IMPLICATIONS OF URBAN AND PERI-URBAN DAIRY FARMING ON SOCIAL-ENVIRONMENT AND POLICY IN NAKURU MUNICIPALITY, KENYA.

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A Thesis Submitted to the Graduate School in Partial Fulfillment for the Requirements of the Award of Master of Science Degree in Environmental Science of Egerton University.

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I hereby declare that this thesis is my original work and to the best of my knowledge has not been presented for examination for an award of a degree in this or any other university.

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DEDICATION

This thesis is dedicated to my mother Rebeccah; my wife Mary and our children (Purity, Victor, Vivian and Zipporah) for their enthusiasm and support throughout the period of my study.

ABSTRACT

Urban and peri-urban dairy farming involves keeping of dairy cattle within and around the administrative boundaries of towns and cities. This activity is viewed as a way that people employ to cope with livelihood needs. Despite its importance and potential it has been neglected in the context of urban planning and even outlawed by most municipal authorities. However it continues to be practiced under conditions of uncertainty and legal threats. Currently, information on the implications of urban and peri-urban livestock farming on the social environment is not clear particularly in developing countries. Additionally, the policy on urban and peri-urban dairy cattle keeping in and around Kenyan towns is not well defined. The objective of this study was therefore to assess the impacts of urban and peri-urban dairy farming on social-environmental and policy in Nakuru Municipality, Kenya. The research adopted a social survey research approach. The target population was the households practicing dairy farming, and their immediate dairy non-practicing neighbours within the study area. A sample of 376 households was used which was purposively distributed equally among the practitioners and non-practitioners as well as between the urban and peri-urban areas. Data collection instruments included questionnaires, a personal observation schedule and secondary data review. The study revealed a consistent increase in the number of those practicing zero grazing over time. The practice contributes significantly to food security ($\chi 2 = 37.408$, $P = 0.000$); employment ($\chi 2 = 15.427$, $P = 0.000$); and income generation ($\chi 2 = 29.147$, $P = 0.000$); but had no significant negative impact on the social environment in terms of human health ($\chi 2 = 6.024$, $P = 0.197$). Awareness of policies related to dairying was found to be very low. The study recommends policy review for legalized but regulated practice; change of attitude towards the practice; improvement in extension services delivery and community sensitization on urban dairying related policies.

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LIST OF ABBREVIATIONS

CBD	-	Central Business District
CBS	-	Central Bureau of Statistics
CCN	–	County Council of Nakuru
CoD	-	Chair of Department
CREEL	-	Centre for Research and Education on Environmental Law
DDC	-	District Development Committee
DLEO	–	Divisional Livestock Extension Office(r)
DLPO	–	District Livestock Production Office(r)
DSR	-	Driving force / State / Response
EMCA	-	Environmental Management and Coordination Act
ENSC	-	Environmental Science
FAN	-	Forest Action Network
FAO	–	Food and Agriculture Organization
FERD	-	Faculty of Environment and Resource Development
GDP	-	Gross Domestic Product
GoK	–	Government of Kenya
IIBRC	-	Interim Independent Boundaries Review Commission
MCN	–	Municipal Council of Nakuru
MDGs	-	Millennium Development Goals
MOH	–	Ministry of Health
MOLD	–	Ministry of Livestock Development
NCC	-	Nakuru County Council
NESC	-	National Economic and Social Council of Kenya
RVIST	-	Rift Valley Institute of Science and Technology
SPSS	-	Statistical Package for Social Sciences
UN	–	United Nations
UNCHS	–	United Nations Commission on Human Settlement
UNDP	-	United Nations Development Programme
USD	-	United States Dollars

CHAPTER ONE
INTRODUCTION

1.1. Background of Urban and Peri-Urban Dairy Farming

Urban and peri-urban dairy farming involves keeping of dairy cattle within and around the administrative boundaries of towns and cities. Mougeot (1994) observes that this is not a modern or recent phenomenon and that from very early times to the present era, urban dwellers have produced a significant proportion of their livestock products and by-products needs in this way. Thus urban and peri-urban dairy farming in its various forms has not only survived and persisted over time, but has grown in importance and scope in recent times.

Dairy farming in Kenyan cities and towns is increasingly gaining significance. A visit to most Kenyan urban centres reveals dairy farming activities everywhere, not only on the outskirts (per-urban), but also in the heart (urban), of the cities and towns. This activity is observed along roadsides, in the middle of roundabouts, along and between railway lines, in parks, along rivers, under power lines, in short, in all kinds of open public spaces (Ayaga *et al.*, 2004). Not immediately visible is the intensive dairy farming in the backyards in the residential areas which are oftenly fortified with masonry walls and iron gates.

Urban and peri-urban dairy farming is thought to be mainly as a response to the demographic factors of rapid population growth in and around cities/ towns due to the current trend of rural-urban migration (Habitat, 2002). Population projections indicated that approximately, 34 percent of the 33 million Kenyans were expected to be living in cities and towns in 1999, with this number projected to grow to 16 million by 2005, representing about half of the population (Ayaga *et al.,* 2004). Regionally, by the year 2025, the urban population of sub-Saharan Africa would be growing at 6.9% per annum as compared to 3.1% of the total population of the region (Ayenew *et al.,* 2007).

As rural-urban migration continues, several scenarios arise. The need for areas to settle within and around the towns, lead to sub-division of the surrounding agricultural land into small land parcels typical of urban land parcels. Acquisition and subsequent settlement on these parcels of land lead to closely built-up areas having urban-like characteristics. This increased population in and around cities increases demand for dairy products and consequently an increase in the

total number of farmers practicing dairy production. This in turn is expected to have some implications on the social environment and dairy related policies.

Though the persistent and continued practice of urban and peri-urban dairying hints to some benefits accruing to the people living in these areas, it is, however carried out oblivious of its possible negative implications on the social environment. Besides this, information is lacking on how the dairy farming practice is influenced by or itself impacts on the policies that are in place to regulate it. This made it necessary to carry out this study with an aim of generating information and approaches necessary for either advocating for exerted efforts to either eradicate, or adopt environmentally sustainable dairy production in the urban and peri-urban areas of Nakuru Municipality, Kenya.

1.2. Statement of the Problem

In Nakuru Municipality, urban and peri-urban dairying is an ongoing practice. However, within the municipality, the authorities perceive the practice as a source of negative impacts on the social environment and therefore have declared it illegal. Meanwhile, the same practice goes on in the peri-urban areas of the municipality under different policy and legal frameworks, since the area does not fall within the administrative jurisdiction of the Municipal Council. The practice in the peri-urban area is therefore legal. These antagonistic and divergent legal positions between the urban and the peri-urban sections raise several concerns considering that the boundary between the two areas is fluid:

- The stretching out of the urban-like development, (urban sprawl), is likely to continue especially considering the current trend of rural-urban migration. The urban sprawls are not annexed to the municipality as soon as they develop and therefore not subject to the municipal by-laws.
- The fluid nature of the boundary between the urban and the peri-urban sections suggest that any negative impacts that may arise out of the dairying practice could spill over from one section to the other thus negating the goodwill meant by the municipal by-laws.
- When practiced under the illegal circumstances, the practice becomes kind of a clandestine activity and thus any negative outcome that may arise there from, such as zoonotic or other emergent diseases could have devastating effects on the residents before being realized.

- Information on the impacts of the dairying practice on the social environment, especially on the urban section of the municipality, is generally too shallow or lacking.
- Policy on urban dairying is lacking, while peri-urban dairy cattle keeping is guided by the National Dairy Policy which guides dairy production in the rural areas of Kenya.
- For the purpose urban and peri-urban dairy farming the Municipal Council By-laws, and, the County Council By-laws,, are either not harmonized, not well defined and/or sometimes applied haphazardly,

Out of the above concerns and guided by the fact that the dairying practice appears to be an omnipresent fact of life for the urban and peri-urban dwellers, it was important to establish whether the practice has any impacts on the social environment and policy with a view of generating and adding to the existing information on urban and peri-urban dairying for use by a wide spectrum of stakeholders.

1.3. Objectives of the Study

1.3.1. Broad Objective

The broad objective of this study was to assess the implications of urban and peri-urban dairy farming on social environment and policy in Nakuru Municipality, Kenya.

1.3.2. The specific objectives

Specifically this study attempted:

i. To assess the temporal trend and intensity of urban and peri-urban dairy farming in Nakuru Municipality.

ii. To establish the socio-cultural, economic and technological factors which motivate urban and peri-urban dairy farming within the study area.

iii. To assess the social environment implications of the practice within the study area.

iv. To find out the effects of the existing dairy related policies on the dairy farming practice within the study area.

1.4. Research questions.

i. What is the trend of dairy production practice in the urban and peri-urban areas of Nakuru Municipality?

ii. What motivates people to practice dairy production in the urban and peri-urban areas of Nakuru Municipality?

iii. What implications does this practice have on the social environment of the people living in these areas?

iv. What are the policy implications of this practice in the study areas?

1.5. Justification of the study

General observations show that dairy farming is practiced in the urban and peri-urban areas of Nakuru municipality classify Twenty percent (20%),of all the Nakuru, (urban area), households were classified as livestock keepers in town (Foeken & Owuor, (2000); Foeken, (2005), and Foeken, (2006)). Nakuru had a population of 38,181 in 1962, the population reached 163,927 in 1989 and 289,385 in 1999 (GoK, 2000). The city's population was projected to rise to 760,000 people by the year 2015 (UN Habitat, 2002). The percentage of urban livestock keepers suggests that the sector provides the much desired benefits in terms of employment, food and income (Foeken, 2006). The municipal council authority has however all through perceived this practice as a threat to human health and also a source of nuisances. It therefore outlaws the keeping of livestock through a by-law (MCN, 2006). Despite these perceptions, no in depth study has been undertaken to assess these assumed social environmental implication of this practice on the rapidly rising population.

Further observations indicated that the areas around Nakuru Municipality are fast gaining urban-like status. The personal observations also revealed that some areas of the urban section such as parts of Lanet (JB and Ngorofani) and Baruti displayed more rural characteristics than some peri-urban sections such as Ngata and Kiamunyi (Figure 3). Since independence (1963), Nakuru has had three major extensions of its boundaries, namely in 1963, in 1972 and the latest one in 1992 (Foeken & Owuor, 2000). This suggests a fluid nature of the boundary between the urban and the peri-urban areas of Nakuru, The continued expansion of these urban-like developments and continued increase and practice of unregulated dairy farming could contribute to negative implications on the social environment.

These concerns needed to be addressed through research taking into account that:-

- Nakuru town is one of the pilot towns involved in localizing Agenda 21 of the Rio Declaration that provides concentrated capacity building interventions to support urban planning and management (Foeken, 2005). In Nakuru, the program has been under implementation since 1995. It had its aims as to:-
    - Support the development and implementation of broad-based environmental action plans focusing on context-specific aspects of municipal planning and management;
    - Incorporate emerging and ongoing settlement improvement initiatives;
    - Enhance the capacity of local authorities to integrate these action plans into Strategic Structure Plans so that they may fulfill their pivotal role between development actors (Mwangi, 2001),

  This notwithstanding, activities as urban dairying remain outlawed.
- Millennium Development Goal 1 targets a reduction by half the number of people living on less than a dollar per day and/or undernourished. To achieve this, strategies such as, putting in place policies and public investments that do not discriminate against small- and medium-sized farms and rural enterprises; encouraging adoption of cost-reducing and resource-conserving technologies; and the removal of trade barriers for many agricultural products such as milk (Satterthwaite, 2003).
- Millennium Development Goal 7 is concerned with environmental sustainability and integration of the principles of sustainable development into the countries policies and programs (Satterthwaite, 2003).
- Kenya's Vision 2030 while aiming at raising income from livestock, also strategizes at lessening by half all environmental-related diseases. Vision 2030 also aims at all Kenyans living in clean, secure and sustainable environment (GoK, 2007).

All government ministries and departments are obliged to focus their planning and development efforts towards realization of these broad objectives.

1.6. Significance of the Study

This study was significant in that it would be beneficial to key local, national, international actors and institutions involved formally and/or informally with the urban and peri-urban dairy farming and the practitioners. The results as presented here will contribute towards the improvement of the consumers' knowledge of the linkages between urban and peri-urban dairying and the implications to both the social environment and policy. In this way the stakeholders will be able to embrace participatory planning and development that may serve all stakeholders interests.

1.7. Scope of the study

The study covered the subject of urban and peri-urban dairy production and more specifically the zero grazing system within the administrative boundaries of Nakuru municipality (referred to in this study as the urban area), and the immediate built-up areas of its adjacent Divisions (peri-urban areas). Within the broad area of environment, it also concerned itself with the implications of the dairying practice on the social environment and the policies regulating the practice within the study area.

1.8. Output of the Study

i. The study specifically yielded some insight on the status of urban and peri-urban dairying practice and its impacts on social environment and policy thus making it possible for stakeholders to put in place in a participatory manner measures to guide the practice and take advantage of the potential benefits inherent in the practice.

ii. Understanding the degree, (trend and intensity), to which urban and peri-urban dairying is being practiced and its impacts on social environment provided information that should advocate for making/revising environmental policies of concern in dairy production in and around towns and cities.

iii. The resultant policies and mitigation measures would greatly improve the wellbeing of people living in and around towns and cities.

iv. In the academic circles, scholars will also benefit by making reference to the thesis and other publications arising there from. The author has prepared and presented a paper from this research at the 5th Research Week and International Conference on "Transformative

Research for Sustainable Development" held on 22nd – 24th September, 2010, at Egerton University.

1.9. Assumptions/Constraints

The successful accomplishment of this study was based on the assumptions that:-

a. Resources, (financial and time), would not be limiting to the timeliness and quality of the study.
b. There would be cooperation from all stakeholders and especially the farmers involved in the study especially during questionnaire administration.
c. Political and climatic condition would be conducive to the study.
d. All the areas will be accessible.
e. No adverse weather conditions would mar the scheduled activities program.

Necessary measures were put in place to ensure that these assumptions and constraints did not in any way affect the successful accomplishment of this study:

a. Resources, (financial and time), did not limit the timeliness and quality of the study.
b. Political and climatic conditions were conducive to the study.
c. Most of the study sites were easily accessible.

1.10. Definition of Terms

Dairy farming – Used in this study is to mean cattle kept for milk production using zero grazing system.

Flying insects - Used in this study is to include house flies, biting flies and mosquitoes.

Peri-urban – Rural areas immediately surrounding the municipality which can easily be confused to be within the municipality due to their closely built up and urban-like characteristics.

Policy - A coherent set of decisions with a common long-term objective (or objectives) affecting or relevant to a sector. In this study the urban and peri-urban dairy subsector.

Social environment – Refers to how people and communities behave, relate, their education and occupation, and the conditions in which they live. The potential economic importance of urban and peri-urban dairy farming and the accompanying potential hazards are part of what is referred to as impacts on social environment.

Stakeholder - Formally defined as somebody with direct interest in something. In this study it refers to all those who have an interest in dairying within the study area.

Urban – For the purpose of this study means area within the administrative boundaries of Nakuru Municipality.

Urban Sprawl - Outward spread of built-up areas as a result of urbanization. These areas are not included in the development plans of the adjoining urban centre (city, municipality, town or trading centre).

Zero grazing – Conventionally defined as feeding animals confined in a structure. In this study is defined as feeding animals enclosed in a space in order to take care of all dairy cattle kept within a farm/plot what is commonly referred to as semi-zero grazing. This excludes dairy cattle grazed outside the owners land such as on roadsides.

Zoonosis - The transfer of diseases from animals to human. Examples include Brucellosis and rabies.

CHAPTER TWO
LITREATURE REVIEW

2.1. Introduction

Agriculture has been and still is an important sector of the Kenyan economy. Currently, the sector contributes about 26% of Kenya's gross domestic product (GDP). The sector also accounts for 80 % of the national employment, 60% of the total export earnings and 45% of the government revenue (MoLD, 2008). The livestock sub-sector accounts for about 10% of the entire GDP and about 42% of the agricultural GDP (*ibid.*). It also supplies most of the domestic requirements of meat; milk and dairy products; and other livestock products. The dairy industry alone accounts for about 3.5% of the GDP (*ibid*). Approximately 86% of this milk is produced by about 600,000 small-holder households, usually with just one or two cows (McSherry, 2007). A substantial amount of the milk, though not well documented, is produced in the urban and peri-urban areas.

In Kenya, urban dairy production flourishes and has been described as one of the major development success stories occurring in sub-Saharan Africa (Staal & Shapiro, 1994). Productivity of this sector has been sufficiently high to more or less keep pace with increasing demand for milk and milk products in Kenyan urban centres and probably accounts to a large extent to the low level of Kenya's dairy imports compared to other sub-Saharan African countries (Olaloku *et al.,* 1990).

An urban household's survey carried out in 1994 which covered six (6) major towns in Kenya, Nakuru being one of them, had shown that 17% of the respondents kept livestock. The estimated 1.4 million heads of livestock kept in these Kenyan towns at the time of the survey were worth about $17 million USD (Lee-Smith & Menom, 1994).

National statistics quoted by van der Bliek (1992) for the livestock population in Nairobi, (25,000 cattle, 30,000 small ruminants, 3,000 pigs, 8,500 rabbits and 350,000 poultry), hinted at the level of production and the importance of the sector in providing livestock based products to the urban population. Other studies regarding urban agriculture in Nairobi by Mwangi (1995), as well as Dennery (1995) concentrated on Nairobi's poor, with the former studying the importance of urban farming for the households' food security and nutritional condition and the latter on decision-making among food producers.

The studies by Lee-Smith & Menom (1994), Mwangi (1995), Dennery (1995) and Foeken & Owuor, 2000) were based within the administrative boundaries of city and municipal councils. Even where the term peri-urban was used it referred to the areas within the municipality boundaries, but, between the built-up area of the town and the town boundary with the rural area (Foeken & Owuor, 2000). The peri-urban area, as defined in this study was a key component in the scope of this study.

2.2. History of Urban and Peri-urban Dairy Production

According to Mougeot (1994), urban and peri-urban livestock production is not a modern or recent phenomenon. Its origin could be traced to as far back as to the Incaic, Aztec and Mayan civilizations. From such early times to the present era, urban dwellers have produced a significant proportion of their food needs. According to Mougeot, ancient Greek cities were self-sufficient in goat milk (*ibid.*). Urban framing in its various forms has not only survived and persisted from such early times through the era of industrialization, but has grown in importance and scope in recent times mainly as a response to the current trend of rural-urban migration. Evidence of spatial growth and economic importance of urban agriculture in general in many world cities and capitals are well documented in literature (Lanyasunya *et al*, 2001; Williams, 2005). However literature addressing livestock production alone and more specifically dairy production within urban and peri-urban areas is limited.

2.3. Importance of Urban and Peri-urban Dairy Farming

Smallholder urban or peri-urban commercially-oriented milk production enterprises are common in and around many African cities. According to Mosha, (1991), livestock population in and around Dar es Salaam, increased dramatically between 1985 and 1989. During the same period, cattle populations in many urban parts of the African continent, increased three-fold. Maxwell (1994) observed that about 25% to 36% of surveyed households in and within a 5 km radius of Kampala were engaged in livestock production.

Further evidence of the growing importance of the sector in Africa, was provided by the following statistics: In Senegal, the main agricultural cities are located in the Niayes Zone, (The Niayes zone comprises of the four administrative regions of Dakar, Thiès, Louga and Saint-Louis). The study indicated that livestock production in this zone was well integrated in the city planning especially in the area of waste recycling. Considerable efforts were being made to

restructure the production system within the zone in order to meet increasing demand for animal products (Fall, 2005), while mitigating against any negative impacts. This kind of efforts were presumed to be limited in the study area and needed to be enhanced through information generation.

According to Baah (1994), 25% of the 4.5million small ruminants in Ghana were raised by people living in and around cities and towns. As a result of this study the author indicated that urban producers holding these animals not only contributed substantially to the animal protein needs of the urban community, but they also benefitted economically, with a resultant improvement in their standard of living. Centres (1991) also stressed the economic benefit accruing to a large number of people that supply inputs and marketing services to the 20,000 households that rear animals in and around Bamako in Mali. A survey carried out by Gefu (1992) in Zaria, a Nigerian university town, revealed that 80% of respondents keep livestock, raising goats, poultry and sheep, primarily to meet immediate household needs, but also to supplement family income.

Previous studies had presumed that the urban poor in Kenya engaged in urban and peri-urban dairy farming as a response to limited alternative livelihood options and food insecurity. To the middle and high income categories, dairy cattle production was thought to be a way of diversifying livelihoods and also as a source of personal satisfaction (Waters-Bayer, 1995; Foeken, 2006). These studies therefore generally suggested that urban dairy farming, without the peri-urban component, has some potential benefits to the residents. Deeper investigation of the potential benefits; inclusion of the peri-urban component; and investigation into potential negative implications were gaps that required to be addressed.

Further, due to the unclear policy and legal frameworks, practicing urban and peri-urban dairy farming under contradicting attitudes, with the practitioners for the practice and the municipal authorities against it, was thought to be a loophole for enhancing rather than mitigating against possible negative social environmental implications and needed to be addressed.

2.4. Controversy over Urban and Peri-urban Dairy Farming

In India, Caste-specific economic traditions and constraints cause certain households to continue dairy farming despite the spatial constraints (Cass, 2000). An observation by Bentinck,

(2005) was that in the streets of urban India, many cows could be seen scavenging around. "At first glance it may have appeared as though the cattle were an undisputed part of city life, but a case study of Delhi showed that the issue is surrounded by controversy" (Bentinck, 2005). Similarly urban and peri-urban dairy farming is somewhat controversial in most African cities. Many policy makers in Africa see it as an undesirable, 'non-urban' activity that causes nuisances (Foeken, 2006).

In Nakuru, after some studies on holistic urban agriculture (Foeken & Owuor, 2000; Foeken, 2005; Foeken, 2006), awareness has been raised among officials that urban farming is a fact of life and a very important livelihood source for the urban poor. Out of this sensitization farming of crop of a certain height is now legally recognized as an urban activity (Bakker *et al.* 2000; MCN, 2006), but not so for dairy keeping. Why the same legal status is not accorded zero grazed dairy cattle production is not clear. Informed decisions to advocate for the change of attitude from viewing the practice just as a source of nuisances (MCN, 2006), to seeing it as a potential contributor to alleviation of hunger and wealth creation needed to be sought.

2.5. Urban and Peri-urban Dairying as it relates to Social Environment

According to Steinfeld (1998), livestock production was the world's largest land user and had the potential of being the most important agricultural activity in terms of economic output. However livestock produced 13 billion tons of waste each year. A large part of this was recycled, mainly as manure for fertilizing soils but, where animal concentrations were high, the high volumes of waste generated posed an environmental hazard. If not well managed, such waste caused smell and attracted flies which were disease carriers (vectors).

Pollution of land and water was another concern as was the impact by livestock, directly or indirectly, on biodiversity. It was expected that this can be minimized through the integration of urban dairying in environmental policy by promotion of safe re-use of urban organic wastes and waste water by urban farmers, and by promotion of appropriate ecologically friendly production systems (Bakker *et al.,* 2000). Not only would these concerns be addressed but the animals would have a positive role in waste management through consumption of some of the organic waste turning them into milk and meat, but would also contribute to the greening of the environment through converting some of the waste into manure which would be used during trees, flowers and crop production.

Greenhouse gases (mainly methane), from livestock and livestock waste is blamed of contributing to global warming (Steinfeld, 1998). Areas of high livestock concentrations are therefore considered environmental hotspots (ibid). Adoption of such technology as biogas production has been recommended as a technology that can address this concern (Mwirigi, 2008). Biogas technology produces two main products, that is, biogas and an organic fertilizer referred to as slurry. Biogas is used in many different ways that include lighting, cooking, room heating, driving stationary and mobile machines and electricity generation among others (ibid). In this way the technology is not only expected to address environmental issues but also act as an income saving strategy which is an indirect benefit accruing from the dairy keeping practice.

2.6. Factors that Influence Urban and Peri-urban Dairy Farming

The persistence of dairy farming in the city was thought to be related to how villages and their people become urbanized. Since 1951, about 140 villages have become completely incorporated into the city of Delhi (Cass, 2000). The same can be said for Nakuru Municipality. For example, since independence in 1963, Nakuru has known three major extensions of its boundaries, namely in 1963, in 1972 and the latest one in 1992. Both the urban and peri-urban areas continue to receive more and more people (Muriithi, 2003), with the peri-urban areas realizing unplanned urbanization, (urban sprawls).

Available information shows a notable rapid increase in Nakuru town's population (GOK, 1971; GOK, 1981; GOK, 1994; GOK, 2001), and this population trend is not projected to fall. Other information reveal that a significant proportion of the world's population growth was expected between 2000 and 2030 to occur in urban areas and that in the beginning of the 20th century only 13% of the world's population was living in cities, but by the year 2010 over half of all people on earth will be urbanites (UN Habitat, 2002). It was especially noted that in the Developing Countries, the urbanization process was taking place at an extremely fast rate: between 1950 and 1990, the urban population increased from 300 million to about 1.3 billion and was projected to be over 2 billion by the year 2000 (GoK, 2000, UN Habitat, 2002).

Under such circumstances the origin of the people involved in urban and peri-urban dairy farming were expected to vary widely as are the motives behind their adoption of the practice. The envisaged scenario was that of:

- Farming families that have gradually become absorbed by the expanding city and often adapt their farming systems to new urban opportunities such as close proximity to market for their produce.
- Recent migrants who engage in dairy farming as a (temporary) survival strategy and who often bring production knowledge and skills from their place of origin, part of which does not apply under the urban conditions and may need adaptation.
- Very poor and food-insecure households who may engage in dairy production out of necessity.
- Low and middle class urban households that seek to complement their incomes by engaging in dairy production activities, often on their homesteads, under zero-grazing dairy units.
- Richer people who see good investment opportunities in dairying with hired livestock managers and/or farm workers.

It was out of the various categories that a high percentage, of between 10-20%, of the population was earlier found to be practicing urban livestock farming (Foeken and Owuor, 2000; Muriithi, 2003; Foeken, 2006). This could therefore be viewed as an adaptive response by the urban and peri-urban households to improve on their food livelihood needs (Mougeot 1994, Foeken & Owuor 2000).

2.7. Policy Concerns in Urban and Peri-urban Dairying

Despite the envisaged benefits that accrue from the urban dairying practice, what often lacks are policy incentives that encourage the adoption of sustainable practice with no or minimal negative impacts on the social environment. Little study however has been undertaken to assess the implication of the existing policies on the practice as is practiced today, in terms of whether the residents are aware of the existence of the policies, what they entail and whether these policies have an encouraging or discouraging effect.

According to the World Bank (1981), government policies play a crucial role in livestock development. They not only affect the economic environment, but also directly affect production, marketing, consumption and external trade in livestock products. Policy issues that may constrain or promote the dairy industry performances under this studies context include; public health; land use; human and livestock diseases; livestock feed, livestock production; dairy

products marketing; extension services delivery; environmental management; and water management.

In Kenya up to 1992, the dairy industry in Kenya was under government control, which gave the policy guidelines, set prices, determined the players in the industry and set the market rules among other things. Currently, the dairy industry is regulated by the Kenya Dairy Board, established under Section 4 of the Dairy Industry Act (Cap. 34 of 1958), which was revised in 1984 (Cap. 336 of 1984). The Kenyan dairy industry is based mostly on smallholder milk production. About 600,000 smallholders produce some 70% of the country's marketed milk. Approximately 56% of this milk is sold raw in the unregulated informal market; leading to public concerns about hygiene and safety. There is a higher concentration of smallholder dairy farms in peri-urban areas with easy access to milk marketing channels. Small-scale dairy farmers typically keep 2 or 3 dairy cows, with their followers (EPZA, 2005; McSherry *et al.*, 2007).

In Nakuru as is the case in many Kenyan towns and cities, the municipal council authorities have all through viewed this practice as a risk on human health and a source of nuisances (MCN, 2006). The dairying activity is therefore essentially illegal and though the by-laws could, out of ambiguity, be misconstrued as allowing the dairying practice on acquisition of a permit, it is clear upon interpretation by the municipal court prosecutors that no such permit could be issued to anybody who wishes to keep livestock for long but it is issued for animals meant for display in the Nakuru Agricultural Society of Kenya show or for animals meant for immediate slaughter. Thus practically no practitioner possesses a livestock production permit within the municipality.

2.8. Conceptual framework

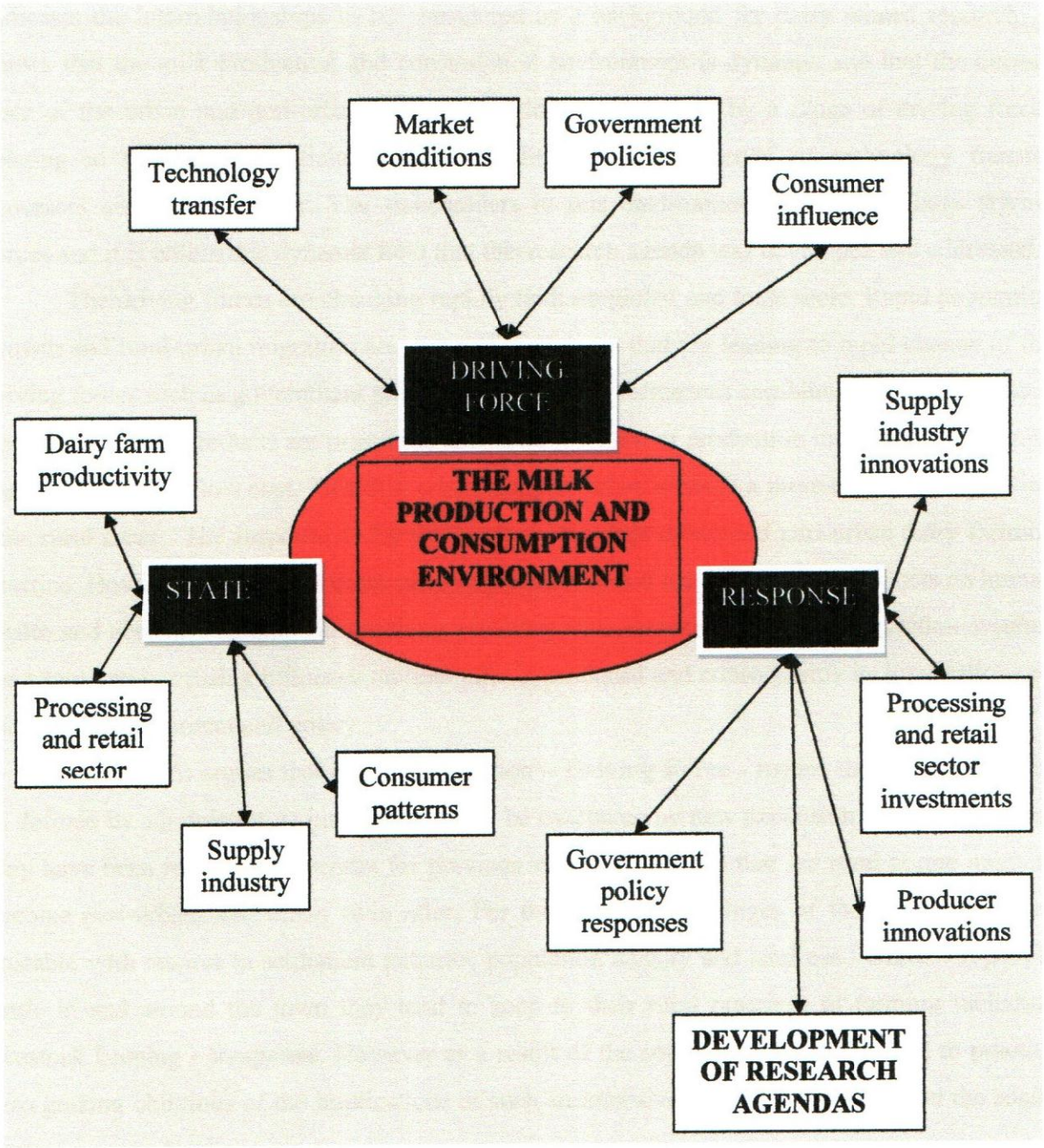


Figure 1: A Driving Force/State/Response Model.

This figure indicates the entry point into this study within the broad dairy related research framework. Source: Adapted and Modified from Leaver et al., 1998.

The conceptualization of this study was based on the conceptual model of driving force / state / response (DSR), (Leaver *et al.* 1998), as illustrated in Figure 1 above. The model indicates the interrelationships to be considered as a background for dairy related research. It shows that the milk production and consumption environment is dynamic and that the current state of the urban and peri-urban dairy production is influenced by a range of driving forces relating to government policies, market conditions, the efficiency of technology transfer processes and the consumer. The stakeholders in this environment respond to these driving forces and it is within this dynamic field that this research agenda was developed and addressed.

The driving forces are changing rapidly both on global and local scale. Rapid population growth and rural-urban migration are some of the factors that are leading to rapid change of the driving forces such as government policies. These policy influences combined with the increased demand for dairy products are presumed to favor expansion of production in regions where milk can be produced at low cost. This puts urban and peri-urban areas in a more competitive position than rural areas. The response is for the residents to adopt urban and peri-urban dairy farming practice. However concerns by consumers and authorities on the safety of the products on human health and about environmental problems resulting from intensive livestock production systems are having an increasing influence on how milk is produced and consequently its implications on the social environment and policy.

Hill (1986) argues that rapid urbanization – **Driving Force** - means that city boundaries as defined by administrative jurisdictions may be overtaken by new expansion almost as soon as they have been redrawn to account for previous spread. Locations that are rural at one moment become peri-urban, and urban soon after. For this reason, the fringes of the municipality are unstable with respect to settlement patterns, population density and land use - **State**. As people settle in and around the town they tend to keep to their rural practices of farming including livestock keeping - **Response**. However as a result of the small land sizes they tend to practice zero grazing oblivious of the implications of such an intensive agricultural practice on the social environment and policy.

The production system despite its potential benefits is faced by various challenges which are assumed to be behind its being outlawed by the municipal authorities. The four main challenges associated with the practice include:

Livestock waste disposal – There is a hint of negative impacts caused by inappropriate livestock waste disposal on water resources and public health (Flynn, 1999) as well as gaseous emissions (carbon dioxide, methane and nitrous oxide) (Steinfield, 1998).

Water availability - For urban and peri-urban livestock, water supply is another issue which needs to be understood more thoroughly. Currently, city planners do not take into account the demands of urban and peri-urban livestock which is paramount to hygiene.

Zoonoses - The existing and potential health risks for humans caused by the transmission of diseases from livestock (Flynn, 1999).

Other nuisances – These include smell, flies and mosquitoes, inconveniences to traffic, noise and other negative aesthetic effects such as soil erosion gullies, devegetation and indiscriminate dunging (Steinfield, 1998).

To effectively tackle these challenges, the researcher conceptualized that the policies, culture and demography, play a key intervening role in regulating the social, economic and technological factors to dairying practice for sustainable dairy production.

In the model on the next page (Figure 2), the direction of the arrow indicates the direction of dependence. It was assumed that the independent variables have either a positive or negative impact on the dependent variable. It was therefore envisaged that the intervening variables (policy, culture and urbanization) could affect the other variables either positively or negatively.

The variables were expected to interact with each other and a change in one was expected to have an effect on the others. It was also expected that some variables would have significant effects on others and insignificant effects on others. On analysis of data, the results supported the conceptualized framework.

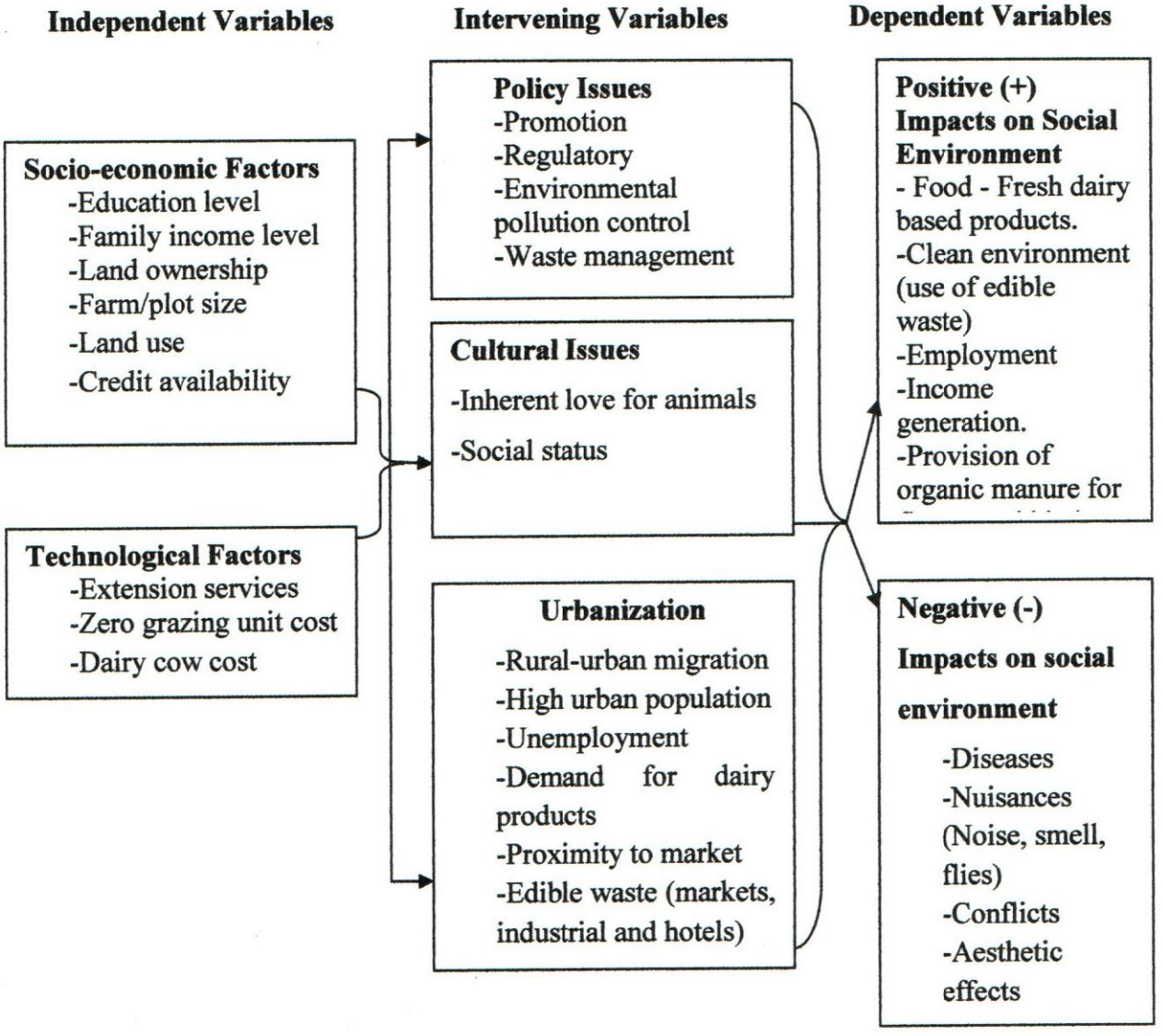


Figure 2: Conceptual framework

CHAPTER THREE
RESEARCH METHODOLOGY

3.1. Research Design

The research adopted a social survey research approach because the data required was mainly meant to explain mass behavior. Weisberg *et al.* (1989) recommends that the explanation of mass behaviour often requires mass attitude data that can be obtained only by a survey.

3.2. Description of the Study Area

3.2.1. Location

The study was undertaken in Nakuru Municipal Council in Kenya. Nakuru town is located 160 km northwest of Nairobi and lies between the latitudes 0°10' and 0°20' South and longitudes 36° and 36°10' East (Figure 3). It is situated at an altitude of between 1,520 and 1,890 meters above the sea level and it is within the region of the Great Rift Valley. By agro-ecological zoning the study area lies within ecological Zone III (DDC, 2003).

It is sandwiched between Lake Nakuru National Park to the south and the Menengai crater and its associated volcanic landscapes. Further to the northeast of the town is the Bahati Escarpment forming the western fridge of the Aberdares Escarpment. Unstable geological zones experiencing frequent local geological faulting characterize the western zone of the town. The most affected area of the Municipality is on the western side of the Central Commercial District around Ngata; Kiamunyi; and Rift Valley Institute of Science and Technology (RVIST).

3.2.2. Climate

The climate of Nakuru is strongly influenced by the altitude and the physical features (escarpments, lakes and mountains). This therefore leads to considerable variation in climate. With an average annual rainfall of about 950 mm, Nakuru has a dry sub-humid equatorial climate. There are two rainy seasons; the long rains fall in March-May and the short rains in October-December. The hottest period is between December and March with average temperature of 30°C and the coldest is July with an average of 23.9°C. (DDC, 2003). Due to its location on the floor of the Rift Valley with its volcanic soils, Nakuru is engulfed with

whirlwinds of dust during the dry season, giving the town its name coined from the Maasai name "nakurro" which means "a place of winds" (DDC, 2003).

3.2.3. Population

Nakuru population has been growing at the rate of 5.6% per annum. From a population of 47,151 in 1969 (GOK, 1971), the population reached 92,851 in1979 (GOK, 1981), 163,982 in 1989 (GOK, 1994) and 231,262 people in 1999 (GOK, 2001). By the year 2015, the population is projected to rise to 760,000, which is approximately 50% above the 1999 levels. The population growth has been influenced by the birth rates, rural-urban migration and boundary extensions. Recently there has been rapid 'urban-like' development at the periphery of the town as many people take refuge in those areas as a result of shortage of housing in the town centre. Most of these settlements take place in areas expropriated from agricultural uses by use of subdivision plans. The area under the municipal council and the surrounding divisions formed the study sites of this study.

The study site was categorized into two, urban and peri-urban; and further clustered into Afraha, Viwanda, Baruti, Lanet and Baharini for the Urban. Ngata, Kiamunyi, Kiamaina, and Menengai for the Peri-urban (See Table 1 and Figure 3 below) (GoK, 2001).

Table 1: Demography of the Study Area.

NAME	POPULATION	HOUSEHOLDS	AREA in Kms^2	DENSITY
Ngata	14,117	3,040	96.8	146
Kiamunyi	7,679	1,782	48.1	160
Menengai	10,814	2,615	150	72
Kiamaina	14,627	3,513	18.6	121
Baruti	9,169	2,048	36.8	249
Viwanda	108,234	34,806	25	4,329
Baharini	49,521	14,663	3.9	12,698
Afraha	27,574	6,692	14.1	1,956
Lanet	36,428	10,119	38.1	959
Total	**278,163**	**79,278**	**431.4**	**645**

Source: Adapted from GoK 2001

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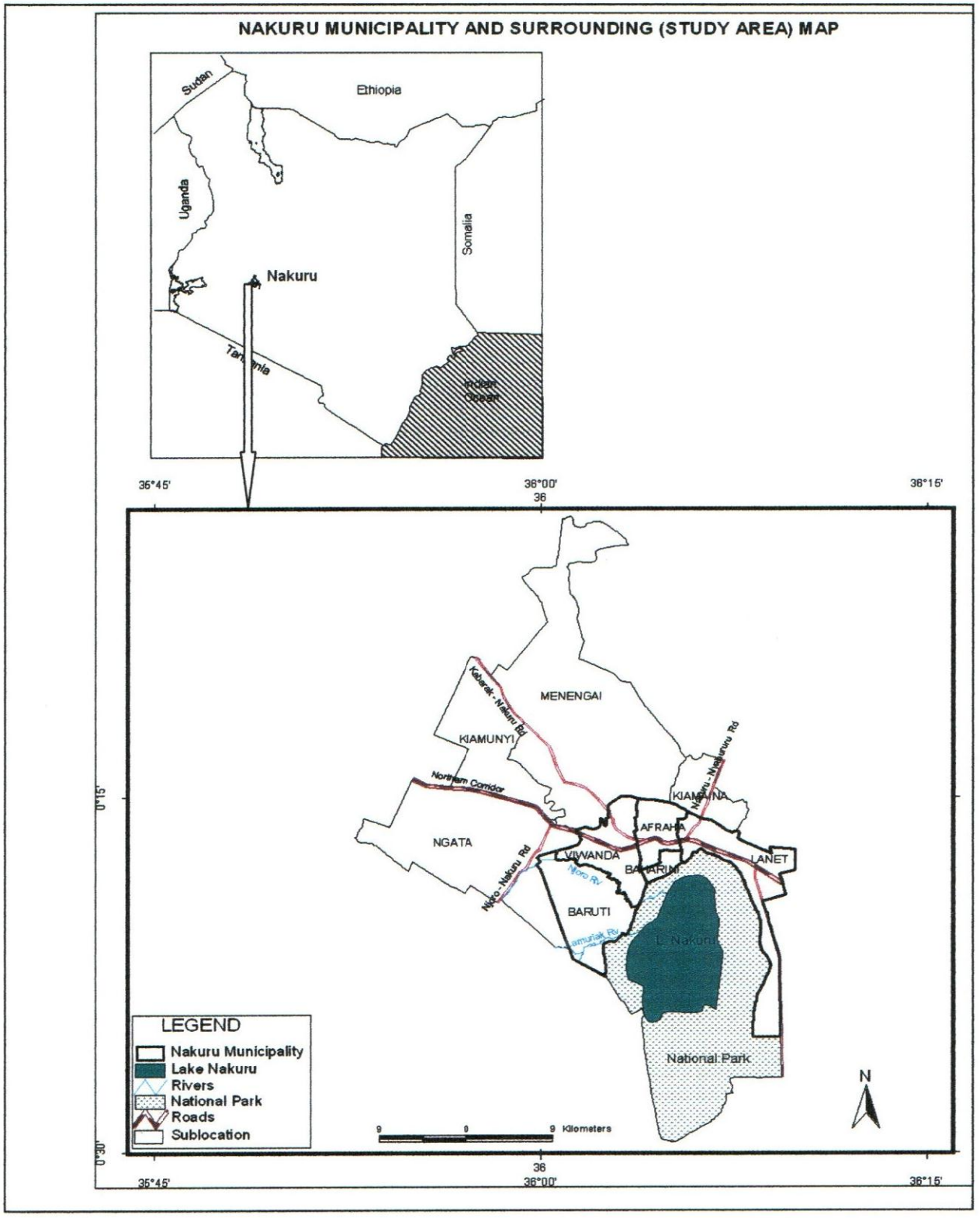


Figure 3: Map of Kenya and Nakuru Municipality (The study area).

Source: Author's field survey (2009).

3.3. Data Collection

3.3.1. Data Sources

The study used both primary and secondary data. The primary data refers to the data collected by the researcher and specific for the study. The primary data was mainly gathered from the respondents in the sampled households, field observations and key policy holders. The secondary data refers to data sourced from works by other people. This kind of data was sought to supplement the primary data. However, the secondary data has not been used directly in the statistical analysis but has been used in the discussion of the findings from the primary data. The sources of secondary data included official reports, Policy documents, strategy papers and development plans; Acts of Parliament and other publications (in hard and soft copy formats).The documents included, Nakuru District Livestock Production Annual Report, 2008; Draft National livestock policy (2006); Dairy Policy (2007); Kenya Vision 2030, 2007; Strategic Nakuru Structure Plan,1999; Municipal Council of Nakuru Environmental Management By-Laws, 2006; Local Government Act (Cap. 265); Environmental Management and Coordination Act (EMCA, 1999); Public Health Act (Cap. 242); The Animal Diseases Act (Cap. 364); The Dairy Industry Act (Cap. 366); and The Water Act of 2002.

3.3.2. Nature of Data

In this study, the data gathered was that relating to the four specific objectives aimed at meeting the broad objective of assessing the impacts of dairying in the urban and peri-urban areas on the social environment and policy. Data was collected for several variables. These included the socio-economic characteristics of the households such as sex, age, education levels, income levels, land size, land ownership, and employment. These parameters were important in order to assess how they influence urban and peri-urban dairy production. Similarly, data was collected on the possible reasons influencing the intensity and the nature of urban and peri-urban dairying. In addition, information was sought on technological and policy issues such as awareness of the laws and policies that in one way or the other touch on the dairy industry and its practice.

3.3.3. Data collection tools

The data was gathered through face-to-face individual household structured questionnaire administration, supplemented with secondary data and personal observation schedule (Appendix I and III). A different questionnaire was administered to officers manning offices that have a mandate to formulate and/or implement laws or policies related to the dairy industry (Appendix II). A questionnaire was chosen due to the ease of administration and scoring of the instruments besides the results being readily analyzable (Mugenda & Mugenda, 2003). The items on the questionnaire were developed based on the objectives of the study and the variables in the conceptual framework model with an aim of obtaining data to test the study questions. The household questionnaire was pre-tested in Nyahururu Municipality. This was because Nyahururu Municipality has similar characteristics with the study area in terms of settlement patterns, demographic dynamics and the dairying practice.

3.3.4. Sampling Procedure, and Sample Size

The target population was the households within the urban and peri-urban sections of Nakuru municipality. The sample frame was derived from the 1999 population and housing census report (GOK, 2001) from which the total number of household data of the nine clusters was extracted. The households were as shown in Table 1. The nine clusters had 79,278 households with 68,328 households being within the Municipality (urban) and 10,950 households in the peri-urban area. The unit of investigation was individual households and the subject of analysis was the household head, spouse, a mature, (person of 18 years and above), family member or the livestock attendant or manager.

A sample of 377 households was calculated using the Raosoft Incorporated (Inc.) sample calculator recommendations of 5% margin of error (confidence interval), 95% degree of confidence, population size of 20,000 households (since the total number of households within the study area was larger than this figure, that is, 70,278), and a 50% response distribution (Raosoft, 2009). The computer program that was used for calculation of the sample size is the Macorr sample size calculator (Macorr, 2009). The sample size was however reduced by one to 376 households, for equal distribution. The sample was distributed proportionately between the urban and the peri-urban sections of the study area. Half of the sample to represent the dairy cattle farmers in each section was purposefully selected using snowball sampling and the other

half to represent the non-practitioners was randomly selected from the nearest non practicing neighbours as follows:

- 94 respondents represented zero grazing practitioners within the urban area.
- 94 respondents represented zero grazing non-practitioners within the urban area.
- 94 respondents represented zero grazing practitioners in the peri-urban area.
- 94 respondents represented zero grazing non-practitioners in the peri-urban area.



Plate 1: Infrastructure around homesteads in Ngata, Nakuru Municipality.

Source: Author's Field Survey (2010).

3.3.4.1. Snowball Sampling

To get to the subjects, Snowball sampling method was chosen because it was not easy to identify those practicing dairy farming as most homesteads are completely enclosed with stone walls and heavy gauge iron-sheet gates as Figure 4 above demonstrates.

An "s" stage "k" name snowball sampling procedure is defined by Goodman (1961) as follows: A random sample of individuals is drawn from a given finite population. Each individual in the sample is asked to name "k" different individuals in the population, where "k" is a specified integer; for example, each individual may be asked to name his "'k' best friends,"

or the "'k' individuals with whom he most frequently associates," or the "'k' individuals whose opinions he most frequently seeks," etc. (Assuming throughout that an individual cannot include himself in his list of "k" individuals). The individuals who were not in the random sample but were named by individuals in the random sample form the first stage. Each of the individuals in the first stage is then asked to name "k" different individuals, (We assume that the question asked of the individuals in the random sample and of those in each stage is the same and that "k" is the same.) The individuals who were neither in the random sample nor in the first stage but were named by individuals who were in the first stage form the second stage. Each of the individuals in the second stage is then asked to name "k" different individuals. The individuals who were neither in the random sample nor in the first or second stages but were named by individuals who were in the second stage form the third stage. Each of the individuals in the third stage is then asked to name "k" different individuals. This procedure is continued until each of the individuals in the "s"th stage has been asked to name "k" different individuals.

For this study "s" = 3 and "k" = 2 (for each category in the sample distribution of 94). Thus S_1 was 14 (random), $S_2 = 28$ and $S_3 = 56$ all totaling 98. The list of the first 14 practitioners was randomly selected from a list from one of the assisting enumerators who was also randomly picked from among the nine assisting enumerators, while the non-practitioners were randomly selected from the immediate neighbours of the practitioners' sample. From this point on the subjects that were picked were asked to name the other subjects in a linear manner thus coverage of the whole study area was assured. The common question that was used was for the respondent to name two dairy cattle farmers in the locality at an interval of about 5 to 10 houses from the respondent's house in the direction away from where the administrator had come from. This interval was determined after preliminary discussions with the assisting enumerators and pretesting of the questionnaire where the respondents indicated that under the urban setting neighbours rarely knew the activities of each other beyond this number of households.

The main advantage of the snowball sampling method was that it was possible to reach even the farmers keeping dairy cattle in zero-grazing units within fully enclosed compounds (Figure 4), and also due to the fact the population was not homogenous in terms of practice, that is, all the residents were not practicing zero-grazing neither were they evenly distributed. The four candidates above the set sample size per category were used for replacement purposes or just dropped when the required number was interviewed.

3.3.5. Data collection process

The researcher upon satisfying the requirements of Egerton University graduate school board of examiners obtained a research permit to carry out research in Nakuru district from the National Council for Science and Technology, Nairobi. This was followed by a visit to the District Commissioner, the District Education Officer Nakuru District and the District Livestock Production Officers in charge of Nakuru Municipality and Rongai Districts, to notify them of the proposed research.

To ensure high data quality and high response rate, the researcher administered the questionnaires himself assisted by trained enumerators. Nine assisting enumerators helped the researcher during the data collection process. An assistant was picked to assist in the area in which he/she was very familiar with and also based on his/her communication skills. To meet these two conditions the assistants were selected from among the agricultural or livestock extension officers working in those areas with the authority of their immediate supervisors. The assistants were trained on how to approach the respondents and carry out any probing without offending or intimidating them. To facilitate the training further, the researcher and the assistants conducted some interviews together. During these theoretical and practical sessions the researcher and the assistants went thoroughly through the questions in the questionnaire carefully, interpreting and/or translating some words from English to Kiswahili and discussing the possible problems that may arise from the questions as they are during questionnaire administration. The questionnaire for the policy holders and sourcing of secondary data was strictly dealt with by the researcher personally.

3.3.6. Validity and Reliability

Validity is the accuracy and meaningfulness of inferences, which are based on the research results, in other words it is the degree to which results obtained from the analysis of the data actually represent the phenomenon under study (Mugenda & Mugenda, 2003). The supervisors, lectures and peers were provided with copies of the questionnaire before it was taken to the field for data collection to check validity of the questionnaire. Their views were incorporated to ascertain content validity before pretesting to ascertain face validity. A sample of 20 households was used. For a survey research, a minimum sample size of 15 is recommended (Kathuri & Pals, 1993). Pilot testing involved administering the instrument meant for data

collection for the proposed study in a different area. Nyahururu Municipality was chosen. This town was used for pre-testing since it had similar characteristics as the study area. The Municipality was also chosen due to its distance from the study area that limited interaction of the survey subjects which could interfere with the main survey. The testing helped to establish clarity and comprehensibility of the items. It also helped to gauge the time needed to administer the questionnaire and get the relevant information.

In this study internal consistency of data of the instrument or reliability was computed using Cronbach Alpha (Fraenkel & Wallen, 2000). The data collected from the pre-testing exercise was organized, coded, cleaned and entered in the computer. Using the SPSS, it was analyzed and a reliability coefficient calculated. A reliability coefficient threshold of 0.7 is recommended for survey research to be adopted (Fraenkel & Wallen, 2000). For this study the actual reliability was 0.71, which was above the recommended threshold. After the pre-testing exercise, several corrections were made to improve the data collection instruments.

3.4. Data Analysis

The computer-based Statistical Package for the Social Sciences (SPSS version 11.5 for windows) was used for data analysis to yield descriptive and inferential statistics. Pearson's chi-square, ($\chi 2$), was used to analyze and determine whether the descriptive and inferential statistics were significant or not. This helped in answering the research questions posed for this study. Chi-square test was deemed suitable for this study's data analysis because the scales were expected to be either nominal or ordinal. The data was also categorical, with practitioners and non-practitioners of dairy production forming one category and the administrative areas, (urban and peri-urban), forming another group. The significance level was 0.05 (one sided) which interpreted to 0.025 (two sided). If the calculated value was less than the significance level, then the relationship was deemed significant and not happening by chance. If on the other hand it was a 2x2 contingency table (nominal parameters) and small expected frequencies occurred, the Fisher's Exact Test value was used instead of the Pearson's $\chi 2$ figure as recommended by Howitt and Cramer (2003).

Pearson bivariate correlation was also used. This type of analysis was employed in an effort to determine whether there was a relationship between two (2) variables, how strong the

relationship was between them and also whether the relationship between the variables was positive or negative, (positive or negative correlation).

RESEARCH QUESTIONS	INDEPENDENT VARIABLE	DEPENDENT VARIABLE	STATISTICAL ANALYSIS TOOL
What is the trend of dairy production practice in the urban and peri-urban areas of Nakuru Municipality?	**Socio-economic Factors** -Education level -Family income level -Land ownership -Farm/plot size **Technological Factors** -Availability of extension services -Zero grazing unit construction cost -Cost of a dairy cow -Availability of credit -System adopted -Year practice commenced	Urban and Peri-urban dairy farming	-Descriptive statistics -Chi-square -Correlation
What motivates people to practice dairy production in the urban and peri-urban areas of Nakuru Municipality?	**Motivators** -Food security -Employment -Income generation -Market availability -Source of feeds	Urban and Peri-urban dairy farming	-Descriptive statistics -Chi-square -Correlation

Figure 4: Research Questions, Variables and Statistical Tools used in this study.

Figure 5 Continued.

Does this practice have any impacts on the social environment of the people living in the study area?	**Social environment issues** -Zoonotic and other diseases -Noise from animals -Smell from units -Flies from units -Conflicts -Environmental aesthetics interference	Urban and Peri-urban dairy farming	-Descriptive statistics -Chi-square -Correlation
What are the impacts on policy of this practice in the study area?	**Policy issues** - Policy awareness level -Number of policy each respondent is aware of. -Effects of policy awareness on practice	Urban and Peri-urban dairy farming	-Descriptive statistics -Chi-square -Correlation

CHAPTER FOUR
RESULTS AND DISCUSION

4.1. Introduction

This chapter presents the results of the descriptive and inferential data analyses. It also presents the discussion of the results in order to respond to the research questions drawn from the objectives of the study.

4.2. Socio-economic Issues

This section discusses the statistical results on the social-economic issues. The parameters include sex, the respondent's relationship with the household, age, education level, occupation, income level, land ownership and occupation. The table also shows which of these factors had significant or insignificant impacts on the dairying practice within the study area.

4.2.1. Sex

The percentage distribution by sex of the 376 respondents, (Table 2) was 58.5% males and 41.5% females in the urban section; 52.7% males and 47.3% females in the peri-urban section of the study area. This was a 55.6% male to 44.4 % female's distribution within the study area. Though there were more males than females to whom the data collection tool was administered, the distribution was found not to be statistically significant, ($\chi 2 = 1.303$, $p = 0.299$) (Table 2). As such, no bias in responses and subsequent inferences is expected out of this factor.

4.2.2. Age

Age is an important socio-economic factor in terms of its influence upon decision making at the household level, especially with regard to issues concerning investment and food security. The study revealed that most of the sample population was in the age of between 19 and 60 years, with the majority (70.5%) being in the age of between 31 to 50 years. Age was however found not to significantly influence the dairy farming practice (Table 2). This is in agreement with studies by Guendel (2002), who found in his five cities case study, in Dar es Salaam (Tanzania), Kampala (Uganda), Kisumu and Nairobi (Kenya), and Addis Ababa (Ethiopia), that people tended to practice urban dairying at the ages of between 31 and 50 years.

4.2.3. Respondents relationship with the household

Majority of the respondents in the survey were either the household owners forming 65.4% or their spouses forming 22.1%. Both these categories totaled (87.5%). Some of the sons or daughters were actually the guardians to their aged parents. This implies that the majority of the respondents were the actual decision makers. Those classified as others included a nephew, a watchmen and a house-help. The relationship of the respondent to the household was found to significantly affect the adoption of the dairying practice ($\chi 2 = 11.117$, $p = 0.025$) (Table 2). This suggests that the decision either to keep dairy cattle or not is highly dependent on the household head.

The positive correlation of these two variables (Table 2) suggests positive attitude of the household head towards urban and peri-urban dairy farming. Thus, the higher the number of household heads with a positive attitude towards dairy farming, the higher the adoption rate of the practice is likely to be. This supports the study finding that the trend of the practice in the study area is on an upward trend (Figure 7).

4.2.4. Level of education

The literacy levels in the two categories, (practicing and non-practicing), were not significantly different. The study also revealed that 97.1% of the respondents had attained some form of education with most of the respondents having had attained secondary and tertiary education. However, nearly half of the sample (81.1%) had at least secondary education. Education level was found to have significant impact on the practice ($\chi 2 = 12.089$, $p = 0.017$) (Table 2). This finding shows that there were higher chances of one adopting urban and peri-urban zero-grazing dairy farming technology if educated. This implies that the level of education is one of the factors that influence the level and trend of adopting the practice.

Education is expected to enhance the household's ability to secure employment, which in turn improves the purchasing power of the household. It is also expected to raise interest of those practicing dairy farming to seek livestock extension services provision and therefore improve the household's awareness level on the best practices in dairy husbandry. This is in agreement with Teich (1990) who indicated that improved communication and higher levels of education make people more adaptable to new ideas and the new social reforms required by the technology.

4.2.5. Level of income

The distribution of the respondents in respect to income in the study area was not significant, ($\chi 2 = 1.247$, $P = 0.536$) (Table 2). This shows that income level distribution was the same in both the urban and peri-urban area. However the study revealed that that 69.1% of the practitioners were in the middle income category. The income levels were further found not to significantly impact on the dairying practice, ($\chi 2 = 3.750$, $P = 0.153$) (Table 2). This is in agreement with previous studies carried within the urban section of Nakuru Municipality by Foeken & Owuor (2000), and Muriithi (2003).

The study had anticipated that people are more likely to adopt the zero grazing dairy production technology if their income levels were medium or high than if it was low. However, within the study area the findings indicated that the practice was cutting across through all the income level categories. This may be explained by the fact that the definition of zero-grazing in this report took care of both intensive and semi-intensive systems. The quality of the animal was also not of concern as long as the animals were kept for milk production. For those who had constructed zero-grazing units, standards of the unit were not a subject of study. Further according to Teich (1990), one adopts a technology if the calculated benefits are more than the costs. The findings of this study therefore suggest that the dairy farmers realize more benefits than costs from the dairying activity.

Sawio (1994) noted that although urban farming was practiced by the rich and the poor alike some of the former practiced it not so much for the need to survive in the city, but rather for the lucrative commercial opportunities it offers. Though he was referring to urban farming in general, the same can be said for dairy farming specifically.

4.2.6. Land ownership

The study revealed no significant impact of land ownership on practice ($\chi 2 = 2.896$; $p = 0.176$) (Table 2).

Security of land tenure was expected to allow for increased investment on the land especially when it involves construction of permanent infrastructure such as zero-grazing units. The study however revealed that lack of permanent ownership of land is not a constraint to adoption of the dairying practice. This is in agreement to a study by FAO (2001) which found

out that privatization of land does not automatically lead to increased investment in more sustainable agricultural practices.

4.2.7. Occupation

The respondent's main occupation contributes to the level of access to milk (through production and/or income) in a household. Households involved in non-farm activities are expected to have higher monetary incomes while those involved in dairying activities are expected to have higher milk production. The occupation of the household head did not have a significant effect on the adoption of the dairying practice, ($\chi 2 = 5.513$; $p = 0.357$) (Table 2).

This means that dairying is practiced across the board by people with all manner of other occupations. However the Table 3 also shows that those who depend on farming as the occupation practiced dairy farming at a higher percentage (46.5%) than those in other categories of occupations. According to Maxwell (1995), people practice urban farming for one of the following four reasons; first as a commercial undertaking, secondly, to try and to reach food sufficiency; thirdly, to raise the household's level of food security and fourthly, just to survive.

4.3. Cultural Issues

Herd ownership was use to bring out the cultural attachment the people had to their cattle. The responses showed that 97.9% of the practitioners owned their herds individually and only 2.1% of the herds were communally owned. This was found to significantly affect the practice ($\chi 2 = 191.967$, $p = 0.000$) (Table 3).

The study refrained from probing the ethnic background of the households considering the negative connotation attached to ethnicity after the 2007 post election violence experiences, however an earlier research by Foeken & Owuor (2000) and Muriithi, (2003), had revealed that the largest group were the Kikuyu (44.3%), followed by Luo (22.4%), Luhya (16.7%), Kisii (6.2%), Kalenjin (3.8%) and Kamba (3.3%). The studies also showed that although other ethnic groups were represented, their numbers were negligible. The significant attachment of individuals to their animals suggests inherent cultural value for cattle which can be considered a key driver to urban and peri-urban dairy farming.

Table 2: Socio-economic Characteristics of the Study Sample

Factor	Practice			
	Practicing %N	Non-practicing %N	$\chi 2$	p
Sex			*0.97*	*0.836*
Males	56.4	54.8		
Females	43.6	45.2		
Age in Years			*5.423*	*0.366*
Below 18	0.4	0.0		
19-30	11.3	15.8		
31-40	32.4	38.6		
41-50	40.7	28.7		
51-60	12.4	13.9		
above 60	2.9	3.0		
Relationship with Household			*11.117*	*0.025*
Owner	71.8	59.0		
Spouse	19.7	24.5		
Son/daughter	4.8	11.2		
Livestock manager/attendant	3.7	3.7		
Other	0.0	1.6		
Education Level			*12.089*	*0.017*
Never been to school	2.9	5.9		
Primary	16.0	21.8		
Secondary	48.0	42.6		
College	28.0	19.8		
University	5.1	9.9		
Income Level			*3.75*	*0.153*
Low	25.0	28.2		
Medium	69.1	67.6		
High	5.9	4.3		
Land Ownership			*2.896*	*0.176*
Squatter	0.7	1.0		
Borrowed	1.8	3.0		
Rented	17.5	11.9		
Communal	1.1	2.0		
Own no title	10.2	12.9		
Own with title	68.7	69.3		
Occupation			*5.513*	*0.357*
Farmer	46.5	43.6		
Business Person	22.2	18.8		
Teacher	5.5	7.9		
Civil Servant	7.6	5.9		
Private Company Employee	8.0	5.9		
Other	10.2	17.8		

N = 188 for each category and for each response in that category. Significance tested at p = 0.5

Source: Author's survey (2010)

Table 3: Herd Ownership

Factor	Practice			
	Practicing %N	Non-practicing %N	$\chi 2$	p
Herd ownership			191.967	0.000
Not applicable	0.0	67.0		
Individual	97.9	31.4		
Group	2.1	1.1		
Other	0.0	0.5		

N = 188 for each category and for each response in that category. Significance tested at p = 0.5

Source: Author's survey (2010)

4.4. Technological Issues

The factors discussed under this subsection include extension service provision, technology awareness, production system adopted, cost of constructing a zero-grazing unit, and cost of dairy cows. Table 4 summarizes the findings about these variables.

4.4.1. Extension service provision

This study revealed that extension services had a significant negative effect on the dairy farming practice, ($\chi 2$ = 16.363, 0.01) (Table 4). Table 4 also shows that out of all the practitioners who required dairy production extension service, only 18.9% received the services. Government extension providers offered 18.5% of these services while 0.4% was offered by consultants. The rest of the practitioners were either not interested or were interested but unable to secure such services.

Extension service providers are agents of change. Extension service provision is the process through which agents of change persuade their clientele to adopt new technologies, improve on existing ones or stop non-desirable practices. Affordable, reliable and efficient livestock extension service, therefore, is likely to result in a sustainable and environmentally friendly production environment and vice versa.

The extension service offered by Ministry of Livestock Development officers, albeit at low levels, suggests that the National Livestock Policy (MoLD, 2008), is not discriminative on where dairy production should take place, whether in urban, peri-urban or rural areas. The Draft

Sessional Paper No....of 2006 on Dairy Industry Development, (MoLD, 2006), which is the Dairy policy in draft form has not also earmarked areas of production. However the document, (MoLD, 2006), points out inadequate extension and advisory service delivery as one of the constraints to dairy production. The term "National" can be interpreted to include the urban and peri-urban areas and why therefore the ministry has posted extension service providers in these areas.

The low service delivery, however can be attributed to the ministerial institutional capacity to post adequate officers to offer such services, and secondly to the existing weak policy and legal frameworks as demonstrated by the National Livestock Policy, (Mold, 2008). An outstanding weakness is the contradiction between the National Livestock Policy (2008) which advocates for dairy production maximization, and the municipal by-laws (MCN, 2006), which outlaws dairy farming within the Municipal boundaries.

4.4.2. Construction cost of a zero grazing unit

A higher proportion of practitioners (56.4%) than non-practitioners, (32.7%), could estimate the cost of constructing a zero grazing unit. This could be attributed to the fact that the practitioners actually had units they had constructed and were giving the values based on the actual cost incurred, whereas for the non-practitioners the estimates could have been from pure perceptions.

The cost of constructing a zero grazing unit was found to be one of the technological factors that had significant effect on the adoption of the dairying practice ($\chi 2 = 27.948, 0.00$) (Table 4). Correlation analysis showed that cost and adoption had a negative relationship. This suggests that as the construction cost go up the adoption of intensive zero grazing as a system of dairy production goes down. This could explain the tendency of the people to practice semi-zero grazing and grazing on farm.

One way of overcoming this constraint was expected to be through seeking for financial support in terms of credit. As demonstrated in table 4 only 4.8% of the sample had gone for credit. This suggests that the practitioners were not ready under the current legal framework to take high financial risks investing in this enterprise. It is important to point out here that though the Nakuru County Council does not have its own by-laws outlawing the practice in the peri-

urban area it invokes the Municipal Council by-laws to deal with environmental issues (Kimani/Ole Tikani)[i].

4.4.3. Dairy Production system

Table 4 shows that 92.1% of the practitioners used either intensive zero grazing where the animals were fully enclosed in structure (42.6%), or semi-zero grazing where the animals spent some time grazing on-farm and then enclosed (49.5%).

Though the study defined zero grazing as feeding animals enclosed in a place, which took care of animals grazed on farm, the high percentage of the practitioners who had adopted conventional zero grazing, (feeding animals enclosed in a structure), suggested that they found the system advantageous over other systems of dairy production. This is in agreement with SAEM (2008), who indicated that zero grazing as a production technology is conducive under such circumstances as the urban and peri-urban environment with such constraints as small land sizes.

In the course of this study, it was found out that 33.5% of those sampled as non-practitioners actually practiced free range dairy production.[ii] These are some of the livestock that can be seen roaming in town, being grazed on roadsides, unoccupied land, on sewage and waste disposal sites and even along the railway lines (Plate 2). From general discussions with the respondents, it was clear that animals kept under free range system within the study area were more likely to cause negative social environment impacts.

[i] Verbal communication. Ole Tikani was the Nakuru County Council Environment officer at the time of this study.

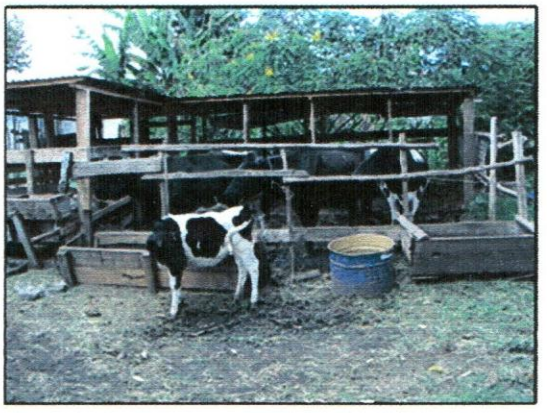
Table 4: Technological Issues

Factor	Practice		$\chi 2$	*P*	*Correlation*
	Practicing %N	**Non-practicing %N**			
Extension Service Provision			*16.363*	*0.01**	*-0.131**
Not Interested	21.8	40.6			
Interested but not offered	59.3	43.6			
By Government officer	18.5	13.9			
By Consultant	0.4	2.0			
Zero Grazing unit construction cost			*27.948*	*0.00**	*-0.151***
Not aware	43.6	67.3			
Less than 20,000 shs	3.3	1.0			
20,000-40,000 shs	19.3	5.9			
40,000-60,000 shs	21.5	11.9			
60,000-80,000 shs	5.1	10.9			
80,000-100,000 shs	3.3	2.0			
over 100,000 shs	4.0	1.0			
Credit Borrowing			*306.976*	*0.00**	*-0.199**
Not in practice-Not interested	0.0	89.9			
Borrowed	4.8	0.5			
Interested but not borrowed	95.2	9.6			
Dairy production system			*376.00*	*0.00**	*-0.064*
None	0.0	33.2			
Zero grazing	42.6	0.0			
Semi zero-grazing	49.5	0.0			
Grazing on farm	8.0	0.0			
Grazing off farm	0.0	33.5			

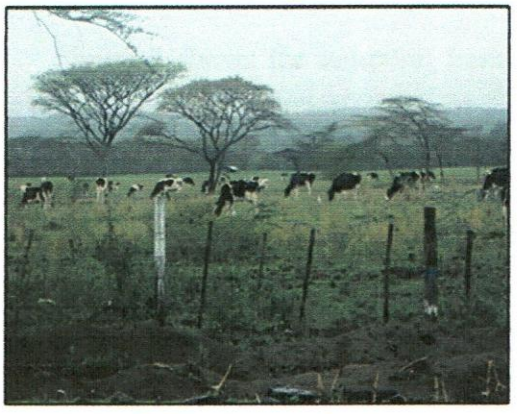
N = 188 for each category and for each response in that category.
*Significance tested at p = 0.025 (two sided).



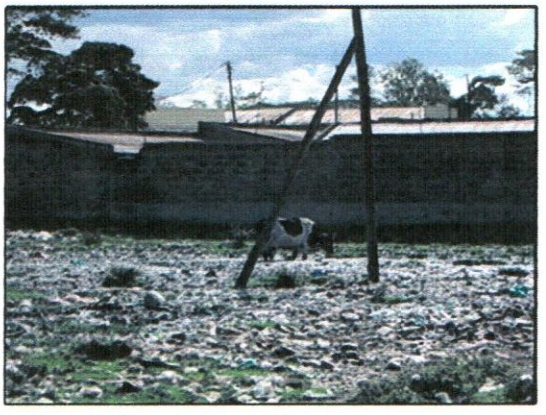
A: Zero Grazing



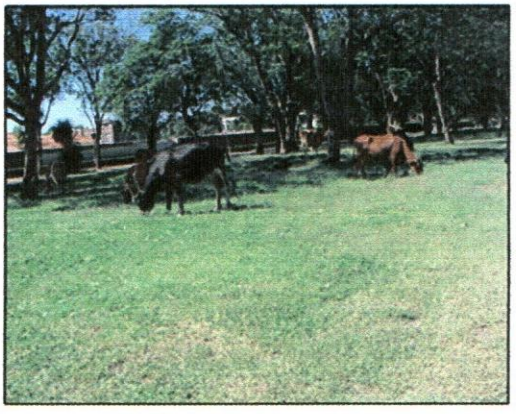
B: Semi-Zero Grazing



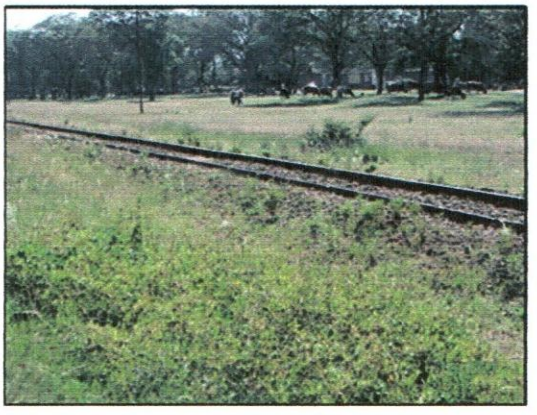
C: Grazing on farm



D: Grazing in a Dump Site



E: Roadside Grazing



F: Grazing along Railway Line

Plate 2: Different Dairy Production systems Observed Within the study Area

Source: Author's Field Survey (2010)

4.5. Temporal Trend, Land Size and Number of Cows.

These parameters are expected to be indicators of how intensive dairy farming is within the study area. These parameters require to be well understood considering the environmental problems of demand-driven livestock production. Where demand for animal products increases rapidly, land-based systems often fail to respond, leading to animal concentrations which are out of balance with the waste absorptive and food supply capacity of the immediate land. High concentrations of animals close to human agglomerations bear enormous pollution problems and associate health risks (Steinfield, 1998).

4.5.1. Temporal Trend of the dairying practice

Figure 5 shows the temporal trend of the dairying practice in the study area. The year 1985 was the earliest year indicated in the data collection tools, while 2009 was the last complete year before the study.

Earlier studies on urban agriculture by Foeken & Owuor (2000) and Muriithi, (2003), indicated that between 10% and 20% of the people living within Nakuru Municipality were livestock keepers. Based on these previous, this study sought to bring out the temporal trend of the dairying practice. This was meant to indicate whether the trend of the practice was going upwards or downwards. This study revealed a consistent upward trend (Figure 5). The sudden and conspicuously notable increase in number of practitioners by 2008 can be associated with the immigrations into the study area due to the 2007 post election violence. Otherwise the other steadily increasing change could be associated with the projected trend of rural to urban migration (UN Habitat, 2002) and the predicted change in preference by Guendel (2002) that the majority of the households in the different cities would like to expand their livestock production. The preferences in terms of the livestock species people would like to have would be dairy cattle, followed by small ruminants (Guendel, 2002). This suggests that the adoption of the dairying practice has been and will continue increasing over time.

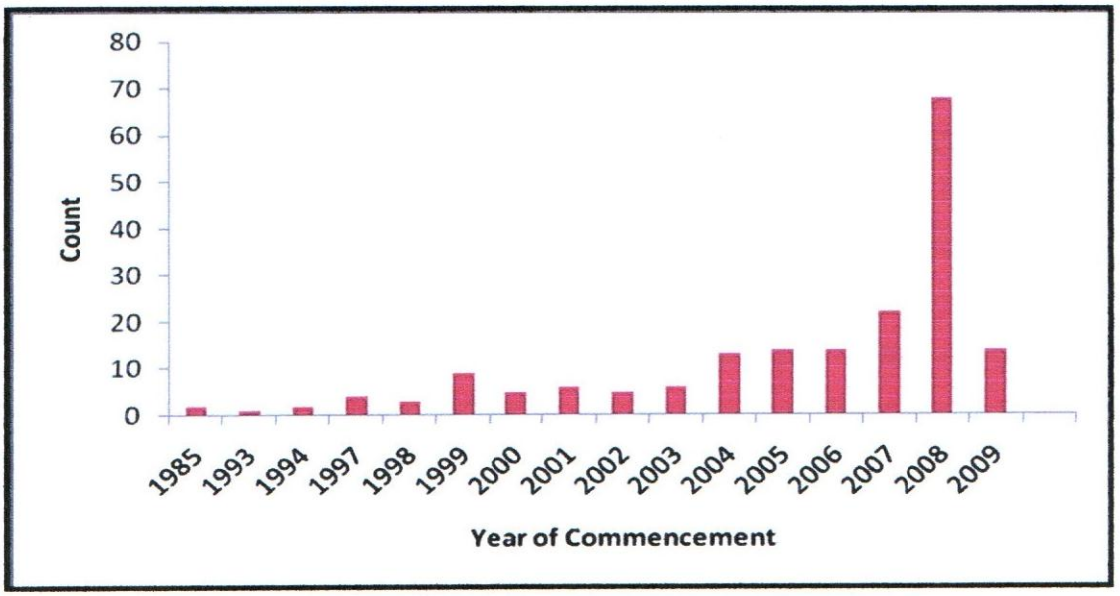


Figure 5: Trend of practice over time

4.5.2. Land Size

Dairy production is influenced to a large extent by a household's farm size. The study revealed that 74.4% of the dairy farming was being carried out on small parcels of land of less than 0.125 acres to 0.25 acres (Figure 6). This finding even with the peri-urban component is in agreement with what was reported by Foeken and Owuor (2000) in their general study of urban agriculture within Nakuru Municipality.

As pointed out earlier Nakuru lies in the Ecological Zone III which is characterized by medium productivity. The livestock carrying capacity recommended for Ecological Zone III is around 1.5 hectares per livestock unit, (ha/l.u), on natural pasture or 0.7 – 1.2 ha/l.u. on artificial pasture of such grass as Nandi setaria (Jaetzold & Schmidt, 1983). The Livestock unit (LU) is a unit used to compare or aggregate numbers of animals of different species or categories. Equivalences based on the food requirements of the animals are defined. By definition, a cow weighing 600 kg and producing 3000 litres of milk per year = 1 LU, a calf for slaughter = 0.45 LU, a nursing ewe = 0.18 LU, a sow = 0.5 LU and a duck = 0.014 LU. (European Commission, 2010).

This means that the land on which the practice is currently taking place cannot in itself support in terms of fodder production the dairy cows kept thereupon. This could be the reason

why most of the practitioners have to depend on external sources of feed. Some of the feeds used are remains from hotels; green grocers, brewing industry and waste generated from other production systems on top of either grazing or fodder (green or hay), bought from outside. Subsequently, the practice becomes a consumer of what could have otherwise been wasted and thus contributing positively to waste management. In view of this, it is evident that the practice is quite intensive and has a high positive potential in organic waste management in terms of organic matter intake but equally high negative potential in challenges of waste disposal. Further the import of feeds in form of green fodder or hay could act as disease or disease vector conveyance avenues.

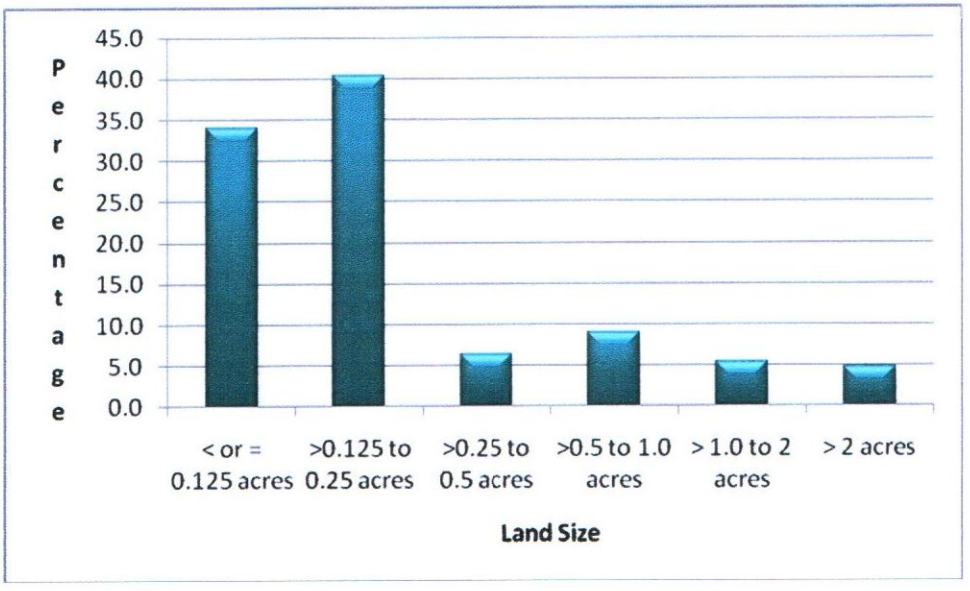


Figure 6: Distribution of Practice by Land Size

4.5.4. Number of dairy cows

The minimum number of dairy cows owned by a single respondent was 1 while the maximum was 12. The mode was 2 and mean of 2.6, (rounded to the nearest whole number was 3), distributed in percentages as shown in Figure 7.

The mode of 2 heads of dairy cows compared well with the national average as given by McSherry et al, (2007). He indicates that in the country's dairy industry; approximately 86% of milk produced comes from 600,000 small-holder households, usually with just one or two cows. This implies that the urban and peri-urban dairy keepers have similar characteristics with their rural counterparts.

Large scale dairying was also observed within the study area. Two conspicuously observable large scale practitioners were the Rift Valley Institute of Science and Technology and Nakuru High School. Some other institutions with over six heads of cattle each included Menengai School for the Mentally Handicapped and Ngala School for the Deaf.

Whether the municipal by-laws allow institutions to keep dairy animals or not is not clear in the environmental by-laws document (MCN, 2006). The tolerance of the dairying practice with the municipality by the municipal authorities tends to agree with Foeken (2005), who indicated that during the 1960s and 1970s, policies were restrictive in the sense that harassment and destruction of property were common measures taken by the local authorities. In the 1980s however, a gradual shift in attitude took place and nowadays, urban farming is usually tolerated as long as it does not become a nuisance. However the change in attitude is not reflected in the municipal by-laws. The change in attitude and subsequently the tolerance negates the good will meant by the by-laws in safeguarding the residents from the social environmental risks that may arise there from.

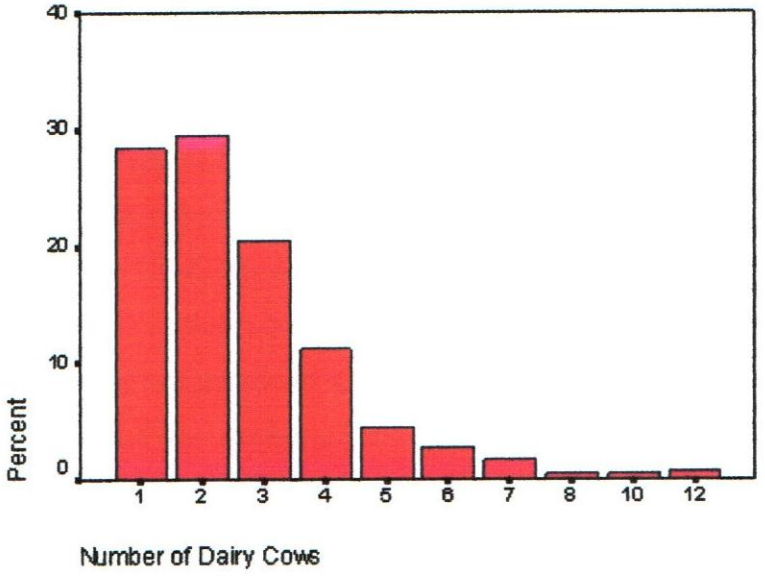


Figure 7: Number of dairy cows

4.6. Motivating Factors

Several parameters were studied in an effort to find out what motivates people to practice urban and peri-urban dairy production. Table 5 below summarizes these findings.

4.6.1. Food Security

The study found that the practice contributed significantly to food security ($\chi 2 = 37.408$, $p = 0.000$) (Table 5). It was revealed that 95.7% of the practitioners and 72.9% of the non-practitioners agreed that dairying within the study area contributes to food security.

Food security is viewed as the availability and accessibility by all people at all times to enough food, both in quality and quantity, for an active and healthy life (Word Bank, 1986). Thus food security incorporates availability and accessibility of food while food insecurity is the lack of access to adequate food for the people who need it (Kwesi, 1988). This can arise either due to inadequate domestic production, limited purchasing power or insufficient distribution of the food to the people who need it. Milk produced within the urban and peri-urban environment is expected to contribute to the overall food security.

To corroborate this information the practitioners were asked to indicate the average amount of milk they consumed per day. The information collected showed that 90.7% of the households took between 1 and 3 litres of milk per day. The minimum and maximum amounts consumed were 1 and 16 litres respectively, with a mean of 2.37 litres.

Millennium Development Goal 1 calls for a reduction of 50% of the proportion of people whose income is less than one US-dollar a day and of the proportion of people who suffer from hunger between 2000 and 2015 (Satterthwaite, 2003). However, Foeken, (2005) argued that during the 1990s, the percentage of people in sub-Saharan Africa living below the 'poverty rate' of $1 a day was on the rise and the number of undernourished people as well and instead of a reduction in poverty, it is actually on the increase in this part of the world. In addition, by the year 2015, about half of its population will be living in urban centres and poverty will have increasingly moved from rural to urban areas. As a response this populace has taken up dairying to resolve to some extent the food security issue.

4.6.2. Employment Creation

The study found out that 91.0% of the practitioners and 76.1% of the non-practitioners agreed, that the practice contributed to creation of employment. This was found to have significant effect on the dairying practice. ($\chi 2 = 15.427$, $p = 0.000$) (Table 5).

This reflects that most households regarded urban and peri-urban dairy farming as an important source of employment. In Kenya, the labour force was estimated to be 11.5 million in 1996 (Chune, 2003). Between 1986 and 1996, the average growth rate in the labour force was 4.1% per year. The growth in employment required to absorb this growing labour force was about 492,000 new jobs annually. Yet employment increased only between 2 and 2.5% annually from 1986 to 1995. As a result, more than two million Kenyans were unemployed, and even among those counted as employed, a significant proportion was underemployed particularly in small scale agriculture and the informal sector in both rural and urban areas. Unemployment in Kenya has therefore become a serious problem. Average unemployment is currently 23%, and is even higher for youth that drop out of school and for women, averaging 25% in both cases. The small-scale agricultural sector is the single largest source of employment in Kenya, absorbing 51% of the labour force. The urban informal sector is the next largest source of employment, comprising over 10% of the labour force, followed by the urban formal sector, at 7% in 1994 (ibid)

It is important to note that by the year 2008 the unemployment rate in Kenya had risen to 40%. The total number of jobs in Kenyan economy can be divided into three broad categories – formal employment, urban informal employment, and rural traditional employment (Pollin & Heintz, 2007). Urban and peri-urban dairy farming falls in the category of urban informal employment sector. Seventy percent of the 40,000 jobs created by milk processing and marketing are in the informal sector, not counting casual employment. Plus, between 600,000 and 800,000 dairy farm households who employ family labour as well as creating 365,000 full time wage jobs, which constitutes 12 percent of the agricultural labour force (Ayaga *et al.*, 2004). With the foregoing therefore the potential of urban and peri-urban dairy farming in contributing towards the reduction of the unemployment rate need not to be overemphasized.

In 1992, the proportion of urban poor was estimated at 29% compared to 42% in rural areas. In 1997, the figure had risen to 49% compared to 52% in rural areas (Odhiambo & Manda,

2003). Urban and Peri-urban dairy farming can therefore be interpreted as an adaptive response by urban and peri-urban households to diversify their livelihood options.

4.6.3. Income generation

The study indicated a significant effect of income generation towards the practice, ($\chi 2$ = 29.147, p = 0.000) (Table 5). Of those practicing, 97.3%, and 79.8% of the non-practicing, households were in agreement that income generation was a motivator that lead to adoption of the practice.

Milk production figures generated from the study showed that an estimated 2943 litres of milk were produced per day out of which 2170.5 litres were sold. Most of the milk (50.5%) (Figure 8), was sold locally at between Kshs. 31 and 40 per litre (Figure 9). Taking an average selling price of Kshs.35 per litre this interprets into a gross income of Kshs. 75,967.50 per day or Kshs. 2,279,025 per month generated from the dairy farming activity. The amount of income accruing indicates a significant potential positive impact on the economic aspect of social environment. This potential however can only be ascertained if the cost of production is known to enable the net income to be deduced.

According to a report by the Small-holder Dairy Project of 1999, Kenya produces 3.078 billion litres of milk annually of which only 200 million litres are processed. Of the 3.078 billion litres, 36% is consumed on farm and 64% offered to market as surplus through either individuals or institutions which accounts for 55% of marketed milk, cooperatives, traders, self-help groups and private processors (Neondo, 2002). These percentages compare closely with this study's findings (Figure 8). Urban and peri-urban dairying can therefore be considered an important informal activity that acts as a source of income diversification through sales of surplus produce or savings on food expenditures as dairy products constitute the single largest food expenditure item across all income classes (Argwings-Kodhek *et al.* 2005).

The results presented for food security, employment and income generation fits well with the findings from the broader urban agriculture study by Foeken (2005). Foeken's study gave an indication that urban agriculture contributes to household food and nutritional security, the creation of informal employment, income diversification, and more broadly promotes urban food supply systems. This study not only supports the contribution of general agriculture to those factors, but more specifically the contribution of urban and peri-urban dairy farming to the same.

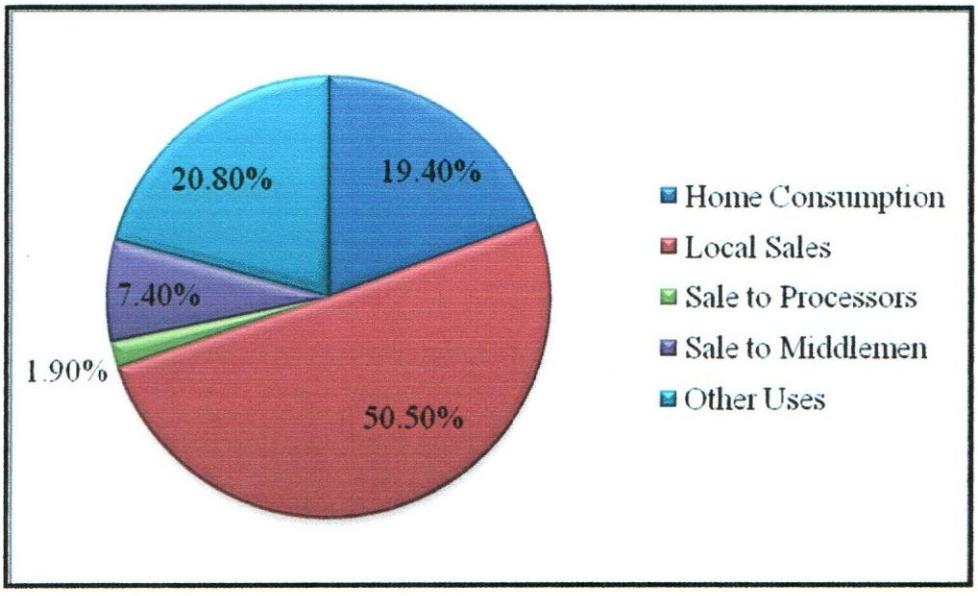


Figure 8: Milk Outlets

4.6.4. Other Motivators

4.6.4(a). Proximity to Ready Market

Consumer preference for raw fresh milk over pasteurized, fermented, powdered or Ultra High Treated (UHT) milk, are reported by the Small-holder Dairy Project report to be as high as 100% even in areas far from farming districts. This has some human health implications in that, normally, after milking, the bacterial count in milk is about 10,000 counts per millilitre. After five hours, this rises to about one million (1,000,000) counts per millilitre. Retention of the basal bacterial count is complicated by the fact that the distance involved in ferrying the milk from farms to consumers is usually long and many consumers always end up with coagulated milk (ibid). The required World Health Organization's bacterial count level is below 500,000 bacteria per millilitre. Milk expresses this by turning sour. The need therefore to have the milk get to the consumer quickly cannot be overemphasized. This has attracted more and more people to practice urban and peri-urban dairy farmers as they have a ready market where they sell fresh whole milk to their neighbours immediately after milking (Plate 3).

However this poses other human health related social environment challenges. While the government has put in place legal frameworks to ensure proper hygiene and quality control and assurance for milk products that flow through large-scale marketing enterprises, through

enactment of Environmental Management and Coordination Act (EMCA, 1999); Public Health Act (Cap. 242); and The Dairy Industry Act (Cap. 366), such assurance for dairy products handled through informal marketing channels has been elusive. Consumption of milk handled through this informal channel can thus be risky to human as it can be a source of zoonotic and/or other transmittable diseases.

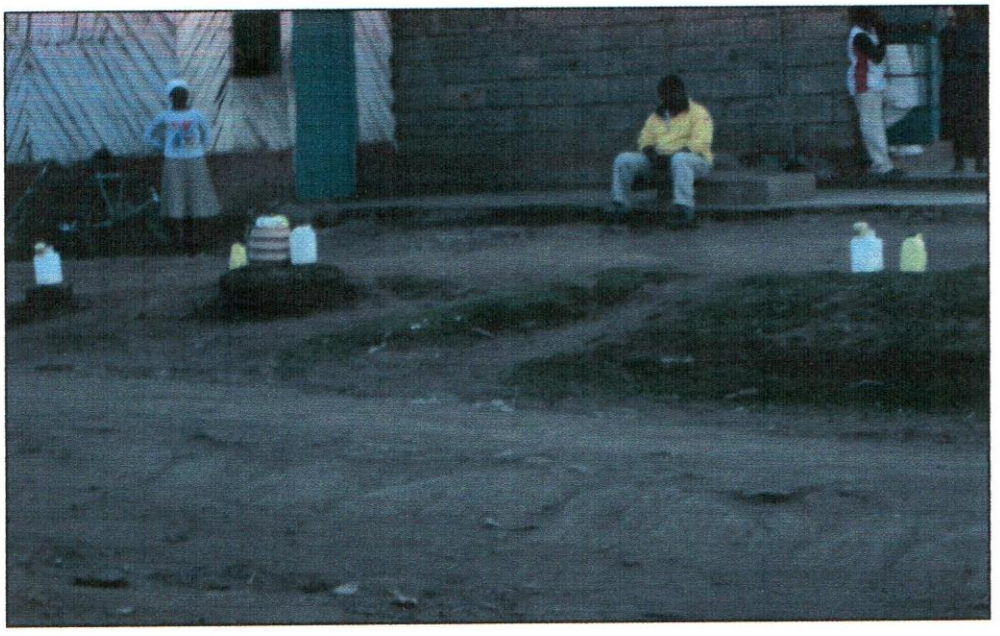


Plate 3: Milk being sold locally.

Consumer preference for fresh raw milk has attracted more and more people to Practice dairy farming near the consumers. ***Source****: Author's Field Survey (2010).*

4.6.4(b). Lucrative Milk Prices

The study showed that about 2943 litres of milk were produced per day. Out of this 2170.5 litres were sold locally as figure 9 above demonstrate. The larger amount of the milk, (77.1%), was sold at between Kshs. 31 and 40 per litre (Figure 9). This had a positive significant effect towards adoption of the practice, ($\chi 2 = 166.536$, $p = 0.000$) (Table 5).

The average price of KShs 35 per litre of fresh raw milk as compared to Ksh100 for a similar amount of processed milk, with a much-reduced butterfat at 2.5%, is favourable to both the producer and the consumer. To the producer the price is higher than that fetched for the same amount in the rural areas or if sold to processors. The consumers argued that the packaged milk is not only expensive, but it also tastes flat. This has created a preference for the raw milk which

they claimed that with only Kshs. 10 one could get enough milk to make tea for a family of three. The money from local sale is also paid promptly as compared to the payment from processors which take time. This has turned urban and peri-urban dairy farming into a thriving economic activity which can be associated to the temporal upward trend observed (Subsection 4.5).

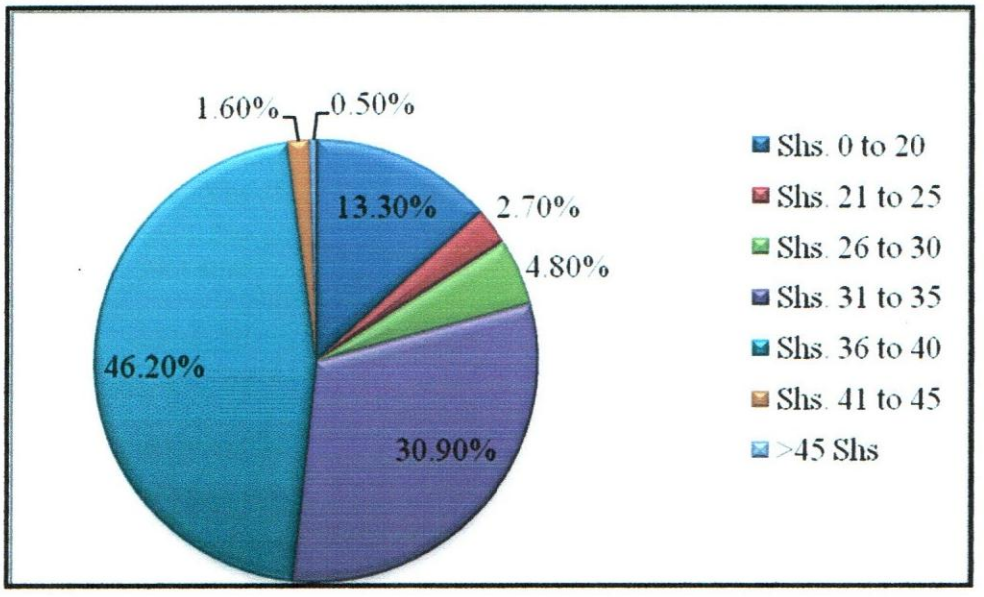


Figure 9: Local Milk Prices

Table 5: Motivators to Practice Urban and Peri-urban Dairy Farming

Factor	Practice		$\chi 2$	p	*Correlation*
	Practicing %N	**Non-practicing %N**			
Food Security			*37.408*	*0.000**	*0.287*
Yes	95.7	72.9			
No	1.6	13.8			
Not sure	2.7	13.3			
Employment			*15.427*	*0.000**	*0.198*
Yes	91.0	76.1			
No	4.8	10.6			
Not sure	4.3	13.3			
Income Generation			*29.147*	*0.000**	*0.249*
Yes	97.3	79.8			
No	0.5	9.6			
Not sure	2.1	10.6			
Milk Prices			*166.536*	*0.000**	
< Shs. 20	13.3	79.3			
Shs. 21 to 25	2.7				
Shs. 26 to 30	4.8	1.6			
Shs. 31 to 35	30.9	9.6			
Shs. 36 to 40	46.3	9.0			
Shs. 41 to 45	1.6	0.5			
>45 Shs	0.5				

* Significant at P = 0.05.

4.7. Social Environment Implications

The parameters analyzed and discussed under this subsection include issues such as human diseases (zoonotic or other human diseases directly related to dairy production), water and air pollution, nuisances such as noise and smell, dairy production based conflicts, interference with environmental aesthetics and issues to do with waste management. Table 8 below summarizes the findings.

4.7.1. Diseases

4.7.1(a). Diseases Causal Awareness

About 50% of the practitioners and 64.9% of the non-practitioners were aware that dairy farming has potential to cause diseases. This had significant effect on the practice, ($\chi 2 = 22.855$, $p = 0.000$) (Table 6).

There are nutritional benefits coming from the products of urban and peri-urban dairy farming, which benefit the health of the urban and peri-urban residents as discussed in subsection 4.6.1. On the other hand, there are related health risks from urban and peri-urban dairy farming, ranging from diseases to chemical poisoning. Zoonotic diseases presenting such risks include brucellosis, taeniasis, echinococcosis, and psittacosis. Other important diseases include rabies, typhoid and brucellosis. Unattended livestock (those allowed to graze, often on refuse, as well as those who are merely strays) are liable to consume industrial effluents or waste products containing heavy metals, which can end up in the human food chain, apart from being hazardous to the animals themselves (Ayaga *et al.*, 2004).

Though the practitioners and non-practitioners were significantly aware that the practice can cause some of these diseases, both categories of respondents however argued that this could only happen if the practice was carried out under unhygienic conditions and/or if due attention was not given to the health of the animals themselves or unhygienic handling of milk. They further argued that this potential is inherent in animals whether kept in the urban, peri-urban or rural areas, and that some of the raw milk consumed in urban areas come from far off rural areas.

These arguments are substantial given the current policy and legal frameworks on milk production and marketing. Milk marketing was liberalized in 1992, leading to the proliferation in the market of private processors and informal traders/hawkers of raw milk. Critical issues that have emerged influencing the development of the sector therefore include, marketing arrangements for private traders, product quality control and assurance (Alila & Atieno, 2006).

The critical issues are collaborated by a survey carried out in Nairobi by New Agriculturist, (2004), which found that very little difference exists in milk quality (based on coliform counts) between licensed and unlicensed traders. Lack of stringent quality control measures compromises the value of milk marketing licensing by the Kenya Dairy Board as required by the The Dairy Industry Act, Cap.366 (New Agriculturist, 2004).

4.7.1(b). Actual Diseases Suffered

Information gathered from hospital attendance records held by the respondents, indicated that 58% of the practitioners and 53.7% of the non-practitioners and other household members commonly suffered from malaria. No other diseases from the records had a prevalence reaching

10%. This interpreted into insignificant contribution of the practice to the diseases suffered, ($\chi 2$ = 6.024, p = 0.197) (Table 6).

The most prevalent disease in the community was malaria. It had 58% prevalence on the practitioners and 53.7% on the non-practitioners. The other diseases included common cold, typhoid and brucellosis in order of prevalence. None of these diseases had a prevalence reaching 10%. The poor environmental conditions observed in the area could be associated with all these diseases. None of the diseases could specifically be blamed on the dairying activity (Plate 4). This could explain the insignificant effect.

The other avenue through which diseases could be passed to human beings is by consumption of unprocessed milk. In Kenya more raw milk than processed milk is consumed not only in the rural areas, but also in the urban centres including Nairobi (Neondo, 2002). No pretreatment of milk before disposal was revealed by this study, however the respondents indicated that boiling the whole milk or as tea before actual consumption is a common practice in homes. The study therefore could not link the dairy farming practice to the diseases currently suffered by Nakuru residents.

Table 6: Contribution of Dairy Farming to Human Health.

Factor	**Practice**		*χ2*	*P*
	Practicing %N	**Non-practicing %N**		
Disease causal awareness			*22.855*	*0.000**
No	28.2	9.0		
Yes	50.0	64.9		
Not sure	21.8	26.1		
Prevalent Diseases			*6.024*	*0.197*
None	27.7	30.3		
Malaria	58.0	53.7		
Typhoid	3.7	6.9		
Brucellosis	1.1	3.2		
Flu (Common Cold)	9.6	5.9		

* Significant at P = 0.05
** Fisher's Exact Test significant at the 0.05 level (one sided)

4.7.2. Increase in Disease Vectors

Out of the three types of flying vector insects studied, only mosquitoes were found to be significantly increased by the practice ($p = 0.009$) (Table 7).

Anopheles mosquito is the vector for malaria which was found to be the most prevalent disease (Table 6). The linkage of this vector with the dairy production activity could not be ascertained since within the study area its proliferation could be associated with the favourable breeding sites such as open sewage channels, open untreated sewage disposal sites, solid waste and vegetation which were observed in the study area (Plate 4).

Table 7: Contribution to the Increase in vector insects

Factor		Practice		*p*
		Practicing %N	**Non-practicing %N**	
Increasing flying insects				*0.902*
	Yes	78.2	77.1	
	No	21.8	22.9	
Increasing houseflies				*0.552*
	Yes	76.6	73.4	
	No	23.4	26.6	
Increasing biting flies				*0.138*
	Yes	8.5	4.3	
	No	91.5	95.7	
Increasing mosquitoes				*0.009***
	Yes	20.2	10.1	
	No	79.8	89.9	

** Fisher's Exact Test significant at the 0.05 level (one sided)



Plate 4: Different open sewage disposal sites in parts of Afraha Division.
Source: Author's Field Survey (2010)

4.7.3. Water and Air Pollution

4.7.3(a). Water Pollution

As regards water pollution, the study revealed that the respondents were significantly aware that the practice can contribute to water pollution, ($\chi 2 = 7.598$, $p = 0.022$) (Table 8). Zero-grazing dairy production can be classified as a point source of water pollution. Contamination of the water resource can be expected to arise from pollutants seeping into the ground or being carried off by surface water runoff (Flynn, 1999).

The urban section of the study area is well served with piped municipal water. This however does not prevent the pollutants emanating from the zero grazing units from contaminating ground water reserves. Therefore though any pollution of the municipal water could on the first instance is blamed on either inefficiency at the water treatment works and/or poor water distribution infrastructure maintenance. Pollutants from diverse sources, including the zero grazing units could seep in through broken points or reach the water sources through contaminated runoff. In the peri-urban areas, where people rely on boreholes or shallow wells for domestic water supply, these may be contaminated directly. Some possible toxic pollutants from the dairy production activity are the agrochemicals used especially for parasites control.

4.7.3(b). Air pollution

The dairy production practice also contributes significantly to air pollution, ($\chi 2 = 12.090$, $p = 0.002$) (Table 8). This in the scope of this study could be associated to the smell emanating from gases emitted from the zero grazing units (Table 9).

Livestock and livestock waste produce gases. Some are local, such as ammonia. Others, such as carbon-dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) affect the atmosphere, by causing 'global warming' or global climate change (Steinfield, 1998).

i. For carbon dioxide the pollution is likely to come from the emissions from the animals during their basic metabolism function or respiration. Carbon emitted this way is estimated at 2.8 billion tons annually worldwide. Also carbon dioxide is emitted from biomass burning especially farm yard manure which in some instances is disposed off this way (*ibid*).

ii. Methane emanating from livestock production is produced as a by-product of the food digestion of mainly ruminants. Of the total 550 million tons of methane produced annually from various sources, livestock and manure management contribute about 16% (US Environmental Protection Agency (USEPA), 1995).

iii. Nitrous oxide is the most aggressive greenhouse gas (320 times CO_2). It is produced in animal manure which contributes 0.4 million tons N per year, or 7% of the total global emissions (Bouwman *et al.*, 1995).

Table 8: Contribution to Water and Air Pollution.

Factor		Practice		χ^2	p
		Practicing %N	Non-practicing %N		
Water pollution				*7.598*	*0.022**
	Yes	5.3	9.6		
	No	43.1	52.1		
	Not sure	51.6	38.3		
Air Pollution				*12.090*	*0.002**
	Yes	16.5	5.3		
	No	42.6	48.9		
	Not sure	41.0	45.7		

** Significant at p = 0.05*

4.7.4. Contribution to Conflicts

The study revealed that the practice significantly contributed to such conflicts such as those related to resource use, and livestock nuisances, ($\chi2$ = 10.278, p = 0.006 (Table 9). On separation, the issues over which the practice had contributed significantly to included nuisances such as proliferation of flying insects (mosquitoes), waste management, noise and smell; while resource related conflicts such as over water, livestock theft and crop destruction were insignificant.

These significant conflicts could be related to the static nature of the production system which acts as point source of the nuisances. The nuisances such as mosquitoes, noise and smell affect people when they enter the atmosphere and land in neighbouring compounds, while waste related nuisances affect people after being poorly managed such as when dumped on roadsides. Households engaged in dairy farming activities within and around the town make use of resources such as land and water. Access to these resources is limited and hence highly competitive and can easily lead to conflicts, not only between the producers; producers and the non-producers; but also between producers and local authorities. However zero grazing as a production system safeguards the animals from directly polluting water, livestock theft or invasion of cultivated land where they could cause crop destruction.

Table 9: Dairy Related Conflicts.

Factor		Practice		$\chi 2$	*P*
		Practicing %N	**Non-practicing %N**		
Cause conflicts				*10.278*	*0.006**
	Yes	60.6	44.1		
	No	31.9	44.7		
	Not sure	7.4	11.2		
Conflict over water					*0.774***
	Yes	14.4	16.0		
	No	85.6	84.0		
Conflict over smell					*0.000***
	Yes	46.3	27.7		
	No	53.7	72.3		
Conflict over noise					*0.002***
	Yes	25.5	12.8		
	No	74.5	87.2		
Conflict over waste					*0.000***
	Yes	40.4	19.1		
	No	59.6	80.9		
Conflict over livestock theft					*0.056***
	Yes	9.0	3.7		
	No	91.0	96.3		
Conflict over crop destruction					*0.177***
	Yes	3.7	7.4		
	No	96.3	92.6		

** Significant at P = 0.05,* *** Fisher's Exact Test significant at the 0.05 level (one sided)*

4.7.5. Waste Management

4.7.5(a). Utilization of Edible Wastes

All the edible organic wastes considered in the study had significant contribution on the practice (Table 10). There was a positive correlation between the two variables.

The wastes included remnants of such products as market and domestic wastes (cabbages, kales, assorted fruits, potatoes that are not fit for human consumption), brewers waste; poultry droppings mixed with litter from poultry pens; and food remnants from hotels and homes (Plates 5 & 6).

The abundance, accessibility and availability of organic wastes and the challenges of their disposal could lead people to adopt the dairy farming practice. When put to use in this way,

the dairy animals play an important role in waste management and nutrient cycling. They convert what could otherwise be considered as useless waste into edible products in form of either milk or meat. The remnants are also turned into farmyard manure which can be used as organic soil fertilizing material for food, flowers and tree production within and without the study area (Figure 10).

However, despite this positive contribution, the physical and chemical safety of the waste being used as animal feed and subsequent health effects on human after consuming products from animals fed on the same remains a grey area.

Table 10: Edible Organic Wastes use in Dairy Production

Factor	**Practice**		*χ2*	*P*	*Correlation*
	Practicing %N	**Non-practicing %N**			
Brewers Waste			*75.421*	*0.000*	*0.437*
Yes	6.4	1.1			
No	93.6	67.0			
Not Sure		31.9			
Hotel Remnants			*73.664*	*0.000*	*0.430*
Yes	4.8	1.1			
No	95.2	67.0			
Not Sure		31.9			
Market Wastes			*97.537*	*0.000*	*0.502*
Yes	35.1	6.4			
No	64.9	61.7			
Not Sure		31.9			
Poultry Waste			*75.606*	*0.000*	*0.451*
Yes	7.4	.5			
No	92.6	67.6			
Not Sure		31.9			



Plate 5: Assorted types of domestic Waste



Plate 6: Poultry Waste

Plates 5 and 6 show two types of waste used as animal feed. ***Source:*** *Authors field survey (2010).*

4.7.5(b). Waste Generation

The study revealed no significant contribution of the practice on the waste generated within the study area, ($\chi 2 = 1.062$, $P = 0.588$) (Table 11s).

Livestock related waste generation and management may be identified as some of the challenges facing urban and peri-urban dairy farming. Poor waste disposal systems as well as the indiscriminate and inappropriate domestic litter disposal habits are common features in semi-urban areas and urban centres of the developing world (Awomeso *et al.*, 2010). This study however did not affirm this observation. Other types of wastes (especially inorganic), observed scattered all over could have masked the waste generated from the dairying activity.

Table 11: Contribution to Waste Generation

Factor		Practice		χ^2	*p*
		Practicing %N	Non-practicing %N		
Waste Generation				*1.062*	*0.588*
	Yes	42.0	42.6		
	No	21.3	25.0		
	Not sure	36.7	32.4		

4.7.5(c). Manure management

To find out exactly how the waste generated and turned into manure was used, the findings were as shown in figure 10. The majority of generators (62%) used it on their own plots while biogas production received the least attention (Figure 10).

Personal observation affirmed this as rarely were heaps of manure observed dumped outside the practitioners' compound but heaps of manure could be seen heaped or in compost pits within the owners' compound. On further probing it emerged that many of the dairy keepers were able to utilize part or all of the waste productively, namely for crop cultivation purposes, either by themselves (on a plot in town or in the rural area) or by their neighbours (Figure 10).

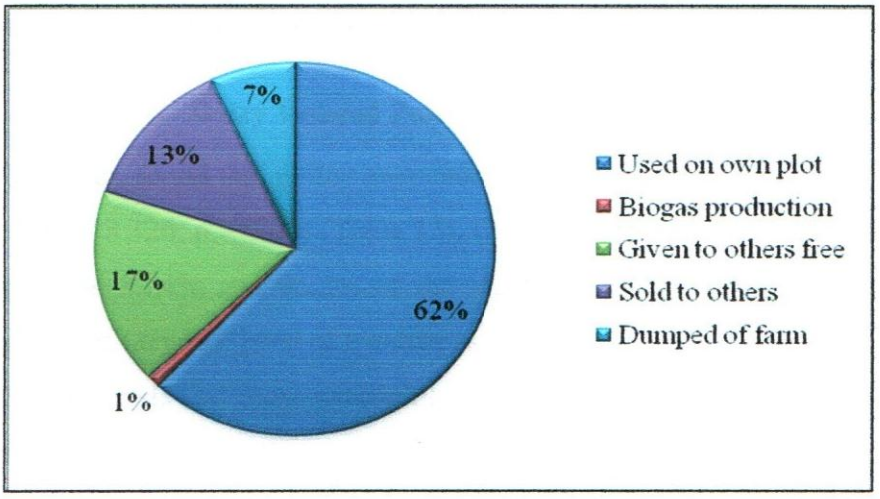


Figure 10: Manure Management.

4.7.6. Environmental Aesthetics

The study revealed significant effect of the practice on environmental aesthetics, ($\chi 2$ = 10.249, p = 0.006) (Table 12).

Social environment could also be impacted upon by way of the physical environmental beauty, (aesthetics), being interfered with. The issues studied included; predation on flowers and other vegetation, littering with muck (droppings), and destruction of infrastructure.

Zero grazing was said to have positive aesthetic effect. Being enclosed the animals do not impart said negative aesthetic effects on the environment. However the manure generated from the units is used as fertilizer while planting trees, food crops, flower beds and grass lawns. In so doing the plants become healthy and green. This practice therefore positively contributes to the photosynthetic capacity of plants and eventual sinking of carbon dioxide leading to a more fresh air environment.

Table 12: Effect on Environmental Aesthetics.

Factor	Practice		$\chi 2$	P
	Practicing %N	Non-practicing %N		
Environmental Aesthetics			*10.249*	*0.006*
Yes	27.1	25.5		
No	33.0	47.9		
Not sure	39.9	26.6		

Significant at p = 0.05

4.8. Policy Implications

4.8.1. Dairy Related Policy awareness

The study found that policy awareness had significant and negative effect on the dairying practice ($\chi 2 = 48.326$, $p = 0.00$) (Table 13). On testing the dairy related policies awareness level, it emerged that 82.4% and 96.2% of the practitioners and non-practitioners respectively had either no idea or very low level of awareness.

This suggests that those practicing urban and peri-urban dairy farming do so oblivious of the implications of the practice on the social environment. Government policies and the legal frameworks arising there from play a crucial role in livestock development (World bank, 1981). They not only affect the economic development, but also directly affect production, marketing, consumption and external trade in livestock products.

Table 13: Policy Awareness Level

Factor	Practice		$\chi 2$	*P*	*Pearson's Correlation*
	Practicing %N	**Non-practicing %N**			
Policy Awareness Level			*48.326*	*0.000*	*-0.354*
No idea	20.7	52.1			
Very low	61.7	44.1			
Low	15.4	3.7			
Moderate	1.6	0.0			
High	0.5	0.0			

4.8.2. Specific Policy Awareness

The study also sought to bring out the awareness level by number of policies or related laws. It was revealed that 37.0%, of the respondents was aware of only one policy or law while 36.4% knew of none (Tables 14 & 15). The statistics as regards individual policy or Acts as presented in Table 15 show that The MCN By-laws 2006; The Local Government Act (Cap.265); The Public Health Act (Cap.242); The Animal Diseases Act (Cap. 364); and The Dairy Industry Act (Cap. 366) were the legal frameworks that had significant effects on the practice.

This could be attributed to the fact that unlike policies which are just guidelines, acts and by-laws have penalty implications if not adhered to. For example the Local Government Act

(Cap.265); gives the council authorities power to formulate by-laws to regulate any development within their areas of jurisdiction; The MCN By-laws 2006, indicates which animals could be kept within the municipality and stipulates the penalties if one contravenes the by-laws; The Public Health Act (Cap.242) requires anybody handling food to have a medical examination certificate; The Animal Diseases Act (Cap. 364), requires livestock keepers to present their animals for compulsory vaccinations especially against notifiable diseases such as Foot and mouth disease and Anthrax; The Dairy Industry Act (Cap. 366) requires any milk trader to have a milk trading license. Another reason which could be attributed to this finding is that the residents, practitioners and non-practitioners, are involved in other activities which expose them to the requirements of these acts and by-laws such as business (Table 2).

Table 14: Awareness by Number of Policies/Laws

Policies' awareness	**Practice**		
	Practicing %N	**Non-practicing %N**	**Total %N**
None	20.7	52.1	36.4
One	38.3	35.6	37.0
Two	23.4	8.5	16.0
Three	11.2	2.7	6.9
Four	4.3	1.1	2.7
Five	1.6	0.0	0.8
Six or more	0.5	0.0	0.3

Table 15: Individual Policy or Act awareness

		Practice			
		Practicing (%)	**Non-practicing (%)**	*χ2 value*	*Fisher's exact test*
N.C.C. By-laws	No	48.5	51.5	*3.234*	*0.104*
	Yes	64.7	35.3		
M.C.N By-laws 2006	No	37.4	62.6	*33.080*	*0.000**
	Yes	67.5	32.5		
EMCA 1999	No	49.3	50.7	*2.846*	*0.174*
	Yes	77.8	22.2		
Local Government Act Cap 265	No	48.0	52.0	*11.436*	*0.001**
	Yes	88.9	11.1		
Public Health Act Cap 242	No	44.4	55.6	*17.451*	*0.000**
	Yes	70.9	29.1		
Animal Diseases Act Cap 364	No	48.1	51.9	*4.626*	*0.023**
	Yes	65.9	34.1		
The Dairy Industry Act Cap 366	No	46.2	53.8	*15.777*	*0.000**
	Yes	77.8	22.2		
Draft National Livestock policy 2006	No	49.6	50.4	*1.826*	*0.372*
	Yes	80.0	20.0		
Dairy Policy 2007	No	49.7	50.3	*0.411*	*0.751*
	Yes	60.0	40.0		
The Water Act 2002	No	50.3	49.7	*0.677*	*0.685*
	Yes	33.3	66.7		

N = 188 for each category and for each response in that category
* Fisher's exact test significant at the 0.05 level.

4.8.3. Effects of Policy/Laws on the practice

The effect of the existing policy and legal frameworks on the practice was revealed to have a significant effect on the practice, ($\chi 2 = 10.809$, $p = 0.004$) (Table 19). Of the respondents 52.9% were unsure of the effects while 34% felt that the legal frameworks had negative affect while only13% felt that the policies had positive effect.

While the growth in Kenya's dairy sector has been heralded as a great success story (Staal & Shapiro 1994), further gains in dairy production and marketing are constrained by a wide range of problems mainly policy related. Many existing dairy related Acts pre-date independence and tend to be discriminative, with standards biased towards the formal sector. However, due to a lack of capacity and resources, implementation of legislation and regulations is generally poor even in the urban and peri-urban areas. This state was echoed by nearly all the stake holding ministries, departments or institutions within the study area.

The speed at which policies are revised even when found wanting is also another area of major concern. For example, the first formulation of the Dairy Development Policy for Kenya began in 1993 after liberalization in the dairy industry earlier the same year. The policy revision exercise was later rejuvenated in 1997 and again in 2000. And yet, even after wide stakeholder consultations in 2000, the pace of policy revision has been slow and the proposed Dairy Act remains unresolved (New Agriculturist, 2004). The National livestock Policy which was in force before the current one was developed in 1980 but with the introduction of the Structural Adjustment Programmes (SAPS), in the early 1990s that emphasized market liberalization the policy kind of became obsolete. Even up to the time of this study the Dairy Industry Development of 2006 and the National Livestock Policy of 2008 were still in draft form (MoLD, 2007; MoLD., 2008).

Table 16: Effects of legal framework on Practice

Factor	Practice		Total %	$\chi 2$	*P*
	Practicing %N	**Non-practicing %N**			
Effect of Policy on Dairying				*10.809*	*0.004*
Positive	16.5	9.6	13.0		
Negative	38.8	29.3	34.0		
Not sure	44.7	61.2	52.9		

CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

i. Urban and peri-urban dairy farming is an activity that is practiced by all classes of people irrespective of age, sex, income level, education level or occupation. Without change of attitude as regards the activity might make the activity to continue being done behind enclosed compounds and therefore difficult to detect and monitor.

ii. Land ownership is a key determinant on whether one is to adopt the activity or not. People who own land with title are more likely to adopt urban and peri-urban dairy farming that those living on hired premises.

iii. The upward trend that was indicated by the research findings is not likely to change given the tendency of the people migrating from rural to urban areas.

iv. Through the dairying activity the households produced their own milk some of which they consumed and sold the balance. This generated and/or freed up scarce cash that would have otherwise gone towards purchase of more expensive milk and food. Some of the cash added to the household savings which were used for other investments or in offsetting other household bills. Urban and peri-urban dairy keeping therefore has great potential in contributing to the livelihoods of the people living in towns and cities around Kenya. From the results presented under both socio-economic and technological factors, there are all indications that the practice will be an important undertaking in the future.

v. Information generated through this study also confirmed that the arguments under which the livestock keeping is outlawed by the municipal authorities were significant. However the levels to which animals kept under zero grazing contributed to such issues as water and air pollution was not ascertained. In line with these findings, the study recommends that, for sustainable production, policy change for a guided / regulated promotion of the same is necessary to avoid any negative impacts that may arise in the future out of the "clandestine" way under which it is currently practiced as a precaution measure.

vi. It also came out that though there are policies which are operationalized by a number of acts of parliament and by-laws, they are not well understood and

internalized by the residents and so they are only either ignored or viewed as having negative effect on the urban and peri-urban dairy farming activity.

5.2. Recommendations

5.2.1. Legalized but guided dairy farming

Legalizing the dairy farming activity so that it is carried out in an open and transparent manner. This would encourage the practitioners to seek immediate help when needed and/or to report any suspicious issue to relevant authorities. This can be achieved through zoning of the urban and peri-urban areas and allowing the dairy farming activity to be practiced under certain conditions. For example, the number of cattle should be bound to a certain maximum and should only be kept under zero-grazing in the designated zones.

5.2.2. Attitude Change

Being an activity that is likely to continue whether recognized or ignored by planners it's a better option to integrate it in development plans. Integration of urban and peri-urban dairy farming in urban planning include:

i. The recognition that dairy farming is not only a rural activity but a community accepted form of urban and peri-urban land use as well
ii. The understanding that urban and peri-urban dairy farming is an important economic activity for many urban dwellers
iii. The conviction that urban and peri-urban dairy farming has to be incorporated in any future town planning exercise
iv. Adopting a fruitful working relationship between the municipal authorities, other stakeholders and the community.

5.2.3. Extension services provision improvement

The area of technology transfer is limited and needs improving. The key players on this matter are the Municipal authorities and the extension officers of the Ministry of Livestock Development, private sector extension service providers, NGOs, Kenya Dairy Board and public health officials.

5.2.4. Improving Community Policy awareness

The level of policy awareness state was found to be very low. There is need to intensify policy awareness especially after legalizing the practice. This would be to ensure that the, guiding principles put in place are adhere to by the current and future practitioners as well as ensuring a clean and safe environment for all. These guidelines should be disseminated to residents regularly and clearly to ensure safe, efficient and effective urban and peri-urban dairy production.

5.3. Addressing further research needs

As with other researches, this study has raised further research concerns:

i. While currently the waste generated from the units has not posed as a problem, continued production may overwhelm the land on which it is applied or kept. Research on how it can be processed and marketed through the formal outlets as is the case of inorganic fertilizers is called for.

ii. The contribution to air and water pollution as a direct result of urban and peri-urban dairying need to be assessed in order to isolate and quantify it from other sources of pollution such as industrial effluents and gases.

iii. Dairy cattle take a substantial amount of water which is otherwise meant for domestic use. A study to assess the current use and the projected water needs is required in order to advice the municipal planners and water service providers on what and how to incorporate the same in the future plans.

iv. A study on the potential of biogas production from the waste generated from the zero-grazing units as an alternative energy source for the urban people is necessary.

v. There is need for a study to look at the quality of the wastes fed to animals, milk from animals fed on the wastes and its effect on human health

vi. An economic survey is required in order to ascertain whether the activity is cost effective or not.

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APPENDIX I

Questionnaire for Community Members - (Those keeping/not keeping Dairy cattle).

Circle the choice that corresponds to your reply and fill in the dotted space where applicable.

I. Personal Information

1. Name (optional).....

2. Address (a) Telephone contact (optional)..... (b) Locality.....

3. Sex (a). Male..... (b). Female.....

4. In which age bracket are you in? (i) Below 18 yrs (ii) 19-30 years (iii) 31-40 years (iv) 41-50 years (v) 51-60years (vi) Above 60 years

5. What is your relationship with the household head? (i) Self (ii) Spouse (iii) Son/Daughter (iv) Livestock manager/attendant (v) Other (specify).....

II. Socio-Economic status

6. What is your level of education? (i) Never been to school (ii) Primary (iii) Secondary (iv) College (v) University

7. What is the household income level? (i)Low (ii) Medium (iii) High

8. (a) Do you hold any leadership position? (i) Yes (ii) No

   (b) If yes, where? (i) Community groups (ii) Church (iii) Provincial administration (iv) Legislative (v) Local authority (vi) Other (specify).....

9. What is your Occupation/Career/Employment? (i) Farmer (ii) Business person (iii)Teacher (iv) Civil servant (v) Private company employee (vi) Other (specify).....

10. Religion (i) None (ii)Christian (iii) Muslim (iv)Other (specify).....

11. Farm/plot size (specify).....(In acres)

12. Farm/plot ownership (i) Squatter (ii) Borrowed (iii) Rented (iv) Communal (v) Own without title (vi) Own with title (vii) Other (specify).....

III. Information on Livestock (For those practicing dairy farming)

13. (a) Do you keep any livestock? (i) Yes (ii) No

(b) If yes, what types of livestock do you keep? (i) Dairy cows (ii)Beef cattle

(iii) Goats (iv)Sheep (v) Poultry (vi)Others (Specify).....

14. Number of cattle

(i) Milk..... (ii)Beef..... (iii)Other (specify).....

15. What is the average cost of a cow in this area (Ksh)?

(i) Millk..... (ii)Beef..... (iii)Other (specify).....

16. Herd ownership (i) Individual (ii) Group (iii)Other (specify).....

17. How many cows are you milking? .....

18. What is the average amount of milk produced (Litres) per cow per day? .....

19. How do you utilize or dispose your milk? (i) Home consumption

(ii) Sold on farm to neighbours (iii) sold to middle men (iv) Sold to processors

(v) Others (Specify).....

20. What amount of milk do you:

(i) Consume at home.....(litres)?

(ii)Sell locally.....(litres) and price per litre.....(KSh)?

(iii)Sell to middle men.....(litres) and price per litre.....(KSh)?

(iv) Sell to processor eg KCC.....(litres) and price per litre.....(KSh)?

(v)Other (specify)..... (litres) and price per litre.....(KSh)?

21. (a)Do you subject your milk to any form of treatment before sale? (i) Yes (ii) No

(b) If yes, which? Specify. Eg Boiling .....

22. (a) Do you do some value addition before disposal? (i) Yes (ii) No

(b) If yes which? (i) Packaging (ii) Fermenting (iii) Yoghurt (iv) Other (Specify).....

23. What is the main source of feed/fodder for your cows?

(i)Grown on own farm.....acres (ii) Grown on rented farm..... acres

(iii)Bought..... acres (iv) Other(specify)..... acres

24. (a) Do you feed your cow(s) on any other feed apart from fodder? (i) Yes (ii) No

(b) If yes, Specify which. (i) Brewers waste (ii) Hotel left-overs (iii) Raw market goods waste (iv) Poultry waste (v) Hay (vi) concentrates (vii) Others (Specify) .....

25. What is the main source of drinking water for the animals?

(i) Municipal piped water (ii) Dam (iii) River (iv) Own bore-hole or well

(v) Rain water harvesting (vi) Water vendors (v) Other (specify).....

26. What is the price of water (KSh)? ..... (specify unit eg per litre; 20 Lt. Jerry can or 200 Lt. drum.

IV. Technological issues (Non practitioners to fill relevant questions only).

27. (a) Livestock production system (i) Zero grazing (Fully enclosed in shed) (ii)Semi zero grazing (sometimes enclosed in shed) (iii)Full time grazing on farm

(iv) Full time grazing off farm (v) Other (specify).....

(b). If you do not own a zero grazing unit, which is the most significant reason?

(i) Not aware of the technology (ii) Lack of money (iii) Lack of construction skills (iv) Lack of interest (v) Other (specify).....

(c). If you own one, what made you adopt the technology? .....

28. Who was the first zero grazing technology promoter that you came into contact with?

(i) None (ii) Government officer (iii) N.G.O. (iv)Church

(v) Constructor (vi) Financial Institution (vii) Other (specify).....

29. (a) How many animals can your unit hold? .....

(b) Width of cubicles (i) Less than 1 meter (ii) 1 to 1.5 meters (iii) Over 1.5 meters

30. What is the estimated cost of constructing the zero grazing unit? (KSh.).....

31. (a) Did you get financial assistance on construction of the unit? (i) Yes (ii)No

(b). If yes from who/ where/ Ratio? Who.....Where.....Ratio.....

32. When did you start using your unit? (State year) .....

33. (a).Is it currently in use? (i) Yes (ii) No

(b). If no when did you stop using it? (i) Less than 1 yr. (ii) over 1 yr

(iii) Other (specify).....

(c). Which is the most significant reason for the operation failure?

(i) Lack of feed (ii) legal Issues (iii) nuisance in compound

(iv) Other (specify).....

34. Who feeds the cows? (i) Household member (ii) Cattle attendant (iii) Other (specify)...

35. (a) How convenient is this system to you? (i)Very convenient (ii) moderately convenient (iii) Not convenient

(b) If convenient, how? .....

36. (a) Do you receive extension services? (i) Yes (ii) No

(b) If yes, who provides these services to you? (i) Government officer (ii) Consultant (iii) NGO (iv) Other (specify) .....

(c) How regularly do you receive these services?

(i) Once a month (ii) once in three (3) months (iii) once in six (6) months (iv) Once in a year (v) Other (specify).....

V. Policy/ Environmental issues (for both practicing and non-practicing)

37. (a). Dairying contributes to family food security?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

38. (a). Dairying contributes to employment?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

39. (a). Dairying contributes to family income?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

40. (a). Dairying contributes to waste management?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

41. How do you manage/use the solid waste (manure) generated from dairy cows?

(i) Use it on farm (ii) Biogas production (iii) Give it free to others (iv) Sell to others (v) Burn (vi) Dump on roadside (vii) Discharge into waterways (viii) Discharge into sewerage system (ix) Other (specify .....

42. (a). Do you think dairying contributes to water pollution? (i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

43. (a). Do you think dairying contributes to air pollution? (i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

44. (a) Dairying contributes to conflicts over resources and environment? (i) Yes (ii) No (iii) Not sure

(b). If yes, conflicts are centered on what? (i) Water (ii) Odour (iii) Noise (iv) Waste (v) Flies (vi) Diseases (vii) Other Specify.....

45. (a). Are you aware that dairying could contribute to human diseases? (i) Yes (ii) No (iii) Not sure

(b). If yes, which? .....

46. (a) Which are the common ailments that the members of this household suffer from? (Please refer to your medical records and can tick more than one). (i) Malaria (ii) Brucellosis (iii) Typhoid (iv) Rabbies (v) Bovine tuberculosis vi) Other Specify.....

47. (a). Do you think dairying contributes to increase of flying insects? (i) Yes (ii) No (iii) Not sure

(b). If yes, which? (i) House flies (ii) Biting flies (iii) Mosquitoes

(iv) Others (specify) .....

48. (a). Do you think dairying contributes to detriment of environmental beauty?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

49. (a). Of the following policies/laws, which ones are you aware of?

(i) County Council of Nakuru By-Laws

(ii) Municipal Council of Nakuru Environmental Management By-Laws (2006)

(iii) Local Government Act (Cap. 265)

(iv) Environmental Management and Coordination Act (EMCA 1999)

(v)Public Health Act (Cap 242)

(vi) The Animal Diseases Act (Cap 364)

(vii) The Dairy Industry Act (Cap 366)

(viii) Draft National livestock policy (2006)

(ix) Dairy Policy (2007)

(x) The Water Act of 2002

(xi) Other (specify) .....

50. (a). In your view how have these laws/policies affected your dairying practice or intention to practice?

(i) Positively (ii) Negatively (iii) Not sure

(b) Briefly explain your answer.....

51. In your opinion on the above laws/ policies, which and what should be done to the policy/ law in order to make dairying in this area more environmentally friendly?

(i) .....

(ii) .....

(iii) .....

END

THANK YOU FOR YOUR CO-ORPERATION.

APPENDIX II

Questionnaire for policy Holders

I. Respondent details

1. Name (optional).....

2. (a) Ministry/Local Authority..... (b)Department.....

3. Telephone contact (optional).....

II. Policy and environmental Issues

4. Are you aware of any dairying production within the urban and peri-urban areas of Nakuru Municipality? (i) Yes (ii) No

If the answer to question 4 is yes, in your view:-

5. (a). Does dairying contribute to family food security?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

6. (a). Does dairying contribute to employment?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

7. (a). Does dairying contribute to family income?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

8. (a). Does dairying contribute to waste management?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

9. (a). Does dairying contribute to water pollution?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

10. (a). Does dairying contribute to air pollution?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

11. (a) Does dairying contribute to conflicts?

(i) Yes (ii) No (iii) Not sure

(b). If yes, conflicts are centered on what? (i) Water (ii) Odour (iii) Noise

(iv) Waste (v) Flies (vi) Diseases vii) Other Specif.....

12. (a). Does dairying contribute to human diseases? (i) Yes (ii) No (iii) Not sure

(b). If yes, which are the common diseases that are most prevalent in these areas?

(i) Malaria (ii) Brucellosis (iii) Typhoid (iv) Rabbies (v) Bovine tuberculosis

vi) Other Specify.....

13. (a). Does dairying contribute to increase of flying insects? (i) Yes (ii) No (iii) Not sure

(b). If yes, which? (i) House flies (ii) Biting flies (iii) Mosquitoes

(iv) Others (specify) .....

14. (a). Does dairying contribute to detriment of environmental beauty?

(i) Yes (ii) No (iii) Not sure

(b). If yes, how? .....

15. Of the following policies/laws, which ones are within your mandate?

(i) County Council of Nakuru By-Laws

(ii) Municipal Council of Nakuru Environmental Management By-Laws (2006)

(iii) Local Government Act (Cap. 265)

(iv) Environmental Management and Coordination Act (EMCA 1999)

(v)Public Health Act (Cap 242)

(vi) The Animal Diseases Act (Cap 364)

(vii) The Dairy Industry Act (Cap 366)

(viii) Draft National livestock policy (2006)

(ix) Dairy Policy (2007)

(x) The Water Act of 2002

(xi) Other (specify) .....

16. (a). In your view are these policies/laws well implemented? (i) Yes (ii) No

(b). If Yes, do they meet the institutional environmental management objectives? (i)Yes (ii) No

(c). If No, please identify the gaps.

(i).....

(ii).....

(iii).....

(iv).....

(v).....

17. In your view how have these policies/laws affected the dairying practice?

(i) Positively (ii) Negatively (iii) Not sure

(b) Briefly explain your answer.....

.....

18. In your opinion what should be done to the policy/ law within your mandate in order to make dairying in this area more environmentally friendly?

(i).....

(ii).....

(iii).....

END

THANK YOU FOR YOUR CO-ORPERATION.

APPENDIX III

Personal Observation Schedule

Respondents Name.....

Locality.....

1. Type of house .....

2. Presence and type of transport.....

3. Breed of the dairy animals.....

4. Presence of a zero grazing unit.....

5. Presence of waste scattered in the compound.....

6. Presence of a waste disposal pit.....

7. Presence of animal waste dumped on roads.....

8. Presence of flies.....

9. Presence of fodder/pasture in the compound.....

10. Presence of other edible waste for livestock.....

11. Presence of a feeding trough.....

12. Presence of a watering trough.....

APPENDIX IV

Research Permit

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telegrams: "SCIENCETECH", Nairobi
Telephone: 254-020-241349, 2213102
254-020-310571, 2213123.
Fax: 254-020-2213215, 318245, 318249
When replying please quote

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref: NCST/RRI/12/1/SS/371

Date: 19th May, 2010

Edward Waithaka Kimani
Egerton University
P.O Box 536
Egerton

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Impact of Urban and Peri- Urban dairy Farming on Social Environment and Policy in Nakuru Municipality Kenya"*** I am pleased to inform you that you have been authorized to undertake your research in ***Nakuru District*** for a period ending ***31st December, 2010.***

You are advised to report to ***the District Commissioner and the District Education officer of Nakuru District*** before embarking on your research project.

Upon completion of your research project, you are expected to submit two copies of your research report/thesis to our office.

P. N. NYAKUNDI
FOR: SECRETARY/ CEO

DISTRICT COMMISSIONER
RECEIVED
DATE 28.5.2010
P.O. BOX 81 NAKURU.

Copy to:
The District Commissioner
Nakuru District

The District Education Officer
Nakuru District

Acknowledged

DISTRICT EDUCATION OFFICER
NAKURU

28/5/2010