Pastoralism: Research, Policy and Practice

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Factors influencing migration and settlement of pastoralists in Nairobi City, Kenya

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Abstract

Pastoralism is globally recognized as the backbone of the economy in the vast arid and semi-arid rangelands. Despite its enormous economic contribution, the system is facing a myriad of challenges, among them, land use and land tenure changes, resulting in diminished grazing land. Accompanying such changes is the conversion of traditional grazing lands into other uses such as settlements, with urbanization being one of the key drivers of pastoral system dynamics. Understanding such dynamics in the face of compounding factors such as frequent droughts linked to climate change is key in guiding policy formulation and interventions aimed at achieving a sustainable pastoral production system. This study investigated factors determining migration and settlement of pastoralists in Nairobi City of Kenya. Data was collected through a snowball sampling approach using semi-structured household questionnaires, focus group discussions (FGDs) and key informant interviews (KIIs) in five Sub-counties of Nairobi City County. A total of 144 household interviews, 6 FGDs and 16 KIIs were conducted to elucidate drivers of urban pastoralism, opportunities and challenges encountered by pastoralists in the city. A binary logistic regression model was used to analyse the determinants of their migration. Results show that search for pasture and water resources, and alternative markets especially during droughts, are the main reasons for pastoralists' migration to the city. In addition, educated herders were found to be more likely to migrate to the city as they pursue wage employment. Whereas these findings revealed that migration to the city exposes pastoralists to diverse livelihood opportunities, they are equally faced by a number of challenges - mainly road accidents involving livestock, frequent land displacements to pave way for development of real estates, and livestock poisoning from sewage and garbage wastes. There is a need for policy and regulatory interventions to recognize pastoralism alongside other forms of urban farming and addressing challenges facing sustainable pastoral production.

Keywords: Alternative markets, Livestock mobility, Pastoralist livelihoods, Pasture and water, Urban and peri-urban pastoralism

Introduction

Pastoralism is widely accepted as the most reliable economic activity and efficient use of the scattered and variable rangeland resources (Freier et al. 2012; IGAD 2013; Koech 2014). It is an economic and cultural livelihood system that involves mobile livestock management in rangelands using the traditional knowledge, skills and experience acquired over many years (Gaitho 2018; Nyariki and Amwata 2019). It is practised on more than 25% of the world's land surface, approximately 66% of Africa and over 80% of Kenya's landmass, that is categorized as arid and semi-arid land (ASAL) (Ameso et al. 2018; Lugusa 2015; UNDP 2013). Rangelands are home to over 2 billion people, 90% of them relying on pastoralism to sustain their livelihoods, of which the majority are found in developing countries (Reynolds et al. 2011; UNEP 2019). In Kenya, the pastoral production system

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is the mainstay of the livestock sector that provides over 75% of the nation's livestock estimated at US$860 million (Krätli et al. 2013; Nyariki and Amwata 2019).

Despite the enormous economic contribution of pastoralism both locally and globally, it has been experiencing a myriad of challenges that undermine productivity and therefore resilience of the system. Some of the main challenges include frequent and prolonged droughts linked to climate change, and increased changes in land use and land tenure systems, thus diminishing land available for grazing (Ayantunde et al. 2011; Biazin and Sterk 2013; Gok 2012; Njiru 2012). Among the most affected pastoralists by these change dynamics is the Maasai pastoralist community located south of Nairobi City in Kenya, who primarily rely on livestock keeping as their main source of livelihood. In the last three decades, there has been a rapid change in land tenure arrangements among the Maasai herders due to the break-down of group ranches, subdivision and conversion of communally-owned land to other land uses such as conservancies and large-scale agriculture, thus limiting access to grazing resources (Galaty 2013; German et al. 2017; Said et al. 2016).

Furthermore, privatization of the traditionally-owned land has become an issue of concern today than years before, resulting in the establishment of fenced enclosures, landlessness and sedentarization of pastoralists due to restricted mobility (Boles et al. 2019; Snorek et al. 2017). Land privatization is largely attributed to the raised demand of land for settlement, and uncontrolled purchase and sale of pastoral land to non-livestock keepers, thus forcing pastoralists to become more immobile, subsequently resulting in overgrazing, increased land degradation and impoverishment among pastoral households (Boles et al. 2019; Cobbinah and Korah 2016; Egeru et al. 2019; Nkedianye et al. 2020). These trends have further occasioned the observed high livestock mortalities due to starvation especially during extended droughts; increased competition for grazing resources; resource conflicts, and livelihood insecurity among pastoral communities (Brussels 2012; Krätli and Swift 2014). The outcome of these challenges is a decline in livestock productivity and pastoral livelihoods, thus necessitating a search for better grazing and livelihood options (FAO, IFAD, UNICEF, WFP, and WHO 2019; Reid et al. 2014; UN 2011).

Pastoralists have traditionally responded to the spatial and temporal resource variability in the rangelands mainly through livestock mobility, which enables tracking of unevenly distributed grazing and water resources. Herd mobility facilitates escape from shocks like droughts, conflicts and diseases and enables access to markets and other opportunities outside the pastoral system. Other coping strategies employed by the pastoralists include the selection of livestock for robust traits, keeping large and mixed herds, maintaining flexible stock sizes, livelihood diversification and maintenance of dry-season grazing reserves (Descheemaeker et al. 2016; Silvestri et al. 2012). Unfortunately, most of these mechanisms have been rendered ineffective given the increased environmental variability and pressure on the pastoral production system. In the last two decades, an increasing number of pastoralists have been observed to migrate from rural areas and settle with their herds in Nairobi City (IOM 2015; Njiru 2012), which traditionally served as a dry-season grazing area for the transhumant Maasai herders, having permanent homes but mobile with their herds (Boles et al. 2019).

Generally, as pastoralists migrate and interact with the urban contexts, they are likely to encounter wider markets for their livestock and livestock-related products as well as new opportunities outside their normal ways of life (Ancey et al. 2020; Van Zanten et al. 2016). Some of them are therefore thought to transit out of pastoralism temporarily or permanently to pursue other livelihoods in the city. In this paper, two forms of migration are considered: permanent migration, where herders move, settle and occasionally engage in other economic activities in Nairobi City, and temporary migration, involving transhumants who move to the city to escape drought and return to their homes in Kajiado and Narok Counties as soon as it rains.

Although urban areas are gaining recognition as important refuge areas for the migrating pastoralists, there is limited scientific knowledge on the determinants of these migrations. For instance, related studies by Ancey et al. (2020) in Chad and Burkina Faso and Munishi (2013) in Tanzania examined rural-urban migration of youths from pastoral areas and their integration in towns; Leighton (2013) studied the trends in pastoralist drop-out and urban migration in Mongolia, whereas Roessler et al. (2016) investigated the livestock demand in urban spaces of West Africa with low attention on determinants of permanent and temporary migration of pastoralists in towns. Understanding the underlying causes and implications of such relocations among pastoralists is fundamental in addressing the challenges facing pastoral systems in the urban and peri-urban areas. The present study investigated the factors influencing the migration of pastoralists and their herds into Nairobi City, which is the highest populated area in Kenya with limited space for livestock production. The results are expected to guide decision-making and formulation of policy measures for resilient pastoral production and urban planning.

Materials and methods

Study area

The study was done in Nairobi City County, the administrative and economic capital of Kenya (Fig. 1). Nairobi City

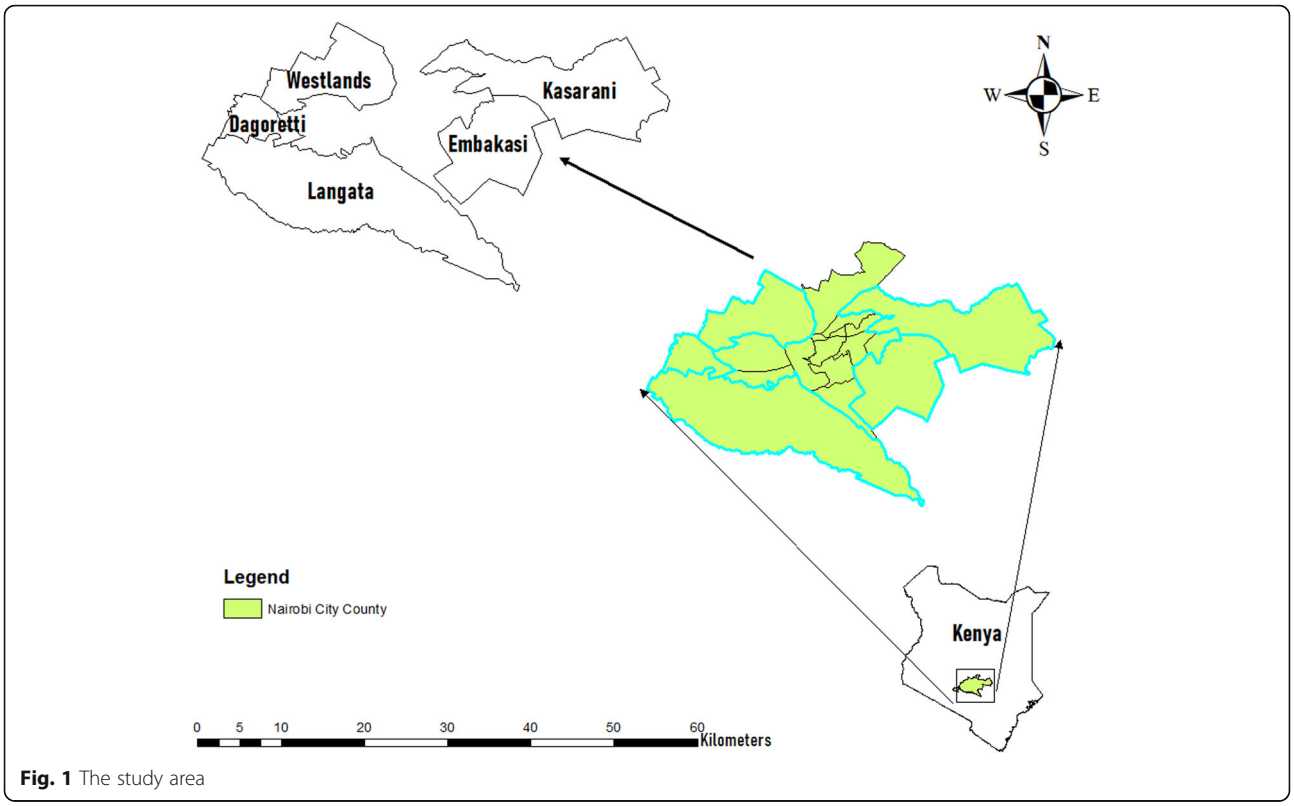

Fig. 1 The study area

County falls between latitude 1° 09′ and 1° 27′ south, between longitude 35° 59′ and 37° 57′ east, and an altitude range of 1600 m to 1850 m above sea level. Although the City covers an area of 703.9km^2, its metropolitan area has stretched out to approximately 3000km^2 in its neighbouring Counties of Kiambu, Machakos and Kajiado to the north, east and south, respectively (Bekker and Fourchard 2013). Nairobi City County falls within agro-ecological zone III and experiences a typically sub-humid climate, with a bimodal rainfall of between 638 and 899 mm on average annually, and an average temperature between 10 and 29°C (GoK 2014). The long rains occur from March to May, while short rains occur from October to December (Amwata et al., 2015).

Nairobi City's population is currently estimated at 4,397,073 people, which accounts for 8% of the nation's populace (KNBS 2019). It is also one of the fastest-growing and highly urbanized cities in Africa (Ren et al. 2020; RoK 2016). The city was selected as a good representative of many other urban areas experiencing high urbanization, population growth, increased migration and settlement of pastoralists in cities and the emergence of alternative livelihoods besides pastoralism. The city is neighbouring Kajiado and Narok Counties, which are dominated by the Maasai nomadic pastoralist community. Besides, Nairobi City is traditionally a dry-season grazing reserve for the Maasai herders who normally returned home when the wet season sets in (Boles et al. 2019). In fact, the name 'Nairobi' is derived from the Maasai words '*Enkare Nyirobi*', which translates to a place with cool waters (Mwita and Giraut 2020). In the city, pastoralist herders resided in pastoralist *bomas* (temporary livestock enclosures) and *manyattas* (permanent settlements) located in Dagoretti, Lang'ata, Embakasi, Kasarani and Westlands Sub-counties of Nairobi. Moreover, Nairobi City has a number of policies and legal frameworks governing rights to use of urban land for connected reasons, among them, the Urban areas and Cities Act, No 13 of 2011 (RoK 2011); the Physical and Land Use Planning Act, No. 13 of 2019 (GoK 2019); and the Nairobi City County Urban Agriculture Promotion and Regulation Act, No. 4 of 2015 (GoK 2015) which promotes inclusion of crop and livestock production in urban farming.

Data collection

Data was collected from five Sub-counties of Nairobi City County, namely Dagoretti, Lang'ata, Embakasi, Kasarani and Westlands (Fig. 1), which were purposively selected due to the presence of pastoralist herds, *bomas* and *manyattas*. A reconnaissance survey revealed the existence of 193 pastoralist households mainly from Kajiado and Narok Counties. Upon siting the first *boma* and household herd, a snowball sampling approach was used to identify the location of other pastoral households and herds in the city. Therefore, each household was

targeted with one respondent (above 18 years), to raise a sufficient sample size for this study. Given the high heterogeneity among the *bomas* and *manyattas*, the intention was to interview all the households. However, only those whose representatives were available and willing were interviewed. A total of 144 households selected through a proportionate sampling of the sub-counties were interviewed in Dagoretti (13), Lang'ata (97), Embakasi (17), Kasarani (15) and Westlands (2) between February and October 2020. In addition, 16 key informant interviews (KIIs) and 6 focus group discussions (FGDs) were conducted to complement and validate the information from individual households. Each FGD comprised between 6 and 8 participants consisting of a mixture of at least 2 youth (between 18 and 35 years) and 2 elderly men and 2 women (above 35 years). On the other hand, KIIs consisted of the leaders of pastoralist *bomas* in the City, area administrative leaders, livestock traders and officials from national and county governments.

Data analysis

Data analysis involved both descriptive statistics and regression using STATA version 15. Descriptive analysis was done to generate means, standard deviations, frequencies and percentages of the socio-demographic attributes of the sampled pastoralist households. Binary logistic regression was used to determine factors motivating migration and settlement of pastoralists in Nairobi City.

Description of variables used in the binary logit model

The migration of pastoralists and their herds into Nairobi City was used as the dependent variable (Y) in the model. The variable was categorized into a binary response, namely pastoralists who have migrated permanently (who migrate, settle and occasionally engage in other economic activities alongside pastoralism in Nairobi City) and those who have migrated temporarily (those moving into Nairobi only during the extended dry season and back home soon after rains). The dependent variable was assigned 1 for the permanent migrants and 0 for the temporary migrants. The independent variables hypothesized to influence the migration of pastoral herders included household herd size, household land size, access to pasture and water, alternative markets, pests and diseases, gender of household head, age of respondent, household size, education level and presence of relatives in Nairobi (Table 1).

Household herd size

Herd size was expected to have a positive relationship with pastoralist migration. It was hypothesized that the larger the number of animals owned by a pastoralist, the faster the depletion of available forage, which increases the chances of migrating permanently into new areas. For the purpose of standardized comparison of livestock numbers, household herds were converted into Tropical Livestock Units (TLUs), a universal unit of measurement of which 1 TLU is equivalent to a 250-kg livestock life body-weight (Abebe 2012) and calculation made using livestock species conversion factor as described by Gietema (2006) and Ducrotoy et al. (2017).[1]

Household land size

Households' land size was hypothesized to have a negative influence on the migration of pastoralists to the city. It was expected that pastoral households owning small parcels of land were more likely to migrate to the city and stay longer than those with larger land sizes. This is partly because the size of land owned by a household is regarded as an indicator of wealth (Omollo 2017). Wealthy households are therefore not only able to afford the cost of temporary migration both within and between seasons, but also have somewhere to go back to as compared to small parcel owners or landless ones. In this study, household land size was a continuous variable measured in hectare (ha) units.

Access to pasture and water

Access to pasture and water resources was expected to have a negative influence on the migration of pastoralist households. It was expected that pastoralists with limited access to pasture and water at origin were more likely to migrate and stay longer in the city as compared to those having better access. This is because pasture and water are central for pastoral livestock production. In this study, access to pasture and water resources was a dummy variable assigned 1 if respondents migrated in search for pasture and water in the city and 0 if they did not migrate for this reason.

Alternative markets

Availability of alternative markets and income-generating opportunities in the urban areas was considered to be positively correlated to the migration of pastoralists to the city. Poor livestock markets and unsupportive market-based policies have been among the major constraints in the pastoral production sector (Amwata et al. 2015; Brussels 2012). Therefore, perceptions of better market opportunities in urban areas are likely to trigger migration and longer stays in the city by pastoralists who wish to take advantage of trade opportunities to enhance their

[1]For tropical animals, 1 dairy cattle = 1 TLU, 1 bull = 0.8 TLU, 1 cattle = 0.7 TLU, 1 heifer = 0.3 TLU, 1 donkey = 0.5 TLU, 1 sheep or goat = 0.1 TLU and 1 chicken = 0.01 TLU.

Table 1 Description of variables and expected influence

Variable	Description and unit of measurement	Expected influence
Dependent variable		
Migration	Nature of migration (1 = permanent migrants, 0 = temporary migrants)	
Independent variables		
Household herd size	Number of livestock units owned by a household (TLU)	+
Household land size	Number of hectares of land owned by a household (ha)	−
Pasture and water	Access to pasture and water (1 = yes, 0 = no)	−
Alternative markets	Seeking alternative markets (1 = agree, 0 = disagree)	+
Livestock pests and diseases	Presence of livestock pests and diseases (1 = yes, 0 = no)	±
Gender	Sex of the household head (1 = male, 0 = female)	+
Age of respondent	Number of years of the respondent (1 = 18–35 years, 0 = above 35 years)	−
Household size	Number of persons living together under one household	+
Education level	Level of formal education attained (0 = no education, 1 = primary, 2 = secondary, 3 = tertiary)	+
Relatives in Nairobi	Presence of relatives in Nairobi (1 = yes, 0 = no)	+

'+' implies likely to migrate permanently, '−' implies likely to migrate temporarily

livelihoods. Alternative markets are opportunities for trade and attractive prices for pastoralists' commodities in the city not available at origin. Such market opportunities include the sale of live animals, milk, livestock manure, leather products (belts, wallets and sandals), clubs, beadwork, wild honey and traditional medicine in the city. Search for alternative markets by pastoralists in Nairobi City was a dichotomous variable assigned 1 if the respondent moved to seek alternative markets and 0 if they did for other reason.

Livestock pests and diseases

Livestock pests and diseases were hypothesized to have both positive and negative effects on the pastoralists' migration. This is because occurrence of pests and diseases such as East Coast fever (ECF), Foot and Mouth Disease (FMD), Rift Valley fever (RVF), and Trypanosomiasis among others, undermine health and productivity of pastoral herds and thus is expected to trigger migration to new areas of refuge (D'Alessandro et al. 2015). Pastoralists who have been previously exposed to pests and diseases are more likely to migrate permanently to other areas to evade such shocks. On the other hand, an outbreak of livestock pests and diseases was unlikely to cause migration of pastoralists to the city, since pastoralists are well-known to possess indigenous technical knowledge (ITK) for management of livestock pests and diseases that have previously faced them (Muricho et al. 2018; Oba 2012; Onono et al. 2019). In this study, this was a dummy variable, denoted by 'yes' if the respondent mentioned pests and diseases as the reason for migration to the city, otherwise 'no' if they did not give that as the reason for migration.

Gender

Gender of the household head was expected to have a positive influence on the settlement of pastoralists in Nairobi City. This is because traditionally, it is men who migrate with herds to distant pastures among pastoralist households, whereas women may just temporarily follow them to supply food. Gender was a dummy variable assigned a value of 1 for the male respondent and 0 for the female respondent.

Age of respondent

Age was expected to have a negative effect on the settlement of pastoralists in the city. It was anticipated that younger pastoralists, being in greater need for employment, are more likely to migrate in search of opportunities in urban areas. Most of the pastoralist youth seek wage employments as security guards, drivers, civil servants, casual labourers, business or petty trade outside herding (Coppock et al. 2017; IOM 2015; Munishi 2013). In addition, the youths are the ones mainly entrusted with herding in pastoral systems and therefore would be the ones to migrate with herds to the city. The respondent's age was categorized into two: youth (between 18 and 35 years) assigned a value of 1 if they migrated, and elderly persons (above 35 years) assigned a value of 0 if they did not for this reason.

Household size

Household size was expected to have a positive effect on the migration of pastoralists to the city. This is because large households with readily available labour are likely to migrate and stay longer than their counterparts with no or less herding labour. Herding labour is a critical production factor in extensive livestock production

systems (Roessler et al. 2016). Respondent's family size was a continuous variable measured as the total number of individuals in a household, consisting of the household head, spouse(s) of the head, children, relatives and employed labourers.

Education level

Education plays a critical role in influencing social networks, access to information and several employment opportunities (Kibera 2013; Ochieng and Waiswa 2019). The respondent's education level was hypothesized to be positively related to the settlement of pastoralists in the city. Pastoralists with higher education level were more likely to access a variety of livelihood opportunities and stay longer in the city as compared to those with no or low education. In this study, education level was measured as the number of years spent in school and assigned four levels, namely 0 if not educated, 1 for primary education, 2 for secondary education and 3 for pastoralists with tertiary education level.

Relatives in Nairobi

Pastoral communities rely on kinship ties especially when faced with shocks such as droughts, and as a result, individuals will tend to gravitate back to the family and clan bonds during hardships. It was hypothesized that the presence of relatives in Nairobi has a positive influence on pastoralists' settlement in the city. Pastoralists with relatives in the city are usually assured of assistance in times of crisis and therefore likely to migrate and settle permanently in the city as compared to the ones without relatives in Nairobi.

Specifications of the binary logit model

The binary logit model was used to determine the factors that influence the migration of pastoralists to Nairobi City, given that the nature of the dependent variable elicited dichotomous responses of 'permanent' and 'temporary' migration. Binary logistic regression (BLR) was selected over ordinary least regression (OLS) because it accommodates categorically measured variables, non-linear relationships and non-normally distributed residuals (error terms). The BLR model was chosen after the statistical test for normality confirmed that the error terms were logistically distributed at $p < 0.05$.

The logit model was represented as follows:

$$Log[\frac{P_1}{1-P_1}] = Logit(P_1) = \alpha + \beta_i x_i + \varepsilon_t \quad (1)$$

$$Y = In\left[\frac{P_1}{1-P_1}\right] \quad (2)$$

The regression model for pastoralist migration was specified as follows:

$$Log[\frac{P_1}{1-P_1}] = \alpha \pm \beta_1 HDSZ - \beta_2 LASZ - \beta_3 APW + \beta_4 ALTM \pm \beta_5 LPD \pm \beta_6 GEN - \beta_7 AGE \pm \beta_8 HSZ \pm \beta_9 EDL \pm \beta_{10} REL \pm \varepsilon_t \quad (3)$$

where:

P_1 is the probability of migrating permanently, (1-P_1) is the probability of migrating temporarily, $[\frac{P_1}{1-P_1}]$ is the odds ratio, Y is the dependent-categorical variable, x_i is the ith predictor variable, α and β_i are the estimated coefficients for predictor variables and ε_t the error terms in the model.

The predictor variables in Eq. 3 are specified as HDSZ = household herd size, LASZ = household land size, APW = access to pasture and water, ALTM = alternative markets, LPD = livestock pests and diseases, GEN = gender of the household head, AGE = age of respondent, HSZ = household size, EDL = education level and REL = presence of relatives in Nairobi.

Multi-collinearity statistical test

To ensure the non-correlation assumption is not violated in the binary logistic model, a multi-collinearity test was carried out in order to establish the relationship between explanatory variables. The variance inflation factor (VIF) method for multi-collinearity detection was preferred since it provides both magnitude and acceptable collinearity limits in the model.

The VIF equation was specified as follows:

$$VIF = \frac{1}{1-R_i^2} \quad (4)$$

where R_i^2 is the R-squared value of the regression with ith predictor variable as a dependent variable.

Table 2 Multi-collinearity test for predictor variables in the model

Variable	VIF	1/VIF (tolerance)
Household size	1.73	0.578
Age of respondent	1.62	0.618
Household land size	1.32	0.758
Education level	1.27	0.789
Household herd size	1.26	0.792
Relatives in Nairobi	1.20	0.834
Livestock pests and diseases	1.12	0.889
Access to pasture and water	1.12	0.891
Alternative markets	1.12	0.894
Gender	1.09	0.918
Mean VIF	1.28	

Results

Results of the multi-collinearity test

The VIF for the predictor variables in the model ranged between 1.09 and 1.73, with a mean VIF of 1.28, which is greater than 1 and less than 5 (Table 2), implying that there was no multi-collinearity and therefore the variables were suitable for use in the model.

Socio-demographic characteristics of the sampled households

The findings of this study show that 41% of the interviewed respondents were permanent emigrants in Nairobi City (Table 3). The average household herd size was slightly different between the permanent pastoral migrants (28.97 ± 2.44 TLU) and temporary pastoral migrants (23.30 ± 1.91 TLU). The average household land size at the respondents' origin was 12.14 ± 1.69 ha and 17.79 ± 1.79 ha for emigrants and migrants, respectively. However, there was no significant difference in the mean family size between permanent migrants (6.36 ± 0.30) and temporary ones (6.84 ± 0.30).

Most of the household heads were males, confirming gender bias with respect to livestock ownership and herding responsibility among pastoralist communities. About 44.1% of the herders in the city were youths aged between 18 and 35 years for the permanent migrants as compared to 62.3% for their temporary counterparts. Permanent and temporary migrants with primary education were 44.1% and 40%, respectively, while those who had attained post-primary education were 27.1% and 8.2%, respectively. Only a few (28.8%) of the permanent migrants had not attended school as compared to 51.8% for the temporary migrants. The majority of the migrants (permanent (69.5%) and temporary (64.7%)) had kinship alliances through relatives in the City. Only 39% of the permanent migrants indicated that they seek pasture and water resources in the city, as compared to 61.2% for temporary migrants. The search for alternative markets was mentioned as the key reason for migration to the city by 62.7% of the permanent migrants and 43.5% of the temporary migrants. Livestock pests and diseases was mentioned to be a driver for pastoralist migration by 25.4% of the permanent migrants and 21.2% of the temporary migrants.

Determinants of pastoralist migration to Nairobi City

The model was found to be suitable and had a good predictive ability as evident in the log-likelihood (−76.08%),

Table 3 Characteristics of sampled households

Variable group		*Proportion of respondents*	
		Permanent migrants *N* = 59 (41%)	**Temporary migrants *N* = 85 (59%)**
Continuous predictor variables		*Mean* (±SD)	*Mean* (±SD)
Household herd size		28.97 ± 2.44	23.30 ± 1.91
Household land Size		12.14 ± 1.69	17.79 ± 1.79
Household size		6.36 ± 0.30	6.84 ± 0.30
Categorical predictor variables		*Frequency* (%)	*Frequency* (%)
Gender	Male	52 (88.1)	77 (90.6)
	Female	7 (11.9)	8 (9.4)
Age of respondent	Youths	26 (44.1)	53 (62.3)
	Elderly	33 (55.9)	32 (37.7)
Education level	Not educated	17 (28.8)	44 (51.8)
	Primary	26 (44.1)	34 (40.0)
	Secondary	15 (25.4)	6 (7.0)
	Tertiary	1 (1.7)	1 (1.2)
Relatives in Nairobi	Yes	41 (69.5)	55 (64.7)
	No	18 (30.5)	30 (35.3)
Access to pasture and water	Yes	23 (39.0)	52 (61.2)
	No	36 (61.0)	33 (38.8)
Alternative markets	Yes	37 (62.7)	37 (43.5)
	No	22 (37.3)	48 (56.5)
Livestock pests and diseases	Yes	15 (25.4)	18 (21.2)
	No	44 (74.6)	67 (78.8)

Source: household survey data 2020 (*N* = 144)

Table 4 Logit model estimates for pastoralist migration to the city

Migration	Coef. (β)	z	p > z	Marginal effect
Household herd size	0.031 (0.013)*	2.31	0.021	0.007 (0.003)
Household land size	−0.037 (0.018)*	−2.08	0.038	−0.009 (0.004)
Access to pasture and water	−1.561 (0.442)**	−3.53	0.000	−0.358 (0.093)
Alternative markets	−1.320 (0.444)**	−2.97	0.003	−0.303 (0.095)
Livestock pests and diseases	−0.428 (0.503)	−0.85	0.395	−0.104 (0.123)
Gender	0.084 (0.736)	0.11	0.909	0.020 (0.175)
Age of respondent	0.432 (0.515)	0.84	0.402	0.103 (0.122)
Household size	−0.052 (0.104)	−0.5	0.619	−0.012 (0.025)
Education level	0.973 (0.322)**	3.03	0.002	0.231 (0.077)
Relatives in Nairobi	0.415 (0.480)	0.86	0.387	0.097 (0.109)
Constant	−0.345 (1.403)	−0.25	0.806	–

Statistical significance levels: **0.01 and *0.05; chi-square (df = 10) = 42.75 (p < 0.001); log-likelihood = −76.08%; R^2 = 0.346; *N* = 144; standard errors in parenthesis

chi-square (42.75) and R^2 (0.346). Five out of the ten explanatory variables were found to significantly influence the migration of pastoralists to Nairobi City, which included household herd size, household land size at origin, access to pasture and water, search for alternative markets and respondent education level (Table 4).

The household herd size had a positive and significant ($p < 0.05$) effect on the migration of pastoralists. An extra TLU increased the likelihood of migrating by 0.7%. This indicates that the larger the number of animals kept, the greater the likelihood of pastoralists migrating and staying longer in the city.

Household land size at origin had a negative and significant ($p < 0.05$) influence on the migration of pastoralists. An additional hectare of land reduced the chances of pastoralist migration by 0.9%. This implies that the smaller the land available for livestock grazing, the higher the likelihood of pastoral herders to migrate to other areas.

Access to pasture and water resources had a negative and significant ($p < 0.01$) effect on migration pastoralists. Pastoralists who had limited access to pasture and water had a higher tendency to migrate and settle permanently in Nairobi City. The marginal effect of –0.358 indicated that increasing access to pasture and water by one unit reduces the chances of migration by 35.8%.

Alternative markets at origin showed a negative and significant ($p < 0.01$) influence on the migration of pastoralist herders. This suggests that lack of reliable markets increases the probability of pastoralist migration and longer stays in Nairobi City, which is perceived to have attractive market opportunities. The marginal effect of –0.303 showed that increasing access to alternative markets by one unit reduces the chances of pastoralists' migration by 30.3%.

Education level had a positive and significant ($p < 0.01$) influence on the migration of pastoralists, implying that educated herders had a higher tendency of migrating and settling permanently in Nairobi City as compared to those with no or low education. The marginal effect of 0.231 means that a unit change in the level of education of a pastoral herder increases the likelihood of migration to urban areas by 23.1%.

Opportunities and challenges faced by herders in Nairobi City

The results showed that pastoralists who migrated into Nairobi City encountered both new livelihood opportunities and challenges in the city (Table 5). The main livelihoods obtained in the City included trade in livestock (62.5%), cattle milk (70.8%), livestock manure (81.3%)

Table 5 Opportunities and challenges encountered in the city

Opportunities	*Frequency* (%)
Livestock trade	90 (62.5)
Cattle milk trade	102 (70.8)
Livestock manure trade	117 (81.3)
Traditional medicine trade	25 (17.4)
Wild honey trade	12 (8.3)
Beadwork trade	43 (29.9)
Clubs and leather product trade	15 (10.4)
Wage employment	58 (40.3)
Challenges	***Frequency (%)***
Frequent road accidents involving livestock	94 (65.3)
Displacement from *bomas*	106 (73.6)
Conflicts over grazing and watering points	43 (29.9)
Livestock poisoning from sewage and garbage wastes	76 (52.8)
Restricted access to pasture and water	54 (37.5)
Inadequate access to veterinary services	38 (26.4)

Source: household survey data 2020 (*N* = 144)

and formal and informal employments (40.3%). Other sources of income for pastoralists included the sale of beadwork (29.9%), traditional medicine (17.4%), clubs and leather products (10.4%) and wild honey (8.3%).

On the other hand, the key challenges faced by migrated herders included frequent road accidents involving livestock (65.3%), displacement from *bomas* (73.6%) and livestock poisoning from sewage and garbage wastes in the City (52.8%). Most of the road accidents involving livestock were reported at the Eastern Bypass, Southern Bypass, and Mombasa roads at animals crossing points to access pasture and water. As indicated by one key informant, among the pastoralists in Nairobi City, it was rare to meet a household herd without a lame animal as a result of a road accident. Also, most herders reported that the law does not protect them since there are no policy and regulatory frameworks supporting both animal and motorist corridors for efficient mobility in the City. In addition, the migrated pastoralists encountered conflicts over grazing and watering points with City residents (29.9%), restricted access to pasture and water resources (37.5%) and inadequate access to veterinary services (26.4%).

Discussion

Particulars of permanent and temporary migrants

The results of this study indicated that the proportion of the temporary migrants in Nairobi City was higher than that of their permanent counterparts. This can be attributed to the fact that when pasture and water are scarce, most temporary migrants are likely to move towards urban areas shortly, which are perceived to have higher pasture and water resources, and go back home after it has rained and pasture has regenerated. These findings agree with those of Njiru (2012) in Kajiado and Machakos, and Akapali (2018) in Ghana, which showed that when pasture and water are limited as a result of droughts, some herders have been migrating to towns in search of pasture and water to safeguard their herds from starvation, unlike the permanent herders who are already settled in the urban areas. However, these findings contrast those of Hoffmann et al. (2019) in India, Leighton (2013) in Mongolia and Lea et al. (2020) in Turkana, which showed that there is no significant difference between the permanent and temporary herders moving to urban areas as a result of pasture and water scarcity at origin.

The findings showed that the temporary migrants in the city owned larger parcels of land at their homes of origin as compared to the permanent migrants. This is probably because access to land at home indicates ability to practise rotational grazing by temporary migrants, since they have something to fall back to when they return home, unlike the permanent migrants with little or no land for grazing at origin. These results agree with the findings of Munishi (2013) in Tanzania, Kimiti et al. (2018) in the Amboseli Kenya ecosystem and Roessler et al. (2016) in West Africa, which pointed out that pastoralists who have little or no access to grazing land are likely to migrate and stay longer away from origin, than those with access to land for grazing when they get back home. In contrast, the findings disagree with those of Nkedianye et al. (2020) in southern Kenya and northern Tanzania, Ogara (2018) in Marsabit (Kenya) , and Ogutu et al. (2016) in twenty-one dryland counties of Kenya, which showed that irrespective of land ownership among pastoralist herders, the continuous loss of grazing land through sub-division, privatization and conversion to other uses, meant that access to livestock grazing has become more difficult, necessitating migration in search of other grazing areas.

In the current study, the majority of the permanent herders in the city were educated (primary and levels beyond) as opposed to the temporary herders. This is possibly because educated pastoralists are likely to secure wage employment or other business opportunities when they migrate and thus stay permanently in the urban areas. In contrast, herders with little or no education are likely to be following their herds, because they lack the skills required for most jobs in towns, and that is the reason why they are unlikely to overstay in the city. The results corroborate the findings of Ameso et al. (2018) in Laikipia (Kenya), Ancey et al. (2020) in West Africa and Hoffmann et al. (2019) in India, which showed that formal education offers migrating herders with tailored skills necessary for wage employment in the urban areas, thus likely to attract settlement among educated herders, unlike their temporary counterparts with little or no formal education. Although several studies have been done on the role of education on migration among pastoralists to towns, no findings specify differences in education among pastoralists who have migrated either permanently or temporarily in the urban areas.

The findings showed that whereas most of the temporary migrants were mainly looking for pasture and water in the City, the majority of permanent migrants were seeking other opportunities besides water and pastures, such as alternative markets for livestock and commodities for trade such as wild honey, beadwork, traditional medicine and leather products. This may be ascribed to the seasonal supply of pasture and water; thus, the majority of the temporary herders are likely to move to the city during droughts, which lead to pasture and water scarcity, and return home during wet seasons when pasture is abundant. Similar observations in Kenya were noted by Hauck and Rubenstein (2017) in Laikipia (Kenya), Opiyo et al. (2015) in Turkana and Ogara (2018) in Marsabit town. They noted that the majority

of temporary pastoralist migrants tend to relocate to urban areas which are less grazed especially during droughts and return home when it has rained and pasture has regenerated. On the other hand, the permanent migrants in the city are in search for something beyond pasture and water, hence likely to participate in the urban markets, which they can easily access, and have higher profits than those in rural and marginal areas. The findings are in support of works by Alarcon et al. (2017b) in Nairobi City, Tessema et al. (2019) in Ethiopia, McCabe et al. (2015) in Tanzania and Little et al. (2014) in the Horn of Africa, which pointed out that urban markets serve as the terminal markets with higher prices and demand for pastoralists' commodities and thus likely to attract migration and extended stays of pastoralists seeking better markets to sustain their livelihoods.

Factors influencing migration of pastoralists to Nairobi City

The results of logit analysis show that the size of household herds, household land size, access to pasture and water, presence of alternative markets and respondent's education level are the key determinants of pastoralists' migration to Nairobi City. These findings are in agreement with the results of a study conducted by Munishi (2013) in Tanzania, and Leighton (2013) in Mongolia, which showed that changes in land tenure systems which results in loss of pastoral land; poor access to livestock markets; reduced sources of income and inability of pastoralists to support their basic needs as well as paying school fees for their children all influence their decision to migrate. Possible stable income and livelihood options in urban and peri-urban areas motivate pastoralists to migrate out of their rural settings (Leighton 2013; Munishi 2013). Additionally, environment-induced disturbances which result in inefficient livestock production and poor livelihood options among pastoralists exacerbate the need to migrate (IFAD 2018).

In the current study, pastoralists with large herds were more likely to migrate because large herds are likely to deplete available forage resources more quickly, thus necessitating migration to less resource-competitive areas. Owners of smaller herds are also likely to comfortably buy supplemental feeds like hay, which is expensive for large herds. Furthermore, the increased rivalry for available resources may lead to violent conflicts and tensions among pastoral herders (Njiru 2012), thus resulting in pastoralist migration and extended stays outside their origins. On the other hand, pastoralists who own smaller herds are less likely to be impacted by conflicts, extreme droughts and floods and thus unlikely to migrate permanently outside their origins (Kagunyu 2014; Kaimba et al. 2011).

The findings revealed that pastoralists with small parcels of land have a higher tendency of migrating and overstaying in the city as compared to their counterparts with more land. This may be attributed to the increasing encroachment of non-livestock keepers into pastoral territories, resulting in land privatization and individualization of tenure systems, thus diminishing available grazing land as well as necessitating migration of pastoralists to new areas of refuge (Galaty 2016; Kimiti et al. 2018; Njeru 2017). While this observation confirms the hypothesis that households with smaller land sizes are more likely to migrate permanently into the city, it also shows that small landholders are less wealthy and thus unlikely to purchase commercial forages especially during droughts. In contrast, the studies by Pas (2018) in Samburu (Kenya) and Lekapana (2013) in Marsabit (Kenya) revealed that pastoralist communities in the ASALs often migrate regardless of the amount of land owned at origin and tenure systems due to uneven pasture distribution.

The results also show that lack of access to pastures and water is one of the main reasons for pastoralists' migration and longer stays in Nairobi City. This could be attributed to the occurrence of frequent and extended droughts leading to water scarcity, poor pasture supply and high livestock mortalities due to starvation (Boles et al. 2019; Koech 2014; Opiyo et al. 2015). In addition, sedentarization of pastoralists at their homes of origin has led to increased resource-based competition that compels pastoralists to migrate and seek pasture and water resources in less competitive areas outside their homes (Gakuria 2013; Nabenyo 2020; Njiru 2012).

This study revealed that the presence of market opportunities attracts the settlement of pastoralists in the city. This can be explained by the fact that pastoralists in East Africa seek strategic market opportunities to expand returns from livestock keeping, as well as livelihood diversification through trade of livestock and livestock-related commodities (Homewood et al. 2012), leading to migration and extended stays outside their origins. These results corroborate the findings of Alarcon et al. (2017a) in Nairobi City and Roessler et al. (2016) in West Africa, which confirm the existence of diverse market opportunities for pastoralists in urban areas. As Tully and Shapiro (2014) reported, pastoral areas have been characterized by poor livestock markets, market information barriers and poor prices, thus upsetting the profitability and viability of the pastoral system.

The results of the regression analysis show that the majority of the permanent herders in Nairobi City were educated as compared to their temporary counterparts with less or no education. This may be attributed to the fact that education provides professional and technical skills necessary for wage employment in urban and peri-urban areas, thus motivating migration and extended

stays in the city. These results agree with the findings of Ochieng and Waiswa (2019) in Uganda and Siele et al. (2011) in Kenya, which showed that education enables acquisition of skills and capacity of pastoralists to access decent employment in urban areas, thus motivating their migration and extended stays in the city for social and economic advancement.

Opportunities and challenges encountered in Nairobi City

The findings of this study indicated that pastoralists who have migrated in Nairobi City mainly encountered a number of income-generating opportunities from trade in livestock, livestock manure, cattle milk and employment both in the formal and informal sectors. The results further reveal that despite their relocation to urban areas, pastoral livelihoods are still centred around livestock-related enterprises. These results agree with the findings from other researchers (Nyariki and Amwata 2019; Little et al. 2014; and Roessler et al. 2016) which confirmed that opportunities for pastoralists in urban areas largely consist of selling animals, milk, livestock manure and hired jobs.

The results also showed that pastoralists who have migrated into Nairobi City frequently experience road accidents involving livestock, displacement from *bomas* to pave way for real estate developments and livestock poisoning from sewage and garbage wastes. These may be attributed to the heavy vehicle traffics; increased land privatization and establishment of new infrastructural developments such as settlements, factories and business hubs; and poor waste and sewerage disposals in the densely populated City environment. The results corroborate the findings of Alarcon et al. (2017b) in Nairobi City, Asadu et al. (2021) in Nigeria and Wilson (2018) in the African Cities, which indicated that urban livestock production is highly constrained by frequent animal-vehicle accidents, increased conversion of available land to other uses, and poor dumping of wastes that are toxic to livestock when fed on.

Conclusion

This study examined the key factors that motivate pastoralists' migration to the city of Nairobi. Contrary to the expectation that herders would be pushed further away from the centre of urban areas, pastoralists from neighbouring Kajiado and Narok Counties have increasingly moved to the city of Nairobi either as part of their seasonal migration routine to seek pasture and water during times of scarcity or to settle and pursue complementary livelihoods besides pastoralism. The results have revealed that whereas pastoralists mainly migrate to Nairobi City to track pasture and water, a significant number are pulled by the economic opportunities in the city. The findings indicated that even with migration to the city, pastoralists' livelihoods are still livestock-centred, mainly involving the sale of live animals, livestock manure and milk. Other economic opportunities in the city included trade in beadwork, traditional medicine, wild honey, clubs and leather products. In addition, once in the city, educated herders are likely to diversify their livelihoods by pursuing wage employment.

Despite these opportunities, herders in the city encounter a number of challenges, mainly frequent road accidents involving livestock, displacement from settled areas to pave way for expanding real estates, and poisoning of livestock from sewage and garbage wastes. There is a need for a more inclusive policy and regulatory framework that recognize and integrate pastoralism with other forms of urban and peri-urban farming. We however recommend further research on the viability of pastoralism and the complementary livelihoods for pastoralists in the urban and peri-urban areas for a sustainable pastoral system.

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Authors' contributions

WMW contributed to designing and drafting the concept for this study, exploration survey, data collection, data analysis, data interpretation, drafting of the manuscript and submitting the approved version. OVW, OKK and SK contributed to the initial design and concept drafting, guidance during the fieldwork process, data collection and data interpretation and supervised drafting and revising of the final manuscript. All authors read and approved the final manuscript for submission.

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Availability of data and materials

All data generated and analysed in this study is presented in the published article.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

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Competing interests

The authors declare that they have no competing interests.

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