WASTE MANAGEMENT IN URBAN AND PERI-URBAN INTENSIVE DAIRY PRODUCTION SYSTEMS. A CASE STUDY OF MAKINDYE AND SSISA SUB COUNTIES

BY
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2010
DECLARATION

I, Kisaakye Steven, hereby declare that this dissertation is my original work and has never been presented to any institution of higher learning for academic assessment. Where works of people have been used, acknowledgements have been duly made.

Signature .......................... Date..............................

Kisaakye Steven

CANDIDATE
DEDICATION

This dissertation is dedicated to my mother, Mrs Nabwire Irene, for all her efforts in paying for my education.
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This study was made possible by efforts and encouragements from a number of people to whom I say thanks a lot. Special thanks go to the almighty God, and to my mother who made sure I pursue a post graduate course.

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God bless you all
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ACRONYMS

LSD : Least Significant Difference

NEMA: National Environment Authority

NGOs : Non Government Organisations

SS : Significantly different

NS : No Significant difference
ABSTRACT

Smallholder dairy production is increasingly becoming recognised by urban and peri-urban dwellers as an important source of income. Previously, some farmers used to practice smallholder dairy production as a hobby however, as farmers begin to realise its benefits it is then considered a commercial activity. Although intensive smallholder dairy production is a valuable source of income and nutrition for numerous households, the wastes generated from the cattle management units has potential to become hazardous to the communities.

The major aim of this study was to assess the status of waste management in intensive urban and peri-urban dairy production systems in Ssisa and Makindye sub counties. Specifically to; estimate the quantity of wastes generated from intensive dairy production systems in the dry and wet seasons, study the effect of location on waste management in urban and peri-urban areas, assess the effect of dairy cattle waste management methods on fodder yields and milk production, and finally to identify options for improving dairy cattle waste management in the study area.

The study employed both quantitative and qualitative methods of data collection and studied 100 farms in six parishes. Three parishes were selected from each sub county to ensure that both urban and peri-urban households were represented.

The overall number of cattle in the study area was 285 including improved and indigenous of which 132 were in urban settlements while 153 were in peri-urban settlements. Of the cattle above 230 were improved while 55 were indigenous.
The research showed that, wastes from intensive dairy production systems was 25% higher in the wet season than in the dry season in both urban and peri-urban settlements. There was less utilisation of the wastes in farmlands by urban households as compared to peri-urban households. Urban farmers heaped the wastes in anticipation of selling them. The heaped wastes affected close neighbours in terms of odour and overflows mostly in wet seasons. On the other hand, some peri-urban farmers composted and applied the waste in gardens and fodder plantations. The study results also indicated that location in terms of urban or peri-urban settlements does not affect waste management. In addition, when the wastes were applied as manure, they had effects on both crop and milk yield.

As such, suggested strategies for improving waste management included, research into more uses of the wastes from intensive dairy production systems, monitoring of dairy cattle production units, government intervention through policy formulation and implementation, registration of farmers and formation of farmer groups to aid marketing of the wastes for manure use. The above strategies could help improve smallholder dairy waste management however, this is also dependant on individual attitudes of the farmers and hence waste management sensitisation would also be a critical requirement.
CHAPTER ONE

1.0 Background

1.1 Role of livestock in urban and peri-urban farming systems

The Ugandan dairy sector is developing rapidly over recent years and is dominated by small-scale farmers owning more than 90% of the national cattle population. Due to market forces and higher competition for production factors, smallholder dairy production systems are intensifying, necessitating proper understanding of the new production tendencies (Oghaiki et al., 2007).

In smallholder production systems which are dominant in urban and peri-urban areas, livestock are important because they provide direct cash income. They are capital assets, cash supplements to low income earners (Kabirizi, 2006). They also produce wastes which can be used as fertilizer to improve crop and livestock production and fuel. In Uganda livestock production contributes 30% of the agricultural Gross Domestic Product with about 7 million heads of cattle, 8 million goats, 1.6 million sheep, 2.1 million pigs and 26 million poultry birds (UBOS, 2007). In Eastern Uganda, livestock production is a means of transportation and cultivation. Production of milk for human food is however the basic reason for livestock keeping for urban and peri-urban small holder farmers as a source of income from milk sales (De Leew et al., 1996).

The annual growth rate of population by 2020 is projected to be 3.2% in developing countries where rapid population growth and urbanization will fuel a strong increase in demand for milk in the developing world (Walshe et al., 1991). It is projected that the population of Sub-Saharan Africa will increase by 3.1% and is expected to reach 675
million people, and almost double by the year 2025 (Winrock International, 1992), resulting in; scarcity of land, labour and high land prices.

Asia is also experiencing similar trends in most of its humid regions due to the strong growth in demand for animal products and better access to feed resources, and other types of infrastructure (Staal, 1995). Milk production is important particularly in south Asian countries due to growing demand in the region favorable policies that many governments have created for the dairy sector (Cees De Haan et al., 1996). Similar peri-urban production systems operate in Africa (Staal, 1995), where over 70% of the milk is sold directly to consumers mainly from small landless enterprises located within the city (Deborah, 1992; Kabirizi, 2006).

1.2 The role of dairy and status of dairy waste management in urban and peri-urban farming in Uganda

Smallholder dairy production is a major source of milk in Uganda, and significantly contributes to nutrition, food security, incomes for producers, processors, traders and retailers along the dairy value chain, and manure for soil fertility improvement and crop production (Ndwani, 1998).

With per capita; output of about 40 litres, dairy production plays a central role in the nutrition and health of many Ugandan households. (DDA, 2002), Due to the small land holdings associated with increasing population in Uganda, the intensive dairy cattle production has been promoted and successfully introduced among small scale farmers, women and orphans for optimal utilization of their land. Smallholder farmers own over 90% of the national population (1.1 million) of improved dairy cattle (Oghaiki et al., 2007). More than 50% of improved dairy cattle breeds with high milk production
capacity in Uganda are kept under the zero-grazing system. These production units are also major sources of wastes which are both beneficial to farmers but can become a threat to the environment if not well managed (Namono, 2006).

1.3 Problem statement

Smallholder dairy farming is practiced in urban and peri-urban areas for various reasons ranging from augmentation to tradition by those who find themselves engulfed by the expanding city boundaries.

Makindye and Ssisa sub-counties located in Wakiso district are some of the fast developing areas around Kampala, the capital city of Uganda. This brings about land use conflicts between agriculture and construction of residential structures which are a necessary requirement for the increasing population as the city boundaries approach the area.

In order to improve household nutrition, incomes and food security among the growing population in Makindye and Ssisa sub-counties, Government and Non Government Organizations (NGOs) have introduced intensive dairy cattle production based on improved or exotic breeds with elephant grass as a major forage (Muwanga, 1994). The initial beneficiaries of the project, who were mainly women, pass on the first in-calf heifer to another woman. As such, smallholder women farmers own over 60% of about 2 million improved dairy cattle in Uganda (Kabirizi, 2006).

The intensive smallholder dairy systems or commonly known as “Stall-feeding or zero grazing” production system generate large quantities of waste products which include
dung and feed refusals. These waste products have to be removed from the cattle unit and transported to agricultural land if they are to be used as manure (Namono, 2006). Alternatively, the wastes have to be treated to avoid contamination of the environment since inappropriate waste disposal causes environmental and public health problems. Environmental problems associated with peri-urban dairy farming include contamination of water, soils and plants by animal waste and elements of production such as water, feed additives and foul gases which do not reach their target (Lekasi et al., 2001).

The extent to which dairy farming impacts on the environment in Uganda is generally not known and no comprehensive research has been carried out to determine problems associated with the activity. Studies carried out on dairy farms in Masaka, Jinja and Mbarara showed that only 2% of the waste from zero grazing stalls was applied to crops and fodder fields (Mubiru, 2008). This indicates that that the remaining 98% of the wastes could become a source of environmental pollution. Currently, the status of dairy waste re-use and disposal around Kampala is not established. As such, with the current upsurge of intensive urban and peri-urban dairy units around Kampala there is need to understand their waste disposal mechanisms and challenges, and identify options for improvement. To address the problems resulting from urban and peri-urban dairy farming systems, it is necessary to quantify the wastes produced and methods of their disposal or management. Therefore, the overall objective of this study was to assess the status of waste management in intensive dairy production systems in the study area which would help in devising means for solving the related problems.
1.4 Research objectives

The broad objective of this study is to assess the status of waste management in intensive urban and peri-urban dairy production systems as a means of identifying strategies for improvement.

1.4.1 Specific objectives

a) To estimate the quantity of dairy cattle waste generated from intensive smallholder dairy production systems in the dry and wet seasons.

b) To study the effect of location on dairy waste management in urban and peri-urban areas.

c) To assess the effect of dairy cattle waste management methods on fodder yields and milk production.

d) To identify options for improving dairy cattle waste management in the study area.

1.5 Justification of the study

Existing evidence of the negative impacts caused by dairy cattle waste management on water sources, public health and generally the environment (Malongo, 1997) calls for a more detailed analysis of the problem. Research is necessary to understand how this problem will develop with increasing intensive dairy cattle production systems overtime (Gundel, 2002). This study will provide a basis for development of environmentally friendly waste management strategies and a basis for further investigation into zero grazing waste management. The results from this study will be significant for the following;
a) Stimulating further research into the uses and possible benefits that can be derived from the wastes mainly the dung, besides the application in gardens.

b) Incorporation of efficient dairy waste management systems into the farmers' curriculums.
CHAPTER TWO

2.0 Literature review

2.1 Dairy wastes generated from smallholder dairy production systems

Wastes from stall-feeding production systems comprise of dung, urine and feed refusals from the animals, which are determined by feeds (quality and quantity) and feed management systems, health status and the breed of the animal (Kabirizi, 2006). The amount of manure produced by a single animal is also a function of age, body weight, sex, and body size as was determined by Namono (2006) in her study that the manure produced by a cow, bull, heifer, and a calf varied where their daily wastes were 27, 24, 20 and 6.6 kilograms a day respectively.

2.1.1 Feeds as determinants of dairy cattle waste produced in zero grazing systems

Feeds are major determinants of the manure produced per animal though in urban areas their availability is limited by the land area possessed by individual farmers who at times have less than an acre or even none for fodder cultivation (Kabirizi, 2006). This is a major constraint because land is one of the basic resources and it leads to the nutritional factor as a binding constraint to increasing milk production in smallholder dairy production systems mostly in the tropics (Saka et al., 1994; FAO, 2001; Ndikumana and Kamid, 2004). Due to limited land, smallholder farmers have limited land available for forage for their animals and often do not have the luxury of being able to select the basal diet. They therefore use whatever is available and at a low cost (Leng, 1990; Kabirizi, 2006). Low quality feeds were defined by Leng (1990) as those forages with less than 55% digestible organic matter (DOM) and are deficient in true
protein (less than 80g/Kg) and low insoluble sugar and starches (usually less than 100g/Kg). Wastes from intensive dairy production systems therefore vary with seasons with more wastes in the wet season due to availability of new flourishing pastures and enough water which are usually scarce during dry seasons (Malongo, 1997).

2.1.2 Major feed resources in smallholder dairy production systems

2.1.2.1 Natural and planted pastures

Natural pastures consist of grasses such as *guinea grass*, *Hyperhhenia spp*, finger grass, *signal grass*, *Imperator* grasses from swamps and *fox tail*; forage legumes (Boonman, 1993; Samanya, 1996). Grasses grow rapidly during the rains and set seeds before the dry seasons (Kabirizi, 2006). The above scenario leads to the rise and drop in crude protein content to less than 7% which is below the maintenance requirement of the ruminant animal (NRC, 2001). As a result the animals gain body weight in the rains and lose it by 15-20% in the dry season. The seasonal gain and loss in weight of the cattle results in poor patterns accompanied by low productive performance and low milk yields of 3-4L/Cow\(^{-1}\)day\(^{-1}\) (Nsubuga, 1993).

Planted pastures on the other hand involve planting forages such as fodder trees, grasses and forage legumes (Boonman, 1993; Saka et al., 1994).

Cultivated forages have a superior feeding value to that of native (Boonman, 1993). However the concept of cultivated pastures is not well adopted in developing countries including Uganda even if the conditions are favorable due to high establishment cost, unfavorable land use rights and non-competitive prices for livestock products in the face of cheap dairy imports (Kabirizi, 2006). The above leads to dependence on natural
forage, which is unreliable thus affecting animal productivity (Mubiru et al., 2001).

2.1.2.2 Crop residues
Mixed crop-livestock production occurs virtually throughout the farming systems of Uganda which results from the declining crop yields per unit area accompanied by progressively increasing requirement for food. This forces the farmers to cultivate more land thus increasing the production of crop residues. There is a heavy reliance on the use of the by-products as feeding during the dry season immediately after harvest (Kabirizi, 2006). Crop residues mainly include sweet potato vines, banana peelings and pseudo stems which are given to the cattle as supplements to elephant grass fodder and commercial feeds in dry season and their absence means a decline in waste production.

2.2 Waste management in zero grazing systems of urban and peri-urban areas
Waste management is the planned and organized management of wastes from different sources in an environmentally and economically sound manner (Nakiryowa, 2006). It encompasses all the processes from waste production, storage, and transportation to disposal or reuse in other areas like gardens (Ngategize, 2002). Manure components and decaying organic matter are natural components of the environment that ultimately contribute to the production of more plant and animal tissue (Van Horn et al., 2008).

2.2.1 Waste management methods
Urine waste from zero grazed cattle is in some cases collected in constructed drainage pits through a drainage channel. Cattle urine is an important raw material for the production of liquid manure. It is kept in cool conditions and stirred every after three
days, for two months. After this time ash is applied and the manure can be used in gardens after mixing it with water at the ratio of 1:2 with (Muwanga, 2005).

Composting is another alternative though mostly applied to manure from dairy farming systems in developing countries. It is a mixture of dung, left over feeds, plant material, ash and water which are covered for some time under controlled temperatures. The temperature is expected to increase in a compost pile due to the breakdown of organic material by micro organisms (Sandeen et al., 2008). The maximum composting rate occurs when the temperature is between 110°F and 150°F. It has been shown that temperatures of 131°F for three days will kill all, parasites, weed seeds, and disease causing organisms. It is important to turn the piles frequently to ensure that all parts of the pile are exposed to these temperatures (Muwanga, 2005; Sandeen et al., 2008).

The dung requires frequent removal from the stalls to avoid piling, which poses a threat to the animals however these processes are labour intensive. As a result, most of the farmers in urban and peri-urban area employ people to take care of their animals (Balalo) and women headed households mostly do this.

2.2.2 Consequences of improper waste management

Waste in stall feeding systems is a major problem in the developing world (Maxwell et al., 1992). The case is not different with Uganda's major urban and peri-urban areas as limited treatment takes place and much of it is deposited in public places despite the adverse impacts on both the environment and public health (Namono, 2006).

In poor management systems, waste is dumped in heaps and when it rains, the waste is washed into surface water systems and into near by gardens as. Namono (2006) from a study done in Kampala argues that 51% (n=94) of the households heap loose dung
near houses, 11% dig pits in which they put the dung but when they are filled, manure is always heaped and overflows. This is very true mostly in areas where the farmers sell the manure and the buyers take large amounts. In the process of waiting for the manure to accumulate, it is heaped to the extent that it overflows. The often occurs in the wet season, which poses a danger to the environment.

The cost of manure disposal can be a precursor to the environmental problems. A study by Foeken and Owour (2000) in Nakuru, Kenya showed that one third of the farmers dump part of all the manure in the streets. This practice was found to be more common among the keepers of a few animals than among those with many cattle. It was more among poorest households (49%), and was attributed to limited land for manure application. In some cities, urban livestock production has reached large numbers that are regarded as industrial.

The sustainability of industrial dairy units with limited land but high capital input as manure disposal creates problems as questioned by Orskov (1994) in his study in Sri Lanka.

In the United States of America the Environmental Protection Agency (EPA) has identified impaired agricultural runoff including nutrients from livestock waste as the largest contributor to pollution (Langham et al., 1998).

Mismanagement of wastes often leads to direct discharge of liquid waste to waterways. This causes serious eutrophication of rivers and lakes, characterized by a high concentration of nutrients that creates an ecological imbalance in the water system.
because it supports abnormally high levels of growth of algae and aquatic plants for example water hyacinths (Burton, 1997). This decreases oxygen levels in the water and has a serious implications on the survival of other organisms in the system and, consequently, on food supply and biodiversity (Burton, 1997). Direct discharge of manure to water ways and percolation to ground water, usually in by-pass flow via cracks and fissures, is a great risk to human and animal health because livestock manure contains numerous pathogens (bacteria, viruses, parasites). Some of these may be transmitted to man, and can cause systemic or local infections, for example *Escherichia coli*, *salmonella*, *Nipah virus* and *Rotavirus* (WHO, 2000).

Transmission of pathogens is enhanced by inappropriate management of animal manure and may be reduced by proper manure handling and use (Fischer et al., 2000). Unsanitary handling of waste may also promote the spreading of parasites to man by introducing larval stages into the food chain. Reviews on the current status of parasitic diseases in Vietnam, including consideration of food borne trematode zoonoses and cystercosis have highlighted the risks of disease transmission through animal manure and human excreta (De et al., 2000). High contagious and pathogenic diseases, such as foot and mouth disease may also spread with animal effluent through water ways and, when one farm is infected with the disease, farms downstream will also be at considerable risk of infection (Cameron et al. 2000). It has not been completely proven, but poor management, the mixing of human and animal excreta, and the close contact between domestic and animal housing may propagate influenza (WHO, 2000).

Dairy waste management varies with distance in many urban areas where farmers in peri-urban areas have more uses for the wastes as compared to urban farmers
(Malongo, 1997). In peri-urban areas waste is applied in gardens and power generation system however urban farmers are limited by land availability.

2.2.3 Dairy cattle housing in relation to waste management

Dairy cattle housing is a major determinant of how the wastes from stalls are managed. Dairy cows are kept in houses with concrete or earth floors with straw bedding where concrete floors are cleaned by water while earth floors are usually cleaned by spades, brooms and hoes at times (IAEA, 2008)

2.3 Effect of dairy cattle waste on fodder and milk production

2.3.1 Effect on fodder production and feed availability

Integration of animal and crop farming is one way of overcoming environmental problems resulting from livestock production although crops and soils can only absorb and utilize nutrients to a certain level. Excessive application of livestock manure on land occurs in areas of limited space, leads to loading of nutrients into the environment (Huijsmans et al., 2003). Drainage of animal waste into waterways leads to increase in the nutrient content of water and may lead to eutrophication of water bodies with subsequent implications for fish and other water dwelling organisms (Chambers et al., 2001).

On the positive side however, manure from zero grazed dairy farms is a great contributor to soil fertility where by there are such minerals like potassium and nitrogen which enrich the soils. This was emphasized by Ndyanabangi and Zaramba (1998) in their study that the animals contribute to the diet inform of milk and manure (42%), which implies that manure is very important since people own small tracts of land in
urban and peri-urban areas. This land is over cultivated due to the food demands by the households.

Manure nutrients and decaying organic matter are natural components of the environment that ultimately contribute to the production of more plant and animal tissue. Thus, concern about manure leakage is no different than concern about commercial fertilizer use. Manure is in fact a resource, based largely on its equivalence with commercial fertilizer, and should not be called a waste when it is recycled through new plant growth (Van Horn et al., 2008).

Information available in literature indicates that manure is of variable composition and its quality and quantity varies with diet of the animals (Malongo, 1997), Up to 95% of the total plant nutrients consumed by livestock are excreted in urine and the dung (Powell et al., 1993). Whereas most nitrogen is voided in both urine and the dung, most phosphorous is voided in the dung. However, most of the nitrogen voided in urine can be lost via volatisation and leaching while little dung nitrogen is lost via volatisation (Roselle, 1992).

Besides enriching the soils, manure from dairy systems is very important in improving the water holding capacity of the soil (Muwanga, 2005). The above comes along when the manure particles cement together soil particle and this in turn avoids the loss of both moisture and water to the atmosphere through evaporation or to lower soil horizons through fast leaching. Existing data on manure application rates have very wide ranges and there is no definite rate of manure application for different crops/cropping systems. Rates used in Botswana on arable land varied from 2.5 and 15 (1965) and up to 50 tonHa⁻¹ in 1978 (Herbert, 1983).
In the semi arid eastern Kenya,Ikombo (1984) reported that the application of farmyard manure at the rate of 8 tonsha\(^{-1}\) appeared to give high and consistent yields, close to that obtained with applying the standard rate of mineral fertilizer, indicating that this supplied maize plants with enough nutrients.

However, it is important to note that as the manure together with other fodder refusals are composted and dried, the salt concentration of the mix can increase which may affect some plants which are very sensitive to soil salinity and may be damaged by compost used as fertilizer (Sandeen \textit{et al.}, 2008). Also after composting, most of the nutrients must be mineralized in the soil before they are available to the plants for example 15\% of the nitrogen is available in the first cropping season which might be a problem especially if the field requires a lot of such nutrients in the first year however they become available in the following years (Sandeen \textit{et al.}, 2008).

Environmentally friendly management of livestock wastes and manures should be an integral part of efforts to improve the sustainability of agriculture because all the stages involved are inter related implying that one affects the other for example experience in Europe and the United States of America shows that, land application of livestock manures for fertilization of the crops and grasslands and for improvement or maintenance of soil fertility is the most suitable method of manure utilization (IAEA, 2008).
2.3.2 Milk yield and productivity in urban and peri-urban intensive smallholder dairying systems

Market-oriented urban and peri-urban dairy production systems are emerging as important components of the overall milk production system in different countries of the tropics (Staal et al., 1996). These systems contribute immensely towards filling the large demand-supply gap for milk and milk products in urban centers, where consumption of milk and milk products is remarkably high (Rey et al., 1993). An example is the total milk production from dairy farms in Addis Ababa which amounts to 34,649,450 litres per annum (Azage et al., 1998). Of this, 73% is sold, 10% is left for household consumption, 9.4% goes to calves and 7.6% is processed mainly into butter and ayib (Azage et al., 1998).

The large demand for milk on the one hand and the small supply of milk and milk products for the major urban centers in the developing countries on the other hand shows the untapped potential for the development of urban and peri-urban dairy farms (Rey et al., 1993). Market-oriented smallholder peri-urban dairy production systems have a tremendous potential for development and could play a significant role in minimizing the acute shortage of dairy products in urban centers (Ghirotti, 1999). Current increases in economic pressure, competition for limited resources and market forces have led to an increase in the level of intensification in these production systems (Namono, 2006).

In order to sustain high milk productivity and profitability, high levels of management in appropriate feeding, health care, and reproductive activities are essential (Kabirizi, 2006). These urban and peri-urban dairy farms are currently facing new challenges associated with intensive production systems. Availability of land, management skills,
labour force, feed and water resources and feeding systems, genetic improvement, control of diseases and parasites, udder health and mastitis, calf mortality, reproductive problems, waste management, quality control, public health, processing and marketing and other socio-economic considerations are becoming important factors influencing and determining the survival of these production systems (Schiere et al, 2001).

2.3.2.1 Effect of wastes from intensive dairying systems on milk yield

Wastes from intensive dairy systems affects milk yield indirectly through its application on fodder (Kabirizi, 2006). The after effects of well prepared manure from wastes of cattle in intensive smallholder units involves dung, urine and feed refusals when applied in fodder plantations, contributes to the quality and quantity of milk produced (Waters-Bayer, 1995). This applies to farmers who have enough land for fodder and dairy cattle production mostly in peri-urban areas and also have an opportunity of using the wastes derived from their stalls (Czech, 2005). However, if applied in the right procedures, manures from intensive dairy systems enrich the soils which results in improved fodder quality and quantity. This could therefore, contribute to reduction in the challenge of dry season feed shortages on dairy farms.

2.4 Waste processing, manure application and the environment

Livestock production systems are intensifying worldwide, particularly in urban and peri-urban areas. As a result, livestock waste is emerging as a serious environmental and public health concern (Maria, 2006).
Livestock waste disposal is to a large extent a problem where animal husbandry is practiced in restricted spaces. Improper handling of such waste is a health hazard to both the livestock keepers and sometimes to the neighbours whose privacy may be violated by smell or streams of livestock wastes flowing into their compounds (Anon, 1997). Diseases related to improper hygiene have become prevalent in some homes keeping animals like cattle and pigs, which include intestinal worms, jiggers, and diarrhea (Namono, 2006). This is very true considering the fact that most of the farmers do not attend animal workshops and thus their management skills for these animals are poor implying that they stay in dirty housings. This may lead to their contraction of diseases, which they can in turn pass on to the family members.

According to the WREN media (Sept 2003), improper waste management also means a problem of disease and living in such close proximity to animals always brings a risk of zoonoses, such as bovine tuberculosis, brucellosis and cysticenosis. With lack of education and limited access to information, symptoms of many zoonotic diseases continue to be confused by malaria and often remain undiagnosed and thus untreated.
CHAPTER THREE

3.0 Materials and methods

3.1 Introduction

This section gives an overview of the materials and methods that were used to conduct the study. It describes methods used to collect data, entails the area and population of the study area and it gives a description of the process that were used in selecting the study population, sampling strategies, and data analysis.

3.2 Study area

The study was conducted in six (6) parishes (Seguku, Ndejje, Bunamwaya, Kitende, Bweya, Namulanda) of Ssisa and Makindye sub counties located in Wakiso District.

3.2.1 Wakiso district

Wakiso district lies in the central region of Uganda, bordering the districts of Luwero and Nakaseke in the north, Mukono and Kampala in the east, Mpigi and Mityana in the west, and Kalangala lying in Lake Victoria to the south (Appendix 1).

3.2.2 Location and human population

Wakiso is the second-most populated district in Uganda with a total population of 957,280 people (UBOS, 2002). It has a total area of 6273 square kilometers. Its proximity to the largest lake in Africa (Lake Victoria) has made it a major destination for tourists and investors.

The district is divided into 13 sub-counties, three (3) town councils (Kira, Nansana and Wakiso) and two Municipal Divisions. It has a total of 135 parishes and 676 villages of
which some are semi-urban surrounded by the city characterized by slums, poorly planned structures and poor garbage disposal. The other rural areas basically rely on subsistence agriculture characterized with both urban and peri-urban settlements; it is the second most populated district in Uganda with the population of about 975,280 people (UBOS, 2002) and with an average density of 206 peopleKm$^{-2}$ (Nuwagaba et al., 1995).

3.2.3 Climate, soil type and Vegetation

The minimum surface temperature of the district is 11$^\circ$C with a maximum temperature of 33.3$^\circ$C (NEMA, 2004). There is little variation in temperature throughout the year. With two temperature peaks, one from the months of January to May and the other from July to September.

Soils in Wakiso district are generally sandy clayey which are of high productivity. The dominant soil types are red gravely loam with occasional murram, reddish brown sandy loam on red clay loam and yellowish sands with quartz grave. The soils in the wetlands include grey sands whose parent material is alluvium and hill wash, grey coarse sand from lake deposits, black and grey clays from river alluvium and peat sands and clay formed from papyrus residue and river alluvium (NEMA, 2004).

The vegetation in Wakiso district ranges from medium altitude evergreen forest, through medium altitude moist semi-deciduous forests, savannas, and swamps. Wakiso has over twenty government forest reserves with a total area of 6,773 ha. Most of the land in the district is mailo (private) land with a lot of deforestation. All the reserve forests have experienced illegal forest activities such as charcoal burning, encroachment, pit sawing
and firewood cutting. There is a lot of deforestation because of the high population density and poverty around the forest. The Savannah type in Wakiso is characterized by a mixture of trees, shrubs and tall grass growth. The grass cover, which is not grazed, exceeds 80cm in height. The more open form of such vegetation is referred to as tree and shrub savannah while the closed form, as savannah and the wood vegetation. The Wakiso Wetlands are shallow, and seasonal. Sometimes they are dry and flooded in the dry and rainy seasons respectively. There are some permanent wetlands as well and these are found in Entebbe municipality and Busiro County along the shores of Lake Victoria.

3.2.4 Livestock production in Wakiso district

The district has a livestock population of: about 33,387 local cattle, 23,873 breeds, exotic/improved cattle breeds, 21,752 goats, 49,074 pigs and the district has a total of 32,677 farmer households (NEMA, 2004). Most households keep cattle for dairy purposes and the supply is usually vended to the near by community. This has greatly helped in improving the nutritional needs as well as supplementing the family earnings. Few cattle are kept for beef purposes although occasionally some are sold to the various abattoirs/butcheries in and around Kampala.

The study focused on manure management in urban and peri-urban intensive dairy production systems and the population of study consisted of one hundred farmers. They were sampled mainly with the help of information obtained from veterinary personnel in the area.
3.3 Research design

The study adopted both qualitative and quantitative methods of data collection. This was intended to gather substantial information on dairy waste management in the study area upon which interpretations, summaries, conclusions, and recommendations would be based.

The study attempted to analyze or identify: waste generated from small holder dairy production systems in the wet and dry seasons, effect of location on dairy waste management and the effects of manure disposal on fodder and milk production. Questionnaires and data sheets were used to collect data from the farmers while the qualitative design involved in depth interviews with dairy farmers, and through direct observation.

3.4 Sampling techniques;

3.4.1 Study population

The area under study comprised of farmers practicing zero grazing in the parishes which have the largest numbers of dairy farmers. The list of farmers was obtained from veterinary officers who are familiar with the study area.

3.4.2 Selection of parishes

Six parishes were randomly selected from the 19 parishes in both Makindye and Ssisa found in Wakiso district. Selection was done randomly as all the parishes had urban and peri-urban settings and dairy farmers were distributed fairly equally across the parishes. In this case, parishes in Makindye Sub County represented the urban while those in
Ssisa Sub County represented peri-urban households. Seguku trading centre was taken as the starting point while calculating distances as it is nearer to Kampala.

3.4.3 Selection of households

The study focused on households engaged in zero grazing activities in the area of study. One hundred households were purposively selected from the six parishes. This ensured that urban and peri-urban settings were well represented, and sufficient data required for the study was collected.

3.4.4 Estimation of waste produced and feeds given to stall fed dairy cattle in the study area

To determine the total waste generated from the feeding stall, the total number of animals in the study area was used. This was followed by categorizing the animals according to age and breeds.

The wheelbarrow technique was used by asking the farmers how many wheelbarrows they produce per day, which were then converted into kilograms because most of the farmers do not weigh the wastes from their Stalls. However, as anticipated the problem encountered was that most of the farmers do not keep records therefore in such situations, dairy wastes were estimated in terms of spades and wheelbarrows because they could remember how many wheel barrows of manure are removed from the animal housing daily.

The researcher spent a day with each farmer both during the dry and wet season to determine how much manure is produced from the Stalls and also observing the general situations that were considered necessary for the study. A standard wheel
barrow of wastes was taken to weigh 36 kilograms to be used by the researcher on all farmers.

Farmers had varying sizes of feeding troughs however a standard weight of 16 Kilograms of chopped fodder was used for each trough after observing that most of the feeding troughs were filled with four basins while a basin of chopped fodder weighs 4 kilograms.

3.4.5 Use of scores for waste management
Scores mainly from 1 to 3 were used while quantifying observed data for example sanitation to aid in statistical analysis of the data. In this case the ascending order was used taking 1 to represent the least or poor while 2 and 3 represented improvements.

3.5 Questionnaires
Data was collected using a questionnaire [Appendix 2] that was individually administered. The questionnaire was structured to obtain information about farmer characteristics, resource endowments, labour, housing, feeds and feed management, types and sources of feeds used during the wet and dry seasons disease control, major constraints to dairy cattle production and environmental issues like diseases resulting from poor manure management.

The questionnaire was basically designed for farmers practicing zero grazing and on environmental issues the dairy farmers were asked whether they experienced problems resulting from manure disposed and if they thought there was any form of pollution or threat from their farming activities.
3.6 Observations and recording

Observations and recording were used mostly for the second objectives where photos were taken and used to show the different ways which farmers manage their wastes (Appendix 3). Physical observations of the surroundings of the households including odour emanating from livestock were also be recorded. This included neighbours who thought they are affected by the works of the farmers. Photos of different methods of manure disposal were taken.

Recording was carried out using data sheets during the dry and wet seasons and on them, the breed, age and status of the cows were recorded along with the amount of manure produced in the respective seasons.

3.7 Interviews

Interviews with key informants focused mostly on the source and type of feeds, environmental issues and major constraints in the stall-feeding dairy production systems. This covered the opportunities for the livestock production in the urban and peri-urban areas. Key informants included: science researchers specializing in natural resources management and/or animal nutrition and various veterinary officers in Wakiso district.

3.8 Secondary data

This was obtained from the Uganda National Bureau of Statistic, District veterinary officer, legal officers about animal populations in the area of study and the area of study. Records from the veterinary offices were used to locate the households keeping dairy cattle for sampling.
3.9 Data analysis

Data processing involved summarizing the data from farmers to produce syntheses that could be analyzed to test the study hypotheses. Descriptive analysis, t-tests and Least Significant Difference tests were done to study differences and trends in the data collected.

Qualitative data from key informants was systematically analyzed across major variables and broad categories developed to differentiate and discuss ideas expressed from generalizations, making summaries, and where appropriate, make comparisons. Quantitative data from questionnaires and data sheets was coded and analyzed using Statistical Package for Social Sciences (SPSS) and GENSTAT (Discovery edition 3 7.0) to attain the different tests.
CHAPTER FOUR

4.0 Results

4.1 Household-head characteristics of farms in the study area

4.1.1 Age of farmers

The results indicated that intensive stall feeding dairying was mostly carried out by the elderly people (40-50 years and above) in all locations as shown in Table 4.1.

<table>
<thead>
<tr>
<th>Age of farmers (years)</th>
<th>Urban (n=50) (%)</th>
<th>Peri-urban (n=50) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-30</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>30-40</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>40-50</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>50-60</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>60 and above</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

The largest percentage of farmers belonged to the age group of 40-50 with an equal (34%) percentage of respondents while the lowest percentage (16%) of farmers in the age bracket of 30-40 years though of those 10% belonged to urban while 6%, peri-urban areas. Unlike any of the other age groups, the age groups of 60 years and above, and 40-50 years had an equal proportion of farmers both in the urban and peri-urban areas. The proportion of farmers was 10 and 4% higher in the urban than in the peri-urban areas in the 20-30 and 30-40 years age groups respectively. The largest disparity in proportion of farmers between the urban and peri-urban areas was in the 50-60 years age group.
4.1.2 Sex of the household heads

Survey results indicated that there were 50% more female than male-headed households (Figure 4.1). There were more female-headed households in the urban areas than in the peri-urban areas.

Figure 4. 1: Proportions of female-headed and male-headed households among the study farms in Ssisa and Makindye sub counties

Fifty one percent of the male headed households were located in urban areas and 49% in peri-urban areas. On the contrary, female-headed households in peri-urban areas were 2% higher than those in urban areas.
4.1.3 Education levels and farming experience of the farm

**Household-heads**

The level of education for household heads in urban areas was higher than those in peri-urban areas. It can be seen from the percentages of farmers who attained both tertiary and university academic levels where peri-urban respondents were less by 26% and 8% respectively (Table 4.2). However the number of household heads who had not attained any formal education was higher in urban areas by 2%. Households in peri-urban areas were more experienced in terms of intensive smallholder dairy production than those in urban areas. Male-headed household heads in urban areas had less experience (less by 2%) than those in peri-urban areas.

**Table 4. 2: Education level and farming experience of household heads on study farms in Ssisa and Makindye sub counties in Uganda**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Study area</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban (n=50)</td>
<td>Peri-urban (n=50)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No formal education</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>10</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Secondary lower</td>
<td>12</td>
<td>6</td>
<td>26</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Secondary upper</td>
<td>4</td>
<td>4</td>
<td>14</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>36</td>
<td>4</td>
<td>20</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

| **Farming experience (years)** |  |  |  |  |
|---------------------------------|  |  |  |  |
| 1-5                             | 20 | 6 | 18 | 18 |
| 5-10                            | 38 | 18 | 40 | 6 |
| 10-15                           | 12 | 2 | 14 | 2 |
| 15-20                           | 2 | 2 | 2 | 0 |
| 20-above                        | 0 | 0 | 0 | 0 |
4.1.4 Major sources of income for urban and peri-urban intensive dairy farmers

Survey results indicated that a majority (44%) of respondents in urban areas were civil servants. A few (8%) households earned their living from crop production. In peri-urban areas, 15% of the respondents were engaged in private business while 18% earned their income mainly from sale of cattle products.

4.1.5 Livestock types and distribution on the study farms in urban and peri-urban areas

Overall, cattle on the study farms totaled 285 heads, out of which 46% were in urban and 54% in peri-urban areas (Table 4.3).

Table 4.3: Cattle types and distribution in urban and peri-urban areas of Ssisa and Makindye sub counties in Uganda

<table>
<thead>
<tr>
<th>Breed/ types</th>
<th>Overall</th>
<th>Urban</th>
<th>Peri-urban</th>
<th>Significance (0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indigenous</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cows</td>
<td>37</td>
<td>15</td>
<td>22</td>
<td>SS</td>
</tr>
<tr>
<td>Calves</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>NS</td>
</tr>
<tr>
<td>Bulls</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>SS</td>
</tr>
<tr>
<td>Heifers</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>NS</td>
</tr>
<tr>
<td>LSD(_{0.05})</td>
<td>1.883</td>
<td>5.381</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Improved</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cows</td>
<td>164</td>
<td>76</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>Calves</td>
<td>42</td>
<td>19</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Bulls</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>NS</td>
</tr>
<tr>
<td>Heifers</td>
<td>16</td>
<td>9</td>
<td>7</td>
<td>SS</td>
</tr>
<tr>
<td>LSD(_{0.05})</td>
<td>3.882</td>
<td>6.245</td>
<td></td>
<td>SS</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD(_{0.05})</td>
<td>7.17</td>
<td>9.64</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Indigenous (local) breeds made up 19% of the total cattle on the farms with about 42% of the indigenous cattle found in urban areas and 58% in peri-urban areas. The study
results showed that 81% of the cattle were improved breeds implying that they were either cross or exotic breeds. Out of the improved breeds, 47% were found in the urban areas while 53% were found in peri-urban areas. Basing on overall total cattle on the study farms, bulls comprised 5% of the numbers. Cows comprised 70.5% of the total cattle studied of which, 45% of them were in urban while 55% in peri-urban areas. Heifers and calves contributed 7% and 18% respectively to the overall cattle numbers.

4.2 Dairy cattle waste management and stall sanitation

Dairy cattle waste is mainly composed of dung, urine and fodder residues from the feeding stalls (feed refusals). Daily estimated waste from the study area (Table 4.4) showed that overall percapita wastes from the peri-urban farms was 34.4% and 39.4% higher than that from the urban in both the dry and wet seasons. Wastes produced from both the urban and peri-urban farms was higher in the wet than in the dry season by 25%.

Table 4. 4: Daily wastes from intensive urban and peri-urban dairy production systems of Ssisa and Makindye sub counties

<table>
<thead>
<tr>
<th>Location</th>
<th>Season</th>
<th>Mean daily waste (DM) KgFarm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>Dry</td>
<td>33.8</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>42.8</td>
</tr>
<tr>
<td>Peri-urban</td>
<td>Dry</td>
<td>69.9</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>98.6</td>
</tr>
<tr>
<td>LSD₀.₀5</td>
<td></td>
<td>1.78</td>
</tr>
</tbody>
</table>

Ninety percent of the farmers in peri-urban areas collected cattle’s urine through drainage channels to pits while the 10% did not manage the urine in any way. The above percentage was higher than that of farmers in urban areas who were only 74%. Seventy two percent of the farmers in urban areas removed the waste from the stalls
using spades while 20% used brooms and 8% used hoes. In peri-urban areas, 46% of farmers used spades while 14% the least used brooms.

During the study cleanliness of the feeding stalls was observed and study results indicated that 42% of the feeding stalls in urban areas were very clean (Table 4.5), 46% of the stalls were fairly clean while 12% of the stalls were very dirty. On the contrary, only 4% of the stalls in peri-urban areas were very dirty, 42% of the stalls were fairly clean while 54% of the stalls were very clean.

Table 4. 5: Scores for stall cleanliness and waste management in urban and peri-urban areas of Makindye and Ssisa sub counties in Uganda

<table>
<thead>
<tr>
<th>Study area</th>
<th>Urban (n=50)</th>
<th>Peri-urban (n=50)</th>
<th>Significance (0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine management Respondents</td>
<td>37</td>
<td>45</td>
<td>SS</td>
</tr>
<tr>
<td>Drainage pit</td>
<td>37</td>
<td>45</td>
<td>SS</td>
</tr>
</tbody>
</table>

Cleanliness of the stalls at the time of study $(r = 0.158)$

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>20</td>
<td>23</td>
<td>6</td>
</tr>
<tr>
<td>Peri-urban</td>
<td>30</td>
<td>21</td>
<td>27</td>
</tr>
</tbody>
</table>

Management of dung $(r = 0.464)$

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Peri-urban</td>
<td>30</td>
<td>44</td>
</tr>
</tbody>
</table>

(a) Cleanliness of the stalls: 1-Poor 2-Medium 3-Good
(b) Dung management: 1-Poor 2-Good
(c) $r$ - Correlation coefficient
(d) SS – Significantly different, NS - No significant difference
The largest proportion of farms with poor waste management involving overflowing cattle waste was found in urban households with 14% more households than in the peri-urban case.

There were conflicts recorded between the farmers and their neighbors in 20% of the households in peri-urban areas while in urban areas 55% of the farmers experienced conflicts which involved quarrels with their neighbors in extreme cases where the wastes overflowed to their homes. Thirty percent of the households experienced cases of hooves rotting in peri-urban areas and 20% of the farmers in urban areas also experienced the same problem.

### Table 4.6: Effect of distance on waste management on diary farms in urban and peri-urban areas of Ssisa and Makindye sub counties in Uganda

<table>
<thead>
<tr>
<th>Distance from main town (Km)</th>
<th>Mean waste management score</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>1.97</td>
</tr>
<tr>
<td>2-5</td>
<td>2.4</td>
</tr>
<tr>
<td>5-10</td>
<td>2.31</td>
</tr>
<tr>
<td>LSD$_{0.05}$</td>
<td>0.62</td>
</tr>
</tbody>
</table>

Definition of Scores: 1- Poor, 2-Medium, 3-Good

Waste management varied with location where best waste management was observed in households located in 2-5 Km range while households in the range of 0-5 Km poorly managed their wastes.

### 4.2.1 Hired labour use

Survey results indicated that only 54% of the farmers in urban areas and 58% in peri-urban areas used hired labour (Table 4.7). The results also indicated that most of the
labour (34%) used in urban areas was permanent while in peri-urban areas casual labour (38%, n=50) was mostly hired (Table 4.7).

In urban areas labour was hired by almost all households as the results indicated that the same percentage (28%) of the labour hired was meant to remove and transport wastes from the feeding stalls, also for fodder production and management. Twenty percent of the hired labour in peri-urban areas was for milking, 18%, for removal and transportation of the wastes, while 16% of the labour was hired for fodder production and management.

Table 4. 7: Proportion of farms in Urban and Peri-urban areas employing labour and major activities handled by hired labour on dairy farms in Ssisa and Makindye Sub counties in Uganda

<table>
<thead>
<tr>
<th>Labour</th>
<th>Urban (n=50)</th>
<th>Peri-urban (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent</td>
<td>34</td>
<td>20</td>
</tr>
<tr>
<td>Casual</td>
<td>20</td>
<td>38</td>
</tr>
<tr>
<td>No hired Labour</td>
<td>46</td>
<td>42</td>
</tr>
</tbody>
</table>

Activities for hired labour

<table>
<thead>
<tr>
<th></th>
<th>Urban (n=50)</th>
<th>Peri-urban (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal and transportation of wastes</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Milking</td>
<td>34</td>
<td>20</td>
</tr>
<tr>
<td>Fodder production &amp; management</td>
<td>28</td>
<td>16</td>
</tr>
</tbody>
</table>

4.2.2 Number of household members and household transport facilities

In urban areas, 60% of the households had family members numbering 4-8 (Table 4.8). There were no households with members above 14. The largest number (80%) of households in peri-urban areas had members ranging from 4-8. The proportion of households with less than 3 members in urban areas was more than twice that in peri-urban areas.
Wheel barrows were the most abundant transport facilities among the study households. Sixty eight per cent and 72% of the respondents in urban and peri-urban respectively owned a wheel barrow. Motorcycles and motor vehicles were the least abundant transport facilities with less than 3% of the farmers in urban and peri-urban areas owning a motorcycle or a motor vehicle.

**Table 4. 8: Number of household members and transport facilities on dairy farms in urban and peri-urban areas in Ssisa and Makindye sub counties in Uganda**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Study area</th>
<th>Urban (n=50)</th>
<th>Peri-urban (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>percentages</td>
<td></td>
</tr>
<tr>
<td><strong>Household members</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 3</td>
<td></td>
<td>36</td>
<td>14</td>
</tr>
<tr>
<td>4-8</td>
<td></td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>8-13</td>
<td></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>14-18</td>
<td></td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Transport availability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle</td>
<td></td>
<td>16</td>
<td>44</td>
</tr>
<tr>
<td>Motorcycle</td>
<td></td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Pickup</td>
<td></td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>Motor-vehicle</td>
<td></td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Wheel barrow</td>
<td></td>
<td>68</td>
<td>72</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

**4.2.4 Land size and utilization**

Sixty eight percent of the farmers in urban areas had less than 0.4 ha of land. Farmers with such small plots of land in urban areas doubled those in peri-urban areas (30%), while 50% of the farmers in peri-urban areas had relatively larger land areas of 0.8-2 ha. Twenty percent of the farmers in urban and 10% in rural areas had plots of 0.4 ha.
Over 60% of the households in both urban and peri-urban areas had their feeding stalls located less than 10 meters from the residential houses. The highest (30%) number of farmers with feeding stalls located more than 20 meters was in peri-urban areas.

The results showed that 92% of the respondents in urban areas had their land divided into less than three plots while 2% had their land divided into 5-10 plots. In peri-urban areas, 68% of the farmers had land divided into 4-6 plots while 8% had their land areas divided into 5-10 plots.

It was also observed that 57% of the farmers had feeding stalls with concrete and/or slates but 24% of the units had murram and graded floors, 18% not done (without grading or leveling) and one farmer had a raised wooden floor.

4.3 Feed types given to dairy cattle in the study area

The feed type offered by the largest proportion of farms was the homemade concentrates while maize stover was the least used feed (Table 4.9). The largest difference between the proportion of farmers using any of the specified feed types in the urban and peri-urban areas was that for the elephant grass and concentrates combination which was 22% higher in the urban areas compared to the peri-urban situation.
Table 4.9: Proportion of farms offering the various specified feed types and their combinations to dairy cattle in urban and peri-urban areas in Ssisa and Makindye sub counties in Uganda

<table>
<thead>
<tr>
<th>Feed types</th>
<th>Location</th>
<th>Urban (n=50)</th>
<th>Peri-urban(n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop residues</td>
<td>Percentage</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Planted elephant grass fodder</td>
<td></td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Elephant grass from public land</td>
<td></td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Crop residues, elephant grass and commercial feeds</td>
<td></td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>Elephant grass and concentrates</td>
<td></td>
<td>38</td>
<td>16</td>
</tr>
<tr>
<td>Crop residues and elephant grass</td>
<td></td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Maize stover</td>
<td></td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Concentrates</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home made concentrates</td>
<td></td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Maize bran</td>
<td></td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Commercial dairy meal</td>
<td></td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Cotton seed cake</td>
<td></td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td><strong>Minerals (Feed Additives)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blocks</td>
<td></td>
<td>80</td>
<td>72</td>
</tr>
<tr>
<td>Common salt</td>
<td></td>
<td>20</td>
<td>28</td>
</tr>
</tbody>
</table>

The major concentrate in urban and peri-urban areas was the locally formulated homemade concentrate made out of maize bran and cotton seed cake. Commercial dairy concentrates composed mainly of maize bran, cotton seed cake and sunflower cake were purchased by less than 15% of the farmers in urban and peri-urban areas and were offered to milking cows at a rate of 1-5 kg/cow/day. Over 70% of the respondents in each of the study areas used commercial Mac lick mineral blocks from Kenya.

From the different combinations indicated in Table 4.8 above, it was observed that farmers in peri-urban areas used almost all feed combinations but very few (12%) of them purchased commercial feeds. Two percent of the respondents in urban and 4% in peri-urban areas fed maize stover to their cattle.
Eighty percent of the farmers in urban areas relied on purchased feeds, 35% plant their own while 5% harvested the feeds from public lands. On the contrary, 40% of the farmers in peri-urban areas relied on purchased feeds, 45% purchased the feeds while 15% harvested the feeds from public lands.

Farmers used a variety of pasture and fodder types (Figure 4.2), In this case, the largest proportion of farmers in urban (58%) and peri-urban (67%) areas used elephant grass which farmers either planted or purchased from nearby farmers. In urban areas 8% of the farmers used Guinea grass (locally known as “mukonzikonzi”) as an additional feed to elephant grass fodder. Six percent of the farmers in peri-urban area used caliandra fodder trees and all of them were located in urban areas. In peri-urban areas the use of Rhodes grass (Chloris gayan) and signal grass was almost similar (14% and 10%) followed by guinea grass (6%), while 6% of the farmers fed their animals with caliandra.
Figure 4. 2: Forage types used by dairy farmers in Ssisa and Makindye sub counties in Uganda

4.3.1 Quantity of feeds given to the cattle daily

Fifty four percent of the farmers in urban areas and 60% in peri-urban areas offered their cattle between 77 and 128 Kgday$^{-1}$ which were the highest percentages in both locations (Table. 4.10).
Table 4.10: Amount of feeds given to the cattle per day

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Location</th>
<th>Urban (n=50)</th>
<th>Peri-urban (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of feeds (DM) Wet season</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Kgday⁻¹)</td>
<td>Percentage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 64</td>
<td>40</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>77 - 128</td>
<td>54</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>140 - 176</td>
<td>6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Amount of feeds (DM) Dry season</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Kgday⁻¹)</td>
<td>Percentage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 64</td>
<td>34</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>77 - 128</td>
<td>45</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>140 - 176</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Grass chopping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>64</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>36</td>
<td>54</td>
<td></td>
</tr>
</tbody>
</table>

Forty percent of the farmers in urban areas fed their cattle with less than 64 Kg while only 6% fed their cattle with 140-176 gday⁻¹. In peri-urban areas, 30% of the farmers fed their animals with less than 64Kg, a percentage less than those in urban areas while 10% of the farmers offered their cattle with 140-176 Kgday⁻¹, which was slightly high than households in urban areas.

On the question of whether the farmers chop the grass offered to their cattle, 64% of the farmers in urban areas reported that they chop their grass while 36% do not. In peri-urban areas lesser (46%), farmers chop the grass while 54% do not. Of all the above farmers, in both urban and peri-urban areas, only one farmer was observed to chop the grass using motorized forage chopper, five percent of the farmers used manual forage chopper, while the rest (94%) use bush knives.
4.3.2 Water availability and distance traveled to water sources

The major source of water for both urban areas and peri-urban households was tap water. However, the proportion of households accessing tap water in the urban areas was twice those in the peri-urban areas. The least used water sources were rivers and boreholes.

Table 4.11: Major sources of water and distance traveled to the source of water in smallholder dairy production systems

<table>
<thead>
<tr>
<th>Source of water</th>
<th>Study area</th>
<th></th>
<th></th>
<th>Significance (0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban (n=50)</td>
<td>Peri-urban (n=50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tap water</td>
<td>32</td>
<td>15</td>
<td></td>
<td>SS</td>
</tr>
<tr>
<td>Rain catchments</td>
<td>8</td>
<td>13</td>
<td></td>
<td>SS</td>
</tr>
<tr>
<td>Rivers</td>
<td>2</td>
<td>4</td>
<td></td>
<td>SS</td>
</tr>
<tr>
<td>Borehole</td>
<td>0</td>
<td>4</td>
<td></td>
<td>SS</td>
</tr>
<tr>
<td>Wells</td>
<td>8</td>
<td>14</td>
<td></td>
<td>SS</td>
</tr>
</tbody>
</table>

The results also showed that the average distance traveled in search water was less than two kilometers.

4.4 Milk yield

Milk yield in both urban and peri-urban areas was higher in the wet than the dry season (Table 4.12). Milk production was 24 and 25% higher in the wet season than in the dry season from urban and peri-urban farms respectively.
Table 4. 12: Milk yield on dairy farms in urban and peri-Urban areas of Ssisa and Makindye sub counties in Uganda

<table>
<thead>
<tr>
<th>Location</th>
<th>Season</th>
<th>Average litrescow⁻¹day⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>Dry</td>
<td>8.4</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>10.4</td>
</tr>
<tr>
<td>Peri-urban</td>
<td>Dry</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>9</td>
</tr>
<tr>
<td>LSD₀.₀₅</td>
<td></td>
<td>1.809</td>
</tr>
</tbody>
</table>

4.4.1 Effect of dairy cattle waste management on fodder and milk yield

Fifty two percent of farmers in urban areas and 80% in peri-urban areas had fodder plantations where they applied the waste or manure from their stalls (Table 4.13). There was a very strong correlation ($r=0.924$) between waste application in terms of manure to elephant grass fodder and the daily amount of fodder given to the cattle while there was a moderate correlation ($r=0.471$) between waste application and milk yield.

Table 4. 13: Farmers perspectives on the effect of dairy cattle waste management on elephant grass availability and milk yield in urban and peri-urban farms in Ssisa and Makindye sub-counties in Uganda

<table>
<thead>
<tr>
<th>Manure’s effect on fodder yield (%)</th>
<th>Location</th>
<th>Proportion of farms (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban (n=26)</td>
<td>Peri-urban (n=40)</td>
</tr>
<tr>
<td>20-30</td>
<td>13</td>
<td>30</td>
</tr>
<tr>
<td>31-50</td>
<td>50</td>
<td>34</td>
</tr>
<tr>
<td>Over 50</td>
<td>37</td>
<td>36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manure’s effect on milk yield (%)</th>
<th>Location</th>
<th>Proportion of farms (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban (n=26)</td>
<td>Peri-urban (n=40)</td>
</tr>
<tr>
<td>10-20</td>
<td>42</td>
<td>26</td>
</tr>
<tr>
<td>20-50</td>
<td>38</td>
<td>46</td>
</tr>
<tr>
<td>Over 50</td>
<td>20</td>
<td>28</td>
</tr>
</tbody>
</table>
Thirteen per cent of the urban farmers reported an improvement in fodder yield by 20 to 30 while the largest number (50%) responded that fodder is improved by 31-50%. In peri-urban areas, many farmers applied waste as manure as compared to urban farmers and they registered positive effects on both fodder and milk yield.

The same farmers in both areas where asked about the effect of wastes from the stalls if used as manure on milk yield. In urban areas 42% of the farmers indicated that milk yield was improved by 10-20% while a few (20%) of the farmers responded that milk yield is improved by over 50%. In peri-urban areas 46% of the farmers had observed a 20-50% improvement, while 26% had observed a 10-20% increase in milk yield. It is important to note that wastes have a direct positive effect on fodder if used as manure and subsequently improves the milk yield.

4.5 Reasons for poor management of in intensive urban and peri-urban dairy production systems

In both urban and peri-urban dairy production systems there were various reasons advanced by farmers for their non effective utilization of the wastes from their stalls. These reasons included;

- Limited land for agriculture (34%)
- Lack of space for waste treatment and storage (44%)
- Lack of farmers’ education (20%)
- Lack of means of transportation and/or labour (43%)
- Lack of farmers’ associations to monitor activities carried out by different farmers
• Expensive permanent labour in urban areas for the elderly people with a few family members
CHAPTER FIVE

5.0 Discussion

The results discussed below were obtained from the study carried out to: (i) estimate the quantity of dairy cattle waste generated from intensive smallholder dairy production systems in the dry and wet seasons; (ii) study the effect of location on dairy waste management in urban and peri-urban cattle systems; (iii) assess the effect of dairy cattle waste disposal methods on fodder and milk production and; (iv) identify options for improving dairy cattle waste management in the study area.

5.1 Household characteristics of farmers in the study area

5.1.1 Farmers’ age and gender of household heads

Both male and female adults of 40 years and above were involved in intensive smallholder dairy farming. This finding is consistent with results of case studies (Sawio, 1993) that showed that urban and peri-urban dairy production benefits both the young and the old poor farmers, and provides an accessible means of diversifying livelihood activities. Furthermore, the results showed that female-headed households, children, retired people, widows and people with limited formal education were involved in urban and peri-urban agriculture as a form of social security strategy. Involvement of people of 40 years and above in urban smallholder dairying is a result of financial responsibilities which cannot be met by their non farm employment and thus resorting to a side income source.

The number and age of household members contributes to labour availability and the efficiency of the dairy enterprise if many household members are not very young children (less than 10 years old) or senile people (over 60 years old). The low numbers
of youths in the study area is probably a result of Acquired Immune Deficiency Syndrome (AIDS) epidemic that has claimed the lives of many youths in the age bracket of 15-40 years in Wakiso district which concurs with previous studies and recent reports (WHO, 2008). Migration of the youths to urban areas in search of employment could also have contributed to fewer youths involved in farming activities. According to Kabirizi (2006), the AIDS epidemic and the migration of the youths to urban centers have had a negative impact on the overall performance of the dairy enterprise because work is left to the elderly women, most of whom are widows and/or HIV/AIDS affected households. The lower number of people aged 20-30 years involved in the dairying sector could also have resulted from the negative attitude of the youth on agriculture related activities. Many parents reported that their children used to help previously and had just quit the responsibilities for leisure attractions in the cities.

Labour availability is positively associated with adoption of improved dairy cattle related activities such as improved fodder production and utilization. However, as the age of the household head progresses, the probability of adoption of improved technologies decreases.

5.1.2 Education levels and farming experience of household heads

The high number of respondents who had primary level of education could be a result of the introduction of Universal Primary Education (UPE) and/or adult education where by even the elderly (over 50 years old) who are interested can get a chance of learning how to read and write. Education is very important in farming since the farmers are now able to participate in technology development and transfer processes. Bosma et al., (2003) showed that the level of education has an impact on ability of the farmer to
participate in on-farm trials and adopt improved technologies which are brought about by the desire to improve on the farmers’ quality and quantity of outputs.

Respondents from the peri-urban areas were more experienced in farming than those in urban areas which was probably due to increased awareness by urban dwellers of the importance of dairying which includes food supplements and as a side income earner. It could also be due to a number of dairy development projects that have been introduced in peri-urban areas where there is availability of land. Farmers in urban areas have access to information on improved dairy farming through media and workshops. This was also observed in previous studies (Ossiya et al., 2002) where they concluded that urban livestock keeping is an entrepreneurial response to increased demand for livestock products like milk, meat and manure. Another factor contributing to farmers in peri-urban areas being more experienced than those in urban areas is land availability. Majority of farmers in urban areas have no land and the cost of labour to do farming is very high which limits them to a few cattle in cases where they can not afford both.

There was also an indication that most of the animals were got from cultural ceremonies and mainly introduction where cows (usually crosses) are brought as a sign of appreciation to the girl’s parents (Namono, 2006) and such cattle provide starter stock for the farmers.

5.1.3 Major sources of income, transport availability and family members in homes of the respondents

Information collected from respondents in urban and peri-urban areas showed that civil service is an important source of income mainly for urban households because the proportion of the farmers particularly the women who attained higher levels of education
was high. This could be attributed to the fast rate at which the city is expanding towards these areas which implies that necessities such as academics and job opportunities are easily accessed.

It was observed that the majority of respondents with off-farm activities were employed by government, Non Government Organizations (NGOs) or self-employed implying that intensive dairy production was done to earn extra amount to supplement wages and/salaries. In addition to wages and salaries, some urban and peri-urban households operate small businesses such as kiosks. The source and level of income has implications on ability of a farmer to purchase inputs and the dairy cattle enterprise as a whole because it is demanding in terms of labour, medicines and fodder mainly in urban areas particularly where payment from milk sales is delayed.

5.1.4 Livestock types and distribution in urban and peri-urban areas
The higher number of cattle in peri-urban areas than in urban areas could be attributed to the fact that urban dwellers are just getting into smallholder dairy production and most of the households have realized that intensive dairy production systems can be carried out even on small land areas despite its constraints like odour in cases where it's distinct. This is a result of the high cost of living which cannot be met only by salaries and thus the need of a side income source. In this case poor people in these areas have come up with coping strategies like starting farmers associations where for example one passes on a cow or calf to another farmer after it gives birth.

Availability of land for fodder cultivation could also have been the reason behind peri-urban farmers having more cattle than urban farmers implying that a farmer with much
feeds can also have many cattle compared to the one with less feed due to smaller land area.

The profit motive is expected to be the reason behind the high ratio of improved to indigenous dairy cattle in the study area. This was observed from the average daily milk yield from improved cows which is almost four times higher compared to that of indigenous cows. However, farmers with indigenous cattle expressed that it was due to lack of funds for management of improved cattle since they required lots of inputs in terms of medication, feeds and other minerals.

Improved and indigenous bulls were minimally kept in the study area due to increasing use of artificial insemination which also helps to control the number of bulls. Bulls consume a lot of fodder ranging from 70 to 90 kilograms of fresh material per day for bulls of an average weight of 450 kg (body weight). This required quantity of fodder is very high for farmers mainly in urban areas with limited land and they depend on purchased fodder. In addition, they would increase the quantity of wastes with the likelihood of increasing the waste handling challenge especially in urban settings.

Peri-urban farmers kept more calves because they had enough land for expansion of their farms for feeds. In addition, urban farmers sold off the calves immediately after weaning to peri-urban farmers and this explains the higher calf and heifers numbers in the peri-urban areas than in the urban across the same number of farms.
5.2 Waste management and stall sanitation in intensive smallholder dairy farming systems

The quantity of waste recorded during the study period varied from parish to parish. This could be attributed to location as it was observed that dairy cattle management and feeding also varied with the different parishes. As reported earlier in section 5.1.4, farmers in urban areas kept more improved dairy cattle and depended largely on hired labour than peri-urban farmers implying that much management was required. Waste variation was also registered with seasons with the wet season having greater waste produced than the dry season.

The seasonal variation in the quantity of wastes produced in smallholder dairy cattle units could be as a result of the decline in feed supply. During the wet seasons, farmers reported that there is plenty of flourishing fodder due to high soil moisture compared to the dry seasons. This implies that cattle are fed less during the dry season which affects the amount of wastes given off by the cattle since feeding is one of the determinants of the quantity of wastes produced.

Fewer farmers collected cow urine from their stalls in urban areas as compared to those in peri-urban areas and this is expected to have resulted from previous findings that a large percentage of farmers in urban areas have less land and therefore do not carry out agriculture so they do not see any use for the urine. These results are in line with the findings of Namono (2006) who observed that most of the farmers in Kampala district, whether they had received farmers’ education or not, did not have drainage pits. So farmers in peri-urban areas had an added advantage of
being with large land areas in that even those who did not have drainage pits could just direct the wastes into gardens and other plantations.

Farmers in urban areas mostly used spades and brooms to remove wastes from the stalls because they had concrete floors in many stalls as compared to those in peri-urban areas. In peri-urban areas however, some of the farmers had leveled floors of murram which at times forced them to clean their floors with hoes although spades and brooms were also pertinent. Despite the fact that these methods of cleaning the stalls and the presence of more concrete stall in urban areas, they had the dirtiest stalls at the time the study was carried out. This could be attributed to the less land areas where by most of the farmers did not at times have land for construction of larger stalls for changing the animals for example having where they stay during day and night. This helps by leaving some dry areas in the stalls such that the cattle can rest on a clean ground which in turn may help control most of the diseases brought about by poor sanitation.

Inadequate land for waste processing and application led to the problem of waste overflow during the wet season. This was particularly in the urban areas and is due to heaping of waste in anticipation of receiving buyers. As a result, the waste is exposed to rain water in wet seasons washing it into neighbours’ premises leading to conflicts. Odour from the wastes was also another source of conflicts between neighbours. Such conflicts were also documented in previous studies in other regions by Lekasi et al (2006).
Poor waste management has health related hazards to the farmers, their cattle, and the neighbours. From the study, malaria cases were recorded mostly in urban farmers’ homes which could be a result of poor urine management. The case of cattle hooves rotting had higher incidence on farms where stall cleaning was infrequent. In some instances dung and wasted fodder piled in stalls to depths close to the knees of the cows.

The relationship between location in terms of distance from Seguku trading centre and waste management which showed a modest correlation implies that as the distance increases from urban areas waste management improves. This can be attributed to an increase in the number of farmers with large land areas availing space for composting and disposal of the wastes.

This could be a result of the availability of free labour for cleaning the stalls since it was observed that families in peri-urban areas had more household members with most of them, ranging from 3 to 8 individuals, staying permanently in the homestead. Households with adequate labour in peri-urban areas had divided it among the members where the young ones were responsible for fodder collection and cleaning the stalls, while their elders were concerned with milking and observing the cattle’s health. On the contrary, in urban areas farmers mostly hired the labour where for example one person had to do almost all the work and since zero grazing dairy management is labour intensive, one individual tended to be overwhelmed by the tasks.
5.2.1 Household members and the use of hired labour used in intensive stall feeding dairy systems

Much reliance on permanent hired labour resulted from the fact that most of the households in urban areas keep dairy cattle as a way of diversifying their sources of incomes or to have a daily source of income but, have other commitments for example most of them indicated that they were social workers implying that they did not have ample time for the farms. Also in urban areas there are long distances between farmers’ homes and their fodder gardens which call for the use of wheel barrows, bicycles and pickups for transporting it. Households with fewer members in urban areas employ permanent hired labour. In peri-urban areas, there were more households with family members ranging from 4 to 8 than in urban areas. This is an indication of sufficient labour on farms however, as previous research (Irungu et al., 1998) indicated, women were the key players in cleaning, forage planting where farmers had enough land, manure application and the general monitoring of on farm activities. Milking and product marketing was mostly carried out by youths while the largest number of men were either civil servants or had private businesses.

This could be the reason why peri-urban farmers employed casual labour mainly in homesteads with the elderly who could not milk and/or transport the wastes. Critically analyzing the former, one can conclude that these are activities that women and children can not do, implying that despite the high numbers of household members, there were only a few capable and thus the need for casual hired labour.
Transport availability is pertinent for the success of intensive dairy production systems. Farmers in the study area owned motor cars, bicycles and wheel barrows and households that owned vehicles were not badly affected during the dry season since they could obtain fodder from distances of more than 30 km from the homesteads. Though they could not transport sufficient quantities like vehicles, bicycles were also an advantage to the farmers because they are used to transport fodder to the household.

The largest number of farmers who had wheel barrows on their farms were in peri-urban areas which was a result of the longer distances were they had to dispose off the waste due to large land areas as compared to those in urban areas. Christine et al (2008) reported that urban farmers do not have enough land to accommodate both their farms inputs and outputs. Therefore, their major method of managing the wastes was mostly by heaping implying that there was less or no need for wheel barrows for farmers who heaped their wastes near the stalls. Despite such cases, wheelbarrows were very crucial for the transportation of farm inputs like feeds and wastes for short distances as other means of transportation were usually for long distances.

5.2.3 Land area, location of feeding stalls and division of farmers’ land area

The number of farmers with relatively larger plots was greater in peri-urban areas than urban areas due to;

a) The high cost of land in urban areas that has made most of the land owners to partition and sell part off their land holdings leaving most of the urban dwellers with at most half an acre. Not only farmers are affected with the small plots but also the
neighbours whose homes are flooded by the wastes during rainy season plus the distinct odour which pollutes the air (FAO, 2000).

b) The availability of unused land in peri-urban areas is an opportunity used by farmers in those areas to hire those plots for some time mainly for fodder production. This is usually done by paying annually or for the specified to the land owner which can be in cash terms or yields from the farm if the farmer is a food producer. This gives peri-urban farmers a chance to own large tracts of land for fodder production.

Most of the feeding stalls in the study area were located in distances of less than 10 meters from farmers’ residential houses. This was due to security reasons. Majority of farmers do not have guards and therefore have fears resulting from rampant and consistent cases of cattle theft and poisoning which were reported during the study.

The largest percentage of farmers in urban areas had small land areas which is another reason as to why these farmers’ stalls are located near residential houses. Most of the farmers had land areas of less than 0.4 ha which is far much smaller for agricultural activities because the above land is divided and allocated to other household activities.

5.3 Quantity of feeds given to cattle in intensive smallholder dairying systems

Although data on feed resources showed that there was a diversity of feed resources offered to the animals, the quantities in which they were offered especially during the dry season were not adequate due to low availability of feeds in the dry season. From the study, it appeared that a few farmers in both urban and peri-urban locations could offer adequate feeds to their cattle. Records showed that the number of farmers in both
locations decreased as the quantity of feed increased. It was also observed that the number of farmers reduces more in urban than in peri-urban areas. This is probably due to the fact that farmers in urban areas lack enough land to grow the fodder and thus supplement the feeds given to their cattle with grasses from public lands and unused plots.

The availability of more feeds to dairy cattle in peri-urban areas than those in urban areas could also have resulted from the fact that there was more land for fodder cultivation and labour for cattle management in these areas than in urban areas. Most of the household heads in urban settlements use dairy farming as an additional source of income and thus do not invest a lot of time and resources into it. Kabirizi (2006) observed that urban farmers find difficulties in getting adequate feeds due to limited land. Poor feeding as a result of inadequate feed results into poor performance of the cattle. The case may not be different with this study in that feeds used by farmers are all purchased. The purchased feeds included maize bran and banana based crop residues which are offered to cattle in less quantity at times depending on their availability and cost. However it is expected that less feeds result into less wastes and hence reduced waste handling challenge. This is supported by the study data showing reduced waste quantities in the dry season.

Chopping fodder is mostly carried out by urban farmers to avoid feed wastage. There are a higher number of farmers who chop fodder in urban areas than in peri-urban areas which could be as a result of income differences followed by farmers’ age differences whereby in urban areas some of the farmers have manual or motorized forage choppers. Those who do not have such machines cannot afford hired labour to
chop the fodder. A majority of peri-urban farmers are aged between 40 and 60 years implying that they can not do the chopping and the largest percentage of them does not have enough funds for hired labour. They rely on household labour from their young children and grandchildren, farmers in peri-urban areas may ignorantly not wish to invest in machines for chopping the feeds.

In peri-urban areas a few farmers chopped the fodder for their cattle than in urban areas which is probably because in urban areas there is always scarcity of fodder; therefore the farmers try to find ways of using the available fodders effectively. Chopping fodder is expected to be a result of feeding mechanisms of the cattle as planned by the farmer in that cattle that feed from well designed troughs are mostly found in urban areas where these troughs are designed basically for chopped grasses and other commercial feeds while in peri-urban areas, fodder is at times not even sorted but given to the cattle directly as it was cut from the fields. It is expected, that chopping fodder increases the feed intake of the cattle. Hence despite increasing cattle performance it will also increase quantity of waste production per cattle unit. As such, waste handling plans and mechanisms should take this into consideration.

Despite the availability of more fodder and ample labour for cattle management, results showed that milk yield in urban areas was greater than that in peri-urban areas with ranges of 2 litrescow\(^{-1}\)day\(^{-1}\) more for urban areas in both the dry and wet seasons. The overall average milk yields were less than the average milk yield of 20 litrescow\(^{-1}\)day\(^{-1}\) reported on improved farms. Besides nutrition due to inadequate feeds and water shortage, poor breeds kept by the farmers mainly in peri-urban areas could have contributed to very low milk yields in all study areas. Though the quantity of milk produced was relatively higher in urban areas, previous studies (Saka et al. 1994;
Samanya, 1996) identified poor breeds, inadequate feeds and poor feed management practices as a major constraint to optimum milk production in this production system. And besides cattle management is another constraint where by most of the farmers do not have time for their cattle in terms of medication, hygiene, while other households do not mind the milk yield as all that is obtained is for home consumption. The relatively low milk yields resulted in low household incomes resulting in poor contribution to hired labour for manure management. This particularly implies to the peri-urban situation where farmers tended to depend exclusively on farm income.

5.3.1 Feed types given to cattle in urban and peri-urban intensive dairy production systems

In the study area it was observed that farmers relied on different feed combinations however elephant grass fodder (planted or/and purchased) was used by all farmers. Farmers explained that it was very hard to depend on a single type of feeds due to seasonal variations in feed availability. Urban farmers indicated that in dry seasons there is scarcity of fodder which makes it very expensive. This makes them switch to other types mainly commercial feeds until the prices stabilize but use of commercial feeds means reducing the amounts given to the cattle daily.

The high number of urban farmers depending on purchased elephant grass fodder and crop residues was a result of small acreage of land and those who had the land for growing the fodder could not estimate the fodder that their cattle could consume throughout the year. Purchased fodder was harvested from farmers who had either specialized in fodder production or, had fewer animals compared to the fodder they had produced. Despite the diversity of feed resources offered to the animals, the quantities
in which they were offered especially during the dry season were not adequate to meet the nutritional needs of the cattle throughout the year. There was also limited use of some forage types like Guatemala and caliandra in the study area which could work as feed supplements in the different seasons because they are not affected so much by the dry season. The above was attributed to the less land acreages in urban areas where a larger percentage of the farmers had land areas of less than an acre which are at times partitioned into plots. In peri-urban areas farmer who had land at times lacked skills of processing the different feed types like preparation of maize stover from maize plantations was at times seen as wastage. The above observations call for more farmers’ workshops in peri-urban areas to educate farmers of skills about fodder production and avoidance of feed wastage which would help improve dairy cattle productivity because even if fodder produced in these areas is enough, farmers hardly process it into hay for example in preparation of feed availability drier seasons.

Maize bran and cotton seed cake were used to formulate homemade concentrates because they were relatively cheaper and more readily available than commercial concentrates. Farmers reported that the homemade concentrate was cheaper than commercial concentrates and it improved milk yields. Despite the lack of cash to buy commercial feeds, farmers also reported that some commercial concentrates were substandard because they were mixed with sand and saw dust in the production process. Due to high cost of commercial concentrates, over 20% of the farmers in urban and peri-urban used maize bran as concentrate supplement. There is therefore a need to train farmers in formulation of balanced homemade concentrates based on maize bran and cotton seed cake which are locally available and affordable and to evaluate its response to dairy cow productivity.
Commercial mineral blocks imported form Kenya was used by majority of respondents in all study areas. Five farmers were making feed blocks using locally available ingredients such as mineral powder, dry grass, poultry litter. Crop residues, maize bran, cotton seed cake and molasses. These farmers had been trained in making the blocks. They reported that these types of blocks were cheap and had a positive effect on milk yield.

The acreage under forage legumes such as lablab was very low in the wet and dry seasons due to high cost and/or scarcity of seed, poor regrowth during the dry season and/or lack of knowledge on their management and utilization. Although leguminous fodder trees were found on 10% of the households in the wet season, the percentage of farmers using them decreased to less than 5% during the dry season. Low production of leguminous forages suggests low protein supply to the animals and this is probably why milk production and reproductive efficiency was below average. Other feeds offered to dairy cattle were the leaves of indigenous fodder trees and shrubs. The use of indigenous fodder trees, shrubs and different grass types was higher in the dry season than in the wet season. Weeds were also fed to animals during the wet season due to their availability. High investment in feed provision to the cattle in the dry season is likely to result in reduced availability of money for hiring labour including labour to involve in waste management.

5.3.2 Water availability

Water shortage and the long distance traveled in search of water during the dry season were major constraints in peri-urban areas. This resulted in low milk yields. The most affected farmers were those who depend on springs and water from wells which reduce
their outputs or dry out during dry seasons. It is therefore important to introduce and teach farmers of coping strategies to efficiently use the water and thus have enough for both humans and the cattle. This would increase labour for more serious engagement in waste management.

5.4 Effect of waste management on fodder and milk yield in the study area
The effect of applying wastes (manure) on fodder production was viewed differently by various farmers. Farmers in peri-urban areas reported that wastes, if well processed and applied to the gardens, improves fodder yield thereby increasing milk production but this depends on the breed of the animals and the general management on the farm. The way different farmers processed their wastes into manures varied greatly with the different locations from those who composted it to those who applied it directly to the fodder fields. From the results, the farmers who indicated that wastes had no or less impact on fodder were physically observed by the researcher to be lacking the knowledge of waste processing. The above was realized by their failure to distinguish between wastes and manure therefore they thought fresh dung and urine were manure and could be applied it directly on the crops and fodder. However, this leads to destruction instead however a reasonable number of farmers knew how to process the wastes into manure and apply it in gardens which led to positive results. The relationship between manure application and fodder yield, which indicated that fodder and manure application were positively correlated infers that more farmers should apply the manure to their fodder for improved feed and ultimately milk production. Nevertheless, it is expected that a stronger correlation between manure application and milk yield could be obtained if manure quantities applied were included in the analysis.
The relationship between waste management and milk yield was indirect in that manure is applied in fodder plantations then fodder is fed to dairy cattle which affects the milk yield. From the analyses carried out to determine the relationship between the two, there was a very weak correlation.

5.5 Strategies to improve waste management in intensive smallholder dairy production systems in Makindye and Ssisa sub counties

5.5.1 Constant monitoring
Monitoring of dairy cattle production units should be carried out to evaluate farmers’ capacity to engage in livestock production in the event of diminishing land area to ensure proper management of livestock waste and manure if processed. In addition to this, authorities should develop clear guidelines for disposal of the wastes to reduce the problem of urban environmental pollution and to promote hygienic handling of the wastes.

5.5.2 Registration
Farmers should be registered which could aid organizations that promote organic farming and other entrepreneurs to collect and compost wastes from intensive dairy production systems so that it can be used on large and demonstration farms. Co-operation among farmers should be encouraged such that there is exchange of information pertinent to waste management because in these farming communities there are farmers who are more experienced and are better equipped with knowledge on waste management. This can be achieved through forming farmers' association where they can share such information.
5.5.3 Limited land for application of the manure

In urban settlements, only over 50% (n=50) of the farmers studied had agricultural land where they apply the manure. The average land area was 0.5 ha yet the respective waste output during the dry and wet seasons were 33.8 and 42.8 kg implying that the annual waste output is 14 tons. The average soil requirement in the short term is 20 tonsha\(^{-1}\)year\(^{-1}\) which means there is an excess of 4 tons.

Urban households therefore have a promising potential for income generation considering the quantities of waste shown above. These wastes when sold could be used for organic fertilizers, briquettes for cooking in stoves, and livestock and fish feeds.

In peri-urban settings farmers suggested that farmer groups should help find market for their manure because individuals and agricultural organizations in need of it fail to reach them due to poor infrastructure and inadequate information about their presence in these remote areas.

5.5.4 Biogas production

Biogas originates from bacteria in the process of bio-degradation of organic material under anaerobic (without air) conditions. It is an important way of utilising wastes from dairy stalls because it has benefits like;

- Production of energy (heat, light, electricity)
- Transformation of organic waste into high quality fertilizer
- Improvement of hygienic conditions through reduction of pathogens, worm eggs and flies
- Reduction of workload, mainly for women, in firewood collection and cooking
Environmental advantages through protection of soil, water, air and woody vegetation;

Micro-economical benefits through energy and fertilizer substitution, additional income sources and increasing yields of animal husbandry and agriculture

Macro-economical benefits through decentralized energy generation, import substitution and environmental protection

Biogas can be produced individually by households or shared by different households in the same neighborhood where they collect wastes and share the gas (pipes from the plant to each household. Households should be in close proximity. For instance if three households in the urban location contribute 50kg DM (200kg fresh weight) that would amount to 600kg fresh weight of waste each day which would produce approximately 2500 litres of biogas. This biogas is enough for all the three households in terms of lighting and cooking because the average consumption of a biogas lamp and cooker (two flame burner) respectively, are 120-150 liters and 400-500 Ltrs/day¹.
CHAPTER SIX

6.0 Conclusion

Dairy farming is an important activity currently in urban and peri-urban settings of Ssisa and Makindye sub counties with a large number of farmers keeping improved breeds however, as observed from the study, intensive dairy production has got both positive and negative consequences that result from mainly waste management.

Dairy waste management is the planned and organized management of wastes from dairy stalls in an environmentally sound manner. Waste management improved as distances increased from urban areas implying it was affected land availability. Waste output and milk yield from the dairy stalls were dependant on fodder availability in that the more the cattle are fed with larger quantities of fodder, the more they produce the milk and consequently, the waste.

Cattle in different locations were fed with various types of fodder which affected their performance either positively or negatively but this was mainly determined by seasons as there seemed to be plenty of feeds during the rainy seasons than in the dry seasons. In peri-urban areas, there were minor variations in feed availability in the dry and wet seasons than in urban areas dry due to better utilization of the wastes from stalls in terms of manure production.

From the above therefore, waste management in intensive urban and peri-urban dairy production systems should be critically observed and studied as dairy farming is on an increase to avoid negative impacts on the environment. In urban areas where the wastes were not effectively used, farmers experienced such problems like odour and diseases to both the cattle and family members. The above problems could be
controlled by constant monitoring, registering of all farmers by the authorities, and using of wastes as a source of fuel (biogas production).
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APPENDIX 1

Map of Wakiso District
APPENDIX 2

QUESTIONNAIRE

QUESTIONNAIRE ON DAIRY CATTLE WASTE MANAGEMENT IN INTENSIVE FEEDING PRODUCTION SYSTEMS

Date…………………… site……………………………………………..
Sub county………………………… Zone……………………… Parish……………………
Name of respondent……………………………………………………
Village-……………………………………………………………………
Position of the respondent on the farm……………………………………

Farmer’s age

(1) 20-30  (2) 30-40  (3) 40-50  (4) 50-60  (5) 60-above

Occupation  1. Part time farmer  2. Full time farmer.

How many years have you been keeping dairy cattle  
(1) 1-5  (2) 5-10  (3) 10-15  (4) 15-20  (5) 20-above

1. Have received u any training in animal husbandry?  (1) Yes  (2) No

2. What is the education level of the household head?
   a. No formal education0
   b. Primary (1-7) 1
   c. Secondary lower 2
   d. Secondary high 3
   e. University 4
   f. Tertiary 6
   g. Others (specify)……………………………………………

3. What is the number of household members living permanently on the compound? (1) Less than 3; (2) 4-8; (3) 9-13 (4) 14-18; (5) more than 19;

4. What is the major source of income for the household head?
   (1) Cattle and products production
(2) Crop production
(3) Others specify …………………….

5. What are the most important family expenditures?
   (1) School fees  (5) Social activities
   (2) Food       (6) Labour
   (3) Fodder     (7) Credit payment
   (4) Health services

6. Which of the following means of transportation does your farm own?
   1. Bicycle  6. Tractor
   2. Wheelbarrow  7. Pickup
   3. Ox cart  8. Car
   4. Oxen  9. None
   5. Motor cycle  10. Other specify…………………………….

RESOURCE ENDOWMENTS

7. How much land do you have for livestock production?
   1. Less than one acre.
   2. One acre
   3. Greater than one acre
   4. More specify………………………….

8. What is the distance from the farm unit to residence?
   (1). 10 metres  (2). 20 metres  (3). Greater than 20 metres

9. To what extent is your farm divided?
   1. Less than 3 plot  2. 4-6 plots  3. 5-10 plots
   4. Over 10 plots
LIVESTOCK INVENTORY AND HOUSEHOLD LABOUR

Record the number of cattle kept on the farm

<table>
<thead>
<tr>
<th>Type</th>
<th>Local</th>
<th>Crosses</th>
<th>Exotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Castrated adult males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cows</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immature males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heifers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. What kind of hired Labour do you use on the farm?
   1. Permanent    2. Casual

11. How much do you pay for hired labour per month?
    (1) Less than Ushs 30,000; (2) Ushs 50,000- 70,000; (3) Ushs 80,000- 100,000;
    (4) More than Ushs 100,000

12. What are the major activities on which hired labour is required and usually deployed?
    1. Removing waste
    2. Transport waste
    3. Milking
    4. Cleaning
    5. Fodder production and Management
    6. Others specify........................................

13. What is the major reason for not using hired labour to manage livestock?
    1. Lack of money
    2. Family labour is sufficient
    3. Not available
    4. Others specify

FEEDS AND FEED MANAGEMENT

14. What type of feeds do you give your animals?
(1). Crop residues (banana based e.g. peelings, pseudo stems etc) (2) Elephant grass harvested from public land e.g. road sides; (3) (Planted elephant grass; (4) a mixture of different grasses from within and outside the farm); (5) Purchased feeds (elephant grass); (6) Commercial feeds (dairy meal, mineral blocks) in addition to the grasses; (7) others specify)

15. What is your major source of feeds?
   1. Purchased  
   2. Cultivated  
   3. Harvested from public land

16. Is there any supplement feeding?
   1. Yes  
   2. No

17. What supplement feeds do you give the animals?
   1. Formulated feed  
   2. Minerals  
   3. Others

18. Which of the following forage grasses do you have on your farm?

<table>
<thead>
<tr>
<th>Grass Name</th>
<th>Area under fodder grasses (acres)</th>
<th>Do you use the grasses feed</th>
<th>If yes, to which animals</th>
<th>In which period of the year</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Chloris gayana</em> (kasibante)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elephant grass (bisagazi)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guatemala</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Setaria</em> (kakirakambwa)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Signal grass</em> (kifuta)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Guinea grass</em> (Mukonzikonzi)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Animals: 1. All  
2. All cows  
3. Lactating cows  
4. Heifers  
5. Calves  
6. Adult bulls
Time of the year: 1. Dry season  2. Wet season  3. All year

19. How much feed do you offer each cow per day? 
   (1) Less than 5 basins  
   (2) 6-10 basins  
   (3) 11-15 basins

20. Do you chop the grass before feeding the animals: 
   (1) Yes  
   (2) No

**MILK PRODUCTION**

21. What is your average milk yield per cow per day?

<table>
<thead>
<tr>
<th>Season</th>
<th>Average quantity of milk per cow per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet season</td>
<td></td>
</tr>
<tr>
<td>Dry season</td>
<td></td>
</tr>
</tbody>
</table>

22. How many times do you milk your cows a day?

1. Once
2. Twice
3. Thrice

23. Do you process the milk from your cow(s)?

1. Yes  
2. No

24. If yes, which products do you make from it?

1. Sour milk  
2. Cow ghee

25. How do you preserve your milk?  

.................................................................
WASTE MANAGEMENT

26. How much waste do you get every day?
   1. Less than 1 wheelbarrow  
   2. One wheelbarrow  
   3. More than 3 wheelbarrows  
   4. More specify…………………………………

27. What methods do you use to manage the cow waste from your farm?

<table>
<thead>
<tr>
<th>Waste management method</th>
<th>Proportion of the waste</th>
<th>score</th>
</tr>
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</table>

Urine management (organized disposal=1, not organized=0) 
Odour (Distinct=0, Mild=1, Absent=3)

28. How frequently is the stall floor cleaned?
   1. Once a day  
   2. Twice a day  
   3. Three times a day  
   4. Once in two days  
   4. Not at all

29. How do you manage (store and apply) the urine from the animals?
   ………………………………………………………………………………………………………………………………………
   ………………………………………………………………………………………………………………………………………

30. What are the major problems with waste disposal?
   a) ………………………………………………………………………………………………………………………………………
   b) ………………………………………………………………………………………………………………………………………
   c) ………………………………………………………………………………………………………………………………………

31. Which are the three most prevalent diseases resulting from cattle rearing?
   a) For your animals  
   ………………………………………………………………………………………………………………………………………
   ………………………………………………………………………………………………………………………………………
   b). to the household members
30. Do you think there is any form of pollution from your activities?

31. Do you experience any problems with your neighbours?

32. What do you consider as the major effect of cow waste on fodder yield?

(1) Increases fodder yield by 20-30%; (2) Increases fodder yield by 31-50% (3) over 51% (4) decreases fodder yield (5) no effect

33. What is the effect of cow waste management on milk yield?

(1) Improved fodder yield results in increased milk yield by 10-20% (2) Increases milk yield by 21-50% (3) Decreases milk yield (4) No effect on milk yield

PHYSICAL OBSERVATION

1. Drainage pit available (1) Yes (2) No
2. Type of floor (1) cemented (2) murram; (3) note done
3. Cleanliness of the floor at the time of the interview (1) very clean (2) fairy (very dirty; (3) very dirty
4) Animal waste (1) Overflowing (2) Not overflowing
5. Method of removing manure from the shed (1) cleaning using a broom; (2) uses a spade (3) uses a how (4) other methods (specify

4. Number of times the farmer removes the waste from the shed (1) not at all (2) once (3) Twice; (4) three times (5) more than 3 times
Cow dung outputs
<table>
<thead>
<tr>
<th>Time</th>
<th>Amount of manure removed</th>
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<tbody>
<tr>
<td>1.</td>
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<tr>
<td>2.</td>
<td></td>
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<td>3.</td>
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THANK YOU FOR YOUR TIME
APPENDIX 3

DATA SHEET FOR THE WASTES COLLECTED FROM THE STALLS

<table>
<thead>
<tr>
<th>Farm name</th>
<th>No. of cattle</th>
<th>Type of floor</th>
<th>Times the stalls are cleaned</th>
<th>Amount of dung (wheelbarrows)</th>
<th>Method of disposal (where does the farmer apply the manure?)</th>
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Plate 1: Heaped waste overflows during the rain season

Plate 2: Waste applied directly to the garden
Plate 3: A wheel barrow and spade used to quantify the wastes

Plate 4: Management of urine from the stall with a drainage pit

Plate 5: The manual (Left) and the automatic grass chopper (Right)
Plate 6: Banana peels being dried for used as cattle feeds

Plate 7: A Maize plantation from which the farmer makes maize stover

Plate 8: Fodder dried and stored to be used in the dry season