The finding contradicts Amadou et al.’s (2012) findings that livestock holders regularly vaccinated their flock in urban and peri-urban areas in Kano, Nigeria and Bobo Dioulasso, Burkina Faso. The plausible reason for the differences in the findings could be attributed to the context within which the two studies were conducted.

Table 6. Supplementary feed provided to small ruminants by sex.

| Feed type          | Sex of Respondents |  |  |
|--------------------|--------------------|---|---|
|                    | Male               | Female | |
| Brans from cereals | 112 (65.1%)        | 60 (34.9) | |
| Forage             | 76 (74.5%)         | 26 (25.5%) | |
| Feed additives     | 41 (74.5%)         | 14 (25.5%) | |
| N = 329, Chi-square ($\chi^2$) = 3.43, df = 2, p-value = 0.180 | | |
conducted. While the current study was carried out in a peri-urban area, the previous study was conducted in an inner city environment.

6. Conclusion and policy recommendations

Urban fringe development negatively affects small ruminant production through the widespread use of weedicides and the frequent theft of animals. Even though these issues could have been avoided through the adoption of the intensive system, the semi-intensive system, which exposes the animals to risks such as poisoning, theft, and straying, was preferred. The adoption of the semi-intensive system was influenced by the holders’ inability to afford the high cost involved with the intensive system. This constrained the production efforts and competitiveness of the holders within the small ruminant market. Addressing the feeding, housing, and safety issues at all stages of the small ruminant production is crucial to sustaining production and competitiveness of small ruminant holders. The study recommends that the Livestock Division of the Department of Agriculture should assist households in constructing low-cost but well-secured housing using local materials such as thatch, mud bricks, gravel, and cow-dung. They should also assist farmers to prepare low-cost feed using crop residue and grasses. Such housing and feeding arrangements will protect the animals from poisoning, theft, straying away and the risk of disease transmission. Finally, the Municipal Assembly through the Livestock Division should link farmers to Microfinance and Small Loans Centre (MASLOC) to securely cheap funds to help them address the housing accommodation, health and feeding challenges.

The novelty of the study lies in its specific focus on the impact of urbanisation on small ruminant production in urban fringe communities. To the best of the author’s knowledge, studies on urban fringe development, especially in Ghana, have focused on general livelihoods and land commodification. Nevertheless, small ruminant production can generate cash income for residents and alleviate the negative consequences of urban land consumption in urban fringes, especially in secondary cities surrounded by large parcels of arable lands. The study’s caveat is that the author used some recall data on the previous flock size and breeds kept. Even though measures were put in place to check the data accuracy, the author acknowledges that there could still be errors in the data that could affect the interpretation of the results.

Declarations

Author contribution statement
Ibrahim Abu Abdulai: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement
Data will be made available on request.

Declaration of interests statement
The authors declare no conflict of interest.

Additional information
No additional information is available for this paper.

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