## LIST OF POLICY BRIEFS

**Project title**: Opportunities and challenge in peri-urban livestock farming in Tanzania

The following is a list of policy briefs that were prepared by MSc. and PhD students

1. Manure Management Practices in Urban and Peri-urban areas of Tanzania pose a Public Health threat. **Lupindu et al**.
    - ❖ Target audience: Councillors, Members of Parliament, Directorate of Livestock Policy and Planning, Local Government Authority, Urban Planners
2. Socio-economic effects of urban livestock farming in Dar es Salaam city, Tanzania. **Malipa et al**.
    - ❖ Target audience: financial institutions (e.g. Banks), Councillors, urban planners, Directorate of Livestock Policy and Planning
3. Porcine cysticercosis is a public health threat alarming for effective control in urban and peri-urban areas of Tanzania. **Makundi et al.**
    - ❖ Target audience: Ministry of Livestock and Fisheries development, Local government authorities, Ministry of health
4. Stocking density and milk quality of cross bred dairy cattle kept in urban and peri-urban areas of Tanzania. **Gillah et al.**
    - ❖ Target audience: Directorate of Livestock Policy and Planning
5. Antimicrobials use and antimicrobial resistance in animals in Tanzania: What is present and what future holds for us. **Katakweba et al**.

Policy Brief on Urban and Peri-urban **Livestock Farming**

# Manure Management Practices in Urban and Peri-urban areas of Tanzania pose a Public Health threat


Pictures: cattle manure is left unmanaged within residential premises in Morogoro, Tanzania

**Summary**

Livestock are increasingly kept in urban and peri-urban areas as a consequence of the growing urban demand for fresh meat and livestock products. Manure is a valuable by-product of livestock production, but if it is not treated according to good manure handling practices, it may cause a public health treat due to the presence of pathogenic bacteria in the dung.

A recent international research project working with cattle farmers in urban areas of Tanzania has documented that good manure handling practices are not always followed, and that this lead to direct human contact and environmental contamination with cattle manure. The manure was shown to contain enteropathogens that can cause disease in humans (zoonotic pathogens). Direct transmission between cattle, humans (both cattle keepers and their neighbors) and the environment was documented.

Current regulations and by-laws regard manure like any other solid household waste that can be disposed within residential premises or collected by municipal sanitation vehicles. There is a need for formulation and enforcement of safe manure management guidelines. This document formulates good manure handling practices and suggests that such guidelines be strictly implemented in urban and peri-urban livestock farming.

## Manure handlings in urban and peri-urban areas may have public health consequences if not performed correctly.

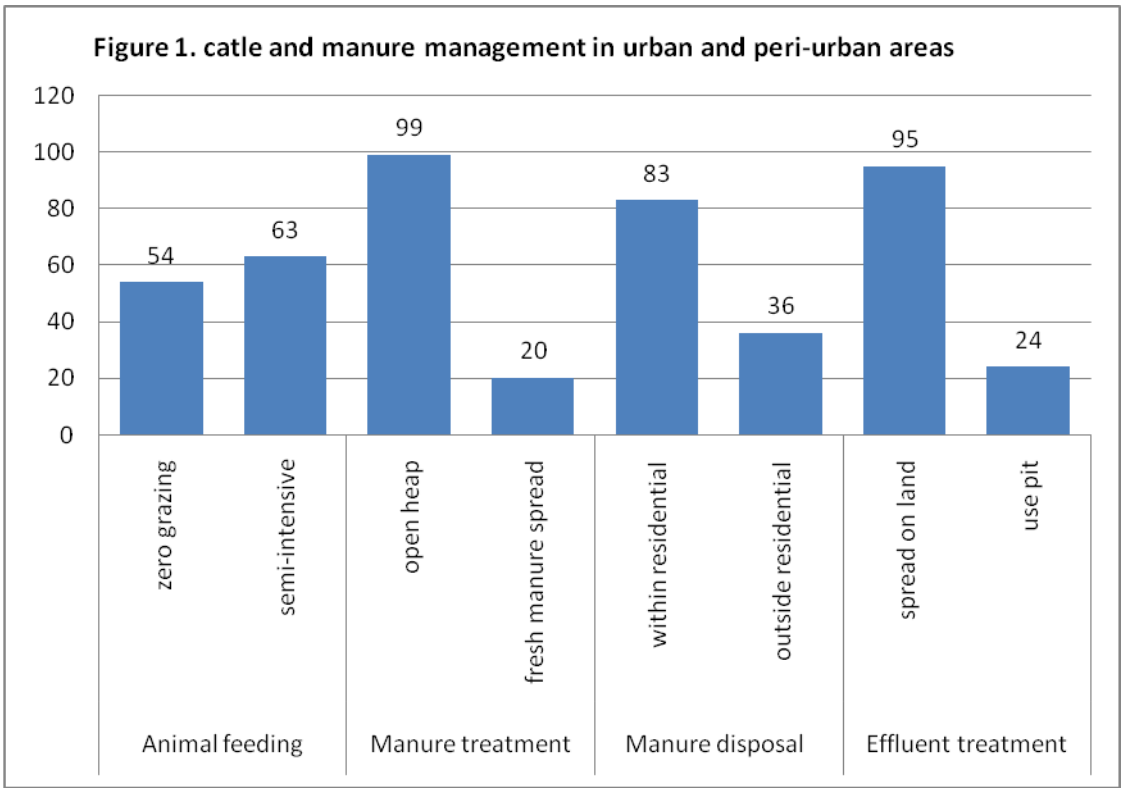
Although bacterial pathogens were only infrequently found, there was documentation for the presence of *Salmonella* (0.5%), diarrheagenic *E. coli*,(2.2 %) and the feared *E. coli* O157:H7(0.9%) in cattle, Campylobacter (40%) in chicken and bacteria with multi-resistance to antibiotics. Such bacteria are a frequent cause of severe disease syndromes such as diarrhoea, dysentery, hemorrhagic colitis and hemolytic uremic syndrome in humans.

In order to document that transfer of bacteria indeed was happening, non-disease causing indicator bacteria were obtained and compared within clusters of cattle, cattle keepers, neighbors, soil and water. Bacteria that were indistinguishable by modern DNA profiling were demonstrated in several clusters (Figure 2), which was a strong indication that transfer between the different hosts was happening. If this can happen for ordinary intestinal bacteria, it can also happen for the pathogenic bacteria harbored in the intestine.

## Main observations from the project

This study focused on cattle keepers in Morogoro and their non-cattle keeping neighbors and was carried out from January 2010 to February 2013.

Results of a survey on manure management practices are summarized in Figure1. Cattle in urban and peri-urban areas either live under zero grazing or they are kept in semi-intensive systems, where they use public land for grazing and are allowed to defecate haphazardly on pubic ground during grazing. Feces that accumulate in zero grazing systems and during overnight housing of animals in both systems were most often collected using utensils, but also collection by bare hands and direct human contact with feces was observed. Manure was either accumulated into a heap or directly spread on land without storage to allow for inactivation of pathogens



Although bacterial pathogens were only infrequently found, there was documentation for the presence of *Salmonella* (0.5%), diarrheagenic *E. coli*,(2.2 %) and the feared *E. coli* O157:H7(0.9%) in cattle, Campylobacter (40%) in chicken and bacteria with multi-resistance to antibiotics. Such bacteria are a frequent cause of severe disease syndromes such as diarrhoea, dysentery, hemolytic colitis and hemolytic uremic syndrome in humans.

In order to document that transfer of bacteria indeed was happening, non-disease causing indicator bacteria were obtained and compared within clusters of cattle, cattle keepers, neighbors, soil and water. Bacteria that were indistinguishable by modern DNA profiling were demonstrated in several clusters (Figure 2), which was a strong indication that transfer between the different hosts was happening. If this can happen for ordinary intestinal bacteria, it can also happen for the pathogenic bacteria harbored in the intestine

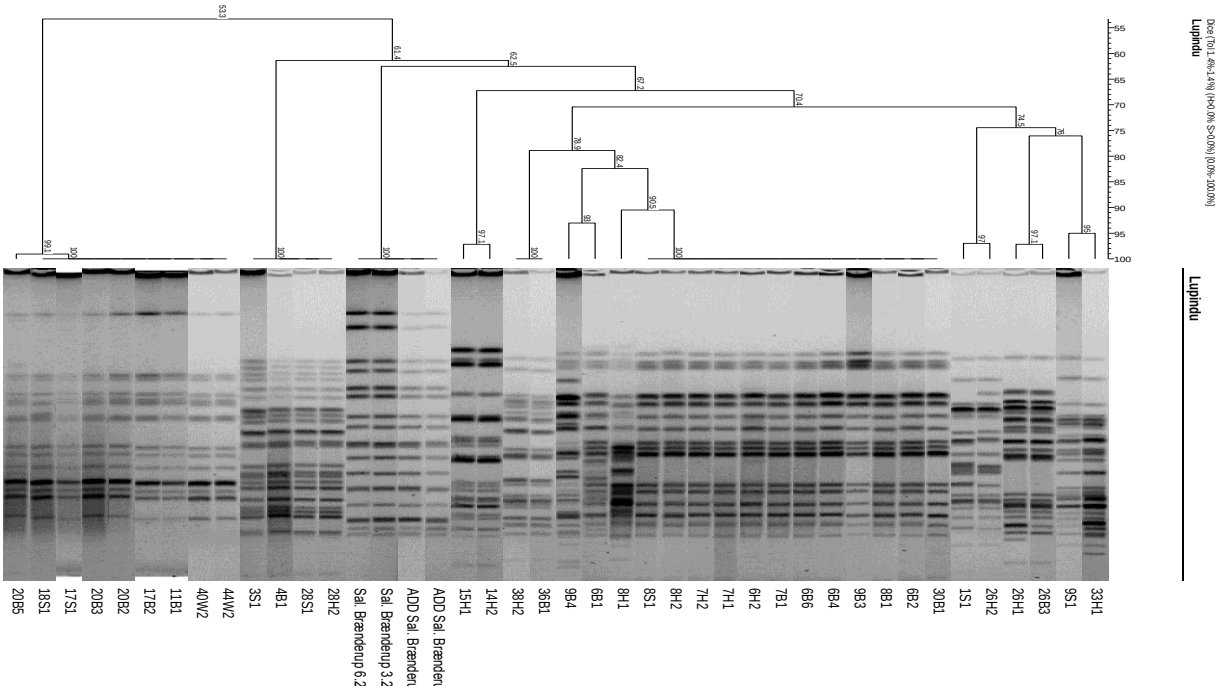



Figure 2.Genetic resemblance among *E. coli* isolates from human, cattle, water and soil

## What needs to be done?

From this study it can be concluded that humans come into contact with manure during manure handling and manure is spread randomly on land in residential area. Moreover, it is evident that livestock such as cattle harbor pathogenic bacteria that can infect humans, and that these pathogens are shed through feces. There is also transmission of bacteria from cattle to humans and or vice versa (both caretakers and neighbors), water and soil. Therefore, humans are at risk of infection. Local authority environmental sanitation regulations and by-laws are same for solid household wastes and manure such that manure can be collected and disposed without considering public health concerns and environmental contamination. There is a need to reconsider whether specific regulation and guidelines are needed for this growing animal waste problem.

## What goes into good manure handling?

Policies at national level should aim at advocating manure-handling practices that are safe and turn manure from a waste into a valuable commodity. There should be formulation of manure management guidelines that are enforced by regulations and by-laws at local government authorities. Below is shown an example of which factors should be taken into account when formulating good manure handling practices.

- *Minimize random animal movements: to prevent haphazard defecation in the environment*
- *Improved animal housing infrastructure: roof, floor and sewage: to prevent uncontrolled manure spread e.g. by rain water*

- *Control animal density: number of animals should match carrying capacity*
- *Use of protective gears during manure handling: to prevent direct contact*
- *Farmers should have enough land for proper manure disposal*
- *Manure should be treated before disposal, e.g. heaping, composting, avoiding spread of fresh manure*
- *Disposal away from residential areas*

**Institutional address**

**Opportunities and Challenges in Peri-urban Livestock Farming in Tanzania (P6-08-Tan)**

Department of Veterinary Medicine and Public Health
Sokoine University of Agriculture, (SUA)
P.O. Box 3021
Morogoro
Tanzania

Department of Veterinary Disease Biology, Faculty of Health and Medical Sciences,
University of Copenhagen
Stigbøjlen 4, 1870 Frederiksberg C
Denmark

**Malipa Isack**

# SOCIO-ECONOMIC EFFECTS OF URBAN LIVESTOCK FARMING IN DAR ES SALAAM CITY, TANZANIA

Urban agriculture is seen as an important economic undertaking for many urban dwellers in developing countries and has expanded enormously in these countries over the past two decades. Recognizing its importance, urban agriculture is now becoming a systematic focus of research and development in developing countries. Nonetheless two different views concerning the development of urban agriculture still dominate the public debate. On one hand, there is the viewpoint that the positive effects of urban agriculture outweigh its negative effects. On the other hand, there is the view that the negative effects associated with expansion of urban agriculture outweigh its positive effects. This study was undertaken as an attempt to address this gap based on evidence from a case study of livestock farming in the Dar es Salaam city to be able to convince urban planners to consider urban agriculture as one of the formal income generating activities in their review of urban plans and policy makers in the process of formulating appropriate policies and strategies to develop urban agriculture and urban livestock farming in particular

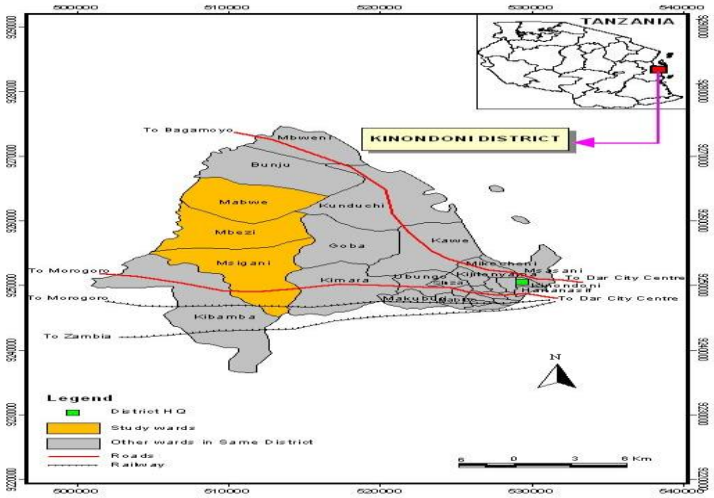


**Figure 1: Map of Kinondoni Municipal**

## Data source and method

### Assessing the effect of urban livestock farming on income and income distribution

Percentage of income from urban livestock farming to total household income was calculated to compare its contribution with other sources of income using the following formula. In analysing income distribution, Gini coefficient was decomposed according to different sources of household income to determine the effect of income from urban livestock farming to the total income inequality basing on two inequality measures: the coefficient of variation and the *Gini* coefficient.

### Assessing the effect of urban livestock farming on household food security and nutrition at household level

Analytical model which was adopted by this study builds on the assumption that participating on urban livestock farming increases dietary diversity hence food security and Poisson regression model was adopted:

### Assessing the effect of urban livestock farming on employment

In determining the effect of urban livestock farming on employment, t test and $\chi^2$ were used and comparisons were made between livestock keepers and non livestock keepers.

### Assessing the effect of urban livestock farming on income and income distribution

Analysis of contribution of urban livestock farming indicated that urban farming had 20% contribution to household income.

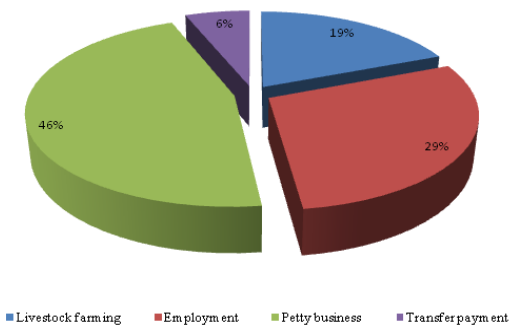


**Figure 2: Contribution of different source of income on total household income**

The difference in income between livestock keepers and non livestock keepers was found to be statistically significant with t=2.622 at p<0.011.

Urban livestock farming also was found to have a negative effect on income distribution. The relative concentration coefficient for livestock keeping was 1.123 indicating that urban livestock farming increases income inequality among households in the study area. The sampled livestock keepers were found to provide more employment than non- livestock keepers.

**Table 1: Relative concentration coefficient of different source of income**

| Source | Relative concentration coefficient (gi) | Ranking |
|---|---|---|
| Livestock | 1.122744 | 2 |
| Employment | 2.79394 | 1 |
| Pet business | 0.534099 | 3 |
| Transfer payment | 0.178652 | 4 |

## Assessing the effect of urban livestock farming on household food security and nutrition at household level

Analysis of the effect of urban livestock farming on food security and nutrition using the number of meals per day, child nutrition and dietary diversity suggest that urban livestock farming has significant positive impact on food security and nutrition in the study area. Children nutrition in most livestock keeping households has been improving since they started keeping livestock. With regard to dietary diversity the results of poisson regression analysis indicate that engaging on urban livestock keeping increases household dietary diversity.

$$\gamma = \alpha + 1.4183\,ponfarm - 0.0412\,pc\exp + 0.8412\,landown + 0.2639\,hhsize + 0.7096\,educave - 0.2.5E - 08\,agehead + \varepsilon$$

**Equation 1: Estimated Poisson regression equation**

## Assessing the effect of urban livestock farming on employment

Urban livestock keepers created more jobs than their counterpart (48% as compared to 19%) and the difference in job creation was statistically significant with $\chi^2$=0.000 at p<0.01. Livestock keepers employed more male workers than the non livestock keepers. Difference in sex of respondents was found to be statistically significant with $\chi^2$=0.000 at p<0.00. Workers were coming from different origins with the majority coming from northern zone. Livestock keepers received an average of 286 164.90 TZS per month by employing themselves on urban livestock farming activities which is higher than the minimum salary of a government worker of TZS 150 000 per month.

**Table 2: employment of livestock and non livestock keeping households**

| Response | Livestock keepers (n=100) | | Non livestock keepers (n=100) | | Total | |
|---|---|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| Household chores | | | | | | |
| Yes | 9 | 9 | 19 | 19 | 28 | 14 |
| No | 91 | 91 | 81 | 81 | 172 | 86 |
| Total | | 100 | | 100 | 200 | 100 |
| Employment in general | | | | | | |
| Employ | 48 | 48 | 19 | 19 | 67 | 33.5 |
| Do not employ | 52 | 52 | 81 | 81 | 133 | 66.5 |

## Conclusions

- Income of livestock keeping households was significantly higher than incomes of non livestock keeping households. On income distribution the concentration coefficient score indicates that the income from urban livestock farming affect negatively the income distribution.

- Livestock keeping households were found to create significantly more jobs than non livestock keeping households.
- The findings of the study indicate that livestock keeping households were significantly able to feed themselves from their own resources than non livestock keeping households. Furthermore diets of livestock keeping households were found to be significantly more diversified than diets of non livestock keeping households

## Recommendations

- Banks and other financial institutions should look for possibilities of giving loans to urban livestock keepers. The loans should be well designed in terms of repayment period

(should reflect life cycle of the animal and long enough) and interest rate to suit the long gestation period of livestock enterprises

- Review of the existing policies and by-laws which seem to be confusing and recognition of urban livestock farming not only on policy documents but also on day to day operations of Municipal authorities.

- Urban planners to see how well they can include urban livestock farming in their land use plans.
- Urban livestock keepers could increase their returns and employ more people if the government subsidizes livestock farming inputs for a given time period.
- The municipal council authorities should make sure that public veterinary officers abide to the laws and regulations which govern provision of their services.

# PORCINE CYSTICERCOSIS IS A PUBLIC HEALTH THREAT ALARMING FOR EFFECTIVE CONTROL IN URBAN AND PERI-URBAN AREAS OF TANZANIA.

**Executive Summary:**
Porcine cysticercosis is a parasitic infection of pigs caused by a larval form of tapeworm called *Taenia solium,* which is an important zoonosis. Pigs usually get infected by eating contaminated food containing human faeces with *T. solium* eggs and human get infected by eating undercooked pork and /or accidental swallowing of *T. solium* eggs. In addition to its public health importance *T. solium* causes great economic losses in the pig industry due to condemnation of carcasses found to have cysts.

Recently in Tanzania, consumption of pig meat (pork) has increased tremendously in urban and peri-urban areas and this has led into dramatic increased pig production and transportation of live pigs from endemic rural areas. This has increased a significant public health threat of consuming infected pigs if proper and effective ante-mortem and post-mortem inspection are not in place.

This study has assessed the status of pork inspection and pig slaughtering in Morogoro region (Urban district), Tanzania and found that the service was actually inefficient or rather collapsed.
Poor slaughter slab design layout, home slaughtering, sanitary facilities, unreliable water supply, lack of lairage/resting places, insufficient meat/pork inspectors and irregularity of time for pork inspection are the main challenges facing slaughter slabs, pork trading and inspection in Morogoro region.

**Introduction:**
*Taenia solium* cysticercosis is an infection involving pig as intermediate host and human being as definitive and/or intermediate host. Ingestion of infective eggs passed by a person with an adult cestode of *T. solium* either by autoinfection, direct contact with another tapeworm carrier or indirectly via ingestion of contaminated food, water, or hands may lead to cysticercosis in humans whereby larval tapeworm cysts develop in the muscles, eye and central nervous system. Pigs get cysticercosis by ingesting *T. solium* eggs primarily as a result of eating contaminated feeds with faeces of a human tapeworm carrier. Human cysticercosis causes a variety of neurological symptoms, most commonly seizures due to cysts in the brain, a condition known as neurocysticercosis.
According to WHO, *Taenia solium* cysticercosis imposes substantial global burden on human beings related to public health and economic losses. These includes the following; stigmatisation, incapacitation, decreased work productivity, reduction in farmers' household income, removal of an important protein source, reduction in trade and public health costs related to diagnose, treat, monitor epilepsy cases.
In Tanzania, *Taenia solium* cysticercosis is endemic and widespread in the northern, central and southern regions based on the reports of porcine cysticercosis surveillance. These regions are the main and leading pig production areas in the country and are the source of pigs transported to the urban and peri-urban for consumption. Porcine cysticercosis leads to considerable agricultural and economic losses because of the necessity to condemn infected pigs.

The increased consumption of pork in urban and peri-urban areas has therefore imposes a great potential risk factor for disease transmission if pig meat isn't properly examined.

**Approaches and Results:**

Morogoro region is located on the eastern part of Tanzania Mainland. Morogoro Urban district is among of the six districts of Morogoro region and it is highly urbanised as the district forms the Morogoro Municipal council with its local administrative wards.

Data collection involved two stages, firstly administration of structured questionnaire to pig keeping households and pork traders and secondly collection of blood samples from the pigs.

Pork trader is here by defined as a person who either slaughtered and sells pork or purchased pork and prepared it for human consumption. Similarly, a pork centre is a place where pork is prepared (usually by frying) for human consumption.

The administration of structured questionnaire was face – to – face interview and whenever possible confirmed by direct observation. A total of 42 questionnaires were administered to pig keeping households to collect information on rearing system, knowledge of porcine cysticercosis, latrine use and pigs bio-data. Similarly, a total of 18 pork traders were visited and interviewed in various pork centres, home slaughters and slaughtering slabs to assess the status of slaughtering facilities and pork inspection in the study area.

The sera from the 260 pig blood samples were used for analysis of circulating antigens of *Taenia solium* cysticercosis detected by the monoclonal antibody–based sandwich ELISA.

Data were entered into Microsoft Office Excel 2007 and exported in Epi InfoTM, version 3.5.3 (CDC. Gov/epi-info) for statistical analysis. Descriptive statistics was computed to determine the prevalence of porcine cysticercosis and its 95% confidence interval. Chi-square test ($\chi 2$) was used to determine whether there is a statistically significant association between prevalence and pig level variables such as age. Analysis of potential risk factors for seropositivity was determined by using a logistic regression model with seroconversion status as dependent variable and farm and pig level variables as the independent variables. Risk factors with $P<0.05$ were considered significant.

**Results:**

**Status of slaughtering facilities and pork inspection**

Thirteen out of 14 slaughtering slabs were home slaughters as they were built within residential compound even though they were operated under business basis. The thirteen (13) home slaughters were regarded as sub-standard/poor slaughtering facility characterised by either of the following features; poor design layout and sanitary measures, unreliable water supply and lack of lairage/resting places (Plate 1).

About 56% of all pigs slaughtered in either home/slaughter slabs came from the study area. The remaining 44% of pigs slaughtered came from the nearby districts and other neighbouring regions.

Five out of 14 pork traders interviewed reported that presence of cysts was the reason for the condemnation of their pork. Plate 2 represents a positive case of cysticercosis identified during the visit in the routine pork inspection and according to the pork trader the pig was sourced from the neighbouring Dodoma region.

Plate 1: **A poor pig slaughter facility**

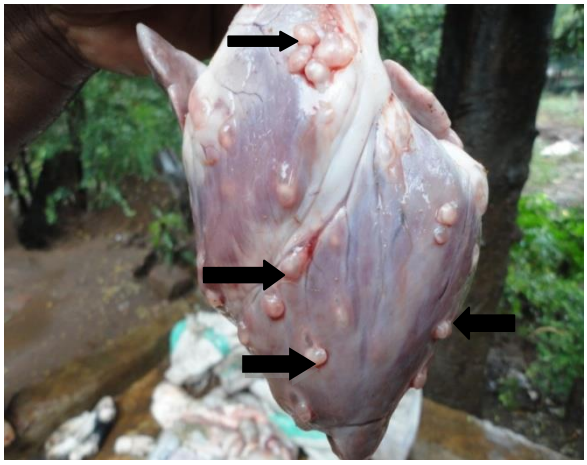


Plate 2: **Multiple cysts (arrows) on heart**

**Prevalence of Porcine cysticercosis:**

The overall prevalence of porcine cysticercosis in Morogoro Urban district was 1.54% (95% CI: 0.04 – 3.1%) based on Antigen ELISA (Table 1) with no statistical significant differences by age group (*P*=0.57).

Table 1: **Prevalence of porcine cysticercosis by age category based on Ag – ELISA**

| Age category | No. Screened | No. Seropositives | % seropositives (95% CI) |
|---|---|---|---|
| Weaners (4months) | 55 | 0 | 0 (0.0 – 0.0) |
| Growers (5–8months) | 96 | 2 | 2.1 (0.0 – 4.3) |
| Adults (>8months) | 108 | 2 | 1.9 (0.0 – 3.8) |
| Total | 259 | 4 | 1.54 (0.04 – 3.1) |

**Factors associated with porcine cysticercosis**

The factors that were considered in the analysis as risks associated with porcine cysticercosis at pig and farm level are presented in Table 2. The dependent variable is disease status. The logistic regression model was used to identify the risk factors which influence the occurrence of porcine cysticercosis in urban/peri-urban pig farming. Considering all risk factors included in the model none of the pig and farm variables were statistically significantly associated with the porcine cysticercosis (*P*>0.05).

Table 2: **Risk factors associated with porcine cysticercosis investigated during the study, 2010/2011.**

| Risk Factor | | OR (95% CI) | p-value | LR |
|---|---|---|---|---|
| **Pig level variables** | | | | |
| Sex | Female (F) | 1.09 (0.61 – 1.98) | 0.765 | |
| | Male (M) | 0.71 (0.35 – 1.46) | 0.355 | 1.201 |
| Age | <8 months | 0.87 (0.59 – 1.27) | 0.462 | |
| | >8 months | 0.94 (0.58 – 1.53) | 0.804 | 0.736 |
| **Farm level variables** | | | | |
| Introduction of pig into the herd | | 0.90 (0.11 – 7.06) | 0.920 | 0.010 |
| Pens allowing pig to get out | | 0.93 (0.09 – 10.08) | 0.953 | 0.003 |
| Knowledge of how pigs get infected | | 0.00 (0.00 - >1.0E1) | 0.638 | 0.411 |
| Observation of cysts in pig | | 0.00 (0.00 - >1.0E1) | 0.743 | 0.203 |
| Latrines without closing door | | 1.38 (0.13 – 14.72) | 0.787 | 0.076 |

NB: OR=Odds Ratio, LR=Likelihood Ratio

**Conclusion:**

There are no published reports of other similar studies that were carried out in urban/peri-urban areas of Tanzania, making this study original in this context.

The study has found inefficient pork inspection and pig slaughtering in Morogoro Urban district. Pork inspection and pig slaughtering in Morogoro is characterised by poor slaughter slab design layout, home slaughtering, poor sanitary facilities, unreliable water supply, lack of lairage/resting places, insufficient meat/pork inspectors and irregularity of time for pork inspection.

These challenges impose a great health risk to pork consumers and general public at large.

The overall prevalence of 1.54% based on detection of circulating antigens found in this study indicates that the disease might be present however, the prevalence obtained may not 100% directly associated with *T. solium* cysticercosis due to cross-reaction with *T. hydatigena* cysticerci in pigs.

The low prevalence may largely be attributed by the intensive farming system mainstreamed by the local government by-laws regulating livestock farming in urban areas.

**Policy recommendation:**

Policies governing the transportation of live animals for the purpose of slaughtering need to be properly implemented in order to ensure that animals slaughtered for human consumption are free from all diseases.

# Policy brief

*Gillah, K.A, Kifaro G.C and Madsen J*
*DANIDA Peri urban Livestock farming*
*P. O. Box 3004 SUA Morogoro, Tanzania*
*Corresponding author: kagillah@yahoo.com*

## Stocking density and milk quality of cross bred dairy cattle kept in urban and peri urban areas of Tanzania

### Summary
- Policies and urban by laws encourage urban and peri urban dairying in Tanzania provided that not more than four heads of animals are kept under"good cattle sheds. However, results show that farmers keep more than four heads, and practise semi zero grazing system and inhumane keeping of cattle.
- Levels of bacteria in milk are high and unacceptable indicating poor hygiene and consumers are at high health risk.
- Existing policies, laws and regulations on hygienic practices in the handling and marketing of milk should be instituted and legal actions taken to dairy farmers who will go against them.

### Introduction
A study was conducted to assess stocking density and milk quality of cross bred dairy cattle kept in urban and peri urban areas of Dar es Salaam and Morogoro towns in Tanzania. The Peri urban livestock farming project carried out the research and was funded by the Danish International Development Agency (DANIDA). The research aimed at evaluating the effect of the existing feeding/management systems on performance of cross bred dairy cows kept in urban and peri-urban areas of Tanzania.

### Data sources and methodology
Cattle sheds were measured to determine number of cattle kept per cattle shade area (stocking density). Monthly milk samples were collected from Morogoro municipal dairy units during wet and dry seasons and analysed for microbiological qualities namely total bacterial count and coliform count. In addition, a cross sectional (one visit per household) survey was conducted between April and August 2010 in Dar es Salaam city and Morogoro town involving 153 smallholder dairy farmers. While longitudinal survey was carried out in Morogoro town between December 2010 and September 2011 involving 60 smallholder dairy units with the aim of collecting data on milk production and handling practices and microbiological qualities of raw milk produced from smallholder dairy units.

### Data analysis
Data analysis focused on herd size, stocking density of cattle sheds and microbiological qualities of milk. Descriptive statistics of General linear model of SAS was used to describe herd size, stocking density and microbiological qualities (total bacterial count and coliform count) of milk. Chi-square test was used to analyze associations between possible combinations of categorical variables.

### Results
#### Herd size and stocking density
The average herd size in the study areas was 8.2 cattle per dairy unit. Dar es Salaam city had significantly ($P< 0.001$) larger herd size of 11.1±0.8 cattle per dairy unit compared to Morogoro town (5.5±0.8) (Figure 1). The majority (n=141; 80.5%) of dairy farmers had 1-

10 cattle and few farmers in peri urban areas (n=12; 6.8%) had more than 21 to 50 animals. Dar es Salaam peri urban dairy units had significantly more (16.0%) dairy farmers who had more than 10 - 50 dairy cattle than 3.4% found in Morogoro town. Keeping large herds of cattle contravenes urban livestock by-laws which require dairy farmers to have not more than four heads in any city of Tanzania.

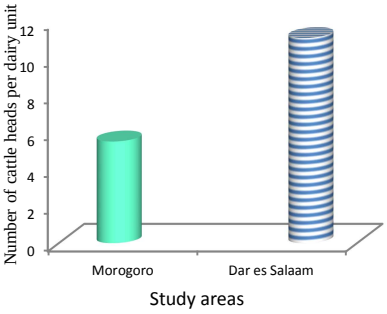
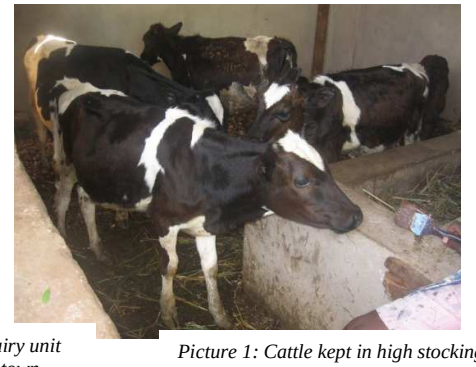



*Figure 1: Average number of cattle heads per dairy unit in Dar es Salaam city and Morogoro town*



*Picture 1: Cattle kept in high stocking density inMorogoro munucipal*

More than half (n=91; 52%) of cattle sheds had high stocking density (Picture 1) and on average each shed accommodated 1.37 animals per 6.7m$^2$standard space required per dairy cattle shed (Figure 2). However, the stocking density per cattle shed in Dar es Salaam city (1.48±0.09) and Morogoro town (1.27± 0.09) was significantly (P>0.05) similar. Also, cattle sheds used by zero grazed cattle (n=45, 34.6% had higher stocking density than semi zero grazed animals (n=16, 12.3%. Many cattle sheds (89.1%) did not conform to FAO (1998) cattle shed standard design that have a provision for sleeping and feeding spaces.

*Picture 2: Cattle sheds that do not have sleeping and feeding spaces (do not conform to standard design) in Morogoro Municipality*

Moreover, some cattle sheds (13.9%) were in poor hygienic condition (Picture 3). Keeping cattle in high stocking densities and in poor hygienic condition are among the indicators of poor animal welfare and affects animal productivity.

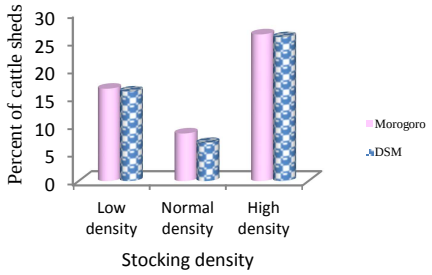



*Figure 2: Percentage of cattle sheds with different stocking density in Dar es Salaam city and Morogoro town*

*Picture 3: Cattle shed in poor hygienic condition in MorogoroMunicipal*

**Microbiological quality of milk**

Milk samples had higher (5.8 $\log_{10}$ cfu/ml) total bacterial count and only 9.8% of the total milk samples qualified for grade one (<200 000 or $\log_{10}$ 5.3 cfu/ml) classification of Tanzania Bureau of Standards grading of raw milk (Figure 3). Total bacterial count of raw milk samples differed significantly (P<0.05) between seasons where by the wet season had the highest counts (5.9±0.04 $\log_{10}$ cfu/ml) than the dry season (5.7 ±0.04 $\log_{10}$ cfu/ml). Poor total bacterial count milk grade samples (grade IV) were 8 (6.5%) and found during the wet season. High total bacterial count implies that cows were kept under substandard hygiene and poor milk handling practices such as hand milking in open dusty places (Picture 4).

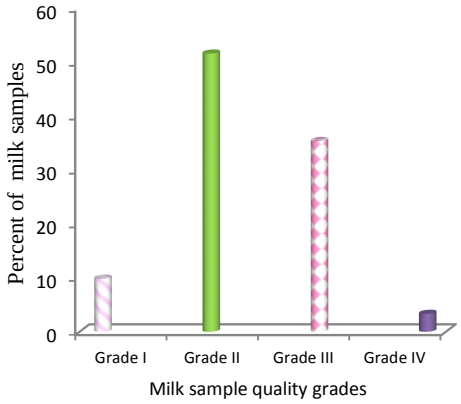



*Figure 3: Percentage of milk quality grades for Total bacterial count (Log $_{10}$ TBC) in Morogoro Municipal*

A high proportion (85%) of the milk samples at farm level had unsatisfactory grade of Tanzania Bureau of Standards coliform count in raw milk (Figure 4). Seasonal distribution of Coliform count in raw milk reveals significantly (P<0.05) higher satisfactory milk samples (n=26, 21.1%) during the dry season than the wet season (n=11, 8.9%). Higher coliform count in raw milk indicates that udders of cows were soiled with faecal materials and/or improperly washed. The fact that Coliform counts in raw milk were higher during the wet season it implies that rains increase the levels of contamination especially for cows kept in poorly constructed cattle sheds/kraals (Picture 3).


*Figure 4: Percentage of milk quality grades for coliform counts( $log_{10}$ coliform counts) in Morogoro town*

*Picture 4: Hand milking in open dusty areas in Morogoro town*

## Conclusion

- Poor welfare of dairy cattle exists in the smallholder production systems in urban and peri urban areas of Morogoro. Poor welfare of animals was a result of dairy farmers using substandard housing designs and structures and poor management practices that include high stocking densities and poor hygiene. Keeping animals in high stocking densities is against animal rights stipulated in Tanzania Animal Welfare Act (2008).
- The levels of total bacterial count and coliform count in raw milk were high and unacceptable. These indicate poor hygiene and it may be a potential source of milk-borne infections.
- Dairy farmers should adhere to effective sanitary measures in order to produce clean milk right from the cow until it reaches the consumers. Failure to produce clean and good quality raw milk contravenes Tanzania Dairy industry regulations (URT, 2007). Moreover, the dairy inspectors in Tanzania are not inspecting cattle sheds and testing raw milk at farm level instead inspection and testing of milk are done at milk processing plants. This encourages informal marketing of untested raw milk.

## Policy recommendations

- Review urban keeping of livestock by laws which sates that “all animals should be kept in a building or enclosures”…instead it should be “recommended building”. The building by laws are silent on this as a result dairy cattle are kept in poorly constructed sheds since the recommended animal buildings are not available and unknown to dairy farmers.
- Harmonize and coordinate inspections of livestock premises by forming a team of experts to minimize wastage of resources and reach many stakeholders. Normally Local Government Authorities (LGA), Tanzania Food and Drugs Authority (TFDA), Tanzania Bureau of Standards (TBS), Tanzania Dairy Board (TDB) and Zoo sanitary department conduct multiple and uncordinated inspections which are mostly done in dairy processing premises and rarely carried out at dairy unit premises.
- Build capacity for Tanzania Dairy Board (TDB), which is the primary regulator of the dairy sector to cover all districts in the country. Currently, the dairy board is limited interms of human resources and infrastructures.