

**DETERMINATION OF CRYPTOSPORIDIOSIS INFECTION AND GENDER DIMENSIONS  
AMONG URBAN DAIRY FARMERS IN DAGORETTI DIVISION, NAIROBI //**

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**THESIS SUBMITTED TO THE UNIVERSITY OF NAIROBI IN PARTIAL FULFILMENT  
OF THE REQUIREMENTS FOR AWARD OF MASTERS OF PUBLIC HEALTH DEGREE**

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**DECLARATION**

I, Julie Ambia declare that this dissertation is my original work and has not been presented to any other institution for the purpose of obtaining a degree.

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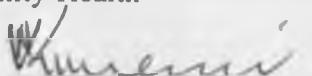
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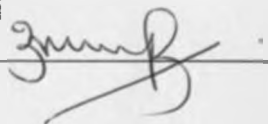
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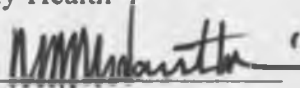
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## ABSTRACT

This study aimed to develop insight on how gender roles, perceptions and access to resources affect the vulnerability of men and women to cryptosporidiosis. Also, to obtain an improved understanding of gender issues with regard to access and control over production resources like milk, manure, land, credit and training. With the intensification of urban dairy production for increased yields, zero grazing activities tends to alter the ecology of urban living providing new environments that are conducive for the emergence of zoonotic pathogens like *Cryptosporidium*<sup>7</sup>. Cryptosporidiosis which is an intestinal infection is transmitted from cattle to humans. In developing countries, *Cryptosporidium* is responsible for 8–19% of cases of diarrheal disease<sup>19</sup>, with a significant effect on mortality<sup>20</sup>. Yet, no effective treatment of cryptosporidiosis exists and the oocysts are resistant to commonly used water disinfectants<sup>30</sup>.

This study was a 3-month longitudinal survey carried out between August 2006 and November 2006. Analysis of 1,422 human faecal samples showed no positive results. The overall prevalence rate of cryptosporidiosis was 0%. From the focus group discussions held, and 296 interviews conducted, it appeared that the community had some positive practices which probably reduced the transmission of cryptosporidiosis. Ninety nine percent of the respondents washed their vegetables before eating or cooking them. Three quarters of the respondents consumed water from the Nairobi Water Company supply. Currently, drinking the Nairobi Water Company supply water is not an important risk factor for zoonotic *Cryptosporidium* infection.

Moreover, it was commendable to note that, the elderly and young children who were at risk of contracting cryptosporidiosis because of their weak immune system, were not in close contact with the cattle and the calves. Other factors such as developing protective immunity against cryptosporidiosis were expected to contribute to the zero prevalence rate in Dagoretti, but could not be proven by the study.

At the same time some negative practices were also noted, all the farmers did not apply correct treatment of composting on their manure before taking it to their farms. They simply heaped the manure; further creating an ideal environment for the survival of *Cryptosporidium* oocysts<sup>35</sup>. More than three quarters of the households did not have clean cattle sheds.

With regards to gender roles, it was eminent that, both men and women had equal opportunities in accessing extension agents and training in dairy farming. With access to first hand information both men and women dairy farmers have increased knowledge on how to reduce the health risks posed by cattle to humans. Land ownership among women had augmented due to an increased purchase of land by women and inheritance.

Also, women were identified as the people controlling funds derived from the sale of milk. This played a part in increasing their status and bargaining power within the household and community. Both women and men had equal opportunities in accessing credit and loans from financial institutions or informal sources such as the self help groups to improve the dairy farming enterprises. Some of the money obtained from the loans can be used to improve the dairy farming enterprise for greater production efficiency. Also, this will enable them to implement better anti-cryptosporidiosis prevention strategies, such as constructing cattle shed with cemented floors to facilitate easier cleaning.

Excluding the hired worker, the quantitative data showed that men and women participated equally in the dairy operations. The findings in this study may be a reflection of improvement of gender aspects in relation to urban dairy farming. It appears that women's workload on dairy farming is becoming lighter in this community

The gaps in implementing ideal practices such as wearing of protective clothing, proper hand washing, composting of manure and ideal shed cleaning practices should be addressed by the extension officers. Continued involvement of training women in dairy farming should be emphasized. Also, there is need for the authorities to provide a coherent legal and policy framework governing urban dairy farming.

## CHAPTER ONE

### INTRODUCTION AND BACKGROUND

Africa is currently undergoing an urban population explosion<sup>1</sup>. Despite slow economic progress since the 1970s, African cities have experienced the fastest population growth rates in world history, at over five percent a year, and a large proportion of all future population growth in Africa is expected to occur in urban areas<sup>1</sup>. Kenya's situation is similar to that of other African countries. The population of Nairobi has been increasing consistently, rising from below 120,000 when the first census was conducted in 1948 to the 1999 size of about 2.1 million people<sup>2</sup>. The projections indicate that the city will continue to grow at the same fast pace in the near future, and absorb another five million people over the next two decades<sup>3</sup>.

In fact, Nairobi's growth rate of about seven percent per annum is one of the fastest city growth rates in Africa. Most of the growth of the city of Nairobi is a result of rural-urban migration rather than from immigration or natural increase<sup>1</sup>. This poses enormous challenges in the areas of health care, employment, and civil order. Poverty has always been considered a predominantly rural phenomenon<sup>1</sup>; recent data show that it is increasingly an acute urban problem as well. For instance, while the proportion of people living below the poverty line increased from 48 to 53 percent in rural Kenya between 1992 and 1997; it almost doubled from 26 to 50 percent in Nairobi over the same period<sup>1</sup>.

For the urban poor, a large and growing segment of the population, food is turning into a "basic luxury." To eat a single meal among the urban poor daily is becoming a common practice, and this undoubtedly affects people's nutritional health<sup>4</sup>. As compared to their rural counterparts city dwellers pay 10 to 30 percent more for their food. Malnutrition in Nairobi, Lomé, and Kampala are considered more acute than in rural Kenya, Togo, and Uganda, respectively<sup>5</sup>. Kenyan urban poor households have to spend 40-50% on food and cooking fuel alone. In Egypt, food represents 60% of family budgets for more than 50% of all urban households, despite state control of food supply and distribution channels, and state subsidies on basic items. In metropolitan USA, households spend 9-15% of their income on food<sup>1</sup>.

Farming which is the growing of crops or rearing of animals, is a widespread activity in the capital city Nairobi and other urban areas of Kenya<sup>5</sup>. Thus it has increasingly received recognition as a survival strategy for the urban poor in the developing world. Until recently urban agriculture – which can be defined as any farming technique in an urban environment – was believed to be an insignificant

cultural practice adopted from rural life, and was ignored by planners<sup>5</sup>. Data shows that increasing numbers of the urban poor are engaged in urban and peri-urban agriculture as a poverty alleviation strategy<sup>6</sup>. Already as many as 800 million people are employed in urban and peri-urban farming and related enterprises worldwide, and these numbers are likely to expand in the future<sup>6</sup>. According to the 1988 census, urban agriculture ranked as Dar es Salaam's second largest employer, after small traders and labourers; and 74 percent of urban farmers were found to be keeping livestock<sup>4</sup>. Besides, studies in Nairobi have shown clear gender differences in urban and peri-urban agriculture in the city<sup>5</sup>. A participatory urban appraisal showed that women were mainly involved in farming while men engaged in various forms of employment<sup>5</sup>.

According to the Ministry of Agriculture urban farming plays a crucial role towards improved livelihoods<sup>8</sup>. The amounts are substantial with an estimated 50,000 bags of maize and 15,000 bags of beans being produced in Nairobi annually<sup>8</sup>. The Ministry estimates that up to a quarter million chickens and about 45,000 goats and sheep are reared within Nairobi. Conservative estimates show that about 42 million liters of milk are produced within Nairobi annually. This, in economic terms, means that milk alone generates up to KShs. 800 million annually if priced at Shs. 20 per liter<sup>7</sup>. In Dagoretti Division the direct sales of milk alone amounts to KShs 48,822,816.00 in the whole division annually<sup>7</sup>. In Kasarani Division, about 180,000 trays of eggs were produced in 1998, worth KShs. 27 million<sup>8</sup>. All these figures indicate the potential economic contribution and magnitude of urban agriculture, not only in Nairobi but also in other urban centers in Kenya, where the situation is similar.

Thus, it is clear that urban agriculture already makes a significant contribution to food self-reliance in many major cities. Food self-reliance is not self-sufficiency but it can go a long way toward reducing the food insecurity of vulnerable groups of people<sup>9</sup>. No one expects urban agriculture to supply largely urban needs for cereals and tubers, which can be stored and transported more easily from rural producing areas with limited losses. However, what is striking and must be recognized is that urban agriculture, with little support, already supplements a significant share of the food the cities need.

Figures from the Ministry of Agriculture and Livestock Production 2000 Annual Report shows that, in the 1980s a total of 23,000 cattle were in Nairobi<sup>10</sup>. In 2000 the number of cattle increased to 27,792. As already highlighted, to the urban dairy farmers, dairy farming contributes to food production, generates cash income, produces manure to support crop production and is a means to accumulate financial assets for emergency cash needs. In addition to providing yields sufficient for subsistence

purposes, urban dairy farming activities have the advantage of allowing women to work close to the homestead. This is important in light of domestic and child-rearing responsibilities for which women often have primary responsibility<sup>11</sup>. However, maintaining profitability in the dairy industry while protecting water quality and health of humans and animals is one of the challenges farmers face in Dagoretti Division.

In 1964 when the Nairobi area increased more than tenfold from 65 sq.km to the present 690 sq.km Dagoretti, an area that was formally rural was carved out from Kiambu District to become part of the City of Nairobi. In the new acquired “urban” areas, land tenure was typically freehold and agricultural activities continued to take place as in rural areas<sup>12</sup>.

Due to the burgeoning population in Dagoretti, from 41,409 in 1969 to 240,509 currently<sup>13</sup> land sizes have decreased and major livestock productions are restricted to zero grazing units. With the intensification of urban dairy production for increased yields, zero grazing activities tends to alter the ecology of urban living providing new environments that are conducive for the emergence of zoonotic pathogens like *Cryptosporidium*<sup>7</sup>. *C. hominis* naturally infects humans whereas *C. parvum* infects both humans and cattle. More than half of human cryptosporidiosis is attributed to *C. parvum* which is transmitted zoonotically<sup>14</sup>. In 2003, cryptosporidiosis was diagnosed in 37/81 (46%) of the students at an educational farm program who cared for calves with cryptosporidiosis<sup>15</sup>. The infective dose is low, and has been shown to vary from 9 to 1042 oocysts depending on the isolate<sup>16</sup>. The low infectious dose and its resistance to environmental degradation enhance the possibilities of zoonotic transmission<sup>14</sup>.

Surveys on the prevalence of cryptosporidiosis show that, in industrialized nations, 0.4% of the population pass oocysts in the faeces at any one time. The sero-prevalence is high and 30 – 35% of the US population have antibodies which developed after a previous cryptosporidiosis infection<sup>17</sup>. In developing countries, the sero-prevalence is higher and up to 60 – 70% of the people have circulating antibodies to *Cryptosporidium*. Attack rates for cryptosporidiosis are in the order of 40% for the population at risk. In AIDS patients, the numbers of individuals suffering from chronic cryptosporidiosis has been about 10% in industrialized nations and up to 40% in developing countries<sup>17</sup>. The mortality rate of cryptosporidiosis among the immunocompromised can be as high as 50 – 60%. More studies indicate that, *Cryptosporidium* oocysts are present in 65% - 97% of surface water (i.e., rivers, lakes and streams) tested throughout United States<sup>18</sup>.

In developing countries, *Cryptosporidium* is responsible for 8–19% of cases of diarrheal disease,<sup>19</sup> with a significant effect on mortality<sup>20</sup>. The rate of diarrhea under three years of age in Nairobi stands at 13%<sup>21</sup>. Diarrhea is also responsible for more than 3.1 million deaths each year among children less than 15 years of age, mostly in developing countries<sup>22</sup>.

*Cryptosporidium* as a pathogen of particular importance was more common in persistent than acute diarrheal episodes in Bangladesh. Persistent diarrhea is a diarrheic episode which starts acutely but lasts for at least 14 days<sup>18</sup>. This persistent diarrhea may account for a large proportion of all deaths due to diarrhea. Evidence from studies in Bangladesh, India, Peru and Brazil indicated that approximately 45 per cent (range 23 per cent to 62 per cent) of diarrhea associated deaths were due to persistent diarrhea<sup>18</sup>.

In general, diarrhea develops when intestinal absorption is impaired or secretion is enhanced. Both of these processes are regulated by the intestinal epithelial cells which are infected by *Cryptosporidium*<sup>23</sup>. Several investigators have identified impaired glucose-stimulated Na<sup>+</sup> and H<sub>2</sub>O absorption and/or increased Cl<sup>-</sup> secretion in experimental models of cryptosporidiosis<sup>24</sup>. In addition to these transport defects, abnormalities in the barrier properties of the intestinal epithelium, mediated in part by intercellular junctional complexes, contribute to *Cryptosporidium* diarrhea. Two groups have found evidence of permeability defects and decreased resistance across *C. parvum*-infected intestinal cell lines<sup>25,26</sup>. In addition, both groups found that *C. parvum* infection of these monolayers resulted in the release of cytoplasmic lactate dehydrogenase, consistent with cellular injury, which ultimately resulted in cell death.

Another group has suggested that *Cryptosporidium* induces apoptosis in biliary epithelial cells, but this mechanism of cell death has not been confirmed in vivo<sup>27</sup>. Malabsorption and abnormal intestinal permeability (decreased vitamin B<sub>12</sub> absorption, decreased D-xylose absorption, and abnormal lactulose/mannitol permeability test) have been confirmed in people with AIDS and cryptosporidiosis<sup>28,29</sup>. One mechanism for the induction of intestinal secretion by *Cryptosporidium* may involve the stimulation of prostaglandin production by intestinal epithelial cells

Currently, there are no effective chemotherapeutic agents against cryptosporidiosis<sup>30</sup>. The *Cryptosporidium* oocysts are also resistant to most of the commonly used disinfectants, and

chlorination of drinking water is not sufficient to prevent an infection<sup>31</sup>. Since treatments are still in the developmental phase, current control efforts are largely directed at prevention methods. Recommendations to avoid disease transmission includes taking steps to ensure the provision of clean water, boiling the drinking water, washing hands frequently with water and soap, thoroughly washing vegetables and fruits with safe water and wearing gloves (can be plastic bags) when handling manure. In addition, compost and drying the manure decreases the number of viable pathogens.

### **Exposure assessment of *Cryptosporidium* associated with UDF**

There is a definite potential for *Cryptosporidium* contamination of ground and surface waters from livestock operations<sup>32</sup>. It is believed that the primary modes by which *Cryptosporidium* parasites are transported to surface water is via the drainage from manure storage areas, direct contact by cows with water, runoff from fields on which manure has been spread and wash out from manure-laden soil<sup>33</sup>. A surface water study conducted in the vicinity of a cattle ranch in British Columbia demonstrated that numbers of *Cryptosporidium* oocysts in raw water from a creek passing through the ranch were higher downstream than upstream of the ranch<sup>34</sup>. Consequently, demonstrating that cattle play a major role in the contamination of surface water used for both drinking and recreational purposes.

This parasite can be present in the intestinal tract of animals including cattle and sheep and can be excreted in stable form as an oocyst from infected hosts. The oocyst can then contaminate the environment and also enter the food chain<sup>35</sup>. A study on Kenyan urban farmers revealed that, 50% of the farmers used manure from their own animals, but close to a half obtained it through informal gift or barter from friends or relatives while only 2 per cent bought it<sup>36</sup>. This may present a higher risk of pathogen transfer to the food chain since faecal material can be highly contaminated with *Cryptosporidium* oocysts. In addition, when farmers graze animals on the field prior to its use for growing of crops, there is a possibility of contamination of the crops with faeces<sup>37</sup>.

The consumer will mostly wash unwashed fruits and vegetables. However, some fruits and vegetables (e.g. kales, carrots, and pears) may be poorly washed before consumption. A surveillance study has shown that around 10% of unwashed vegetables may be positive for *Cryptosporidium* with numbers present ranging between 1-5 oocysts per 5 or 20 gram<sup>37</sup>. Cool, moist vegetables provide an ideal environment for *C. parvum* survival and oocysts have been found on the surface of raw vegetables sold at the market. One study in Costa Rica found oocysts on cilantro leaves and roots, lettuce, radishes, tomatoes, cucumbers and carrots<sup>38</sup>. Another study in Peru found, in addition to some of the above

foods, cabbage, basil, parsley, celery, leeks, green onions and ground green chili to be contaminated<sup>39</sup>. Of note, outbreaks have been associated with drinking fresh-pressed apple juice using apples from the ground near to cattle pasture or apples washed with well water contaminated with feces<sup>38</sup>. Refrigeration does not compromise oocysts viability<sup>40</sup>. Fortunately, cooked foods are not thought to be at risk; the normal recommended time and temperature for controlling bacterial food poisoning (cooking to an internal temperature of 70 deg C for 2 minutes) will probably inactivate *C. parvum*. Heat processed foods have never been shown to be a source of infection<sup>38</sup>.

### **Human susceptibility factors for cryptosporidiosis**

The pathogenic potential of the parasite was not fully appreciated until 1982, when the prevalence figures began to rise, largely as a result of the onset of AIDS epidemic. A survey on the prevalence of cryptosporidiosis among human immunodeficiency virus (HIV)-infected children with persistent diarrhea at Mulago Hospital in Uganda showed that 31.3% (76 of 243) were excreting *Cryptosporidium*<sup>41</sup>. *Cryptosporidium* was the most common pathogen (17%) identified in stools analyzed from 75 consecutive HIV seropositive patients with chronic diarrhea admitted to a Nairobi hospital<sup>42</sup>.

In addition to HIV status, other immunosuppressive states have been shown to increase the risk outcomes with cryptosporidiosis. People who undergo bone marrow transplantation are at their highest risk 30 to 100 days post transplant<sup>40</sup>. That correlates with their greatest loss of both immunoglobulins and cell-mediated immunity, and the same kind of phenomenon is seen with people who undergo organ transplants<sup>40</sup>. Chemotherapy, especially that associated with hematopoietic cancers, where the target cells of the chemotherapy are actually the immune cells themselves, is associated with increased risk of severe cryptosporidiosis<sup>43</sup>. The infection tends to disappear when the drop in the white blood cells has resolved

In immunological healthy persons the illness is rarely serious, typically characterized by a self-limiting diarrhea<sup>43</sup>. Results from several studies support the concept that symptomatic infections result in the development of protective immunity; this immunity may not completely block infection on re-exposure to oocysts, but it may protect the host against clinical illness<sup>43</sup>. A similar scenario may be occurring in communities such as the one studied in Fortaleza, Brazil. In communities where *C. parvum* is highly endemic, the first and perhaps the second exposure result in severe diarrheal illness in young children; subsequent oocyst challenge over time probably results in no infection, asymptomatic infection, or mild



cryptosporidiosis, depending on the level of protective immunity at the time of exposure<sup>44</sup>. Drastic weather changes have also been implicated in the propagation of oocysts. Increased concentrations of oocysts have been observed to coincide with heavy rainfall; work in Guinea-Bissau has shown that, the peak prevalence of cryptosporidiosis occurred during the rainy season<sup>20</sup>.

Higher incidences of cryptosporidiosis have been reported in older patients and young children. The authors believed that the infections in older patients and young children (median age 3 years) were due to lowered resistance or immune response<sup>45</sup>. Considerable evidence exists to show that immunological deficiency is a natural consequence of aging. *Cryptosporidium spp.* was more frequently detected in children less than two years of age (96%), a finding previously reported in studies from Bangladesh as well as from other countries<sup>46,47</sup>.

*Cryptosporidium spp.* infection has been reported to be more common in malnourished children than in well-nourished children and the consequences of the disease are more severe in the former than the latter. Severe malnutrition results in depressed cell-mediated immunity, which then leads to chronic cryptosporidiosis<sup>48</sup>. In countries such as Brazil, Peru and, Guinea-Bissau, cryptosporidial infection in early childhood has been reported to be associated with subsequent impairment in growth, physical fitness, and cognitive function<sup>48,49</sup>. However, a study in urban Zambian children found no significant association of cryptosporidial infection with nutritional status<sup>50</sup>. Generally, it is difficult to determine if malnourished children are at higher risk of chronic cryptosporidiosis due to immune suppression, or if cryptosporidiosis is an independent risk factor for becoming malnourished<sup>43</sup>.

As already indicated, *Cryptosporidium oocysts* are found in the dung of infected cattle and calves. One of the main ways humans acquire the infection is animal-to-person contact, or contact with faecal-contaminated environmental surfaces<sup>51</sup>. Therefore, people who are in constant contact with the infected cattle and calves and manure, such as the veterinarian, dairy cattle farm workers, and researchers have a high risk of developing cryptosporidiosis.

In spite of the overall normality of most immune functions in pregnancy, an increased risk from certain infections has been suggested, perhaps because of decreased cellular immune responses to selected antigens<sup>52</sup>. Whether this depression in cell-mediated immunity in pregnancy is sufficient to increase the severity of cryptosporidiosis is unclear. To date there is very little in the literature on the effects of

*Cryptosporidium* in pregnancy<sup>53</sup>. In part this may be because of under-reporting, as many laboratories do not routinely screen faeces for the presence of *Cryptosporidium* spp.

### **Place of gender in dairy farming**

The role of women in household food delivery exemplifies their central role in urban agriculture. Most urban farmers in Kenya are women (56 per cent), with the proportion of women being higher in the larger towns (62 per cent in Nairobi). Among household heads engaged in urban farming, women form an even higher proportion (64 per cent)<sup>36</sup>.

In a recent study conducted in Dagoretti Division only 4% (7 /180) of the women had ever heard of cryptosporidiosis<sup>54</sup>. Despite the important role of women in livestock production, dairy projects have been directed towards men<sup>57</sup>. As pointed out in the 1997 Human Development Report of the United Nations Development Program, "No society treats its women as its men"<sup>55</sup>.

It is three decades since (1970) called into question if women and men benefited equally from economic development<sup>55</sup>. Since then, gender issues in agriculture, more so dairy farming, have become an important subject of inquiry. Gender is a socio-economic variable used to analyze roles, responsibilities, constraints, opportunities and incentives of people involved in agriculture<sup>56</sup>. Despite such a definition, gender is often misunderstood as being the promotion of women only. However, gender issues focus not only on women, but on the relationship between men and women, their roles, division of labour, and access to and control over resources. Access is the ability to use a resource. On the other hand, control is the ability to define and make binding decisions about the use of a resource<sup>68</sup>. Hence, gender relations will determine household security, well-being of the family, planning, production and many other aspects of life.

Gender and gender related aspects are often given lip-service by politicians and briefly noted in policy papers. However, to actually incorporate the concept of gender across all operational levels is more difficult. To give the support required to ensure that it can be properly applied and that some measure of success can be made, demands even more effort<sup>57</sup>.

Concerning livestock development, there is a high level of agreement in the literature that socio-economics and institutional frameworks play an important role in determining who does what, and who gets what. Social and cultural norms dictate the division of labour and control over assets. Policy

and institutional structures often restrict existing sources of support to women, particularly to acquire credit and loans<sup>57</sup>.

Values, norms and moral codes embedded in culture and tradition have very strong influence on gender issues as they determine attitudes and the organizational set-up of the whole community system. Like culture and traditions, political, institutional and legal structures also change slowly. Hence, these latter factors often impede the implementation of gender balanced programs<sup>57</sup>.

Social and cultural factors determine the possible margin of action of women and their activities. In cases where women are excluded from community meetings, have no access to education and training, and where their capacity to become actively involved is not strengthened, they will always be left behind. Only 30% of the women in Kagero, Tanzania were able to attend extension services on livestock production processes<sup>58</sup>. Thus, understanding gender relationships and adjusting methods and messages to them is crucial for full participation by all sectors of the community

Today our efforts are aimed at correcting this imbalance. In most cases it is the adult women household member who is more likely to clean the cattle shed, milk and take care of the animals in the absence of the hired men worker<sup>54</sup>. Among the family members, she is the person with a high potential of contracting zoonotic infections. As a result, this requires a gender approach to fully understand the occupational exposure and vulnerability of women dealing with livestock husbandry.

### **Promoting gender issues**

There is a strong relation between gender and agriculture in developing countries. Women are twice as likely as men to be involved in agriculture-related activity, according to the 2000 United Nations report on the status of women. In Dagoretti division, women are the most important labour force, engaged in multiple ways in animal, crop and family related work<sup>54</sup>. The promotion of gender aspects in urban dairy farming, offers advantages over other agricultural sectors because of the fact that in most dairy farming households, women have access to the cattle but not control, whereas access and control to land is often biased towards men.

In livestock systems, it is easy to show how gender imbalances affect productivity and the possibilities of change are often more evident than in other sectors. For example, if the men realise how their wives' commitment to livestock management changes and leads to better animal health and higher

milk output when women have access to the proceeds from milk sales, the men's willingness to change increases <sup>59</sup>.

The most appropriate strategy to reach and assist greater numbers of the women is to integrate them in mainstream of the risk analysis with the objective of reaching both women and men with the ideal risk mitigating practices of cryptosporidiosis. In contrast to crops, livestock activities are a daily occupation and activities related to animal husbandry occur all year round. As dairy production is not subjected to seasonal restrictions, it is an interesting sector for promoting gender aspects in an ongoing process.

## CHAPTER TWO

### LITERATURE REVIEW

#### **Gender Analysis**

Gender analysis is about understanding culture, expressed in the construction of gender identities and inequalities<sup>60</sup>. It does not advocate a response but it does enable decision-makers to consider potential differential impacts on women and men when choosing between policy options<sup>60</sup>. While the views of organizations can certainly be examined in the course of the analysis, gender analysis is not about simply accepting these views without question. It is research and analysis that takes both women and men into account using a variety of quantitative and qualitative data.

Gender analysis poses questions on the differences between men and women in terms of activities, roles and resources so as to determine needs. It is a tool for creating economic and social gains<sup>61</sup> overcoming the gender barriers that hinder effective implementation of risk mitigating strategies on cryptosporidiosis.

Whereas, sex refers to the permanent and immutable biological characteristics common to individuals in all societies and cultures, gender defines traits forged throughout the history of social relations. Yet, while one's sex does not change, gender roles are learned and change over time<sup>62</sup>. These roles are constructed through forces such as culture, tradition, politics, and need, varying from culture to culture, and often from one social group to another within the same culture (according to characteristics such as class, ethnicity, race, age, caste, and marital status). Recognizing that relationships are gendered allows for the issue of power to be addressed.

Although gender inequality is thus found throughout society, an analysis of it generally starts by looking at kinship and family. This is because it is the primary form of an organization that is inherently gendered. Women's and men's roles and responsibilities in the domestic domain also reveal how the wider society views their natures and capabilities and hence constructs gender difference and inequality<sup>63</sup>. In addition, a great deal of productive, as well as reproductive, activity is organized through kinship and family. Consequently, even when women and men participate in the wider economy, their participation is partly structured by relations in the household. Different rules, norms and values govern the gender division of labour and the gender distribution of resources, responsibilities, agency and power. These are critical elements for understanding the nature of gender inequality in different societies. Ideas and beliefs about gender in the domestic sphere often get

reproduced in other social relations, either consciously as gender discrimination or unconsciously as gender bias<sup>63</sup>.

Outsiders' intervention in social institutions is particularly difficult, given sensitivities to accusations of "cultural imperialism"<sup>64</sup>. To reform personal law and the family norms and codes is a very complex task; families generally refuse penetration of their private sphere by their own governments and even more so by donors. This resistance is not specific to any religion or culture. In Kenya, people consider foreign interventions against genital mutilation as similar to cultural colonialism, and they see governmental decisions in favor of women as an abandonment of African traditions to occidental values<sup>64</sup>.

A successful improvement in the situation of women will not occur if the focus rests only on improving women's education, health care and credit markets. In fact, a central characteristic of gender mainstreaming has been the "evaporation problem" where gender-sensitive strategy and policy statements evaporate by the time they get to the operational stage of a project or program<sup>65</sup>. There are no simple solutions to this problem. Changes and improvements in the situation of women do not depend on specific levels of income or dominant religions. Changing social institutions in existence for centuries requires approaches at both the national and the community levels<sup>66</sup>. Thus, there is a need for women to be empowered to the point where they can exert influence and participate in decision-making on issues that affect their health.

Women's empowerment is the process of increasing their capacity to make choices and to transform those choices into desired actions and outcomes<sup>67</sup>. The emphasis on empowerment reflects a concern that women and men have equal opportunities to make choices about what gender equality means and work in partnership to achieve it<sup>67</sup>. In fact, gender equity is impossible without women's empowerment<sup>65</sup>. Women's empowerment through active participation in project planning, design implementation and evaluation is essential. This often results to achieving the redistribution of roles, responsibilities and power between the man and the woman leading to reduced inequities that predispose them to cryptosporidiosis infection. Outsiders cannot empower women, only women can empower themselves<sup>68</sup>.

### **Gender differences in urban dairy farming**

Gender interactions and gender relations in any activity are very important, as the extent of gender equality determines not only social but economic justice. Any disparity in gender equality creates inefficiencies, inhibits growth and lowers the potential well being of society. The most important factor affecting women's equal right to own, control and access resources (including property) in Kenya is culture<sup>69</sup>. A married woman's access to, use, control and ownership of property depends on the kind of system under which she was married and on the prevailing customary practices in the community in question.

Ownership of large animals such as cows is often related to ownership of the land<sup>57</sup>. How can a woman own a cow while the land she uses belongs to her husband? As already stated, traditions more than laws prevent women from inheriting and controlling land and animals on an equal basis with men<sup>69</sup>. In the southern highlands of Tanzania, even if a married woman signs the ownership contract or pays for a cow, the animal still belongs to the husband, and even in case of divorce, the wife cannot take the animal with her. The statutory law does not recognize many of these marriages and women have no redress in cases of dissolution of their marriages<sup>57</sup>. Similar experiences are related from pastoral societies in Niger, where livestock is often a part of the bride price, but the control over the animals after marriage belongs to the man<sup>70</sup>. The perceptions of these cultures imply that with marriage all the belongings of the women, including herself, reverts to the ownership of men. The Nuer society in Sudan do not permit women to own cattle and goats, but they are often charged with the responsibility for grazing these animals<sup>57</sup>. Benefits of owning a cow to women include economic independence, mobility, and increased ability to make their own decisions<sup>57</sup>.

However, in extensive animal husbandry systems in Pakistan, women continue to own the animals they brought as a part of their dowry. They can decide by themselves what to do with them, but if they want to sell livestock, then they need the men's agreement<sup>71</sup>. Thus, even if women are the rightful and legal owners of livestock, they still depend largely on decisions and agreements made by men. However, when women own and control the cow better animal health and higher milk output has been reported<sup>72</sup>.

There exists an urban situation where there is no recognition of the traditional gender division of labour; this may be due to loss of influence of the social norms brought from the country side. Households in Kisumu city are seen to apply the cultural traditions of the Luo community that prevail in the rural areas differently. Cases of women owning property are found, where this would be

impossible if the Luo tradition would be completely adhered to. Another example of changing gender roles due to urbanization is that women in Kisumu are inheriting livestock; while tradition prescribes that wives and daughters' do not inherit<sup>69</sup>.

Another way to look at ownership patterns is in terms of management of income generated from the dairy cow. The general trend seems to be that men are the ones who control the income generated. In Nigeria, households where husbands were not involved in urban dairy farming; men impinged on women's benefits (i.e. cash) from this activity. Rather than give the man the money, so as to purchase household needs, some women retained part of the money without consent or knowledge of their husbands. Others gave the money to their women friends or their own children to keep<sup>72</sup>. In the Democratic Republic of Congo women were found to hide portions of profits from their husbands by storing monies in kitchen pots<sup>73</sup>. But there are also exceptions to this. Examples from India show that women have learned to keep their own personal accounts and the pattern of income management in women-managed households is quite different from men. Generally, women's control over livestock resources tends to occur with widowhood and to increase with age<sup>57</sup>.

In Ethiopia highlands, it is the main responsibility of women to remove and make manure into cakes and sell or use as fuel<sup>74</sup>. However, this has significant short run implications contributing to them having increased risks of contracting cryptosporidiosis.

In the Arab community, women working in urban dairy farming have little access to financial resources and services that enable them to improve productivity<sup>75</sup>. Women's limited access to credit is exacerbated by their limited access to land tenure. Land tenure often acts as collateral when obtaining credit and loans. As a viable intervention women have developed their small credit/loan systems. The members of the group save a certain amount of money which is then granted to one of the women as a loan. Micro-credit institutions are also common and there are geared for urban dairy farming.

Due to the multiple roles of women, it is more difficult for women to attend training courses or demonstrations on animal health. Besides, it is documented that women spend longer amounts of time in the fields than men, commit substantial amounts of labour into dairy production, processing and marketing and must fetch water, prepare meals, care for children, and so on, upon returning to the homestead<sup>76</sup>. In Dagoretti women spend up to 16 hours daily on agricultural tasks and domestic chores<sup>54</sup>. In Yemen, women often work up to 16 hours while men work up to 12<sup>55</sup>. There also exists a



severe imbalance in agricultural extension services. In the late 1980s only 13 per cent of agricultural field agents in the developing world were women and in Africa the figure was a mere 7 per cent<sup>77</sup>.

Yet, an important factor that enhances agricultural productivity is the extent to which farmers and farm workers have access to training and extension services<sup>78</sup>. Studies have shown positive effects of training on technology adoption and agricultural productivity. However, women are rarely targeted for livestock – related training and extension services. Information and training programmes are generally directed to men. Why women are not targeted can be explained by the following assumptions: (i) information given to men is automatically passed to their wives; (ii) women are less literate than men and will not understand the proposed technology, and (iii) women are much occupied with housework<sup>79</sup>.

In a study done among Kenyan dairy farmers in the Coast province, 69% of those first exposed to information regarding the zero grazing technology were men, while only 19% were women, yet women undertook most of the dairy operations<sup>59</sup>. Similarly, though women are involved in the management of crossbred cows in some areas of Ethiopian highland, only one- third of the surveyed women acknowledged receipt of extension advice. The remaining two- thirds of the women had never attended a demonstration or field day programme. Women felt the information they had about improved dairying was inadequate, the main source was from their husbands. The surveyed women expressed a desire for more advice, especially on disease control and feeding<sup>80</sup>.

Other factors hindering women's access to extension are their lack of formal schooling, mobility and time for extension activities<sup>59</sup>. However, women are good at finding ways of balancing domestic responsibilities with farm duties<sup>59</sup>. Their inclusion in extension programs would make their work more productive, helping to boost agricultural production. Extension programs would be more likely to succeed if they were tailored to women's special circumstances.

Lack of knowledge on cryptosporidiosis may further limit participation of women in implementing prevention strategies. A study carried out in Kano State, Nigeria, showed that women respond promptly and positively to any opportunity that enables them to participate in development and control of health problems<sup>81</sup>.

It is fairly common for men to decide on intensification of livestock production, while it is the women who end up doing the extra work -- usually without access to extension services or other sources of needed information. Often the remittances received from absent men are not enough to permit the hiring of labour, and women end up taking on the tasks. In the highlands of Kenya, it was found that improved cattle breeds and a strategy of zero-grazing increased women's workloads because women had to spend more time collecting animal feed<sup>59</sup>. As their workloads increase, women may even be forced to take short cuts in implementing the prevention strategies. They will tend to cut back on those requiring additional time and effort, such as cleaning the cow shed.

Decision-making patterns are also highly gendered on account of differences in men's and women's ability to exert power and control within the household, community and municipality. Beyond recognizing such gendered experiences, access to resources and decision making capacities, it is important to design an urban agriculture agenda that has gender needs at its core. In 50% of the zero – grazing dairy units in the five districts of Kenya studied husbands are the main decision makers in relation to land use for fodder production, buying and selling of cows. If new livestock activities are introduced, it is mainly men who decide on whether or not to participate<sup>59</sup>. Hence, as much as the emphasis is on increasing information access to women on prevention of cryptosporidiosis it is imperative that men not to be left out. Otherwise the impact of the project would be minimal.

Besides gender differences in access to productive resources within households, one can also find gendered differences between women heads-of-households and men heads-of-households. Often, the first tend to own resources of a poorer quality that consequently result in lower production<sup>36,74</sup>.

At the household level, the decision of a family member to go see a doctor also depends on the approval of the husband; as he is the one who mostly pays for the expenses incurred. Thus, the imbalance in power relation between women and men means different access to and control over resources to respond to health problems.

### **Impacts of gender analysis**

Several studies have demonstrated that focus on gender has led to a series of outcomes that increase the ability of communities to fight gender inequality. In particular, it has contributed to (a) better targeted, more efficient and sustainable extension services; (b) less rigid gender roles that may in turn lead to better intra-household resource allocation; and (c) women's empowerment<sup>82</sup>.

Extension agents reported that gender analysis had improved their ability to deliver extension services by helping them identify the appropriate beneficiaries of their services. Targeting increased and more appropriate extension activities for women were developed as the agents increased their awareness of the role of women in agriculture. In addition, a number of agents observed that women who attend training sessions can clarify or share information with their husbands, a fact that was affirmed by men. Several extension agents also noted that now women are less shy and speak more freely with them<sup>82</sup>.

As a result of their increased realization of how hard women work, a number of men in Honduras—although by no means the majority – report that they now assist their wives with domestic activities such as cooking, child care and cleaning, which they did not do previously<sup>82</sup>. Both men and women also reported a greater degree of men insertion into traditionally women spaces. As for women, increased access to technical assistance has resulted in increased women's participation in agricultural activities<sup>82</sup>. In large part as a result of the gender division of labour exercise, men consistently reported a newfound realization of how hard their wives work. In almost identical terms, men in each community noted that their wives typically get up much earlier than them and go to sleep much later<sup>82</sup>. Many also observed that whereas they generally return from the fields in the early afternoon and rest for the remainder of the day, their wives remain busy with housework until late at night.

Due to their participation in technical assistance activities in agriculture, women have an increased sense of empowerment and independence<sup>82</sup>. While they have traditionally participated in community affairs as members of different committees, these numbers appear to have increased. Many women observed that their husbands would previously not have given them permission to attend meetings on their own, nor to receive technical assistance; particularly, from men extension agents<sup>82</sup>. However, they claimed that since the invitation to attend the meetings and receive on agricultural activities was extended to men and women, their husbands were more willing to let them participate. As a result, a number of women stated that they would be more likely to attend such meetings in the future; with or without permission from their husbands. Several women also commented that they are happy to be receiving the training and because they had previously “never been included in anything outside the home”<sup>82</sup>.

Further research shows that, the engagement of men and women in the planning and execution of extension services and the adaptation of extension services to men's and women's agricultural and non-agricultural needs and interests will likely contribute to a higher application of the methods and

information imparted in the future. In addition, the teamwork promoted by the gender analysis has resulted in greater collaboration among individuals and a sense of common purpose for both men and women. This may constitute a solid social basis for future projects and initiatives<sup>57</sup>.

## CHAPTER THREE

### RESEARCH PROBLEM

#### 3.1 Statement of the problem

International organizations and governments give greater recognition to the need to strengthen the participation of women in order to achieve sustainable development. Although the contribution of women is rather more visible now than it was 25 years ago, there is still a long way to go<sup>62</sup>. Lack of adequate data on true gender disparities in everyday life, as well as in the economic, social and political spheres, has frequently given rise to inappropriate policies, plans and projects. Food and Agriculture Organization (FAO) estimates of women's share of the agricultural labour force indicate that women form a substantial part, varying from 44 to 51 per cent in developing countries as a whole. In sub-Saharan Africa this figure is higher: women contribute between 60 and 80 per cent of the labour in food production both for household consumption and for sale<sup>83</sup>. But, more importantly, women have broadened and deepened their involvement in livestock operational activities production over the last few decades.

Macroeconomic policies such as trade liberalization, structural adjustment programs and modernization of agriculture have prompted men to look for employment outside the agricultural sector. Women have been left agriculture-related tasks and the responsibilities of heading the household<sup>84</sup>. Planning on protecting health of the humans and livestock requires gender specific information and gender-disaggregated data as well as a thorough understanding of the differences in gender contributions to the specific roles. The advantage of a gender perspective is that it allows for the advancement of gender equality and equity regardless of whether it is women or men whose position needs to be advanced. In some regions and sectors, for example, women are in a more advantageous position than men, and gender analysis can reveal this. However, given the fact that historically it is women, who have tended to be disadvantaged, and that a number of inequalities remain, projects and programs on risk mitigating strategies on cryptosporidiosis may need to target women.

The other element is the clear articulation of practical and strategic needs of men and women that are appropriate to the context at hand. Practical needs are "immediate needs related to the inadequacy of [people's] living conditions, such as the supply of food, water, health care and employment". Satisfying them implies no change in gender relations. Strategic needs "are related to the division of

labour, power and control by the genders<sup>85</sup>. Satisfying them helps men and women achieve greater equality and bring about shifts in existing roles.

Practical and strategic needs are interrelated, and involvement in urban dairy farming can contribute to satisfying both. Ideally, planning around urban dairy farming should address gender issues as well as women's issues in two ways: first, by helping women to cope with their immediate, and often marginalized, circumstances; and second, by helping women achieve positive, structural change in their lives. Identifying the type and scale of intervention should rely on a solid understanding of the local context and structural factors that delineate opportunities and constraints for individual producers. Short-term and localized interventions may involve small lines-of-credit or extension services, while longer-term and institutional interventions may require more substantial changes to legal frameworks, land allocations, cow ownership, controlling income generated from urban dairy farming activities and social norms that often marginalize women relative to men such as decision making<sup>86</sup>.

To make reforms of social institutions happen as well as to ensure their sustainability, women must obtain empowerment and become their own agents in handling their lives<sup>68</sup>. Working towards gender equality and women's empowerment means; enabling women to express that potential, to the benefit of their households and their communities. Research on agricultural productivity in Africa shows that, reducing gender inequalities could significantly increase agricultural yields.

Given the same level of agricultural inputs, access to information, credit, and extension as men producers, women producers could increase their yields by more than 20%<sup>87</sup>. In many societies and for various reasons men often take the decisions that concern the lives of women. Most of the dairy farming research has targeted large-scale production of dairy products neglecting small scale production. As women urban dairy farmers are more involved in small-scale operation, this hampers their ability to undertake activities aimed at protecting health in both humans and cattle. For this reason, where the capacity to become actively involved in the implementation of prevention strategies of cryptosporidiosis is not strengthened, the impact of the project will be minimal.

This study aims to obtain an improved understanding of gender issues that exist in Dagoretti with regard to urban dairy farming. Also to find out how gender roles, perceptions and access to resources affects the vulnerability of men and women to cryptosporidiosis.

### 3.2 Justification

Urban agriculture has increasingly received recognition as a survival strategy for the urban poor in the developing world. In Nairobi city, urban agriculture is becoming increasingly important due to rapid urbanization accompanied by the increased growth of unemployment and unsatisfied demand for food<sup>88</sup>. Urban dairy farming is a growing activity in Dagoretti division with a population of 6948 cattle<sup>8</sup>. The division is chosen as the study site because it represents many urban settings in Kenya and East Africa.

Like rural agriculture, urban dairy farming entails risks to health of the urban population if not managed and carried out properly. This is compounded by the fact that the animals are in very close contact with the people due to inadequate grazing land, and by-laws, which prohibit the practice. City authorities have often been reluctant to accept urban dairy farming because of perceived health risks. Yet, many people derive their livelihood from there. Rather than general laws prohibiting urban dairy farming, prevention strategies are needed to manage the health risks.

Cryptosporidiosis was formerly considered to be a harmless or at most an acute disease, but now it poses a serious threat to life. This is due to a predisposing condition (immunosuppression) on the part of its human hosts, mediated by the AIDS epidemic. Cryptosporidiosis has a worldwide distribution and in most surveys is among the four major pathogens causing diarrheal diseases in children<sup>89</sup>.

The transmission of *Cryptosporidia* from cattle to human has been well established, and several sporadic outbreaks of cryptosporidiosis have been implicated to livestock. A previous study conducted in Dagoretti showed that 11% of the calves had cryptosporidiosis<sup>7</sup>. Nevertheless, the specific *Cryptosporidium* species affecting these calves had not been identified.

The oocysts are extremely resistant to disinfection and cannot be killed with the routine water disinfection procedures. Since there is no known effective treatment of cryptosporidiosis, control methods are largely directed at prevention methods. Cryptosporidiosis is not reportable in Kenya. However, cryptosporidiosis infection is of particular interest because these communities in Dagoretti Division are populated by families who practice urban dairy farming. These, increases the likelihood of a person being infected with cryptosporidiosis.

Implementing prevention strategies of cryptosporidiosis in Dagoretti Division can easily fail if the project does not pay enough attention to gender roles and its relations to urban dairy farming. Application of gender analysis seeks to examine the ways in which gender roles, perceptions and access to resources impact upon women's and men's risk of exposure to cryptosporidiosis. The information obtained from the study will identify engendered mitigation strategies for the urban livestock producer to safeguard against the health risks, as well to policy makers to safeguard the public from the hazards.

### **3.3 Research question**

The research questions pursued in this study are as follows: -

1. Is cryptosporidiosis present among the dairy farmers in Dagoretti?
2. What are some of the risk factors in relation to dairy farming that predispose the dairy farmers to cryptosporidiosis in Dagoretti?
3. Who has access and control to resources and benefits (outputs and income) related to urban dairy farming in Dagoretti?
4. Any implications of gender roles in dairy farming?

### **3.4 Objectives**

On the basis of the foregoing statements and discussions, this study aimed to achieve the following objectives: -

1. To determine the presence of cryptosporidiosis among the dairy farmers in Dagoretti;
2. To describe some of the risk factors in relation to dairy farming that predispose the dairy farmers to cryptosporidiosis in Dagoretti;
3. To determine the person who has access and control to resources and benefits (outputs and income) related to urban dairy farming in Dagoretti;
4. To establish the implications of gender roles in dairy farming.



## CHAPTER FOUR

### METHODOLOGY

#### 4.1 Study area

Dagoretti Division lies to the west of Nairobi city, with the area coverage of 38.7 sq.km. It is one of the eight Divisions in Nairobi<sup>90</sup>. Waithaka, Ruthimitu, Uthiru and Mutuini are locations in the division which maintain a semi rural appearance, whereas Kawangware and Riruta are urban, with a large proportion of low-income urban slums<sup>54</sup>. As an urban area Dagoretti Division qualified to be the study site due to the high number of cattle and the presence of the smallholder dairy farmers in the area. In addition, considering the funding allotment for transport costs, Dagoretti was an ideal site due to the close proximity of Kabete Research Laboratories where the analysis of the faecal sample was conducted. Thus, extra transportation costs were not incurred.

Urbanization in Dagoretti has occurred amidst economic liberalization, structural adjustment programs, retrenchment and cost-recovery plans. A clear consequence of the urbanization amidst economic deceleration in Kenya resulted in privation of the residents. Forty six percent (46%) of the Dagoretti population lives below the poverty line<sup>1</sup>. The major housing difference in terms of quality is between mud and wattle, timber, iron sheets and stone or block rooms which accommodate households of three to five people<sup>21</sup>.

Historically, urbanization has been presumed to lead to morbidity and mortality reduction due to economic prosperity and increased access to modern medical care. However this has not been the case<sup>91</sup> evidence suggests that quality of life in some urban areas is even worse than in rural areas mainly due to high levels of poverty in pockets of the urban population<sup>92</sup>. These urban poor experience high unemployment levels leading to income poverty that further limits their access to health, education and opportunities for skills development. Experiencing less access to health, water and sanitation services the inhabitants of Dagoretti suffer from all the usual diseases of the poor and infectious diseases in the tropics such as malnutrition, acute respiratory tract infections and diarrhea. The infant mortality rate is 69.7 per 1000 and under 5 mortality rate is 123.1 per 1000 while the total fertility rate stands at 3.7 per woman<sup>21</sup>.

Of the 240,509 inhabitants of Dagoretti, 125,072 (52%) are men and 115,437 (48%) are women making 11.2% of the total population of Nairobi. In addition, 101,408 (42.1%) are below 19 years of

age, 109,403 (45.5%) are between 20-39 years, while 29,698 (12.4%) are 40 years and above<sup>13</sup>. By projection the current population figure is 350, 290. The local people are predominantly Kikuyu who are mainly subsistence farmers. Rainfall is between 800 – 1, 400 mm annually, with the long rains from March to July and short rains from October to December. The average temperature is about 24°C with a range of 21.5°C - 28°C. Main food crops include maize, kales, cow peas, beans, Irish potatoes and bananas<sup>93</sup>. Insecurity in the area is high and this forces farmers to keep their animals close to the main house for fear of being stolen, this enhances risks of zoonotic transmission.

#### 4.2 Study population

This included men and women from selected urban dairy farms who keep one or more dairy cattle.

#### 4.3 Study design

The study design was a three month longitudinal. Both qualitative and quantitative methods of data collection were used in this study. Structured questionnaires were also administered to dairy farmers. Qualitative data was collected through participatory methodologies such as, key informant interviews and focus group discussions. The groups were segregated by sex.

#### 4.4 Sample size determinant

##### Sampling for dairy farmers

The sample size was derived from the following sample size formula for descriptive studies.

$$n = \frac{Z^2 p (1-p)}{d^2}$$

Where **n** = Sample size

**p** = Proposed population prevalence of 50% of cryptosporidiosis.

**z** = Critical value corresponding to 95% confidence interval obtained from the Table of standard normal distribution = (1.96)

**d** = Degree of precision desired, set at ± 5% <sup>94</sup>

To substitute in the formula:-

$$n = \frac{(1.96)^2 p (1-p)}{(0.05)^2} = \frac{(1.96)^2 (0.5) (1-0.5)}{(0.05)^2} = 384 \text{ Participants}$$

The above is only applicable when the population to be studied is greater than 10,000. From the sampling frame made of the dairy farmers in the study area, there are 920 households. Hence, Fisher's formula was used to determine sample size for population less than 10,000 individuals.

$$nf = \frac{n}{1 + n/N}$$

Where:

**nf** = the desired sample size (when the population to be studied is less than 10,000)

**N** = the estimate of the study population size

**n** = the desired sample size (when the population is more than 10,000)

To substitute in the formula:

$$\begin{aligned} &= \frac{384}{1 + 384/920} \\ &= 271 \text{ households} \end{aligned}$$

Therefore, a minimum of 271 households was required in this study.

#### 4.5 Sampling procedure

A sampling frame of all the nine hundred and twenty dairy farming households was constructed by the extension personnel of Dagoretti. Three hundred household samples of dairy farmers were selected randomly from the entire sampling frame. Using computer generated random numbers between zero and nine hundred and twenty.

In the selection of the twenty five key informant interviewers, a ratio of the number of clinics to be visited was calculated from a list of all the health facilities in Dagoretti, provided by the Ministry of Health. This was done on the basis of the six locations. Once the proportions were arrived at, every third health facility was picked from the list, until the total reached twenty five.

#### 4.6 Inclusion criteria

- a) Consenting men and women from selected study farms.

#### 4.7 Exclusion criteria

- a) Those who do not give an informed consent.
- b) Those who are not residents in Dagoretti Division.
- c) Those who do not give human faecal samples.

#### 4.8 Procedure

Stool specimens from households of men and women from selected urban dairy farms who keep one or more dairy cattle were used in this study. They were collected during the dry season (August 2006) and wet season (November 2006). The bio-samples were stratified on age and sex of those at risk. Three aliquots of the faecal specimens were preserved in 2.5% potassium dichromate for DNA extraction, 75% ethanol and formalin to preserve the structure of the oocysts<sup>95</sup>.

Modified acid-fast staining (MZN) and direct immunofluorescence assay (IFA) were used to determine the presence of *Cryptosporidium* in stool samples. The above tests are not particularly specific when required to distinguish between *C. parvum* and non-*C. parvum*<sup>95</sup>. Polymerase Chain Reaction (PCR) was then used to distinguish accurately between *C. parvum* and non-*C. parvum*<sup>31</sup>.

#### Quality Control

- A negative control was used each day to check the quality of staining – this was a negative sample on the previous day.
- A reference slide (positive for cryptosporidiosis) was examined at the start of each microscopy session.
- The number of slides examined each day and the number positive, negative and equivocal was recorded.
- Five negative samples were retained each day for re-examination by IFA. They were identified by dividing the total number of negative samples for the day by five to get number x and then taking every xth negative sample in order of ascending laboratory identity number until five had been chosen.

- All positive samples were retained for DNA extraction and analysis.
- At the end of the week, twenty positive and twenty negative samples were reassessed by an external laboratory.

#### **4.9 Variables**

The following variables were used in order to achieve the objectives of the study.

##### **Independent variables**

###### **1. Knowledge about cryptosporidiosis**

This was defined as the respondent being able to state whether they have ever heard of the disease called cryptosporidiosis. It was assessed by collecting data on the respondent's knowledge about cryptosporidiosis.

###### **2. Fertilizing crops**

This was defined as the type of fertilizer one uses for food grown for home consumption. It was assessed by recording the type of fertilizer one uses for food grown for home consumption.

###### **3. Contact with cattle or dung**

This was defined as how frequent all the household members get into contact with cattle. It was assessed by recording the frequency of coming into contact with cattle.

###### **4. Age of respondent**

This was defined as the number of complete years the clients has lived since birth. It was assessed by recording age of the client

###### **5. Sex of respondent**

This was defined as the condition of being men or women. It was assessed by recording sex of the client.

##### **Dependent variables**

###### **1. Cryptosporidiosis**

This was defined as whether an individual had the cryptosporidiosis infection.

#### **4.10 Data collection**

Collection of data took three weeks during each season. This started after the necessary clearance and authorization was obtained from the Department of Community Health, University of Nairobi, and the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee.

#### **4.11 Instruments of data collection**

These include:            Questionnaires  
                                  Focus group discussion (FGD) guide  
                                  Key informant interview guide

##### **a) Questionnaires**

Quantitative data was collected using structured questionnaires, with both open ended and close ended questions. This was done by the principal investigator with the help of four trained research assistants. The questionnaires were pre-tested in Kasarani Division where urban dairy farming is also practiced. The purpose of the pre-test was to determine the overall feasibility of the tool for effectiveness and efficiency in actual data collection. The questionnaire that was used for the urban dairy farmer appears in Appendix 2.

##### **b) Focus Group Discussion Guide (FGD)**

FGD was conducted in each of the six locations. The groups were segregated by gender. Participants were selected from those who had attended the workshops. A set of prepared questions that was used for collection of qualitative data appears in Appendix 3. Note that, on the aspects of division of labour, scoring will be used. Participants are given 100 pebbles for each activity, to put in proportion with the person who does the activity in their homes. Then the average figures obtained

##### **c) Key informant interviews**

This was used to provide an overview of the issue at hand by analyzing the realities of gender analysis in urban dairy farming, and its implications on the implementation of prevention strategies on cryptosporidiosis. A set of prepared questions that was used for collection of qualitative data appears in Appendix 4.

#### **4.12 Data processing and analysis**

##### **Quantitative Data**

The completed questionnaires were checked daily to ensure each question had been filled correctly and no data is missing. They were then numbered and coded for ease of handling. Data were entered using Ms - Access data entry programme and analyzed using Instant and Genstat computer program of data analysis. The results were then presented in a descriptive form using frequency tables, cross tabulations

tables and bar charts. The Chi- square test, and odds ratio were used to determine the significance of the relationships between independent and dependent variables.

#### **Qualitative data:**

The focus group discussion and the key informant interview were analyzed by content analysis. Discussions were conducted in a non threatening manner. Main items discussed were on gender roles and access to and control over resources. The local people were considered as capable of interpreting and changing their situations themselves. Pebble stones were used for the scoring exercise.

#### **Data Quality Control**

The interviewers were given a brief overview of the study and trained on interviewing techniques, logistics and accurate recording of data into the questionnaires before the commencement of the study; standardized questionnaires were used and all questionnaires reviewed by the research assistants at the end of the day. Necessary corrections were also made. Assistants were trained on translation to either Kiswahili or Kikuyu for respondents who cannot understand English. As already indicated pre-testing of the questionnaire was done. Data was coded accurately and research assistants supervised.

#### **4.13 Ethical considerations**

Permission to carry out the study was obtained from Kenyatta National Hospital Ethical/University of Nairobi and Research Committee and the Ministry of Education. The purpose of the study was explained to all potential participants and informed consent of willing participants was obtained. Researchers were made aware of the fact that, persons who are made subjects of the research have a right to anonymity of all the information they give. Subjects of the research were informed if they were likely to be quoted verbatim (for example, in focus group discussion or key informant interview) and they were assured of anonymity. Any participant was at liberty to refuse to participate in the study or terminate the interview any time. As much as possible, disruption of the day-to-day activities of participants was avoided. The respondents were provided with appropriate information after the completed interview or focus group discussion.

## CHAPTER FIVE

### RESULTS

The study aimed to determine the presence and risk factors of cryptosporidiosis among dairy farmers. Also, to establish the implications of gender roles associated to dairy farming. Information was collected from a total of 296 households.

#### 5.1 Demographic characteristics

The demographic characteristics included age, sex, level of education of the respondents (Table 5.1).

**Table 5.1 Demographic characteristics (n= 296)**

Characteristics of the respondents		Women	Men	Overall %	p value	95% CI
Age	13- 19 years	2	4	2	0.036	(-0.0856,0.0092)
	20- 29 years	16	13	10	0.039	(-0.1644,0.0058)
	30 -39 years	38	12	17	0.046	(-0.0545,0.1273)
	40 - 49 years	46	8	18	0.043	(0.0380,0.2055)
	>50 years	110	47	53	0.527	(-0.1663,0.0850)
Marital status	Single	4	4	3	0.169	(-0.0778,0.0203)
	Married	129	84	73	<0.001	(-0.4572,-0.326)
	Widowed	62	5	23	<0.001	(0.1535, 0.3124)
Level of education	None	28	7	12	0.242	(-0.0259,0.1234)
	Incomplete primary	37	20	19	0.211	(-0.1680,0.0409)
	Complete primary	54	17	24	0.342	(-0.0517,0.1564)
	Secondary	66	37	35	0.035	(-0.2523,-0.060)
	Post secondary	10	16	9	<0.001	(-0.2320,-0.055)

There were more women (72%) respondents than men (28%). Literacy levels are quiet high. More men than women had acquired post secondary education ( $p = <0.001$ )



## 5.2 Prevalence of cryptosporidiosis

Testing for cryptosporidiosis was done in series; an initial screening test was administered. The faecal samples with positive results were reevaluated with other additional tests. Initially, Modified Ziehl Neelsen (MZN) was carried out in all the 1,422 human faecal samples. Forty five samples turned out to be positive for cryptosporidiosis. MZN exhibited a high specificity of 97.7%

All the forty five samples which were positive on MZN and 20% of the samples selected randomly that had been negative on MZN were further subjected to direct immunofluorescence assay (IFA) test. In total IFA was done on 188 of the human faecal samples. Only 4 turned out to be positive with IFA. IFA exhibited 97.9% specificity.

The four that were positive on IFA were further reevaluated using polymerase chain reaction (PCR), and all tested negative for cryptosporidiosis.

The overall prevalence rate of cryptosporidiosis in Dagoretti was 0%.

## 5.3 Risk factors of cryptosporidiosis

### 5.3.1 Treatment of manure

Before using the cow dung in their farms 287 (98%) of the dairy farmers' heap to dry and 6 (2%) apply the cow dung directly to their farms. Ideally, composting should be done.

### 5.3.2 Crop fertilization

Table 5.2 Types of fertilizer (n = 296)

Types of fertilizer	Responses	%
Chemical fertilizer alone	2	1
Cattle manure alone	99	33
Other manure other than cattle manure	2	1
Both cattle manure and chemical fertilizer	88	30
Both chicken manure and chemical fertilizer	2	1
Other manure and cattle manure but no chemical fertilizer	56	19
All three in use, cattle manure, other manure, and chemical fertilizer	47	16

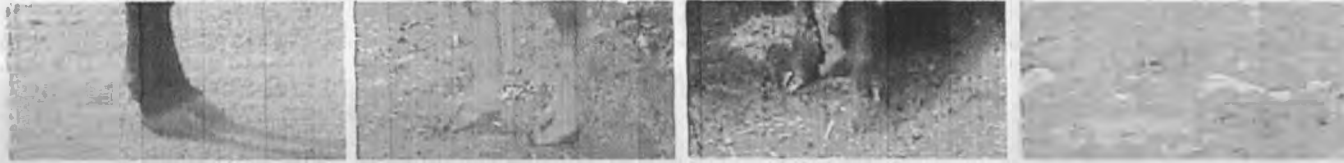
Of the 296 households, at least 290 (98%) of the households used cattle manure in their farms 6 (2%) used other combinations of manure such as goat, sheep, chicken or chemical fertilizer (Table 5.2).

Other than cattle, the animals mostly kept in the home included; chicken 242 (61%) dogs 223 (57%), cats 206 (52%), pigs 48 (12%) and donkeys 4 (1%).

### **5.3.3 Cleanliness of the cattle shed**

Cleanliness of the cattle shed was assessed by observation, using 4 levels. In this study, a completely dry standing area was awarded a score of 1. If mainly dry with some wet patches, a score of 2. If wet a score of 3 and if boggy a score of 4. Similarly, scoring for the cattle shed's sleeping area was done by comparing the photo and what was on the ground, as presented in Figure 5.1 and 5.2.

## STANDING AREA



Score 1	Score 2	Score 3	Score 4
Completely dry No feces/mud on ground Hoofs remain clean	Mainly dry some wet patches Less than 1cm feces/mud on ground Hoofs on hard ground	Wet 1- 3 cm of feces/mud on ground Hoofs sink a little in ground	Boggy More than 4 cm feces/mud on ground Hoofs sink deeply in ground

Figure 5.1

## COW CLEANLINESS

### LYING/SLEEPING AREA



Score 1	Score 2	Score 3	Score 4
Completely dry and clean	Mainly dry and clean - some feces	Damp, deep bedding with trodden in feces	Wet and filthy

Figure 5.2



	Score 1	Score 2	Score 3	Score 4	Score 5
<b>Udder</b> Includes fore and rear udders and all teats and flaps					
<b>Lower rear legs</b> Area from point of back to floor including hoof.					

**Table 5.3 Cleanliness of cattle shed: Standing area (n = 296)**

Cleanliness of cattle shed	Count	%
Completely dry	7	2
Mainly dry with some wet patches	54	8
Wet	61	21
Boggy	171	58

**Table 5.4 Cleanliness of cattle shed: Lying area (n = 296)**

Cleanliness of cattle shed	Count	%
Completely dry and clean	15	5
Mainly dry and clean, but with some faeces	54	18
Damp, deep bedding with trodden in faeces	73	25
Wet and filthy	152	51

In both the standing and lying area, more than three quarters of the households had unclean cow sheds, the results are summarized in Table 5.3 and 5.4.

## 5.4 Knowledge

### 5.4.1 Knowledge on symptoms and zoonotic infections

**Table 5.5 Knowledge on symptoms and zoonotic infections (n = 296)**

Knowledge on symptoms and zoonotic infections	Women	Men	Overall %	p value	95% CI
Bovine tuberculosis	61	28	30	0.430	(-0.1024,0.1228)
Aflatoxins	18	6	8	0.431	(-0.0365,0.0907)
Brucellosis	86	28	39	0.013	(0.02109,0.2519)
E. coli	13	7	7	0.610	(-0.0721,0.0545)
Worm	51	22	25	0.332	(-0.0815,0.1286)
Diarrhea	43	23	22	0.700	(-0.1317,0.0767)
No idea	38	16	18	0.328	(-0.0720,0.1154)

To assess the level of knowledge on symptoms and zoonotic infections, the respondents were asked to mention any zoonotic infections or health hazards associated with dairy farming. No significant difference between men and women who knew cattle could predispose them to the above diseases except for brucellosis where a significant proportion of women thought that the disease could be cattle related risk ( $p=0.013$ ) (Table 5.5).

### 5.4.2 Knowledge on cryptosporidiosis

As pertaining to awareness on cryptosporidiosis, only 29 (10%) of the respondents had ever heard of this disease as per August 2006 (dry season). When data collection was repeated three months later (November, 2006) the number of persons who knew about cryptosporidiosis had increased to 124 (42%). Increased awareness on cryptosporidiosis resulted from door-to-door teaching during the initial collection of human faecal samples in the dry season. On further analysis by sex, the findings show that, 22 (10%) of the women and 7 (8%) of the men had heard about cryptosporidiosis in August 2006. As for the month of November, 2006; the proportion of the men respondent who had heard about cryptosporidiosis was 43% and the women respondents was 42%.

**Table 5.6 Awareness on cryptosporidiosis and education level after door-to door teaching (n = 292)**

Education level	Awareness on cryptosporidiosis		
	Those who have heard about cryptosporidiosis	Those who have not heard about cryptosporidiosis	Total
None	7 (6%)	28 (17%)	35
Primary	57 (46%)	71 (42%)	128
Secondary or higher	60 (48%)	69 (41%)	129
Total	124	168	292

$$\chi^2 = 8.32, p = 0.016$$

Further computations showed that, there was a significant relationship between education level and knowledge on cryptosporidiosis ( $p = 0.016$ ) (Table 5.6). This means that, the people who were more educated had heard about cryptosporidiosis than those who were not educated.

### 5.4.3. Knowledge on disease transmission

Half of the respondents (149, 50%) knew that they can get diseases from handling cow dung. Ninety nine (33%) thought otherwise and 48 (16%) had no idea whether handling cow dung with bare hands could pose any threat to their health.

**Table 5.7 Knowledge on disease transmission (n = 149)**

Knowledge on how the diseases are transmitted	Responses	%
Physically handling of manure	124	83
Physically handling cattle	8	5
Physically handling other animals	2	1
Drinking dirty water	18	12
Washing in dirty water	3	2
Drinking contaminated milk	67	45
Eating contaminated food	33	22
Contamination by cattle manure unspecified	30	20
Don't know	6	4

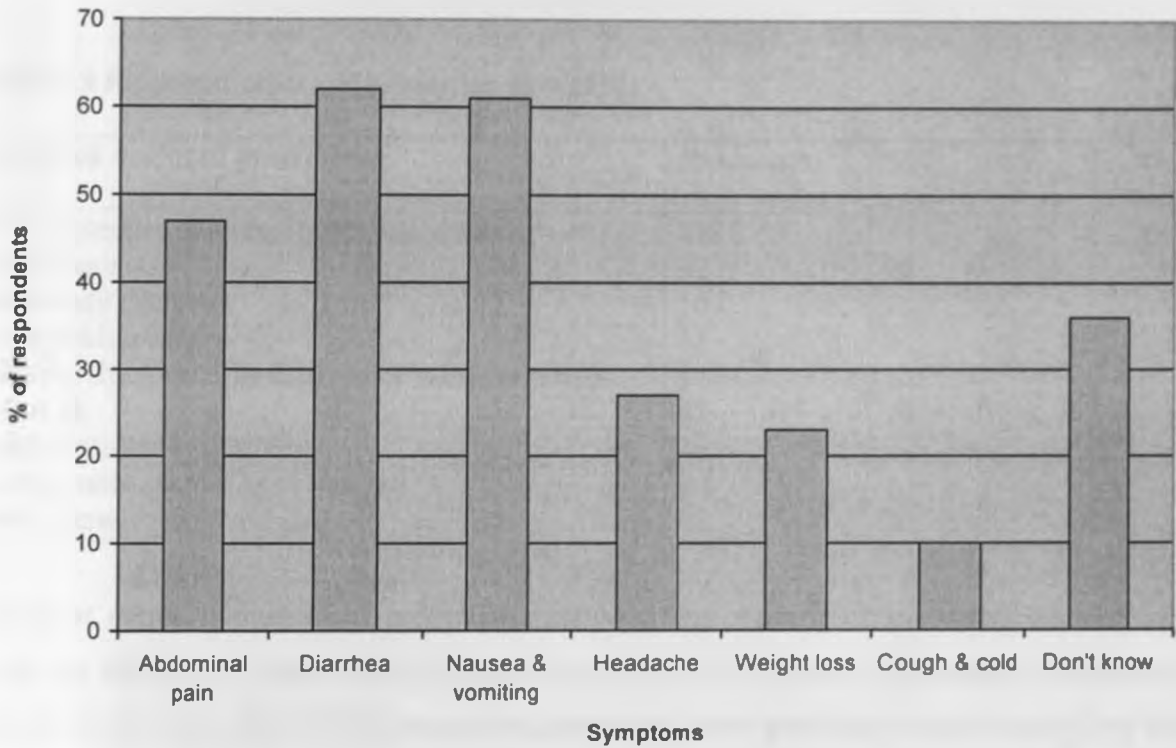
Among the 149 respondents who knew that handling cow dung could pose a threat to their health, 124 (83%) considered that the transmission of the diseases could occur by physically handling of the manure. Only 6 (4%) did not know how an individual could get a disease as a result of handling cow dung, as seen in Table 5.7.

**Table 5.8 Causes of cryptosporidiosis (n = 124)**

Causes of cryptosporidiosis	Responses	%
Drinking contaminated water	58	47
Contact with infected faeces	98	79
Eating contaminated raw vegetables	60	48
Person to person contact	42	34
Don't know	7	6

Out of the 124 respondents who knew about cryptosporidiosis, 98 (79%) knew that contact with infected faeces causes cryptosporidiosis. The transmission pathway that was least mentioned was person to person contact (42, 34%). In addition, 7 (6%) of the respondents had no idea on what causes cryptosporidiosis, as depicted in Table 5.8.

**Figure 5.3 Symptoms of cryptosporidiosis (n = 124)**



Cryptosporidiosis was mostly associated with watery diarrhea (62%), nausea and vomiting (61%) and abdominal pain (47%). Not only did 10% of the respondents have misconceptions about the symptoms of cryptosporidiosis, mentioning coughs and colds. But also, 36% did not know of any symptoms of cryptosporidiosis (Figure 5.3). Besides, 14 (56%) of the health care workers (nurses and clinical officers) interviewed knew no symptoms of cryptosporidiosis. Nonetheless, 40% of the health care workers were able to mention diarrhea as a symptom.

Fifty two percent of the health care workers interviewed did not know of any risk factors associated with cryptosporidiosis. Immunosuppression as a risk factor was mentioned by 28% of the health care workers, likewise 28% mentioned poor hygienic practices. Merely one health care worker mentioned about contact of animals as a predisposing factor to cryptosporidiosis.

One hundred and fifty one (51%) mentioned that one could protect themselves from these diseases. Eight (3%) thought there was no means of protection available. Eleven (4%) had no idea whether an individual can protect oneself.

**Table 5.9 Perceived modes of protection (n = 151)**

Perceived modes of protection	Responses	%
Wear protective clothing (boots and gloves)	122	81
Wash hands	32	21
Wash body generally	10	7
Boil drinking water	12	8
Treat drinking water by filtering or using chemicals	2	1
Boil milk	42	28
Wash fruits and vegetables	3	2
Protect water sources from manure	2	1
Don't know	11	7

The most common method of protection mentioned was wearing of protective clothing such as gumboots and gloves. Hand washing was mentioned by 21% of the respondents. In protecting the community at large, only 2 (1%) respondents mentioned about protecting water sources from manure (Table 5.9)

The results from key informant interviews showed that most of the health care workers (68%) did not know about any prevention strategy against cryptosporidiosis. Moreover, only one knew that there was no effective drug against cryptosporidiosis. As for the rest who responded to the treatments available, most of them mentioned flagylates (16%), antidiarrheals (8%), and antibiotics (4%) which were incorrect answers. When educating the patients on preventing diarrheal diseases, most of them (60%) spent less than ten minutes on the topic.

### 5.5 Practices

In order to assess on practices, several components such as the use of protective clothing, hand washing and treatment of drinking water were considered. Majority of the respondents (289, 99%) washed their fruits and vegetables before eating or cooking them.



### 5.5.1 Hand washing

For the 246 household members who provided assistance during the collection of cow dung, only 22 (9%) washed their hands after the procedure and the rest (224, 91%) did not wash their hands.

### 5.5.2 Wearing of protective clothing

Protective clothing were described as a specific set of clothes and pair of shoes set aside for wearing when carrying out dairy farming activities and removed thereafter. Two hundred and three (52%) respondents mentioned that they wear protective clothing when working with cattle. This data was further analyzed according to sex, 68% of the women and 32% of the men answered in the affirmative. Among the 203 respondents, 120 (59%) always wore protective clothing when handling animals and 83 (42%) wore protective clothing occasionally.

### 5.5.3 Water

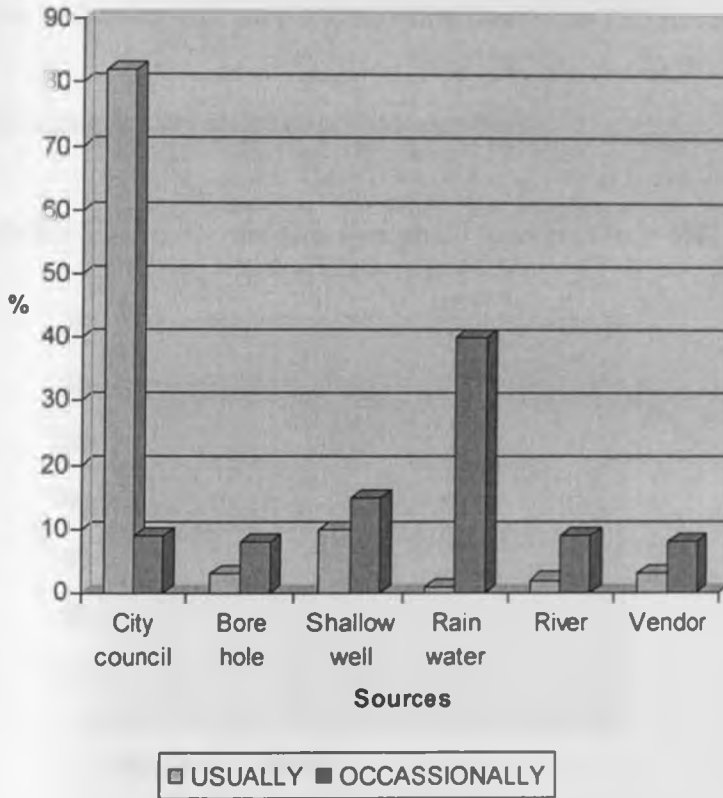
Ninety four (32%) of the households had shallow wells in their homesteads. One hundred and eighteen (40%) of the households had a water frontage which included; streams, rivers, ponds and swamps with standing water whether seasonal or permanent.

**Table 5.10 Source of drinking water for cattle**

Source of water for cattle	Usually		Occasionally	
	Responses	% (n = 296)	Responses	% (n = 176)
Nairobi Water Company supply	210	71	21	12
Bore hole	15	5	15	9
Shallow well	62	21	42	24
Rain water	1	0.3	56	32
Stream or river	7	2	29	16
Purchase from vendor	2	1	13	7

Two hundred and ten (71%) of the households with cattle gave them drinking water from Nairobi Water Company supply. Sixty two (21%) fetched the water from the shallow well, 15 (5%) from bore holes and 7 (2%) obtained the water from the stream or river (Table 5.10)

**Figure 5.4 Sources of drinking water for people (n = 296)**



Most of the households (246, 83%) obtained their drinking water from Nairobi Water Company supply. Thirty (10%) drew their water from the shallow well and 9 (3%) fetched from the borehole, as shown in Figure 5.4.

Two hundred and sixty three (67%) households treated their drinking water. Boiling as a form of water treatment was done 228 (87%) of the respondents. Filtration was done by 2 (1%) respondents.

Thirty nine (10%) of the households interviewed had their children swim, paddle or play in river streams, ponds or standing water in Dagoretti Division.

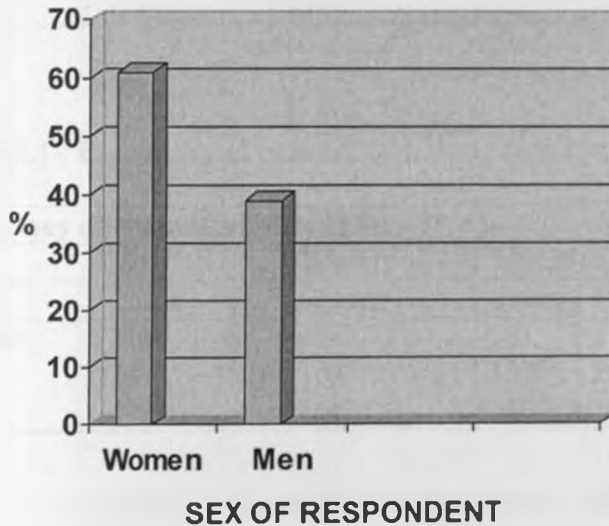
#### **5.5.4 Distance**

One hundred and ninety nine (67%) of the urban dairy farmers do not have shallow wells. Of the 97 (33%) who have shallow wells; the average measured distance from the well to the cattle shed is about 73 meters. The range is from 0 to 1200 meters, with about half the distances being from 12.3 to 60.0 meters.

Besides, out of the 95 (32%) who have manure piles around their homesteads; the average measured distance from the manure pit/pile and the shallow well is 107 meters. The range is from 0 to 4000 meters, with about half the distance being from 17 to 75.5 meters.

### 5.5.5 Caring for the sick household members

Figure 5.5 Caring for the sick household members (n = 698)



Among the household members, women (420, 61%) were more likely to care for the sick, than the men (278, 39%). (Figure 5.5).

## 5.6 Gender division of labour

### 5.6.1 Activity profile

**Table 5.11 Frequency of contact with cattle (n = 1543)**

Frequency of contact with cattle									
	Daily		Weekly		Infrequent		Never		Total
	Count	%	Count	%	Count	%	Count	%	
Women	255	33	56	7	149	19	305	40	765
Men	318	41	114	15	143	18	203	26	778
Total	573		170		292		508		1543

**Table 5.12 Frequency of contact with dung (n = 1543)**

Frequency of contact with dung									
	Daily		Weekly		Infrequent		Never		Total
	Count	%	Count	%	Count	%	Count	%	
Women	196	26	58	8	163	21	348	45	765
Men	280	36	108	14	157	20	233	30	778
Total	476		166		320		581		1543

The activity profile conducted in the quantitative survey showed that in general, more men were involved in the activities associated with urban dairy farming. The results are summarized in Table 5.11 and 5.12.

One hundred and seventy one (58%) of the dairy farming households had hired workers, and 128 (43%) of the workers were involved in the day-to-day dairy farming activities. Among the dairy farmers who were above 65 years old, all (48) of them had hired workers, to carry out the dairy farming activities.

**In the absence of workers what sex is involved in the daily activities? As pertaining to:-**

**Table 5.13 Daily contact with dung by sex (n = 1422)**

Sex	Daily contact with dung		
	Yes	No	Total
Women	188 (25%)	569 (75%)	757
Men	167 (25%)	498 (75%)	665
Total	355	1067	1422

$$\chi^2 = 0.01, p = 0.904, OR = 1.0$$

**Table 5.14 Daily contact with cattle by sex (n = 1415)**

Sex	Daily contact with cattle		
	Yes	No	Total
Women	241 (32%)	510 (68%)	751
Men	204 (31%)	460 (69%)	664
Total	445	970	1415

$$\chi^2 = 0.31, p = 0.580, OR = 1.1$$

**In the absence of hired workers,** there was no association as pertaining to what sex is more involved in the daily dairy operations. Both the man and the woman in the households were equally involved in carrying out daily activities associated with urban dairy farming. These findings are illustrated in Table 5.13 and 5.14.

**Table 5.15 Activity profile as reported by men participants in the focus group discussions**

Activity	Person doing the activity						TOTAL
	Father	Mother	Male worker	Female worker	Son	Daughter	
1. Shed cleaning	42.5	17.5	18	2.5	15.5	4	100
2. Manure disposal	33.5	12	32.5	3	17.6	1.4	100
3. Feed harvesting	28.6	27.2	19.2	0	17	8	100
4. Giving fodder	38.5	32.4	17.4	0.7	8	3	100
5. Preparing utensils and water for milking	1	89.9	0	2.2	1.1	5.8	100
6. Milking	15.6	47.1	19.8	0	5.6	11.9	100
7. Milk distribution	11.1	48.8	10.8	2	15.6	11.7	100
8. Treatment giving	61.7	25.7	2.3	0	10.3	0	100
9. Spraying cows.	55	18	17	0	10	0	100
10. Giving milk to calves	35.6	45	7.9	0	6.5	5	100

Five focus group discussions were held. The average numbers of participants were 10 women and 10 men. Participants were asked to pile 100 pebbles on each activity, in relation to the person doing the activity in the homestead. After all the participants had done the piling, average figures were then obtained.

**Table 5.16 Activity profile as reported by women participants in the focus group discussion**

Activity	Person doing the activity						
	Father	Mother	Male worker	Female worker	Son	Daughter	TOTAL
1. Shed cleaning	11.9	48.7	26.1	0	6	7.3	100
2. Manure disposal	11.2	38.4	37.8	0	7	5.6	100
3. Feed harvesting	11	51.5	22	2	8	5.5	100
4. Giving fodder	7.9	59.3	23.9	0	3.1	2.7	100
5. Preparing utensils and water for milking	1.1	71.2	2.4	4	6	15.3	100
6. Milking	11.6	56.7	27	0	4.7	0	100
7. Milk distribution	3.5	45	22	0	10.1	19.4	100
8. Treatment giving	30.8	32.8	27.8	0	8.3	0.3	100
9. Spraying cows.	30.9	26.6	36	0	6.5	0	100
10. Giving milk to calves	5	74	12.5	1.7	4	2.8	100

As already described, results from the quantitative survey showed that men were more involved in the dairy farming activities. However, results from the qualitative survey conducted in the same community shows a strong diversion of perceptions about many of the tasks. The women participants gave themselves the highest scores on all activities listed, with the exception of spraying the animals. As for the men they gave themselves the highest scores in most activities with exceptions on activities related to milking. These included milking, milk distribution, giving milk to calves, and preparing utensils for milking.

Dairy farming being a laborious task, most participants said they would rather employ male workers. Hence, the female employee had low scores in all the listed activities. Furthermore, children had low scores in the dairy farming activities as they were mostly in school.

## 5.7. Access to and control over resources

The study examined gender division of access to and control over resources under two issues. The first issue was about access to and control over productive resources, like land, credit, and training. The second was the control over the benefits of dairy production, like cash income, milk, manure and the cow.

**Table 5.17 Access to and control over resources in Dagoretti**

Productive resources	Access		Control	
	Men	Women	Men	Women
Land	◆◆◆	◆◆◆	◆◆◆	◆◆
Social capital (credit and loans)	◆◆◆	◆◆◆	◆◆◆	◆◆◆
Human capital (training, information)	◆◆◆	◆◆◆	◆◆◆	◆◆◆
<b>Benefits of production</b>				
Income from the sale of milk	◆	◆◆◆	◆	◆◆◆
Income from the sale of the cow	◆◆◆	◆◆◆	◆◆◆	◆◆◆
Manure usage	◆◆	◆◆◆	◆◆	◆◆◆

**Key:** - ◆◆◆ Indicates complete access/control  
 ◆◆ Indicates partial access/control  
 ◆ Indicates limited or no access/control

### 5.7.1 Access to and control over productive resources

As already discussed, access is the ability to use a resource. Whereas, control is the ability to define and make binding decisions about the use of a resource

Women and men were both identified as having equal access to land. Women were the main decision makers in regard to planting of crops on the farms. Land ownership which is linked to control was ascribed to men by lineage. Land ownership among women had augmented due to an increased purchase of land by women and an increased receipt of land by women as an inheritance from parents and spouses. Moreover, participants acknowledged that they could assign their daughters some piece

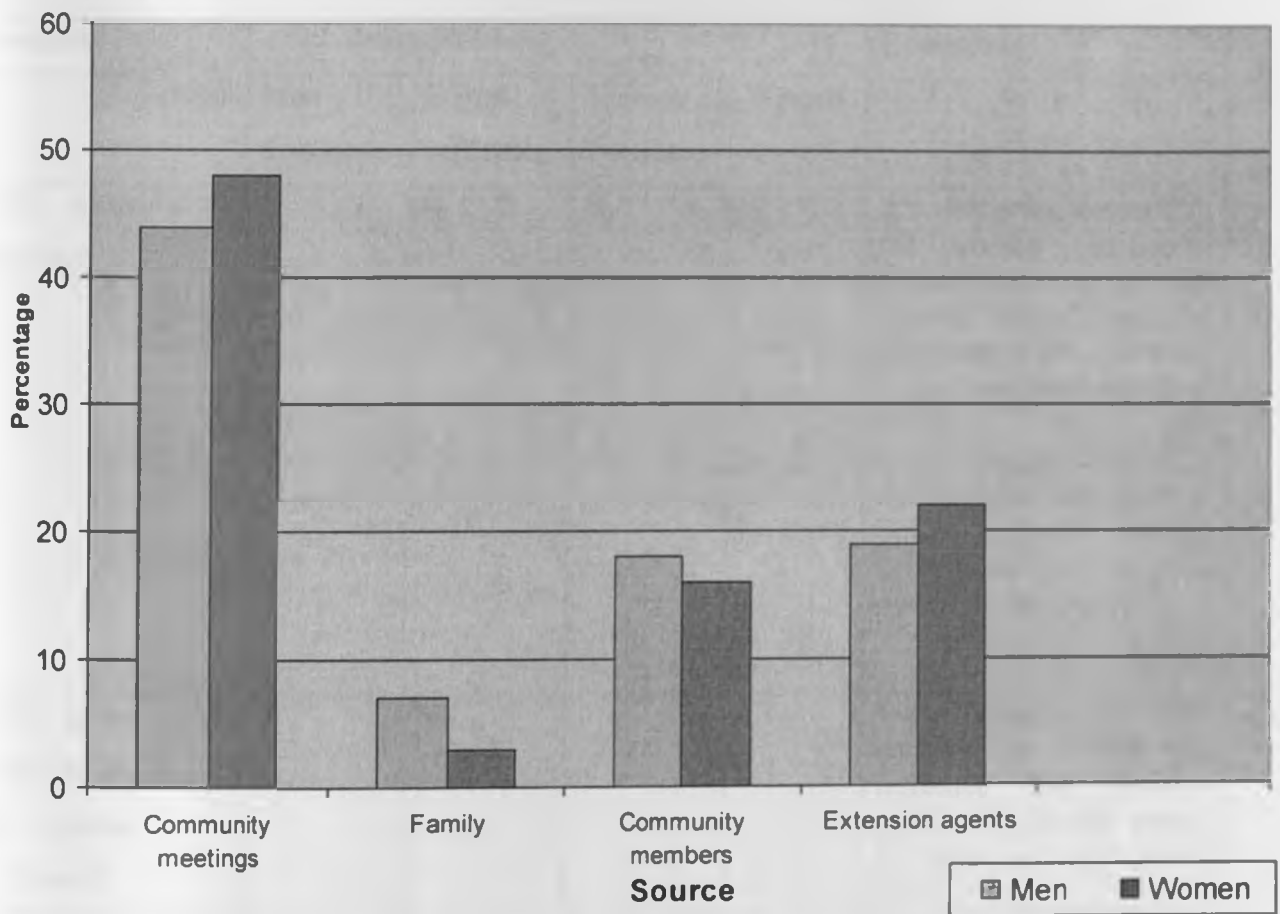


of land whether married or not. "As girls were more responsible and they take care of you during old age" this was said by both the men and the women participants.

Collateral demands of financial institutions have been adjusted to suit the needs of the vulnerable population. Therefore, dairy farmers can now use milk as collateral in the formal institution. But the women participants lacked information about obtaining loans from formal institutions. Self-help groups were the informal sources where women obtained loans with low interest rates. Men obtained loans from banks and church welfare groups. Lack of funds at Agricultural Finance Corporation (AFC); a leading institution that gives loans to farmers was reported as a major constraint when obtaining loans for livestock enterprises. Another constraint was the fear that the animal acting as a guarantee may die before it is fully paid for.

It was unanimously agreed that, both sexes had equal access to training and information in relation to urban dairy farming. Both the men and the women participants wanted to learn about construction of the zero-grazing units, maximizing on dairy production, diseases that affect cattle and drug administration.

Figure 5.6 Sources of information (n = 149)



Sources of information on the health risks associated with handling of cow dung varied between men and women. The proportion of women obtaining information from community meetings was 48% and extension agents 22%. As for men the findings were; 44%, and 19% respectively (Figure 5.6).

### 5.7.2. Access to and control over benefits of production

Women were more commonly involved in the selling of milk and disposing of the manure than the men. Women made decisions on spending the money if the amount is small (from the sell of milk). The money was used mostly in buying foodstuffs, paying the hired worker, and paying for veterinary services. Women mostly used the manure in their farms and also gave some to their friends. Men had an upper hand on the decisions as pertaining to the selling of the cow. Money obtained was used to pay school fees, buy another cow or meet other expenses.

**Table 5.18 Decision making matrix in Dagoretti Division households**

Decisions	Men	Joint decisions			Women	Comments
		Men dominate	Equal influence	Women dominate		
Who owns the cow?	•		◆			It is interesting to note that; the women participants pointed out that the cow was for both of them. On the other hand, the men participants said that they owned the cow (“everything with blood in the household was theirs”). For women headed households the cows were owned by the woman.
Who gives authority for the animal to be sold?		◆	◆			Men usually take this decision but women can influence this decision specifically to raise money in times of a financial crisis.
Who decides on the number of cows to be bought?					◆	Women dictate on the number of cows.

Decisions	Men	Joint decisions			Women	Comments
		Men dominate	Equal influence	Women dominate		
Who calls the vet when the cow is sick?			◆	◆		Women know when the cow is sick, but informs the men partner before calling the veterinary officer.
Who decides what cow feed to buy?					◆	Women know and decide on what the animals needs.
Who decides to hire additional labour?					◆	Women dominate over the decision. ("If the woman decides the worker is going; then the worker goes. And if she wants to hire she goes ahead to do it as she is the one who gets tired - men we have no say in that").
Who owns the land that you are staying in right now?	◆				◆	In the men headed households it was the men who owned the land. Vice versa, for women headed households, it was the women who owned the land. In addition, some women had also purchased land.
Who decides on the crops to be grown on the farm?					◆	Women were the main decision makers.
Who decides to take a loan?		◆	◆			Participants agreed that men dominate.

### 5.8 Perceptions on the quality of wealth owned by women household heads

Throughout the world, it has been observed that dairy farming households headed by women are usually poorer. In order to assess the participants perception on why households headed by dairy farming women are usually poorer a series of questions were asked as illustrated in Table 5.19. Based on those results an evaluation of the participants' perception towards dairy farming women headed households was done.

**Table 5.19 Quality of wealth owned by women household heads**

Perceptions			
	Yes	No	Comments
a) Women do not know how to work.		•	Actually, women know how to work. Exceptions are when such women are alcoholics.
b) Women lack access to the credit that would boost their productivity (they cannot acquire fertilizers, pesticides, improved seeds, etc.).		•	Whether men or women, all have equal access to credit. A men participant said that women even repay better than them.
c) Women do not know how to manage their resources.		•	Women household heads know how to manage their resources. ("Look at widowers, their homes fall apart if they are on their own. Hence, they remarry").
d) Women are paid less for the work they do.		•	Both have equal pay.
e) Women cannot be landowners.		•	Women inherit the land after their husband dies. Nowadays, women can purchase land.

**Key: - • Indicates the perception of all the participants**

## CHAPTER SIX

### DISCUSSIONS AND RECOMMENDATIONS

#### 6.0 Discussions

##### 6.1 Prevalence of cryptosporidiosis

In this study, all human faecal samples collected tested negative for cryptosporidiosis. The faecal samples were collected during the dry and wet seasons. Collection during the two seasons was important as several studies had shown varying results in the number of cryptosporidiosis cases depending on the climatic conditions. For example, it was noted that there was an increase in the number of cryptosporidiosis cases found in Gaza, Egypt during the dry season than in the wet season<sup>96</sup>. Other investigations in Guinea Bissau found high prevalence rates during the wet season<sup>20</sup>. Nevertheless, the reason for the dairy farmers' and their households testing negative for the zoonotic *Cryptosporidia* species may be attributed to the following explanations.

The first explanation is that, persons in close contact with cattle and calves who were at risk of contracting cryptosporidiosis took preventive measures. This is seen in the context where children and elderly are considered to be at risk as their immune systems is either not fully developed or weakened<sup>45</sup>. It is commendable to note that, parents were not allowing their small children to go near the dairy operations. As for the elderly who were above sixty-five years, they had hired workers. This means that the persons who were considered to be at risk had minimum contact with the sources of causative agents. Hence, they were less likely to develop cryptosporidiosis infection.

Secondly, more than three quarters of the households interviewed obtained their drinking water from Nairobi Water Company supply, regardless of whether they had shallow wells in their compounds or not. Currently, drinking the Company water is not an important risk factor for zoonotic *Cryptosporidium* infection. In addition, most of them washed vegetables before eating or cooking. This meant that, the respondents were unlikely to be at risk of contracting cryptosporidiosis from drinking unsafe water or eating contaminated vegetables.

Thirdly, there is a possibility that the dairy farmers and their households may have developed protective immunity from previous exposures. However, this could not be proven by the study. Scientific research has shown immunological healthy persons with preexisting antibodies may be less likely to develop cryptosporidiosis due to its low pathogenicity<sup>43</sup>. Thus, this may have resulted to them being asymptomatic on re-exposure to oocysts.

Lastly, faecal constituents such as bilirubin, bile salts and polysaccharides inhibited polymerase chain reaction (PCR) detection<sup>97</sup> on 4/1,422 of the samples that had been positive on IFA. Thereafter, several measures were undertaken to reduce the inhibition. The impact this problem caused on the estimation of the prevalence of cryptosporidiosis is not clear but it is possible that it may have contributed to low detection rates of cryptosporidiosis infection.

## 6.2 Risk factors of cryptosporidiosis

All farmers in the study practiced the wrong methods of composting cow dung manure before applying it onto their farms. Yet, runoffs from farms where manure had been spread during rainy seasons have been shown to contribute to environmental contamination with *Cryptosporidium* oocysts<sup>33</sup>. In this study, manure was heaped on a designated spot and then applied on the farms during the planting season. Thus, the manure could be applied on the farms after 4 months. The heaping of cow dung results in anaerobic process of decompositions. Due to high moisture content; it does not generate heat or ammonia that would kill pathogenic *Cryptosporidia* oocysts<sup>98</sup>.

Ideal composting involves mixing the manure with ash and organic waste such as leaves. Then leaving contents for 8 weeks, the heat and ammonia generated will kill the oocysts. Tentatively, farmers can put the manure in small heaps to dry. The heat produced by the sunshine contributes to inactivation of the oocysts<sup>37</sup>. In this case, manure usage in Dagoretti represents a definite potential for *Cryptosporidium* contamination of surface water.

As demonstrated, more than three quarters of the households interviewed did not have clean cattle sheds. Removal of manure from cattle sheds should be done as frequently as possible. It is best that the cattle shed is cleaned once a week<sup>99</sup>. This is putting into consideration that, appropriate cleaning and disinfection procedures are of great importance. In order to break the faecal-oral transmission cycles of *Cryptosporidia* oocysts that contaminates housing and feeding equipment. Clean cattle sheds are critical for long term success in the control of cryptosporidiosis.

## 6.3 Knowledge

As pertaining to knowledge on cryptosporidiosis, only 10% of the respondents had ever heard of this disease by August 2006 (dry season). When data collection was repeated three months later (November, 2006) the number of persons who knew about cryptosporidiosis had increased to 42% in Dagoretti. The probable explanation for improved knowledge is that, most of the respondents received

door to door teaching about cryptosporidiosis. This occurred during the administration of the questionnaires and collection of faecal samples for analysis in the dry season.

Further computations showed that, there was a significant relationship between education level and knowledge on cryptosporidiosis ( $p = 0.016$ ), after the door-to door teaching. Ability to comprehend information on cryptosporidiosis among the educated was better as compared to the illiterate. In this study, both educated and illiterate showed a difference on retaining the information they heard about cryptosporidiosis.

#### **6.4 Access to and control over resources**

Data on the quantitative survey from this study showed that the adult men and women were both actively involved in the daily operations of dairy farming activities. Women were also noted to be the main decision makers in hiring additional labour, thus complementing women's labour activities. However, a previous study conducted in Dagoretti showed higher proportions of the adult women contributing to total labour in dairy farming in the absence of a hired work<sup>54</sup>. The findings in this study may be a reflection of improvement of gender aspects in relation to urban dairy farming. As it appears that women's workload on dairy farming is becoming lighter in this community. This array of facts is advantageous in terms of forming the infrastructure needed for narrowing the gender disparity gap.

In the present study men (44%, 19%) and women (48%, 22%) had equal access to extension services and community meetings, respectively. Both men and women participants in the focus group discussions reported equal access to training and information with regard to dairy farming. Conversely, these results are in contrast with the results from other studies. For instance, Food and Agriculture Organization (FAO) studies have clearly shown how women have little access to production support services such as extension and training<sup>83</sup>. Nevertheless, FAO's studies focused mainly on rural women. With access to first hand information both men and women dairy farmers have increased knowledge on how to reduce the health risks posed by cattle to humans.

All respondents in the focus group discussions were of the opinion that men and women had equal access to land. Women of the households made the decision on what crops to grow. Historically, land ownership was skewed towards men. However, land ownership among women is also increasing either through purchase or inheritance. Whether, married or not parents were also willing to give their daughters a portion of their land as an inheritance. This shows a transformation in the current



patrilineal form of inheritance among the Kikuyu community of Dagoretti. This implies that, in the foreseeable future many women in Dagoretti will be included in property ownership. This is good in that, security of land tenure is the key to having control over major decisions in agriculture and livestock production, for example what techniques to use, which products to sell and which to consume.

Men and women had varying degrees of ownership, access, rights of disposal and use of incomes from sales of cattle and their products. Men controlled income from the sales of cattle and women from sales of milk and dairy products. Income obtained was used to meet different family needs - men for larger expenses such as paying school fees and women for continuous expenses such as buying of foodstuff. An increasing body of evidence from Asia, Africa, and Latin America confirms the positive impact of women controlling income on household food expenditure, calorie intake, and anthropometric indicators. One study demonstrated child survival in urban Brazil is twenty times greater when certain income sources accrue to women rather than men<sup>100</sup>. Women also made decisions on the amount of milk for household consumption, in which children consumed the most. In individuals with good nutrition and health, cryptosporidiosis rarely develops to a clinical disease.

Through the Microfinance Act of 2006, a legal framework has been put in place by the Government to enable equal access to micro credit financing<sup>101</sup>. This is meant to facilitate the women dairy farmers to acquire credit and loans just like their men counterparts by using milk as collateral. However, findings from this study showed that most women obtained loans from self help groups and they were not aware about the fact that one could obtain credit from formal institutions using milk produced. As for the men participants they had information about accessing credit from formal institutions such as banks. They were the main decision makers in obtaining loans. A similar situation has been observed in Uganda where more men have availed institutional credit facilities<sup>102</sup>. Some of the money obtained from the loans can be used to improve the dairy farming enterprise for greater production efficiency and implementing better anti-cryptosporidiosis prevention strategies, such as constructing cattle shed with cemented floors to facilitate easier cleaning. Therefore, the risks that dairy cattle and calves pose to humans are decreased.

## **6.5 Limitations of the study**

The focus of this study was on a community based project. Hence, the insights obtained will be difficult to adopt at the policy levels as the research scrutinized gender aspects in urban dairy farming at the household level. Political and economic factors were neglected. Other institutions such as the market and the state were left out.

In this study, awareness of cryptosporidiosis increased from 10% to 42%. This occurred within a period of 3 months. In the initial stages the respondents received door-to-door teachings on cryptosporidiosis during the collection of the human faecal samples. This implies that an intervention was introduced into the study. However, during the sampling period of the stool samples it was imperative that no intervention takes place. This is according to the laid down protocol of longitudinal study design<sup>103</sup>.

Human immunodeficiency (HIV) status and age were the potential confounders in this study. Failure to adjust for these confounders when testing for cryptosporidiosis may have affected the overall results and their interpretation.

Despite the highlighted limitations that may affect the generalizability of the study results, there were significant findings which demonstrated that urban dairy farming which is a source of livelihood and does not pose a major threat to human health.

## **6.6 Conclusions**

This study analyzed various practical and strategic issues affecting men and women involved in urban dairy farming. As discussed, it appears that the gender disparity gap is becoming narrower, and this is beneficial to women as it strengthens their participation in dairy farming activities, which in turn improves their incomes and social and economic stability. Aspects on gender analysis between women and men testify to improvements in gender relations.

Both the man and the woman of the households were equally involved in the daily operations of dairy farming. In addition, women controlled income from the sale of milk. Hence, the women in this community are not marginalized.

Men and women had equal opportunities in accessing information and training on dairy farming. The higher ratios of women receiving information from outside sources points to the fact women's participation and efficiency in activities related to dairy farming is not limited.

The prevalence of cryptosporidiosis was 0%. As alluded to earlier, several hypotheses could be considered as to why nobody tested positive for cryptosporidiosis in Dagoretti. Nevertheless, some negative practices were also noted. Three quarters of the dairy farmers did not keep clean cattle sheds. All the farmers did not practice the ideal way of composting manure before spreading in the farms.

Gaps exist between knowledge and practice. For instance 81% mentioned wearing of protective clothing as a means of protection. However, only 52% reported wearing protective while working with cattle.

### **6.7 Recommendations**

Urban dairy farming plays a significant role in Dagoretti, as it is a source of livelihood. Moreover, dairy farming operations in Dagoretti are not a major threat in transmitting cryptosporidiosis to humans. Therefore, dairy farming should continue to be supported and promoted by sensitizing the greater population on its benefits. This support is needed from all quarters, from entrepreneurs, local authorities, farmers and civil society. Hence, there is need for the authorities to provide a coherent legal and policy framework governing urban dairy farming.

Health risks perceived or real, are the main reasons that authorities object to urban dairy farming. Of concern is noise, odours from livestock wastes and danger of contracting zoonotic diseases<sup>7</sup>. Results from this study found humans to be free from cryptosporidiosis. This implies that the dairy farmers are doing something so good that is breaking cryptosporidiosis transmission from cattle to humans. In relation to that, the authorities need to support and amend policies against urban dairy farming.

It is commendable to note that, the women practicing dairy farming in Dagoretti were not marginalized. This is due to the fact that, women were participating in decision making in relation to dairy farming. Women were also accumulating income from the sale of dairy products. Hence, women need to be empowered more for the good of the community. Continued involvement of women in training on dairy farming should be emphasized.

The study has highlighted gaps in selected practices. They should be addressed by the extension officers and the farmers who were trained. The extension officers need to develop strategies aimed at promoting hygienic standards on all dairy farming operations and educate the farmers. These includes, wearing of protective clothing, proper hand washing composting of manure and ideal shed cleaning practices.

Lastly, there is need for further research on the role of political, societal and economic impact on power relations between men and women. When determining whether development interventions contribute to gender equalities or inequalities, these factors are important.

## REFERENCES

- <sup>1</sup> United Nations Center for Human Settlement (HABITAT). Global report on human settlements. 1996. Nairobi, Kenya.
- <sup>2</sup> Central Bureau of Statistics. 1999 Population and housing census. Volume I. Central Bureau of Statistics Ministry of Finance and Planning. 2001.
- <sup>3</sup> Matrix Development Consultants. Nairobi's informal settlements: An inventory. A Report Prepared for United States International development Agency (USAID). Nairobi: USAID. 1993.
- <sup>4</sup> Egzibher A., Lee-Smith D. and Maxwell D. Cities feeding people: an examination of urban agriculture in East Africa. Ottawa, International Development Research Center. 1994; 146.
- <sup>5</sup> Ayaga G., Kibata G., Lee-Smith D., Njenga M. and Rege R. Policy Prospects for Urban and Peri-Urban Agriculture in Kenya. Urban Harvest – International Potato Center, Lima Peru. 2004.
- <sup>6</sup> Urban Harvest. About Urban Agriculture. Urban Harvest – International Potato Center, Lima Peru. 2005
- <sup>7</sup> Kang'ethe E. Health Risk Analysis of Cryptosporidiosis in Urban Smallholder Dairy Production, Dagoetti, Nairobi, Kenya. International Development Research Centre (IDRC), 2005.
- <sup>8</sup> Ministry of Agriculture. 1998 Annual Report. 1999.
- <sup>9</sup> Smit T and Nasr K. Urban Agriculture Shouldering Cities' Food Self-Reliance. 1992
- <sup>10</sup> Ministry of Agriculture and Livestock Production 2000. Annual Report. 2000
- <sup>11</sup> Ratta, A. City women farm for food and cash. International Ag-Sieve. 1993; 6:2.
- <sup>12</sup> Ekuttan C. Milk borne health risks in urban and peri-urban smallholder dairy production in Dagoretti Division, Nairobi (Kenya). Unpublished. Masters Thesis, 2006.
- <sup>13</sup> Ministry of Planning and National Development of Kenya. 1999 Population Census.
- <sup>14</sup> Guyot K Follet-Dumoulin A. and Lelievre E. Molecular characterization of *Cryptosporidium* isolates obtained from humans in France. *J Clin Microbiol* 2001; 39(10):3472-80.
- <sup>15</sup> Kiang K., Scheftel J. and Leano F. Recurrent outbreaks of cryptosporidiosis associated with calves among students at an educational farm programme, Minnesota, 2003. *Epidemiol Infect.* 2006; May 3; 1-9.
- <sup>16</sup> Okhuysen P., Chappell C. and Crabb J. Virulence of three distinct *Cryptosporidium parvum* isolates for healthy adults. *J Infect Dis.* 1999; 180(4):1275-1281.
- <sup>17</sup> Upton J Basic Biology of *Cryptosporidium*. Kansas: Kansas State University Press, 2003.

- 
- <sup>18</sup> Addiss D. Reduction of risk of watery diarrhea with point-of-use water filters during a massive outbreak of waterborne *Cryptosporidium* infection in Milwaukee, Wisconsin, 1993. *Am J. Trop. Med. Hyg.* 1996; 54:549-553.
- <sup>19</sup> Tzipori S. and Ward H. Cryptosporidiosis: biology, pathogenesis and disease. *Microbes Infect* 2002; 4: 1047–1058.
- <sup>20</sup> Molbak K, Hojlyng N, Gottschau A, Sa JC, Ingholt L, da Silva AP, Aaby P, 1993. Cryptosporidiosis in infancy and childhood mortality in Guinea Bissau, West Africa. *BMJ* 307: 417–420.
- <sup>21</sup> African Population and Health Research Centre (APHRC). Population and health dynamics in Nairobi's Informal Settlements. Nairobi: African Population and Health Research Centre. 2002.
- <sup>22</sup> Anonymous. Ominous trends for infectious diseases (editorial). *Science* 1996;272: 1269
- <sup>23</sup> Clark, D. P., and C. L. Sears. The pathogenesis of cryptosporidiosis. *Parasitol. Today* 1996; 12:221-225.
- <sup>24</sup> Moore R., Tzipori S., Griffiths J., Calderon R. and Juranek D. Temporal changes in permeability and structure of piglet ileum after site-specific infection by *Cryptosporidium parvum*. *Gastroenterology* 1995;108:1030-1039
- <sup>25</sup> Adams R., Guerrant R. and Zu S. *Cryptosporidium parvum* infection of intestinal epithelium: Morphologic and functional studies in an in vitro model. *J. Infect. Dis.* 1994; 169:170-177.
- <sup>26</sup> Griffiths J., Moore K. and Dooley S. *Cryptosporidium parvum* infection of Caco-2 cell monolayers induces an apical monolayer defect, selectively increases transmonolayer permeability, and causes epithelial cell death. *Infect. Immun.* 1994; 62:4506-4514
- <sup>27</sup> Chen X., Levine A. and Tietz P. *Cryptosporidium parvum* is cytopathic for cultured human biliary epithelia via an apoptotic mechanism. *Hepatology* 1998; 28:906-913
- <sup>28</sup> Goodgame R., Kimball K. and Ou, J. Intestinal function and injury in acquired immunodeficiency syndrome-related cryptosporidiosis. *Gastroenterology* 1995; 108:1075-1082
- <sup>29</sup> Stockman M., Fromm M and Schmitz H. Duodenal biopsies of HIV-infected patients with diarrhoea exhibit epithelial barrier defects but no active secretion. *AIDS* 1998; 12:43-51
- <sup>30</sup> Abubakar I., Aliyu S. and Arumugam C. Prevention and treatment of cryptosporidiosis in immunocompromised patients. *Cochrane Database Syst Rev.* 2007 Jan 24 ;( 1):CD004932.
- <sup>31</sup> Khan O. A Review of Cryptosporidiosis. Baltimore: John Hopkins School of Public Health, 1997.
- <sup>32</sup> LeChevallier M., Norton W., and Lee R. Occurrence of *Giardia* and *Cryptosporidium* spp. in surface water supplies. *Appl Environ Microbiol.* 1991; 57:2610–2616.
- <sup>33</sup> Bagley S., Auer M and Stern D. Sources and fate of *Giardia* cysts and *Cryptosporidium* oocysts in surface waters. *J. Lake Res. Manage.* 1998; 14:379-372.

- 
- <sup>34</sup> Ong C., Moorehead W. and Ross A. Studies of *Giardia* spp. and *Cryptosporidium* spp. in two adjacent watersheds. *Appl Environ Microbiol.* 1996;62:2798–2805
- <sup>35</sup> Warnes S. and Keevil C. Survival of *Cryptosporidium parvum* in faecal wastes and salad crops. Southampton: Environmental Healthcare Unit, University of Southampton, 2004.
- <sup>36</sup> Mireri C., Kyessi A. and Mushi N. Urban Agriculture in East Africa: practice, challenges and opportunities. Ottawa, International Development Research Center, 2005.
- <sup>37</sup> Hoonstra E and Hartog B. A quantitative risk assessment on *Cryptosporidium* in food and water. Teagasc Irish Agriculture and Food Development Authority, 2004.
- <sup>38</sup> Monge R. and Chinchilla M Presence of *Cryptosporidium* oocysts in fresh vegetables. *Journal of Food Protection.* 1996; 59, 202-203.
- <sup>39</sup> Ortega Y, Sheehy R. and Cama V., Restriction fragment length polymorphism analysis of *Cryptosporidium parvum* isolates of bovine and human origin. *Journal of Protozoology* 1991; 38: 40S-41S.
- <sup>40</sup> Fayer, R., Morgan, U. and Upton, S. Epidemiology of *Cryptosporidium*: transmission, detection and identification. *International Journal of Parasitology* 2000; 30:1305-1322.
- <sup>41</sup> Tumwine J., Kekitiinwa A. and Bakeera-Kitaka S. Cryptosporidiosis and microsporidiosis in Ugandan children with persistent diarrhea with and without concurrent infection with the human immunodeficiency virus. *Am. J. Trop. Med. Hyg.* 2005; 68:710-715.
- <sup>42</sup> Mwachari C, Batchelor B, and Paul J. Chronic diarrhoea among HIV-infected adult patients in Nairobi, Kenya. *J. Infect.* 1998; 37(1): 48–53.
- <sup>43</sup> Current W and Bick P. Immunobiology of *Cryptosporidium* spp. *Pathol Immunopathol Res.* 1989; 8:141-60.
- <sup>44</sup> Newman R., Zu X. and Wuhib T. Household epidemiology of *Cryptosporidium parvum* infection in an urban community in northeast Brazil. *Ann Intern Med.* 1994; 120: 500-5.
- <sup>45</sup> Dillingham R, Lima A. and Guerrant R. Cryptosporidiosis: epidemiology and impact. *Microbes Infect* 2002; 4: 1059–1066.
- <sup>46</sup> Bhattacharya M., Teka T. and Faruque A. *Cryptosporidium* infection in children in urban Bangladesh. *J Trop Pediatr* 1997; 43: 282–286.
- <sup>47</sup> Haque R, Mondal D, and Kirkpatrick M. Epidemiologic and clinical characteristics of acute diarrhea with emphasis on *Entamoeba histolytica* infections in preschool children in an urban slum of Dhaka, Bangladesh. *Am J Trop Med Hyg* 2003; 69: 398–405.
- <sup>48</sup> Checkley W, Epstein L. and Gilman R. Effects of *Cryptosporidium parvum* infection in Peruvian children: growth faltering and subsequent catch-up growth. *Am J Epidemiol* 1998; 148: 497–506

- 
- <sup>49</sup> Guerrant D., Moore S. and Lima A. Association of early childhood diarrhea and cryptosporidiosis with impaired physical fitness and cognitive function four-seven years later in a poor urban community in northeast Brazil. *Am J Trop Med Hyg* 1999; 61: 707-713
- <sup>50</sup> Nchito M, Kelly P. and Sianongo S. Cryptosporidiosis in urban Zambian children: an analysis of risk factors. *Am J Trop Med Hyg* 1998; 59: 435-437
- <sup>51</sup> Juranek D. Cryptosporidiosis: sources of infection and guidelines for prevention. *Clinical Infectious Diseases* 1995, 21(Suppl 1):S57-61
- <sup>52</sup> Gehrz R, Christianson W. and Linner K. A longitudinal analysis of lymphocyte proliferative responses to mitogens and antigens during human pregnancy. *American Journal of Obstetrics and Gynecology* 1989; 140:665-670.
- <sup>53</sup> Weinberg ED: Pregnancy associated depression of cell-mediated immunity. *Reviews of Infectious Disease*. 1994; 6:814-831
- <sup>54</sup> Ngonde A. Gender segregated perceptions and behaviour on benefits and selected health risks associated with urban dairy farming in Dagoretti Division, Nairobi. Unpublished. Masters Thesis, 2006.
- <sup>55</sup> United Nations Development Programme (UNDP). *Human Development Report*. New York, Oxford, Oxford University Press. 1997.
- <sup>56</sup> Poats S. The role of gender in agricultural development. *Issues in Agriculture CGIAR (Consultative Group on International Agricultural Research)*, 1991; 3: 63.
- <sup>57</sup> Bravo-Baumann H. *Livestock and Gender a winning pair*. Swiss Agency for Development and Cooperation . Working Document. 2000.
- <sup>58</sup> Ochola W. *Gender Integration in Agricultural and Livestock Extension. A Training Guidebook*. Nairobi: Industrial Printing Works Limited, 2002.
- <sup>59</sup> Maarse L. *Making change strategies work, Gender sensitive client oriented livestock extension in Coast Province, Kenya*. Royal Tropical Institute, The Netherlands. 1998.
- <sup>60</sup> Ministry of Indian and Northern Affairs Canada. *Gender equality policies*. Ministry of Public Works and Government Services Canada. 1991.
- <sup>61</sup> United Nations *Gender in agriculture and agro-processing in Lebanon*. United Nations New York, 2001
- <sup>62</sup> Sustainable Development Department. *Agricultural Censuses and Gender Considerations - Concept and Methodology*. FAO, Rome. 2001.
- <sup>63</sup> Kabeer N. *Gender Mainstreaming in Poverty Eradication and the Millennium Development Goals. A handbook for policy-makers and other stakeholders*. 2003;35



- 
- <sup>64</sup> Jütting J and Morrisson C. Changing Social Institutions to Improve the Status of Women in Developing Countries. The Development Center (OCED), 2005.
- <sup>65</sup> Socio-Economic and Gender Analysis (SEAGA). Gender analysis in macroeconomic and agricultural sector policies and programmes. Macro Level Handbook. Food and Agriculture Organisation of the United Nations Rome, 2003
- <sup>66</sup> Commonwealth Secretariat. Gender Mainstreaming in. Agriculture and Rural Development A Reference Manual for Governments and Other Stakeholders. Marlborough, 2001; 24.
- <sup>67</sup> OECD. DAC Guidelines for Gender Equality and Women's empowerment in development co-operation. Paris, 1999.
- <sup>68</sup> Pan American Health Organization (PAHO). Workshop on Gender, Health and Development. Facilitators Guide. Washington DC: PAHO, 1997.
- <sup>69</sup> Ishani Z. Key Gender Issues in Urban Food Production and Food Security: Case Study of Kenya Gender Mainstreaming in Urban Food Production and Food Security 20<sup>th</sup> – 23<sup>rd</sup> September 2004, Accra, Ghana Mazingira Institute. 2004.
- <sup>70</sup> Rushton J. Poultry, women and development: old ideas, new applications and the need for more research. Food and Agriculture Organisation (FAO), Rome, 1998.
- <sup>71</sup> Dohmen C. The role of livestock in the farming system and involvement of women. Social Forestry Project, Pakistan. 1992.
- <sup>72</sup> Ofei-Aboagye E. Memo on gender analysis of agriculture in Ghana. Sent to Kathleen Clancy, Gender and Sustainable Development Unit, IDRC on 14<sup>th</sup> February 1997. Report for IDRC Project No. 96-0013 003149. Ottawa: IDRC, 1997.
- <sup>73</sup> Mianda G. Women and garden produce of Kinshasa: the difficult quest for autonomy. In: Ghorayshi P. and Belanger C. (eds), Women, Work, and Gender Relations in Developing Countries (Westport Connecticut: Greenwood Press). 1996; 91-101.
- <sup>74</sup> Odenyo A., Tegegne A. and Hanson J. Alleviation of rural poverty and improved women's livelihoods through dairy development: The role of International Livestock Research Institute and its partners. Presented at the 3rd World Congress of Rural Women, Madrid, Spain, October 2-4, 2002. Urban Agriculture Magazine 2004; 12:29-31.
- <sup>75</sup> Abou L. "Mainstreaming a gender perspective into policies, plans and programmes at the national level: a model action plan". Second Arab Meeting for Follow-up to Beijing Conference. Beirut, 12-15 December 1998.
- <sup>76</sup> Mudimu G. Urban agricultural activities and women's strategies in sustaining family livelihoods in Harare, Zimbabwe. Singapore Journal of Tropical Geography. 1996; 17(2):179-194.
- <sup>77</sup> UNDP. Human Development Report. New York. Oxford, Oxford University Press. 1995.

- 
- <sup>78</sup> Overholt C., Anderson M., Cloud K. and Austin J. Women in development: A framework for project analysis. In: Overholt C., Anderson M., Cloud K. and Austin J. (eds), *Gender roles in development projects. A case book*. West Hartford, Connecticut: Kumarian Press, 1995: 3–15
- <sup>79</sup> Paris T. Socio-economic issues concerning women in animal production. In: Bunyavejchewin P., Sangdid S. and Hangsanet K. (eds), *Animal production and rural development. Proceedings of the sixth AAAP animal science congress held at Sukhothai Thammathirat Open University, Nonthaburi, Thailand, 23–28 November 1992*. AHAT (Animal Husbandry Association of Thailand), 1992; 1: 247–270.
- <sup>80</sup> Whalen I. Ethiopian highlands programme: Problems and perspectives in expanding the participation of women. Paper prepared for Ford Foundation workshop on Women in Agriculture in West Africa, Ibadan, Nigeria, 7–9 May. 1994: 24.
- <sup>81</sup> Tarfa S. and Ogunwale S. Women's integration into decision-making on the utilization of agricultural processing technologies in Nigeria. In: Ranaweera N.F.C, Gunasena H.P.M., Senanayake Y.D.A. (eds), *Changing agricultural opportunities: The role of farming systems approaches. Proceedings of the 14th International Symposium on Sustainable Farming Systems, Colombo, Sri Lanka, 11–16 November, 1996*. AFSA (Asian Farming Systems Association), Nov. 1998: 279–285.
- <sup>82</sup> Maria E. and Ronald S. Gender mainstreaming in rural extension services: A case study from the Honduras-PAAR project. Rural Land Management Project (Proyecto de Administracion de Areas Rurales- PAAR) in Honduras. 2000.
- <sup>83</sup> FAO. *Filling the data gap: Gender-sensitive Statistics for Agricultural*. FAO, Rome. 1999
- <sup>84</sup> Streiffeler F. *General Principles and Approaches for Sustainable Urban Greenbelts with Special Reference to Africa*. Berlin. 1993.
- <sup>85</sup> Wilbers J, Hovorka A. and van Veenhuizen R. Editorial: gender and urban agriculture. *Urban Agriculture Magazine* 2004; 12: 1–5.
- <sup>86</sup> Hovorka, A. Urban agriculture: addressing practical and strategic gender needs. *Development in Practice* 2006; 16:2.
- <sup>87</sup> Saito, A. and Spurling L. *Raising the Productivity of Women Farmers in Sub-Saharan Africa*, World Bank Discussion Paper, Africa Technical Department Series, No. 230, Washington DC. 1994.
- <sup>88</sup> Ministry of Planning and National Development of Kenya. *Economic Survey*. 2003.
- <sup>89</sup> Gatei W, Wamae C, Mbae C., Kang'ethe S. and Irungu T. Cryptosporidiosis: prevalence, genotype analysis, and symptoms associated with infections in children in Kenya. *Am. J. Trop. Med. Hyg.* 2006; 75(1):78-82.
- <sup>90</sup> African Medical and Research Foundation (AMREF). *Dagoretti Street Children's Programme. Baseline Survey*, 2002.

- 
- <sup>91</sup> Dobson M. Contours of death: disease, mortality and the environment in early modern England. *Health Transition Review*, Vol. 2 Supplementary, 1992; 77-94.
- <sup>92</sup> Zulu E, Dodoo F. and Ezeh A. Sexual risk taking in the slums of Nairobi, Kenya, 1993-1998. *Population Studies*, 2002; 56: 311-323.
- <sup>93</sup> Ministry of Transport. Kenya Meteorological Department. Review of the weather in March-April-May (MAM) and June July-August (JJA) 2006 seasons and the outlook for the October-November-December 2006 “short rains” season. Ref. No. Met/ 1622. September 2006.
- <sup>94</sup> Lwanga S. Sample size determination on health studies. A practical manual. Geneva: WHO, 1991.
- <sup>95</sup> Johnson D, Pieniazek N, Griffin D. and Juranek D. Development of a PCR protocol for sensitive detection of *Cryptosporidium* oocysts in water samples. *Appl. Environ. Microbiol.* 1995; 61:3849-3855.
- <sup>96</sup> Sallon S, el-Shawwa R, Khalil M, Ginsburg G, el Tayib J, el-Eila J, Green V, Hart CA, 1994. Diarrhoeal disease in children in Gaza. *Ann Trop Med Parasitol* 88: 175–182.
- <sup>97</sup> Monteiro L, Bonnemaïson D, Vekris A, Petry K G, Bonnet J, Vidal R, Cabritta J, Megraud F. Complex polysaccharides as PCR inhibitors in faeces: *Helicobacter pylori* model. *J Clin Microbiol.* 1997; 35:995–998.
- <sup>98</sup> Gichangi, E. M; Karanja, N.K and Wood, C.W. Compositing of manure from zero –grazing systems with agro-organic waste to minimize nitrogen losses in smallholder farms in Kenya. *Tropical and Subtropical Agro-ecosystems.* 2006: 6; 57-64.
- <sup>99</sup> Mohammed HO, Wade SE, and Schaaf S. Risk factors associated with *Cryptosporidium parvum* infection in dairy cattle in southeastern New York State. *Vet Parasitol.* 1999; 83:1-13.
- <sup>100</sup> Lynn B, Feldstein H, Haddad L, Peña C, and Quisumbing A. Generating Food Security in the Year 2020 Women as Producers, Gatekeepers, and Shock Absorbers. International Food Policy Research Institute (IFPRI) 2020 Vision Brief 17. May 1995.
- <sup>101</sup> The Microfinance Act. Laws of Kenya, 2006.
- <sup>102</sup> Esenu B and Ossiya S. Positioning agro-pastoral women in livestock production. The Link between Socio-Economic Factors and Improved Household Food Security. 2006.
- <sup>103</sup> Dodani S. Epidemiological study design. Pakistan: Aga Khan University, 2005.

## APPENDICES

### Appendix 1

#### Consent form (For individual respondents)

My name is Julie Ambia a student at the University of Nairobi. I am studying on cryptosporidiosis among men and women. Cryptosporidiosis is a zoonotic infection. *Cryptosporidium* is an important enteric pathogen that causes diarrhea illness in humans and animals. In humans cryptosporidiosis presents with; watery diarrhea, dehydration, weight loss, stomach cramps, nausea and vomiting. The routes of transmission are by faecal- oral, through contaminated water, food borne, occupational and recreational. Hence, in a gender sensitive manner the study aims at establishing appropriate prevention strategies.

I am asking you to participate in the study by giving fecal samples from all the household members currently staying with you. I will give you polypots for each member and collect them the following day. The fecal samples will be analyzed in the laboratory. No risks are involved and the information offered will be treated with confidentiality. This study will assist the government in developing programmes to prevent this disease. Moreover, if you decline to participate in the study, you will not be intimidated or coerced to do so under any circumstance.

A copy of the study report will be presented to the department of Community Health University of Nairobi. Copies will also be provided to the University of Nairobi Library Services for future reference.

I have been explained the purpose of the study and hereby agree to take part in this study.

\_\_\_\_\_  
Signature or Thumb print

.....

Date

\_\_\_\_\_  
Investigator

.....

Date

Appendix 2

QUESTIONNAIRE (FOR INDIVIDUAL DAIRY FARMERS)

(Household identity) HHID : \_\_\_\_\_

Location Code: \_\_\_\_\_

Characteristics of study subjects

1. Name of respondent \_\_\_\_\_

2. Age ----  13-19 years,  20-29,  30-39,  40-49,  50-65,  >65years

3 Sex:

Male  Female

4 Marital Status

a. Single

b. Married

c. Widowed

5 Level of Education

a. Primary (Incomplete)

b. Primary (Complete)

c. Secondary (Incomplete)

d. Secondary (Complete)

e. Post secondary

f. None

6 Main Occupation (Probe for combination)

a. Farmer

b. Small-scale business

c. Housewife

d. Others ( specify) \_\_\_\_\_

7. What zoonotic infections and health hazards are you aware of?

a) Bovine tuberculosis (BTB)

b) Cryptosporidiosis

- c) Aflatoxins
- d) Brucellosis
- e) E. coli
- f) None
- g) Others (specify) \_\_\_\_\_

8(a) Can people get diseases from handling cow dung?

Yes  No  Unsure  Don't know  Decline to answer

8(b) If yes to Q 8 (a), how are these diseases transmitted?

Open response (write in) \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**(Categorization will be done during data entry. Check all categories that apply)**

- Physically handling manure
- Physically handling cattle
- Physically handling other animals
- Drinking dirty water
- Washing in dirty water
- Drinking contaminated milk
- Eating contaminated food
- Contamination by cattle manure unspecified
- Don't know

9. If the answer is yes to Q 8 (a), where did you learn this?

**(Let respondent answer and check those that apply)**

- From community meetings /participatory activities
- From other family members
- From neighbours or other community members
- From extension agents
- Read about it –books, pamphlets etc.
- Heard about it on radio or television
- Decline to answer.

- Cannot remember
- Not applicable
- Other (write in) -- \_\_\_\_\_

**Knowledge about the disease**

10. Have you heard of the disease called cryptosporidiosis?

- Yes  No

11. If yes to Q 10, what are the causes of cryptosporidiosis that you know of?

**(Let respondent answer and check those that apply)**

- a) Drinking contaminated water
- b) Contact with infected faeces
- c) Contaminated raw vegetables
- d) Person to person contact
- e) Don't know
- f) Unsure
- g) Not applicable
- h) Others (specify) \_\_\_\_\_

12. If yes to Q10, mention the symptoms of cryptosporidiosis?

**(Let respondent answer and check those that apply)**

- a. Abdominal pain
- b. Watery diarrhoea
- c. Weight loss
- d. Nausea
- e. Vomiting
- f. Headache
- g. Cough
- h. Cold
- i. Don't know
- j. Unsure
- k. Not applicable
- l. Others \_\_\_\_\_

13. Can people protect themselves from this disease or diseases as a result of handling cow dung?

No  Yes  Unsure  Decline to answer  Don't know  Not applicable

14 If yes to Q 13, what can people do to protect themselves?

Open response (write in) - \_\_\_\_\_

\_\_\_\_\_

**(Researcher to categorize before data entry, check all those that apply)**

- Wear protective clothing (boots, gloves, etc)
- Wash hands
- Wash body generally
- Boil drinking water
- Treat drinking water in some other way (filter, chemical,)
- Boil milk
- Wash fruits and vegetables
- Protect water sources from manure
- Don't know
- Decline to answer
- Not applicable
- Other \_\_\_\_\_

**Practices**

15. Do you wash your fruits and vegetables before eating or cooking them?

Yes  No

16. Is there a shallow well in the homestead? **(Observed by interviewer)**

No  Yes  Unable to observe-- why \_\_\_\_\_

17. Does the household farm have a water frontage? (Stream, river, pond, swamp with standing water whether seasonal or permanent—**interviewer to observe**)

No  Yes  Unable to observe-- why \_\_\_\_\_



18. Where do you get your **drinking water?** (Check all that apply)

- City council supply     usually     occasionally
- Bore hole                 usually     occasionally
- Shallow well               usually     occasionally
- Rain water                 usually     occasionally
- Stream or river             usually     occasionally
- Purchase from vendor     usually     occasionally
- Decline to answer
- Other \_\_\_\_\_

**Prevention interventions**

19. Do you treat your drinking water?

- No     Yes     Unsure     Don't know     Declines to answer

20. If yes to Q 19, how often do you treat it?

- Always             occasionally

21. If yes to Q19, How do you treat it?

**Free response** \_\_\_\_\_

- Boil
- Filter
- Treat with chemical (bleach, water-guard)
- Decline to answer
- Other \_\_\_\_\_

22. Do your children swim, paddle, or play in river, streams, ponds, standing water pools. in Dagoretti?

- No     Yes     Unsure     Don't know     Declines to answer     Not applicable (no children)

23. What is the source of water for the cattle? (Check all that apply)

- City council supply     usually     occasionally
- Borehole                 usually     occasionally
- Shallow well             usually     occasionally

Rain water                       usually     occasionally

Stream or river                 usually     occasionally

Purchase from vendor     usually     occasionally

Decline to answer

Other \_\_\_\_\_

24. Do you wear any protective clothing when working with cattle?

No    yes    decline to answer

25 If yes to Q24, how often?

Always when handling animals    occasionally

26. Other than cattle, which of the following animals do you keep at this homestead? **(Read out and check all that apply)**

Dog(s)

Cat(s)

Pig(s)

Chicken(s)

Donkey(s)

Declined to answer

Not applicable

Other \_\_\_\_\_

27. Does this household grow any food crop for home consumption?

No

Yes

Declined to answer

28. If yes to Q27, How do you fertilize these crops? **(Check one that applies)**

Chemical fertilizer alone

Cattle manure alone

Chicken manure alone

- Both cattle manure and chemical fertilizer.
- Both chicken manure and chemical fertilizer
- Both chicken and cattle manure but No chemical fertilizer
- All three in use, cattle manure, chicken manure, chemical fertilizer
- Do not fertilize at all
- Declined to answer
- Other (write-in) \_\_\_\_\_

**(All distance in meters)**

- 29. Dist. between cattle shed/enclosure and house \_\_\_\_\_
- 30. Dist. between cattle shed/enclosure and shallow well \_\_\_\_\_
- 31. Dist. between manure pit/pile and house \_\_\_\_\_
- 32. Dist. between manure pit/pile and shallow well \_\_\_\_\_
- 33. How do you treat cattle dung before use in the shamba?
  - No treatment at all
  - Heap to dry
  - Decline to answer
  - Other

**Table 3**

Household Members (including regular workers)

Coding for contact with cattle: **Daily, Weekly, Infrequently, Never**

Coding for contact with cattle dung: **Daily, Weekly, Infrequently, Never**

household member	Q35. Number	Q36. Female Male	Q37. Age Class	Q38. Usual Contact with cattle	Q39. Usual Contact with cattle dung	Q40. Presently has diarrhoea symptoms	Q41. Has had diarrhoea symptoms in last month	Q42. Is worker?	Q43. Cares for sick members of family
			<5 years ; 5-12 13-19 ; 20-29 30-39 ; 40-49 50-65 ; >65			No Yes Unknown	No Yes Unknown	No Yes	No Yes Unknown
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									

44. Cleanliness of cattle shed: standing area: Closest to picture 1, 2, 3 or 4.  Unable to observe why \_\_\_\_\_

45. Cleanliness of cattle shed: lying area: Closest to picture 1, 2, 3 or 4.  Unable to observe why \_\_\_\_\_

46. Did household member helping wear protective clothing? :  No  Yes  Unable to observe Why \_\_\_\_\_

47. Did household member helping wash hands after assisting? :  No  Yes  Unable to observe Why \_\_\_\_\_

### Appendix 3

#### FOCUS GROUP DISCUSSIONS

My name is Julie Ambia from the University of Nairobi. I would like to welcome you all to this participatory group discussion and thank you for coming. We shall discuss about gender based prevention strategies of cryptosporidiosis in urban dairy farming. I encourage free discussion because your information will be used to improve the program.

With me are \_\_\_\_\_ and \_\_\_\_\_ who will help with recording information.

A radio cassette recorder will be used to record the discussion for later reference (optional).

Name of assistant moderators:

1. \_\_\_\_\_

2. \_\_\_\_\_

Date of FGD \_\_\_\_\_

Time started \_\_\_\_\_

Time ended \_\_\_\_\_

Venue \_\_\_\_\_

Number recruited for FGD \_\_\_\_\_

No. of participants: - Men \_\_\_\_\_

Women \_\_\_\_\_

#### A. Preamble

- Who does most of the domestic chore in the household? a ( ) men; b ( ) women; c ( ) both equally.

#### B. Gender division of labor

##### Activity Profile

##### *Probes:*

Probe who does the following activities/roles most of the time (focus on handling animals and animal products): Proportionate piling using 100 stones. Target male and female participants

Activity	Person doing the activity			
	Man	Woman	Hired worker	Comments
1. Shed cleaning				
2. Manure disposal				
3. Feed harvesting and transportation				
4. Giving fodder				
5. Preparing utensils and water for milking				
6. Milking				
7. Milk distribution				
8. Treatment giving				
9. Dipping/ spraying cows.				
10. Giving milk to calves				

## **C. Gender division of access to and control over resources**

### **Access and control over productive resources**

#### **i) Land**

- Who owns the land you are occupying now?
- Do the women in the female headed households own the land they are occupying currently?

#### **ii) Access to credit and loans**

- Where do you obtain loans from?
  - Formal sectors
  - Informal sectors
- Is getting loans for livestock enterprises an easy task?
- Are there any constraints you experience

#### **iii) Access to knowledge**

- Is access easy?
- What do the women really want to learn in relation to urban dairy farming?
- What do the men want to learn in relation to urban dairy farming?

### **Control over the benefits of production**

- Do we have to account for the money obtained from the selling of the dairy products?  
If the amount is: - 1. a small sum    2. a big sum
- **Women**, the money obtained from milk, what do we do with it?
  - ( ) Give our husbands
  - ( ) Share it with our partner
  - ( ) Withhold the money without his consent
- What are the uses for these monies obtained from milk
  - ( ) Buying foodstuff
  - ( ) Buying households goods
  - ( ) Others \_\_\_\_\_



**Decision making matrix in Dagoretti Division households**

Decisions	Men	Joint decisions			Women	Comments
		Men dominate	Equal influence	Women dominate		
Who owns the cow						
Who gives authority for the animal to be sold						
Who decides on the number of cows to be bought						
Who calls the vet when the cow is sick						
Who decides what inputs e.g cow feed to buy for the cow						
Who decides to hire additional labour						
Who owns the land that you are staying in right now						
Who decides on the crops to be grown on the farm						
Who decides to take a loan						
Who has access to information on dairy farming activities						
Who decides on going to see the doctor						
Who takes care of the sick members of the family						

**D. Perceptions on the quality of wealth owned by women headed household**

Throughout the world, it has been observed that dairy farming households headed by women are usually poorer. Which of the alternatives below are the causes of this? The range of scores to be used in each table is 50. The male and female participants will place pebbles in each cell of the table. A low score represents a low preference. Target male and female participants

<b>Proportionate piling</b>	<b>Male participants</b>	<b>Female participants</b>
a) Women do not know how to work.		
b) Women lack access to the credit that would boost their productivity (they cannot acquire fertilizers, pesticides, improved seeds, etc.).		
c) Women do not know how to manage their resources.		
d) Women are paid less for the work they do.		
e) Women-headed households usually lack the support of another adult, in comparison with households headed by a man, where there is usually a wife to do the domestic chores and bring in another salary.		
f) Women cannot be landowners.		
g) Women have less access to training.		
h) Public assistance favors men.		

**E. Urban agriculture as a strategy to alleviate urban poverty**

- What are the benefits of practicing dairy farming?

Appendix 4

**GUIDELINE FOR KEY INFORMANT**

**Health Care Worker**

**Location:** \_\_\_\_\_

**Name of health institution:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Preamble**

1. What are the common health problems in this area?

**Knowledge, perception and practices**

2. What is our general qualification? \_\_\_\_\_

3. How many years have you been stationed in Dagoretti Division? \_\_\_\_\_

4. How much time is dedicated on educating the patients on how to prevent diarrheal diseases? \_\_\_\_\_

5. Were you taught on cryptosporidiosis during your training? \_\_\_\_\_

6. What are the risk factors of cryptosporidiosis?

a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

d) \_\_\_\_\_

e) \_\_\_\_\_

7. What are some the symptoms of cryptosporidiosis you know of? (Spontaneous mentioning)

a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

d) \_\_\_\_\_

e) \_\_\_\_\_

8. Are you aware of any drug that can treat cryptosporidiosis? \_\_\_\_\_

9. What do you think should be done to reduce the exposure to cryptosporidiosis?