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Assessment of Urban Cattle Keeping Patterns and Waste Disposal Mechanisms in Nakuru Municipality, Kenya

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Abstract

Urban livestock production has recorded significant growth in East Africa since the 1970's. However, proximity of cattle to urban centres creates potential hazards to public health due to poor hygiene caused by the presence of dung, and flies and parasites that transmit zoonotic diseases. These environmental problems from urban cattle farming threaten both human life and ecosystems. The objective of the current study was to assess the patterns of cattle keeping in Nakuru Municipality in Kenya, and identify cattle waste disposal mechanisms in relation to environmental pollution. Through a cross-sectional survey, primary data was collected using sets of structured and semi-structured questionnaires, and focused group discussions. To select the respondents to be interviewed, stratified sampling was used followed by simple random sampling within the strata. Fishers Exact Formula was then applied to get the 186 cattle keepers that were interviewed. Subsequently, descriptive statistics were used to explain the results, and Chi-square and paired t-tests performed to determine if differences existed between observations. Results indicate that almost all cattle (99.5% of the survey respondents) were found on owners' and landlords' plots. The number of cattle kept on "own plot" differed ($P<0.005$) from that reared on "tenant/ rental plot" ($t_{183}=7.95$, $P=0.000$). Most of the cattle were grazed on roadsides/ streets (58.4%), some under zero-grazing (31.4%) and the rest (10.3%) under semi zero-grazing. Differences existed between various grazing systems, i.e., zero-grazing vs semi zero-grazing ($t_{77}=2.280$, $P=0.012$) and roadside/ street grazing vs semi zero-grazing ($t_{165}=3.50$, $P=0.001$). Much of the cattle waste was used as manure for crops (52.2%), and the rest given to neighbours (26.9%), and dumped on the streets (10.2%) and dustbins, pits and compounds (10.2%). Use of cattle waste as manure on crops differed from giving it away to neighbours ($t_{145}=3.137$, $P=0.001$). Generally, land was a limiting factor that made the cattle keepers opt for free-range grazing, which exposed the Municipality to cattle waste. Use of manure on crops as the major method of waste disposal was inadequate as a means of disposal, resulting in exposure of the Municipality to a serious menace of cattle waste. The findings of this study would be useful to the Municipal authorities, policy makers and cattle keepers in devising strategies to manage the nuance of cattle waste in the Municipality.

Keywords: Environmental Pollution, Cattle Waste, Urban Cattle Keeping, Kenya

1. Introduction

Livestock provide essential commodities and services to the majority of the world's population. With increasing human population, global meat and milk production are projected to increase from 200 to 310 million tons, and 600 to 900 million liters per year by the year 2020, respectively (de Haan, 2007). Although the demand for livestock products is stagnating in developed countries, it is rapidly increasing in developing countries due to urbanization and associated shift in eating habits of the populace towards livestock products (Pun et al., 1997). Besides, provision of meat, milk, eggs, hides and skins, livestock provide manure to enhance soil fertility and draught power. Livestock also form an integral part of the social fabric for many communities, and serve as a capital reserve available when cash money is required as well as an insurance against emergencies (Kosgey, 2004).

Despite their growing global importance, livestock are increasingly being held responsible for many adverse effects on the environment (de Haan, 2007). Loss of vegetative cover, reduced biodiversity, soil erosion and compaction, and excessive run-off often result from over-grazing (FAO, 2006). High concentrations of livestock contribute to

contamination of ground water, eutrophication and soil pollution (Delgado et al., 1999). The processing of animal products in urban areas of developing countries especially generates waste materials that create disposal problems (de Haan, 2007). Livestock can also produce significant quantities of "greenhouse" gases (e.g., methane) that contribute to global warming (Ishani et al., 2000) However, most criticisms of livestock agriculture do not take into account the fact that negative effects are frequently related to underlying driving forces like inappropriate land use policies, population pressure, rural poverty, insufficient ecological knowledge in tropical areas and inappropriate technology.

Urban livestock production has recorded significant growth in East Africa since the 1970's (Sawio, 1993; Mwangi & Foeken, 1996; Smith et al., 1996; Mireri et al., 1997). In Kenya, for instance, it is practiced mainly on private residential land, on roadsides and on other public lands. Land is always a limiting factor of production as most cattle keepers occupy plots (i.e., small parcels of land measuring less than a quarter of an acre). In these plots, cattle are kept at the backyards. However, proximity to cattle creates potential hazards to public health due to poor hygiene caused by the presence of dung, and flies and parasites that transmit zoonotic diseases (Ishani et al., 2002; FAO, 2006). Cattle keeping without proper animal waste management may also cause serious environmental hazards (e.g., creating breeding grounds for insects that transmit malaria, yellow fever, and Rift Valley and Nile fevers). These environmental problems from cattle farming threaten both human life and ecosystems. Consequently, it is important to examine and assess the systems of cattle keeping and waste disposal methods in urban areas, which was the objective of this study for Nakuru Municipality in Kenya.

2. Research Materials and Methods

The study was carried out in Nakuru Municipality in Nakuru County of Kenya. The Municipality is located in the heart of the Great Rift Valley, about 160 km North-West of Nairobi city, at an altitude of 1,700 meters above sea level, and is fairly flat (except for the Menengai Crater and the northern boundary of the Municipality). It lies in agro-ecological zone IV, which is classified as semi-arid, and has fertile volcanic soils (MCN, 2006). Although most of the Municipality is built and occupied by residential and commercial premises, the vegetation consists mainly of star grass (*Cynodon dactylon*) with scattered trees of *Acacia* species. The average annual rainfall is about 940 mm and is bimodal, with a peak in April and November. Nakuru County has a population of about 1,603,235 people, with Nakuru Municipality consisting of approximately 307,990 people (Kenya National Bureau of Statistics (KNBS), 2009). It is considered the "farmers' capital" of Kenya (Foeken & Owuor, 2000). The total area covered by the Municipality is approximately 300 km^2, of which 40 km^2 is covered by Lake Nakuru (MCN, 1999).

A sociological inquiry in the form of a cross-sectional survey was used in the current study, with structured and semi-structured sets of questionnaires being employed as the primary data collection instruments. To select the survey respondents, stratified (cluster) sampling was performed, with simple random sampling within the strata applied to pick the cattle keepers that were interviewed. For the purposes of this study, the Municipality was divided into five clusters according to the existing administrative locations, namely; Afraha, Baharini, Barut, Kaptembwa and Lanet,. Cluster sampling was chosen for the study because it is more focused, is less costly and less time consuming. Cluster sampling also enables randomization of sampling units, and different clusters can be compared (Kothari, 1990; Mugenda & Mugenda, 1999). Since the study design was cross-sectional, Fishers Exact Formula was applied to get the sample size of 186 households that were interviewed as shown in equation 1 below:

$$n = z \text{ þ} pq/d^2 \qquad (1)$$

where: n = desired sample size, z = z-score associated with 95% confidence, p = proportion in the target population who believed waste disposal methods posed a threat to the urban environment (an estimate of 50% was used), q = 1–p (proportion in the target population who did not believe waste disposal methods posed a threat to the urban environment), and d = amount of discrepancy tolerated on p (this was set at 0.072). Subsequently, a table of random numbers was used to randomly select respondents from the population from a list of cattle keepers in the Municipality provided by the Nakuru County Livestock Production Office.

First, the cattle keepers were directly interviewed using a pre-tested set of structured and semi-structured questionnaires. Secondly, key informants interviews were undertaken with the use of structured interviews to collect data from individuals who had special knowledge or perceptions on the subject of the study. These included the County Director of Environment, County Director of Social Services and the Chief Public Health Officer. Other key

informants included officers from the Ministry of Agriculture, Livestock and Fisheries (i.e., Departments of Animal Production and Veterinary Services), and the County Administration. Subsequently, focused group discussions were carried out in each location with groups of individuals who were well informed about the research topic or were likely to provide more informed responses to obtain perceptions on environmental concerns arising from cattle farming in the Municipality. The information derived from the focused group discussions was used to strengthen the information from the structured and semi-structured questionnaires. Observation schedules were also used to assess relationships, attitudes, feelings and beliefs of beneficiary groups, and also to see the physical environmental effects of cattle keeping in the Municipality. Descriptive statistics were then used to present the results, and Chi-square and paired t- tests performed to determine whether or not there were any significant differences between observations.

3. Results and Discussions

3.1 Cattle Management in Nakuru Municipality

Land ownership was a limiting factor in the study area (Table 1). Almost all cattle could be found either on owners' or landlords' plots. About 78.5% of these plots were located in the survey respondents' own compounds. The proportion of the survey respondents that kept cattle on "own land" differed ($P<0.05$) from the fraction that reared cattle on "tenant/rental" land ($t_{183}= 7.95$, $P=0.000$). The survey respondents indicated that keeping cattle on government land or on land where the user did not know who it belonged to was riskier because of constant harassment by the Municipal officials and the fines preferred on them. Ishagi et al. (2002) made similar observations of land ownership and limitation of land size among urban livestock keepers in Kampala City, Uganda. Other forms of ownership (0.5%) as indicated in Table 1 denotes grazing of cattle on public land, leased pasture lands and invading unoccupied land.

Table1. Land ownership of cattle keepers in Nakuru Municipality, Kenya

Land ownership	n	%
Tenant/ rental	39	21.0
Own	146	78.5
Other	1	0.5
Total	186	100.0

3.2 Cattle Rearing/ Grazing Systems

Most (58.6%) of the cattle in the Municipality were grazed on roadsides/ streets (Table 2) due to limited space in the plots and inadequate external feed supply. Many low-income households had no compound or had only a very small one. Free-range grazing was, therefore, dominant by necessity. The findings are akin to those of Maxwell & Zziwa (1992) and Ishagi et al. (2002) in Uganda. Households with high income had relatively large compounds, but there was also adequate space outside where the cattle could freely roam around. The middle income households had compounds (but smaller) too and lived in more densely populated areas than the high income households. Consequently, their cattle were often kept within the compound under zero-grazing (31.2%).

Table 2. Cattle rearing/ grazing systems in Nakuru Municipality, Kenya

Rearing/ grazing system	n	%
Zero-grazing	58	31.2
Semi zero-grazing	19	10.2
Roadside/street grazing	109	58.6
Total	186	100.0

The various rearing/ grazing systems practiced by the survey respondents in the Municipality differed. A paired comparison of the number of survey respondents practicing zero-grazing and semi zero-grazing yielded a significant

difference (t_{77}=2.28, P=0.012). Similarly, the number of those practicing roadside/ street grazing differed from those who practiced semi zero-grazing (t_{165}=3.50, P=0.001).

3.3 Inputs for Cattle Production

Inputs for cattle farming in the Municipality are as shown in Table 3 below. All types of inputs were mostly used except for urban waste (e.g., kitchen waste and unsold/ spoiled crop produce from the markets) as feed and ethno-veterinary medicine (10.2% each). Use of family labour and hired labour differed (t_{183}=3.319, P=0.001). Hired labour force was higher (61.8%) than family labour. Majority of the survey respondents treated their cattle with veterinary drugs, and gave mineral supplements and concentrates. Feeding cattle with crop residues was quite common (99.5%). Genetic improvement through artificial insemination was also very common. Surprisingly, extension and veterinary services were largely available (99.5%). Similar patterns in urban livestock inputs were documented by Tegegne et al. (2000).

Table 3. Inputs for cattle production in Nakuru Municipality, Kenya

Types of input	n	%
Labour		
Family	71	38.2
Hired	115	61.8
Artificial insemination	129	69.4
Veterinary drugs	167	89.8
Mineral supplements and concentrates	91	48.9
Use of urban waste as feed	19	10.2
Use of crop residues as feed	185	99.5
Ethno-veterinary medicine	19	10.2
Mineral supplements	48	25.8
Extension and veterinary services	185	99.5

3.4 Challenges of cattle keeping in the Municipality

Table 4 presents the most frequently mentioned problems faced by the cattle keepers in the Municipality. Arrests/ harassment, which mentioned by 81.7% of the survey respondents, was a constraint to cattle keepers in the Municipality. A study by Maxwell and Zziwa (1992) reported similar harassment among urban cattle keepers in Kampala City, Uganda. Arrests/ harassment may be related to the regulation that forbids cattle from freely roaming in the Municipality. Lack of feeds and safe drinking water (34.4%) was also big challenge, probably because cattle ate and drank a lot. A study by Foeken & Owuor (2000) found the same problem of lack of feeds and safe drinking water in the same Municipality. The proportion of survey respondents citing arrests/ harassment highly differed from those indicating inadequate pastures and water (t_{214}=7.04, P=0.000). The Municipality streets were frequently littered with garbage and cattle sometimes fed on poisonous material (30.1%) that often led to their sickness and death. The fraction of the survey respondents indicating the challenge of inadequate pastures and water and that citing roaming cattle feeding on poisonous materials were similar (t_{118}=0.504, P=0.307). All other challenges, including disease outbreaks, dishonest workers, expensive feeds, expensive artificial inseminations services and competition from milk hawkers were similar in proportion.

Table 4. Most frequently mentioned challenges of cattle keeping in Nakuru Municipality, Kenya

Challenge	Frequency	%
Arrests / harassment by Municipal guards	152	81.7
Inadequate pasture and water	64	34.4
Disease outbreaks	19	10.2
Roaming cattle fed on poisonous material	56	30.1
Dishonest workers	17	9.1
Expensive artificial insemination services	17	9.1
Expensive feeds	14	7.5
Competition from milk hawkers	14	7.5

3.5 Some Solutions to Existing Challenges of Cattle Keeping in the Municipality

The survey respondents indicated that it was possible to solve problems of cattle keeping in the Municipality (Table 5). These could include review of by-laws to accommodate agri-urban farming, education of the public on waste disposal, proper waste management and disposal by the Municipal authorities, and the control and check of feed manufacturers by the government to improve and maintain feed quality.

Table 5. Proposals of the survey respondents to solve the existing challenges of cattle keeping in Nakuru Municipality, Kenya

Respondents proposals	Frequency	%
Review of by-laws to accommodate agri-urban farming	152	81.7
Government to control and check feed manufacturers	34	17.7
Management of waste collection and disposal	59	19.9
Education of the public on waste disposal	57	30.6
Control of milk hawking	14	7.5
Subsidies on veterinary charges	10	5.4
Proper feed formulation	27	9.1
Water provision	19	10.2

3.6 Methods Used in Cattle Waste Disposal

One of the major nuisances of cattle keeping in Nakuru Municipality was cattle waste management. Different forms of cattle waste management used are given in Table 6. Although much of the cattle waste was used as manure (52.2%) in the cultivation of crops, a considerable proportion of it was dumped on the streets, in dustbins and pits, and on compounds. Similar observations have been made in other studies (e.g., Karanja et al., 2010; Lee-Smith, 2010; Njenga et al., 2010). The proportion of the survey respondents who used part or all cattle waste for own crop cultivation and that who gave part or all of it to neighbours differed (t_{145}=3.137, p=0.001). There was also a difference in preference between those who gave their cattle waste to neighbours and those who chose to dump it either on the streets, or in dustbins and pits, and on compounds (t_{67}=1.785, P=0.037). Generally, the systems of cattle waste disposal were inadequate and exposed the Municipality to serious problems of cattle waste management, i.e., effluent discharge, air pollution, destruction of aesthetic values of the Municipality, traffic hazards and possibility of disease transmission to humans.

Table 6. Cattle waste disposal mechanisms in Nakuru Municipality, Kenya

Waste disposal mechanism	n	%
Used part or all of it for own crop cultivation	97	52.2
Gave part or all of it to neighbours	50	26.9
Dumped part or all of it on the street	19	10.2
Dumped part or all of it in dustbins, pits and on compounds	20	10.8

3.6 Importance of Cattle Waste to the Famer

As stated earlier, most of the cattle waste was used in the cultivation of crops as manure because the survey respondents considered cattle waste as being useful in reducing the cost of production of farm products, especially the cost on inorganic fertilizer. This highly differed from those who considered cattle waste for income generation (t_{115}=4.952, P=0.000). Few (9.1%) of the survey respondents were not stressed by where to take the cattle waste. It is notable that, like in Yauonde (Cameron) where about 10.0% of the capital city's livestock manure production was sold for use in urban farming in other cities (Lee-Smith, 2010), the same (10.2%) was recorded for urban cattle keepers in Nakuru Municipality.

4. Conclusions and Recommendations

From the findings of the current study, it is concluded that land ownership was a limiting factor for cattle keeping in Nakuru Municipality. Many low income households had no compound of their own or had only very small ones. Due to high cost of external feed inputs, free-range grazing was dominant and exposed the Municipality to cattle waste. Use of manure on crops was the major method of cattle waste disposal; others included dumping on the streets and in dustbins and pits, and on compounds. This system of waste disposal was inadequate and exposed the Municipality to serious problems of cattle waste management, i.e., effluent discharge, air pollution, destruction of aesthetic values of the Municipality, traffic hazards and possibility of disease transmission to humans. Based on the findings, it is recommended that the Municipality should have special waste collection trucks with appropriate loading and unloading facilities (e.g., hydraulic compactor trucks). Such equipment would facilitate effective collection, transportation and disposal of solid waste, including cattle waste. Additionally, there is need for improved urban cattle housing systems and regular cleaning of sheds to overcome smells from dung, urine and decomposing manure. Manure should also be used for energy production (i.e., biogas) to reduce on their environmental pollution. Generally, the findings of this study would be useful to the Municipal authorities, policy makers and cattle keepers in devising strategies to manage the menace of cattle waste in the Municipality.

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